

INDIGENOUS PAPUANS IN SUSTAINABLE RESEARCH AND INNOVATION

ISBN 978-630-95064-2-9



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EDITORIAL OFFICE
TECHNIUM
E.U.



For citation purposes, cite as indicated below:

Agustinus Hartopo, et al, INDIGENOUS PAPUANS IN SUSTAINABLE RESEARCH AND INNOVATION; ISBN 978-630-95064-2-9, TECHNIUM, 2024..



FIRST EDITION 2024

ISBN 978-630-95064-2-9 (PDF)

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Agustinus Hartopo, et al

Indigenous Papuanans

in Sustainable Research and Innovation



Technium Science

INDIGENOUS PAPUANS IN SUSTAINABLE RESEARCH AND INNOVATION

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Prof. Dr. Bohari Mohd Yamin



 Preface

It is with great pride and enthusiasm that we present this work, which encapsulates the dynamics of the lives of the indigenous people of Papua and the innovation potential rooted in their local wisdom. This research was born from a strong desire to explore, understand, and appreciate the rich and diverse cultural heritage of Papua. Chapter by chapter, this document guides us through a journey that begins with an overview of the study's perspective and the dynamics of indigenous communities' lives, and proceeds to explore how innovation can play a critical role in preserving local wisdom. Through a comprehensive and interdisciplinary approach, each chapter reveals the complexity and uniqueness of the Papuan people, including their social structures, traditions, and local potentials that can support sustainable innovation. At every step of this research, we acknowledge the various challenges that hinder change, such as social and structural barriers, as well as gaps in access to technology and infrastructure. However, behind these challenges lie great opportunities to transform local wisdom into global innovation that can inspire and provide broad benefits. We believe that strengthening the capacity and education of indigenous communities, especially the younger generation of Papua, is key to facing future challenges. With strong collaboration between indigenous communities, academics, industry, and government, we are confident that Papua can become a center for sustainable innovation rooted in tradition and local wisdom. This document also offers strategic recommendations and action plans aimed at supporting tradition-based development, enhancing the effectiveness of innovation, and ensuring the sustainability of indigenous communities in Papua. We hope that through this research, we can together build a better future for Papua, where local wisdom and innovation reinforce each other and provide benefits for future generations. Lastly, we express our deepest gratitude to all parties who contributed to the preparation of this document. May this work serve as a valuable reference for stakeholders in developing Papua as a center for sustainable innovation based on local wisdom.

Authors



As the editor of this document, I am honored to present this comprehensive exploration of Papua's rich cultural heritage and its potential for innovation rooted in local wisdom. This work represents the culmination of extensive research and collaborative efforts aimed at understanding and harnessing the unique traditions and strengths of the indigenous communities in Papua. Prof. Dr. Bohari Mohd Yamin is a distinguished chemist born in 1950, in Port Dickson, Negeri Sembilan, Malaysia. With over four decades of experience, he has made significant contributions to the fields of inorganic chemistry, organometallic chemistry, and crystallography. He is currently an Emeritus Professor at

the Faculty of Science and Technology, Universiti Sains Islam Malaysia (USIM). He earned his Ph.D. in Chemistry from King's College London, following a bachelor's degree from Universiti Malaya. Prof. Bohari began his academic career as a tutor in 1974 at Universiti Kebangsaan Malaysia (UKM) and was promoted to full Professor in 1994. Throughout his career, he served as Head of the Department of Chemistry, Deputy Dean of the Faculty of Science, and Head of the School of Chemical Sciences and Food Technology at UKM. As a researcher, Prof. Bohari specializes in the synthesis of organometallic compounds, chemical kinetics studies, and applications of X-ray crystallography. He has published over 336 scientific papers in prestigious international journals, with an H-index of 18 and more than 1,900 citations. Prof. Bohari has received numerous accolades, including the P.J.K., K.M.N., and D.N.S. honors, recognizing his contributions to science. As a keynote speaker and guest lecturer, he has shared his insights at international conferences across Asia, Europe, and the Pacific. His academic networks, such as the SAFEnetwork, foster cross-national collaborations involving Malaysia, Indonesia, the Philippines, and Thailand. Since retiring in 2017, Prof. Bohari has actively supported the development of young academics through charitable initiatives and professional training. He continues to contribute to building research and publication capacities at various regional and international universities. With his exceptional dedication and achievements, Prof. Dr. Bohari Mohd Yamin stands as a role model in academia, advancing chemical sciences and inspiring the next generation of scientists. It is my sincere hope that the knowledge and recommendations presented here will inspire further research and initiatives that honor and uplift the rich heritage of Papua. I extend my deepest gratitude to all contributors who have provided their expertise and insights throughout this project. It is my sincere hope that the knowledge and recommendations presented here will inspire further research and initiatives that honor and uplift the rich heritage of Papua.

Contributors



Agustinus Hartopo, born in Sleman, Yogyakarta, in 1970, is a Senior Researcher and Head of the Research and Innovation Division at the Regional Planning, Research, and Innovation Agency of Papua Province, Indonesia. His educational journey began in Yogyakarta and culminated in a Bachelor's degree from Universitas Cenderawasih, Jayapura, Papua. Hartopo has made significant contributions to research, with his findings published in books that address critical topics such as the income analysis of sago farmers, the economic impact of development based on customary regions in La Pago, and strategies for cocoa development in Papua Province. His research is deeply focused on understanding and addressing regional economic challenges, particularly in Papua, demonstrating his commitment to sustainable development and economic growth in the region. In addition to his regional work, Hartopo is actively engaged in international scholarly activities. He contributes to global academic discourse through the publication of academic articles, further establishing his expertise and influence in the field. His dedication to regional development, along with his scholarly achievements, underscores his pivotal role in advancing research and innovation in Papua and Indonesia.



Heri Wahyudianto, is a Functional Researcher at the Regional Development Planning, Research, and Innovation Agency of Papua Province, Indonesia, based in Jayapura. He completed his Master's degree in Financial Management in 2004 at Universitas Hasanuddin Makassar, specializing in Geography. He also earned his undergraduate degree from the Surabaya Institute of Technology in East Java, where he obtained a Master's in Technology Management, with a concentration in Urban Development Management. Heri is an active writer and researcher, contributing to international journals and participating in academic activities at universities in Papua Province. His research focuses on regional development, urban planning, and sustainable growth, with particular attention to addressing the economic challenges and opportunities in Papua. Through his work, he continues to play a key role in advancing knowledge and innovation in the region's development.



Andjar Prasetyo, holding a Master's degree in Economics, is a regional economic expert researcher based in Magelang City, Central Java Province, Indonesia. He is an accomplished author of numerous international scientific articles and books published by both domestic and international publishers, focusing on economics and regional development issues. Andjar Prasetyo is actively engaged in multidisciplinary research collaborations, contributing innovative perspectives to address complex economic and regional challenges. His work reflects a commitment to advancing scholarly understanding and practical solutions for sustainable development and economic growth in regional contexts.



Bachtari Alam Hidayat, born on 1979, in Palembang, is a Young Expert Researcher specializing in Development Economics. He currently serves at the Palembang City Government's Research and Development Agency and holds membership and administrative roles in the Indonesian Researchers Association for South Sumatra Province. In academia, Bachtari is a permanent lecturer in the Master of Government Science Postgraduate Program at Tamansiswa University Palembang and an extraordinary lecturer at the University of Muhammadiyah Palembang. He earned his Doctorate in Development Economics from Padjadjaran University, Bandung, in 2018 and further enhanced his expertise by completing a Postdoctoral Fellowship at the National

Research and Innovation Agency in 2023. Bachtari is an accomplished author, with six ISBN books published between 2022 and 2023. His works cover diverse topics, including political economy, governance, human resource management, and village development. Through his research, teaching, and writing, he contributes significantly to advancing knowledge and practice in development economics and governance.



Asriani holds a Master's degree in Psychology from Gadjah Mada University (2017) and a Bachelor's degree in Psychology from Makassar State University (2007). With extensive expertise in regional development planning and human resource development, Asriani combines a strong academic foundation with practical experience in governance and organizational management. Currently, Asriani serves as a researcher at the Wajo Regency Regional Development Planning, Research, and Development Agency. In this role, she has also led the Innovation and Technology Utilization Subdivision, driving advancements in local governance and development strategies. Her previous tenure at the Wajo Regency Civil Service Agency showcased his

proficiency in planning and reporting management, as well as his focus on integrity analysis and the enforcement of disciplinary measures among civil service personnel. Asriani's work reflects a commitment to fostering sustainable regional growth and enhancing human resource capabilities through innovative planning and effective policy implementation.



Andi Tenri Awaru, born on 1982, in Soppeng, is a dedicated State Civil Apparatus currently serving as a Young Expert Researcher at the Regional Development Planning, Research, and Development Agency of Wajo Regency since 2021. She holds a Master's degree in Public Administration from the Puangrimaggalatung College of Administration, Sengkang. Andi Tenri Awaru's career spans various leadership roles in regional governance and development. She previously served as the Head of Innovation and Technology Development Sub-Division at Balitbangda Wajo Regency (2017–2018), the Head of Chemical Industry at the Wajo Regency Industry Office (2018–2020), and the Head of

Economy and Development Sub-Division at Bappelitbangda Wajo Regency (2020–2021). Throughout his career, Andi Tenri Awaru has demonstrated a strong commitment to fostering regional innovation, advancing industrial development, and driving economic growth through strategic planning and research. Her expertise contributes significantly to the development initiatives of Wajo Regency.



Husnah Rahman is a Young Expert Researcher at the Regional Planning, Research, and Development Agency of Wajo Regency, a role she has held since 2021. A recent graduate of Puangrimaggalatung Sengkang University (2023), she brings academic rigor and practical experience to her contributions in regional development. Husnah Rahman previously held leadership roles as Head of Sub-Divisions in various domains at Regional Research and Development Agency of Wajo Regency. Her responsibilities included overseeing the Dissemination of Research and Development and Assessment of Rules and Natural Resources (2017–2018), Regional, Physical, and Infrastructure Development (2018–2019), and Social and Government Affairs (2020–2021). With a strong background in research dissemination, infrastructure planning, and governance, Husnah Rahman is dedicated to advancing regional development through evidence-based strategies and collaborative innovation.



Herie Saksono is an Associate Expert Researcher (IV/c) specializing in Business and Management. He is affiliated with the Domestic Government Research Center under the Research Organization for Governance, Economy, and Community Welfare at the National Research and Innovation Agency. Herie is an accomplished academic with a strong portfolio of publications in reputable scientific journals. His works can be accessed through his ORCID ID: <https://orcid.org/0000-0002-0464-5311>. He also serves as an editor for the Bina Praja Journal, a publication under the Ministry of Home Affairs of Indonesia. Herie's research and editorial contributions reflect his dedication to advancing knowledge in business, management, and governance, supporting both academic excellence and practical applications in these fields.



Sekar Nur Wulandari is a Young Expert Researcher at the Riau Islands Provincial Planning, Research, and Development Agency. With a strong background in public policy and regional development, Sekar is a prolific author and active contributor to the scientific community. Sekar has published two notable books, "Poverty Alleviation Strategies: A Study on Riau Islands Province" (2021) and "Fiscal Decentralization: Reformulation of General Allocation Fund Policy for Islands Regions", both released by Blue Ocean. His expertise extends to collaborative research, having led teams for projects like the Feasibility Analysis of the Establishment of the Riau Islands Energy BUMD and the Evaluation of the Riau Islands Provincial RPJMD 2016-2021. She actively participates in international academic forums, contributing to proceedings at SHIMBA 2023 and ICOSI-HESS 2022. Sekar also engages with professional and community organizations, including the Indonesian Muslim Intellectuals Association of Tanjungpinang City and the IPB Alumni Association of Riau Islands Province. As a peer reviewer, Sekar has contributed to respected journals like the Australian Journal of Maritime & Ocean Affairs. His own scientific publications are featured in high-impact journals, including Sustainability (Q1), Bulletin of Electrical Engineering and Informatics (Q3), Bina Praja Journal (SINTA 2), and Economics & Public Policy Journal (SINTA 2). Sekar's dedication to advancing knowledge in regional policy, fiscal decentralization, and sustainable development highlights his commitment to the growth and welfare of island communities.



Mohamad Miftah was born in Demak on December 20, 1977. He is a researcher and practitioner in the field of education with extensive experience at regional and national levels. Since 2016, he has served as a Senior Researcher (IVB rank) in education policy at the Provincial Government of Central Java. Previously, he worked as an education researcher at BPMPK Pustekkom/Pusdatin, Ministry of Education and Culture, from 2006 to 2015. Miftah holds a Bachelor's degree in Arabic Education from IAIN/UIN Surabaya (2002), a Master's degree in Learning Technology from UNY Yogyakarta (2006), and a Doctorate in Educational Management from UNNES Semarang (2021). He also pursued non-formal education at Roudlotutholibin Islamic Boarding

School in Demak (1985–1996) and Attauhid and An-Nur Islamic Boarding Schools in Surabaya (1996–2002). Miftah is the founder of PTM Bintoro in Demak, a table tennis club established in 2011. He is also the developer of the Jateng Belajar Portal (2019–present) and has been actively involved as a media learning practitioner and instructor specializing in ICT-based educational tools since 2006. His expertise extends to serving as the lead researcher in the Central Java Provincial Study on Accelerating Solutions for Out-of-School Children (2022) and the Team Leader for Strengthening Human Resources through Science and Technology for Jateng 2045 (2023). He is a member of the Central Java Forum for Research and Innovation Communication (2023–present) and the Indonesian Researchers Association for Central Java (2021–present). Miftah has authored numerous academic works, including books, modules, and journal articles. Some notable publications include Learning Resources and Media Development (2021), E-Learning Model Development (2022), and Strategies for Addressing Out-of-School Children in Central Java (2022). His journal contributions focus on ICT-based learning, such as “Management of ICT-Based Learning Systems” (2022) and “Feasibility Study of Integrated ICT-Based Learning Media Services” (2023). Miftah's dedication to education is complemented by his hobby in table tennis, where he actively nurtures community interest through PTM Bintoro.



Sahlan was born in 1956 in Cepu, Blora, Central Java, Indonesia. He graduated from the Oil and Gas Mechanical Engineering School in Cepu in 1975 and earned his bachelor's degree from the Nuclear Technology College in Jakarta in 1983. He completed his Master's program in Materials Science at the Faculty of Mathematics and Natural Sciences, Universitas Indonesia, in 1990. From 1980 to 2020, Sahlan worked at the Agency for the Assessment and Application of Technology (BPPT), where he served as Project Leader for the Defense System Study (1985–1997) and as a Senior Principal Researcher (Grade IVe) from 2006 to 2020. Since 2020, he has continued his career at the National Research and

Innovation Agency (BRIN). Sahlan is an active author of scientific articles published in international journals, reflecting his dedication to research and advancements in science and technology.



Achmad Tarmizi is a distinguished academic and professional with an unparalleled array of qualifications, holding 11 academic degrees and recognized for his extensive contributions to education, research, and governance. He achieved a MURI Record in 2021 as "Secretary of Region with the Most Academic and Non-Academic Degrees." His expertise spans diverse fields, including Mechanical Engineering, Educational Management, Law, and Agribusiness. Dr. Tarmizi has earned degrees from leading institutions, such as a Master's in Mechanical Engineering from Universitas Gadjah Mada (2003), a Doctorate in Agribusiness from Universitas Sriwijaya (2012), and a Professional Engineering Certification from Universitas Lampung (2019). His academic journey is complemented by achievements in law and education management, with degrees from institutions like Universitas Muhammadiyah Palembang and Universitas PGRI Palembang. Recognized internationally, Dr. Tarmizi has received accolades such as the Family Role Model Award and Indonesia Development Award (2019) from the IHRDP International Foundation. Beyond his accolades, he actively participates in international seminars and has contributed to global scientific publications, underscoring his commitment to advancing knowledge and fostering collaboration across disciplines. As a multifaceted professional, Dr. Tarmizi exemplifies lifelong learning and innovation, inspiring both his community and the academic world. His record-breaking achievements and dedication to education and governance make him a prominent figure in Indonesia's intellectual and professional landscape.



Agus Fanar Syukri, Ph.D., born in Demak in 1969, is a distinguished researcher and policy expert specializing in Public Policy, Governance of Science, Technology, and Innovation, and Quality Management. After graduating from SMA Negeri 1 Kudus in 1988, he earned a government scholarship from the Ministry of Research and Technology to study in Japan. He completed his Bachelor's degree in Informatics at Saga University (1990–1994), his Master's degree in Information Management at the Japan Advanced Institute of Science and Technology (1994–1998), and his Doctorate in the same field at The University of Electro-Communications, Tokyo (2001–2005). Currently, Syukri serves as a Principal Researcher at the Center for Public Policy Research under the Governance, Economics, and Community Welfare Research Organization at the National Research and Innovation Agency. His extensive career includes roles in policy formulation and management across various institutions, including the Directorate for Research, Technology, and Innovation Policy (2021–2022), and the Research Center for Policy and Management of Science, Technology, and Innovation (2019–2021). Previously, he led the Research Center for Quality Systems and Testing Technology at LIPI (2016–2019). Syukri actively contributes to professional organizations, serving as Secretary of the Supervisory Board for the Indonesian Researchers Association (2018–2021) and Indonesian Researchers Society (2022–2024). He is also Vice Chairman of the Indonesian Public Policy Society (2021–2024) and Chairman of the Advisory Council of IABIE (2020–2024). His academic contributions include a decade of teaching at the State College of Cryptology (2005–2015). A leader in research and innovation policy, Syukri continues to influence the intersection of science, governance, and society through his academic, organizational, and governmental roles.



Shinta Rahma Diana, SE., M.Si is a Senior Researcher at the Research Centre for Public Policy, Research Organization for Governance, Economy, Community Welfare part of National Research and Innovation Agency, Indonesia. Currently, she is a member of the Research Group of IPTEKIN Policy and Governance. Was born in Cilacap on 1978. She graduated from Bachelor of Accounting in 2000 and Master of Accounting in 2003 in Yogyakarta. During college, she filled her time by becoming a Lecturer Assistant for several courses, including Financial Management and Financial Statement Analysis. She is currently pursuing Doctoral studies at the Faculty of Administrative Science, University of Indonesia (UI). Her career journey started from working in several private companies, state-owned enterprises, and teaching at several universities. Starting her career as a Civil Servant at the National Institute of Aeronautics and Space in 2010 and joining BRIN since 2021. Functional researcher started in 2014 until now. Several research activities were carried out including using grant funding including the Indonesian Ministry of Research, Technology and Higher Education Grant and the Indonesia Endowment Fund for Education Agency. Some publications have been produced in national and international journals, included works in the form of books, entitled "*Investasi di Sektor Keantarikaan*" and "*Analisa Laporan Keuangan dan Aplikasinya*". She has also shared her insights at national and international conferences. Journal review activities have been carried out, including being a Peer reviewer in several journals.



Ery Agus Kurnianto, born on 1975, in Purwodadi, Grobogan, is a distinguished researcher in literature with a focus on interdisciplinary studies. He earned his Master's degree in Literature from the Faculty of Cultural Sciences at the University of Indonesia in 2009. His research career began at the Balai Bahasa Palembang, Ministry of Education and Culture, where he worked from 2002 to 2015. In 2016, Ery continued his contributions to language and cultural studies at the Balai Bahasa in Central Java Province. Currently, Ery serves as a researcher at the National Research and Innovation Agency, under the Research Organization for Archaeology, Language, and Literature, specifically within the Language, Literature, and Community Research Center. He has an extensive portfolio of published works in national and international journals and proceedings, reflecting his expertise in cultural and linguistic studies. Some of his key publications include *The Vulnerability of Indonesian Language Culture: A Search for Encoded Politeness in the Use of Plural Second-Person Pronouns* at the Talent Search Events (2023), *The Cultural Meaning of the Wonosobo Social Community in Agricultural Spells* (2022), and *Sufferings Due to Beautiful Face in A South Sumatra Folktale: "Putri Pinang Masak"* (2021). Other significant works explore local wisdom, gender representation, and cultural practices, such as *The Local Wisdom in the Rhymes of Tari Topeng Lengger Wonosobo* (2020) and *Cultural Meaning of the Morge Siwe Wedding of Kayu Agung People, South Sumatera* (2021). With a strong interdisciplinary approach to literature and culture, Ery continues to advance research that bridges linguistic traditions and cultural heritage. His work offers valuable insights into Indonesia's rich literary and cultural landscape.



Silvia Darina is a dedicated professional at the Regional Planning, Research, and Development Agency of North Sumatra Province, Indonesia. With a Bachelor's degree in Agricultural Science earned in 2008 from the University of North Sumatra, Silvia Darina has cultivated a robust career in regional development planning and research. Their expertise extends to international arenas, as demonstrated by their participation in the International Training Program Agritech Startups for Enhancing the Agri Value Chain (ITEC Program, India, 2024). This training underscored their commitment to advancing agricultural innovation and sustainable value chains. Silvia Darina has contributed significantly to academic and applied research. Key publications include a marketing model for red chili institutions in agricultural centers, studies on optimizing village fund management for economic development, and strategies for marine tourism innovation on the east coast of North Sumatra. In addition to peer-reviewed journal articles, their works span influential policy analyses, development strategies, and practical guides for regional governance. An advocate for local potential, Silvia Darina has also explored the development of Andaliman as a signature product for the UNESCO Global Geopark area around Lake Toba. Their recent focus includes infrastructure optimization, blue carbon stock studies in mangrove ecosystems, and the empowerment of millennial farmers to bolster sustainable agricultural practices. With a passion for community development, Silvia Darina continues to shape research and policy frameworks aimed at economic growth, environmental conservation, and regional resilience in North Sumatra Province.



Dara Windiyarti, born in Temanggung in 1960, is an accomplished literary researcher specializing in Interdisciplinary Literature. After graduating from SMA Negeri Temanggung in 1977, Dara pursued higher education at the University of Diponegoro, earning a Bachelor's degree in Indonesian Literature in 1985. In 2003, Dara advanced her academic career by undertaking postgraduate studies in Literary Studies at the same university, completing her Master's degree in early 2005. Dara's professional journey spans over three decades. She worked at the Provincial Department of Education and Culture in East Timor from 1989 to 1999 and subsequently in East Java from 1999 to 2000. From 2000 to 2021, Dara served as a literary researcher at the East Java Language Center. Since January 2022, she has been contributing her expertise to the Center for Language, Literature, and Community Research at the National Research and Innovation Agency (BRIN). Her notable scholarly contributions focus on the intersections of gender, culture, and literature. Key works include studies on the cultural dislocation in *Burung Kayu* by Niduparas Erlang, gender imbalance in *Gadis Kretek* by Ratih Komala, and the feminist resistance in *Tarian Bumi* by Oka Rusmini. Her research is widely published in respected academic journals, including *Atavisme*, *Humaniora*, and *Bahasa dan Seni*. Dara's dedication to exploring literary narratives through diverse perspectives highlights her commitment to advancing the understanding of culture, identity, and societal challenges in Indonesian literature.



Tri Weda Raharjo, with affiliation Research and Innovation Agency of East Java Province, Indonesia. Tri Weda Raharjo holds a doctoral degree from Airlangga University, where he specialized in areas pertinent to marketing and tourism management. His academic background has equipped him with a robust understanding of the dynamics within these fields, enabling him to contribute effectively to research and development initiatives. Currently serving as a middle-level researcher at the Research and Development Board of East Java Province, Dr. Raharjo has dedicated his career to exploring innovative solutions and strategies that enhance marketing practices and tourism management in Indonesia. His role involves conducting comprehensive research,

analyzing data, and providing insights that inform policy and decision-making processes. Dr. Raharjo's primary research interests lie in marketing management and tourism management. He is particularly focused on the intersection of these fields and how they can be leveraged to promote sustainable practices and economic growth. His work often emphasizes the importance of adapting to changing market conditions and consumer behaviors, especially in the context of global challenges. Dr. Raharjo recently participated in the 4th Borobudur International Symposium on Humanities and Social Science 2023, where he shared his insights on contemporary issues in humanities and social sciences. His contributions to the symposium reflect his commitment to advancing knowledge and fostering dialogue in his areas of expertise. One of his notable publications is the article titled "Adoption of the Green Economy through Branchless Rural Credit Banks during the COVID-19 Pandemic in Indonesia," published in *Sustainability* (2023, Volume 15, Issue 3, Article 2723). This work explores the innovative financial solutions that emerged during the pandemic and their implications for sustainable development in rural areas. Through his research and professional endeavors, Dr. Tri Weda Raharjo continues to make significant contributions to the fields of marketing and tourism management, advocating for sustainable practices that benefit both local communities and the broader economy.



Hasniati, SE, MM, born in 1973, is a dedicated professional with a strong academic and career background. She obtained her Bachelor's degree in Accounting from Universitas Muhammadiyah Makassar and later pursued a Master's degree in Regional Governance Management at Institut Nobel Indonesia. Currently, Hasniati serves as a Civil Servant in the Research and Development Division of the Regional Development Planning, Research, and Development Agency in Takalar Regency, South Sulawesi Province, Indonesia. In this role, she has made significant contributions as a researcher, focusing on fostering innovation and supporting sustainable development initiatives in the region. Hasniati's

expertise and dedication to her field reflect her commitment to advancing research and innovation, driving impactful change in Takalar. Her work continues to be a key factor in the development and progress of the community, reinforcing her passion for promoting positive growth and sustainable development.



Sartika Dewi Sasnita is a seasoned professional with extensive experience in various areas of government and public policy analysis. She completed her Diploma in Communication Science at the Padang Academy of Communication Sciences in 2002, followed by a Bachelor's degree in Communication at STIKOM IGA Tanjungpinang in 2012. She earned her Master's degree in Public Administration from Open University in 2015. Sartika's career began as a Family Planning Field Extension Officer at BP3AKB from 2010 to 2016, where she was actively involved in family development programs and community empowerment. She then served as the Mayor's Protocol Officer at the Tanjungpinang Regional Secretariat from 2016 to 2017, further enhancing her skills in event coordination and public service. In the subsequent years, Sartika held several key positions in government, including Tax Analyst (2017-2018), Public Service Analyst (2018-2021), and Community Organization Analyst (2021-2022). In these roles, she contributed to policy formulation and improving the quality of public services. Currently, Sartika serves as the First Expert Researcher since June 2023, after previously holding the position of Compiler of Materials for Research and Development Implementation (2022-2023). With a strong background in communication, public administration, and government policy, Sartika Dewi has proven herself to be a competent and dedicated professional in the development of public policy and public service.



Acknowledgements

We, the authors, would like to express our deepest gratitude to Almighty God for His guidance and blessings, which have allowed us to complete this work. His grace has been our source of strength throughout this journey. This book, spanning eleven chapters, is the culmination of efforts from many individuals and institutions. Each chapter reflects a collaborative process enriched by contributions from various stakeholders. We extend our heartfelt thanks to the indigenous communities of Papua, whose experiences, traditions, and perspectives are the heart of this work. Their stories illuminate the significance of local wisdom and its role in innovation, as explored in chapters such as *Papuan Identity: A Portrait of Local Uniqueness and Utilizing Papua's Strategic Potential*. To our academic mentors and colleagues, thank you for your insights and constructive feedback, which have shaped the foundational ideas in chapters like *The Beginning of the Journey* and *Challenges Hindering Change*. Your expertise has helped us explore the dynamics of tradition, technology, and innovation. Special gratitude goes to the institutions and organizations that supported this endeavor, particularly the Regional Development Planning, Research, and Innovation Agency of Papua Province, Jayapura, Indonesia. Your collaboration and resources have been pivotal in addressing themes such as the design of innovation systems, as discussed in *Capacity Strengthening and Education of Indigenous Communities* and *Policy and Legal Support for Innovation*.

We also wish to thank our peers and reviewers, whose critical insights contributed to refining this work, particularly in chapters focusing on research dynamics, capacity building, and policy integration. Finally, we extend our warmest appreciation to our families and friends for their unwavering support and patience. Your encouragement has been a vital source of motivation, allowing us to delve into complex subjects like *Knitting the Future: Directions for Papua's Sustainability*. This work represents a shared commitment to preserving and advancing Papua's cultural heritage and innovative potential. To all who have contributed, directly or indirectly, to the completion of this work, we offer our deepest thanks. May this book serve as a meaningful resource for fostering sustainable development and innovation rooted in local wisdom.

Authors



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Abbreviations

ABCD	Asset-Based Community Development
ABM	Agent-based model
AI	Artificial intelligence
AOIP	ASEAN Outlook on the Indo Pacific
AR	Augmented Reality
BRI	Belt and Road Initiative
BTP	Bandung Techno Park
CBE	Community-Based Ecotourism
CBEM	Community-based monitoring
CBFM	Community-based Forest management
CBHRD	Community-Based Human Resource Development
CBR	Community-Based Research
CFM	Collaborative Forest Management
CLD	Causal Loop Diagram
CSR	Corporate social responsibility
CTS	Creative Technology Solution
DFA	Design for Assembly
EGD	European Green Deal
ESG	Environmental, Social, and Governance
FCO	Forest Community Outreach
FEP	Field Environmental Philosophy
FGD	Focus group discussion
FSC	Forest Stewardship Council
GDP	Gross Regional Domestic Product
GIAHS	Globally Important Agricultural Heritage Systems
GIS	Geographic Information Systems
HDI	Human Development Index
HR	Human resources
IBL	Industry-Based Learning
ICBM	Indigenous Community-Based Monitoring
ICT	Information and Communication Technology
ILK	Integration of local knowledge
IoT	Internet of Things
ITIKI	Information Technology and Indigenous Knowledge with Intelligence
JITRI	Jiangsu Industrial Technology Research Institute
KMF	Korea Muslim Federation
KOICA	Korea International Cooperation Agency
KPI	Key performance indicators
KTO	Korean Tourism Organization
LDSP	Logistics digital sharing platform
NbS	Nature-based solutions
OMA	Orinoco Mining Arc
PBL	Problem-Based Learning
PjBL	Project-Based Learning

PES	Payment for Ecosystem Services
PGS	Participatory Guarantee Systems
PMGSY	Pradhan Mantri Gram Sadak Yojana
PPP	Public-Private Partnership
PRA	Participatory Rural Appraisal
QFD	Quality Function Deployment
R&D	Research and development
RBM&E	Results-Based Monitoring and Evaluation
REC	Renewable Energy Communities
REDD+	Reducing Emissions from Deforestation and Forest Degradation Plus
ROI	Return on investment
SDG	Sustainable development goals
SLM	Sustainable land management
SLRT	Sustainable Landscapes Rating Tool
STD	Super tax deduction
STEM	Science, technology, engineering, and mathematics
TEK	Traditional Ecological Knowledge
TMDL	Total Maximum Daily Load
UI	University of Indonesia
UNCTAD	United Nations Conference on Trade and Development
VE	Value Engineering
VR	Virtual Reality



1.1. Introduction : Study Perspective

The multidimensional perspective in the study of Papua, especially regarding economic, social, and cultural aspects, can be understood through the application of various relevant theories. These theories provide a conceptual framework for exploring the challenges and potentials of indigenous Papuans amid the pressures of globalization and climate change. In this context, the theory of dependency, the theory of cultural pluralism, and the theory of community empowerment are significant foundations for studying the phenomenon holistically. Dependency theory explains the dynamics of the dependency relationship among developing countries and developed countries in the global economic system. This theory was first introduced by Latin American economists such as Raul Prebisch in the 20th century as a critique of the modernization theory. In this framework, developing countries are positioned as suppliers of raw materials and consumers of developed countries' products, thus creating structural inequalities that hinder the economic growth of developing countries. The main concept of dependency theory is the exploitation of resources and the economic marginalization of local communities due to global economic domination. The basic assume this theory is that dependence on the global market dominated by developed countries makes it difficult for developing countries to develop independently. With the center-periphery structure as its theoretical model, the theory aims to uncover the structural inequalities experienced by developing countries, including Papua, in the face of exploitation of natural resources by external actors. For illustration, the extraction of Papua's natural resources by multinational companies often does not provide significant benefits to local communities, but rather strengthens economic dependence on outsiders (Andi Ayudhia Tenri Batari Yasin & Firdaus W Suhaeb, 2023). The advantage of this theory is its ability to provide structural analysis of global economic inequality, although it pays less attention to internal factors in developing countries.

Additionally, the theory of cultural pluralism provides a perspective on how cultural diversity can coexist in a society without losing its unique identity. This theory was first introduced by Horace Kallen in the early 20th century to explain the dynamics of multicultural society in the United States. The main concept is the recognition and respect for cultural diversity as an essential opponent in society. In

the context of Papua, this theory helps to understand the social dynamics among indigenous peoples and a more dominant national culture. The basic assume the theory of cultural pluralism is that all cultures have an equal right to develop and exist in society. With a model of cultural mosaic, in which each element remains unique but complements each other, the theory aims to create social harmony amidst diversity. However, this theory has a weakness, namely the potential for identity conflicts that can occur due to sharp cultural differences. In the context of practice, this theory can be used to analyze the interaction among Papuan culture and national culture as well as the challenges of social integration that arise. For illustration, the social life of Papuans in the midst of modernization and national multiculturalism often shows a dynamic among the preservation of local traditions and the adoption of foreign cultures (Bintang & Warsono, 2021). Thus, this theory is relevant in helping to create social harmony and maintain local cultural identity.

The theory of community empowerment is also an important framework in examining the potential and challenges of the Papuan people. This theory emerged in response to the failure the top-down development approach implemented in many developing countries. Conceptually, this theory emphasizes a participatory, asset-based, and sustainable approach in the community development process. The basic assume community empowerment theory is that every society has the potential that can be optimized to achieve economic, social, and cultural empowerment. One of the models that is often used is the Asset-Based Community Development (ABCD) approach, which focuses on the use of local assets as the basis for empowerment. In the context of Papua, this theory aims to provide solutions to the challenges of globalization and climate change through the development of culture-based local potential. For illustration, ecotourism programs involving indigenous Papuans can increase awareness of the importance of environmental conservation while providing local economic benefits (Habib, 2021). The advantage of this theory is its ability to increase local autonomy and development sustainability, although its implementation takes a long time.

Practical studies of dependency theory, cultural pluralism, and community empowerment in different countries show how these concepts are applied in different socio-economic contexts. Through learning from other countries, Indonesia can find relevant solutions to the multidimensional challenges in Papua. The practice of dependency theory, cultural pluralism, and community empowerment is also widely applied in various countries, including Japan, Korea, Germany, China, and Russia. This implementation provides an illustration of how theoretical concepts can be adapted to the social, cultural, and economic context of each country.

Table 1.1. The Practice of Dependency Theory, Cultural Pluralism, and Community Empowerment

Theory	Country	Practice
Dependencies	Brasil (Bintang & Warsono, 2021)	The use of natural resources for local industries through the industrialization policy of import substitution, although it still faces the challenge of technological dependence on developed countries.
	South Africa (Habib, 2021)	The penetration of multinational companies in the mining sector has boosted economic growth but marginalized local communities.
	China (You et al, 2021)	The Belt and Road Initiative (BRI) strategy is used to address dependency through strengthening regional infrastructure and trade with partner countries in Asia and Africa.
	Russia (Mortensen & Smith, 2020)	Focus on economic diversification through strengthening the domestic energy sector to reduce dependence on the European energy market and expand trade networks to East Asia.
Cultural Pluralism	Canada (Bintang & Warsono, 2021)	The country's multiculturalism program supports immigrant communities to preserve their indigenous culture while participating in Canadian society.
	Indonesia (Bintang & Warsono, 2021)	The social harmony among Papuan students and the people of Surabaya shows the practice of multiculturalism, although the challenges of social integration still exist.
	Germany (Müller, 2022)	Migrant integration programs through language training and community cooperation programs that aim to maintain cultural identity while promoting social harmony.
	South Korea (S. Kim et al, 2023)	A multicultural education program for immigrant children with a focus on learning local languages and preserving the culture of origin.
Community Empowerment	Bangladesh (Habib, 2021)	Females' empowerment programs through microfinance have increased the capacity of local economies and reduced dependence on formal institutions.
	Indonesia (Habib, 2021)	The implementation of community-based ecotourism in Papua is to increase environmental awareness and provide economic benefits to indigenous peoples.
	Japan (Sato et al, 2021)	The rural revitalization approach through government support to smallholder cooperatives in promoting organic farming and community-based tourism.
	Russian (Belova & Ivanova, 2023)	Females' empowerment programs in rural areas with a focus on entrepreneurship skills training to improve the family economy.

Source: Author Search, 2024

The application of theory in various countries shows its own successes and challenges. For illustration, Brazil has managed to reduce import dependence through local industrial substitution policies, although technology dependence remains a barrier. On the other hand, South Africa faces the social impact of the dominance of multinational corporations that often marginalize local communities. In China, the practice of dependency theory is focused on endeavors to reduce economic dependence through global infrastructure investment. Instead, Russia chose to

diversify its domestic economy to expand its energy market. In the context of cultural pluralism, Canada offers successful illustrations where policies of multiculturalism actively support cultural diversity. On the other hand, the practice of multiculturalism in Indonesia still faces obstacles to social integration, especially in areas with sharp cultural differences, such as the interaction among Papuan students and the people of Surabaya. Germany and South Korea demonstrate the importance of integration through multicultural education and community programs that promote social harmony. This approach has succeeded in creating a balance among the preservation of the culture of origin and adaptation to local culture. Community empowerment in Bangladesh and Indonesia shows that community-based approaches, such as microfinance and ecotourism, are effective in increasing local capacity. However, this success requires active community involvement and ongoing policy support. Japan and Russia provide illustrations of how government support can improve the welfare of local communities. Japan has shown success in rural revitalization through cooperatives and tourism, while Russia has focused on empowering females in rural areas.

By learning from the practices of other countries, Indonesia can adapt similar approaches to address multidimensional challenges in Papua, such as economic dependence, cultural harmony, and empowerment of indigenous communities. These practices provide valuable lessons for Indonesia, especially in formulating inclusive and sustainable development strategies for Papua. An approach that integrates these three theories can be a solution to face the challenges of globalization, structural inequality, and the preservation of local culture. The three theories are not only independent but also complementary in analyzing multidimensional aspects in Papua. Dependency theory provides a framework for understanding structural economic inequality, cultural pluralism helps explain social and cultural dynamics, while community empowerment theory offers solutions to increase local capacity to face global challenges. In practice, the integration of these three theories can create a holistic approach to understand and overcome problems in Papua, ranging from resource exploitation, modernization pressures, to the preservation of local culture. The use of these theories is not only relevant but also essential in developing inclusive and sustainable development strategies in Papua.

1.2. Dynamics of Indigenous Peoples' Lives

Indigenous peoples' lives in Papua are heavily influenced by traditions, collective values, and a strong connection with nature. This dynamic of life shows their ability to adapt to change, although sometimes they experience conflicts with modernization endeavors that are often not in line with local values. For illustration, customary land ownership systems often clash with national development policies that do not involve local community participation. This system is based on collective

values that consider land to be an ancestral inheritance, in contrast with the concept of individual ownership that is often applied in modern policies. This discrepancy creates challenges for indigenous peoples, especially when customary lands are converted without their consultation or consent (Kurniawan et al., 2021). In addition, indigenous peoples face challenges in the form of limited access to education, health, and infrastructure, which directly affects their quality of life. In rural Papua, access to formal education is often limited due to a lack of adequate facilities and teaching staff. This condition is exacerbated by the difficult access to basic health services and supporting infrastructure. For illustration, many villages in Papua do not have proper roads, making it difficult to mobilize essential goods and services. As a result, indigenous peoples experience significant social and economic disparities compared to other regions in Indonesia (E. Jones et al., 2017).

However, in the midst of these challenges, indigenous Papuans have shown extraordinary adaptation capacity. They are able to integrate certain elements of modernization without leaving local traditions and values. For illustration, in the field of education, some communities have adopted culture-based learning methods that combine local knowledge with the national curriculum. This approach allows indigenous children to obtain formal education without losing their cultural identity. In addition, in the context of health, some communities have developed local initiatives to improve access to health services, such as training local medical personnel who understand local geographical and cultural conditions (Habib, 2021). The perspective needed in understanding these dynamics must include approaches that integrate local values into development policies. Instead of imposing irrelevant modern systems, a community-based approach can be a middle ground to create harmony among tradition and modernity. For illustration, participation-based infrastructure development can ensure that the needs of local communities are met without sacrificing traditional values. Similarly, an inclusive education policy that respects local wisdom can help the young generation of Papuans bridge the traditional and modern worlds (Chrystomo et al., 2020; Gaspersz et al., 2024). The active involvement of indigenous peoples in the process of planning and implementing policies is the key to success. In this context, the theory of cultural pluralism and community empowerment provides a framework for creating a space for dialogue among indigenous peoples and governments. By encouraging active participation and collaboration, this approach not only improves the well-being of indigenous peoples but also reduces conflicts arising from differences in perspectives among local values and national policies. Inclusive and sustainable policy implementation can create a development model that is not only relevant to Papua but also an inspiration for other regions facing similar challenges in the world.

Papua is one of the regions of Indonesia that has a wealth of natural resources and extraordinary cultural diversity. Mineral resources such as gold and copper, as

well as biodiversity in its tropical forests, make Papua a very strategic region. However, behind all this potential, Papua also faces various significant challenges. Problems such as limited infrastructure, low access to education, and economic inequality are the main issues that hinder development in this region. According to research by (Munawaroh & Haryanto, 2021), infrastructure development such as roads and educational facilities has a significant impact on Papua's economic growth. Road infrastructure not only improves connectivity, but also opens up opportunities for local communities to access better education and health services. However, major challenges remain, especially in the interior of Papua where access is very limited.

In the education sector, the collaboration among the Indonesian government and UNICEF through the development acceleration program has shown positive results. This program has succeeded in increasing the availability of educational facilities in remote areas and improving the quality of teaching, although there are still obstacles such as the lack of teachers in remote areas (Mantiri et al., 2024). The availability of equitable educational infrastructure remains a priority to ensure that Papuans can enjoy education on par with other regions in Indonesia. In the economic field, research by (Rahim et al., 2024) revealed that domestic investment in the industrial sector has a significant impact on reducing poverty rates in Papua. This study shows that local investment is more effective than foreign investment in improving the economic performance of the region. However, the involvement of indigenous peoples in this investment is still minimal, so a more inclusive and locally-based approach is needed. The environmental aspect is also an important concern in the development of Papua. A study by (Ririhena et al., 2024) shows that the development of a green economy in Papua requires the active participation of local communities. Education on environmental conservation and the use of environmentally friendly technologies must be improved to support sustainable development in the region. This is relevant considering that Papua has biodiversity which is one of the biggest assets for the region. In the social context, infrastructure development often creates tensions among local communities and migrants. Studies by (Y. I. Sari & Rahman, 2021) show that although infrastructure such as Trans-Papua roads provide wider access, increased economic inequality and social conflicts are often unintended impacts. Therefore, it is important to integrate a community-based approach in every stage of development. Papua has great potential to develop through the use of natural resources, increased local investment, and the implementation of environment-based policies. However, challenges such as social inequality, infrastructure limitations, and environmental impacts must be addressed holistically with a holistic and inclusive approach. Collaboration among the government, local communities, and international partners will be the key to the success of Papua's transformation toward a better future.

As an integral part of Indonesia, Papua has a strategic role in national development. With its location in the easternmost region of Indonesia, Papua is an important gateway to develop the potential of the Pacific region. However, to realize the vision of inclusive and sustainable development, a strategy that can integrate local needs with national policies is needed. In this context, strengthening the capacity of indigenous peoples and preserving local wisdom is one of the main keys to achieving this goal. According to (Munawaroh & Haryanto, 2021), integrated infrastructure development in Papua, especially road infrastructure and education, has had a significant impact on economic growth in the region. The infrastructure not only improves connectivity among regions, but also opens up opportunities for local communities to participate in economic and educational activities. On the other hand, (Rahim et al., 2024) emphasized the importance of investment in the industrial sector in Papua. Domestic investment, compared to foreign investment, has proven to be more effective in lowering poverty rates and improving the welfare of indigenous peoples. This shows that an approach that focuses on local needs can accelerate economic development in Papua. However, the preservation of Papua's environment and biodiversity is also an urgent issue. A study by (Ririhena et al., 2024) shows that an approach based on green economy and environmental preservation is urgently needed to ensure sustainable development. This approach includes community participation in conservation programs and the development of environmentally friendly technologies. Furthermore, a study by (Y. I. Sari & Rahman, 2021) revealed that the construction of the Trans- Papua Road often causes social conflicts among indigenous peoples and migrants. Although this project provides economic benefits, the tensions that arise show the importance of local community involvement in the development planning and implementation process.

Papua is a reflection of the complexity and beauty of Indonesia. On the one hand, the wealth of natural resources such as mines, forests, and the sea provides great opportunities for economic development. However, on the other hand, challenges such as inequality in development, the issue of indigenous peoples' rights, and lack of attention to education and health are obstacles that require serious attention. Therefore, a holistic and local-based approach is needed to overcome this problem. The opportunities that Papua has are not only limited to natural resources, but also to the potential of culture and human resources. The local wisdom possessed by the indigenous Papuan people can be the basis for the development of a sustainable innovation system. By utilizing modern technology combined with local traditions, Papua can be an illustration of inclusive development and rooted in the culture of its people. In addition, Papua's biodiversity also opens up great opportunities for the development of the tourism sector, research, and innovation in the environmental sector.

However, the realization of these various opportunities requires commitment and cooperation from various parties. The government, the private sector, academia, and civil society must work together to create an ecosystem that supports the development of Papua as a whole. In this case, policies that favor indigenous peoples, strengthening infrastructure, and increasing access to education and health are priorities that cannot be postponed. The first step that can be taken is to conduct a thorough mapping of the problem, starting from the village to the provincial level. Accurate and relevant data will be the basis for effective policy formulation. In addition, the empowerment of indigenous peoples through training, education, and access to technology also needs to be the main focus. Thus, the Papuan people can become the main actors in the development of their own territory. This chapter also highlights the importance of a locally-based approach in designing development strategies. The local wisdom possessed by the Papuan people is not only relevant to maintain environmental sustainability, but also to create innovations that suit local needs and conditions. Thus, Papua's development is not only exploitative, but also sustainable and inclusive. Papua has challenges and opportunities that must be managed wisely. By combining local wisdom, technological support, and inclusive policies, Papua can be an illustration of successful innovation-based development. This chapter is the beginning of a long journey to understand and respond to the challenges and opportunities that exist in Papua to create a better future for all its people.

Papua Province has abundant and diverse natural resources, but its use has not been optimal due to limited technology and innovation. In the Agriculture and Plantation sector, Papua controls 85% of the total area of sago forests in Indonesia, which is an important source of food. The potential of sago land in this region reaches hundreds of thousands of hectares. In the Papua Long-Term Development Plan 2025-2045 document, it is stated that Papua has great potential for the development of cocoa and coffee plantations, especially in highland areas. In the Fisheries and Marine sector, Papuan waters have a very abundant potential for marine fisheries. For illustration, Papua's total marine fisheries production reaches more than 700,000 tons per year, most of which has not been fully explored. Marine commodities such as crabs and lobsters are also the mainstay of Papua with great potential for export. In the Mining and Energy sector, Papua is the location of the world's largest gold and copper mines with huge mineral reserves. Freeport Indonesia, one of the companies that manages this mine, produces about three million ounces of gold per year. In addition, Papua has large oil and gas reserves, especially in offshore blocks such as the Cassowary Block. Meanwhile, in the forestry sector, Papua has extensive tropical forests with the potential for timber and rattan that can be utilized. The area of forest area in Papua reaches more than 30 million hectares, making it one of the areas with the largest forest cover in Indonesia. This abundance of natural resources provides

great opportunities for Papua's economic development. However, technological and infrastructure challenges are still the main obstacles in utilizing this potential to the fullest. With sustainable management and innovation support, Papua has the opportunity to become a driving force for national development while preserving its environment.

To accelerate economic development in Papua and improve the welfare of its people, it is necessary to advance science and technology that focuses on local needs. The development of science and technology is the main solution in overcoming challenges such as limited infrastructure, suboptimal management of natural resources, and low productivity in the agricultural and fisheries sectors. Papua, which is rich in natural resources, such as gold mines, copper, tropical forests, and fisheries, has not been able to maximize this potential due to the lack of application of cutting-edge technology in production and processing processes. The development of science and technology to accelerate economic development in Papua has been highlighted in various sectors scientifically categorized in the Sustainable Development Goals (SDGs).

Table 1.2. Number of Scientific Articles based on SDGs with the Papua Province in 2022-2024

No.	Category	Number of Articles
1	<i>No Poverty</i>	236
2	<i>Zero Hunger</i>	587
3	<i>Good Health and Well-Being</i>	2881
4	<i>Quality Education</i>	857
5	<i>Gender Equality</i>	203
6	<i>Clean Water and Sanitation</i>	99
7	<i>Affordable and Clean Energy</i>	443
8	<i>Decent Work and Economic Growth</i>	364
9	<i>Industry, Innovation and Infrastructure</i>	105
10	<i>Reduced Inequalities</i>	326
11	<i>Sustainable Cities and Communities</i>	390
12	<i>Responsible Consumption and Production</i>	159
13	<i>Climate Action</i>	975
14	<i>Life Below Water</i>	816
15	<i>Life on Land</i>	1443
16	<i>Peace, Justice and strong institutions</i>	1199
17	<i>Partnerships for the Goals</i>	34

Sumber : Dimensions, 2024

The data are in table 1.2. relevant in endeavors to encourage economic transformation, strengthen leading sectors, and increase Papua's competitiveness through research and innovation.

1. *No Poverty and Zero Hunger*, the number of studies in this sector shows significant endeavors to reduce poverty and hunger in Papua. The use of this research is very relevant to strengthen the agricultural sector which plays an important role in providing food and improving the welfare of local communities. Through sustainable agricultural technology innovations, such as increasing sago and sweet potato production, Papua can address food security and empower local farmers to increase their incomes. Papua has abundant natural resources, making it a strategic region in an effort to achieve the SDGs, especially No Poverty and Zero Hunger. However, despite being rich in resources, structural challenges such as limited technology, infrastructure, and market access still hinder poverty and hunger alleviation in the region. In the agricultural sector, the implementation of integrated agricultural systems has proven to be an effective solution to increase food production and the welfare of local communities. A study in Tambrau, West Papua, shows that this system can increase agricultural and livestock productivity, create jobs, and promote sustainable food production (Theotama & Syahputra, 2024). In addition, the use of organic technology and a holistic approach have a positive impact on the environment and local communities. Papua also has great potential in the development of local commodities such as sago and sweet potato. This commodity not only plays a role as the main source of food, but also has high economic value. In the context of food security, research on the transition of consumption patterns in Papua shows that people are starting to switch from traditional foods such as sago to processed foods. This poses new challenges related to the sustainability and preservation of local food culture (Nurhasan et al., 2022). In the fisheries sector, Papua has abundant marine fisheries potential, with a production of more than 700,000 tons per year. Superior commodities such as crabs and lobsters have significant export value. However, the lack of access to modern seafood processing technology is the main obstacle in maximizing this potential. Technology-based programs, such as sustainable fisheries management, are needed to optimize marine products without damaging ecosystems (Mollet & Silo, 2024).
2. *Good Health and Well-Being*, the high number in this study shows great concern for the health of the Papuan people. Good health supports labor productivity, which is important for leading sectors such as agriculture and fisheries. Innovation in health technology, as well as increasing access to research-based health services, will improve people's welfare which plays a key role in economic transformation. Good health is the foundation of labor productivity, which in turn is the driving force of economic transformation, especially in leading sectors such as agriculture and fisheries. Papua, with its wealth of natural resources, has great potential to realize sustainable development through improved health systems and technological innovation. However, various strategic challenges still need to

be overcome to ensure the effective implementation of the public health agenda. Strategic Issues in Good Health and Well-Being in Papua: Limited Health Infrastructure, Health infrastructure in Papua tends to be inadequate, which has an impact on low public access to basic health services. Research shows that although road infrastructure and education have a significant positive impact on economic growth in Papua, health infrastructure has not had a significant effect. This indicates the need to improve the quality of health facilities in remote areas (Munawaroh & Haryanto, 2021). Inequality in access to health services, other research in Papua shows that low levels of health services, especially in childbirth and handling of pregnant females, are the cause of high maternal and infant mortality rates. This inequality is exacerbated by geographical isolation and a lack of health professionals (Cholily, 2023). The importance of Health Technology and Information, the implementation of geographic information technology (GIS) and digital-based health systems can provide solutions to the fragmentation of health data. A study in Papua New Guinea found that the use of these technologies was able to improve the quality, accessibility, and utility of health data, allowing for more effective interventions (Rosewell et al., 2021). Global research shows that workforce health significantly affects economic productivity. Ill health increases health costs and reduces labor productivity, which ultimately hampers economic growth (Mehmood & Siddique, 2022).

3. *Quality Education and Gender Equality*, quality education is the foundation to increase the competitiveness of human resources (HR) in Papua. Through improved education relevant to local needs and female's empowerment, Papuans can be more empowered to create innovations in creative economy and technology sectors that support economic growth. Quality education is an important pillar to improve the competitiveness of HR, especially in areas such as Papua which have geographical and socio-economic challenges. By focusing on the relevance of education to local needs and female's empowerment, Papuans can contribute to innovation in the creative economy and technology sectors, accelerating inclusive and sustainable economic growth. Strategic Issues Related to Education and Gender Equality in Papua, including the Gap in Access to Education, the Gender Development Index (IPG) and the Gender Empowerment Index (IDG) of Papua are still relatively low compared to other regions in Indonesia. This shows inequality in access to education, especially for females, which has an impact on their participation in the formal and informal sectors (Annastasya, 2024). This gap hinders the improvement of the quality of HR and local innovation. A Strong Patriarchal Culture in Papua, as revealed in the study, limits females from taking an active role in education and decision-making. This results in low female participation rates in further education and a more productive work sector (Merina & Muhaimin, 2023). Lack of Educational Suitability with Local Needs, Education in

Papua is often irrelevant to local needs. For illustration, the current education system has not fully integrated the potential of the creative economy and technology by the characteristics of Papua's culture and natural resources (Hasyati & Sahara, 2020). Lack of a Comprehensive Gender Equality Policy, despite endeavors from the government and the private sector, such as the AMINEF diplomacy education program in Papua, gender equality policies have not been optimally integrated in vocational education and training (Danomira & Safirah, 2022).

4. *Industry, Innovation, and Infrastructure and Decent Work and Economic Growth*, research on industrial and infrastructure innovation is very important to accelerate the downstream of Papua's superior products such as marine products and plantation products. The development of technology-based industries as well as transportation and digital infrastructure will strengthen Papua's competitiveness in the national and global markets. The development of technology-based industries and adequate infrastructure is very important to maximize the potential of Papua's natural resources. Focusing on the downstream of superior products such as marine products and plantation products can increase the added value of Papua's economy and competitiveness in the national and global markets. Strategic Issues in Industrial and Infrastructure Development in Papua, in more detail can be identified in the form of Transportation and Energy Infrastructure Limitations, Papua has major challenges related to infrastructure limitations, including roads, ports, and energy. Research shows that the development of road infrastructure, such as Trans Papua, can provide economic benefits, but often faces obstacles such as social conflicts and negative environmental impacts (Kambu et al., 2022). In addition, the cost of energy production in Papua is much higher than in other regions in Indonesia, which hinders industrialization in this region (Wibawa et al., 2021). Lack of downstream industry, most of Papua's marine products and plantations are still exported in raw form. This is due to the lack of processing industry in the region. Industrial revitalization strategies through domestic and foreign investment can accelerate the downstream process and create significant jobs (Rahim et al., 2024). Lack of Digital Technology Integration, The use of digital technology is still low in Papua, which hinders industrial efficiency and the marketing of superior products. The increase in the Information and Communication Technology (ICT) Development Index will accelerate the adoption of industry 4.0 technology in this region (Susilo, 2020). Lack of local community involvement, Indigenous Peoples' Participation in Infrastructure Development is often overlooked. This causes social tensions that can hinder the sustainability of development projects (Y. I. Sari & Rahman, 2021).
5. *Life Below Water and Climate Action*, the marine sector is one of the leading sectors in Papua, and the high number of ocean-related research reflects the

importance of sustainable management of marine resources. Through this research, Papua can encourage innovation in sustainable fisheries and protect marine ecosystems that support a marine-based economy. The marine sector in Papua has an important role in the economy, especially through the fisheries and sea-based ecotourism sectors. However, global challenges such as climate change and overexploitation of marine resources demand sustainable and ecosystem-based management approaches. Strategic Issues in Papua's Marine Resources Management include the Threat of Climate Change to Marine Ecosystems, Climate change has a significant impact on marine ecosystems, including rising water temperatures, ocean acidification, and increasing frequency of extreme weather. These impacts threaten the survival of coral reefs and other important habitats, which are home to various commercial fish species (D. A. A. Sari & Muslimah, 2020). Overexploitation and Habitat Degradation, Research in Berau Bay shows that overfishing activities and pollution from human activities increase the vulnerability of important fish species in the region (Maulana et al., 2024). Meanwhile, the use of fishing gear that is not environmentally friendly continues to cause damage to marine habitats, such as coral reefs and seagrass (Tebaiy et al., 2021). Lack of Implementation of Ecosystem-Based Approaches, Marine resource management often does not consider ecosystem-based approaches, which are essential for sustainability. Studies in Papua show that this approach can improve fisheries yields while protecting marine habitats (Yarangga et al., 2023). Lack of Community Awareness and Participation, Local community awareness of the importance of marine ecosystem management is still low. This leads to a lack of participation in conservation initiatives and community-based policies (Rumahorbo et al., 2020).

6. *Life on Land*, research related to land life is also important to support the agriculture and forestry sectors, which are an integral part of Papua's economy. Sustainable forest management, as well as innovations in agroforestry, will ensure that Papua can preserve nature while maximizing its economic potential. Papua has a wealth of tropical forests that are very valuable as one of the main contributors to the world's biodiversity. The agriculture and forestry sectors that are integrated in an ecosystem-based approach are able to make a significant contribution to the local economy, while protecting the environment. Sustainable forest management and agroforestry are strategic solutions to achieve a balance among economic development and nature conservation. Global and Strategic Issues in Land Life Management in Papua have been identified as Deforestation and Forest Degradation, Deforestation which continues to be the main threat to the Papuan ecosystem. Studies show that the conversion of forests for intensive agricultural and plantation purposes is the main cause of forest cover casualty in many regions, including Papua (Nurrochmat et al., 2023). Therefore, the

implementation of conservation-oriented agroforestry is an urgent need. The low use of local agroforestry, despite having great potential, agroforestry practices in Papua are still underdeveloped. Research in Manokwari shows that optimizing traditional agroforestry systems can increase economic value and carbon stocks by 91% and 53%, respectively (Hendri et al., 2023). Lack of Technological Innovation in Agroforestry, lack of information and technology in agroforestry practices in Papua hinder more efficient management. Research in Fakfak shows that adaptation of climate-based agroforestry techniques can improve food security and ecological sustainability, especially in areas with extreme climates (Tuturoop et al., 2022). Lack of Supporting Policies, although social forestry policies have been implemented in Indonesia, implementation support on the ground is often inadequate. Studies in West Java reveal the need for training, access to markets, and incentives to support the success of agroforestry systems (Sanudin et al., 2024).

7. Peace, Justice, and strong institutions, justice and strong institutions are needed to create a stable business climate and innovation in Papua. Political stability and security will encourage more investment in research and technology, which will ultimately increase Papua's competitiveness on the global stage. Justice and strong institutions are the foundation for inclusive and sustainable development in Papua. With political stability and security, Papua has the potential to attract more investment in research and technology, ultimately increasing economic competitiveness on the global stage. However, various strategic challenges need to be overcome to realize this vision. Global and Strategic Issues in Peace and Justice in Papua in the form of Stability in Papua cannot be separated from historical challenges and complex socio-political contexts. For decades, Papua has faced tensions among the need for development and the recognition of the rights of indigenous peoples. Research shows that ongoing conflicts, both related to land rights and the marginalization of indigenous peoples, hinder economic development and create social instability (Kossay & Wahid, 2022). Socio-economic inequality is also a strategic issue that affects the level of peace in Papua. Data shows that Papua has the highest poverty rate in Indonesia, with most of the investment concentrated in extractive sectors such as the Freeport mine, which has less of a positive impact on the well-being of local communities (Astuti, 2023). This injustice exacerbates conflicts and creates a sense of distrust in state institutions. In addition, research on special autonomy shows that although it has been implemented for more than two decades, this program has not had a significant impact on improving the welfare of the Papuan people. The lack of effectiveness in the implementation of special autonomy funds is often attributed to weak local institutions and high levels of corruption (Giban & Faishal Fadli, 2024).

1.3. Significance of Innovation in Preserving Local Wisdom

In an era dominated by technology and innovation, the local wisdom of the Papuan people play an important role in maintaining sustainability. This local wisdom is not only a symbol of cultural identity but also offers practical solutions in the wise management of natural resources. Traditions such as "sasi laut"—customary rules governing the use of marine products based on a specific season—reflect an approach that is in line with modern sustainability principles. This practice demonstrates the ability of indigenous peoples to maintain ecosystem balance while meeting the economic needs of their communities (Kurniawan et al., 2021). The advantage of local wisdom in this context is its relevance to modern sustainability principles, which emphasize harmony among environmental conservation and economic development. Traditional approaches such as "ocean sasi" can be a model for broader conservation policies, especially in regions with similar ecological challenges. In addition, this tradition also reflects the integration of collective values, a sense of shared responsibility, and respect for natural resources. In a global context, similar practices have been recognized as a form of effective community-based resource management (E. R. Jones et al., 2021). However, the main challenge is how to integrate this local wisdom with modern technology without eliminating the underlying core values. Innovative locally-based approaches are a significant solution to strengthen tradition while taking advantage of technological advancements. For illustration, the use of GIS (Geographic Information Systems) technology to map marine sasi areas can help improve management effectiveness and provide accurate data for decision-making. Collaboration among indigenous peoples and research institutions can also produce innovations that are relevant to local needs, such as the development of an early warning system for marine ecosystems based on local traditions (Habib, 2021).

In the context of sustainable development, local wisdom plays an important role as an effective framework for natural resource management. Different countries are implementing this approach in a way that is in line with their cultural traditions, proving that local values can be combined with modern technology to produce optimal results. Illustrations from Germany, Russia, Saudi Arabia, Nigeria, Turkey, and the United States show how each country manages their local resources in a unique yet effective way (table 1.3.). The practice of local wisdom is not only important to maintain local ecosystems but is also relevant in the context of global sustainability. In Indonesia, traditions such as sea sasi are an effective model of community-based resource management. Meanwhile, practices in developed countries such as Japan and South Korea show that modernization does not have to sacrifice traditional values, but can instead integrate traditional elements into modern technology. Management based on local wisdom in various countries proves the flexibility of traditional values in adapting to the challenges of the times. For illustration, a simple

technology such as a rainwater harvesting system in India can be adopted in other semi-arid contexts.

Table 1.3. Local Wisdom Practices in Supporting Sustainable Development

Country	Local Wisdom Practices	Description
Indonesia	Sasi Laut (Kurniawan et al., 2021)	Customary rules that limit the use of marine products over a certain period to restore marine populations and maintain ecosystems.
Japan	Satoyama (Habib, 2021)	Management of semi-natural landscapes by maintaining biodiversity through traditional agrarian and forestry systems.
South Korea	Use of Hanok (traditional architecture) (Y. Kim et al., 2023)	A traditional Korean house that integrates eco-friendly design with energy efficiency, using natural materials such as wood and clay.
India	Rainwater Harvesting System (E. R. Jones et al., 2021)	Indigenous peoples use simple technology to store rainwater in semi-arid areas, supporting water security and local resource management.
Australia	Fire Management by Indigenous Peoples (Smith et al., 2021)	Indigenous Australians use "fire-stick farming" to control land fires, help with vegetation regeneration and wildlife management.
Chinese	Terraces in Agriculture (F. Li et al., 2021)	Terraces are used in rice farming in the mountains to prevent soil erosion and improve water use efficiency.
Germany	Sustainable Forest Management (Brüllhardt et al., 2022)	Silviculture practices that support biodiversity conservation through replanting and forest use rotation to maintain ecological balance.
Russia	Traditional Life in the Interior (Smith et al., 2021)	Traditional management of hunting and fishing by indigenous peoples in Siberia, using methods that do not damage the environment and pay attention to the reproductive cycle of wildlife.
Arab Saudi	Traditional Water Harvesting System (Gezuraga & Benito, 2021)	The use of qanat (underground irrigation system) that flows water from the mountains to agricultural fields by minimizing evaporation and supporting the sustainability of agriculture in dry areas.
Nigeria	Community-Based Agroforestry System (Eseberri Barace et al., 2020)	Combining forestry with traditional agriculture to increase land productivity while preserving local ecosystems.
Turkey	Use of Traditional Architecture (Erden & Topal, 2021)	The use of local materials such as bricks and wood to build houses that are resistant to extreme weather, reduces the use of energy for cooling or heating.
United States	Resource Management by Indigenous Peoples (Farrell et al., 2021)	Native American traditional methods for grassland and water conservation, including controlled wildfire control to encourage vegetation regeneration.

Source: Author Search, 2024

In addition, the ecological approach by Indigenous Australians emphasizes the importance of culture-based resource management to deal with climate change. Local wisdom can be used to support environmental and economic sustainability. Sustainable forest management practices in Germany and traditional forest management in Russia demonstrate how natural resource conservation can be achieved through a tradition-based approach. In Nigeria and the United States, community-based approaches help ensure that the ecological balance is not disturbed. The use of the qanat system in Saudi Arabia and traditional architecture in Turkey demonstrate the adaptation of simple technologies that are very relevant to overcome modern environmental challenges, such as drought and extreme weather. This shows that local values can be combined with innovation to create resilient solutions. This practice is relevant for Papua, where the integration of local traditions such as sea sasi with a modern approach can help achieve broader sustainability, both ecologically and socio-economically. These practices can inspire the implementation of strategies that respect tradition while leveraging modern technology. By learning from other countries' approaches, Indonesia can adapt local wisdom such as sea sasi into broader sustainable development policies. This integration is important to ensure that resource management not only maintains the ecosystem but also provides economic and social benefits for local communities.

It is important to emphasize that locally-based innovation not only serves to preserve traditions, but also strengthens the position of indigenous peoples in sustainable development. By actively involving indigenous peoples in the innovation process, development policies can become more inclusive and responsive to local needs. For illustration, technology training programs tailored to the local cultural context can expand the capacity of indigenous peoples to manage their resources. This not only improves the welfare of the community but also strengthens environmental sustainability at the regional and global levels (Yigitcanlar, 2021). In addition, local wisdom can be a bridge among tradition and modernity. In the action of Papua, traditions such as "sasi laut" can be developed into part of national or even international policy through formal recognition and policy support. This requires an approach that respects local sovereignty while leveraging technology support and global financing. Thus, local Papuan wisdom can be an illustration of how tradition and innovation can go hand in hand to create a sustainable future.

This perspective underscores the importance of collaboration among indigenous peoples, governments, and the scientific community to ensure that local wisdom remains relevant in the modern era. In the context of sustainable development, the integration of local values with modern technological approaches not only increases policy effectiveness but also enriches insights into sustainability. Thus, Papua can be a model for other regions in developing inclusive, tradition-based, and technology-based development strategies. Through the use of local wisdom such

as "sea sasi," indigenous Papuans have proven that a community-based approach can provide effective solutions to environmental and development challenges. By integrating this tradition into modern development policies, Indonesia can create a development framework that is not only sustainable but also respectful of its cultural and ecological diversity. This perspective is relevant to previous discussions on the importance of active participation of indigenous peoples in the development process and the need for an inclusive and sustainable community-based approach. This integration shows that the local wisdom of Papua is not only a cultural heritage, but also a strategic asset for future development.

1.4. Foundations of Thought and Direction

The foundation of thinking is the basis of development strategies in Papua, with an emphasis on local context, recognition of indigenous peoples' rights, and multi-stakeholder collaboration. A deep understanding of Papua's unique characteristics is a key element for designing relevant policies. For illustration, a community-based approach that involves indigenous peoples in the planning process and policy implementation has proven to be effective in creating sustainable development (Khan et al., 2022). Through mapping local potential, such as the practice of sea sasi and other ecological wisdom, Papua has the opportunity to blend tradition with modernity without sacrificing cultural identity. The direction of the research is directed toward developing policies that respect local traditions while encouraging the adoption of modern technologies. This approach refers to the integration of customary values with the principles of global sustainability, which can be seen in community-based development policies in various countries. For illustration, in Japan, the "Satoyama" approach shows that the management of semi-natural landscapes that maintain biodiversity can be a model for Papua in managing its natural resources (Habib, 2021). Thus, an approach that integrates cultural values and technological innovation is an important foundation for the direction of Papua's development.

Evaluation of previous policies is also an important opponent in formulating the direction of development. Data shows that policies that do not actively engage indigenous peoples tend to fail to achieve SDGs. In contrast, participatory approaches based on the recognition of indigenous rights, such as in Australia with the practice of fire management by indigenous peoples, show more effective results in maintaining ecological balance and improving the quality of life of local communities (E. R. Jones et al., 2021). Taking these lessons into account, Papua can develop a more inclusive and local needs-based policy framework. Mapping local potential is also a strategic foothold in determining the direction of development. For illustration, the community-based ecotourism sector has great potential to be developed in Papua. This approach not only supports environmental conservation but also improves the economy of indigenous peoples. Studies show that ecotourism managed by local communities in

countries such as Indonesia and Malaysia have succeeded in increasing local income while preserving biodiversity (Kurniawan & Rauf, 2022). By adapting a similar approach, Papua can leverage its natural and local cultural advantages to drive sustainable growth. This framework also includes an analysis of the quality of life of indigenous peoples. Data related to education, health, and access to infrastructure show that indigenous Papuans still face significant disparities compared to other regions in Indonesia. Therefore, the integration of local culture-based education programs with the national curriculum is one of the solutions that can be implemented. These programs have been shown to be effective in several other indigenous areas in increasing literacy while maintaining cultural identity (Bintang & Warsono, 2021). With an in-depth study-based approach, it is hoped that the direction of development in Papua can be more inclusive, directed, and sustainable. The development of policies that integrate local traditions with modernity, supported by collaboration among the government, indigenous peoples, and academia, is key to success. This framework is not only relevant for Papua but can also serve as a model for other regions facing similar challenges. By harnessing local potential and maintaining environmental sustainability, Papua can create a development ecosystem that respects culture while encouraging technological advancement.

1.5. Problem-Solving Approach

1. Strategic Framework

The Strategic Framework is an effective tool to review and plan the future of science and technology development in Papua. By using this approach, the government can formulate the stages of science and technology development in a systematic and sustainable manner. The Strategic Framework assists Papua in identifying research needs, allocating resources, and targeting key innovations needed for the advancement of the agriculture, fisheries, and creative industries sectors. Each step in the Strategic Framework is designed to be adaptive to global technological dynamics and local needs. The Strategic Framework serves as a key guide for targeted and sustainable science and technology development in Papua, allowing the government to plan and optimize resource allocation effectively. By identifying research needs and setting innovation targets in strategic areas, the Strategic Framework ensures an approach that aligns with global technology trends and specific local needs. This approach facilitates structured planning that can identify priority research areas, ensuring that investments are relevant to local needs and global trends (Sumule & Matualage, 2024). This emphasizes the importance of domestic investment and industrial growth, which are crucial to improve economic performance and reduce poverty in Papua (Rahim et al., 2024). The Strategic Framework also supports initiatives aimed at strengthening local food commodities. A 30% increase in production over the past five years demonstrates the effectiveness

of this approach in promoting sustainable food security (Saa, 2024). Investment in education is also a top priority, given the significant impact on the human development index which ultimately drives economic growth in Papua (Oktania et al., 2024; Silfani et al., 2024). While the Strategic Framework offers a comprehensive strategy for development, challenges such as inadequate infrastructure and limited market access must be addressed to optimize its full benefits.

2. Evidence-Based Policy

Evidence-based policy is an approach that uses data and research results to formulate and implement effective policies. This approach is very relevant to support the Master Plan and Roadmap for Science and Technology Submission in Papua Province, a region that has unique challenges as well as great potential for science and technology development. This policy allows local governments to prioritize strategic issues, design relevant programs, and measure the effectiveness of their implementation. Evidence-based policies require reliable data and access to scientific research to ensure the effectiveness of implementation. However, Papua faces several major challenges in this regard. Limited data collection infrastructure, such as uneven internet access and lack of regional data centers, are often major barriers to collecting accurate information (Korwa, 2021). In addition, the limited capacity of local institutions to analyze data and design policies also slows down the progress of evidence-based policy implementation. Global challenges also affect the development of these policies, including reliance on development models that are based on international standards but often ignore local contexts. A study in Papua New Guinea shows that global policies tend to be difficult to adapt at the local level without strong collaboration among governments, communities, and other stakeholders (Joskin, 2021). Despite the challenges, Papua has a great opportunity to implement evidence-based policies that support science and technology and development. Capacity building of local institutions is a crucial first step. A collaborative approach involving local universities, research institutions, and the private sector can help address this gap. For illustration, an evaluation study of science and technology policies in Indonesia shows that policies based on science and technology performance indicators can encourage innovation-based development if managed properly (Mustangimah et al., 2021). In addition, regional statistical data should be integrated with academic research to ensure policy relevance. Recent research in Papua shows that local food production increased by up to 30% after the implementation of evidence-based policies designed to support commodities such as sago and sweet potatoes (Saa, 2024). A similar approach can be applied to other sectors, such as information technology and renewable energy.

Multi-stakeholder collaboration is an important element in the success of evidence-based policies. This approach includes cooperation among the government, the private sector, universities, and local communities. In West Papua, a community-

based approach to green infrastructure development has shown that strong collaboration can lead to sustainable solutions, especially in the face of the challenges of climate change and environmental degradation (Charlton Parlindungan et al., 2023). Regular evidence-based monitoring and evaluation is needed to ensure policies remain relevant and effective. Studies in Papua show that the analysis of human development and infrastructure indicators has a significant impact on economic inequality. Therefore, consistent evaluation can help identify problems and improve implementation strategies (Weya et al., 2023). Evidence-based policies are the necessary foundation for the effective planning and implementation of the Master Plan and Roadmap for Science and Technology Submission in Papua. By addressing local challenges through better data collection, institutional capacity building, and multi-stakeholder collaboration, Papua can harness the potential of science and technology to support sustainable development. These measures should be complemented by consistent monitoring and evaluation to ensure policies remain relevant and deliver the desired impact.

3. Strengthening the Research and Innovation Ecosystem

Figure 1.1. on Strengthening the Research and Innovation Ecosystem explains how the research and innovation ecosystem can be strategically integrated into regional development planning through Regional Science and Technology Submission Master Plan and Roadmap. Here is a detailed explanation of each element in the image. Strengthening the research and innovation ecosystem is a strategic approach in increasing regional competitiveness, including in Papua Province. This approach involves the development of evidence-based policies and the provide adequate infrastructure. This approach not only supports research and scientific development, but also ensures that innovation can be strategically integrated in regional development planning through the Regional Science and Technology Submission Master Plan and Roadmap.

Policies as the Basis of the Research and Innovation Ecosystem, strong policies are a fundamental element in building research and innovation ecosystem. In Indonesia, legal foundations such as Presidential Regulation Number 78 of 2021 and Head of National Research and Innovation Agency of the Republic of Indonesia Regulation Number 5 of 2023 are the main framework in directing the development of this ecosystem. The policy emphasizes the importance of collaboration among local governments, research institutions, the private sector, and the community in encouraging innovation. Studies on innovation ecosystems show that evidence-based policies that involve multiple stakeholders are more effective in creating relevant and sustainable outcomes (Pidorycheva et al., 2020). In China, for illustration, the implementation of regional-based innovation policies has succeeded in optimizing interactions among stakeholders and improving the local innovation ecosystem (Rong et al., 2021). Research and Innovation Infrastructure: Operational Pillar, Adequate

infrastructure includes laboratories, research centers, technology facilities, and digital access needed to support research activities. This infrastructure must be supported by sustainable funding and careful planning. In developed countries, such as Finland, smart specialization-based approaches have been a successful model in utilizing infrastructure to support local innovation (Takala & Tukiainen, 2023).

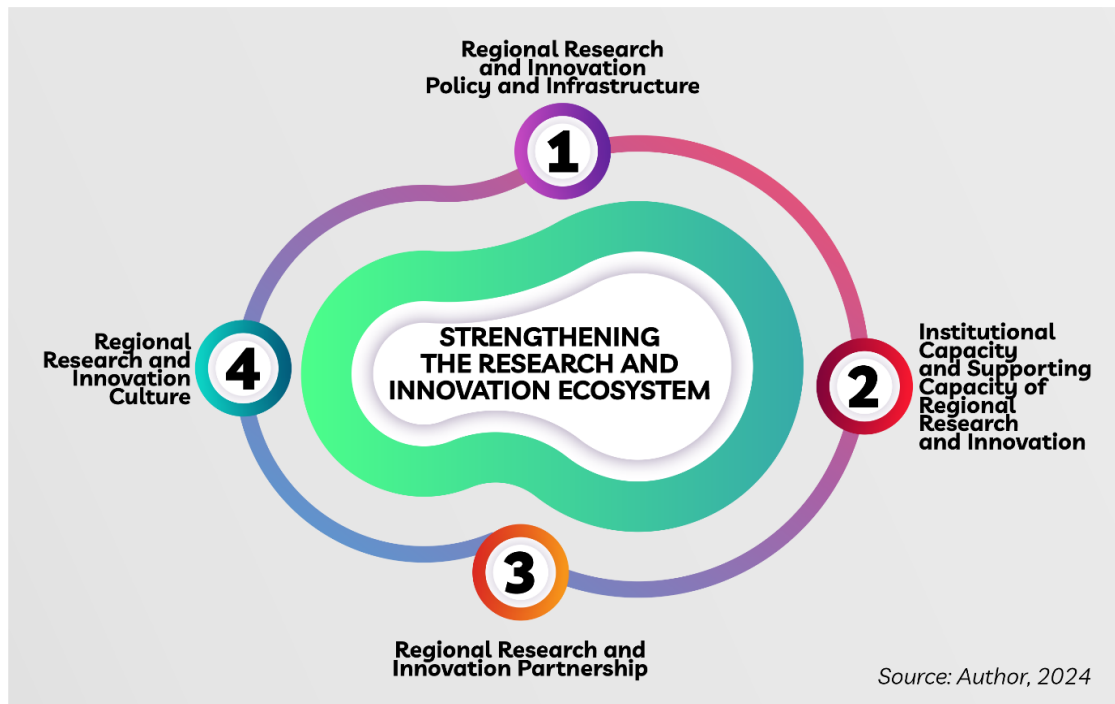


Figure 1.1. Strengthening the Research and Innovation Ecosystem

However, in Papua, geographical challenges and limited access to modern infrastructure are significant obstacles. Research shows that infrastructure development based on local needs can be an effective solution to increase research and innovation capacity in remote areas (Pranuza, 2024). The success of strengthening the research and innovation ecosystem also depends heavily on collaboration among stakeholders. An ecosystem-based approach involving educational institutions, the industry sector, and local communities can create the synergies needed to drive innovation. For illustration, programs in the European region that involve universities in regional leadership roles have been shown to improve connectivity among academic research and practical implementation in industry (SAVAŞ YALÇIN, 2022). In Indonesia, a similar approach can be applied by strengthening the role of universities and local research centers as drivers of innovation in Papua. This involves providing training, financial support, and access to a global network to ensure the success of locally and globally relevant research.

It is important to create data-driven monitoring and evaluation mechanisms to assess the success of policy implementation and research infrastructure. This evaluation should include indicators such as the number of patents, scientific

publications, as well as the economic impact of innovation. In the United States, the National Science Foundation's Innovation Engines program uses data-driven evaluation to tailor policies and investments to the needs of local ecosystems (Guzman et al., 2024). Strengthening the research and innovation ecosystem in Papua requires a holistic approach that includes evidence-based policies, adequate infrastructure, multi-stakeholder collaboration, and continuous monitoring. With this strategy, Papua can harness the potential for innovation for inclusive and sustainable development. This approach not only supports economic growth, but also creates a foundation for the advancement of science and technology that is locally relevant and globally competitive.

Institutional capacity building is a strategic element in building effective research and innovation ecosystem at the regional level. In Papua Province, strengthening research institutions such as the Regional Research and Innovation Agency (BRIDA) and/or the Regional Development Planning Agency (BAPPEDA) is very important to direct relevant resources in supporting research and innovation according to local needs. This institutional capacity includes increasing budgets, strengthening HR, and developing networks with various stakeholders. Global studies show that strong institutional capacity is a prerequisite for successful innovation at the regional level. In countries such as Italy, the quality of public institutions, including the effectiveness of governance and regulation, plays an important role in creating a productive innovation ecosystem (Mosconi & D'Ingiullo, 2023). On the other hand, regions with weak institutions tend to face major challenges in managing research and innovation resources, including corruption and inefficient budget allocation. In the context of Papua, the main challenge lies in the gap in adequate infrastructure and HR. Research in regions facing similar situations shows that the capacity of local institutions can be increased through training programs, digitization of public services, and the integration of technology in the management of research resources (Pfister et al., 2021).

The quality of HR is a key element in institutional strengthening. A study in China found that investment in workforce training in the research sector has a direct impact on increasing regional innovation capacity (Hu et al., 2023). In Papua, improving the competence of research personnel can be done through collaboration with local and international universities to provide technical training, scholarships, and knowledge exchange programs. Multi-stakeholder collaboration among local governments, universities, the private sector, and local communities is also needed to create synergies in the innovation ecosystem. Research in Europe shows that collaboration among universities and the industry sector significantly increases regional innovation output (J. Li & Xing, 2020). In Papua, BRIDA and BAPPEDA can act as facilitators in connecting these various stakeholders. Adequate research infrastructure is an essential element to support the innovation ecosystem. This

infrastructure includes laboratories, data centers, technology facilities, and a stable internet network. Studies in the United States show that the development of a "research triangle" such as North Carolina can significantly increase regional innovation capacity through the grouping of research institutions, universities, and industrial sectors in one location (Shestakovich, 2021). For Papua, the development of infrastructure based on local needs can include the construction of mobile laboratories in remote areas, the use of digital technology for field data collection, and the development of regional research centers integrated with local universities.

Adequate budget support is the main prerequisite for strengthening research institutions. Budget allocation for research and development in Papua can be increased through synergy among local and central governments, including the use of special autonomy funds to support research programs. In addition, periodic evaluations of the use of the budget are needed to ensure its effectiveness. Studies show that transparency and accountability in the management of research budgets can increase public trust and the success of innovation programs (Ganau & Grandinetti, 2021). Strengthening institutional capacity to support research and innovation in Papua requires a comprehensive approach, involving improving the quality of HR, infrastructure development, adequate budget support, and multi-stakeholder collaboration. With this strategy, Papua can create a research and innovation ecosystem that can answer local challenges while contributing to sustainable development at the national and global levels.

A culture of research and innovation is a fundamental element in sustainable development at the regional level. In Papua Province, building a strong research culture not only requires government commitment, but also involves the active role of the community, educational institutions, the private sector, and research institutions. The Master Plan and Roadmap for Regional Science and Technology Submission is designed to create an ecosystem that advises creativity, collaboration, and technology development relevant to local needs. At the global level, the success of a research culture is highly dependent on the capacity of local institutions and the integration of technology. A study in Switzerland showed that higher education institutions that focus on applied research were able to increase the number of patents by up to 6.8% in their regional areas, underscoring the impact of research on regional innovation (Pfister et al., 2021). In Indonesia, one of the main challenges is the lack of adequate infrastructure support and low community involvement in research activities. The importance of a research culture is also reflected in the approach of Scandinavian countries, where multi-stakeholder collaboration among universities, governments, and the industrial sector has been shown to increase the competitiveness of regional innovation (Katimertzopoulos et al., 2023).

Education and Training for the Community, education and training programs are the first step in building research culture at the local level. Local governments

should integrate technology-based training into the educational curriculum, as well as provide scholarships to encourage the younger generation to engage in research and innovation. Research in Europe shows that higher education directed at the development of innovation skills can increase regional capabilities to adapt to global technological changes (Montero-Lobato et al., 2020). Collaboration among the Government and Educational Institutions, in Papua, this collaboration can be directed to build a locally-based innovation center that focuses on agricultural technology and renewable energy. Case studies in the Baltic Sea Region show that creative industries and educational institutions can be key drivers of innovation through strategic synergies (Gerlitz & Prause, 2021). Technology ecosystem development, a technology ecosystem that supports research and innovation includes access to laboratories, research centers, and digital facilities. Investment in technological infrastructure has been proven to increase research productivity. Successful illustrations can be found in Italy, where the management of local knowledge networks and diverse industrial structures increases regional innovation capacity (Innocenti et al., 2020). Increasing public awareness of the importance of innovation, building a culture of innovation also requires a change in people's mindset. Socialization programs can help increase public awareness of the importance of innovation to encourage regional development. Research shows that the involvement of local communities in research can produce innovative solutions that are more in line with regional needs (Huang & Zou, 2024). To ensure the sustainability of the research culture, the government must prioritize periodic evaluations of the RIPJ-PID policy. This includes measuring the impact of research on regional development indicators such as economic growth, job creation, and social inequality reduction. Studies on innovation policies in the European Union show that data-driven monitoring is essential to adjust policy strategies according to regional needs (Annette, 2021). Building a culture of regional research and innovation requires a holistic approach involving education, cross-sector collaboration, technology ecosystem development, and increasing public awareness. With the strategic implementation of RIPJ-PID and multi-stakeholder support, Papua can create an innovation ecosystem that supports regional competitiveness in the long term.

1.6. Purpose and systematics

The purpose of this chapter is to provide an initial overview of the challenges and opportunities facing Papua and the strategic steps that can be taken to overcome them. By understanding the current conditions, it is hoped that policies and innovations can be formulated that are not only relevant but also have a positive impact on the Papuan people. This chapter is the starting point for further discuss important issues in the following chapters. Chapter II, Papuan Identity: A Portrait of Local Uniqueness, will explore Papua's unique and diverse cultural identity. This identity includes the language, traditions, arts, and values that shape the character of

Papuan society. A deep understanding of local identity is needed to design policies and programs that are by the needs of the local community. Chapter III, Dynamics of Research and Innovation in Papua, will review the development of research and innovation in Papua as a basis for data-driven decision-making. Relevant and contextual innovations can be the main drivers to overcome development challenges in Papua, such as infrastructure, education, and health problems.

Chapter IV, Challenges Hindering Change, explores the obstacles that hinder Papua's transformation. These obstacles include lack of access to education, limited infrastructure, economic inequality, and indigenous peoples' rights issues. Identifying these obstacles is the first step in formulating effective and sustainable solutions. Chapter V, Utilizing Papua's Strategic Potential, highlights potential sectors that can be developed in Papua. Natural resources, biodiversity, and tourism potential are illustrations of strategic opportunities that can be leveraged to drive economic growth and social development in the region. Chapter VI, Capacity Strengthening and Education of Indigenous Communities, discusses the importance of strengthening the capacity of indigenous peoples through education, training, and economic empowerment. Improving skills and access to education is key to building competent HR that are ready to face global challenges.

Chapter VII, Design of Innovation System Based on Local Wisdom, integrates modern technology with local wisdom to create a sustainable innovation system. This approach is not only relevant for economic development, but also supports cultural and environmental preservation. Chapter VIII, Policy and Legal Support for Innovation, emphasizes the importance of adequate policy support and legal frameworks to encourage innovation in Papua. Collaboration among governments, the private sector, and civil society is needed to create an ecosystem conducive to innovation. Chapter IX, Innovation-Based Papua Transformation Steps, offers concrete steps to transform Papua by harnessing local potential. This innovation-based approach includes infrastructure development, increased access to education and health, and empowerment of indigenous peoples. Chapter X, Action Agenda for the Future of Papua, develops an action agenda that includes short, medium, and long-term development priorities. This agenda is designed to ensure that every step of development brings real benefits to the people of Papua. Chapter XI, Knitting the Future: Directions for Papua's Sustainability, summarizes the long-term vision for Papua's sustainability. By integrating cultural, economic, and environmental elements, this chapter offers a strategic direction to create an inclusive, sustainable, and prosperous Papua. Each chapter is interrelated and provides a solid foundation for achieving the SDGs of Papua. By understanding the challenges and opportunities that exist, as well as integrating approaches based on local wisdom and modern innovation, Papua has the potential to become a model of inclusive and sustainable development in Indonesia.

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2.1. Rich Geographical and Cultural Advantages

Papua, as the easternmost province in Indonesia, has a significant geographical advantage with a total area of 131,582.85 km². This area consists of a land area of 82,688.37 km², or about 62.84% of the total area, and a sea area of 48,894.48 km², or 37.16% of the total area. Administratively, Papua is divided into eight districts/cities, including Jayapura Regency as the administrative capital and Jayapura City as the center of government. The province is directly bordered by the Pacific Ocean to the north, Papua New Guinea to the east, and Central Papua and Mountainous Papua Provinces to the south and west (Bapperida Provinsi Papua, 2024). The topography of Papua is very diverse, covering lowlands, highlands, mountains, coasts, and islands. About 60.79% of its area consists of mountainous areas, which include the Jayawijaya Mountains with Puncak Jaya as one of the highest peaks in Indonesia. The lowland area covers about 39.20% of the total area, with an area of 3,241,694.74 hectares that has an altitude among 0 to 100 meters above sea level (masl). Areas with an altitude among 100 to 3000 meters above sea level cover 5,025,909 hectares, while areas above 3000 meters above sea level have an area of 1,233.57 hectares. Mamberamo Raya Regency is the area with the largest lowland area, while Keerom Regency has an area at an altitude of more than 3000 meters above sea level which is significant (Biro Hukum Provinsi Papua, 2013).

Papua also has extraordinary marine wealth, covering a sea area as far as 12 miles from the coastline with a total area of 4,889,447.97 hectares. In this region there are 540 islands, of which 517 islands are in the sea and 28 islands are spread across Lake Sentani. The coastal area of Papua has great potential for fisheries management and marine tourism. Biak Numfor, Yapen Islands, and Supiori Regencies are strategic areas that have unique marine ecosystems, including coral reefs, mangrove forests, and seagrass beds that are home to marine biodiversity. Administratively, the mainland of Papua consists of 115 districts and 1,032 villages/sub-districts. The district with the largest area is Mamberamo Raya which covers 28,043.47 km², or about 33.91% of the total area of the province, while Supiori Regency has the smallest area of 660.69 km², equivalent to 0.80% of the province's area. Jayapura City has the smallest area for the city level with 835.69 km². Biak Numfor Regency has the highest number of villages, namely 268 villages, while Supiori Regency has the fewest

villages, only 38 villages. This administrative division presents a unique challenge in managing a vast and diverse territory.

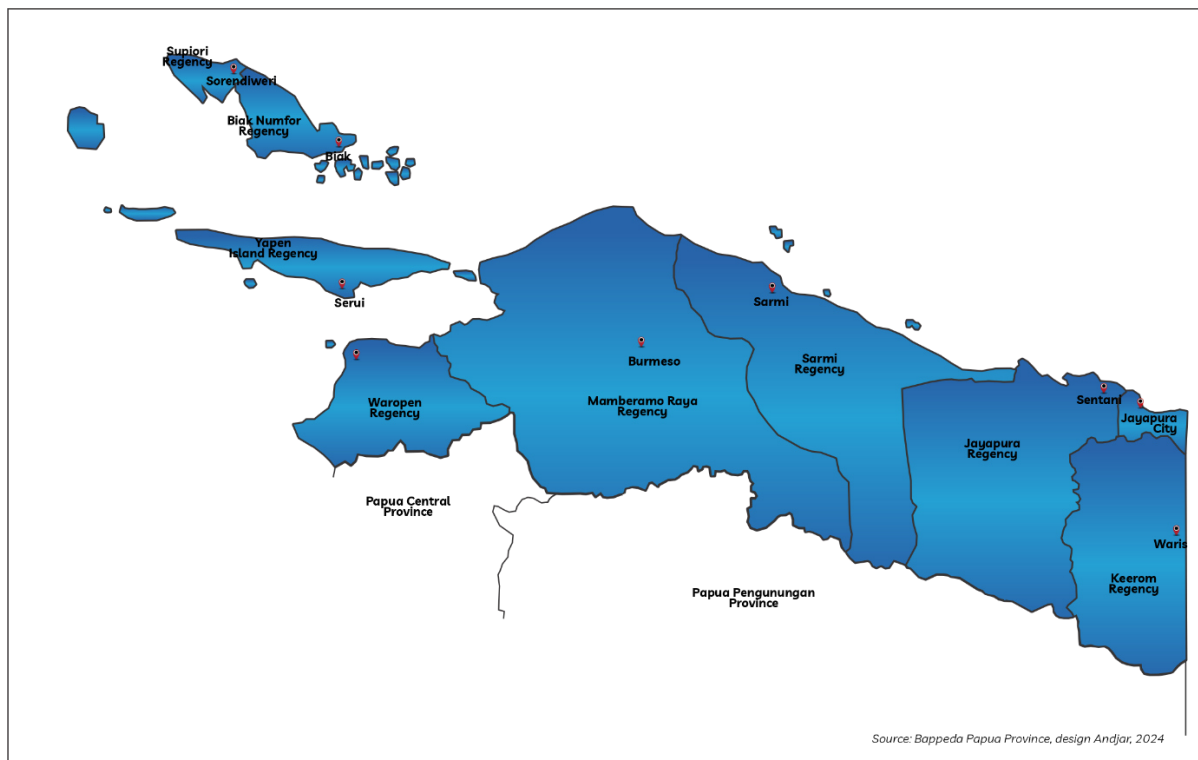


Figure 2.1. Map of Regencies, Cities and Provinces of Papua since 2023

Papua's cultural diversity adds an important dimension in regional development. With more than 250 ethnic groups, Papua has an incredible diversity of languages and customs. The tradition of carving, such as Asmat art, traditional dances, and religious rituals reflects the close relationship among the Papuan people and nature. In the social context, this culture is an important basis for sustainable management of natural resources. In addition, Papua has a forest area of 5,027,142.57 hectares in the highlands which is the main ecosystem buffer in this region. The region also has a wealth of minerals and renewable energy potential that supports environment-based economic development. In recent years, the tourism sector in Papua has shown a significant increase with a growth in foreign tourist visits by 15%, especially in the Biak and Raja Ampat areas.

Papua is also known for its customary areas that have a great influence on natural resource governance. The Mamta/TABI and Saireri customary territories cover most of the districts and cities in Papua, with a social structure based on local wisdom. In the long-term development plan, this area is the main focus for the empowerment of indigenous peoples through local culture-based education and training. Papua is also known for its customary areas that have a great influence on natural resource

governance. The following is a table that illustrates the division of customary areas in Papua and their characteristics.

Table 2.1. The division of customary areas in Papua

Customary Areas	Main Region	Characteristics
Mamta/TABI	Jaipur, Keeron	Coastal and marine management based on indigenous communities, carving arts, and religious rituals.
Saireri	Biak, Yapen Islands	Focus on traditional fisheries and the preservation of marine ecosystems.
Domberai	Sorong, Raja Ampat	Conservation of coral reefs and marine biodiversity.
Firefighter	Fakfak, Kaimana	Traditional use of forests and sago.
Anim Ha	Merauke	Peatland and agricultural management based on local wisdom.
La Pago	Central Mountains	Conservation of mountain forests for agriculture and biodiversity.
me Pago	Nabire Mountains	Management of water resources and forests with strong customs.

Source: RTRW Papua, 2024

Indigenous areas in Papua play a central role in sustainable natural resource governance. Each customary area has a unique approach that suits the local geographical and socio-cultural conditions. The Mamta/TABI and Sareri areas, for illustration, use marine and coastal ecosystems wisely for fisheries and tourism. On the other hand, mountainous areas such as La Pago and me Pago stand out in the preservation of forests and water resources. The integration of local wisdom in the management of customary areas makes a great contribution to environmental preservation and economic strengthening of indigenous peoples. However, key challenges include strengthening the capacity of indigenous peoples, implementing relevant technologies, and increasing collaboration with the government to support the vision of sustainable development in Papua.

Papua's development strategy emphasizes a sustainability approach by making optimal use of its rich natural and cultural resources. The 2022-2041 Papua Development Acceleration Master Plan (RIPPP) is the main reference to achieve a balance among economic development and environmental conservation. Papua has great potential in various sectors that can be developed sustainably to improve the welfare of the local community. Community-based tourism is one of the main focuses in Papua's development strategy. Leading destinations such as Raja Ampat and Cenderawasih Bay have recorded a growth of foreign tourist visits of up to 15% in the last three years, making a significant contribution to regional revenue. The Raja Ampat area, with an area of 4.6 million hectares, covers more than 600 islands and is home to 75% of the world's coral reef species. Meanwhile, Cenderawasih Bay, which covers an area of 1,453,500 hectares, is the largest marine national park in Indonesia and home to rare species such as whale sharks. Community-based tourism

development programs include skills training for local communities in destination management, provide eco-friendly accommodation, and promotion of sustainable tourism. In addition, the implementation of conservation zoning policies in tourist areas has succeeded in suppressing negative impacts on ecosystems, such as coral reef degradation which previously increased by 5% per year.

Education based on local wisdom is an important pillar in the development of Papuan human resources. Data shows that school participation rates in Papua have increased by 10% in the last five years, driven by scholarship programs for indigenous peoples and the construction of 1,032 educational facilities in remote areas. The Papuan government has also noted an increase in the number of technical trainings, such as ecotourism and forest management, involving more than 5,000 local participants each year. In addition, indigenous female's empowerment programs are also a priority, with more than 200 female's groups active in entrepreneurship training based on local products, such as woven and processed foods. This initiative has succeeded in increasing family income by 20% in the participating areas over the past three years.

Papua has a tropical forest area of 5,027,142.57 hectares, which accounts for more than 25% of Indonesia's total forest cover. The conservation program has succeeded in reducing the rate of deforestation by 1.2% per year, lower than the national average of 2.3%. In addition, forest rehabilitation initiatives involving the planting of more than 1 million trees in the 2020-2023 period have increased the carbon sequestration capacity of Papua's forests to 12 million tons of CO₂e per year. Marine conservation is also a major focus, with more than 20,000 hectares of mangrove areas protected through coastal ecosystem restoration programs. On the other hand, zoning-based fisheries management has increased sustainable catches by up to 18% in the Saireri and Domberai areas, contributing an economic contribution of Rp2.5 trillion per year. The sustainability approach to Papua's development shows positive results in economic, social, and environmental aspects. The contribution of the tourism sector to Papua's Gross Regional Domestic Product (GDP) has increased by 7.5% in the last five years, while conservation endeavors have succeeded in preserving biodiversity and reducing environmental damage.

The topography of Papua is very diverse, covering lowlands, high mountains, to coastal areas and islands. Most of the mountainous area covers about 60.79% of the total area of Papua, including the Jayawijaya Mountains which are famous for their snow peaks. The lowland area covers 39.20%, with an altitude among 0–100 meters above sea level of 3,241,694.74 hectares, 100–3000 meters above sea level of 5,025,909 hectares, and more than 3000 meters above sea level covering an area of 1,233.57 hectares. This mountainous area is not only a habitat for various endemic flora and fauna, but also holds great potential for mineral resources (RTRW Papua 2023-2042). Papua also has 540 islands, of which 517 are in the sea and 28 islands

are spread across Lake Sentani. The marine area covers up to 12 miles of coastline with a total area of 4,889,447.97 hectares. Biak Numfor Regency, Yapen Islands, and Supiori are centers for the development of marine tourism and fisheries. In addition, Mamberamo Raya Regency is the largest area with an area of 28,043.47 km², while Supiori Regency is the smallest with an area of only 660.69 km².

Papua is home to more than 250 ethnic groups that have their own languages, traditions, and customs. Traditional carvings, traditional dances, and religious rituals are an important part of cultural heritage. For illustration, the famous Asmat carving art to foreign countries depicts the close relationship among humans and nature. This culture supports the principles of sustainable community-based development.

Table 2.2. Tribal Languages in Papua

No	Language Name	Description
1	Aabinomin	The Aabinomin language is spoken by the Aabinomin ethnic group in Baso Village, Mamberamo Hulu District, Mamberamo Raya Regency, Papua Province. The district is located in the interior region and is surrounded by the Mamberamo River.
2	Abrap	The Abrap language is spoken by the people of Sawanawa Village, Arso District, Keerom Regency, Papua Province. According to the residents' confession, the Abrap-speaking area borders the Marap-speaking area to the east, the Meluap language-speaking area to the west, the Biyekwok-speaking area to the north, and the Molof language-speaking area to the south of Sawanawa Village.
3	Adagum	The Adagum language (Citak Wagabus) is spoken by the Citak ethnic group in Wagabus Village, Suator District, Asmat Regency, Papua Province.
4	Afilaup	The Afilaup language is spoken by the Kawe ethnic group in Kawe Village, Awinbon District, Pegunungan Bintang Regency, Papua Province.
5	Aframa	The Aframa language (Usku) is spoken by the people of Usku Village, Senggi District, Keerom Regency.
6	Airo	The Airo language is spoken by the people of Dabra Village, Mamberamo Hulu District, Mamberamo Raya Regency, Papua Province.
7	Airoran	The Airoran language is spoken by the people of Airoran Village, West Coast District, Sarmi Regency, Papua Province.
8	Ale	The Ale language is spoken by the people in Tembutka Village, Ninati District, Boven Digoel Regency, Papua Province. Tembutka Village is bordered by Waropko Village to the east, Timka Village to the west, and forests to the north and south. According to the residents' confession, Waropko Village uses the Are language and Timka Village uses the Jonggom (Muyu) language.
9	Amathamit	The Amathamit (Athokhin) language is spoken by the people of Yahoi Village, Kasuari Beach District, Asmat Regency, Papua Province.
10	Ambai	The Ambai language is spoken by the people of Ambai II Village, Ambai Islands District, Yapen Islands Regency, Papua Province.
11	Amungkal	The Amungkal language (Amume) is spoken by the people of Kiliarma Village, Agimoga District, Mimika Regency, Papua Province.
12	Anasi	The Anasi language is spoken by the Merhahi ethnic group in Anasi Village, Sawai District, Mamberamo Raya Regency, Papua Province.

No	Language Name	Description
13	Ansus-Papuma	The Ansus-Papuma language is spoken by the people of Wimoni Ansus I and Papuma Villages, West Yapen District, Yapen Islands Regency, Papua Province.
14	Anus	The Anus language is spoken by the Anus ethnic group in Anus Village, Bonggo District, Sarmi Regency, Papua Province.
15	Arakam	The Arakam language is spoken by the people of Karbis Village, Suator District, Asmat Regency, Papua Province.
16	Are	The Are language is spoken by the people in Upkim Village, Waropko District, Boven Digoel Regency, Papua Province. Upkim Village is bordered by Wametkopa Village to the east, Wombon Village to the west, Ikcan Village to the north, and Waropko Village to the south. According to the residents' confessions, Wametkopa Village uses the Are language, Wombon Village uses the Mandobo language, Ikcan Village uses the Komela language, and Waropko Village uses the Are language.
17	Armati Sarma	The Sarma Armati language is spoken by the Munuk people in Munukania Village, South Sarmi District, Sarmi Regency, Papua Province.
18	Arubos	The Arubos language (Arubkor) is spoken by the Arubos ethnic group in Burupmakot Village, Seredela District, Yahukimo Regency, Papua Province.
19	Arui-Mor	The Arui-Mor language is spoken by the people of Arui and Moor Villages, Moora District, Nabire Regency, Papua Province.
20	Asmat Bets Mbut	The Asmat Bets Mbut language consists of three dialects, namely the Asmat dialect of Bets Mbut, the Asmat language of the Bismam dialect, and the Asmat language of the Simay dialect.
21	Asmat Safan	The Asmat Safan language (Asmat Pantai) is spoken by the Asmat Safan ethnic group in Aworket Village, Safan District, Asmat Regency, Papua Province.
22	Asmat Sawa	The Asmat Sawa language is spoken by the people of Sawa Village, Sawaerma District, Asmat Regency, Papua Province.
23	Asmat Sirat	The Asmat Sirat language is spoken by the people of Yaosakor Village, Sirets District, Asmat Regency, Papua Province.
24	Asmat Unir Sirau	The Asmat Unir Sirau language is spoken by the people of Kampung Paar, Unir Sirau District, Asmat Regency, Papua Province.
25	Asmat Waijens	The Asmat Waijens language is spoken by the people in Waijens Village, Kolf Braza District, Asmat Regency, Papua Province. Based on the information of the speakers, to the east of Waijens Village is Butuketnau Village whose people speak the Korowai language, to the west is Bor Village whose people speak Momuna, to the north is Woutu Braza Village which and to the south is Patipi Village whose people speak Asmat language.
26	Atam	The Atam language (Temma) is spoken by the Ti ethnic group in Ti Village, Suru-suru District, Asmat Regency, Papua Province. Other villages that speak the language are Koba Village and Yensuku. According to the residents' confession, the Asmat Kontre language is spoken by the people of Kampung Se in the east, the Tomor language is spoken by the people of Kampung Tomor in the west, the Nale language is spoken by the people of Kampung Nale in the north, and the Sambogo language is spoken by the people of Kampung Fim in the southern part of Kampung Ti.
27	Auye	The Auye (Ause) language is spoken by the Napan ethnic group in Napan Village, Napan District, Nabire Regency, Papua Province.
28	Awban	The Awban (Bese) language is spoken by the people of Awban Village, Seredela District, Yahukimo Regency, Papua Province.
29	Awera	The Awera language is spoken by the people of Awera Village, Wapoga District, Waropen Regency, Papua Province.

No	Language Name	Description
30	Awyu Anggai	The Awyu Anggai language is spoken by the people of Anggai Village, Jair District, Boven Digoel Regency, Papua Province.
31	Awyu Darat Kotiak	The Awyu Dari Kotiak language is spoken by the Awyu people in Kotiak Village, Passue District, Mappi Regency, Papua Province.
32	Awyu Darat Yagatsu-Kiki	The Yagatsu-Kiki Awyu Dari language consists of two dialects, namely (1) the Yagatsu dialect of Awyu Darat and (2) the Kiki dialect of Awyu Darat.
33	Awyu Laut	The Awyu Laut language is spoken by the people of Bade Village, Edera District, Mappi Regency, Papua Province.
34	Awyu Meto	The Awyu Meto language (Awyu Metto) is spoken by the people of Metto Village, Ki District, Boven Digoel Regency, Papua Province.
35	Awyu Tokompatu	The Awyu Tokompatu language (Awyu Tokhompatu) is spoken by the people of Tokhompatu Village, Passue District, Mappi Regency, Papua Province.
36	Baedate	The Baedate (Nisa) language is spoken by the Baedate tribe, Bariwaro Village, Waropen Atas District, Mamberamo Raya Regency, Papua Province.
37	Barapasi	The Barapasi language is spoken by the Barapasi ethnic group in Barapasi Village, Waropen Atas District, Waropen Regency, Papua Province.
38	Batero	The Batero language is spoken by the Kawena ethnic group in Pepasena Village, Mamberamo Hulu District, Mamberamo Raya Regency, Papua Province.
39	Bauzi	The Bauzi language is spoken by the people of Wakeyadi Village, Central Mamberamo District, Mamberamo Raya Regency, Papua Province.
40	Bawija	The Bawija language is spoken by the people of Bawija Village, Central Mamberamo District, Mamberamo Raya Regency, Papua Province.
41	Beneraf	The Beneraf language is spoken by the Waynok ethnic group in Betaf Village, East Coast District, Sarmi Regency, Papua Province.
42	Berbai	The Berbai language (Woda) is spoken by the Berbai ethnic group in Woda Village, Raibawi District, Yapen Islands Regency, Papua Province.
43	Berik	The Berik language is spoken by the Berik ethnic group in Samanente Village, Tor Atas District, Sarmi Regency, Papua Province.
44	Betaf-Takar	The Betaf-Takar language (Fitooow Or) is spoken by the people of Betaf Village, East Coast District and Finyabor (Takar), West East Coast District, Sarmi Regency, Papua Province.
45	Beyaboa	The Beyaboa language is spoken by the people of Ubiyau Village, Arso District, Keerom Regency, Papua Province.
46	Biak	The Biak language is spoken by the Biak ethnic group in Kajasbo Village, East Biak District, Biak Numfor Regency, Papua Province.
47	Bian Marind Deg	The Bian Marind Deg language is spoken by the Marind tribe in Muting Village, Muting District, Merauke Regency, Papua Province.
48	Biritai	The Biritai language is spoken by the people of Kampung Biri, East Central Mamberamo District, Mamberamo Raya Regency, Papua Province.
49	Biyekwok	The Biyekwok language is spoken by the Skamto ethnic group in Skanto Village, Skanto District, Keerom Regency, Papua Province.
50	Bku (Bgu)	Bku language (Bgu) is spoken by the people of Kampung Kiren, Central Bonggo District, Sarmi Regency, Papua Province.
51	Blue Klesi	The Blue Klesi language is spoken by the people of Dukeno Village (Dikening) and Klaisu, South Gresi District, Jayapura Regency, Papua Province.
52	Boi	The Boi language is spoken by the people of Nadofuai Village (Bera), Waropen Atas District, Waropen Regency, Papua Province.
53	Bonoi	The Bonoi language (Boni-Bunu) is spoken by the people of Bonoi Village, Sawai District, Mamberamo Raya Regency, Papua Province.

No	Language Name	Description
54	Bora-Bora	The Bora-Bora language is spoken by the people of Bora-Bora Village, Ismari District (Tor Atas), Sarmi Regency, Papua Province.
55	Bouram	The Bouram language is spoken by the people in Sasime Village, Kopay District, Asmat Regency, Papua Province. Kampung Sasime is bordered by Kampung Kawem to the east, Kampung Wagaso to the west, Kampung Amaru to the north, and Kampung Hogar to the south. According to the residents' confessions, the people of Kampung Kawem use the Bouram language, the people of Wagaso Village use the Bouram language, the people of Kampung Amaru use the Bouram language, and the people of Hoger Village use the Bouram language.
56	Buagani	The Buagani language is spoken by the people in Bu Village and Agani Village, Sawaerma District, Asmat Regency, Papua Province. Kampung Bu is bordered by Kampung Manep to the east, Kampung Pupis to the west, Kampung Momogo to the north, and Kampung Sawaerma to the south. According to the residents' confessions, the people of Manep Village use the Manep language, the people of Pupis Village use the Pupis language, the people of Momogo Village use the Momogo language, and the people of Sawaerma Village use the Sawa language.
57	Burate	The Burate language is spoken by the people in Burate Village, Wapoga District, Waropen Regency, Papua Province.
58	Burukmakot	The Burukmakot language (Burupmakot) is spoken by the people of Burupmakot Village, Seredela District, Yahukimo Regency, Papua Province.
59	Burumeso	The Burumeso language (Burmese) is spoken by the people of Burmeso Village, Central Mamberamo District, Sarmi Regency, Papua Province.
60	Busami	The Busami language is spoken by the people of Kamanaf Village, Kosiwo District, Yapen Regency, Yapen Island, Papua Province.
61	Citak	The Citak language is spoken by the Citak tribe in Tugumau Village, Ti Zain District, Mappi Regency, Papua Province.
62	Dabe	The Dabe language is spoken by the people of Dabe Village, East West Coast District, Sarmi Regency, Papua Province.
63	Dabra	The Dabra language is spoken by the people of Kampung Taria, Mamberamo Hulu District, Mamberamo Raya Regency, Papua Province.
64	Daikat	The Daikat language (Taikat) is spoken by the Brotian ethnic group in Arso Kota Village, Arso District, Keerom Regency, Papua Province.
65	Dajub	The Dajub language (Tokuni) is spoken by the people in Tokuni Village, Seredela District, Yahukimo Regency, Papua Province.
66	Damal	The Damal language is spoken by the Damal ethnic group in Kampung Karang Mulia, Nabire District, Nabire Regency, Papua Province.
67	Dani	The Dani (Hubula) language is spoken by the Mukoko ethnic group in Wesaput Village, Wamena Kota District, Jayawijaya Regency, Papua Province.
68	Dani Atas	The Upper Dani language is spoken by the Dani ethnic group in Piramyd Village, Asologaima District, Jayawijaya Regency, Papua Province.
69	Dani Bawah	The Lower Dani language is spoken by Asotipo in Putageima Village, Asotipo District, Jayawijaya Regency, Papua Province.
70	Dani Bokondini	The Dani Bokondini language is spoken by the Dani Bokondini ethnic group in Bokondini Village, Bokondini District, Tolikara Regency, Papua Province.
71	Dani Tengah	The Central Dani language (Dani Baliem) is spoken by the people in Pugima Village, Walelagama District, Jayawijaya Regency, Papua Province.
72	Daranto	The Daranto language (Deranto) is spoken by the people in Deranto Village, Ismari District, Sarmi Regency, Papua Province. Apart from Deranto Village, this language is spoken in Waf Village.

No	Language Name	Description
73	Dasigo	The Dasigo language (Sidoghu) is spoken by the people of Dabra Village, Mamberamo Hulu District, Mamberamo Raya Regency, Papua Province.
74	Dem	The Dem language is spoken by the Wonda tribe in Molu Village, Pogoma District, Puncak Jaya Regency, Papua Province.
75	Demisa	The Demisa language (Hoo') is spoken by the people of Kampung Desawa, Lower Waropen District, Waropen Regency, Papua Island, Papua Province.
76	Diae	The Diae language is spoken by the people in Kampung Bor, Sumo District, Yahukimo Regency, Papua Province. Based on the speaker's information, the Diae language is also spoken in Obokain Village, Sumo District.
77	Dinana	The Dinana language (Marenggi) is spoken by the people of Tarawasi Marenggi Village, East Bonggo District, Sarmi Regency, Papua Province.
78	Dintere	The Dintere language is spoken by the Murop ethnic group in Iwur Village, Iwur District, Pegunungan Bintang Regency, Papua Province.
79	Diuwe	The Diuwe language is spoken by the majority of the Obokain ethnic group in Obokain Village, Somu District, Yahukimo Regency, Papua Province.
80	Dra	The Dra language is spoken by the people of Amgotro Village, Yaffi District, Keerom Regency, Papua Province.
81	Dubu	The Dubu (Tepi) language is spoken by people living in Dubu Village, Web District, Keerom Regency, Papua Province.
82	Duvle	The Duvle language is spoken by the people of Dagai, Mbomban, Soi, and Gueri Villages, Dagai District, Puncak Jaya Regency, Papua Province.
83	Eik	The Eik language (Foau) is spoken by the people of Foau Village, Mamberamo Hulu District, Sarmi Regency, Papua Province.
84	Eipumek	The Eipumek language is spoken by the majority of the Eipumek ethnic group in Eipumek Village, Eipumek District, Pegunungan Bintang Regency, Papua.
85	Ekari	The Ekari language (me) is spoken by the me tribe in Enarotali Village, East Paniai District, Paniai Regency, Papua Province.
86	Elseng	The Elseng language is spoken by the Koya and Koso tribes in Koya Koso Village, Abepura District, Jayapura City, Papua Province.
87	Elseng Koarjap	The Elseng Koarjap language (Elseng Kwarja) is spoken by the people of Kampung Kwarja (Koarjap), Yapsi District, Jayapura Regency, Papua Province.
88	Emem	The Emem (Emumu) language is spoken by the people of Yurouf Village, Yaffi District and Semografi Village and Yamraf Dua, Web District, Keerom Regency, Papua Province.
89	Engkalembu	The Engkalembu language is spoken by the people of Sota Village, Sota District, Merauke Regency, Papua Province.
90	Etik	The language of ethics (Barto, Maria) is spoken by the people of Kampung Komra (Biridua), East Coast District, Sarmi Regency, Papua Province.
91	Fakafuku	The Fakafuku language is spoken by the people in Fakafuku Village, Agiguga District, Mimika Regency, Papua Province. Fakafuku Village is bordered by Nakai Village to the east, Menarari Village to the west, Otakana Village to the north, and the forest to the south. According to the residents' confessions, Nakai Village uses the Fakafuku language, Manarari Village uses the Fakafuku language, and Otakana Village uses the Fakafuku language.
92	Fayu	The Fayu language is spoken by the Fayu tribal people in Otodemo Village, Inggerus District, Waropen Regency, Waropen Island, Papua Province.
93	Fermanggem	The Fermanggem language is spoken by the majority of residents of Ampas Village, Waris District, Keerom Regency, Papua Province.
94	Fokri	The Fokri (Hokli) language is spoken by the people in Syewa Merare Village, Wapoga District, Waropen Regency, Papua Province. Kampung Sewa Merare is bordered by Kampung Yermeki to the east, Kampung Pirare to the

No	Language Name	Description
		north, and forests and oceans to the west and south. According to the residents' confession, Yermeki Village uses the Demisa language and Pirare Village uses the Demisa language.
95	Gufinti	The Gufinti language is spoken by the Taronta ethnic group in Tarontha Srum Village, Bonggo District, Sarmi Regency, Papua Province.
96	Hubla	The Hubla language is spoken by the Siep Aso ethnic group in Obolma Village, Kurima District, Yahukimo Regency, Papua Province.
97	Iau	The Iau language is mostly spoken by the Iau tribe in Fawi Village, Fawi District, Puncak Jaya Regency, Papua Province.
98	Imbuti	The Imbuti language (Marind) is spoken by the Marind ethnic group of Kampung Samkai, Merauke District, Merauke Regency, Papua Province.
99	Intamaja	The Intamaja language is spoken by the Intamaja ethnic community in Obio Village, Obio District, Yahukimo Regency, Papua Province.
100	Irawa	The Irawa language is spoken by the Taru Irawa tribe in Pirare-Awera Village, Wapoga District, Waropen Regency, Papua Province. According to the residents' confession, to the east of Kampung Pirare is Kampung Somiangga which is spoken in Serui Laut language; to the west, namely Kampung Ansus is spoken Serui; and to the north, namely Merare Village, the Wairate language is spoken.
101	Isirawa	The Isirawa language is spoken by the Isirawa ethnic group in Kasukwe Village, Sarmi Kota District, Sarmi Regency, Papua Province.
102	Jair	The Jair language is spoken by the people of Kampung Jair, Kouh District, Boven Digoel Regency, Papua Province.
103	Jelako	The Jelako language is spoken by the Luban ethnic community, Luban Village, Aboy District, Pegunungan Bintang Regency, Papua Province.
104	Jinak	The Jinak language is spoken by the Jinak ethnic group in Jinak Village, Suatorsuru District, Asmat Regency, Papua Province.
105	Joerat	The Joerat language is spoken by the people in Kampung As and Kampung Atat, Pulau Tiga District, Asmat Regency, Papua Province. Kampung As and Kampung Atat are next to Kampung Nakai to the west, Kampung Kapi to the south, Kampung Weo to the east, and Kampung Esmapan to the north. According to the residents' confessions, the people of Nakai Village use the Nakai language, the people of Kapi Village use the Kapi language, the people of Weo Village use the Yakapis language, and Esmapan Village uses the Yakapis language.
106	Jorop	The Jorop language is spoken by the Jorop ethnic group in Warlef Village, Senggi District, Keerom Regency, Papua Province.
107	Juvutek	The Juvutek language is spoken by people living in Kampung Komra, East Coast District, Sarmi Regency, Papua Province.
108	Kadi	The Kadi language (North Muyu) is spoken by the people of Woropko Village, Waropko District, Bouven Digoel Regency, Papua Province.
109	Kaigar	The Kaigar language is spoken by the people of Amagais Village, Der Koumur District, Asmat Regency, Papua Province.
110	Kaiya	The Kaiya (Kaiy) language is spoken by Oitai and Seritai in Kai Village, Rufaer District, Mamberamo Raya Regency, Papua Province.
111	Kamindip	The Kamindip language is spoken by the people in Sesnuk Village, Sesnuk District, Boven Digoel Regency, Papua Province. Kampung Sesnuk is bordered by Kampung Kanggup to the east, Kampung Amboran to the west, Kampung Jomkondo to the north, and Kampung Butipiri to the south. According to community admissions, Kanggup Village uses Kamindip language, Amboran Village uses Kamindip language, Jomkondo Village uses Kamindip language, and Butipiri Village uses Mandobo language.

No	Language Name	Description
112	Kamoro	The Kamoro language is spoken by the people of Atuka Village, Central Mimika District, Mimika Regency, Papua Province.
113	Kanum Barkari	The Kanum Barkari language is spoken by the people of Kondo Village, Naukenjerai District, Merauke Regency, Papua Province.
114	Kapayap	The Kapayap language (Soko Benanu) is spoken by the people in Kapayap II Village, Kolf Braza District, Asmat Regency, Papua Province. Based on the speaker's information, the Kapayap language is also spoken by the people in Kampung Kapayap I and Kampung Wutuketnau.
115	Kapori	The Kapori language (Kapauri) is spoken by the people of Pagai Village, Airu District, Jayapura Regency, Papua Province.
116	Kaptiau	The Kaptiau language (Kapitiau) is spoken by the Kapitiau ethnic group in Kapitiau Village, Bonggo District, Sarmi Regency, Papua Province.
117	Karufo Auf	The Karufo Auf language is spoken by the people in Mabul Village (Maitali), Kolof Brasa District, Asmat Regency, Papua Province.
118	Kaureh	The Kaureh language is spoken by the people in Lereh Village, Kaureh District, Jayapura Regency, Papua Province.
119	Kawera	The Kawera language is spoken by the Soromaja ethnic people in Kasonaweja Village, Central Mamberamo District, Memberamo Raya Regency, Papua Province.
120	Kawiyet	The Kawiyet language is spoken by the people in Wanggatkibi Village, Mindiptana District, Boven Digoel Regency, Papua Province. Kampung Wanggatkibi is bordered by Kampung Amuan to the east, Kampung Langgowan to the west, Kampung Kanggewot to the north, and Kampung Kakuna to the south. According to the residents' confessions, Wanggatkibi Village uses the Okpari language, Langgowan Village uses the Wanbon language, Kanggewot Village uses the Kawiyet language, and Kakuna Village uses the Okpari language.
121	Kayo Pulau	The Island Kayo language is located in Tahima Soroma Village, South Jayapura District, Jayapura Regency, Papua Province.
122	Kejer Manirem	The Kejer Manirem language is spoken by the people in Keder Village (Timron), East West Coast District, Sarmi Regency, Papua Province.
123	Kekawia	The Kekawia language is spoken by the people in Kekawia Village, Iwaka District, Mimika Regency, Papua Province. Kekawia Village is bordered by Mioko Village to the east, Aikawapuka Village to the west, Atuka Village to the north, and Kekwa Village to the south. According to the residents' confessions, Mioko Village uses the Kekawia language, Aikawapuka Village uses the Kekawia language, Atuka Village uses the Kekawia language, and Kekwa Village uses the Kekawia language.
124	Kemtuk	The Kemtuk language is spoken by the people of Kampung Sabeab Kecil, Kemtuk District, Jayapura Regency, Papua Province.
125	Kenyam Niknene	The Kenyam Niknene language is spoken by the people of Talma Village, Kenyam District, Nduga Regency, Papua Province. The Kenyam Niknene language is also spoken in Kampung Kenyam and Mamugu 2.
126	Ketengban	The Ketengban language is spoken by the people of Borme Village, Borme District, Pegunungan Bintang Regency, Papua Province.
127	Keuw	The Keuw language is spoken by the Kewete ethnic group in Keuw Village, Wapoga District, Nabire Regency, Papua Province.
128	Kimaam	The Kimaam language is spoken by the people of Padua Village, Kimaam District, Merauke Regency, Papua Province.
129	Kimagima	The Kimagima language is spoken by the Kimagima tribe in Turiram Village, Kimaam District, Merauke Regency, Papua Province.

No	Language Name	Description
130	Kimki	The Kimki language is spoken by the Kimki ethnic group in Batom Village, Batom District, Pegunungan Bintang Regency, Papua Province.
131	Kimyal	The Kimyal language is spoken by the people of Korupun, Dagi, Duram, Kwan Dua, and Debula Villages, Korupun District, Yahukimo Regency, Papua Province.
132	Kiri-Kiri	The Left-Left language is spoken by the Left-Left ethnic group in Wafuka Village, Kirihi District, Waropen Regency, Papua Province.
133	Kitum	The Kitum language is spoken by the Kitum ethnic community in Bayanggop Village, Manggelum District, Boven Digoel Regency, Papua Province.
134	Kiwai	The Kiwai language is spoken by the people of RT 3, Tomer Village, Naukenjerai District, Merauke Regency, Papua Province. The Kiwai language is also spoken in Kampung Kuler, Nasim, Buti, Tomer, and Ginggimop.
135	Klesi	The Klesi language is spoken by the people of Iwon Village, South Gresi District, Jayapura Regency, Papua Province.
136	Klufo	The Klufo language (Krowai Rawa, Krowai Umum) is spoken by the Korowai ethnic group in Rekortu Village, East Korowai District, Pegunungan Bintang Regency, Papua Province.
137	Kofey	The Kofey language is spoken by the people of Sauri Sirami Village, Waropen Atas District, Papua Province.
138	Kokenop	The Kokenop language is spoken by the people in Kampung Bukit, Arimop District, Boven Digoel Regency, Papua Province. Kampung Bukit is next to Kampung Anyumka to the east, Kampung Ujung to the west, Kampung Kuken to the north, and Kampung Iniyandit to the south. According to the residents' confession, the people of Anyumka Village use the Kokenop language, Kampung Ujung uses the Kenonden language, Kampung Kuken uses the Kitum language, and Kampung Iniyandit uses the Kenemaf language.
139	Kombai	The Kombai language is spoken by the people of Kombai Village, Kouh District, Boven Digoel Regency, Papua Province.
140	Kombai Kali	The Kombai Kali (Tajan) language is spoken by the Kombai Tajan (Kali) ethnic group in Viru Hamlet RT 3, Yaniruma District, Boven Digoul Regency, Papua Province.
141	Komela	The Komela language is spoken by the people in Ikcan Village, Waropko District, Boven Digoel Regency, Papua Province. Kampung Ikcan is bordered by Kampung Upkim to the west, Kampung Okdongbon to the south, Kampung Tutuman to the east, and Kampung Ulkopit to the north. According to the residents' confessions, Upkim Village uses the Are language, Okdongbon Village uses the Komela language, Tutuman Village uses the Komela language, and Ulkopit Village uses the Are language.
142	Komolom	The Komolom language (Mombun) is spoken by the people of Komolom Village, Kimaam District, Merauke Regency, Papua Province.
143	Komyandaret	The Komyandaret language is spoken by the people of Kampung RT four Danau Kit, Firiwage District, Boven Digul Regency, Papua Province.
144	Konerau	The Konerau language is spoken by the people of Konoraw Village, Kimaam District, Merauke Regency, Papua Province.
145	Kopkaka	The Kopkaka language is spoken by the people of Seredela Village, Seredela District, Yahukimo Regency, Papua Province.
146	Kopkaka Seredela	The Kopkaka Seredela language (Kopkaga Seredela) is spoken in Seredela Village, Seredela District, Yahukimo Regency, Papua Province.
147	Korowai Baigun	The Korowai Baigun (Atigun) language is spoken by the people of Baigun Village (Atigun), Kolf Braza District, Asmat Regency, Papua Province.

No	Language Name	Description
148	Korowai Karuwage	The Korowai Karuwage (Korowage) language is spoken by the people of Karuwage Village, Firiwage District, Boven Digoel Regency, Papua Province.
149	Korowai Selatan	The South Korowai language (Korowai Lumpur/Klufwo Auf Umbale) is spoken by the people of Yaniruma Village, Yaniruma District, Boven Digoel Regency, Papua Province.
150	Kurudu	The Kurudu (Myobo) language is spoken by the Mauri ethnic group in Kororompui Village, Raibawi District, Yapen Regency, Papua Province.
151	Kwari	The Kwari language is spoken by the people of Aipawah Village (Aepawa), Oudate District, Waropen Regency, Papua Province.
152	Kwer	The Kwer language (Kofet/Kwet) is spoken by the Agumatum ethnic group in Kampung Koper or Omakot (Omakol/Kwer/Temple), Seredela District, Yahokimo Regency, Papua Province.
153	Kwerba	The Kwerba language is spoken by the Armati ethnic group in Wamariri Village, Apawer Hulu District, Sarimi Regency, Papua Province.
154	Kwesten Arare	The Kwesten Arare language is spoken by the people of Arare Village, West East Coast District, Sarimi Regency, Papua Province.
155	Kwinsu	The Kwinsu language is spoken by the people of Ansudu Village, East Coast District, Sarimi Regency, Papua Province.
156	Lani	The Lani language is spoken by the Lani ethnic group in Ninabua Village, Tiom District, Lanny Jaya Regency, Papua Province.
157	Lepki	The Lepki language is spoken by the majority of the Lepki ethnic group in Luban Village, Aboy District, Pegunungan Bintang Regency,
158	Liki	The Liki language is spoken by the people of Liki Village, Sarimi Kota District, Sarimi Regency, Papua Province.
159	Makleu	The Makleu language is spoken by the people of Welbuti Village, Tubang District, Merauke Regency, Papua Province.
160	Mander	The Mander language is spoken by the Buknes ethnic group in Rotea Village, Bonggo District, Sarimi Regency, Papua Province.
161	Mandobo	The Mandobo language is spoken by the people of Kampung Persatuan, Mandobo District, Bouven Digoel Regency, Papua Province.
162	Mandobo Bawah	The Lower Mandobo language is spoken by the people of Selil Village, Ulilin District, Merauke Regency, Papua Province.
163	Mandobo Tengah	The Central Mandobo language (Kop Kambo) is spoken by the people of Wakeriop Village (Maju), Arimop District, Beven Digoul Regency, Papua Province. The Central Mandobo language (Kop Kambo) is also spoken in Patriot Village, Komanik, Kuat Kubun, Aroa, and Ginggimop which are next to Wakeriop Village (Maju). Other languages spoken by the people of Kampung Wakeriop (Maju) are Wambon and Ketagut.
164	Manem	The Manem language is spoken by the majority of the Manem ethnic group in Wembi Village, Manem District, Keerom Regency, Papua Province.
165	Manua	The Manua language (Eritai) is spoken by the Manua ethnic community in Eri Village, East Central Mamberamo District, Mamberamo Raya Regency, Papua Province.
166	Marap	The Marap language is spoken by the people of Kwimi Village, Arso District, Keerom Regency, Papua Province.
167	Maraw	The Maraw language is spoken by the Wondeu ethnic group in Webi Village, West Yapen District, Yapen Regency, Papua Province.
168	Marita	The Marita language is spoken by the people of Wapoga Village (Wobari), Wapoga District, Waropen Regency, Papua Province.
169	Marori	The Marori (Morori) language is spoken by the Marori (Morori) natives of Wasur Village, Merauke District, Merauke Regency, Papua Province.

No	Language Name	Description
170	Masep	The Masep language is spoken by the people of Masep Village, West Coast District, Sarmi Regency, Papua Province.
171	Masimasi	The Masimasi language is spoken by the people of Masimasi Village (Artibe Pulau), East Coast District, Sarmi Regency, Papua Province.
172	Mawes Dey	The Mawes Dey (Mawesdey) language is spoken by the people of Mawesdey Village, East Bonggo District, Sarmi Regency, Papua Province. According to the residents' confession, the language is also spoken in Mawes Mukti and Maweswares.
173	Mawes Wares	The Mawes Wares language (Maweswares) is spoken by the people of Maweswares Village, Bonggo District, Sarmi Regency, Papua Province.
174	Mee Ugia	The me Ugia language is spoken by the people of Ugima Village, Siriwo District, Nabire Regency, Papua Province. The me Ugia speaking area borders the me speaking area.
175	Mek Kosarek	The Mek Kosarek language is spoken by the people of Yaholikma Village, Anggruk District, Yahukimo Regency, Papua Province.
176	Mek Naica	The Mek Nalca language is spoken by the Mek tribe of Kampung Kosarek, Kampung Benawa, Kampung Bari, and Kampung Lelambo, north of Yahukimo Regency, Papua Province.
177	Mek Nipsan	The Mek Nipsan language is spoken by the people of Nipsan Village, Nipsan District, Yahukimo Regency, Papua Province. The language is also spoken to the east of Nipsan Village, namely Nalca Village, to the west, namely Kosarek Village, to the north, namely Pini Village, and to the south, namely Lelambo Village.
178	Melayu	The Malay language is spoken by the people of Waena Village, Abepura District, Jayapura City, Papua Province. The language is also spoken in Abepura and Sentani Villages.
179	Mnanggi	The Mnanggi language is spoken by the people of Skopro Village, East Arso District, Keerom Regency, Papua Province. According to the residents' confession, in the east of the Mnanggi-speaking area, namely Kampung Tapos (PNG) is spoken Mnanggi; to the west, namely Jangke Village, Nyau language is spoken, and to the north, Kriku Village, Webbi language is spoken.
180	Moi Maniwo	The Moi Maniwo language is spoken by the majority of the Ayapa ethnic group in Maniwo Village, Wapoga District, Nabire Regency, Papua Province. Other areas that speak the language are Dabowto, Bami, Menipe, and Kwi Villages.
181	Molof	The Molof language is spoken in Warley and Molof Villages, Senggi District, Keerom Regency, Papua Province. In addition to Warley and Molof villages, the Molof language is also spoken in Purwasi, Tawasi, and Tiarsi villages.
182	Momuna	The Momuna language is spoken by the people of Ureas Village, Dekai District, Yahukimo Regency, Papua Province.
183	Moni Bibida	The Moni Bibida language is spoken by the Zonggonau, Kobogau, and Yatipai ethnic groups in Bibida Village, Bibida District, Paniai Regency, Papua Province.
184	Moni-Kegouda	The Moni-Kegouda language is a language spoken by the people of Kegouda Village, West Paniai District, Paniai Regency, Papua Province.
185	Monuna Samboga	The Momuna Samboga language (Momuna Samboka) is spoken in Samboga Village (Samboka), Seledela District, Yahukimo Regency, Papua Province.
186	Mooi	The Mooi language is spoken by the people of Kampung Maribu, West Sentani District, Jayapura Regency, Papua Province.
187	Motu	The Modu language is spoken by the people in Tomer Village, Naukenjerai District, Merauke Regency, Papua Province. Kampung Tomer is bordered by

No	Language Name	Description
		Kampung Kondo to the east, Kampung Kuler or Onggawa to the west, Kampung Rawabiru to the north, and the sea to the south. According to community admissions, Kampung Kondo uses the Kanum language, Kampung Kuler or Onggawa uses the Kanum language, and Kampung Rawabiru uses the Smarki Kanum language.
188	Munggui	The Munggui language is spoken by the Wondey ethnic group in Munggui Village, Windesi District, Yapen Regency, Papua Province.
189	Murkim	The Murkim language is spoken by the Murkim ethnic group in Kopuni Village (Mot), Batom District, Pegunungan Bintang Regency, Papua Province.
190	Muyu	The Muyu language is spoken by the people of Kamka Village, Mindiptana District, Boven Digoel Regency, Papua Province.
191	Muyu Selatan	The South Muyu language is spoken by the people of Anggumbit Village, Mindiptana District, Boven Digoel Regency, Papua Province.
192	Nafri	The Nafri language is spoken by the people of Nafri Village, Abepura District, Kodya Jayapura, Papua Province.
193	Nagi	The Nagi language is spoken by the Nagi ethnic group in Nanum Village, Kawor District, Pegunungan Bintang Regency, Papua Province.
194	Nai	The Nai language is spoken by the people of Burunggop, Tarkop, Kawor, and Muturkip Villages, Manggelum District, Boven Digoel Regency, Papua Province.
195	Nalik Selatan	The South Nalik language is spoken by the South Nalik ethnic group in Hokhom Village, Suru-Suru District, Asmat Regency, Papua Province. Other villages that speak the language are Kampung Katerina, Krobu, Muaik, Amoma, Momnoak, Pasir Putih, and Obio.
196	Namak	The Nama language is spoken by the people of Kampung Kuken RT 2, Ambatkwi District, Boven Digoul Regency, Papua Province.
197	Namalu	The Namalu language is spoken by the people of Muara Village, Batom District, Pegunungan Bintang Regency, Papua Province. Kampung Muara is located inland with a hilly topography.
198	Namas	The Namas language is spoken by the people of Moukbiran Village, Kombut District, Boven Digoel Regency, Papua Province.
199	Namblong	The Namblong language is spoken by the people of Sanggai Village, Nambluong District, Jayapura Regency, Papua Province. According to the residents' confession, the Namblong language is also spoken in the east, south, west, and north of Sanggai Village.
200	Namla	The Namla language is spoken by the people of Namla Village, Senggi District, Keerom Regency, Papua Province. Apart from the village, the Namla language is also used by the people of Tapanema and Dubu Villages.
201	Narau	The Narau language is spoken by the people of Narau, Harna, Aurina, and Soksotek Villages, Kaureh District, Jayapura Regency, Papua Province.
202	Nare	The Nare language is spoken by the people in Joshua Village, Suru-Suru District, Yahukimo Regency, Papua Province. Joshua Village is next to Tomor Village to the east, Solok Village to the west, Jinusugu Village to the north, and Rentis Village to the south. According to the residents' confessions, the people of Tomor Village use the Nare language, the people of Solok Village use the Nare language, the people of Jinusugu Village use the Nare language, and the people of Rentis Village use the Nare language.
203	Ndarame	The Ndarame language is spoken by the Agumatum ethnic group in Wowi Village, Seledela District, Yahukimo Regency, Papua Province.
204	Ndauwa	The Ndauwa language is spoken by the people of Pogoma Village, Pogoma District, Puncak Jaya Regency, Papua Province.

No	Language Name	Description
205	Ndom	The Ndom language is spoken by the people of Kalilam Village, Kimaam District, Merauke Regency, Papua Province.
206	Ngalum	The Ngalum language is spoken by the Ngalum ethnic group in Kabidding Village, Oksibil District, and Iriding Village, Okbibab District, Pegunungan Bintang Regency, Papua Province.
207	Nggem	The Nggem language is spoken by the Winya (Yali) ethnic group who live in Kobakma Village, Kobakma District, Jayawijaya Regency, Papua Province.
208	Ngguntar	The Ngguntar language is spoken by the Ngguntar ethnic group in Yanggandur Village, Sota District, Merauke Regency, Papua Province. According to the residents' confession, the village to the east of Yanggandur Village, namely Tamer Kol Village, speaks the Tamer Tunai language; to the west, namely Wasur Village speaks Morari language; and to the south, namely Yerew Village, which speaks the Smerki language.
209	Ngkalembu	The Ngkalembu language is spoken by the people of Tomer Village, Naukenjerai District, Merauke Regency, Papua Province.
210	Ningrum	The Ningrum language is spoken by the Ningrum ethnic community in Jetetkun Village, Waropko District, Boven Digoel Regency, Papua Province.
211	Nobuk	The Nobuk language (Kwerba) is spoken by the majority of the Kwerba ethnic group in Kwerba Village, Central Mamberamo District, Mamberamo Raya Regency, Papua Province.
212	Nosaudare	The Nosaudare language is spoken by the Pandori and Kurukuwe tribes in Aniboi Village, Demba District, Waropen Regency, Waropen Island, Papua Province.
213	Nubuai-Waren	The Nubuai-Waren language is spoken by the people of Nubuai Village, Urei Faisei District and Uri Village, Lower Waropen District, Waropen Regency, Papua Province.
214	Nyaw	The Nyaw language is spoken by the people of Moso Village, Muara Tami District, Jayapura City, Papua Province. The Nyaw language is also spoken in Kampung Sangkil, Skopro, and in Papua New Guinea.
215	Obokuitai	The Obokuitai language is spoken by the people of Obogai Village, East Central Mamberamo District, Sarmi Regency, Papua Province.
216	Oedate	The Oedate (Kerema) language is spoken by the people in Kerema Village, Benuki District, Memberamo Raya Regency, Papua Province. Kampung Kerema is bordered by Kampung Kamai to the east, Kampung Poiwai to the west, Kampung Dadat to the north, and Kampung Naohi to the south. According to community admissions, Kampung Kamai uses the Baudi language, Poiwai Village uses the Kaipuri Kurudu language, Kampung Dadat uses the Oedate language, and Naohi Village uses the Oedate language.
217	Okpari	The Okpari language is spoken by the people in Kampung Amuan, Kombut District, Boven Digoel Regency, Papua Province. Kampung Amuan is bordered by Kampung Kawangtet to the east, Kampung Imko to the west, Kampung Kandon to the south, and Kampung Kanggewot to the north. According to community admissions, Kampung Kawangtet uses the Yonggom language, Kampung Imko uses the Okpari language, Kampung Kanggewot uses the Kasaut language, and Kampung Kandon uses the Okpari language.
218	Ormu	The Ormu language is spoken by the people of Nehibe Village, Newa, Yongsu Dosoyo, Yongsu Sapari, Ravenirara District, Jayapura Regency, Papua Province.
219	Orya	The Orya language is spoken by the people of Beneik Village, Unurum Guay District, Jayapura Regency, Papua Province.

No	Language Name	Description
220	Pigapu	The Pigapu language is spoken by the people in Pigapu Village, Iwaka District, Mimika Regency, Papua Province. Kampung Pigapu is next to East Mimika Village to the east, Miyoko Atuka Village to the west, Timika Kota Village to the north, and the sea to the south. According to the residents' confession, the people of East Mimika Village use the Hiropo and Tipoko languages, and the people of Miyoko Atuka Village use the Etame language.
221	Pijin	The Pijin language is spoken by the people of Akarenda Village, Web District, Keerom Regency, Papua Province.
222	Poom	The Poom language is spoken by the Arui ethnic group in Poom two Village, Poom District, Yapen Regency, Papua Province.
223	Pupis	The Pupis language is spoken by the people of Pupis Village, Sawa Erma District, Asmat Regency, Papua Province. The language is also spoken in Kampung Bugani, Jawaer, Momogo, Fi, Jakapu, and Abamu.
224	Rarankwa	The Rarankwa language is spoken by the people of Necheibe Village, Raveni Rara District, Jayapura Regency, Papua Province. According to the residents' confession, the Rarankwa language is also spoken in Yawei, Yowari, and Trong villages.
225	Riantana	The Riantana language is spoken by the people of Kampung Suam, Tabonji District, Merauke Regency, Papua Province.
226	Ro	The Ro (Ru) language is spoken by the people of Kampung Keta, Lower Passue District, Mappi Regency, Papua Province. The language is also spoken in the west of Kampung Keta. To the east and south of Kampung Keta is spoken U and to the north is spoken Citak.
227	Sagapu	The Sagapu language is spoken by the people of Sagapu Village, Suru-Suru District, Asmat Regency, Papua Province. Kampung Sagapu is next to Kampung Abamu to the east, Kampung Menep to the west, Kampung Ujin to the north, and Kampung Buek to the south. According to the residents' confessions, the people of Abamu Village use the Asmat Sirau language, the people of Menep Village use the Menep language, the people of Ujin Village use the Ujin language, and the people of Buek Village use the Buek language.
228	Saman	The Saman language is spoken by the people of Saman Village, Safan District, Asmat Regency, Papua Province.
229	Saponi	The Saponi language is spoken by the Worja ethnic group in Botawa Village, Oudate District, Waropen Regency, Papua Province.
230	Sasawa	The Sasawa language is spoken by the people in Sosawakwesar Village, Central Mamberamo District, Mamberamo Raya Regency, Papua Province. Kampung Sasawakwesar is bordered by Kampung Murara to the east, Kampung Anggreso to the west, Kampung Swaseso to the north, and Kampung Muramare to the south. According to the residents' confessions, the people of Murara Village use the Murara language, the people of Anggreso Village use the Kawera language, the people of Muramare Village use the Kawera language, and the people of Swaseso Village use the Kawera language.
231	Saurisirami	The Saurisirami language is spoken by the people of Saurisirami Village, Masirei District, Waropen Regency, Papua Province.
232	Sause-Ures	The Sause-Ures (Barazre) language is spoken by the people of Lapua and Umbron Villages, Kaureh District, Jayapura Regency, Papua Province.
233	Saweru	The Saweru language is spoken by the people of Saweru Village, Ambai Islands District, Yapen Islands Regency, Papua Province.
234	Sawi	The Sawi language is spoken by the people of Saramit Village, Kasuari Beach District, Asmat Regency, Papua Province.

No	Language Name	Description
235	See	The See language is spoken by the people in See Village, Suru-Suru District, Asmat Regency, Papua Province. Kampung See is bordered by Kampung Katalina to the east, Kampung Joshua to the west, Kampung Jifak to the north, and Kampung Ajin to the south. According to the residents' confessions, the people of Kampung Katalina use the See language, the people of Josua Village use the Nare language, the Village of Jifak uses the See language, and the people of Kampung Ajin use the See language.
236	Segar	The Segar language is spoken by the people of Kampung Segar Tor, Ismari District, Sarmi Regency, Papua Province. The Segar language is also spoken in Kampung Segar Mebor, Sasua Pece, Baguija, Matweja, and Sormaja Gunung.
237	Sempan	The Sempan language is spoken by the people of Inauga Village, Wania District, Mimika Regency, Papua Island, Papua Province.
238	Senggi	The Senggi language (Find) is spoken by the majority of the residents of Senggi Village, Senggi District, Keerom Regency, Papua Province.
239	Sentani	The Sentani language is spoken by the people of Nendali Village, East Sentani District, Jayapura Regency, Papua Province.
240	Serui Laut	The Serui Laut language is spoken by the residents of Serui Laut Village, South Yapen District, Yapen Regency, Papua Province.
241	Sikari	The Sikari language is spoken by the Totow ethnic group in Sikari Village, Roufaer District, Mamberamo Raya Regency, Papua Province.
242	Silimo	The Silimo language is spoken by the people of Silimo Village, Silimo District, Yahukimo Regency.
243	Sipisi	The Sipisi language is spoken by the people in Kampung Sipisi, Waropen Atas District, Mamberamo Raya Regency, Papua Province. Sipisi Village is bordered by Bariwaro Village to the east, Nadofuai Village to the west, Marikai Village to the north, and the ocean to the south. According to the residents' confessions, Bariwaro Village uses the Bariwaro language, Nadofuai Village uses the Nadofuai language, and Marikai Village uses the Marikai language.
244	Skou	The Skou language is spoken by the people of Skouw Yambe, Skouw Mabo, and Skouw Sae Villages, Muara Tami District, Kodya Jayapura, Papua Province.
245	Smarki Kanum	The Smarki Kanum language is spoken by the people of Yerew Village or Rawa Biru, Sota District, Merauke Regency, Papua Province.
246	Soba	The Soba language is spoken by the Hupla ethnic group in Soba Village, Soba District, Yahukimo Regency, Papua Province.
247	Sobey	The Sobey language is spoken by the people of Bagaiserwar Village, Sarmi District, Sarmi Regency, Papua Province.
248	Sobey Wakde	The Sobey Wakde language is spoken by the people of Wakde Village, West East Coast District, Sarmi Regency, Papua Province. According to the residents' confession, the Sobey Wakde language-speaking area borders the Manirem language-speaking area to the east, west, and south of Wakde Village.
249	Sorabi	The Sorabi language is spoken by the people of Sorabi Village, Sawai District, Waropen Regency, Papua Province.
250	Sowiwa	The Sowiwa (Morowa) language is spoken by the people of Sowiwa Village, Oudate District, Waropen Regency, Papua Province.
251	Soytai	The Soyta language is spoken by the people of Taiyeve Village, Mamberamo Hulu District, Mamberamo Raya Regency, Papua Province.
252	Srum	The Srum language is spoken by the people of Tarontha Srum Village, Bonggo District, Sarmi Regency, Papua Province.

No	Language Name	Description
253	Sudate	The Sudate language (Sehudate) is spoken by the people of Otodemo Village, Inggerus District, Waropen Regency, Papua Province. According to the residents' Confession, the Sudate language is only spoken by the residents of Otodemo.
254	Sumuri	The Sumuri language is spoken by the people of Kampung Padang Agoda, Sumuri District, Teluk Bintuni Regency, Papua Province.
255	Sunum	The Sunum language is spoken by the Sunum ethnic group in Sunum Village (Yamna), East Coast District, Sarmi Regency, Papua Province.
256	Tabahair	The Tabahair language (Bipim, Bipin) is spoken by the people of Bipim Village, Atsy District, Asmat Regency, Papua Province.
257	Tabla	The Tabla language is spoken by the people of Waiya Village, Depapre District, Jayapura Regency, Papua Province.
258	Tamakuri	The Tamakuri language is spoken by the people in Tamakuri Village, Sawai District, Mamberamo Raya Regency, Papua Province. Tamakuri Village is bordered by Kampung Bagusa to the east, Kampung Anasi to the west, Kampung Gesa Baru to the north, and the sea to the south. According to the residents' confession, the people of Kampung Bagusa use the Bagusa language, the people of Kampung Anasi use the Anasi language, and the people of Kampung Gesa Baru use the Gesa language.
259	Tamario	The Tamario language is spoken by the people of Pagai Village, Haju District and Magabag Village, Nambai District, Mappi Regency, Papua Province.
260	Tamer Tunai	The Tamer Tunai language is spoken by the Tamer Tunai ethnic group in Tamer Kol Village, Sota District, Merauke Regency, Papua Province.
261	Tangko	The Tangko language is spoken by the Okdamor ethnic community in Okdamor Hamlet, Awinbon District, Pegunungan Bintang Regency, Papua Province.
262	Tapea	The Tapea language is spoken by the Yapo ethnic group in Samorkena Village, Apawer Hulu District, Sarmi Regency, Papua Province.
263	Tarfia	The Tarfia language is spoken by the people of Kamdera Village, Demta District, Jayapura Regency, Papua Province.
264	Tause	The Tause language is only spoken by the people of Derapose Village, Wapoga District, Waropen Regency, Papua Province.
265	Tawu Ane	The Tawu Ane language is spoken by the people in Kaugapa Village, East Mimika District, Mimika Regency, Papua Province. Kaugapu Village is bordered by Hiripau Village to the west and forests to the east, north, and south. According to the residents' confession, Hiripau Village uses the Tawu Ane language.
266	Tebako	The Tebako language is spoken by the people of Bareri Village, Rufaer District, Mamberamo Raya Regency, Papua Province.
267	Tefanma	The Tefanma language is spoken by the people of Tefanma Village, Senggi District, Keerom Regency, Papua Province.
268	Tefaro	The Tefaro language (Demba) is spoken by the people of Urato Village (Tefaro), Masilei District, Waropen Regency, Papua Province.
269	Telepe	The Telepe language is spoken by the Telepe, Ketengban, and Yefmum ethnic groups in Atembabol Village, Okbab District, Pegunungan Bintang Regency, Papua Province.
270	Tevera Pew	The Tevera Pew language is spoken by the people of Tabla Supa Village, Depit District, Jayapura Regency, Papua Province.
271	Tobati	The Tobati language is spoken by the people of Tobati Village, South Jayapura District, Jayapura City, Papua Province.
272	Tomor	The Tomor language is spoken by the people of Tomor Village, Suru-Suru District, Asmat Regency, Province.

No	Language Name	Description
273	Torweja	The Torweja language is spoken by the Kwersa, Torowu, and Kasitai ethnic groups in Kai Village, Rufaer District, Mamberamo Raya Regency, Papua Province.
274	Totoberi	The Totoberi language is spoken by the people of Totoberi Village, Wapoga District, West, Waropen Regency, Papua Province.
275	Towe	The Towe language is spoken by the people of Towe Hitam Village, Towe District, Keerom Regency, Papua Province.
276	Trimuris-Bagusa	The Trimuris-Bagusa language is spoken by the people of Trimuris and Bagusa Villages, Mamberamo Hilir District, Mamberamo Raya Regency, Papua Province.
277	Tsaukwambo	The Tsaukwambo language is spoken by the people of Biwage Village, Kawagit District, Bouven Digoel Regency, Papua Province.
278	Ulakin	The Ulakin language (Ulakuno) is spoken by the people of Ulakin Village, Kolf Braza District, Asmat Regency, Papua Province. The language is also spoken in Kampung Markatun, Kedayap, and Tanah Merah.
279	Una	The Una language is spoken by the people of Langda Village, Langda District, Yahukimo Regency, Papua Province.
280	Vamin	The Vamin language is spoken by the people of Kampung Bumu (Patipi), KolofBrasa District, Asmat Regency, Papua Province. The Vamin language is also spoken in Wanjes, Boutu Brasa, and Pira Pinak Villages.
281	Vedan Nus	The Vedan Nus (Podena) language is spoken by the people of Podena Village (Vedan Saw), Bonggo District, Sarimi Regency, Podena Island, Papua Province.
282	Wabo	The Wabo language is spoken by the people of Wabo Village, East Yapen District, Yapen Islands Regency, Yapen Island, Papua Province.
283	Waicen	The Waicen language is spoken by the people in Sanem Village, Kopay District, Asmat Regency, Papua Province. Kampung Sanem is bordered by Kampung Sinepit to the east, Kampung Saman to the west, Kampung Emene to the north, and Kampung Bawor to the south. According to the residents' confessions, the people of Kampung Sinepit use the Atokhoim language, the people of Kampung Saman use the Saman language, the people of Kampung Emene use the Asmat language, and the people of Bawor village use the Atokhoim language.
284	Wairate	The Wairate language (Debra) is spoken by the people of Syewa Merare Village, Wapoga District, Waropen Regency, Papua Province.
285	Walak	The Walak language is spoken by the Walak ethnic group in Wolo Village, Wolo District, Jayawijaya Regency, Papua Province.
286	Walsa	The Walsa language is spoken by the people of Kampung Pund, Waris District, Keerom Regency, Papua Province.
287	Wambo Tawe Tirop	The Wambo Tawe Tirop language is spoken by the people of Kampung Ujung, Arimop District, Boven Digoel Regency, Papua Province. Kampung Ujung is bordered by Kampung Bukit to the east, Kampung Niop to the west, Kampung Manggelum to the north, and Kampung Maju to the south. According to the residents' confessions, Kampung Bukit uses the Kokenop language, Kampung Niop uses the Wambo Tawe Tirop language, Kampung Manggelum uses the Wambo Kenidik language, and Kampung Maju uses the Kopwamup (Central Mandobo) language.
288	Wambon Kenondik	The Wambon Kenondik language (Wombon, Womsi) is spoken by the people of Manggelum Village, Manggelum District, Boven Digoul Regency, Papua Province.
289	Wanggom	The Wanggom language is spoken by the people of Kawagit Village, Kawagit District, Bouven Digoel Regency, Papua Province.

No	Language Name	Description
290	Wano	The Wano language is spoken by the people of Lumo Village, Lumo District, Puncak Jaya Regency, Papua Province.
291	Warari Onate	The Warari Onate language is spoken by the people of Warari Village, South Yapen District, Yapen Islands Regency, Yapen Island, Papua Province.
292	Warembori	The Warembori language is spoken by the majority of the Tandarengga ethnic group in Warembori Village, Memberamo Hilir District, Mamberamo Raya Regency, Papua Province.
293	Wari	The Wari language is spoken by the Dasigo ethnic group in Taiyeve Village, Mamberamo Hulu District, Sarmi Regency, Papua Province.
294	Warlon	The Warion language is spoken by the people of Abukerom Village, Batom District, Pegunungan Bintang Regency, Papua Province.
295	Warry	The Warry language is spoken by the people of Ambora Village, Demta District, Jayapura Regency, Papua Province.
296	Wate	The Wate language is spoken by the people of Kimi Village, Teluk Kimi District, Nabire Regency, Papua Province.
297	Weinami	The Weinami language is spoken by the people of Weinami Village, Napan District, Nabire Regency, Papua Province. According to the residents' confessions, to the west of Kampung Weinami is Kampung Napan where the Weinami language is spoken; to the north, namely Mosan and Maspawa Villages, Mor is spoken; and to the south, namely Kamarsano Village, the Waropen language is spoken.
298	Wiyagar	The Wiyagar language is spoken by the people of Sigare Village, Assue District, Mappi Regency, Papua Province.
299	Wolani	The Wolani language is spoken by the Wolani ethnic group in Ipakiye Village, East Coast District, Paniai Regency, Papua Province. According to the residents' confession, in the east, west, and north of Ipakiye Village, the Akari language is spoken, while in the south the Moni language is spoken.
300	Wombon	The Wombon language (Womsi) is spoken by the people of Winiktit Village, Waropko District, Bouven Digoel Regency, Papua Province.
301	Wonti	The Wonti language (Waropen) is spoken by the Wonti ethnic group in Koweda Village, Masilei District, Waropen Regency, Papua Province.
302	Wooi	The Wooi language is spoken by the Wihiyawari ethnic group in Woiwani Village, West Yapen District, Yapen Islands Regency, Papua Province.
303	Woria	The Woria language is spoken by the people of Botawa Village, Oudate District, Waropen Regency, Papua Province.
304	Yabanda	The Yabanda (Away) language is spoken by the people of Yabanda Village, Yaffi District, Keerom Regency, Papua Province.
305	Yabega	The Yabega language is spoken by the people of Bibikem Village, Ilwayab District, Merauke Regency, Papua Province. The language is also spoken to the east of Bibicam Village, namely Woboyo Village.
306	Yafi	The Yafi language is spoken by the people of Warlef Village as a combination of Tokondo, Abiu, Sungguar, and Tainda Hamlets; Senggi District; Keerom Regency; Papua Province.
307	Yaghai Mur	The Yaghai Mur language is spoken by the people of Kampung Mur, Mambiomani Bapai District, Mappi Regency, Papua Province. The language is also spoken in Wairu Village.
308	Yaghai Wairu	The Yaghai Wairu language is spoken by the people of Wairu Village, Obaa District, Mappi Regency, Papua Province.
309	Yakapis	The Yakapis language is spoken by the people in Yakapis, Eroko, Esmapan, and Weo Villages, Pulau Tiga District, Asmat Regency, Papua Province. Kampung Yakapis is bordered by Kampung Mumugu to the east, Kampung As to the west, and Kampung Pupis to the south. According to the residents'

No	Language Name	Description
		confession, the people of Kampung Mumugu use the Mumugu language, the people of Kampung As use the Joerat language, and the people of Pupis use the Pupis language.
310	Yali Anggruk	The Yali Anggruk language is spoken by the people of Herelaki Village, Anggruk District, Yahukimo Regency, Papua Province.
311	Yali Kosarek	The Yali Kosarek language is spoken by the people of Wahaldak Village (Wesaltek), Kosarek District, Yahukimo Regency, Papua Province.
312	Yali Ninia	The Yali Ninia language is spoken by the people of Somaaba Village, Ninia District, Yahukimo Regency, Papua Province.
313	Yali Pass Valley	The Yali Pass Valley language is spoken by the Yali ethnic group in Abenaho Village, Yalimo Regency, Papua Province.
314	Yamas	The Yamas language is spoken by the people of Yamas Village, Joerat District, Asmat Regency, Papua Province.
315	Yaur	The Yaur language is spoken by the people of Akudiomi Village (Kwatisore), Yaur District, Nabire Regency, Papua Province. The language is also spoken in Kampung Yaur, Napan Yaur, and Bawei.
316	Yaur Rihegure	The Yaur Rihegure language is spoken by Napan Yaur in Napan Yaur Village, Teluk Umar District, Nabire Regency, Papua Province.
317	Yawa Onate	The Onate Yawa language is spoken by the Onate ethnic group in Tatui Village, Kosiwo District, Yapen Islands Regency, Papua Province. According to the residents' confession, in the east, west, and north of Tatui Village, the Onate language is spoken.
318	Yei	The Yei language is spoken by the people of Kampung Bupul, Elikobel District, Merauke Regency, Papua Province. The language is also spoken in the west and south of Kampung Bupul. To the north of Kampung Bupul is spoken Bian Marind.
319	Yei Bawah	The Lower Yei language is spoken by the people of Poo Village, Jagebob District, Merauke Regency, Papua Province.
320	Yelmek	The Yelmek language is spoken by the people of Wanam Village, Abenaho District, Yalimo Regency, Papua Province.
321	Yeresiam	The Yeresiam language is spoken by the people of Kampung Sima, Yaur District, Nabire Regency, Papua Province.
322	Yeretuar	The Yeretuar language (Umare) is spoken by the people of Yeretuar Village, Teluk Umar District, Nabire Regency, Papua Province.
323	Yetfa	The Yetfa language is spoken by the people of Dules Village, Aboy District, Pegunungan Bintang Regency, Papua Province.
324	Yokari	The Yokari language is spoken by the people of Meukisi Village, Yokari District, Jayapura Regency, Papua Province.
325	Yoke	The Yoke language is spoken by the people of Yoke Village, Mamberamo Hilir District, Mamberamo Raya Regency, Papua Province.
326	Yonggom	The Yonggom language is spoken by the people of Ninati Village, Waropko District, Boven Digoel Regency, Papua Province.

Source: Siswanto, 2024

Demographically, Papua has a population spread across 115 districts and 1,032 villages/sub-districts. Biak Numfor Regency has the most villages, namely 268 villages, while Supiori Regency has the fewest villages, namely 38 villages. Indigenous communities play an important role in the management of natural resources, according to the principles of local wisdom. Empowerment of indigenous peoples

through the development of culture-based tourism and nature conservation is a strategic step in achieving Papua's vision 2045: "Advanced and Sustainable Papua Province Based on Blue Economy, Agroindustry, and creative economy" as stated in the Papua Provincial Regional Long-Term Development Plan 2025-2045. The Blue Economy is an economic approach that focuses on the sustainable use of marine resources to support economic growth, improve social welfare, and preserve marine ecosystems. This concept was first introduced by Gunter Pauli in 2010 in an effort to create economic solutions inspired by the principles of natural ecosystems. The Blue Economy is considered the answer to global challenges such as climate change, degradation of the marine environment, and the need to create new, sustainable jobs (Nazari et al., 2022).

The background of the emergence of the Blue Economy is inseparable from the world's need to use the ocean more efficiently and sustainably. The oceans cover more than 70% of the earth's surface, providing vital resources such as food, energy, and raw materials for medicines. However, overexploitation and marine pollution have caused significant ecosystem damage. Therefore, the Blue Economy seeks to integrate economic activities with environmental conservation endeavors, including better management of marine resources and the use of environmentally friendly technology (Youssef, 2023). The main concepts in the Blue Economy include various sectors such as renewable energy, sustainable fisheries, aquaculture, eco-based tourism, and marine biotechnology. Renewable energies such as offshore wind and ocean waves, for illustration, have become an important part of the transition strategy toward a low-carbon economy. In addition, the ecological-based tourism sector offers a way to support marine conservation while creating jobs in coastal areas. Sustainable aquaculture is also a solution to meet global protein demand without damaging marine ecosystems (Djoric, 2022). The basic assume this theory is that the ocean has great potential to support global economic development if managed with a sustainable approach. This management requires innovative technologies and a clear regulatory framework to ensure that resource exploitation does not exceed the regenerative capacity of marine ecosystems. Thus, the Blue Economy aims to create a balance among economic growth and environmental preservation (Lee et al., 2021). The Blue Economy model or structure involves a cross-sectoral approach that includes the integration of various economic activities with environmental conservation. For illustration, the EU's strategy for promoting the Blue Economy covers five key sectors, blue energy, aquaculture, maritime tourism, blue biotechnology, and seabed mining. Each of these sectors is geared toward reducing environmental impact, improving resource efficiency, and promoting innovation. The framework also includes marine spatial management mechanisms to optimize the use of marine space that is often contested by various parties (Schutter et al., 2021). The main goal of the Blue Economy is to reduce pressure on marine ecosystems while

increasing the contribution of the maritime sector to the national and global economy. In the context of sustainable development, the Blue Economy provides a framework to create a balance among economic development, social sustainability, and environmental protection. Concrete illustrations of this implementation can be found in the "Blue Growth" program initiated by the European Union, which focuses on creating jobs in the maritime sector while ensuring the conservation of marine ecosystems (Djoric, 2022).

However, despite offering a lot of potential, this concept has not gone unnoticed. One of the main drawbacks is the lack of alignment among various stakeholders in its implementation. Conflicts of interest often arise among the conservation and exploitation of marine resources. In addition, the implementation of this concept requires large investments in technology and infrastructure, which can be a barrier for developing countries. Therefore, a more inclusive and collaborative framework is needed to ensure the success of the Blue Economy in various national and regional contexts (Kedia & Gautam, 2020). Applications of the Blue Economy in practice can be found in various countries that have adopted this approach to support economic development and marine conservation. For illustration, Seychelles has integrated the Blue Economy in its national policy to develop ecologically-based tourism and protect marine biodiversity. Similarly, China is using the Blue Economy as part of its modernization strategy with a focus on sustainable ocean management and marine technology innovation (Fabinyi et al., 2021). About other theories, the Blue Economy has a close relationship with the concepts of Green Economy and Circular Economy. These three concepts share the same goal, which is to achieve sustainable development through efficient resource management and environmental conservation. However, the Blue Economy has a special focus on the ocean as a key element of its economic strategy, which sets it apart from other approaches (Youssef, 2023). The Blue Economy offers a great opportunity to create a more sustainable future, both economically and environmentally. However, its success depends heavily on collaboration among governments, the private sector, and communities in developing policies and practices that support these goals. With the right framework, the Blue Economy can become a key pillar of inclusive and sustainable global development.

Agroindustry is an economic sector that integrates agricultural activities with industrial processes to create value-added products. In the context of economic development, agroindustry plays an important role as a driver of innovation, job creation, and poverty reduction in rural areas. By processing agricultural products into more valuable products, agroindustry not only increases farmers' income but also supports food security and environmental sustainability (Djamali et al., 2018; Reichembach & Lúcia de Oliveira Petkowicz, 2021). The agroindustry is developing in response to global challenges in improving the efficiency of agricultural resources

and reducing waste. Historically, the sector has its roots in the industrial revolution that allowed the transformation of agricultural products into products that are more durable and have a higher selling value. With technological advancements, the agroindustry has evolved into a more integrated sector, leveraging innovations such as renewable energy and digital technologies to support more efficient production processes (Carneiro Neto et al., 2022).

Agroindustry involves several key elements, including the use of raw materials from the agricultural sector, the processing process, and the distribution of the final product to the market. An illustration is the processing of agroindustrial waste into bioenergy or environmentally friendly food additives. This approach not only reduces the environmental impact but also provides added value to these waste products (Leyva-López et al., 2020). In addition, business models implemented in agroindustry are often based on circular economy principles, which aim to minimize waste and maximize the reuse of materials. This involves efficient supply chain management and technology integration to increase productivity (Tumuyu et al., 2024). Agroindustry is based on the assumption that agricultural products can provide added value through efficient processing, storage, and distribution. This requires adequate infrastructure, such as cold storage facilities and cutting-edge processing technology, to support the efficiency and sustainability of the sector. In addition, the role of government regulations in providing incentives and supporting research is also the main pillar of the success of the agroindustry (Santoso, 2023).

The structure of agroindustry involves a value chain ranging from the production of raw materials to the marketing of finished products. A model that is often applied is the "input-output model," in which raw materials are processed into various products by utilizing efficient technology. An illustration is the coconut sugar industry which produces crystal sugar and by-products such as energy from biomass (Syamsiar & Arumsari, 2021). The main objectives of agroindustry are to increase the added value of agricultural products, create jobs, and support sustainable RD. The agroindustry is also relevant in the global context to support the sustainable development goals (SDGs), especially in reducing food waste and supporting economic and environmental sustainability (Lestari et al., 2021). The main advantages of agroindustry are its ability to create significant added value for agricultural products, support food security, and reduce poverty in rural areas. However, the downside is the large capital requirements for infrastructure and technology, as well as the risk of dependence on volatile global markets. Another challenge is the lack of technology transfer in developing countries, which often hinders the maximum development of this sector (Angulo-López et al., 2023). Agroindustry applications involve various sectors, such as processing agricultural products into processed food products, bioenergy, and pharmaceutical materials. In Indonesia, for illustration, the coconut sugar agroindustry has succeeded in increasing

the income of local farmers and creating jobs in rural areas. In addition, agroindustry contributes to the development of innovative products such as bioenergy from agricultural waste that can support the transition to a low-carbon economy (Boron et al., 2020).

Agroindustry has a close relationship with the theory of sustainable development and circular economy. Both of these theories provide a framework for understanding how agroindustry can support environmental sustainability while still providing economic benefits. In addition, agroindustry is also related to innovation theory, which highlights the importance of technology in improving the efficiency and productivity of this sector (Sangadah et al., 2020). Concrete illustrations of agroindustry can be found in the fish processing industry in Palembang, which produces processed products such as fish crackers. Despite its great potential, the industry faces challenges in achieving full sustainability. The proposed strategies include waste management, improving product quality, and developing the business capacity of small business actors (Mutiara Pertiwi et al., 2023). Agroindustry offers sustainable solutions to increase the added value of agricultural products while supporting rural economic development. However, the success of the sector is highly dependent on policy support, technological innovation, and collaboration among various stakeholders.

The creative economy is an economic approach based on the exploitation of individual and collective creativity to generate added value through products and services based on ideas, art, technology, and culture. This concept first gained global attention through the "creative economy" report published by the United Nations Conference on Trade and Development (UNCTAD) in the early 2000s. In the modern context, the creative economy is increasingly considered as a strategic sector that advises innovation, economic growth, and social sustainability. The creative economy integrates elements of culture, technology, and entrepreneurship to create products that not only have economic value but also social value (Centárová, 2020). The background of the creative economy is rooted in the transformation of the global economy toward a knowledge-based and innovation-based economy. In the post-industrial era, the role of intellectual capital and creativity has become increasingly dominant in creating competitive advantages. The creative economy is developing in response to the need for economic diversification, especially in countries that want to reduce their dependence on natural resources. In many developed countries, this sector has become a major contributor to job creation, technology development, and cultural exports (Sanakoieva et al., 2023). The creative economy encompasses a wide range of sectors, including performing arts, design, film, music, digital media, advertising, fashion, and software development. The main components that underlie the creative economy are human creativity, intellectual capital, and technology. The concept of "creative class," as introduced by Richard Florida, highlights the importance

of the social class involved in the creation of innovative ideas and creative products. The creative economy is also often associated with the digital economy, as the development of information technology has opened up new opportunities to create and distribute creative products globally (Kryvtsova, 2021).

The creative economy is based on the assumption that human creativity is an infinite resource and can be a major driver of economic growth if supported by the right policies. Another assumption is that the sustainability of the creative economy requires synergy among arts, technology, and economic institutions to create an ecosystem that supports innovation. The importance of investment in creative education and training is also a key pillar in supporting the growth of this sector (Rodrigues et al., 2023). Creative economy models are often based on a "triple helix" approach that involves interaction among academia, business, and government. Some approaches also extend this model to a "quintuple helix" by adding environmental and civil society dimensions. This model aims to create an innovation ecosystem that supports cross-sector collaboration in creating economic and social value. This approach allows for the development of creative products that are not only commercial in nature but also have a wide cultural and social impact (Sanakoieva et al., 2023). The main goal of the creative economy is to encourage innovation, expand employment, and increase the competitiveness of the national economy. In the context of sustainable development, the creative economy is also relevant in supporting the achievement of the SDGs, especially in promoting social inclusion, reducing economic disparities, and protecting local cultures. The creative economy also plays an important role in strengthening national identity through cultural products exported to global markets (Manioudis & Angelakis, 2023).

The advantage of the creative economy lies in its flexibility to adapt to technological changes and market demands. In addition, this sector has great potential to create added value from non-material resources such as ideas and innovations. However, the downside is the high dependence on the quality of human resources and access to cutting-edge technology. Another challenge is the lack of clear regulation and adequate investment in many developing countries, which can hinder the growth of this sector (Gouvea et al., 2021, 2023; Gouvea & Vora, 2018). The apply the creative economy can be seen in the development of creative cities such as Bandung in Indonesia, which integrates art, technology, and culture in its economic development strategy. At the international level, the sector has made a significant contribution to GDP in various countries, especially through the export of creative products such as films, music, and digital applications. In the digital age, platforms such as YouTube and Spotify have also become an important means for individuals and creative communities to reach global audiences (Lazzaro, 2018, 2021). The creative economy has a close relationship with knowledge-based economic theories and the digital economy. This concept also complements the theory of sustainable

development by emphasizing the importance of creativity as the main driver of inclusive and sustainable economic growth. Also, the creative economy is often associated with innovation theory, which highlights the role of creativity in creating new solutions to economic and social challenges (Gouvea et al., 2023).

A real illustration of the creative economy can be found in the fashion industry in Paris, France, which is not only a hub for design innovation but also makes a major contribution to the national economy through exports and tourism. In Indonesia, the development of local products such as batik is also an illustration of how creativity can support the economy while preserving traditional culture. Digital transformation has also enabled many MSMEs in the creative sector to access global markets, increase income, and create new job opportunities (Đorić, 2020). The creative economy offers a great opportunity to create inclusive and sustainable economic growth. However, the success of the sector relies heavily on investments in education, technological infrastructure, and regulatory frameworks that support innovation and creative entrepreneurship.

Papua's geographical and cultural potential makes it a center for tourism development and conservation. The development plan of this region prioritizes: Community-based tourism: Use of areas such as Raja Ampat and Cenderawasih Bay as premium destinations. Improving the quality of human resources (HR): through local culture-based education and ecotourism training. Environmental conservation: Management of marine, coastal and forest ecosystems to maintain biodiversity. This priority program is by the direction of the 2022-2041 Papua Development Acceleration Master Plan, which emphasizes the sustainability and welfare of indigenous peoples. Studies show that the success of this development is highly dependent on multi-stakeholder collaboration involving the government, local communities, and the private sector (Anindhita et al., 2024). Community-based tourism is an approach that involves local communities in tourism management with the aim of empowering the local economy, preserving culture, and protecting the environment. Conservation in this context includes the management of marine, coastal, and forest ecosystems to maintain biodiversity and environmental sustainability. Improving the quality of HR through local culture-based education and ecotourism training is a key opponent in supporting this development. This approach provides significant benefits, such as the preservation of the local culture of the Kamoro tribe which integrates tradition with ecotourism management to attract tourists who appreciate cultural and environmental values (Novie Wurarah et al., 2023).

Papua's long history of exploitation of natural resources has left a significant impact on the environment and local communities. With the growing global awareness of the importance of sustainability, there is a need to integrate conservation-based approaches and inclusive tourism. Papua has more than 50% of

Indonesia's marine biodiversity and is home to a variety of endemic species. These factors place Papua as a priority area for conservation and sustainable tourism. In addition, management based on local wisdom, such as applied in the concept of a green economy in West Papua, shows great potential in creating a balance among economic benefits and environmental protection (Mollet & Silo, 2024). The development of community-based tourism in Papua requires education and training focused on the management of tourist destinations. This can increase the capacity of the community in providing quality services to tourists while preserving local traditions. Ecotourism training provides knowledge to the community about sustainable natural resource management, while ensuring that tourism development does not damage existing ecosystems. In addition, the integration of local cultural values into educational programs helps communities understand the importance of cultural preservation as an economic asset and their identity. A clear illustration of this application can be seen in conservation and ecotourism development endeavors in Biak Numfor, which involves synergy among the local government and local communities to optimize the potential of coastal and marine tourism (Kusumawardhana et al., 2021).

This development is based on the assumption that direct involvement of local communities can improve the effectiveness of conservation programs and reduce reliance on resource exploitation. In addition, local culture-based education can strengthen community identity and prepare them to adapt to global changes. The success of this management also depends on collaboration among the government, local communities, conservation agencies, and the private sector. The development model in Papua can be described as a cross-sectoral system involving the government as policymakers and facilitators, local communities as key actors, conservation institutions and academics as partners in research and training, and the private sector to support infrastructure and investment (Elia Ramandey et al., 2023). The main goal of community-based tourism development and conservation in Papua is to create a sustainable tourism ecosystem, empower local communities, and conserve biodiversity. This initiative is also relevant on a national scale to support the achievement of the SDGs, especially in reducing poverty, preserving the environment, and promoting social inclusion. Papua has a great opportunity to become a model of sustainability that integrates economic growth, cultural preservation, and environmental protection. However, the success of these initiatives depends heavily on the commitment of all parties, including governments, local communities, and the private sector, to work together toward a common goal.

2.2. Social Structure and Traditions of Indigenous Communities

Papuan indigenous peoples have a social structure based on collective values and kinship. Each indigenous community is organized into a clan or tribe that has

customary rules and a resource management system based on local wisdom. These traditions, such as customary land management and customary distribution of natural products, show how Papuans manage resources fairly and sustainably. This tradition is also the foundation for maintaining social harmony in the midst of modernization challenges. The social structure of indigenous peoples reflects the importance of balancing social, economic, and cultural functions, where local wisdom is at the core of collective decision-making (Sokoy, 2022) as mandated in the Papua Regional Long-Term Development Plan (RPJPD) to ensure that indigenous rights remain guaranteed (RPJPD Papua 2025-2045). The long history of marginalization of indigenous Papuans in various aspects of development shows that their involvement in the decision-making process is crucial. Globalization and modernization bring positive impacts as well as challenges for indigenous communities. Meanwhile, the relationship among indigenous peoples and migrants shows a change in the pattern of social relations. Research shows that interaction with outside cultures through migration and globalization often enriches local cultures, but also creates tensions that require a community-based approach to resolve them (Paramma et al., 2021). Local traditions and wisdom embraced by indigenous Papuans, such as the use of customary land, are not only a tool to maintain cultural identity, but also serve as an adaptation strategy to modern economic challenges. The management of customary land, for illustration, shows how indigenous peoples integrate sustainability principles in their social and economic systems. However, the distinction among customary law and formal state law often creates challenges in the implementation of sustainable development policies. Ethnographic studies show that the integration of customary law and formal law can increase the effectiveness of development programs while protecting the rights of indigenous peoples (Apriani & Hanafiah, 2022).

The model of the social structure of Papuan indigenous peoples also includes the important role of females in the social and economic system. Recent research shows that indigenous Papuan females play a significant role in natural resource management and household economies, although they often face challenges from patriarchal social structures. In the context of modernization, indigenous females face the threat of marginalization, but they also demonstrate adaptability through innovations based on local wisdom. A concrete illustration can be seen in female's economic initiatives in Jayapura that have succeeded in improving community welfare through household-based industries (Merina* et al., 2023). Papuan customary traditions, such as conflict resolution mechanisms through customary fines, reflect the importance of local wisdom in maintaining social harmony. This mechanism allows for the peaceful resolution of conflicts and is accepted by all parties involved. In addition, this tradition shows how indigenous peoples are able to maintain their social structure despite facing various challenges from outside, such as modernization and resource exploitation. The success of this mechanism depends on

customary leadership and the collective participation of indigenous peoples in safeguarding their traditional values (Arsensius, 2023).

However, despite this social structure, indigenous peoples often face marginalization in development decision-making. This can be seen in the management of natural resources which often do not involve indigenous peoples directly, even though they have traditional rights to the area. The importance of a community-based approach in development planning in Papua is emphasized in various policies, including the Papua Regional Long-Term Development Plan (RPJPD). This policy aims to ensure that indigenous rights remain guaranteed and indigenous peoples can actively participate in sustainable development (Lyons et al., 2023; Zurba & Papadopoulos, 2023). The development of indigenous Papuans requires an approach that respects local traditions and values while facilitating adaptation to modernization. By integrating indigenous traditions and modern policies, Papua has a great opportunity to create a development model that is not only sustainable but also inclusive and based on social justice. Empowerment of indigenous peoples, recognition of customary law, and active participation in decision-making are important steps toward harmony among the development and preservation of Papuan indigenous culture.

2.3. Local Potential that Supports Sustainable Innovation

Papuan indigenous peoples have a social structure based on collective values and kinship. Each indigenous community is organized into a clan or tribe that has customary rules and a resource management system based on local wisdom. These traditions, such as customary land management and customary distribution of natural products, show how Papuans manage resources fairly and sustainably. This tradition is also the foundation for maintaining social harmony in the midst of modernization challenges. The social structure of these indigenous peoples reflects the importance of balancing social, economic, and cultural functions, where local wisdom is at the core of collective decision-making (Sokoy, 2022). The long history of marginalization of indigenous Papuans in various aspects of development shows that their involvement in the decision-making process is crucial. Globalization and modernization bring positive impacts as well as challenges for indigenous communities. Meanwhile, the relationship among indigenous peoples and migrants shows a change in the pattern of social relations. Research shows that interaction with outside cultures through migration and globalization often enriches local cultures, but also creates tensions that require a community-based approach to resolve them (Paramma et al., 2021).

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3.1. Local Community-Based Research Ecosystem

The local community-based research ecosystem emphasizes the importance of active community involvement in the research process, so that the results obtained are relevant and applicable to local needs. In Papua, this approach has become increasingly relevant because of the socio-cultural context of indigenous peoples who are rich in local wisdom. Community-based research not only aims to identify problems facing communities, but also to unearth solutions that align with their local values, traditions, and knowledge. In the Papua RPJPD 2025-2045 document, the integration of research results with local practices is called one of the main pillars of development based on local wisdom. This reflects the importance of research that is not only scientifically oriented but also respects and utilizes local potential.

The theories underlying this approach include the concepts of community participation, integration of local knowledge, and contextualization of problems. The community is not only a passive subject, but an active partner in research. For illustration, natural resource management involving indigenous Papuans, such as the apply sustainable agricultural technologies and biodiversity conservation, shows how local knowledge can be integrated into scientific solutions. Previous research has shown that an approach based on local wisdom is not only relevant but also increases public acceptance of research results (Wahyuni et al., 2023). The local community-based approach is based on the assumption that communities have the capacity and knowledge that can be used to address local challenges. Research on disaster management based on local wisdom shows that communities use traditional knowledge to understand natural risks and develop appropriate mitigation strategies (Hariadi et al., 2020). In the context of Papua, this approach is very relevant, considering the various indigenous traditions that are rich in local knowledge, including in the fields of environmental conservation and sustainable agriculture.

Local community-based research ecosystems bid an approach that puts the community at the center of research to create relevant and sustainable solutions. One of the models that is often applied is Problem-Based Learning (PBL), which aims to improve students' understanding of local environmental issues. For illustration, research shows that the apply PBL to ecosystem learning helps students develop learning motivation, both internally and externally. This approach allows students to

actively understand and solve environmental problems around them (Herwansyah et al., 2023; Ratnasari et al., 2020). In addition, the model based on group dynamics and community resilience also shows its effectiveness in building collective action to face environmental challenges. Research on fishing communities shows that group communication and social cohesion play an important role in building resilience, both in social, economic, and infrastructure, so as to overcome damage to marine ecosystems. This model is very relevant to be applied in coastal areas such as Papua, which depend on marine resources for their economic sustainability (Hidayati, 2020).

Another effective model is contextual learning based on local wisdom. This approach integrates cultural elements and traditional knowledge into educational materials, such as biology or physics, to improve students' understanding. For illustration, a textbook based on local wisdom developed at SMA Negeri 01 Seponti allows students to learn science concepts through the context of daily life, increasing learning engagement and relevance (SA et al., 2022; Sari et al., 2021). Furthermore, the development of Project-Based Learning (PjBL) based on local wisdom is also an effective model to increase students' interest in cultural preservation while developing creative and independent thinking skills. In Majalengka, this model has been used to teach the preservation of local culture through projects involving the active participation of students, which significantly increases their independence and creativity (Nurhikmayati & Sunendar, 2020). An approach based on river ecosystem management with a bombon system is also feasible to be applied in local communities. In Ranau, the bombon system is used to preserve the river ecosystem through the active participation of village communities in regulating the sustainable use of resources. This system not only helps maintain the balance of the ecosystem, but also increases economic and social value for local communities (Dg Nur Fairuzzimah & Jurry Foo, 2021; Rahmawati et al., 2024). One interesting model is the economic valuation of ecosystem services, which links economic value with environmental conservation. Research in the Indragiri Hilir conservation area shows that the mangrove ecosystem has great economic value, both in provision, regulation, support, and cultural services. This model involves the community in managing natural resources in a sustainable manner, thereby creating economic benefits while maintaining environmental sustainability (Deviasari et al., 2024).

In Japan, the development of Fablab is an important model in local community-based research. Fablabs, like those in Kamakura and Kitakagaya, are digital production spaces that engage the community in sustainable product innovation. Through Fablab, communities can access advanced technology to create local solutions that have a direct impact on daily life (Ross, 2018). South Korea adopts a community-based approach in the development of clean energy through a Logistics Digital Sharing Platform (LDSP). The project allows local communities to participate in the management and optimization of digital-based transportation technologies,

which not only support local needs but also strengthen digital transformation at the community level (Coo, 2023). Germany stands out for its urban revitalization model that focuses on the management of public spaces through community involvement. These projects often involve local communities in the management of renewable energy such as solar and wind, which are designed to meet the specific needs of local communities while supporting global sustainability goals (Bucchiarone et al., 2020). In the United States, a community-based approach is particularly evident in the development of green open spaces in cities. This approach involves the community in decision-making related to the design and management of urban parks, with a focus on improving the quality of life and strengthening social bonds among residents (Yamashita, 2018). In China, community-based ecosystem models often focus on the conservation of natural resources, particularly through the apply agricultural technology. Local communities engage in agricultural experiments designed to increase productivity while maintaining environmental sustainability (H. Chen et al., 2022). Russia utilizes local wisdom in biodiversity management through conservation projects. This approach involves indigenous peoples to conserve rare species while leveraging their traditional knowledge in maintaining the balance of the ecosystem (Sukhanov, 2023). In the Netherlands, the local community approach is seen in the management of water systems. Flood mitigation projects involve communities in the design and management of infrastructure such as levees and canals, which are an important part of adaptation to climate change (Feng et al., 2023). Saudi Arabia is implementing a community-based approach to greening desert areas. These projects involve local communities in the greening and protection of endemic species, which helps to reduce environmental degradation and restore ecosystem balance (Fragkos et al., 2021).

These models show that local community-based research can empower communities while providing solutions that are relevant to local needs. In Papua, the apply these models can support the integration of local wisdom in natural resource management, education, and sustainable development. An approach that actively engages communities not only strengthens sustainability, but also ensures that research results are acceptable and implemented by local communities. Local community-based research ecosystem processes in various countries bid valuable lessons that can be adapted and applied in Indonesia to strengthen sustainable development based on local wisdom. One of the main lessons is the importance of local contextualization, as was done in Japan and South Korea. Japan through the Fablab model has successfully integrated modern technology with the needs of local communities, while South Korea leveraged digital platforms to share logistics to support digital transformation rooted in community needs. In Indonesia, a similar approach is seen in the management of the environment based on indigenous

traditions, demonstrating the relevance of the integration of technology and cultural values to produce appropriate solutions.

In addition, multi-stakeholder collaboration is an important element in the success of community-based research ecosystems, as seen in the Netherlands and the United States. Flood mitigation projects in the Netherlands and green open space management in the United States show that collaboration among governments, communities, and researchers creates more inclusive and sustainable outcomes. In Indonesia, this collaborative approach can be strengthened through the involvement of indigenous peoples, academics, and governments in environmental projects, such as biodiversity conservation in Papua. Another lesson that can be learned is the importance of active community participation in each stage of research, as applied in Russia and China. In Russia, the involvement of indigenous peoples in the conservation of biodiversity has proven the success of the conservation of rare species. In China, local communities play a major role in the management of technology-based agricultural resources. This is in line with the practice in Indonesia, where indigenous peoples are involved in preserving ecosystems through rich traditional knowledge. This approach underscores the importance of community empowerment as the main actor of research, not just the object of research. Countries such as Germany and the United States also emphasize the role of technology-based innovation in supporting community research ecosystems. In Germany, the development of renewable energy involves the community in the design of projects that optimize local needs, while in the United States, digital technologies are applied to strengthen the management of public spaces. Indonesia can take inspiration from this approach by utilizing modern technologies such as remote sensing and big data to support more efficient and sustainable management of natural resources. In addition, ecosystem sustainability is a key principle in community-based research in countries such as Saudi Arabia. Sustainable farmland management in Vietnam and reforestation projects in Saudi Arabia show that sustainability-focused research not only improves environmental conditions but also improves the well-being of local communities. In Indonesia, this principle can be applied to strengthen climate change mitigation programs and natural resource conservation. These processes in different countries teach the importance of adapting to global challenges through an integrated local approach. Countries such as the Netherlands and Japan have successfully faced the challenge of climate change by optimizing technology and community collaboration. In Indonesia, this approach is relevant to be applied in coastal areas and other vulnerable areas, to increase environmental resilience while empowering local communities. By learning from the successes of these countries, Indonesia can strengthen a community-based research ecosystem that is not only useful but also aligned with local values.

The main goal of this approach is to create solutions that are more tailored to local needs, while strengthening people's capacity to adapt to global challenges. This is in line with research findings that show that the integration of local values in education or research increases understanding and acceptance of research results. For illustration, the local culture-based learning model in Lamongan increases students' appreciation of science by using local wisdom as a learning medium (Sulistiyawati, 2020). However, the local community-based research ecosystem also faces challenges. One is the need to align the views of communities with often different scientific approaches. In addition, this collaborative process requires time, resources, and a local context-sensitive approach. However, the benefits produced, especially in sustainability and community self-reliance, make this approach very feasible to implement in Papua. With the integration of research results and local practices, as proposed in the Papua Provincial Regional Long-Term Development Plan 2025-2045, it is hoped that development based on local wisdom can have a real and sustainable impact on the Papuan people.

3.2. The Role of Actors in Strengthening Regional Innovation

Strengthening innovation in Papua requires the active role of various actors, including the government, academics, indigenous institutions, and the private sector. The government plays a role as a director and facilitator in providing regulations and infrastructure that support research and innovation activities. Academics are the main motor in producing innovative research that is relevant to local needs, such as the development of agricultural technology-based on the Papuan ecosystem. Indigenous institutions have a strategic role to play in bridging traditional values with modern innovations, ensuring that the development of innovation does not conflict with the local culture. The private sector, especially through partnerships with indigenous peoples, contributes to the adoption of research results into products or services of economic value. The Papua RPJMD 2025-2029 highlights the importance of this multi-stakeholder collaboration to create inclusive and sustainable innovation (Bapperida Provinsi Papua, 2024).

Strengthening regional innovation, especially in Papua, is indispensable to improve community welfare and the sustainability of local development. With its wealth of natural resources and unique culture, Papua faces the challenge of creating innovations that are relevant to the local social context and ecosystem. This need is emphasized by the low Human Development Index (HDI) in several regions of Papua and development inequality, as outlined in Penta Helix's approach to the creative economy in Papua (Atmojo et al., 2023). Penta Helix is a collaborative framework that involves five key actors, government, academia, the business sector, society, and the media. This theory aims to create innovation and sustainability through synergy among sectors, utilizing the strengths and resources of each actor in solving complex

problems (Febrianty et al., 2020). The theory of the triple helix (academic-government-industry) and Quadruple Helix (plus society) models, which aims to answer global challenges such as environmental sustainability, digital transformation, and economic inequality. Penta Helix was introduced to expand the scope of collaboration by including the media as an important Actor in supporting communication and dissemination of innovation information (Adisaputra, 2023). The main components of Penta Helix's theory include: Academics create new knowledge and technologies. The government provides policies and regulations that support innovation. Businesses implement and commercialize innovations. The community provides feedback to ensure the relevance of innovations. The media disseminates information and builds public opinion (Sudiana et al., 2020). This theory is based on the assumption that cross-sector collaboration is more effective in solving complex problems than a single approach. Each actor has a complementary uniqueness to create innovative solutions (Pradhipta et al., 2021; Zhou & Etzkowitz, 2021). The structure of Penta Helix consists of interactive relationships among five actors through collaborative forums. Each actor has a specific role, the government as a director, academics as innovators, businesses as technology adopters, the community as users, and the media as information connectors (Simanjuntak et al., 2024). The goal of this theory is to create inclusive and sustainable innovation, as well as integrate various interests in achieving social, economic, and environmental development. Its relevance is high in the global context, especially to achieve the Sustainable Development Goals (SDGs) (Cabrera-Flores et al., 2020).

Strengthening innovation in Papua involves various actors, such as the government, academics, the private sector, indigenous institutions, and the community. The government acts as a director and facilitator through policies and infrastructure, as exemplified in effective collaborative policies for local innovation in Indonesia (Noor et al., 2023). Academics lead innovative research, the private sector supports technology implementation and commercialization, while indigenous institutions serve as a link among traditional values and modern innovations. The government has a strategic role as a policy director and the main facilitator in strengthening innovation. The government has a strategic role as a policy director and main facilitator in supporting the strengthening of innovation in Papua. Governments act as creators of a conducive environment through the policies, regulations, and infrastructure needed to support innovation. For illustration, research on government collaboration in innovation in Indonesia highlights that the Papuan government provides facilitation policies such as legal guarantees and financial support for other actors in the innovation ecosystem, including the private sector and society (Noor et al., 2023). In addition, local governments play an important role in integrating SDGs with local resource management, such as in the indigenous forest rehabilitation program in Wamesa, West Papua, involving indigenous peoples and the

private sector (Kurube et al., 2023). Academics play a key role in creating new knowledge and innovative technologies relevant to the local context. In Papua, this role can be seen in the development of research-based solutions for sustainable natural resource management, such as the preservation of mangrove forests based on local wisdom in Youtefa Bay (Tebay, 2023). Collaboration among universities, communities, and the government is also key in technology transfer and capacity building of local communities, which can support the development of Papua's natural resource-based creative economy. The private sector plays an important role in supporting the implementation of technology and the commercialization of innovation results. In the context of Papua, large companies, including those involved in the mining and agribusiness sectors, can contribute through partnerships with indigenous peoples to create economic value from local products. For illustration, the private sector is helping to expand market access for products based on local wisdom, such as honey and eucalyptus oil, through corporate social responsibility (CSR) programs involving indigenous peoples (Effendi & Purnomo, 2020). Indigenous institutions in Papua hold a unique role as guardians of traditional values as well as facilitators in bridging modern innovation with local culture. They help ensure that the innovations implemented do not conflict with traditional values. In the customary village management program in Jayapura, for illustration, customary institutions collaborate with the government to develop policies based on local wisdom that support sustainable management of natural resources (Rode, 2021). This role includes mediating conflicts related to land use, as well as promoting conservation values relevant to sustainable development. Local communities in Papua play the role of users and main implementers of innovation. Their active participation in the development of innovations helps ensure the relevance and sustainability of the implemented programs. For illustration, in the development of innovation villages on Raam Island, communities are involved in the identification of local challenges, such as fisheries infrastructure, as well as in the implementation of solutions based on multi-actor collaboration (Poltak et al., 2024). The Penta Helix-based collaborative approach is the main mechanism in integrating the roles of various actors in Papua. This concept prioritizes synergy among the government, academia, the private sector, indigenous institutions, and communities to create inclusive and sustainable innovation. In the development of Papua's creative economy, for illustration, the government facilitates policies, academics support capacity building, the private sector provides financing and technology transfer, while the media promotes creative products to a wider market (Atmojo et al., 2023). Through structured and synergistic collaboration, strengthening innovation in Papua can create a wider impact, both in economy, social, and environment. This approach provides a great opportunity to improve the well-being of local communities while respecting traditional values and harnessing local potential in a sustainable manner.

The distribution of roles is arranged to ensure efficiency and sustainability. The government is responsible for providing regulations and facilities, as seen in the management of mangrove areas in Papua with a collaborative approach (Tebay, 2023). Academics develop research-based innovations, such as agricultural technology that supports local ecosystems. The private sector contributes through investment and technology, while indigenous communities and institutions ensure cultural relevance in innovation. Indigenous institutions, although not explicitly mentioned in the framework of Penta Helix, can be considered an important part of the "community" in this theory. Customary institutions play the role of guardians of local values, norms, and wisdom that are the basis for the development of innovations that are relevant to the local cultural context. In the context of multi-actor collaboration-based development, indigenous institutions serve as a bridge among modern innovation and local traditions, ensuring that changes are made remain aligned with community values. As part of society, indigenous institutions have a strong moral authority in shaping society's view of innovation. In Indonesia, for illustration, research on Penta Helix's collaboration in the development of the creative economy in Papua shows that indigenous institutions play a key role in ensuring the participation of indigenous peoples in the development of creative products based on local wisdom. Indigenous institutions also help integrate traditional perspectives into modern business policies and practices, making innovation more inclusive and accepted by local communities (Atmojo et al., 2023). Specific Contributions of Indigenous Institutions include mediators of traditional and modern values, Indigenous institutions bridge the process of adopting new technologies by ensuring there is no clash with local cultural values. Strengthening local identity through collaboration in Penta Helix-based programs, indigenous institutions help maintain local cultural identity as part of innovation. Conflict resolution, in conflict situations, indigenous institutions are often respected neutral parties to resolve disputes regarding the use of resources or the implementation of new innovations. Community empowerment, in the context of economic empowerment, customary institutions play a role in encouraging the active involvement of local communities, especially in the management of natural resources based on local wisdom such as forest or fisheries management (Isa Elfianto et al., 2023). One illustration of implementation is a CSR-based planning program in Dumai, Indonesia, where indigenous institutions contribute to designing a technology-based fish catch improvement program. Through the Penta Helix approach, indigenous institutions work closely with academics, the private sector, government, and the media to ensure the program is accepted by local communities and is in line with traditional values (Isa Elfianto et al., 2023). Indigenous institutions strengthen collaboration with the government as policymakers, academics as providers of technology and knowledge, the private sector as adopters and developers of innovation, and the media as disseminators of

information. This synergy ensures that innovation-based development is not only oriented toward economic outcomes but also pays attention to social and cultural sustainability. Indigenous institutions play an important role in strengthening the sustainability of innovation through cultural perspectives. Within the framework of Penta Helix, they provide social legitimacy to innovation, bridge traditional values with modernity, and ensure inclusive and relevant development to the needs of local communities. This makes customary institutions an integral opponent in creating a sustainable innovation ecosystem.

The collaboration mechanism involves a systematic and inclusive approach. Concepts such as Penta Helix show the importance of synergy among the government, the private sector, academia, the community, and the media in creating sustainable innovation. In Papua, this mechanism can be implemented through a collaborative forum that allows each actor to convey their aspirations and roles. The government serves as a mediator and facilitator, providing legal grounding and facilitating access to resources for other actors (Kurube et al., 2023). In Japan, strengthening regional innovation involves collaboration among the government, academia, and the industrial sector through a national innovation system. For illustration, Japan's science and technology policy shows how large investments in research and development (R&D) have succeeded in creating a sustainable innovation ecosystem. The government facilitates regulation and provides subsidies for R&D, while technology companies play a central role in commercializing the results of innovation (Mishchenko, 2023). South Korea uses the triple helix model which involves synergy among the government, universities, and the private sector to encourage innovation. Regional innovation policies, such as public R&D investment programs, improve the efficiency of technology development and commercialization of innovations. In addition, the country is also focusing on digitalization to accelerate economic transformation at the local level (Min et al., 2020). In Germany, local governments are working closely with companies and research institutes to create sector-based innovation ecosystems. This approach is seen in the development of renewable energy, where innovation is centered on green technology and sustainability. Local actors, including universities and research institutions, play a role in designing data-driven solutions that support green development (Kondo, 2022). The United States relies on cross-sector collaboration to build an innovation ecosystem. Local governments provide a policy framework, while universities like MIT play a role in creating research-based technological innovations. Private companies, especially in Silicon Valley, serve as the driving force in the adoption of new technologies through startup investment and incubation (Lovely & Dahlman, 2022). In Vietnam, the role of actors in regional innovation is especially seen in the strengthening of global value chains. Collaborations among the government and foreign investors, such as South Korean companies, have improved the country's

manufacturing capabilities and diversified industrial sectors, including electronics and high technology (Korgun, 2023). China is implementing a Quadruple Helix-based approach to regional innovation, involving the government, the private sector, academia, and the community. The focus on green technology and renewable energy innovation through university-industry alliances is a clear illustration of the role of actors in a stable innovation ecosystem (Yang et al., 2021). In Russia, approaches based on local wisdom and international collaboration are applied to support regional innovation. The government supports technology transfer through partnerships with countries such as Japan and South Korea to improve national R&D capabilities (Fedorovsky & Shvydko, 2021). In the Netherlands, the innovation ecosystem is centered on infrastructure solutions and water management. Local governments are working with universities and the private sector to develop data-driven flood mitigation technologies. The role of these actors strengthens their capacity to adapt to climate change (Vosman et al., 2023). In Saudi Arabia, the strengthening of regional innovation is driven by massive investment in green technology and renewable energy. The government supports cross-sector collaboration through projects such as NEOM that integrate modern technology with the sustainable development of autonomous regions (Alhyari & Al Ani, 2022).

Each country has a unique approach to empowering local actors to support regional innovation. This model can be an inspiration for other countries, including Indonesia, to adopt best practices in creating an inclusive and sustainable innovation ecosystem. In Japan, the government plays a major role through science and technology policies that provide R&D subsidies to encourage cross-sector collaboration, creating a sustainable innovation ecosystem (Mishchenko, 2023). In South Korea, the government is using the triple helix model by facilitating public investment in R&D to improve the efficiency of technology development at the local level (Min et al., 2020). Another illustration is the Netherlands, where local governments are collaborating with universities and the private sector to develop flood mitigation technologies, strengthening climate change adaptation capacities (Vosman et al., 2023). Academics play the role of creators and main drivers of research-based innovation. In the United States, institutions like MIT focus on relevant technology-based research to meet local and global needs (Lovely & Dahlman, 2022). In China, universities play an important role in alliances with the industry sector to develop green technologies, creating a stable innovation ecosystem (Min et al., 2020). Academics in Germany also contribute greatly through the development of renewable energy technologies designed to support regional sustainability (Kondo, 2022). The private sector acts as a motor in the implementation and commercialization of innovation. In Saudi Arabia, the private sector is working closely with the government to build ambitious projects such as NEOM, which integrates modern technology with sustainable development (Alhyari & Al Ani, 2022). In Vietnam,

collaborations among the private sector and foreign investors such as South Korean companies have strengthened the manufacturing capabilities and diversification of local industries (Korgun, 2023). The private sector in Russia also plays a role in technology transfer through international partnerships, supporting the development of national R&D capacity (Fedorovsky & Shvydko, 2021). Customary institutions are an important link in bridging traditional values with modern innovations. Although its contribution is more visible in the context of developing countries, a local culture-based approach is often used to ensure that innovation does not conflict with local norms and traditions. In Indonesia, the role of customary institutions can be seen in the management of natural resources based on local wisdom, as applied in Papua. Customary institutions ensure that innovation-based development still respects local values and strengthens the cultural identity of the community. The community plays a crucial role in implementing and utilizing innovation. In Japan, the community is actively involved in the development of green technology to support sustainable energy initiatives (Mishchenko, 2023). In South Korea, a community-based approach is applied to increase the acceptance and sustainability of innovation at the local level (Min et al., 2020). Communities in the Netherlands are also involved in the management of water infrastructure to ensure that adaptation to climate change runs effectively (Vosman et al., 2023). Strengthening innovation involving various actors, such as governments, academics, the private sector, indigenous institutions, and communities, creates an inclusive and sustainable ecosystem. Each actor has a unique but complementary role, reflecting the importance of collaboration to achieve the success of wide impact innovations. By taking inspiration from best practices in different countries, the innovation ecosystem at the local level can be strengthened to face global challenges. In addition, adaptive collaborative governance involving indigenous peoples such as in Papua can be used to resolve conflicts and increase community capacity through education and training. This approach has succeeded in strengthening collaboration among the private sector and local communities in various regional development contexts (Iswandi, 2023). Strengthening regional innovation requires coordinated and collaborative multi-actor involvement. By leveraging approaches such as Penta Helix and adaptive governance, Papua has great potential to create relevant and sustainable innovations, in line with the vision of inclusive local development.

3.3. Patterns of Synergy Among Tradition, Technology, and Innovation

Papua, with its rich local traditions such as the practice of sea sasi which regulates the use of marine products based on seasonality, offers a resource management model based on sustainability and the value of local wisdom. In the context of globalization and the acceleration of modernization, the integration of tradition and technology is an important foundation to encourage sustainable

development as well as locally relevant innovation. Traditional practices such as sea sasi not only align environmental management with the lifestyle of local communities, but also open up space for technological transformation and tradition-based innovation. In the face of the era of modernization and globalization, the main challenge facing society is how to maintain cultural identity while adopting technology and innovation to improve the quality of life. The synergy pattern among tradition, technology, and innovation offers a strategic approach to achieving sustainable development that not only maintains cultural values, but also promotes economic growth and environmental sustainability. The integration of tradition and technology requires a deep understanding of the local wisdom owned by a community. As a first step, a collaboration-based approach among local stakeholders, governments, and the private sector can be implemented. A study by (Lukita et al., 2024) shows that the adoption of digital technologies such as data-based monitoring can improve the preservation of cultural traditions, while maximizing the efficiency of resource management. An illustration is the digitization of cultural heritage through Augmented Reality (AR) and Virtual Reality (VR) technology, which allows interactive and educational experiences for the younger generation without changing the essence of the tradition. Furthermore, it is important to build a system that supports the participation of local communities in the digitalization process. This active participation not only increases community engagement, but also ensures the relevance of the technology to local needs. In this context, education and training on technology should be a priority to empower local communities so that they can use technology as a tool for cultural preservation and economic development. Tradition-based innovation is one of the main pillars in creating this synergy. (Widowati & Wakid, 2024) show that integrating ethnoscience with modern education can produce locally and globally relevant innovations. For illustration, the development of traditional herb-based products combined with modern biotechnology can increase the added value of such products in the global market. In addition, traditional arts such as wood carving, weaving, or other handicrafts can be adapted into creative products with high market value through innovative design approaches. In Italy, research by (Cosentino et al., 2021) shows that small and medium enterprises (SMEs) in the agro-food sector have successfully combined modern technology with local traditions to improve product quality, environmental sustainability, and global competitiveness. A similar pattern can be applied in various other cultural sectors to create new economic opportunities. The role of policy is very important in realizing this synergy pattern. Policies that support the locally-based innovation ecosystem must include incentives for small and medium-sized businesses, training programs, and adequate technology infrastructure. (Tartaruga, 2020) emphasizes the importance of building an inclusive regional innovation system, in which all actors, including local communities, are involved in the decision-making and implementation process. In addition, cross-sector

collaboration among governments, educational institutions, and the private sector is needed to create a holistic innovation ecosystem. The triple helix model involving academia, industry, and government has proven effective in integrating tradition with technology to produce sustainable innovation. Public awareness of the importance of cultural preservation must continue to be increased through educational programs and public campaigns. Social media and community-based apps can be tools to document and promote traditions, while also creating a discussion space for people to share ideas and experiences. It can also encourage collaboration among communities to create more inclusive innovation. Various global case studies show the successful integration of tradition and technology in various contexts. For illustration, cultural revitalization initiatives in Portuguese villages through the apply the Internet of Things (IoT) to monitor local resources have had a positive impact on economic and environmental sustainability (Tartaruga, 2020). This approach could serve as a model for other regions looking to integrate local traditions with modern technology. In Asia, the development of traditional culture-based tourism villages using advanced technology such as digital mapping software has succeeded in attracting global tourists while empowering local communities. This experience shows that the integration of tradition and technology not only increases economic value but also strengthens cultural identity in the midst of modernization. The synergy pattern among tradition, technology, and innovation is a strategic approach to create sustainable development. By integrating digital technology into local traditions, fostering tradition-based innovation, and strengthening policy support, communities can maintain their cultural identity while leveraging technology to improve their quality of life. The success of this approach depends on cross-sector collaboration, active community participation, and holistic policy support. Therefore, this synergy pattern is not only relevant for cultural preservation, but also as a solution to face the challenges of globalization and modernization in various contexts.

Integration of Tradition with digital technology, the use of digital technology is the key in supporting and strengthening traditions such as sea sasi. For illustration, data-driven software can be used to monitor marine products and forecast the right season for harvest, as proposed in research that addresses the role of technology in cultural heritage preservation (Lukita et al., 2024). This technology can increase the effectiveness of resource management while maintaining traditional values. In addition, the strategy of strengthening the synergy of tradition and technology has also proven successful in increasing community involvement and the effectiveness of cultural preservation, as found in the apply SmartPLS in digital cultural heritage management. In the face of the era of modernization and globalization, the main challenge facing society is how to maintain cultural identity while adopting technology and innovation to improve the quality of life. The synergy pattern among tradition, technology, and innovation offers a strategic approach to achieving

sustainable development that not only maintains cultural values, but also promotes economic growth and environmental sustainability. The integration of tradition and technology requires a deep understanding of the local wisdom owned by a community. As a first step, a collaboration-based approach among local stakeholders, governments, and the private sector can be implemented. A study by (Lukita et al., 2024) shows that the adoption of digital technologies such as data-based monitoring can improve the preservation of cultural traditions, while maximizing the efficiency of resource management. An illustration is the digitization of cultural heritage through AR and VR technology, which allows interactive and educational experiences for the younger generation without changing the essence of the tradition. Furthermore, it is important to build a system that supports the participation of local communities in the digitalization process. This active participation not only increases community engagement, but also ensures the relevance of the technology to local needs. In this context, education and training on technology should be a priority to empower local communities so that they can use technology as a tool for cultural preservation and economic development.

Quantitative models for the integration of traditions with digital technology, to understand the impact of digital technology on the preservation of traditions such as sea sisi, a quantitative model approach that combines various important variables can be used. The model uses a multiple linear regression approach, in which the main variables influencing conservation outcomes are analyzed. This model can be formulated in the form of the following equation:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \varepsilon \dots\dots\dots (1)$$

Information:

- Y : The success rate of tradition preservation (measured through indicators such as reduction in the exploitation of natural resources, the number of communities using technology, or the level of community participation in preserved traditions).
- X_1 : The rate of adoption of digital technologies (e.g., marine product monitoring software, digital applications, or IoT-based devices).
- X_2 : Local community participation (measured through the amount of training, involvement in decision-making, or the level of use of technology by the community).
- X_3 : Government policy support (measured by the number of incentives, government programs, or policies that support the digitalization of traditions).
- β_0 : Intercept constant (the basic value of the success of tradition preservation when all independent variables are zero).

$\beta_{1,2,3}$: Regression coefficients that show the magnitude of the influence of each independent variable on the dependent variable Y

ϵ : Errors or other factors that are not measured in the model.

Adoption of digital technology (X_1), this variable reflects the extent to which technology is applied to support the preservation of traditions. Illustrations are the use of marine product monitoring software for marine fisheries or AR/VR applications to preserve cultural heritage. Community Participation (X_2), community involvement is essential for success. Communities that are active in using technology to preserve traditions can significantly increase conservation outcomes. Policy Support (X_3), the role of the government in providing policies, incentives, and digital infrastructure is a key variable to support the integration of tradition with digital technology. Interpretation of the model, the value of the regression coefficient ($\beta_{1,2,3}$) can be interpreted as follows:

If $\beta_1 > 0$: The adoption of digital technology has a positive influence on the success of preserving traditions.

If $\beta_2 > 0$: Community participation increases the effectiveness of tradition preservation.

If $\beta_3 > 0$: Policy support strengthens the integration of tradition and digital technology.

This model can be used for impact evaluation, measuring the effectiveness of digital technology in preserving traditions. Decision-making, providing data-driven recommendations to increase synergies among tradition, technology, and policy. Policy planning, identifying factors that need to be strengthened to support the successful preservation of traditions.

Table 3.1. Variable value estimation

Technology Adoption (X_1)	Community Participation (X_2)	Policy Support (X_3)	Preservation Success (y)
3.75	9.7	0.31	32.57
9.51	7.75	6.36	62.11
7.32	9.39	3.14	49.61
5.99	8.95	5.09	50.16
1.56	5.98	9.08	48.03

Source: Author's Assumptions, 2024

In the first row, when technology adoption was 3.75, community participation was 9.70, and policy support was 0.31, the success of tradition preservation reached 32.57. In the second row, higher technology adoption (9.51), slightly decreased community participation (7.75), and greater policy support (6.36), resulted in a preservation success of 62.11. This model shows that improvements in all three

independent variables significantly increase the success of tradition preservation. Digital Technology Adoption (X_1) by definition, measures the extent to which digital technology is used in support of the preservation of tradition. Technology Adoption (X_1) describes the level of use of technology in the preservation of traditions, with a value among 0-10. Community Participation (X_2) measures local community involvement, with a value among 0-10. Policy Support (X_3) indicates the extent to which the government provides incentives and support programs, with a score among 0-10. Conservation Success (Y), the result of success calculated based on a quantitative model:

$$Y=5+2.5 \cdot X_1+1.8 \cdot X_2+3.0 \cdot X_3+\varepsilon \dots\dots\dots (2)$$

The data source comes from surveys or questionnaires, collecting data from local communities or related organizations regarding the use of digital technology, such as marine product monitoring applications or the use of IoT devices. Data of technology institutions, information from technology service providers that shows the number of devices or applications used in cultural preservation. Government or non-profit documentation, reports on traditional digitization projects or statistics on the use of technology in local communities. Field case studies use field studies that measure the rate of technology adoption in a given region through interviews or direct observation. Community participation (X_2), by definition, measures the extent to which local communities are actively involved in the preservation of traditions and their use. The data source comes from community survey data, questionnaires to local communities to measure the level of community involvement in training or technology implementation. Project or activity reports, records from local organizations that include the number of participants in a training program or tradition preservation event. Education and training statistics, data from educational or training institutions that bid courses on technology and cultural preservation. Field observations, qualitative notes from observers or researchers about the number of individuals involved in the process of preserving traditions. Government policy support (X_3), by definition, measures the level of government support in the form of policies, incentives, or programs related to the digitalization of traditions. Data sources are obtained from official policy documents, government strategic plans, regional regulations, or national policies that support the digitization of traditions and cultural preservation. Public budget data, statistics on the allocation of funds for traditional preservation and technological innovation projects. Government program reports, the results of the implementation of government programs such as technology training for local communities or subsidies for digital devices. Government performance index, a score from a survey or study that assesses the effectiveness of government policies in supporting traditional and technology-based initiatives. Tradition preservation

success (Y), by definition, is an indicator of tradition preservation success that reflects the impact of technology adoption, community participation, and policy support. Data sources can be obtained from the results of surveys or questionnaires, measuring public perceptions of the success of tradition preservation. Environmental or social statistical data, sustainability indicators such as increased natural resource yields (e.g., marine products), community satisfaction levels, or reduction in exploitation. Project evaluation reports, reports from tradition preservation projects that measure their success in engaging communities or preserving culture. Academic studies, research that measures the effectiveness of tradition preservation uses indicators such as the level of introduction of the younger generation to the tradition.

Figure 3.1. shows the relationship among each independent variable (technology adoption, community participation, and policy support) and the success of tradition preservation.

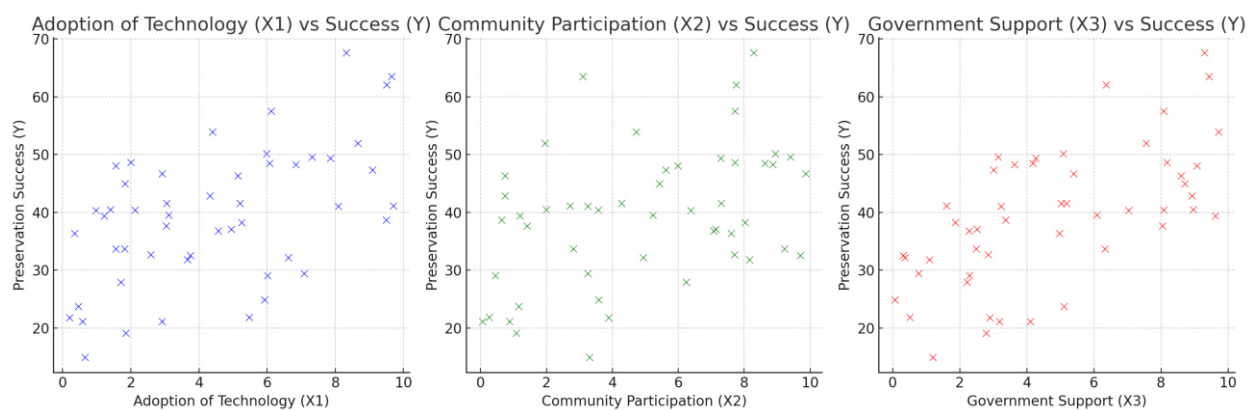


Figure 3.1. The relationship among each independent variable and the success of tradition preservation

Here is an interpretation of each scatterplot, technology adoption (X₁) vs. Conservation Success (Y). The first scatterplot shows that increased technology adoption tends to result in a higher conservation success value. This indicates the positive influence of technology on the preservation of traditions. Community Participation (X₂) vs. Preservation Success (Y), the second scatterplot shows that the higher the level of community participation, the greater the success of tradition preservation. This underscores the importance of community involvement in supporting conservation endeavors. Policy Support (X₃) vs. Preservation Success (Y), the third scatterplot shows a positive relationship among policy support and tradition preservation success. Government support, such as incentives and training programs, plays a crucial role in this success. The results of linear regression show the relationship among independent variables (technology adoption, community participation, and policy support) and the success of tradition preservation.

$$Y = 5.25 + 2.46 \cdot X_1 + 1.79 \cdot X_2 + 3.00 \cdot X_3 \dots\dots\dots (3)$$

Intercept (β_0), 5.25, this is the basic value of the success of tradition preservation when all independent variables are zero. Coefficients ($\beta_{1,2,3}$), technology adoption (X_1)= 2.46, each one unit increase in technology adoption increases conservation success by 2.46 units. Community Participation (X_2)=1.79, every one unit increase in community participation increases conservation success by 1.79 units. Policy Support (X_3)= 3.00, every one unit increase in policy support increases conservation success by 3.00 units. R-squared (R^2): 0.99, a very high R^2 value (99.36%) indicates that this model can explain almost all variations in the success of tradition preservation. The independent variables in the model are very good at predicting the success of tradition preservation. These results confirm the importance of the three variables in supporting the success of tradition preservation, policy support (X_3) has the greatest influence. Technology adoption (X_1) and community participation (X_2) also make significant contributions.

Furthermore, tradition-based innovation has an important role in building synergy among local values and global needs. Ethnoscience, as a science based on local wisdom, contains great potential to be integrated into modern education to create locally relevant and competitive innovations in the global market. Widowati and Wakid (2024) show that combining traditional elements such as herbal plant knowledge with modern technology, including biotechnology, can expand the scope of innovation, not only in educational aspects but also in economic aspects (Widowati & Wakid, 2024). Ethnoscience-based education provides a framework for integrating local traditions into the modern curriculum. In this context, ethnoscience-based teaching, such as that applied to the development of e-learning-based learning modules, has proven to be effective in improving students' critical thinking skills, enriching learning experiences, and promoting sustainability (Sari et al., 2021). Modern technologies, such as biotechnology, are the main drivers in increasing the added value of tradition-based products. The use of biotechnology to modify the traditional herbal production process not only improves efficiency but also product quality. This merger allows for the creation of more competitive products in the global market. Studies on the integration of biotechnology in education systems show that cross-disciplinary training involving modern technologies can bridge the gap among academic research and industry needs (Mendoza-Ruiz et al., 2022). In the context of herbal innovation, for illustration, modern fermentation technology can be used to improve the bioavailability and efficacy of active compounds in traditional herbal products. With this approach, products such as herbal medicine are not only able to compete locally but also gain trust in the international market through scientific certification and quality improvement.

The integration of ethnosciences in innovation also has a significant impact on sustainability and local economies. The sustainable use of local natural resources not only preserves culture but also provides significant economic benefits to local communities. In this case, an ethnoscience-based approach can increase environmental awareness while strengthening the local economy through community empowerment and community involvement in the production process (Tsaniyah & Fadly, 2024). In addition, the integration of ethnoscience into national education policies, such as the Independent Curriculum in Indonesia, shows a positive impact on students' critical thinking skills. The results of the study show that an ethnoscience-based approach improves students' understanding of science and problem-solving skills, which ultimately supports the development of more competent human capacity (Hasibuan et al., 2023).

Table 3.2. Implementation of Ethnoscience and Modern Technology

Country	Key Implementations
Japan	Integrating sustainability education (ESD) in the national curriculum with a focus on local community-based projects and international collaborations to expand the scope of social and environmental issues (Fredriksson et al., 2020).
South Korea	The apply ethnoscience-based learning to increase multicultural awareness through contextual learning, as well as the apply digital technology to support educational transformation (Kim, 2020).
Germany	Internationalization of higher education through the integration of international students and the use of digital-based curriculum for sustainable development (Park, 2024).
United States	Focus on the integration of modern technologies such as IoT in higher education to support distance learning and improve educational accessibility (Ali et al., 2023).
Vietnam	Aligning ethnoscience-based education with national policies for the preservation of local culture as well as the development of innovative technologies in the education sector (Ryazantsev et al., 2020).
China	Adoption of an AI-based approach to higher education that balances a focus on national security with the development of modern technologies in learning (Xie et al., 2024).
Russia	The development of inclusive education takes into account ethnocultural factors, especially in regions with significant multicultural populations (Akhmetova et al., 2021).
Netherlands	Implementation of sustainability-based curriculum with local cultural integration and a global approach to the development of sustainable higher education (Fredriksson et al., 2020).
Arab Saudi	Increasing adoption of IoT technology in e-learning systems to expand access to education, with a focus on workforce training for the high-tech sector (Ali et al., 2023).

Source: Author Search, 2024

The integration of ethnoscience with modern technology and education provides a great opportunity to create tradition-based innovations that are not only locally relevant but also able to compete globally. By combining traditional and technological elements, we can maximize local potential to create innovative,

sustainable, and economically value-added products. Research shows that these endeavors also strengthen education and environmental awareness, making them an important pillar in sustainable and inclusive development. The integration of ethnoscience and modern education has developed in many countries to create sustainable and culturally relevant education systems (table 3.2.). Developed and developing countries show a consistent focus on the use of modern technology to support local culture-based education. Japan, South Korea, and the United States stand out in the integration of digital technology, while countries like Russia and Vietnam emphasize the preservation of local culture through education. However, there is a difference in focus, East Asia (Japan, Korea, China, Vietnam), focuses on international collaboration and national capacity building while maintaining local cultural values. Western countries (the United States, Germany, the Netherlands), place more emphasis on sustainability and the development of modern technology to create inclusive and future-oriented education. Then in constraints and opportunities, some countries, such as Saudi Arabia, face infrastructure challenges and workforce readiness to adopt new technologies. However, this approach provides a great opportunity to accelerate the modernization of education in the region. The integration of ethnoscience and modern technology requires a balanced approach among cultural preservation and technology adoption. Countries can learn from each other's experiences in leveraging technology to strengthen local education while participating in the global ecosystem. Strategic measures like these can help locally relevant and globally competitive education, creating an adaptive, inclusive and sustainable education system.

Tradition-based innovation is one of the main pillars in creating synergy among tradition, technology, and innovation. Research by (Widowati & Wakid, 2024) shows that integrating ethnoscience with modern education can produce locally and globally relevant innovations. One illustration is the development of traditional herb-based products combined with modern biotechnology. Products such as herbal medicines, natural cosmetics, or dietary supplements can be produced by utilizing traditional knowledge of medicinal plants that have been passed down from generation to generation. This combination not only increases the added value of products in the global market, but also strengthens local cultural identity. Furthermore, these innovations require a framework that involves a wide range of stakeholders. Academics can play a role in R&D, while governments can provide policies and incentives to support these initiatives. The private sector, especially the creative and pharmaceutical industries, can be strategic partners in marketing these innovative products to domestic and international markets. A clear illustration of this approach can be found in the development of the natural ingredients-based cosmetics industry in Southeast Asia, where traditional knowledge of herbal ingredients is combined with modern technology to create products that are in

demand globally. In addition, traditional arts such as wood carving, weaving, or other handicrafts can be adapted into creative products with high market value through innovative design approaches. In Italy, research by (Cosentino et al., 2021) shows that SMEs in the agro-food sector have successfully combined modern technology with local traditions to improve product quality, environmental sustainability, and global competitiveness. A similar pattern can be applied in various other cultural sectors to create new economic opportunities.

The role of policy is very important in realizing this synergy pattern. Policies that support the locally-based innovation ecosystem must include incentives for small and medium-sized businesses, training programs, and adequate technology infrastructure. (Tartaruga, 2020) emphasizes the importance of building an inclusive regional innovation system, in which all actors, including local communities, are involved in the decision-making and implementation process. In addition, cross-sector collaboration among governments, educational institutions, and the private sector is needed to create a holistic innovation ecosystem. The triple helix model involving academia, industry, and government has proven effective in integrating tradition with technology to produce sustainable innovation. The synergy pattern among tradition, technology, and innovation is a strategic approach to create sustainable development. By integrating digital technology into local traditions, fostering tradition-based innovation, and strengthening policy support, communities can maintain their cultural identity while leveraging technology to improve their quality of life. The success of this approach depends on cross-sector collaboration, active community participation, and holistic policy support. Therefore, this synergy pattern is not only relevant for cultural preservation, but also as a solution to face the challenges of globalization and modernization in various contexts.

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Papua, with its rich culture and unique traditions, has great potential to develop the creative economy sector through tradition-based innovation. Papuan carvings, such as motifs from the Sentani and me tribes, are a clear illustration of how tradition can be adapted into creative products oriented to the global market. These motifs full of philosophical value can be developed into modern products such as jewelry, souvenirs, or decorative artworks using technologies such as laser engraving and 3D printing, without losing the authentic value of the unique culture (Yektingtyas & Morin, 2020). The use of sustainable local materials, such as wood, rattan, and bamboo, ensures sustainable production while supporting a green economy that integrates cultural values and environmental sustainability (Mollet & Silo, 2024). This tradition-based approach also opens up great opportunities for local communities to participate in the creative economy value chain. By empowering local communities as key actors, tradition-based innovation not only creates jobs but also helps preserve local wisdom that is a cultural asset of Papua (Atmojo et al., 2023). The multi-stakeholder collaboration strategy or Penta Helix, which involves the government, academia, the private sector, the community, and the media, is the key to the successful development of this sector. The government can act as a facilitator through regulations and policies, while the private sector supports through funding and marketing of traditional art products. Academics can contribute to the R&D of technologies relevant to local needs. The annual cultural festival is also an effective strategy to introduce Papuan carving art to the national and international markets. This kind of festival not only promotes creative products but also raises public awareness about the importance of preserving local culture. The support of digital technology, such as ecommerce and social media, allows the marketing of Papuan carved art globally. In addition, AR technology can be used to create interactive experiences for consumers, such as witnessing the carving process virtually (Sidiq et al., 2023). The success of this tradition-based innovation has an impact on cultural preservation, economic sustainability, and increased tourism. Traditions that are at risk of extinction can be preserved through adaptation into modern products with high economic value. This creative economy model creates a new sustainable source of income for local communities, while introducing Papua as a cultural destination in the global market. With an integrated approach among tradition preservation, technological innovation, and multi-stakeholder collaboration, Papuan carving has the potential to be a key driver in a sustainable creative economy.

Table 3.3. Implementation of Traditional Arts and Creative Economy

Country	Key Implementations
Japan	Focus on the development of the animation, design, and traditional arts industries with a collaborative approach to enhance global competitiveness. Japan leverages handicraft expertise and innovation to create export-oriented cultural products (Guo, 2024).
South Korea	Through initiatives such as Hallyu (Korean wave), the country has promoted pop culture, visual arts, and film to strengthen the creative economy and cultural diplomacy. The government also supports the creative industry through cross-sectoral policy programs (Lopez-Leyva & Guzmán-Solano, 2021).
Germany	Implementation of the creative economy ecosystem through the integration of advanced technology in digital art and design. The country promotes cross-industry collaboration, primarily through public art initiatives and international exhibitions (Fragkos et al., 2021).
United States	Supporting public art through the National Endowment for the Arts and facilitating the development of traditional and contemporary art in public spaces, such as the "Art in Architecture" program (Kartseva, 2022)
Vietnam	Focus on the export of design-based creative goods and traditional arts, such as textiles and handicrafts, by leveraging government policies that support arts education and connection with global markets (Dong & Truong, 2020).
China	Enhancing the competitiveness of the creative industry with the integration of traditional arts in digital content, including animation and social media, as part of the "One Belt, One Road" strategy (Gomboeva, 2022)
Russia	Developing public art and creating a creative city ecosystem as part of a sustainable city development strategy. Russia has also adopted an approach to integrating traditional arts in the global creative economy (Kartseva, 2022).
Netherlands	Supporting arts and culture through innovative art exhibitions and supporting local artisans with access to digital technology for promotion and marketing (Guo, 2024).
Arab Saudi	Provide modern technological facilities for traditional arts, including art galleries and digital platforms, as part of the Vision 2030 plan to increase cultural contribution in the national economy (C. Chen et al., 2022).

Source: Author Search, 2024

The creative economy based on art and tradition has become one of the important strategies in the development of the modern economy. The following is a table of the implementation of traditional arts-based innovations and creative economies in Japan, South Korea, Germany, the United States, Vietnam, China, Russia, the Netherlands, and Saudi Arabia (table 3.3.). All countries show a commitment to the development of traditional arts as part of the creative economy. Increasing global competitiveness and preserving local culture are top priorities. Although there are differences in focus on East Asia (Japan, South Korea, China, Vietnam) with a focus on the integration of traditional culture with digital technology to support exports and cultural diplomacy. Meanwhile, Western countries (the United States, Germany, the Netherlands), place more emphasis on public art and the development of contemporary art with the support of cultural institutions. The Middle East (Saudi Arabia), meanwhile, integrates traditional arts into long-term economic plans through the use of modern technology. The technology-based approach provides an opportunity to expand global market access, but requires significant investment in

digital infrastructure and arts education. In addition, the challenge of maintaining the authentic value of traditional art remains significant in the midst of modernization. The implementation of traditional arts in the creative economy requires cross-sectoral support and integrated strategies to ensure cultural sustainability while increasing economic contribution. The implementation model in these countries can be a reference for other countries to develop their traditional arts in a more innovative and globally competitive direction.

Policy Support and Local Innovation Ecosystem The implementation of tradition-based innovation requires strong policy support. In the context of Indonesia, Law Number 59 of 2024 emphasizes the importance of strengthening the locally-based innovation ecosystem as a priority for regional and national development. This policy includes the development of a framework that involves local communities, educational institutions, and the industry sector to create sustainable synergies (Tartaruga, 2020). In a global context, similar approaches have been successfully applied in various regional development projects, such as culture-based innovations that combine IoT technology and local values to support the development of remote areas. The development of tradition-based innovation requires strong policy support to create an inclusive and sustainable innovation ecosystem. In Indonesia, Law Number 59 of 2024 emphasizes the importance of strengthening the local innovation ecosystem as a regional and national development priority. This policy emphasizes the need for synergy among local communities, educational institutions, and the industrial sector to support tradition-based innovation. This support includes the provide a legal framework that allows collaboration among stakeholders. In the global context, various countries have successfully implemented similar policies with a focus on place-based development and the integration of traditional values into modern innovation. For illustration, an innovation program in the United States that combines traditional art with modern technology can create new opportunities in the global market (Kartseva, 2022).

Tradition-based innovation policies have a wide impact, not only for economic development but also for the preservation of cultural values. At the local level, this approach can increase the capacity of communities to use local resources for innovation. For illustration, through training and mentoring programs, the community can be directly involved in the process of creating added value. In addition, the development of a tradition-based innovation ecosystem is also relevant in cultural diplomacy in the international market. Studies show that place-based approaches that focus on local needs and potentials tend to be more successful in creating long-term impacts than generic policies (Liu et al., 2023). Technology plays an important role in the development of local innovation ecosystems. Tradition-based innovation can be scaled up through the integration of technologies such as the IoT, cloud computing, and data analytics. This technology allows for more efficient data

processing and better connectivity among ecosystem actors. An illustration is an initiative in Europe that uses a sustainable innovation ecosystem model to support the development of traditional arts oriented toward digitalization (Costa & Matias, 2020). In addition, investment in digital infrastructure is also needed to support the adoption of technology by local communities. Despite its many benefits, the implementation of tradition-based innovation policies faces several challenges. These challenges include a lack of technical capacity of local communities, limited funding, and resistance to change. Research shows that the success of the innovation ecosystem is highly dependent on the ongoing engagement of all stakeholders, including local communities, the private sector, government, and academia (Hoffecker et al., 2023).

To address these challenges, several policy recommendations can be proposed. First, the government needs to provide incentives, such as tax cuts for industries involved in tradition-based innovation. Second, the capacity building of local communities must be integrated into the educational curriculum. This can be done through practice-based training programs that involve collaboration with educational institutions and the industry sector. Third, the government can help funding through grant mechanisms or revolving funds to support local initiatives. With this integrated approach, tradition-based innovation can become an important pillar in sustainable development. Strengthening local innovation policies and ecosystems not only aims to create economic growth but also preserve cultural values and traditions. With the support of adequate technological infrastructure and effective cross-sector collaboration, tradition-based innovation can provide long-term benefits to local communities and strengthen Indonesia's position in the global arena. The pattern of synergy among tradition, technology, and innovation in Papua provides great opportunities for cultural preservation as well as the creation of sustainable economic value. By leveraging digital technologies, developing tradition-based innovations, and strengthening policy support, Papua can be an illustration of successful integration among local wisdom and modern progress. This approach not only advances regional development but also enriches national cultural diversity in the midst of the challenges of globalization.

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The enormous maritime potential is very likely to be developed in the Papua region, which has a long and diverse coastline that stretches along its territory, also has the potential to be a pioneer in sustainable economic development (Aminuddin & Agussalim Burhanuddin, 2023). Including for high-tech development such as rocket launchers or spaceports (Widiyasmoko et al., 2023). If built, the spaceport will be the starting point of an *empire in spaceport use*, which can revive Indonesia's leadership in Southeast Asia (Johni RV Korwa et al., 2024). This is because Papua has a strategic position at the equator. Papua's many potentials are opportunities in the future to increase economic added value, including supporting the development of a green economy (Ririhena et al., 2024). The added value of the economy, especially from the contribution of infrastructure development, where with the construction of infrastructure, it can increase the capacity of the region (Démurger, 2001), can eliminate inequality with other regions, in various aspects related to education, knowledge, health, and the economy (Fernández-Serrano et al., 2019; Mahmud & Akita, 2018). However, there is a lot of potential in the Papua region, there are many obstacles to realizing the existing opportunities. Obstacles are mainly in infrastructure development, including digital infrastructure in the Papua region. These obstacles are due to many problems, including the unpreparedness of human resources, such as the lack of higher education competence, limited knowledge of science and technology (Fauzi et al., 2019). In addition, cultural problems, and weak coordination among each level of local government institutions, are the main problems in Papua's infrastructure development (Fauzi et al., 2019). The unaffordable digital infrastructure in the Papua region has the impact of uneven inavailability across the archipelago, with some islands, such as Java, benefiting from much faster and cheaper internet than others, such as Papua (Salam et al., 2018).

4.1. Social and Structural Barriers to Innovation

Social and structural barriers are the main barriers to encouraging innovation in Papua. One of the major obstacles is the marginalization of indigenous peoples in development decision-making. Governance systems that do not fully accommodate local values often ignore local wisdom, so that the innovations designed are irrelevant or even contrary to the needs of indigenous peoples. In addition, the existence of educational gaps worsens the ability of indigenous peoples to actively participate in

the innovation process. The marginalization of indigenous peoples in the development process reflects challenges in governance systems that often fail to accommodate local values. Marginalization theory refers to social, economic, and political processes that cause certain groups to lose access to resources, participation, and decision-making. In the context of indigenous peoples, marginalization arises when development governance ignores local values, traditional wisdom, and land rights. The theory of marginalization evolved from postcolonial studies that highlight how indigenous groups are losing their voice in a system dominated by global and modern perspectives. One of the factors that drives the development of this theory is the increasing expand land conflicts and social exclusion due to infrastructure development. A recent study by (Pamungkas et al., 2022) shows that governance policies are often less adaptive to the needs of local communities. The main concept of marginalization theory is that there are three important things that are highlighted in this chapter.

1. Rights to Land and Resources.

Marginalization often occurs due to land ownership conflicts. Land and resource rights have a fundamental role in the social, economic, and political structure of society. Land ownership conflicts are often a trigger for the marginalization of certain groups, especially when access to land is unequal or not protected with legal certainty. This marginalization can occur due to inequality in the control, use, and protection of agrarian resources, resulting in economic and social vulnerability for vulnerable groups. Land ownership conflicts often occur due to a lack of public understanding of the importance of land registration and the absence of adequate physical and juridical data. According to research by (Patittingi, 2020), the lack of public awareness to register land is the main cause of land disputes among residents. Socialization about the importance of physical and juridical data in land registration has been proven to be able to reduce land conflicts and increase legal certainty at the local level (Farida Patittingi et al., 2021). Furthermore, economically oriented development often ignores indigenous peoples' land rights. In the context of development in Indonesia, research by (Darmawan, 2022) shows that human rights violate the environment often occur due to priorities for economic growth without paying attention to the sustainability of natural resources. This is not only detrimental to the environment, but also exacerbates the marginalization of groups that depend on the land. Fair land management is a global issue, as evidenced by the experience in several countries. Research in Ethiopia shows that land use policies often ignore citizens' rights, especially in urban planning which is often associated with forced evictions and political conflicts. This emphasizes the importance of fair cross-border land governance to prevent socio-economic marginalization (Alem, 2021). In Bangladesh, the distribution of land is heavily influenced by colonial history, where the Zamindar system created structural inequalities that limited smallholder access

to productive land. These ownership conflicts are exacerbated by gender injustice and social status, resulting in females and minority groups often losing access to land, which exacerbates their poverty and vulnerability to environmental disasters (Ahmed et al., 2023). In addition, agrarian conflicts in South Africa reflect race-based inequalities that persist post-apartheid. The capitalist-oriented land ownership system led to the mass eviction of farm worker families from commercial farmland, which shows the resistance of landowners to tenure rights reform (Andrew et al., 2022).

Endeavors to reduce land conflicts can be made through effective land registration. (Amini & Suratman, 2023) shows that the low level of land registration in the community results in minimal ownership of land certificates, which has an impact on weak legal certainty over ownership. From the perspective of legal certainty theory, land registration is a crucial step to prevent arbitrary actions and provide legal protection for land owners. In addition, the urgency of recognizing customary rights for customary law communities is also an important focus in ensuring justice and preventing marginalization. The research of (Dirkareshza et al., 2020) highlights the need for laws that regulate the recognition and protection of customary rights, considering the many conflicts that occur due to the neglect of indigenous peoples' traditional rights to land. Effective land registration is the main solution to minimize conflicts. In Russia, the policy of redistribution of marginal land for migrants demonstrates land management endeavors that integrate social and economic aspects. This program aims to reduce idle land and increase productivity by involving marginalized groups such as migrants and refugees as part of the RD strategy (E. V. Mitin & Sul'din, 2022). The experience in Canada also shows how public narratives can influence land governance policies. Public consultation on agricultural land ownership in Saskatchewan highlights the social and cultural values that communities use to challenge the dominance of foreign financiers and maintain local ownership of agricultural land (Beingessner, 2021). Rights to land and resources play an important role in maintaining the social and economic stability of the community. Land ownership conflicts can be minimized through transparent land registration and recognition of traditional rights. Policies that prioritize sustainability and justice in land resource management will help prevent marginalization and create harmony among development and environmental conservation.

2. Participation and Representation

The involvement of indigenous peoples in the decision-making process is still low (Banobe, 2023). Indigenous peoples have an important role in cultural preservation, environmental sustainability, and natural resource management. However, their involvement in decision-making, especially when it comes to indigenous rights and the resources they have, is still very low. This is due to various factors, including structural marginalization, lack of legal recognition, and lack of

inclusive representation mechanisms. The factors causing low participation occur due to limited access and information, research by (Ardiansyah Arif et al., 2020) shows that indigenous peoples often do not have adequate access to information about policies that impact them. In the Baduy community, their traditional values are often not accommodated by the government, even though these values are relevant in maintaining environmental balance. The dominance of non-indigenous actors in decision-making, in the context of forest management in Indonesia, (Dhialulhaq & McCarthy, 2020) highlight that indigenous peoples often lose out to large companies and governments in the negotiation process. This leads to a lack of their representation in decisions related to agrarian and natural resources. Regulatory constraints and legal recognition, lack of legal recognition of indigenous peoples' rights are major problems in many countries. For illustration, in Canada, indigenous peoples often have no influence on land-use policies even though indigenous lands are an integral part of their lives (Beingessner, 2021). The consequences of low participation, lack of participation and representation of indigenous peoples in decision-making have a negative impact on social and environmental welfare. The (Mastrangelo et al., 2019) study notes that agricultural expansion in South America often reduces indigenous peoples' access to resources, forcing them to live on increasingly marginalized land.

Solutions to increase participation, inclusive representation mechanisms, improved indigenous representation mechanisms, such as those proposed by (A. G. Bezrodny & H. Yan, 2019), can help indigenous peoples actively participate in decision-making. This includes integrating customary rights in national policies. Capacity strengthening and legal support, (A. Mitin et al., 2023) highlights the importance of empowering indigenous peoples through training and legal recognition of their customary rights to protect their resources. Increasing indigenous peoples' participation and representation in decision-making requires stronger legal recognition, access to information, and more inclusive representation mechanisms. With these measures, indigenous peoples can further contribute to policies that affect environmental sustainability and their own well-being.

3. Good Governance

Principles such as accountability, transparency, and fairness are often overlooked. Good Governance is a basic principle that ensures that the government carries out its duties efficiently, effectively, and fairly. This concept involves the apply accountability, transparency, community participation, and justice in every policy and implementation of public services. However, reality shows that many of these principles are often overlooked, resulting in a decline in public trust and the inability of governments to meet the needs of society as a whole.

Accountability means that public officials are responsible for their decisions and actions to the public. In the research of (Prathiwi et al., 2021)), it was found that

in the South Sulawesi Regional Police Directorate, the principle of accountability has a significant influence on the performance of police personnel. However, its implementation is often hampered by the lack of an effective monitoring system and coordination among institutions. On the contrary, in a study conducted by (Andi Hendrawan, 2020) on the management of village funds, it was found that although transparency has been implemented in planning, accountability is often neglected, especially at the stage of reporting results to the community. This causes uncertainty in the use of village funds, which hinders public trust in the village government.

Transparency is information disclosure that allows the public to know and supervise the course of government. However, in many cases, transparency is only partially done. Research by (Indra Kristian et al., 2020) in West Java shows that despite endeavors to increase transparency through governorship policies, public access to information is still limited, especially in budgets and financial statements. In addition, (V. Anggraini, 2020) revealed that in Banjarsari Village, Malang, transparency in the management of village funds has not met standards. For illustration, activity and budget reports are not published thoroughly, hindering public participation and potential oversight of budget use.

Justice is an important element of good governance that is often overlooked. In the context of public policy, research by (Gani & Suparman, 2023) emphasizes the importance of justice in policy implementation in Subang Regency. However, there are still obstacles, including bias in resource distribution and non-inclusive decision-making. Similarly, (Dewi et al., 2021) highlighted that justice is often neglected in the management of village funds in Sindanghaji Village, where budget distribution is not carried out based on the needs of the community evenly. Although Good Governance aims to create fair and transparent governance, the reality is that many principles such as accountability, transparency, and fairness are often overlooked. The main causes include a lack of competent human resources, weak supervision, and lack of community involvement in the decision-making process. To address this, governments need to strengthen institutional capacity, improve public access to information, and ensure equitable distribution of resources.

Land and resource rights play an important role in the social, economic, and political structure of communities, including in Papua. The marginalization of indigenous peoples often occur as a result of land ownership conflicts, which are exacerbated by a lack of land registration and legal uncertainty. These conflicts cause economic and social vulnerability for vulnerable groups, such as indigenous Papuans who depend on land for their survival and culture. (Patittingi, 2020) noted that the low awareness of the importance of land registration resulted in disputes among residents. Adequate socialization can help reduce these conflicts by providing clear physical and juridical data. In the context of Papua, development often ignores indigenous peoples' rights to their land. According to (Darmawan, 2022), focusing on

economic growth without paying attention to the sustainability of natural resources exacerbates the marginalization of indigenous peoples, who have a close relationship with customary lands as important resources. This inequality reflects policies that are not yet inclusive and do not take into account the unique needs of local communities. Effective land registration is an important step to prevent conflicts and increase legal certainty. In Papua, this is relevant because many rural areas do not have access to formal legal mechanisms. Research by (Amini & Suratman, 2023) shows that without land certificate ownership, it is difficult for people to get adequate legal protection. By strengthening legal recognition of customary rights, conflicts can be minimized, and justice for indigenous Papuans can be improved.

The involvement of indigenous Papuans in the decision-making process is very low. This is mainly due to limited access to quality education, especially in rural areas. The Papua RPJPD 2025-2045 (Bapperida Provinsi Papua, 2024b) notes that this educational inequality must be overcome immediately to support inclusive development. (Ardiyansah & Robby, 2023) show that the lack of access to information makes indigenous peoples often not involved in policies that directly impact them. In natural resource management, indigenous peoples often lose out to large corporations and governments, as noted by (Dhialulhaq & McCarthy, 2020). Their lack of representation in negotiations leads to policies that do not reflect the needs of indigenous peoples. To address this, improving inclusive representation mechanisms and strengthening the capacity of indigenous peoples are important priorities. These solutions include stronger legal training and recognition of the customary rights of indigenous Papuans. (A. Mitin et al., 2023) highlight the importance of community empowerment through training that allows indigenous peoples to actively participate in development. The principles of Good Governance, such as accountability, transparency, and justice, are often overlooked in the context of development in Papua. The government's inability to adopt these principles has exacerbated social inequality. (Kristian et al., 2022) noted that partial transparency in budget policies hinders the participation of Papuans in monitoring development. Accountability is also a problem, especially in the management of village funds. (Andi Hendrawan, 2020) shows that although transparency is implemented, reporting results is often neglected, so that the public does not know how the funds are used. To overcome this, it is necessary to strengthen the capacity of local institutions in Papua to effectively implement the principles of Good Governance. The apply justice in policy is also very important. (Gani & Suparman, 2023) emphasized that the distribution of resources must be carried out in an inclusive manner to reduce inequality. By prioritizing quality education for the young generation of Papuans, the Papua RPJPD 2025-2045 (Bapperida Provinsi Papua, 2024b) emphasizes the need for strategic steps to create equitable and inclusive development in the region.

4.2. Technology and Infrastructure Access Gap

Papua still faces significant gaps in access to technology and infrastructure. Many remote areas in Papua are not yet connected to basic infrastructure, such as roads, bridges, electricity, and internet access. This condition hampers the distribution of local products and reduces the competitiveness of indigenous peoples in the wider market. In addition, limited access to modern technology, such as mechanized agricultural tools and digital devices, reduces efficiency in the management of local resources. In the 2025-2029 Papua RPJMD, it is stated that strengthening infrastructure in remote areas must be a priority to create better accessibility and support the development of locally-based innovations (Bapperida Provinsi Papua, 2024a). Papua, as one of Indonesia's easternmost regions, has abundant natural resources and extraordinary cultural uniqueness. However, the region also faces significant challenges, especially in access to basic infrastructure. The absence of roads, bridges, electricity, and internet access in many remote areas of Papua creates deep socio-economic disparities and reduces the competitiveness of indigenous peoples in a wider market. Infrastructure development in remote areas is a global challenge faced by many countries. Hard-to-access regions require a unique approach that takes into account geographical conditions, resource constraints, and the needs of local communities. Developed and developing countries have implemented a variety of innovative strategies to address these barriers, from renewable technologies to collaborative frameworks with local communities.

The development gap among regions, especially in indicators of infrastructure, technology, macroeconomic stability, and innovation capabilities, is a global issue that continues to be a concern. In an increasingly connected world, a region's ability to compete and thrive is often determined by its capacity to meet these basic needs. According to recent research, inequality in these indicators can affect a region's ability to improve community welfare and promote sustainable economic growth (Džiugaitė-Tumėnienė et al., 2021). One way to understand and evaluate this gap is to use visualization tools such as heatmaps (figure 4.1.). Heatmaps allow for a deeper analysis of the scores of various indicators among different regions. This data can provide a focused view of the strengths and weaknesses of each region, so that it becomes the basis for formulating appropriate development policies. For illustration, differences in indicators of information and communication technology (ICT) adoption are often associated with challenges in equitable internet access and digital literacy, which ultimately impacts public participation in the digital economy (Satriadi & Pramudita, 2021). Furthermore, macroeconomic stability indicators show a close relationship with the fiscal and monetary policies adopted by local governments. Higher stability usually advises investment inflow, increased regional competitiveness, and inclusive economic growth. Similarly, innovation capabilities measured by investment in research and development are often catalysts in creating

creative solutions to local challenges, especially in the era of a knowledge-based economy (A. Mitin et al., 2023). Based on the competitiveness of the city districts in Jayapura Province can be interpreted with a heatmap (figure 4.1.).

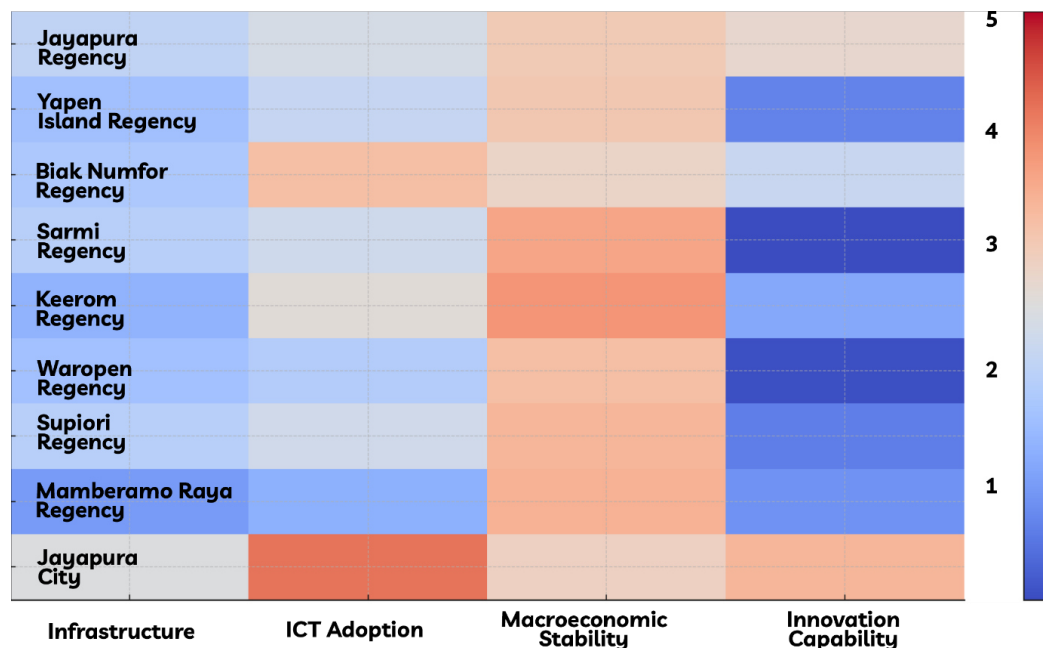


Figure 4.1. Heatmap of Infrastructure, ICT Adoption, Macroeconomic Stability and Innovation Capabilities of Urban Regencies in Papua in 2024

The infrastructure Indicator, Keerom Regency, and Memberamo Raya Regency show low scores on infrastructure indicators. These infrastructure gaps are often attributed to geographical barriers or a lack of government investment. According to studies, infrastructure development in disadvantaged areas requires a community-based approach and public-private financing to maximize its impact (Astuti, 2022). ICT Adoption Indicators, the difference in scores in ICT adoption is striking, with the city of Memberamo Raya Regency showing the lowest score. This indicates that there is a significant digital divide, which can hinder the participation of local people in the digital economy. A study by (Satriadi & Pramudita, 2021) confirms that investment in fiber optic networks and increasing digital literacy are important steps to close this gap. Keerom Regency recorded the highest score in macroeconomic stability, which is usually an important prerequisite for attracting investment and developing productive sectors. Research suggests that this stability is often the result of prudent fiscal policy and prudent debt management (Gani & Suparman, 2023). Innovation capability is an aspect that shows significant variation among cities in the heatmap. Jayapura City has a high score, reflecting considerable investment in education, research, and development. This is in line with research findings that the innovation ecosystem requires synergy among universities, industry, and government to achieve sustainability (A. Mitin et al., 2023). This heatmap analysis shows the need for a

specific approach based on the unique conditions of each region. For illustration, areas with low infrastructure such as Keerom Regency, and Memberamo Raya Regency require priority attention for physical development. Meanwhile, investment in ICT and innovation in low-scoring cities such as Memberamo Raya Regency can support technology-based economic development. By integrating policies that focus on these key indicators, disparities among regions can be minimized, creating more equitable development.

The limited infrastructure in Papua can be seen from the low connectivity among regions. According to relevant studies, infrastructure development in Papua is often hampered by difficult geographical conditions, such as steep mountains and dense forests. This leaves many areas only accessible by air or sea, which increases logistics costs and hampers the distribution of local products. Reliance on air transport, for illustration, worsens accessibility due to high costs and limited capacity. The gap in internet access is also a big challenge. In today's digital era, adequate internet access is a prerequisite for connecting people to the global market. However, in Papua, many regions still do not have a stable internet connection, hindering the development of the digital economy and technology-based education. The absence of basic infrastructure has a direct impact on the distribution of local products, such as coffee, handicrafts, and non-timber forest products. These products can often only be marketed locally, with a selling cost that is much lower than the value in the national or international market. According to the study, limited access to roads and bridges is a major barrier for indigenous peoples to reach a wider market. In addition, this condition also exacerbates income inequality among Papua and other regions in Indonesia. For illustration, many indigenous communities still rely on subsistence methods to meet their living needs, which limits their ability to thrive in the modern economy.

References related to infrastructure, ICT Adoption, Macroeconomic Stability and Innovation Capabilities, for illustration, Canada has been a pioneer in harnessing renewable energy for remote areas. Research shows that solar and wind power installations have reduced the reliance of rural communities on fossil fuels. In addition, microgrid technology has been used to integrate renewable energy into local power systems, providing stable access to energy in hard-to-reach areas (Beingessner, 2021). In Norway, the transportation system in remote areas is improved by using digital technology. Projects such as "Smart Roads" allow real-time monitoring of road infrastructure, reducing the risk of damage due to extreme weather. The technology also integrates satellite-based navigation systems to improve the efficiency of logistics delivery to hard-to-access regions (A. Mitin et al., 2023). India is launching schemes such as the "Pradhan Mantri Gram Sadak Yojana" (PMGSY) designed to connect remote villages with the national road network. This program involves local communities in the planning and development process, thereby increasing the sense

of ownership and sustainability of infrastructure projects. Studies show that this scheme has significantly improved market access and public services in remote areas (Gani & Suparman, 2023).

The government has made endeavors to address this problem through programs to accelerate infrastructure development in Papua, such as the Trans Papua Highway and the East Palapa Ring project for internet access. However, the implementation of these programs often faces challenges, including social conflicts, budget overruns, and poorly managed environmental impacts. Therefore, there is a need for a more inclusive and sustainable approach. For illustration, involving indigenous peoples in the planning and implementation of infrastructure projects can improve the sustainability of development. Other studies show that renewable energy-based technologies, such as solar power plants, can be an effective solution for remote areas with minimal access to electricity. Despite many best practices, infrastructure development in remote areas often faces obstacles such as high costs, technological limitations, and social conflicts. Innovative approaches are needed to overcome these obstacles: Cooperation models among the government and the private sector, such as those implemented in Indonesia through the Public-Private Partnership (PPP) scheme, allow the financing of large projects without completely burdening the state budget (Astuti, 2022). In countries like Japan, the construction of fiber optic networks in remote areas has provided fast and reliable internet access. This technology enables the development of online education and distance health services, which are very important for people who live far from urban centers (Satriadi & Pramudita, 2021).

The infrastructure gap in Papua reflects the fundamental challenge of creating equitable and inclusive development. Limited access to roads, bridges, electricity, and the internet not only hampers the distribution of local products, but also limits the economic potential of indigenous peoples to compete in a wider market. With a more inclusive development strategy, involving local communities, and leveraging appropriate technology, Papua has a great opportunity to reduce these disparities and improve the well-being of its people. Global experience shows that infrastructure development in remote areas requires an inclusive and innovative approach. Successful countries have adopted cutting-edge technologies, empowered local communities, and integrated renewable energy into their strategies. By learning from these best practices, other countries can reduce infrastructure gaps and improve the quality of life in remote areas.

4.3. Impact of Challenges on the Sustainability of Indigenous Lives

The social and structural barriers faced by indigenous peoples often hinder innovation and sustainability of their lives. A modern economic system that does not pay attention to indigenous values creates challenges for the cultural and ecological

sustainability of indigenous peoples. A relevant approach to addressing these problems must consider social, cultural, ecological, and economic aspects holistically. Previous research has shown the importance of local community participation in sustainable development, social adaptation in the modern context, and criticism of social inequalities that harm indigenous communities. Social and structural barriers that hinder innovation and sustainability of indigenous peoples are a global concern. In this context, other countries are also facing similar challenges, and the approach taken can be a reference to strengthen policies in protecting the rights of indigenous peoples in Indonesia. Academic studies show that cultural value-based solutions and green economic integration are relevant approaches to overcome these barriers. Relevant approaches that can be an option, for illustration the participation of local communities in sustainable development, the participation of indigenous peoples in sustainable development is essential to achieve a balance among ecological, socio-cultural, and economic sustainability. This shows that the approach to education and capacity building of local communities must pay attention to traditional values while opening up space for adaptation to modern dynamics. Criticism of social and structural inequalities, other research underscores the importance of critique of social inequalities that negatively impact indigenous communities. A study on Balinese short stories shows how social criticism can be a medium to understand the inequality that occurs in indigenous peoples due to the influence of the modern economic system (Turaeni & Hardiningtyas, 2021). This is relevant to highlight the importance of a sensitive approach to customary values in the development process.

Referring to other countries, for illustration, Canada has a policy that emphasizes the recognition of indigenous land rights as an important element to empower indigenous peoples. Research by (Whalen, 2021) shows that programs such as the "First Nations Land Management Act" allow indigenous peoples to manage their land independently, which not only strengthens the local economy but also preserves their cultural traditions. This policy can be adapted to the Indonesian context, where indigenous Papuans, for illustration, can be given greater authority in the management of their local resources. In Australia, an indigenous entrepreneurship-based approach is one of the strategies to overcome social disparities. Research by (Smith, 2021) notes that programs such as the "Indigenous Business Sector Strategy" have been successful in encouraging the economic participation of indigenous peoples by providing access to business training and specialized funding. This concept is relevant to be applied in Papua to increase the competitiveness of indigenous peoples in the global market without abandoning their traditional values. Brazil offers an interesting approach through the integration of indigenous peoples in the preservation of tropical forests. According to (Stegmann et al., 2024), programs such as the "Amazon Fund" involve indigenous peoples in conservation endeavors, by providing economic incentives to preserve biodiversity.

This approach not only protects the environment but also ensures the cultural sustainability of indigenous peoples. In Norway, the Sami indigenous people are directly involved in decision-making related to environmental and natural resource policies. A study by (Broderstad et al., 2020) shows that the existence of the "Sami Parliament" provides a strong representation space for indigenous peoples in determining policies that affect their lives. This model can be adopted in Indonesia to increase the participation of indigenous peoples in national policies. These approaches from other countries provide important lessons for Indonesia in overcoming the social and structural barriers faced by indigenous peoples, especially in Papua. Approaches from Canada, Australia, Brazil, and Norway can be effective solutions to address social and structural challenges in Papua and other indigenous areas in Indonesia. This approach needs to be implemented while still respecting local cultural values, so that ecological and cultural sustainability can run in harmony. By adopting elements such as land rights recognition, economic empowerment, community-based conservation, and participation in decision-making, Indonesia's policies can be more responsive to the needs of indigenous peoples. For illustration, the integration of environmental conservation programs with economic incentives can be a strategy that not only protects biodiversity but also strengthens the position of indigenous peoples in modern economic structures. Approaches to address social and structural barriers of indigenous peoples must include active community participation in development, support for social adaptation processes, and pay attention to criticism of social inequality. By involving indigenous peoples in the development process and strengthening traditional values, it is hoped that ecological, socio-cultural, and economic sustainability can be achieved. Scientific references support this approach as a strategic step in realizing inclusive and sustainable development.

The massive exploitation of natural resources in Papua can disrupt the ecosystems that are the main support for the lives of indigenous peoples, such as forests and the sea. In addition, modernization that is not properly managed can erode customary values that have been a guide in maintaining social and environmental harmony. Law Number 59 of 2024 emphasizes that the sustainability of indigenous lives must be the main concern in any development policy in Papua, emphasizing the importance of protecting the rights of indigenous peoples and local wisdom (Law Number 59/2024). Endeavors to maintain the sustainability of indigenous peoples' lives in Papua as mandated by Law Number 59 of 2024 require holistic steps and involve various stakeholders. Indigenous peoples have a vital role in maintaining the sustainability of local culture, ecology, and economy. However, challenges such as the exploitation of natural resources, social change, and inequality of access to education and technology require integrated solutions. This approach

should involve governments, indigenous peoples, academia, and the private sector in a collaborative framework focused on sustainable development.

Endeavors that need to be made, First, it is important to strengthen the education system based on local culture. Culture-based education can promote local wisdom, while still providing access to modern knowledge. This is in line with research that shows that culture-based education can improve the social and economic sustainability of indigenous peoples (Singh et al., 2021). Second, strengthening land and natural resource rights for indigenous peoples is very important. The government must ensure the implementation of formal recognition of customary territories regulated through a transparent and inclusive process. These protections can prevent land conflicts and exploitation by outsiders, as revealed by research on the protection of Indigenous rights in Canada that has succeeded in reducing social conflicts and improving local economic well-being (Stevenson et al., 2020). Third, the apply environmentally friendly technology to support the economic activities of indigenous peoples must be a priority. These technologies can be applied in the traditional agriculture, forestry, and fisheries sectors, while maintaining ecological sustainability. Case studies from the Philippines show that the integration of modern technology with traditional practices can increase productivity without damaging local ecosystems (Gómez-Ruiz et al., 2022).

The role of stakeholders, the government has the primary responsibility in creating policies that protect the rights of indigenous peoples and support the sustainability of their lives. The implementation of evidence-based policies involving the participation of indigenous peoples is very important (Turner et al., 2021). As the main actors, indigenous peoples must be involved in every stage of decision-making. Their active participation can ensure that the policies made are in line with local needs and values (Oloso et al., 2020). The private sector can contribute through responsible investment and support local economic development without sacrificing ecological and social sustainability.

One of the models that can be applied is the Community-Based Development Model (CBDM). This model places indigenous peoples as the main actors, with a participatory approach in designing, implementing, and evaluating development programs. The main components of this model include: active participation, involving indigenous peoples in the planning and implementation process of development programs. This approach has been successfully implemented in New Zealand to preserve Maori culture, with significant results in strengthening local cultural and economic identity (Ellis et al., 2023). Strengthening local capacity, providing training and education to indigenous peoples to manage their resources independently. Research in India shows that strengthening local capacity can increase efficiency in natural resource management (Chakraborty et al., 2021). Technology Integration, using eco-friendly technologies to support sustainable traditional practices. For

illustration, the use of blockchain technology in managing local product certification has succeeded in increasing transparency and market trust in indigenous peoples' products in South Africa (Lambert, 2021).

The Papua region in Indonesia has rich culture and abundant natural resources. However, development that does not involve indigenous peoples often ignore traditional values that are important for social and environmental sustainability. For this reason, the CBDM is a relevant alternative in designing and implementing development programs in Papua. The following is a real simulation of the applies the model. The first step in the implementation of this model is to involve indigenous Papuan peoples, such as the Asmat and Dani tribes, in the planning and implementation of development programs. Active involvement can be done through customary deliberations that aim to identify the priority needs of the community. For illustration, a similar approach has been implemented in New Zealand, where the Maori community is directly involved in preserving their cultural heritage. The results of (Ellis et al., 2023) show that active participation can increase the strengthening of cultural identity while supporting local economic development. In Papua, this customary deliberation can be focused on sectors such as sago forest management and the preservation of wood carving art. Training and education programs are key to improving the ability of indigenous Papuans to manage their resources independently. For illustration, training related to forest management techniques based on local wisdom and ecosystem conservation can be provided to indigenous youth. Research by (Chakraborty et al., 2021) in India proves that strengthening local capacity through community-based education improves the efficiency of natural resource management. In Papua, local governments and non-governmental organizations can work together to provide training programs for indigenous peoples on environmentally friendly agricultural technologies and culture-based ecotourism management. The use of eco-friendly technologies can support sustainable traditional practices in Papua. For illustration, blockchain technology can be applied to ensure transparency in the certification of local products such as handicrafts and non-timber forest products. Research by (Lambert, 2021) in South Africa shows that the use of blockchain technology in the management of local product certification has succeeded in increasing market confidence. With a similar approach, local Papuan products, such as noken and carved sculptures, can have added value in the national and international markets. In addition, renewable energy technologies such as solar panels can also be introduced to support energy needs in remote areas. Once the program is implemented, a participatory evaluation process must be undertaken to assess the success of this model. This evaluation involves indigenous peoples, governments, and other partners to ensure the sustainability of the program. In addition, the learning from implementation in the field can be used to improve the program in the future. Case studies from different regions (Europe, Eastern countries,

Western countries, Africa, Eastern world countries including Russia, and Asia Pacific) that discuss a participatory evaluation process to assess the success of sustainable programs. This table summarizes the approaches, key outcomes, and success factors in each region to provide a complete overview (table 4.1.).

Table 4.1. Case Studies of Participatory Evaluation in Various Regions

Pendekatan	Key Results	Success Factors
Forest management with participatory systems and cross-sector collaboration models	Improving inclusive and sustainable local governance.	Involvement of all stakeholders and transparency in governance.
Adherent-based climate adaptation with agent-based models	A better understanding of local culture-based adaptation needs.	Integration of local knowledge with adaptive technology and cross-sector collaboration.
Multiscalar governance for environmental justice	Reduce policy inequality across scales and increase decision-making inclusivity.	Cross-scale approach and inclusion of indigenous peoples in policy design.
Participation-based rangeland restoration	Increasing ecological resilience through social inclusion in planning.	The involvement of females and marginalized groups in governance.
Custom-based resource management	Preservation of local culture and adaptation strategies to climate change.	Collaboration among governments, indigenous peoples, and scientists.
Participatory environmental management	An environmental plan that reflects local needs and is widely accepted by the community.	Procedural clarity and community empowerment in the decision-making process.

Source: Author Search, 2024

A participatory approach in program evaluation has been one of the effective strategies to ensure sustainability. This approach involves a wide range of stakeholders, including indigenous peoples, governments, and other partners, to create solutions that are locally relevant and able to adapt to the specific needs of communities. Recent articles show that this method can produce more inclusive and sustainable results. Participatory guarantee systems for environmental sustainability, study by (Cazas et al., 2020) explores the apply Participatory Guarantee Systems (PGS) in Europe to evaluate the sustainability of the built environment. The system engages local stakeholders in the development of evaluation frameworks and criteria, which ensures consistency with local practices. This model enhances collective learning, empowers stakeholders, and creates a form of responsible local governance. Indigenous community-based evaluation, Study by (Clarke et al., 2022) shows how participatory evaluation is applied in federal programs for indigenous peoples in the United States. Although not based in Europe, this approach is relevant to the concept of participation where local cultural values are integrated in the development of the

program's logic model. This evaluation resulted in a deeper understanding of community traditions and local needs. Participation-based resource management, other studies show that participation involving various actors, including indigenous peoples and governments, can improve the quality of environmental governance. This approach supports environmental justice and allows indigenous peoples to have influence in the design of relevant institutions and policies (Gustafsson, 2024).

Key success factors, active stakeholder engagement, active participation of local communities and other stakeholders in each stage of evaluation ensure the relevance of evaluation results to local needs. Capacity building and collaboration, study by (Tremblay et al., 2020) highlights the importance of community capacity building through ongoing training and support in participatory research projects. This approach helps create better relationships among the government and indigenous communities. Local context adaptation, participatory evaluation should consider local context to increase relevance and impact. For illustration, the use of dynamic SWOT methods in policy development in Italy shows how local approaches can create more sustainable outcomes (Cisilino & Monteleone, 2020). Participatory evaluation involves indigenous peoples, governments, and other partners as a strategic approach to ensure the sustainability of the program. By empowering local stakeholders, strengthening collaboration, and adapting methods to local needs, these evaluations can create more inclusive and sustainable outcomes. This approach is not only relevant in Europe but also provides important lessons for the global context.

Participatory evaluation has become an important tool in ensuring the sustainability of programs involving various stakeholders, including indigenous peoples, governments, and other partners. This approach prioritizes the active involvement of all parties in the decision-making process to ensure the relevance of the program to local needs. Countries in the Eastern region, with their cultural diversity and social challenges, bid many valuable lessons in the apply participatory evaluation. Transformation of forest governance in Indonesia, A study conducted by (Marta, 2021) shows how forest governance in Indonesia has shifted from a top-down to bottom-up approach. This transformation is carried out through the apply participatory governance principles involving the government, indigenous peoples, the private sector, and civil society organizations. As a result, forest governance has become more transparent and accountable, with a focus on the public interest. This synergy among stakeholders also advises sustainable forest management to protect ecosystems and natural resources. Niteni Approach in Indonesia, In the context of sustainability in rural areas, (Utami et al., 2022) adopted a participatory approach based on local traditions, namely niteni. This approach is used to encourage collaboration among indigenous peoples, governments, and academics in supporting sustainable development. One of the main actions is the reintroduction of local agricultural traditions, such as planting native rice varieties that follow the natural

cycle of the seasons. This strategy not only restores human-nature relationships but also strengthens regional identity through innovative product design and branding. Sustainability assessment with a participatory approach in Southeast Asia, (Lairez et al., 2020) used participatory methods, including simulation games and agronomic field monitoring, to assess the sustainability of agricultural systems in Southeast Asia. This approach combines the perspectives of farmers and scientists to identify locally relevant sustainability criteria, such as resource use efficiency and soil erosion risk. The results of the study show the importance of a combination of economic, social, and environmental dimensions in creating a sustainable system. The learning success factor is multistakeholder engagement, participatory evaluation requires synergy among governments, indigenous peoples, and other partners to create relevant and sustainable solutions. This process not only strengthens accountability but also empowers local communities to be actively involved in resource management. Local context adaptation, approaches that are adapted to the local cultural context, such as the *niteni* method in Indonesia, are able to increase the effectiveness of programs while preserving traditions and customary values. Capacity building and collaboration: participatory programs that prioritize training and ongoing support can increase the capacity of local communities to take an active role in program planning and implementation. Participatory evaluation processes in Eastern countries have shown a positive impact in ensuring the sustainability of the program. By involving indigenous peoples, governments, and other partners, this approach not only results in locally relevant policies but also supports the preservation of culture and ecosystems. Lessons from these studies can be a valuable guide for the implementation of participatory evaluation in other contexts.

A participatory evaluation approach involving indigenous peoples, governments, and other partners is key to ensuring the sustainability of the program. In the context of Western countries, collaboration among various stakeholders is carried out by prioritizing local wisdom, customary rights, and adaptation to complex socio-ecological challenges. Recent studies highlight how these processes are applied in various sectors, including environmental governance, public health, and economic development. Participation in Forest Ecosystem Management, A study by (Peteru et al., 2021) shows how the Sustainable Landscapes Rating Tool (SLRT) is used in several regions of Latin America and Europe to evaluate jurisdiction-based environmental governance. The process involves multistakeholder workshops, including indigenous peoples, governments, and civil society organizations, to validate sustainability indicators. The results show that the involvement of various actors strengthens the alignment among local policies and their implementation. Improving public health through an intercultural approach, (Sarmiento Medina et al., 2020) reported on intercultural strategies for cervical cancer prevention in indigenous communities in Colombia. This approach involves training indigenous females' leaders in

ethnographic research and health programs that are in harmony with local cultures. As a result, the program increased indigenous peoples' awareness of health, minimized the dominance of Western culture, and created culturally safe health practices. Multiscalar governance for environmental justice, (Schilling-Vacaflor & Gustafsson, 2022) explores environmental governance involving indigenous peoples at various scales, ranging from local to global. The study identifies barriers, such as weak cross-scale connections and policy misalignments, but also points to opportunities for transformation through inclusive participatory spaces. Success determinants include active engagement of indigenous peoples, an inclusive process that allows indigenous peoples to contribute based on their local wisdom. This strengthens the legitimacy and relevance of the program to the needs of the community. Inter-Stakeholder Collaboration, the study shows that synergies among various actors, including governments, the private sector, and local organizations, create more integrated and sustainable solutions (Peteru et al., 2021). Implementation of a Culture-Based Approach, the success of the program largely depends on the extent to which the approach used is aligned with the cultural values of indigenous peoples, as found in the study of (Sarmiento Medina et al., 2020). Participatory evaluations in Western countries show how the involvement of indigenous peoples, governments, and other partners can create more inclusive and sustainable programs. By integrating local wisdom, strengthening cross-sector collaboration, and adopting a culture-based approach, this process not only improves program success but also supports social and environmental justice.

The participatory evaluation process is an important approach in ensuring the sustainability of programs that are relevant to the needs of local communities. In Africa, this approach is used to align resource management with local wisdom, confront the challenges of climate change, and empower indigenous peoples. Recent studies show that the active participation of various stakeholders, including governments, indigenous peoples, and other partners, is key to the success of these programs. Inclusive rangeland management in South Africa, A study by (Slayi & Ashmawy, 2021) highlights the importance of social inclusion in rangeland restoration in South Africa. The study shows that the involvement of marginalized groups, including females and indigenous communities, in participatory planning improves social justice and ecological resilience. Although challenges such as cultural norms and resource limitations still exist, social inclusion has been proven to strengthen governance structures and produce more sustainable restoration results. Adherent-based climate adaptation in Zimbabwe, (Eitzel et al., 2020) explored custom-based adaptation in agro-pastoral systems in Zimbabwe. The study uses a participatory agent-based model (ABM) to evaluate various definitions of sustainability, such as ideal farmland proportions and resource resilience. The participation of local communities in designing and testing these models generates locally relevant

insights and supports collective action for sustainable land-use planning. Community-Based Environmental Management (CBEM) in Ethiopia, Study by (Zikargae et al., 2023) observed community-based environmental programs in Ethiopia. The program successfully connects environmental sustainability with sustainable development through participatory communication among local communities, governments, and non-governmental organizations. Although communication strategies need to be improved, the results of the study show success in addressing climate challenges through the involvement of local communities. The key success factor that emerged was indigenous peoples' involvement, the success of the program largely depends on the extent to which indigenous peoples are actively involved in the evaluation and decision-making process. A study by (Eitzel et al., 2020) shows that the direct participation of indigenous communities creates locally relevant and practical models to apply. Multistakeholder collaboration, Involvement of government, private sector, and civil society organizations create synergies that support program sustainability, as demonstrated by the study by (Nyambo et al., 2024). Integration of local knowledge, Studies show that local knowledge is an important foundation in developing adaptive and sustainable solutions, such as in Zimbabwe and Ethiopia. Participatory evaluation processes in Africa show that this approach can create relevant, inclusive and sustainable programs. By involving indigenous peoples, governments, and other partners, this approach not only supports sustainable resource management but also empowers local communities to face environmental and social challenges independently.

Community sustainability in Eastern Siberia, A study conducted by (Krasnoshtanova, 2023) highlights the impact of industrial exploitation of natural resources on the sustainability of local communities in Eastern Siberia. Through semi-structured interviews and quantitative surveys, the study found that management involving indigenous peoples can reduce negative impacts on the environment and local culture. Community participation in development planning, including water and soil resources management, allows for the integration of local perspectives in development policy. As a result, sustainable development models can be applied without sacrificing cultural diversity and local ecosystems. Adherent-based biodiversity management in Sakha Republic, Russia, Research by (Ksenofontov & Petrov, 2024) shows how indigenous peoples in the Sakha Republic are using their traditional knowledge to confront global challenges such as climate change. This local knowledge is used in land and water management practices, thus being able to sustain traditional activities such as hunting and fishing. The study also emphasizes the importance of collaboration among local governments, indigenous communities, and scientists to create effective and custom-based adaptation strategies. Participatory Environmental Planning in Japan, A study by (Ohnuma et al., 2022) observed how a program of participatory measures involving a panel of citizens and

other stakeholders in Sapporo, Japan, successfully created a sustainable environmental master plan. The results show that community participation in scenario-based planning not only increases public acceptance but also ensures that policy outcomes reflect local needs. Evaluations by participants and non-participants revealed that procedural justice is a key element in the success of this program. Success factors that can be referred to are the Active Involvement of Indigenous Peoples, the participation of indigenous peoples in decision-making to create a sense of ownership of programs and policies. In a study in Sakha Republic, this approach has proven to be effective in maintaining local wisdom while facing global challenges. Multistakeholder Collaboration, the success of the program also depends on collaboration among the government, local communities, academia, and the private sector. Studies in Eastern Siberia show that cross-sector partnerships can lead to more holistic solutions. Integration of local knowledge with modern science, the study by (Ksenofontov & Petrov, 2024) highlights the importance of integrating local knowledge with modern scientific methods to create policies that are adaptive and relevant to local conditions. Participatory evaluation processes in Eastern world countries show that this approach can create inclusive, relevant, and sustainable programs. By involving indigenous peoples, governments, and other partners, this process not only ensures the sustainability of the program but also strengthens the relationship among people and the environment.

Case Study in Asia Pacific Countries, can be shown with sustainable livelihoods in West Nusa Tenggara and Papua New Guinea, Research by (Butler et al., 2020) observes a participatory approach in the development of system-based livelihood adaptation in West Nusa Tenggara, Indonesia, and Papua New Guinea. This process involves local communities in planning adaptation strategies through social learning approaches. Although these strategies have proven effective in improving sustainable fisheries management, the results show that socio-ecological diversity poses a major challenge in large-scale implementation. Therefore, successful adaptation requires mainstreaming social learning into the community decision-making cycle. Revitalization of customary values in Sabrang Village, Indonesia, (Utami et al., 2022) uses a participatory co-design approach based on customary values to support sustainability in Sabrang Village. The project includes the reintroduction of local agricultural traditions such as Pranatamangsa, which connects humans to the cycle of the seasons. As a result, this model not only strengthens cultural identity but also increases local economic resilience through product innovations such as branding design for local rice varieties. Environmental management in Japan, the (Ohnuma et al., 2022) shows how a gradual participatory program in Sapporo has succeeded in creating a sustainable environmental master plan. Involving a random panel of citizens and other stakeholders, the study found that procedural justice is a key element in ensuring public acceptance of environmental policies. Evaluations by

participants and non-participants showed that policy outcomes better reflected local needs thanks to this approach. Success Determinants in the form of Integration of Local Knowledge with Modern Policies, Indigenous knowledge plays an important role in creating locally relevant sustainability strategies. Studies in West Nusa Tenggara and Papua New Guinea show that collaboration among local communities and governments can address the challenges of climate change. Procedural Justice and Inclusivity, in a participatory evaluation in Japan, procedural justice was shown to increase public acceptance of environmental policy outcomes. This approach also allows input from various community groups. Strengthening local capacity, the co-design approach in Indonesia provides evidence that training and empowerment of local communities not only strengthens cultural resilience but also supports economic sustainability. The participatory evaluation process in Asia Pacific shows that this approach can produce more inclusive and sustainable programs. Through collaboration among indigenous peoples, governments, and other partners, program sustainability can be achieved by paying attention to social, ecological, and cultural aspects holistically.

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5.1. Opportunities for Transforming Local Wisdom into Global Innovation

Papua has various local wisdom that can be adapted into global innovations. Traditions such as sea sasi, customary land management systems, and traditional hunting methods reflect the ability of indigenous peoples to maintain a balance among the use and conservation of natural resources. This transformation of local wisdom is a great opportunity to create innovations that are not only locally relevant, but also contribute to the achievement of global sustainable development goals. In the Papua RPJPD 2025-2045 document, this strategy is prioritized to increase Papua's competitiveness in the national and international context (Bapperida Provinsi Papua, 2024). Sustainable management of customary forests refers to the use of natural resources by maintaining the sustainability of local ecosystems, cultures, and economies. According to the principles of sustainable development in the forestry sector, there is a synergy among ecological, social, and economic aspects (Doman & Doman, 2020). This is also supported by the concept of ecotourism that prioritizes nature conservation, local community empowerment, and educational experiences for visitors (Indrayani & Jumanah, 2023). The Community-Based Ecotourism (CBE) approach emphasizes that the active involvement of indigenous peoples in tourism management is the key to success that not only supports environmental conservation, but also strengthens local wisdom and community economy (A. Purnomo, 2020). Conservation and preservation of customary forests, customary forests can be used as the main attraction of ecotourism while maintaining the preservation of flora, fauna, and ecosystems. For illustration, the mangrove forest in Karangsang, Indramayu, is developed as an ecotourism center based on a sustainability approach and involves local communities as the main managers (Indrayani & Jumanah, 2023). Local community empowerment, Indigenous peoples' involvement in ecotourism is carried out through training, community organizing, and skill development. An illustration of implementation in the Kertalangu Cultural Village shows that the stages of community integration in ecotourism include identifying issues, planning, implementation, and evaluating the success of the program (Kameswara & Suhirman, 2017). The use of digital technologies such as social media and travel platforms can promote customary forests as unique destinations that bid

cultural and ecological experiences. In addition, collaboration with international travel agents can expand the reach of the global market (Umarputri & Rahardjo, 2020). Environmental education and education, customary forest-based ecotourism can also be used for environmental education programs that introduce visitors to the concept of sustainability and local wisdom. Activities such as interpretation tours and ecology workshops provide added value to the tourist experience (Baroroh, 2020). The integration of sustainable customary forest management techniques with the concept of modern ecotourism is a strategic approach to attract the attention of the international market. Implementations involving conservation, local community empowerment, digital promotion, and environmental education can yield significant ecological, social, and economic benefits. Along with this, it is important to continuously evaluate and adjust strategies to align with market needs and environmental sustainability.

Customary forests have great potential as the main attraction of ecotourism due to their high ecological value and the existence of distinctive flora and fauna. In addition, the local wisdom that exists in the community around the customary forest provides its own uniqueness that can attract tourists, both domestic and international. To ensure sustainable management, practical and technical models are needed that not only preserve the environment, but also empower local communities. Conservation and zoning of the area, a practical model in the form of the apply zoning of customary forest areas. According to research by (Wahyuni et al., 2023), ecotourism zoning can be divided into three main areas, core zones, buffer zones, and limited use zones. Core zone: This area is intended for conservation and research only, with very limited access for tourists. Buffer zone: In this zone, educational tourism activities such as animal and flora observation are carried out with special guidance. Limited use zone: This area can be used for activities such as trekking, homestays, and local cultural attractions. Technologies such as Geographic Information Systems (GIS) can help monitor environmental changes in each zone. The involvement of indigenous peoples in ecotourism management is the main key to the success of this model. (Senoaji et al., 2020) emphasized the importance of education based on local wisdom to strengthen the role of the community in ecotourism. The community can be trained to become tour guides, homestay managers, and handicraft business actors. The training also includes financial management, foreign languages, and digital promotion skills. The community cooperative model can be used to manage income fairly and ensure the economic sustainability of local communities. Environmentally friendly infrastructure, the development of tourist infrastructure such as trekking trails, observation towers, and tourist information centers needs to be designed with environmentally friendly principles. Research by (Firmansyah et al., 2021) shows that the use of local materials and renewable energy can reduce the carbon footprint of ecotourism activities. Trekking trails can be made from natural materials such as

wood or stone, so that they blend in with the surrounding environment. An integrated waste management system, including composting and recycling, can be implemented to maintain the cleanliness of tourist areas. International Marketing Strategy, to attract the attention of the international market, the promotion of customary forest ecotourism must use digital technology. (Alfiana, 2021) suggests the use of social media and online travel platforms to promote destinations globally. Creating an interactive website that showcases the natural beauty of customary forests, tourist activities, and stories of local people can attract tourists. Collaborate with international travel agencies to promote exclusive tour packages focused on authentic experiences. Monitoring and evaluation, the implementation of a continuous monitoring system is very important to measure the impact of tourism activities on the environment and society. Technologies such as drones and data-driven applications can be used to monitor the condition of ecosystems in real-time. (Budiaman & Audia, 2022) found that intensive monitoring helps prevent ecosystem damage due to excessive tourism activities. The use of customary forests as the main attraction of ecotourism requires a holistic approach that integrates conservation, community empowerment, development of environmentally friendly infrastructure, digital promotion, and continuous monitoring. With this model, the ecotourism potential of customary forests can be optimized to provide ecological, social, and economic benefits without sacrificing environmental sustainability.

Customary forests in Europe have great potential to be conserved through the effective implementation of regional zoning. Zoning systems not only ensure the preservation of ecosystems and biodiversity but also maximize social, economic, and ecological benefits. Studies on forest zoning in Europe provide insights into how this management can be applied sustainably. The concept and implementation of forest zoning in Europe, according to (Sabatini et al., 2020), zoning in primary forests in Europe is carried out with the aim of ensuring ecosystem sustainability and providing key ecosystem services such as biodiversity protection, climate change mitigation, and water regulation. Zoning is carried out through, core zone areas are focused on strict conservation without significant human activity, ensuring safe habitats for endangered species. Buffer zone, this area allows for limited activities such as conservation research and management. Sustainable use zone, this area allows the use of natural resources such as timber and non-timber products with strict supervision. In addition, (Nichiforel et al., 2020) noted that land ownership rights in Europe affect the implementation of zoning. Countries with strict regulations such as Scandinavia tend to prioritize the protection of primary forests through zoning systems that are integrated with national policies. In the Scandinavian region, forest zoning is applied to protect endemic species while utilizing ecosystem services. (Gustafsson et al., 2020) noted that the conservation forestry approach or maintaining certain groups of trees after felling is one of the effective methods in this

region. This model improves sustainability by drastically reducing habitat disturbance. Benefits of zoning in Europe, Biodiversity, Zoning helps maintain biodiversity through the protection of critical habitats. Forests in Northern Europe, for illustration, show an increase in the presence of rare species within the core zone (Burner et al., 2022). Climate change mitigation, according to (Palmero-Iniesta et al., 2021), zoning also contributes to carbon sequestration by protecting forest areas from excessive human activity. Sustainable Economic Resources, Management of use zones in Central Europe has shown that timber products can be produced sustainably without sacrificing the ecological function of forests (Gregor et al., 2024). The forest zoning model in Europe provides a framework that can be adapted in various global contexts, including in Indonesia. Forest zoning not only protects the environment but also supports sustainable economic development. Strong implementation requires coordination among national policies, local communities, and international actors to ensure holistic sustainability.

Customary forests in Japan have long been an important part of the country's cultural and ecological landscape. With the challenges of modernization and socio-economic changes, the concept of zoning forest areas has become a strategic tool to maintain a balance among ecosystem conservation and resource use. Recent studies show that the zoning approach provides benefits in biodiversity conservation, resource management, and the well-being of local communities. Forest zoning for sustainable management, one of the important studies on zoning in Japan was conducted by (Miyamoto et al., 2021), which evaluated the relationship among core zones, buffer zones, and the distribution of timber resources in national parks on the island of Okinawa. The results show that forests with high timber volumes located in the buffer zone play an important role in preventing the ecological isolation of the core zone. This study highlights the importance of considering ecological connectivity in zoning planning. A similar approach is applied to the cultural landscape of "Satoyama," where zoning is used to manage secondary forests, farmland, and settlements. (Hiratsuka et al., 2020) noted that although land-use change has reduced the structural diversity of Satoyama's landscape, adaptive zoning can help maintain its ecosystem and ecosystem services. The Impact of Zoning on Biodiversity and Ecosystem Services, Zoning has also proven to be effective in preserving biodiversity. (Nagaike, 2020) compared forest management plans at the regional and national levels in Japan, finding that regional plans tend to focus more on the conservation of specific forests, while national plans incorporate broader biodiversity considerations. This indicates the need for a more integrated top-down approach to accommodate biogeographic variations across Japan. In addition, (Piras et al., 2022) evaluated the role of small forests, or "igune," found in the cultural landscape of the Osaki Kodo. Despite its small size, the "igune" provides a wide range of ecosystem services such as wildlife habitat, fuel, and protection from cold winds. This study

shows the importance of preserving these small units through zoning to maintain their ecological function. Major challenges in zoning implementation in Japan include a lack of awareness among landowners about their own forest boundaries. (Kajima et al., 2020) found that factors such as age, gender, and involvement in landowner cooperatives affect owners' awareness of their land boundaries. To overcome this, education and incentives are needed for land owners to be more involved in forest management. In addition, government policies that encourage zoning need to be adjusted to local needs. (Ota, 2023) suggests that greater financial support and the integration of multi-level government can help improve the effectiveness of forest zoning in Japan. Zoning of customary forest areas in Japan provides an effective framework for achieving a balance among conservation and resource use. With strong policy support and local community involvement, this approach can be scaled to a larger scale to support environmental sustainability and social well-being.

Brazil, home to the Amazon which is the largest tropical rainforest in the world, faces major challenges in protecting indigenous forest areas. Zoning forest areas is one of the approaches adopted to ensure ecological sustainability while supporting social and economic development. Recent scientific articles provide important insights into how zoning can be effectively implemented in Brazil. Zoning and conservation in the Amazon customary forest, according to the research of (Silva Junior et al., 2020), ecological-economic zoning has been implemented in the state of Maranhão to manage the remaining forest areas. However, this zoning is faced with major challenges such as unlawful deforestation and forest fragmentation. This research suggests the need for new policies to protect primary forests and secondary vegetation that have great potential in ecosystem restoration. In addition, (Pinillos et al., 2021) noted that the participation of local landowners in the zoning of forest areas through "Legal Reserves" can improve forest conservation while supporting sustainable agricultural intensification. This research highlights the importance of a community-based approach to integrating conservation and productive land use. Potential for Forest Restoration and Resource Management, Research by (Heinrich et al., 2021) emphasizes that secondary forests in the Amazon have great potential as carbon sinks for climate change mitigation. These forests can absorb carbon up to 20 times faster than primary forests, making them a key element in zoning that supports conservation and sustainable resource management. On the other hand, (Balée et al., 2020) show that traditional practices of indigenous peoples, such as those applied in the Iriri River region, support biodiversity conservation through local forest management. This study recommends the integration of local knowledge into zoning policies to maximize ecological and social benefits. Strategy to Optimize Zoning, Brazil has a strong legal framework through the "Forest Code" which requires landowners to maintain "Legal Reserves" on their land. (Brock et al., 2021) noted that the full implementation of this law can have a significant positive impact on biodiversity

conservation if carried out in conjunction with habitat restoration measures. Furthermore, (Stabile et al., 2022) propose a market-based compensation mechanism to encourage farmers to keep their forests intact. Programs such as "CONSERV" bid practical solutions to reduce legal deforestation by providing financial incentives to landowners. Zoning of indigenous forest areas in Brazil is an important strategy to manage the challenges of deforestation and promote conservation. By integrating community-based approaches, local knowledge, and market-based policies, zoning can support environmental sustainability and social well-being. Effective implementation requires government commitment, collaboration with local communities, and support from the international community.

Zoning of indigenous forest areas in Africa plays an important role in protecting biodiversity, mitigating climate change, and supporting local livelihoods. This approach includes community-based forest management, conservation, and land use planning. Recent scientific articles provide in-depth insights into how zoning is applied in different African countries. The concept and implementation of zoning, research by (Grantham et al., 2020) shows that forests in Central Africa, such as those in the Democratic Republic of the Congo, have high biodiversity and require a zoning approach that considers the richness of biodiversity and the integrity of forests. This multi-impartial approach combines conservation priorities with economic benefits through REDD+ initiatives and the expand protected areas. In South Africa, (Sinthumule & Mashau, 2020) found that local wisdom and traditional ecological practices such as rituals and taboos play an important role in protecting sacred forests. Zoning in this context focuses on preserving areas that are considered sacred by local communities to avoid deforestation and habitat degradation. The impact of zoning on biodiversity and sustainability, research by (Zhao et al., 2021) shows that zoning can reduce the effects of forest fragmentation caused by fires and human activities. Fires often increase deforestation rates at forest edges, but zoning with tight protection can help mitigate these impacts. In addition, (Wingate et al., 2022) highlight the importance of protecting small forest fragments in West Africa to ensure the sustainability of ecosystem services. These fragments, although small, make a major contribution to carbon sequestration and the preservation of rare species. One of the main challenges in the implementation of zoning is the pressure from agricultural expansion and urbanization. (Nackoney et al., 2022) found that a combination of agricultural interventions and participatory zoning in the Democratic Republic of the Congo resulted in an increase in crop yields of up to 60%, but also triggered deforestation in the buffer zone. To address these challenges, (Charnley et al., 2022) recommend increasing the technical and financial capacity of local communities, as well as strengthening national policies that support community-based forest management. Forest certification such as Forest Stewardship Council (FSC) can also increase economic incentives for sustainable management. Zoning of

indigenous forest areas in Africa is an effective strategy to conserve ecosystems, support local economic sustainability, and protect ecosystem services. Successful implementation requires integration among community-based approaches, national policies, and international support. With careful planning, zoning can be a key tool in addressing deforestation and forest degradation in Africa.

The implementation of zoning of customary forest areas in the United States is one of the important strategies to ensure the sustainability of forest management. This approach combines biodiversity conservation, resource management, and socio-economic use of indigenous peoples. Recent studies provide insight into how this zoning is being applied to answer the challenges of modern forest management. Zoning and multifunctional management, one of the zoning models that has been successfully implemented is multifunctional management in family forests in the southern region of the United States. (Resch et al., 2023) showed that functional zoning based on location indices can support competing goals, such as timber production and wildlife habitat conservation. The study found that zoning increases the economic value of the land without sacrificing conservation goals. In addition, (Wells et al., 2020) highlight the importance of zoning to protect the intact North American boreal forests. The region includes large areas of Canada and Alaska, most of which are under the management of indigenous peoples. Zoning in this area includes the management of large conservation areas and indigenous people-based resource management, ensuring that biodiversity is maintained. The impact of zoning on biodiversity, zoning has also been proven to improve ecosystem services in threatened areas. (Betts et al., 2021) proposed a Triad model that divides the landscape into three zones, conservation, ecological management, and forest plant intensification. This model shows that proper zoning can reduce negative impacts on biodiversity while meeting global timber demand. In Latin America, (Soler et al., 2021) noted that zoning that integrates indigenous management practices with modern policies can improve conservation effectiveness. The study found that the participation of local communities in zoning promotes ecosystem sustainability and reduces deforestation. Although the benefits of zoning are enormous, its application in America faces various challenges. (Basso et al., 2020) found that the main obstacle in implementation is the difficult adhering to strict environmental standards, such as those set by the FSC certification system. However, endeavors to increase management capacity and improve forest management practices have helped to overcome these obstacles. In addition, (Wells et al., 2020) recommended increased funding for indigenous peoples' conservation activities and the development of a co-management model involving the government and local communities. This strategy allows zoning to be more inclusive and sustainable. Zoning of indigenous forest areas in the Americas offers a strategic approach to integrating biodiversity conservation, sustainable resource management, and the empowerment of local communities.

With proper planning and policy support, zoning can be a key tool in ensuring the sustainability of forests across America.

Zoning of customary forest areas in Australia is an important approach to managing forests sustainably by taking into account social, economic, and ecological aspects. Research shows that the integration among custom-based management and scientific approaches can yield significant benefits for biodiversity and livelihoods of local communities. Zoning and forest management, (Jackson et al., 2021) emphasized the need for more collaborative forest management, including integration among governments and indigenous peoples. This approach includes zoning forest areas that combine traditional knowledge with modern science to build forest ecosystem resilience in Australia. A customary-based approach is also emphasized in forest management in northern Australia. (Meadows et al., 2020) noted that zoning can be used to identify the commercial potential of customary forests, including community-based forestry in the Arnhem Land and Cape York regions. This zoning supports conservation while developing local economic capacity through training and technical support. The impact of zoning on ecosystems, (Sangha et al., 2024) highlighted the importance of ecosystem restoration as part of forest zoning in Australia. Many forest areas that were previously used for the forestry industry now require active intervene restore their ecosystems. This restoration aims to support the goals of the global biodiversity framework. On the other hand, (Lindenmayer et al., 2023) stated that changes in forest management policies are needed to overcome the negative impacts of logging and forest degradation. Zoning that focuses on stopping logging in natural forests such as the Mountain Ash Forest in Victoria is a solution to reduce ecosystem damage and increase carbon storage capacity. The main challenge in the implementation of zoning is the mismatch among national policies and local needs. According to (Kanowski & Edwards, 2021), it is important to align policies with local conditions through a multi-level governance approach. This includes collaboration among governments, indigenous peoples, and the private sector. In addition, (Meadows et al., 2020) recommend community-based training programs such as "Forest Ranger Training" to build the capacity of local communities in forest management. This approach has proven effective in improving technical skills and strengthening the economy of indigenous peoples in forest areas. The zoning of customary forest areas in Australia shows how the integration of traditional and scientific knowledge can lead to sustainable management solutions. With careful planning and inclusive policy support, zoning can contribute to environmental conservation while supporting the livelihoods of local communities.

South Korea is known for its significant forest conservation endeavors, especially in the face of environmental challenges and urbanization. A study by (Lim, 2024) highlights the importance of ecological networks in the Demilitarized Zone (DMZ) to improve ecosystem connectivity. The study identified a previously

unregistered potential conservation area of 564.33 km², which contributes to the habitat management of endangered species. This approach uses spatial analysis to develop a 452.36 km long ecological network, which strengthens ecological sustainability in this politically sensitive region. In addition, (Kim et al., 2020) emphasized the importance of forest management based on South Korea's contribution to the international regime. The study shows that South Korea is rapidly adopting new policies in response to international issues, such as sustainable forest management and biodiversity. This contribution not only supports national goals but also stimulates the participation of other countries through incentives to address global issues. In the context of forest restoration, research by (Oh et al., 2020) compares forest restoration policies in South Korea and North Korea. The study identifies four main success factors in South Korea, policy and system improvement, evaluation and capacity building, community participation, and the creation of restoration foundations. These factors play a crucial role in the success of reforestation projects in the country. South Korea also stands out in community-based forest management. (E. P. Purnomo et al., 2020) discussed the comparison of community-based forest management among South Korea and Indonesia, highlighting the differences in local institutions. The study suggests that learning from South Korea's success can help other countries in achieving sustainable community-based forest management. South Korea has developed innovative strategies for zoning and management of customary forest areas through an ecology-based approach, international collaboration, and community participation. These measures not only strengthen biodiversity but also increase local and global awareness of the importance of forest conservation.

Zoning of customary forest areas in Germany plays an important role in preserving biodiversity, meeting the needs of communities, and supporting climate change mitigation. The apply the zoning concept in Germany involves a variety of approaches, ranging from multifunctional management to ecosystem protection through science-based policies. Zoning and multifunction of forests, research by (Simons et al., 2021) shows that forests in Germany are managed with a multifunctional approach that considers various ecosystem services, such as carbon storage, recreation, and habitat protection. Through a national data-based zoning model, different types of forests can be managed differently to achieve a balance among economic productivity and environmental protection. A similar approach is seen in Bavarian Forest management, where zoning is used to create a balance among timber use and environmental protection. Research by (Lutze, 2021) underscores the importance of forest management service contracts involving local forest owners' associations to strengthen sustainable smallholder forest governance. Climate change risk management and adaptation, Germany faces significant climate change challenges, including drought and insect infestation. (Friedrich et al., 2021)

used a simulation approach to integrate climate uncertainty into forest zoning. This study shows that adaptation of tree species composition through zoning can increase forest resilience while reducing the risk of economic casualty. In addition, (Mann et al., 2023) highlight the importance of reducing forest fragmentation to improve ecosystem resilience to extreme heat. This study identified that less fragmented forest areas have higher vitality and can serve as an effective climate buffer. The impact of zoning on biodiversity, research by (Brackhane et al., 2021) shows that zoning that integrates natural disturbances such as forest fires and floods can restore threatened habitats. This study recommends site-specific management that combines spatial data to identify conservation priority areas. To improve the effectiveness of zoning, (Elsasser et al., 2021) developed the concept of spatial valuation of forest ecosystem services, including the value of recreation, conservation, and landscape management. This study provides guidance for policymakers to integrate these values into land use planning. On the other hand, (Holzwarth et al., 2023) highlight the importance of using remote sensing technology to monitor forest conditions in real-time. This data helps inform evidence-based zoning policies to improve ecosystem resilience. Zoning forest areas in Germany offers a strategic approach to integrating biodiversity conservation, climate change adaptation, and community-based management. With the support of evidence-based policies and modern technology, zoning can be a key tool in ensuring environmental sustainability and community well-being.

China has adopted a variety of zoning approaches to customary forest management that combine the principles of ecology, community needs, and conservation. One prime illustration is zoning in Giant Panda National Park in Sichuan Province. Research by (Y. Wang et al., 2021) shows that the core zone in the park covers about 80% of the panda's habitat, including perfectly suitable habitats and important corridors for species movement. However, major challenges remain, especially in eliminating human interference in the core zone. In addition, the study in Qianjiangyuan National Park highlights the need for ecological sensitivity evaluation to determine optimal functional zoning. The zoning in this park includes areas of strict protection, ecological conservation, traditional use, and recreation. This approach ensures the integrity of natural ecosystems while meeting the needs of local communities (Liu & Yu, 2020). In the Hubei region, research on the quality of forest land in Hefeng County shows that the quality of forest land in this area is greatly influenced by climate, topography, and socio-economic conditions. The study divides protected zones into key, active, and general protected zones, each reflecting the quality of the land and its management needs (L. Wang et al., 2021). In addition, ecosystem zoning policies in China have focused on protecting key ecosystem services, such as carbon sequestration and water production. Studies in the Lake Poyang area show that zones with high ecosystem importance cover more than 26%

of the total area. These zones are designed to support the conservation of complex aquatic and terrestrial ecosystems (Xu et al., 2021). The zoning approach in China reflects integrative endeavors to manage customary forests in a sustainable manner. This strategy not only increases biodiversity conservation, but also supports the socio-economic needs of the surrounding community. Further implementation is needed to ensure the effectiveness of zoning in addressing climate change and human pressure on forest ecosystems.

Zoning of customary forest areas has become an important strategy in conserving biodiversity, supporting sustainable natural resource management, and meeting the needs of local communities. Each country has its own unique approach, but there are general lessons to be learned from these practices. In South Korea, the zoning of customary forests is regulated through a strong community-based approach. A study by (E. P. Purnomo et al., 2020) shows that the success of community-based forest management (CBFM) lies in the development of strong local institutions. Local community participation and inclusive government policies are the keys to this success. China has adopted ecology-based zoning within its national parks, such as the one implemented in the Giant Panda National Park. A study by (Y. Wang et al., 2021) found that the park's core zoning covers 80% of the panda's critical habitat, although major challenges remain in reducing human disturbance. In Japan, zoning is used to integrate conservation and resource use. A study by (Miyamoto et al., 2021) demonstrates the importance of buffer zones rich in timber volume to prevent isolation of the core zone, which facilitates ecosystem connectivity among the conservation area and the surrounding area. Germany applies a multifunctional approach to forest management, which combines ecosystem protection, forest product use, and community needs. This approach highlights the importance of adaptive management to face the challenges of climate and social change (Benz et al., 2020). In the United States, zoning of forest areas is more focused on forest fire risk mitigation and biodiversity protection. Analysis of fire zoning in high-risk areas has shown the effectiveness of spatial-based prevention strategies (Quan et al., 2022). In Australia, zoning is based on land use based on ecological capacity and economic needs. Big data-based management has been implemented to maximize land productivity by considering sustainability (Fragkos et al., 2021). Brazil uses productivity zoning for plantation forest management, such as Eucalyptus. A machine learning-based approach allows for more effective zoning management, increasing yields without expanding land (Alvares et al., 2023). The practice of zoning customary forest areas in various countries provides important insights into the importance of integration among conservation and human needs. Key lessons include the importance of local participation, data-driven management, and adaptive approaches to address ecological and social challenges. These strategies can be

adapted to improve the effectiveness of customary forest management in other countries.

Table 5.1. Indicators, Parameters, and Elements of CBE

Indicator	Parameter	Element
Milieu	Ecological sustainability	Habitat conservation, waste management, and sustainability of natural resources.
	Balance of biodiversity	Protection of endemic flora and fauna, minimizing the environmental impact of tourism activities.
	Carrying capacity management	Environmental capacity assessment to support tourism activities.
Social	Local community participation	Community involvement in the planning, implementation, and evaluation of ecotourism programs.
	Improved quality of life	More income, access to education, and health services through ecotourism.
	Cultural preservation	Promotion of local traditions, customs, and culture in tourism activities.
Economics	Financial sustainability	Fair distribution of profits, local product development, and long-term income.
	Diversification of the local economy	Increase in small businesses, local crafts, and tourism services.
	Partnerships and market access	Collaboration with external parties, marketing of local products and services.
Institutional	Institutional capacity	Training and skills development for local communities.
	Policy framework	Regulations that support ecotourism and shared resource management.
	Transparency and accountability	An open monitoring and reporting mechanism.

Source: Author's Summary, 2024

The Community-Based Ecotourism (CBET) approach involves local communities in sustainable tourism management, with a focus on environmental conservation and socio-economic benefits (table 5.1). Environmental aspects are at the core of CBE. Habitat conservation and biodiversity protection ensure ecological sustainability. Carrying capacity management is also important to avoid overexploitation of the environment. This indicator confirms that tourism activities must pay attention to ecological balance. Community participation is key to the success of CBET. Active involvement in the planning and implementation of programs not only improves the quality of life of the community, but also ensures that tourism activities are in line with local values and traditions. Financial sustainability is an important indicator in ensuring long-term benefits. Fair distribution of profits and economic diversification create local economic stability, while partnerships with external parties help expand market access and increase income. Strong institutional capacity provides the foundation for the success of ecotourism. Training, policy development, and transparency in management are important elements to create a

sustainable ecotourism ecosystem. The CBET approach offers a holistic framework that integrates environmental, social, economic, and institutional dimensions. This table provides general guidance for managers and stakeholders to design and implement sustainable ecotourism with maximum benefits for local communities and the environment.

5.2. Tradition-Based product development and Creativity

The creativity of the Papuan people, such as carving, weaving, and traditional music, is a cultural asset that can be developed into high-value economic products. The development of this tradition-based product not only preserves cultural heritage but also creates new economic opportunities. In Japan, this approach has evolved to become an integral part of product development that puts traditional values first, aligned with modern principles of innovation and efficiency. This is relevant in the context of preserving traditions that are aligned with the needs of the global market. Apply Value Engineering in Japan with the NJ-GMM Model in Japanese Global Manufacturing. Japan has developed the "New Japan Global Manufacturing Model" (NJ-GMM), which is supported by the concept of Value Engineering to improve global manufacturing strategies. This model integrates various approaches such as the "Intellectual Working Value Improvement Management Model" (IWV-IMM) which improves work value and the "Strategic Quality Management" (SQM-PMM) which combines performance measurement with quality strategy. The apply this model has proven effective in the Japanese automotive industry, such as Toyota, which shows improved efficiency and quality through strategic value management (Amasaka, 2020). Integration of Value Engineering (VE) with Traditional Methods, recent research shows the integration of Value Engineering with traditional Japanese methods such as Kansei Engineering, which aims to understand the psychological needs of consumers and translate them into product design. For illustration, the development of sago-based products such as analog rice is processed using VE to ensure optimal function and quality, while maintaining traditional taste and aesthetics (Septiani et al., 2023). Japan is also developing an integrated approach that combines VE with Quality Function Deployment (QFD) and Design for Assembly (DFA). This approach is used to improve product performance based on customer needs, without sacrificing cost efficiency. Research shows that this integration not only lowers costs, but also speeds up product development time without compromising its quality (Handa Rivaldi Husal et al., 2024). Relevance to tradition preservation, In Japan, the apply VE is often aligned with endeavors to preserve cultural heritage. A vivid illustration is how VE is applied in the design of traditional products such as local crafts, which are redesigned to meet global standards but still retain authentic cultural elements. VE also helps to optimize production costs, so that traditional products can be more competitive in the international market. The apply VE in Japan shows how this

method can increase the value of products while maintaining a balance among modern efficiency and preserving tradition. This approach not only helps to increase the competitiveness of products in the global market, but also supports the sustainability of cultural heritage. In this case, VE becomes a strategic tool for innovation that still respects traditional roots.

Meanwhile, in Africa, with its cultural diversity and natural resources, it has great potential to develop tradition-based products through Model VE. This approach allows for the optimization of the value of traditional products while maintaining the essence of local culture while improving efficiency and competitiveness in the global market. The adoption of VE in Africa is evolving in tandem with the need to improve the efficiency of the manufacturing industry and optimize available resources. In this context, VE has been adopted to develop tradition-based products with a value- and sustainability-oriented approach. For illustration, the development of a VE model for state-owned enterprises in South Africa demonstrates the importance of management support and organizational culture supporting VE for successful implementation (Kilian et al., 2024). Traditional Product Development with VE Approach, identify traditional elements: traditional products such as local vegetables in Africa have been identified as essential elements to increase their value. This process includes an in-depth analysis of traditional techniques that can be modernized to improve product quality and safety (Mazike et al., 2023). Innovative design and technology, VE is applied to integrate modern technology into traditional production. For illustration, advanced processing technology is used to produce products with high added value while still retaining the unique taste and characteristics. Increased Production Efficiency: VE helps reduce production costs by replacing expensive materials with more economic alternatives without compromising on quality. In road infrastructure projects in Ghana, VE is used to improve project sustainability with more effective cost management (Danku & Antwi, 2020).

VE Model on Infrastructure Projects, In Ghana, VE is used in highway projects to improve sustainability and construction efficiency. This approach involves analyzing the project's functions to reduce costs without compromising quality. Studies show that the implementation of VE can increase confidence levels in contract compliance, construction delivery effectiveness, and project sustainability (Danku & Antwi, 2020). VE in the cement industry, In the cement industry, VE is applied to create value by integrating systems thinking models. Research shows that the implementation of VE can strengthen the relationship among engineering service providers and cement manufacturers, improve operational efficiency, and optimize resources. This shows how VE can support traditional sectors that rely heavily on infrastructure (Meyer & Pretorius, 2021). VE for traditional product development, the apply VE also includes the development of traditional products by taking into account

the needs of the local community. Studies show that products designed based on VE principles can be better suited to the local environment and terminate-user needs. This advises product efficiency and relevance, so that it can support the preservation of local traditions (Eneh et al., 2022). VE in education and industrial transformation, in the context of engineering education and industrial transformation in Africa, VE is applied to improve the quality of training and skill development. This approach emphasizes curriculum redesign and investment in human resources to support cultural sustainability and technological innovation (Ongbali et al., 2024).

Culture-based marketing, a marketing strategy that emphasizes the cultural story behind a product is used to attract global consumers. This not only increases demand but also provides economic benefits for local communities. The implementation of VE in Africa has had a positive impact on various sectors. For illustration, the adoption of VE in the development of tradition-based food products has improved food security and nutritional value, while creating new economic opportunities for local farmers (Mazike et al., 2023). In addition, VE has helped transform traditional production processes into more efficient and sustainable. The use of advanced technologies allows for improved product quality, as seen in solar thermal projects in Africa, which optimizes local resources for more efficient energy solutions (Kanyarusoke, 2020). The VE model in Africa shows that tradition and innovation can be combined to create products that are relevant in international markets. With this approach, Africa is not only preserving its cultural heritage but also creating sustainable economic opportunities through the development of tradition-based products.

Furthermore, South Korea, known for its innovative approach in technology and manufacturing, has integrated VE in product development to improve efficiency and value. VE is a strategic tool to manage cost and quality, especially in the context of preserving local traditions combined with the needs of the global market. This approach is relevant in accommodating technological transformation while preserving Korea's cultural heritage. The Apply Value Engineering in Tradition-Based product development in the form of VE Integration with Technological Innovation, South Korea has used VE as part of its smart manufacturing strategy, where digital technologies such as the Internet of Things (IoT) and artificial intelligence (AI) are applied to improve production efficiency. This application includes the process of product planning to distribution, which allows traditional companies to adapt to the needs of the modern market while retaining their cultural elements (Lee & Cho, 2022). Research shows that investment in research and development (R&D) as well as industrial design contributes significantly to the export of tradition-based products in Korea. R&D allows companies to adapt products to global demand without losing their traditional values. For illustration, food companies in Korea use VE to develop traditional products that are environmentally friendly and in line with global health

trends (Al-Shawaf & Yasmin, 2021). Furthermore, Collaboration in product development, In the food sector, the use of collaboration networks among governments, companies, and universities has enabled the development of tradition-based products with high added value. VE is used to identify the main functions of traditional products such as kimchi, so that it can be optimized in production costs without compromising quality and cultural identity (Jeong & Shin, 2020). Applying VE to Traditional Products Based on Green Technology, South Korea has also developed VE that supports environmental sustainability through the "Korean New Deal" project. The project integrates traditional values with green technology, such as the use of environmentally friendly materials for traditional products. This allows for a reduction in environmental impact without sacrificing the cultural value of the product (Intaratat, 2021). The apply Value Engineering in South Korea shows that VE can be an effective tool to integrate modern innovation with the preservation of tradition. Through inter-agency collaboration, investment in R&D, and the use of green technology, products based on Korean traditions can compete globally while maintaining their cultural identity. This approach not only improves efficiency and competitiveness but also supports cultural sustainability in the modern economy.

The VE approach has proven to be an effective method in optimizing product design and development. In the Netherlands, the apply VE has received special attention, especially in the development of tradition-based products that balance cultural values with economic efficiency. This article will discuss the practice of VE in the Netherlands, its relation to tradition-based products, and its implications for innovation and sustainability. VE is a systematic method that aims to increase product value by reducing costs without sacrificing quality or function. In the Netherlands, VE is used extensively in product design and manufacturing processes to ensure that the products developed are not only economically competitive but also retain inherent traditional values. According to (Ongbali et al., 2024), the implementation of VE at the initial design stage allows for savings of up to 70-80% of the total cost of the product, making it a strategic tool in efficient product development. Tradition-based products in the Netherlands, such as handicrafts, classic furniture, and traditional textiles, face challenges in maintaining relevance in the modern market. VE helps manufacturers integrate modern technology with traditional elements through a collaborative design process. (Murukina et al., 2020) state that the implementation of VE involves customer participation at every stage of product development, which allows for a balance among traditional values and modern market needs. An illustration is the development of Delft Blue crafts which are now produced with the VE approach. Manufacturers use modern manufacturing techniques to keep production costs down while maintaining their traditional aesthetics. (Prilutskaya et al., 2021) emphasized that the flexibility in design provided by VE allows for a rapid response to changing consumer preferences without compromising the traditional identity of the product.

Sustainability is a key focus in product development in the Netherlands. For illustration, the traditional furniture industry in the Netherlands is adopting the VE approach to recycle old materials into new products with modern designs. (Sigüenza-Andrés et al., 2024) highlight that this model not only reduces waste but also provides added value for consumers who value sustainability. In the Netherlands, the successful implementation of VE in tradition-based product development is highly dependent on collaboration among stakeholders. (Schutselaars et al., 2023) developed a tool to link a corporation's value proposition to the Sustainable Development Goals (SDGs), which allows the integration of cultural values in product innovation. This approach also creates new opportunities for traditional artisans to enter the global market through product innovation that is based on local identity but has universal appeal. This is supported by research that shows that products designed with traditional and modern aspects in mind have higher competitiveness in the international market. The apply VE in the Netherlands has shown how tradition and innovation can go hand in hand. With a systematic approach, VE enables the development of tradition-based products that are not only culturally relevant but also competitive in the global market. This practice provides important lessons for other countries that want to preserve traditions while embracing technological advancements. Going forward, the integration of VE with a sustainable business model will continue to be key in creating innovative, efficient, and value-based products. China, as one of the countries with a rich cultural heritage, has leveraged VE in the development of tradition-based products to increase competitiveness in the global market. VE is used to optimize the value of traditional products without sacrificing quality or cultural value. This approach reflects the integration of modern technological innovation with the preservation of relevant traditions in the era of globalization. Apply Value Engineering in Traditional Product Development, Value Optimization in the manufacturing industry, Research shows that technological innovation supported by VE can improve the quality of Chinese export products and help the manufacturing industry move up the global value chain. By integrating VE, the manufacturing industry in China can reduce production costs and improve efficiency without sacrificing the aesthetic value or traditional function of their products (Gaol, 2023). Tradition-Based product development through sustainable design, in the central China region, design practices for sustainability are used to support the preservation of local traditions such as handicrafts. VE is applied in the traditional product design process to create innovative solutions that maintain cultural values while meeting the needs of the modern market. In addition, VE is also used in branding and marketing to increase the attractiveness of traditional products in the global market (W. Zhang, 2021). Integration of digital technology in VE, Digital transformation plays an important role in improving the efficiency of traditional product development in China. By using digital technology, VE can be applied to

reduce costs and increase innovation capacity, thus allowing traditional Chinese products to better compete in the international market. Digitalization also facilitates the collaboration process among stakeholders in the development of tradition-based products (Ze Liang, 2024). Apply VE in green supply chain ecosystem, VE-based ecodesign practices in China have become an important part of green supply chain management. This approach emphasizes the use of environmentally friendly materials and sustainable production processes that are in line with the philosophy of Chinese culture. This allows traditional products to remain relevant in global sustainability trends (Li & Sarkis, 2022). The apply VE in China shows great potential in supporting tradition-based product development. By combining technological innovation, sustainable design, and digitalization, China has succeeded in increasing the competitiveness of its traditional products in the global market without losing its inherent cultural values. This approach not only provides economic benefits, but also supports cultural preservation and sustainability.

Then the apply VE in the UK has a significant role in product development, especially in maintaining a balance among cost efficiency and traditional cultural values. This article discusses how VE is integrated in tradition-based product development in the UK, its economic implications, and the relevance of sustainability in the modern context. The Concept of VE in Traditional Products, VE is a systematic method that aims to increase the value of a product by lowering its cost without compromising its quality or function. In the UK, VE has become a major tool in a variety of sectors, including tradition-based products such as textiles and handicrafts. Based on the research of (Ongbali et al., 2024), the implementation of VE at the initial design stage allows for cost savings of up to 70% of the total cost of the product, which provides a great opportunity to maintain traditional value while improving economic efficiency. In the traditional British textile sector, for illustration, VE is used to integrate modern production techniques such as automation and robotics. (Prilutskaya et al., 2021) state that the flexibility in design provided by VE allows manufacturers to respond quickly to changing consumer preferences without sacrificing traditional aesthetic values. VE Practice in Tradition-Based product development, Tradition-based product development in the UK often involves collaboration among designers, manufacturers, and consumers. According to (Murukina et al., 2020), VE's approach to traditional product development not only focuses on cost efficiency, but also ensures customer involvement in the design process, which helps maintain the cultural relevance of the product. For illustration, traditional silversmiths in the UK are using VE to develop new collections that blend traditional motifs with sustainable manufacturing techniques. The use of technologies such as 3D printing allows for the reduction of material waste while retaining the traditional details desired by consumers. Sustainability and Environmental Efficiency: Sustainability is an important aspect of the implementation

of VE in the UK, especially in tradition-based industries. According to (Younis Elfargani, 2023), VE helps reduce waste and energy use during the production process, which is important in supporting global sustainability goals. For illustration, in the development of traditional wood craft products, VE is used to replace raw materials that are difficult to renew with more environmentally friendly alternatives. Research also shows that this approach not only reduces environmental impact but also increases the attractiveness of products in international markets that are increasingly knows sustainability. VE's practice in the UK shows that collaboration among stakeholders is key to success. (Mckendry & Whitfield, 2022) emphasized the importance of cooperation among the public and private sectors in integrating VE into tradition-based product innovation projects. Through this collaboration, traditional industries such as ceramic crafts can maintain their competitiveness by utilizing modern technology without sacrificing the cultural elements that become the product's identity. Additionally, research shows that this collaborative approach also increases consumer engagement, which helps create products that are more relevant to the needs of the modern market. The apply VE in the UK shows how tradition and innovation can come together to create products that are relevant, efficient, and sustainable. By integrating modern technology into the design and production process, VE not only supports the preservation of cultural values but also opens up new opportunities in the global market. The success of this practice provides important lessons for other countries that want to develop tradition-based products in the modern era.

In Russia, VE is increasingly used in the development of products that combine traditional elements with modern needs, such as in the machinery and manufacturing industries. This approach is important to face global competition while still preserving the uniqueness of local culture. The apply VE in Russia for illustration the Product Development of the Machinery Industry, Research shows that the machinery industry in Russia faces challenges in meeting the needs of the ever-changing global market. To overcome this, VE is implemented to speed up the product development process and increase competitiveness. By involving consumers in every stage of product design, VE helps to balance customer value with product characteristics, thereby increasing efficiency and competitive advantage (Murukina et al., 2020). Flexible Approach in Mechanical Product Design, VE is also applied in mechanical product design by integrating new technologies and robotization to meet the increasingly complex needs of consumers. This process allows machine companies to bid products with unique functions, tailored to customer needs without significantly increasing costs. This strategy is a key competitive advantage in a dynamic market (Prilutskaya et al., 2021). Consumer-Based Innovation, In the region of North-West Russia, consumer-based innovation is used to create shared value among companies and customers. Through VE, the corporation engages customers in

the co-creation process to ensure that the products produced meet local needs and remain relevant in the global market. This strategy improves the corporation's operational efficiency and competitiveness (Molchanov & Rybakova, 2020). Integration with Modern Methods, the implementation of VE in Russia is also often combined with other methods, such as QFD and DFA. This approach ensures that each product function can be measured efficiently, and the associated costs can be minimized. As a result, the product not only meets customer expectations but also remains economic to produce (Setti et al., 2021). The apply VE in Russia shows that this approach can help local industries to remain competitive in the global market while retaining traditional elements. By combining VE with technology and consumer-driven innovation, companies can create products that are not only efficient, but also relevant to market needs. This strategy emphasizes the importance of VE as a key tool in future-oriented product development.

Germany is known as one of the countries with the world's leading manufacturing sector. The integration of VE in product development has helped German companies improve the value and efficiency of products, both modern and tradition-based. With a strong background of tradition and innovation, Germany uses VE to maintain a balance among cost efficiency, high quality, and respect for local cultural heritage. Apply Value Engineering in Germany, Tradition-based development with digitalization manufacturing companies in Germany adopted VE to develop tradition-based product innovations by utilizing digital technology. Digitalization allows the integration of traditional production processes with modern technology, such as the use of computer-based design to preserve cultural elements while meeting the demands of the global market. Integration of traditional ethics and values in product innovation, VE in Germany is often applied with a values-based approach that considers ethical and sustainability aspects. In product development, the German company focuses on meeting customer needs while maintaining traditional value principles. This approach shows that value-based planning can increase product creativity and durability against the challenges of the modern market (Kathrin Bednar & Sarah Spiekermann-Hoff, 2021). Apply VE to mechanical engineering, in the mechanical engineering sector, VE is used to create product designs that are more flexible and can be adapted to consumer needs. Research has found that German companies are able to integrate traditional elements in modern mechanical products in an efficient way, such as through designs for assemblies that blend traditional elements and new technologies (Prilutskaya et al., 2021). Multidisciplinary Collaboration in Traditional Product Development, VE is also applied through multidisciplinary collaboration to integrate various methods such as QFD and DFA. This combination allows companies to improve the quality of traditional products while still maintaining a cultural identity. This strategy supports production efficiency and global competitiveness (Setti et al., 2021). Industry 4.0 Approach in

Traditional Product Development, in the era of industry 4.0, German companies are leveraging VE to support digital transformation while maintaining traditional elements. With this approach, they are able to develop products that are not only in line with customer needs but also environmentally friendly and sustainable. As a result, traditional products are well received in modern markets that increasingly prioritize sustainability (Kinkel et al., 2020). The apply VE in Germany shows great potential to integrate tradition with modern innovation. By leveraging digital technologies, multidisciplinary collaboration, and value-based approaches, Germany has managed to maintain its cultural identity while improving the efficiency and competitiveness of traditional products in the global market. This strategy reflects the importance of VE in the development of culturally and economically relevant products.

Table 5.2. Common Indicators for the Apply VE in Tradition-Based Products

Indicator	Description
Integration of Modern Technology	Using technologies such as digitalization, automation, and computer-based design to improve the efficiency of the production process while retaining traditional elements.
Value-Based Approach	Ensuring products meet customer needs by adding emotional, aesthetic, and functional value, without sacrificing traditional elements.
Multidisciplinary Collaboration	Combining various expertise, such as engineering, design, and marketing, to create products that are relevant in the market while maintaining a cultural identity.
Environmental Sustainability	Utilizing green technology, sustainable design, and eco-friendly materials to reduce negative environmental impacts in the production process.
Consumer Engagement	Involve consumers in the design and development process to ensure products are in line with market preferences while still retaining distinctive cultural elements.
Cost and Production Efficiency	Apply functional analysis to optimize costs without compromising product quality or functionality, so that products are more competitive in the market.
Use of Green Supply Chain	Integrate sustainability in the supply chain, including the use of local ingredients and environmentally friendly distribution strategies, to support tradition preservation and sustainability.
Design Flexibility	Develop adaptive designs, which can be adapted to consumer needs and market trends while maintaining cultural characteristics and traditions in products.
Increased Global Competitiveness	Improve product quality and efficiency so that it can compete in the global market, while maintaining local and traditional identities.

Source: Author's Summary, 2024.

From the practice of implementing VE in various countries, there are some common indicators that can be applied to integrate tradition, efficiency, and innovation in product development. The following table summarizes the relevant indicators for the successful implementation of VE in the context of tradition-based products. Indicators of table 5.2. shows that the successful implementation of VE in

tradition-based product development requires a holistic approach that integrates technology, sustainability, and focuses on cultural values. Successful tradition-based product development requires a holistic approach that integrates technology, sustainability, and cultural values. VE can serve as a strategic tool to optimize product value by balancing cost and quality while maintaining local cultural elements. This approach has proven effective in creating products that are not only locally relevant but also competitive in the global market (Xiang et al., 2022). Training and skills development, RPJMD Papua 2025–2029 emphasizes training local communities to improve design, production, and marketing skills. This strategy is aligned with the need to support sustainability through human resource development. Studies show that sustainability-based training helps participants understand elements of sustainable design and cultural values, which can be applied in traditional products with high added value (Achille & Fiorillo, 2022). Integration of Local Values with Sustainability, Tradition-based products often require elements of sustainability to be able to compete in the modern market. The VE approach can be used to guide training in understanding sustainability design indicators such as material use efficiency, waste minimization, and energy optimization. This skills-based training allows local communities to produce products that not only reflect their culture but also meet global sustainability standards (Perpignan et al., 2020).

Strengthening local economic independence, training in culture-based design and marketing also strengthens the local economy by creating new business opportunities. In the context of Papua, the development of these skills can include the production of handicrafts, traditional textiles, and other local products that have high market potential. Studies on entrepreneurship training show that community involvement in understanding culture-based design directly increases local economic independence (Widodo, 2023). The integration of VE with sustainability-based training can help Papua achieve the goals of the 2025–2029 RPJMD in engaging local communities to create competitive and sustainable tradition-based products. This approach not only preserves the cultural element but also paves the way for the strengthening of the local community's economy and self-reliance.

5.3. Learning from Best Practices in Other Regions

Learning from best practices in other regions is a strategic step in strengthening the management of local potential in Papua. For illustration, the ecotourism development model in Bali can be an inspiration to create cultural and nature-based tourist destinations in Papua. In addition, the implementation of technology in marine product management in Sulawesi can be applied to increase the productivity of Papuan fishermen. Collaboration with other regions that have successfully harnessed their local potential can also encourage innovations that are relevant to Papua. The document Law Number 59 of 2024 emphasizes that Papua

must adopt these approaches adaptively, adapted to local social and cultural conditions (Law Number 59/2024). Collaboration with other regions that have successfully harnessed their local potential plays an important role in driving innovation in cultural and nature-based ecotourism development models. Areas such as Pekon Kiluan Negri in Lampung show the importance of social empowerment of local communities in ecotourism management, including the allocation of ecotourism proceeds to support the socio-economic sustainability of the surrounding community (A. Purnomo, 2020). With a local wisdom-based approach, areas such as Bugisan Village in Central Java integrate local art, culture, and socio-economic values to support the Plaosan Temple tourist area, showing that culture-based strategies can significantly increase the attractiveness of local tourism (Deskarina & Atiqah, 2020). The implementation of technology also has a big impact on marine product management to increase fishermen's productivity. For illustration, the use of technology in seaweed cultivation such as *Eucheuma cottonii* in Lemukutan, West Kalimantan, has been proven to increase crop yields by up to 220% within 50 days through optimal cultivation methods (Sofiana et al., 2021). In addition, strengthening the capacity of octopus fishermen in North Sulawesi with an ecosystem-based approach shows that education and technical training are able to improve sustainable fisheries management and improve the economic welfare of fishing communities (Dwihastuty et al., 2023). Innovation in ecotourism and marine resource management requires an integrated strategy among local empowerment and technology implementation. Activities such as technical guidance on fishery product processing in Tomini Bay, Gorontalo, show that marine product processing skills can open up micro business opportunities that provide added value for coastal communities (Niswatin et al., 2022). Through the synergy among cross-regional collaboration and modern technology, cultural and nature-based development models can not only increase productivity, but also provide significant economic and social impacts to local communities.

Cross-regional collaboration in various countries is a very effective strategy to share knowledge and experience in making the most of local potential. The scientific basis for this approach is supported by research that shows that collaborative networking allows for the transfer of knowledge, technology, and best practices relevant to local needs. For illustration, research by (Deskarina & Atiqah, 2020) underlines how the integration of local wisdom in the development of ecotourism in Bugisan Village has succeeded in providing added value to the Plaosan Temple area through collaboration with other stakeholders. Cross-regional collaboration also supports the development of local innovation through the exchange of experiences among regions. For illustration, the program in Sungsang IV Village, South Sumatra, has successfully adopted a tourism village management model based on local wisdom applied in other regions to create a sustainable Muslim-friendly tourism

concept (Helfa Septinar et al., 2023). By adapting this concept to the local context, the region can develop tourism that not only enhances the local economy but also preserves cultural identity. In addition, research by (Mandowen & Mambrasar, 2021) shows that the use of technology such as GIS in coastal land management in the Padaido Islands has been successfully improved through cross-regional collaboration. Through knowledge exchange with other regions, this technology is used to identify suitable areas for sustainable tourism and conservation activities. Furthermore, research by (A. Purnomo, 2020) highlights the importance of collaboration in the social empowerment of local communities. In the context of ecotourism development in Pekon Kiluan Negri, Lampung, a collaborative approach allows the active participation of local communities in ecotourism management. This not only increases community involvement but also ensures that the economic benefits of ecotourism are felt equally. Cross-regional collaboration is an important basis in managing local potential. With collaborative networks, regions can leverage experiences and innovations from other regions to optimize the sustainable management of local resources. This approach not only improves efficiency but also creates opportunities for economic growth and wider cultural preservation.

South Korea has shown success in developing a sustainable ecotourism model through cross-regional collaboration, which integrates local culture and modern technology. One of the strategic steps taken is to establish partnerships among local governments, non-governmental organizations, and local communities to create a tourism ecosystem that is friendly to nature and culture. This program is supported by the Korean Tourism Organization (KTO) and the Korea Muslim Federation (KMF), which develops Muslim-friendly tourism services, such as worship facilities and halal food, to attract tourists from various Muslim-majority countries (Samsudin, 2022). Another initiative is coastal area management that uses a collaborative and community-based approach. This program aims to involve coastal communities in natural resource management, as seen in coastal management practices on Jeju Island. The island is known for its CBE management, including the preservation of the culture of Haenyeo females' divers as a tourist attraction. Through knowledge transfer among regions, models like this can be applied in other regions with similar potential to increase tourist attraction while preserving local traditions (Park & Lee, 2023). In addition, South Korea is leveraging technology in the fisheries sector to increase productivity and sustainability. An illustration of technology implementation can be seen in GIS used to map the potential of waters suitable for aquaculture. This approach allows fishermen to maximize their catch without damaging the marine ecosystem. Similar technologies are also being applied in coastal regions of South Korea to identify suitable areas for marine tourism development, ensuring a balance among environmental conservation and economic development (Jang et al., 2020). The combination of cross-regional collaboration, local culture-based management,

and the adoption of advanced technology creates an integrated tourism and fisheries ecosystem. This model can be adapted by other countries, including Indonesia, which has abundant cultural diversity and natural resources. By adopting the South Korean approach, coastal areas and ecotourism in Indonesia can be managed more effectively to support local economic growth as well as cultural and environmental preservation.

Japan has been one of the countries that has been successful in utilizing cross-regional collaboration to support the development of cultural and nature-based ecotourism. One form of implementation is through regional cooperation with ASEAN in protecting marine ecosystems, which are an important part of ecotourism. For illustration, the "Joint Statement Japan Cooperation on ASEAN Outlook on the Indo Pacific (AOIP)" project has successfully developed mitigation measures such as training and waste management to reduce the impact of plastic waste in the sea, which also supports the sustainability of the tourism sector in coastal areas (ASEAN, 2020). In addition, Japan also implements a culture-based approach in ecotourism management. A real illustration is the preservation of local cultural traditions combined with modern technology to attract tourists, as is done in rural areas. This model involves the use of digital technology to improve the accessibility of cultural and historical information of an area. This move not only involves local communities in preserving their culture, but also provides them with new economic opportunities through a thriving tourism sector. The implementation of technology in marine product management is also a major concern in Japan. One important breakthrough is the use of data-driven predictive technology to manage fisheries sustainably. This technology allows fishermen to use environmental data such as water temperature, ocean currents, and fish migration patterns to improve catch efficiency without damaging marine ecosystems. Collaboration with local universities and research centers is a key driver of the success of this technology, as seen in marine product management programs in various coastal areas of Japan (Sakurai & Uehara, 2020). Furthermore, Japan is leveraging a community approach to promote environmental and culture-based tourism. This approach involves various parties, including local governments, academics, and local communities, to create an integrated management model. For illustration, local communities in rural areas of Japan are working with the government to develop "smart villages" that combine water tourism with smart technology, to increase tourist attraction while preserving local natural resources (Romanda, 2020). Cross-regional collaboration in Japan is the foundation for sharing knowledge and technology, which ultimately advises innovation in ecotourism development and marine product management. By combining cultural, natural, and technological aspects, Japan shows how an integrated approach can support environmental sustainability and the well-being of local communities.

China has shown success in leveraging cross-regional collaboration to develop cultural and nature-based ecotourism. One illustration is the marine ecosystem protection program which involves collaboration among provinces and with other countries. The program focuses on better ecosystem management through a data-driven approach, including the use of geographic information technology (GIS) for mapping areas with potential for conservation and ecotourism. In this context, the integration of technology has had a major impact in determining policies that support the sustainability of ecotourism (A. P. Zhang et al., 2015). In seafood management, China has implemented advanced technologies such as AI-based prediction systems to help fishermen in increasing their catches without damaging the marine environment. The program involves collaboration among universities, research institutions, and local governments to transfer technology to local fishers, resulting in a more productive and sustainable ocean management model. Successful illustrations of this implementation can be seen in China's coastal regions, where catches have increased significantly thanks to the use of prediction technology based on marine environmental data (Ye et al., 2022). In addition, the development of culture-based ecotourism is carried out through the revitalization of traditional villages as tourist destinations. These villages are often used as models for ecotourism projects that focus on cultural and nature preservation, such as Kertalangu Village in Indonesia which adopts a similar approach (Kameswara & Suhirman, 2017). This collaboration allows for the transfer of knowledge from more developed regions to developing regions in best practices in natural and cultural resource management. Overall, practice in China shows that cross-regional collaboration, supported by advanced technology and community-based approaches, is key to maximizing local potential in ecotourism and seafood management. This model is relevant to be adapted by other countries, including Indonesia, in managing cultural and natural potential in a sustainable manner.

Brazil is known as one of the countries with great success in utilizing cross-regional collaboration to support the development of cultural and nature-based ecotourism. The country uses an approach that involves different regions with different cultural and ecological characteristics. For illustration, Brazil has built a sustainable ecotourism model that combines environmental conservation with the empowerment of local communities. This is reflected in the management of ecotourism areas such as the Amazon and Pantanal, where cross-regional collaboration is the main strategy to share experiences and technologies in environmental conservation and nature-based tourism management (Oliveira Filho, 2024). In marine product management, Brazil has adopted advanced technologies such as AI-based prediction systems and GIS. This technology helps fishermen in Brazil maximize their catch in a way that does not damage the marine ecosystem. For illustration, fishermen in coastal areas of Brazil now use environmental data such as

water temperature and ocean currents to determine ideal locations to catch fish. Ecotourism in Brazil also places great emphasis on preserving local culture. Regions like Bahia, with its rich Afro-Brazilian culture, have made local music, dance, and culinary traditions a major attraction for tourists. Cross-regional collaboration allows the management of this tourist area to be integrated with environmental conservation, creating a tourism model that supports the local economy without sacrificing cultural heritage and biodiversity. Research shows that the high participation of local communities in ecotourism is an important factor for the sustainability of these programs (Ferreira Menezes et al., 2021). Through a collaborative approach involving local governments, local communities, and international partners, Brazil can create synergies in the management of ecotourism and marine resources. Thus, Brazil's experience shows the importance of cross-regional collaboration in managing local potential in a sustainable manner. Models like this can be an inspiration for other countries, including Indonesia, to make the most of their natural and cultural potential.

Saudi Arabia has undertaken various innovative initiatives to develop cultural and nature-based ecotourism through cross-regional collaboration. One illustration is The Red Sea Project, which covers an area of more than 28,000 km² along the Red Sea coast. The project involves collaboration among local and international developers to combine environmental conservation with the development of sustainable luxury tourism. This project uses a marine spatial planning approach to optimize the preservation of the marine environment, including coral reefs, seagrass beds, and mangroves. This shows how coastal development can be carried out without sacrificing environmental sustainability (Chalastani et al., 2023). In addition, Saudi Arabia uses GIS-based technology (Geographic Information System) to assess the spatial suitability of ecotourism in various regions, such as Hail and Al-Ahsa Provinces. This approach allows the identification of the most suitable locations for ecotourism development based on environmental and cultural criteria. The study highlights the importance of infrastructure, such as road access, to increase the attractiveness of ecotourism destinations. GIS is used to create maps of strategic locations for ecotourism, which can increase local community participation and attract international tourists (Mohammed et al., 2022). Saudi Arabia also focuses on marine product management to increase fishermen's productivity by integrating modern technology. For illustration, strategies such as the increase in industrial fishing vessels and the training of local fishermen to use environmental data have resulted in significant increases in catches. In addition, programs such as the National Transformation Program also aim to increase fisheries production through technological innovations that support the sustainability and preservation of marine ecosystems in the Red Sea and Arabian Gulf (Alnafissa et al., 2021). In the context of culture-based ecotourism, Saudi Arabia is developing regions such as Al-Ula and

Jeddah as major tourist destinations. In Jeddah, endeavors to preserve cultural heritage are carried out by integrating sustainable tourism management. This includes strategies to manage the impact of overtourism, preserve cultural heritage sites, and encourage economic growth through cultural and historical tourism (Bagader & Bagader, 2021). Through a collaboration-based, technology-based approach, and local community involvement, Saudi Arabia has proven that the development of ecotourism and innovative management of marine products can be achieved without sacrificing environmental and cultural sustainability. This model can be an inspiration for other countries that want to develop their natural and cultural potential in a sustainable way.

The development of cultural and nature-based ecotourism and the sustainable management of marine products in various regions show that cross-regional collaboration and the apply modern technology are the keys to success. Inspiration from regions such as Bali and Sulawesi in Indonesia, as well as countries such as South Korea, Japan, Brazil, Saudi Arabia, and China, shows the importance of local community empowerment, cultural preservation, and technological innovation. For illustration, Bugisan Village in Central Java blends arts and culture to support ecotourism, while data-driven GIS and predictive technology helps manage marine resources efficiently. Strategies such as fisherman technical training in Sulawesi and local community engagement in Jeju, South Korea, show significant impact on economic and social sustainability. Through a culture-based approach, cross-regional collaboration, and technology, local potential can be optimally managed to support community welfare and preserve the environment.

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6.1. Training and Education for the Young Generation of Papua

The young generation of Papuans is the main pillar in the sustainable development of indigenous peoples. This chapter highlights the need for an education system that is integrated with local cultural values, such as teaching about indigenous history and traditions, while equipping them with modern skills. For illustration, vocational training in sustainable agriculture, culture-based handicrafts, and information technology can provide new economic opportunities for the younger generation. Local culture-based education provides an opportunity to preserve traditional values through relevant curricula. One effective approach is integrated learning that is oriented toward local wisdom. In this context, learning methods such as Project-Based Learning (PjBL) based on local culture have been proven to improve students' creative thinking skills while fostering a love for local culture (Adriyanto et al., 2023). The PjBL model is an educational approach that focuses on solving real problems through structured projects. This model is designed to improve students' critical thinking, creativity, and cooperation skills. PjBL emphasizes on the active involvement of students in learning, so that they can apply theory into real practice. This approach is very relevant in the modern era that requires students to have high adaptability and innovation (Nurhidayah et al., 2021). The PjBL model has its roots in the progressive education theory introduced by John Dewey in the early 20th century. Dewey believes that hands-on experience and activity-based learning can improve students' understanding of the real world. This concept was then developed into a PjBL model that emphasizes exploration, questioning, and the creation of solutions to authentic problems. In a global context, PjBL has been widely adopted as a pedagogical approach since the terminate of the 20th century until now, especially in science, technology, engineering, and mathematics (STEM) fields (Jannah & Khairuna, 2022). Scientifically, PjBL is based on the theory of constructivism which states that learning is an active process in which students build new knowledge based on previous experiences. PjBL also integrates elements of collaboration, reflection, and problem-based learning to create meaningful learning experiences. Influence on creativity and critical thinking, Studies show that PjBL is effective in improving students' creativity and critical thinking skills. This model allows students to solve real problems in an innovative and reflective way. For illustration, the research of (Chintya

et al., 2023) showed a significant increase in student creativity after the apply PjBL in science learning in elementary schools. Improving 21st century skills, PjBL has also proven to be effective in developing 21st century skills such as collaboration, communication, and problem-solving. The research of (Namira et al., 2024) shows that students who learn using PjBL have better science literacy skills compared to students who use conventional methods. Effectiveness in various disciplines, PjBL has been applied in various disciplines, such as biology, physics, and history, with significant results on student learning outcomes. For illustration, the study of (Wardah et al., 2022) shows that the use of PjBL in social science subjects can increase students' historical awareness and conceptual skills. Influence on learning outcomes, in a meta-analysis conducted by (Uki et al., 2024), PjBL was found to be very effective in improving student learning outcomes at all levels of education, from elementary to high school. PBL is an educational approach that is not only relevant in equipping students with academic skills but also helping them develop non-academic competencies such as creativity, cooperation, and problem-solving. With a strong historical background and a solid scientific foundation, PjBL has become one of the most effective and relevant learning methods for the modern era.

The implementation of PjBL for the younger generation in the development of indigenous peoples begins with the identification of problems in indigenous communities. This stage involves discussions with indigenous elders and community members to understand the challenges faced, such as a decline in interest in traditional crafts or a lack of documentation of oral traditions. The younger generation is invited to collect related data, such as the number of local artisans, information about traditions that are beginning to be abandoned, and the potential of natural resources that have not been used optimally. For illustration, they may find that traditional crafts are less in demand because their designs are considered irrelevant by the younger generation. After that, it was followed by project planning, where the young generation together with the community prepared concrete steps to present solutions. Working groups are formed with a clear division of tasks, such as documentation, production, and promotion teams. They designed activities such as workshops on making traditional crafts guided by local artisans, as well as strategies to promote cultural products through digital media. For illustration, they can schedule training to learn weaving techniques and develop ideas for creating custom-based products that appeal to the modern market. The next stage is the implementation of the project, where the younger generation practices the plan that has been prepared. They held skill workshops such as weaving or carving, and began producing the community's signature crafts. In this process, oral traditions are also documented in the form of videos or writings to be uploaded to digital platforms. For illustration, a group can work with traditional elders to create a documentary video about the traditional way of making a typical musical instrument. The products produced are

then promoted through social media or local exhibitions. At the monitoring and guidance stage, teachers or facilitators together with traditional elders provide help to the younger generation to ensure that the project runs as planned. They also provide feedback on the cultural authenticity that must be maintained in the project. For illustration, a sponsor might suggest that the woven pattern remain traditional, even if the design is modified, to appeal to the modern market. With this help, the project can run more purposefully and sustainably. After the project is completed, the work of the younger generation is presented through local exhibitions or community events, where the community can see and appreciate the cultural products produced. Digital media is also used to promote project results to a wider audience, such as tourists or potential buyers. For illustration, the younger generation can upload video documentation to social media to raise awareness about local traditions. The last stage is evaluation and reflection, where the young generation together with the community assesses the success of the project and the learning obtained. They noted what was successful, such as increasing public interest in traditional crafts, as well as challenges that needed to be improved. This reflection also helps the younger generation understand the importance of preserving culture while creating innovations that are relevant to today's needs. With this approach, PjBL not only strengthens the involvement of the younger generation with cultural heritage but also opens up new economic opportunities for indigenous peoples.

Several countries that have implemented PjBL have obtained results by the plan. Indigenous peoples in Russia, such as the Nenets, Khanty, and Evenk, face significant modernization challenges, including the loss of language, cultural traditions, and equal access to education. The younger generation plays an important role in preserving indigenous culture while utilizing modern technology to overcome this challenge. The PjBL provides an effective approach to combine modern education with the preservation of local cultural values. The apply PjBL to indigenous communities in Russia can be a way to integrate tradition into the formal education system and empower the younger generation through practical skills. Stage 1: problem identification, the first stage is to understand the main challenges facing indigenous communities in Russia. In this context, for illustration, the Nenets community faces the problem of environmental degradation and the loss of the deer herding tradition. The younger generation is invited to identify this key issue through discussions with traditional elders, field surveys, or interviews. Research such as those conducted by (Kozlova & Zamaraeva, 2022) shows that digitalization can be used to support social adaptation and the preservation of cultural identities of the indigenous young generation. Stage 2: project planning, once the problem is identified, the younger generation together with the sponsor designs a solution-oriented project. For illustration, they could develop digital platforms to document oral traditions or create apps to monitor deer populations. In this stage, working groups are formed

with specific tasks such as cultural documentation, technology design, and project management. A digital initiative, such as the "Snoword" educational platform designed for indigenous peoples in Siberia, has been shown to help preserve local culture through a technology-based approach (Kozlova & Zamaraeva, 2022). Stage 3: project implementation, the project is then implemented by involving indigenous communities directly. For illustration, students can create video documentation about the tradition of deer herding or host a typical Nenets craft workshop. This stage involves the practical apply the plan that has been made, such as the creation of cultural products to be exhibited or the use of technology such as augmented reality to support the learning of indigenous traditions. Studies in Yamalo-Nenets show that digital approaches can strengthen the engagement of young people with their culture through distance education based on local traditions (Sitnikova & Nikolaeva, 2021). Stage 4: monitoring and guidance: teachers, facilitators, and indigenous elders monitor the progress of the project, provide guidance, and ensure the project remains relevant to cultural values. In this stage, mentors provide feedback to ensure cultural authenticity is maintained despite utilizing modern technology. For illustration, the "Camp School-Garden" program in Khanty-Mansiysk shows how project-based education can blend technology with traditional resource management (Galyamov, 2022). Stage 5: presentation and promotion of project results, the younger generation presents the results of their projects to indigenous peoples and other stakeholders. The result can be traditional documentation, craft products, or technology applications designed to support the sustainability of local culture. For illustration, local cultural festivals can be a platform to display the results of the project while drawing the attention of the wider community to the importance of preserving indigenous culture. Stage 6: evaluation and reflection, the final stage is to evaluate the project results based on the initial objectives. The younger generation together with the community can assess the extent to which the project has succeeded in preserving indigenous culture or increasing community participation in culture-based activities. Studies in Arctic Russia show that project-based education can reduce inequality in access to education for indigenous peoples and strengthen the sense of cultural identity of the younger generation (Pitukhina & Valery, 2022). The apply PjBL to the younger generation in Russia's indigenous peoples provides an opportunity to preserve local culture while utilizing modern technology to face global challenges. Through a systematic process, PjBL not only strengthens the cultural identity of the younger generation but also creates innovative solutions that are relevant to indigenous communities.

Indigenous peoples in Japan, such as the Ainu community in Hokkaido, face challenges in maintaining their language, traditions, and culture amid modernization. The younger generation plays an important role in preserving cultural heritage while adapting to global developments. The PjBL model has been adopted in various

educational contexts in Japan to integrate PjBL with local cultural values, creating innovative and sustainable solutions for the development of indigenous communities.

Stage 1: identification of local problems, the initial stage in PjBL is to identify the main challenges facing indigenous communities. For illustration, the Ainu community often struggles to preserve their endangered language and artistic traditions such as handicrafts or traditional dances. Discussions with indigenous elders, field surveys, and interviews with community members are used to understand the issue. Research in Japan shows that place-based education is effective in connecting students with local culture, especially through a community resource-based approach such as the one applied in projects in Ena City (Hakeem et al., 2024).

Stage 2: project planning, after the problem is identified, the younger generation together with mentors or teachers design a project that can be a solution. These projects can include developing digital apps to document Ainu traditions or hosting art workshops to learn traditional skills. In place-based projects, students are invited to use local resources innovatively, such as combining modern technology with traditional practices (Hakeem et al., 2024).

Stage 3: project implementation, the project is implemented by actively involving the local community. For illustration, students can produce documentary videos about the daily lives of indigenous peoples or design digital-based educational games to learn the Ainu language. The implementation of this project can also use modern technology to support the sustainability of learning outcomes. Cross-cultural education projects that connect students in Japan with other countries have shown that technology can reinforce learning outcomes in local contexts (Koesoema et al., 2021).

Stage 4: monitoring and guidance, teachers, mentors, and traditional leaders play an active role in monitoring the progress of the project. Constructive feedback is provided to students to ensure that the project outcomes remain relevant to the needs of the community. In this stage, mentors also ensure that the cultural authenticity integrated in the project is maintained.

Stage 5: presentation and promotion of project results, project results are presented to indigenous peoples and other stakeholders. Students can organize cultural festivals to showcase their work, such as Ainu tradition-based handicrafts or digital apps for language learning. Research in Japan shows that community-based initiatives like this can increase public awareness of local cultural values while encouraging sustainable innovation (Hakeem et al., 2024).

Stage 6: evaluation and reflection, the last stage is to evaluate the success of the project. This evaluation involves students, teachers, and indigenous communities to assess the project's impact on cultural preservation and student learning. Reflection is carried out to record the challenges faced and lessons that can be applied to future projects. Through PjBL, young people in Japan can contribute to the preservation of local culture while developing modern skills. This process connects students with their cultural roots, strengthens local identities, and creates relevant innovations for

community building. The implementation of place-based PjBL has proven to be an effective approach in the context of indigenous peoples' education in Japan.

In China, PjBL is an innovative approach to building the skills of the younger generation in the context of formal education. However, the implementation of PjBL for indigenous peoples present challenges, especially in integrating local culture with modern curricula. Indigenous communities in China, such as the Yi or Miao tribes, have a rich culture that can be leveraged as part of contextual learning. Through PjBL, the younger generation can learn while contributing to the development of their indigenous communities, both through cultural preservation and practical skill development. Stage 1: identify local problems, the first stage is to understand the main problems faced by indigenous communities. In China, communities like Miao face challenges in preserving their traditional handicrafts due to the influence of modernization. Discussions among students, teachers, and the community are conducted to identify specific issues, such as the loss of traditional embroidery art. Research shows that students' involvement in the exploration of local problems advises them to understand the needs of the community and design project-based solutions (Y. Hu, 2024). Stage 2: project planning once the problem is identified, students work in groups to design a solution. For illustration, they can design a project to document traditional embroidery patterns and teach them to the younger generation through workshops. At this stage, detailed planning is vital, including scheduling, task division, and identification of the resources needed. This approach aims to improve students' collaboration and leadership skills while integrating local cultural values into learning (Zhao, 2024). Stage 3: project implementation, students carry out the project with the guidance of teachers and community support. For illustration, they can produce documentary videos about the process of making traditional embroidery or create modern designs inspired by traditional patterns. Studies in China show that the implementation of locally-based projects helps students develop practical skills while increasing their appreciation for their cultural heritage (Hazard & Li, 2024). Stage 4: monitoring and mentoring, during implementation, traditional teachers and mentors monitor the progress of the project, provide constructive feedback, and help students overcome emerging challenges. Monitoring also includes ongoing evaluation to ensure that project outcomes are in line with community needs and educational goals. Stage 5: presentation and promotion of project results, project results are presented to indigenous communities and other stakeholders. For illustration, students can organize local cultural exhibitions to showcase embroidery patterns they have documented. A study in Ninghua, Fujian, shows that the integration of local knowledge in education can increase students' sense of pride in their cultural heritage and strengthen community engagement (Shanshan & Islam, 2024). Stage 6: evaluation and reflection, the last stage is to evaluate the success of the project. This evaluation

involves students, teachers, and community members to assess the impact of the project on student learning and cultural preservation. Reflection is carried out to record lessons that can be applied to future projects, as well as to improve the learning process in the future. Through PjBL, young people in China can play an active role in the development of their indigenous peoples in innovative and relevant ways. This process not only supports the preservation of local culture but also equips students with skills that are useful for modern life. Research shows that the implementation of PjBL based on local culture helps to strengthen cultural identity while encouraging sustainable community development.

Indigenous development in Papua requires an approach that focuses on inclusivity and capacity building for the younger generation, as mandated in the Papua RPJPD 2025–2045 (Bapperida Provinsi Papua, 2024). This document highlights the importance of access to quality education in remote and hard-to-reach areas, as well as the need to strengthen through scholarships and student exchange programs that can broaden the horizons and skills of Papuan children to contribute to regional development. One relevant method to achieve this goal is PjBL. This method involves learners in projects oriented toward developing practical, collaborative, and contextual skills that are aligned with local needs. The successful implementation of PjBL in various countries demonstrates its potential to support inclusive indigenous education.

6.2. Increasing Technological Capacity at the Local Level

Indigenous peoples in various parts of the world, including in Indonesia, play an important role in maintaining cultural and environmental diversity. However, they often face challenges in adopting modern technologies that are often inappropriate for their specific cultural context and needs. The apply technology that is relevant and contextual to the needs of indigenous peoples can be a strategic solution to improve their well-being without compromising their cultural identity. This article discusses the importance of a contextual approach in the apply technology, supported by various scientific studies. Apply Contextual Technology and Cultural Relevance, according to research in Kampung Adat Segunung, East Java, the apply digital technology such as the online ticket system turned out to be less effective because it did not consider the local context. Factors such as the inability of managers to communicate with technology providers and the low participation of young people are the main obstacles. This study emphasizes the importance of "contextualizing" technology to suit the capacities and needs of indigenous peoples (Nuryananda et al., 2023). In addition, research conducted in Taman Ayu Village shows that the apply corn and chattel integration technology (SIJASA) has succeeded in increasing farmers' productivity by up to 60% and supporting the sustainability of the local economy. This innovation is relevant to the condition of the local agroecosystem and

involves direct help by experts to ensure the success of the technology in supporting indigenous peoples (Mashur et al., 2021). Benefits of Technology in Supporting Cultural Preservation, Technology also plays a role in preserving the culture of indigenous peoples. In this context, digital-based information systems can help document traditions, arts, and traditional rituals that are vulnerable to being lost due to modernization. For illustration, the apply digital methods to support the management of custom-based tourist destinations such as in Kemutug Lor Village can help expand the market while maintaining the traditional values of the community (Nurhidayati et al., 2022).

Challenges in the apply technology, although the potential is great, the apply technology in indigenous peoples has challenges. Low levels of technological literacy, limited infrastructure, and knowledge gaps are often obstacles. A study in Cimekar Village, Bandung, shows that technological innovations such as the SALIBU method in rice farming can help increase productivity, but require continuous support in the form of training and technological adaptation relevant to local needs (Adji, 2022). The apply relevant and contextual technology to the needs of indigenous peoples not only increases productivity and well-being, but also maintains their cultural uniqueness. The contextualization of technology and the active participation of local communities are key to success. Therefore, governments and other stakeholders need to ensure that technological innovation is not only based on modernization, but also respects the traditions and needs of indigenous peoples.

The technology contextualization approach focuses on adapting technology to the specific needs of indigenous peoples, including cultural values, human resource capacity, and available infrastructure. the action study in the Segunung Traditional Village emphasizes the importance of contextualization through the Participatory Rural Appraisal (PRA) and Asset-Based Community Development (ABCD) methods to identify local needs before implementing technology (Nuryananda et al., 2023). PRA is a participatory approach designed to involve communities in identifying problems, analyzing conditions, and designing development solutions by utilizing local knowledge. PRA aims to empower communities to have the ability to conduct assessments and planning that are relevant to their needs. PRA techniques such as transect walks, SWOT analysis, participatory mapping, and the use of Venn diagrams help communities understand socio-economic and environmental dynamics in more depth (Auerbach, 2020). ABCD, on the other hand, is an approach that focuses on identifying and empowering local assets to drive social change. This approach shifts attention from problems to opportunities by leveraging the strengths of community, such as natural resources, social relationships, and community skills. For illustration, research in Pennsylvania shows how ABCD helps create place-based knowledge through citizen involvement in community regeneration planning that involves all levels of society (Bowns, 2021). The apply ABCD is also seen in participatory mural

programs in rural communities in Ecuador, where children depict their community assets through mural paintings, which help identify the natural and social forces of their communities (Bates et al., 2022). The PRA and ABCD approaches complement each other. PRA helps communities recognize existing challenges and design participatory data-based solutions, while ABCD ensures that the development process is based on positive assets that are already owned by the community. Collaboration among students, local organizations, and communities is often a key catalyst in the implementation of these two approaches, as reflected in service-based learning programs in rural Italian communities (Guarino et al., 2023). PRA and ABCD are approaches that provide a strong focus on community empowerment and sustainability. PRA engages the community in analysis and planning, while ABCD advises them to leverage their assets to create innovative and sustainable solutions. The combination of the two can create community-based development that is inclusive and based on local resources.



Figure 6.1. Illustration of PRA (source: Authors,2024).

PRA and ABCD are community-based development approaches that emphasize the active involvement of communities in identifying their problems and potentials. PRA focuses on participatory collect local information, while ABCD focuses on empowering assets that the community already owns. In Japan, the apply these two approaches is very relevant to support the development of indigenous peoples, especially in the context of cultural revitalization, natural resource management, and improving the welfare of indigenous peoples in rural areas. PRA has been applied in various contexts of indigenous peoples in Japan, in particular to analyze community needs and identify local potential-based solutions. A study in Noto, Japan, used PRA to collect data through the active participation of indigenous peoples in building a transdisciplinary knowledge base that supports community-based development (Kitamura et al., 2023). This approach integrates PRA methods with interactive technology, allowing indigenous peoples to document and use local knowledge assets. In addition, the PRA approach is also used in public health programs involving indigenous peoples of Japan. The "Healthy Akame!" program, for illustration, involves community advisory boards to identify key health issues such as lifestyle diseases and provide solutions based on local resources such as agriculture and public spaces (Haya et al., 2020). The ABCD approach in Japan is used to empower indigenous peoples' local assets, including cultural traditions, natural resources, and social relations. For illustration, research in the Noto region highlights how indigenous communities leverage the results of community-based research to create a new cycle of knowledge that contributes to the development of asset-based communities (Kitamura et al., 2023). ABCD is also applied in the context of cultural revitalization of indigenous peoples. Through collaborative programs involving the government, academia, and communities, indigenous peoples in Japan are leveraging their cultural assets to create products and services based on local traditions that strengthen local cultural and economic identities (Haya et al., 2020). PRA and ABCD are complementary approaches in supporting the development of indigenous peoples in Japan. PRA provides a framework for identifying community problems and needs in a participatory manner, while ABCD leverages the power of local assets to create sustainable solutions. The implementation of these two approaches shows that the active participation of indigenous peoples can improve their well-being while respecting local cultural values and traditions.

In South Korea, this approach is particularly relevant to support sustainability in indigenous and rural communities, given the modernization and urbanization challenges they face. PRA is implemented in South Korea to involve indigenous and rural communities in planning sustainable development. In a study in Yeongju, a rural area in Korea, PRA was used to design community regeneration through the development of non-agricultural businesses. By involving local residents, especially

the elderly group, the project successfully identified local assets that can be leveraged to improve the community's economy, such as cooperation in sustainable small businesses (Baek & Kwon, 2021). In addition, the PRA approach is also used in the assessment of ecosystems in the border region of South Korea. The project leverages community participation to evaluate available ecosystem services and identify preferences for the development and conservation of ecosystem assets. As a result, cultural-related assets gain preference for development, while agricultural assets are more directed toward conservation (I. Kim et al., 2021).

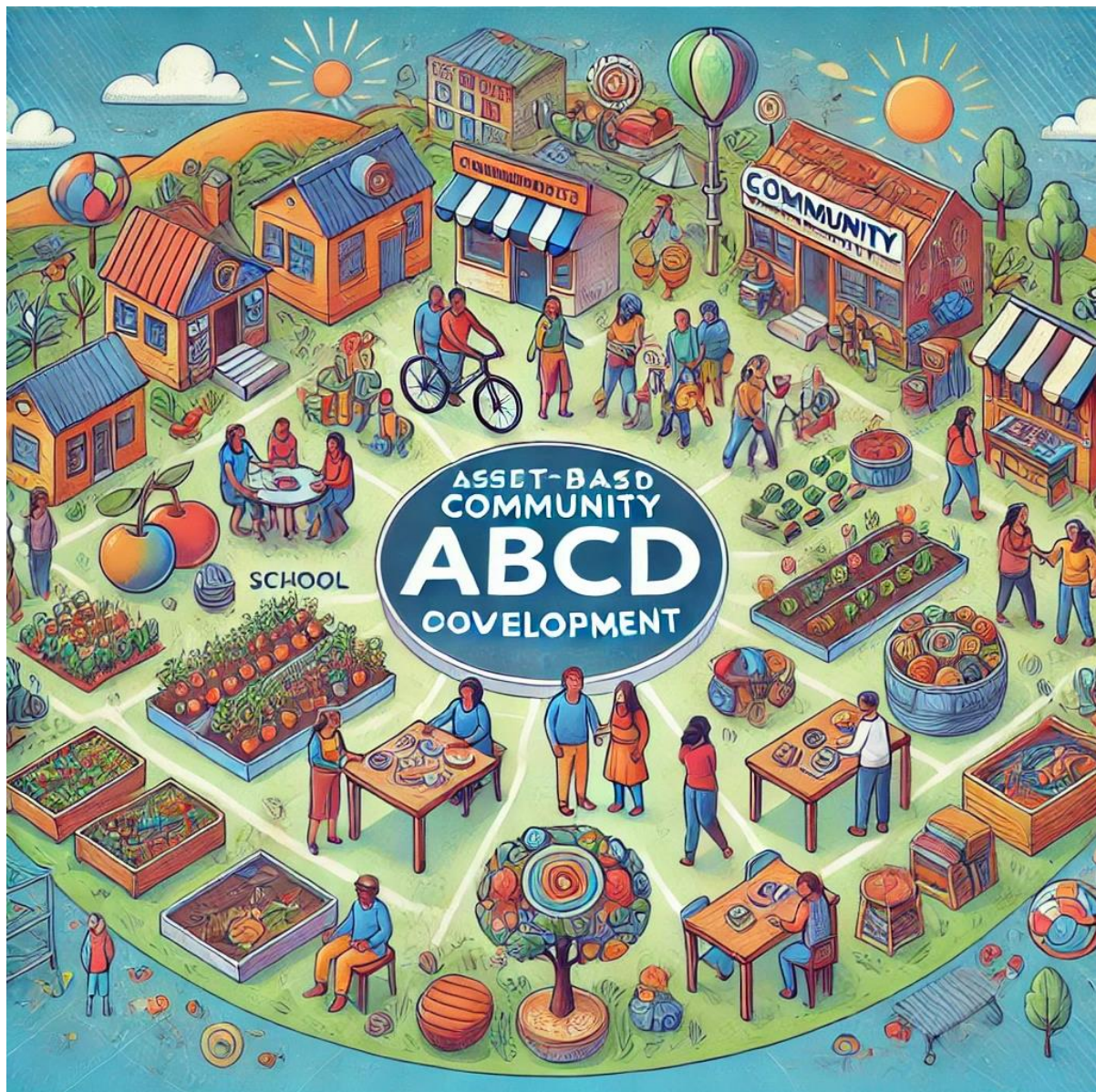


Figure 6.2. Illustration of ABCD (source: Authors,2024).

ABCD in South Korea is applied to empower the local assets of indigenous communities in the face of the challenges of globalization and urbanization. Studies on the apply community-based development models show that communities can

leverage their social and cultural assets to promote inclusive development. For illustration, the Saemaul Undong movement, adapted from traditional Korean practices, has succeeded in improving the welfare of rural communities by utilizing community cooperation as a key asset (Ofosu-Anim & Back, 2020). In the context of indigenous peoples in border areas, ABCD is also applied to support ecosystem preservation while creating economic opportunities. For illustration, this approach identifies local potentials such as rice farming and culture-based activities to drive economic development without sacrificing environmental sustainability (I. Kim et al., 2021). PRA and ABCD have shown success in supporting the development of indigenous peoples in South Korea. PRA is effective in identifying local needs and problems in a participatory manner, while ABCD leverages local assets to create sustainable solutions. This approach not only improves the well-being of the community, but also preserves the local culture and environment, making it a powerful tool for community-based development in the modern era.

In China, these two methods are used to support the development of indigenous peoples, especially in the context of cultural revitalization, natural resource management, and strengthening social ties affected by modernization and urbanization. The implementation of PRA in indigenous communities in China aims to encourage community participation in development planning. One case study in Fengqing County, Yunan Province, used this approach to strengthen the sustainability of rural communities. The project involves local residents in the design and construction of public areas, including green spaces and community facilities. This approach has succeeded in improving social relations among residents and encouraging collaboration in maintaining environmental quality (Yan et al., 2023). In addition, PRA is also applied in the development of ecotourism in indigenous communities in Guizhou, as happened in Miao Village of a Thousand Houses. Through this method, local communities are able to identify challenges in communication and management of tourism resources, thereby increasing their participation in decision-making and local cultural preservation (Y. Hu & Ngai, 2021). The ABCD approach in China is applied to use local assets as a key development force. For illustration, in Yucun Village, Zhejiang Province, ABCD is used for rural revitalization by utilizing the uniqueness of local natural resources and culture. Through this approach, villages have succeeded in developing sustainability strategies involving ecological conservation, collective financial management, and community-based economic innovation (Ma et al., 2024). ABCD is also applied in the context of developing cultural communication through social media in rural communities in Hunan Province. This approach involves the community in creating digital content that promotes local cultural products such as Huayao embroidery. This strengthens local cultural identity while creating economic opportunities through digital platforms (Pan & Liu, 2023). PRA and ABCD are complementary approaches in supporting the development of

indigenous peoples in China. PRA helps communities to identify challenges and needs through participatory methods, while ABCD prioritizes local forces to create sustainable solutions. The implementation of these two approaches shows success in improving the welfare of indigenous peoples, preserving culture, and supporting sustainable development in the era of modernization. The combination of these approaches becomes an effective model for community-based development in various contexts.

In Brazil, this approach is relevant to support indigenous peoples who often face social, economic, and environmental challenges due to the exploitation of natural resources and marginalization. PRA is applied in Brazil to assess the sustainability of indigenous communities in the context of local development. For illustration, a study of the Catu indigenous community in the state of Rio Grande do Norte shows how PRA is used to identify community challenges and potentials. Through techniques such as interviews and focused group discussions, indigenous communities are able to identify key issues such as environmental pressures due to urbanization and commercial cultivation of sugarcane. As a result, a community action plan was developed to introduce sustainability strategies that respect customs and support the sustainability of local cultures (Silva & Filgueira, 2020). PRA techniques such as SWOT analysis and participatory maps are used to understand social interactions, environmental dynamics, and access to public services. Indigenous peoples play an active role in formulating solutions that consider cultural preservation and improving their quality of life. The ABCD approach in Brazil focuses on the use of local assets to support the development of indigenous peoples. Research shows that indigenous peoples have a close relationship with their natural and cultural resources, which can be a foundation for sustainable development. For illustration, an asset-based development program in the Amazon region integrates local wisdom in natural resource management. Indigenous peoples leverage their traditional skills in forest management to support ecosystem conservation while creating economic opportunities through ecotourism and forest-based products. In addition, ABCD is applied in the development of cultural products of Brazilian indigenous communities. The program includes training in the design and marketing of products such as handicrafts and traditional foods, which aims to increase people's incomes and strengthen their cultural identity. Partnerships among indigenous communities, governments, and non-governmental organizations have successfully expanded the market for these products, creating an inclusive and sustainable development model. PRA and ABCD are complementary approaches in supporting the development of indigenous peoples in Brazil. PRAs allow communities to recognize their problems and potentials through a participatory process, while ABCDs leverage local assets to create sustainable solutions. The implementation of these two approaches not only improves the well-being of indigenous peoples but also preserves their local culture

and environment. This approach shows that inclusive and community-oriented development can be an effective tool to support the sustainability of indigenous peoples in Brazil.

Indigenous development in Papua requires an approach that focuses on inclusivity and capacity building for the younger generation, as mandated in the Papua RPJPD 2025–2045 Document. This document highlights the importance of access to quality education in remote and hard-to-reach areas, as well as the need to strengthen through scholarships and student exchange programs that can broaden the horizons and skills of Papuan children to contribute to regional development. One relevant method to achieve this goal is PjBL. This method involves learners in projects oriented toward developing practical, collaborative, and contextual skills that are aligned with local needs. The successful implementation of PjBL in various countries demonstrates its potential to support inclusive indigenous education. The implementation of PjBL with the Papua RPJPD 2025–2045 (Bapperida Provinsi Papua, 2024) allows project-based education to become a strategic tool in the development of indigenous peoples. Through a participatory and contextual approach, the young generation of Papuans can be empowered to become agents of change that contribute to cultural preservation and inclusive regional development.

6.3. Collaborative Initiatives to Improve Well-Being

Strengthening the capacity of indigenous communities is one of the strategic steps to preserve traditional values while improving community welfare. This process cannot be done unilaterally, but requires close collaboration among the government, academia, the private sector, and indigenous peoples themselves. Through holistic cooperation, training and education programs can be designed to meet the specific needs of the community. Some of the key approaches that have proven effective in these endeavors are the participatory empowerment model, Gradual Community Organizing, and Community-Based Human Resource Development. These three approaches are not only theoretically relevant but have also been proven through research and field practice in various countries.

1. Participatory Empowerment Model

The participatory empowerment model emphasizes the active involvement of indigenous communities in every stage of the empowerment process, from needs identification to outcome evaluation. This approach aims to ensure that indigenous peoples are not only the object of policy, but also as subjects who have control over decisions that affect their lives. The main goal of the participatory empowerment model is to increase the independence of indigenous communities in managing their resources, involving them in decision-making, and promoting social, economic, and environmental sustainability. By providing space for indigenous peoples to participate, this approach helps them maintain their cultural identity while benefiting

from relevant and sustainable development (Sidiq, 2020). This model involves various actors who play a role in its implementation, namely indigenous communities as the main actors who determine the needs, priorities, and direction of the program; the government as a facilitator and provider of policies, funds, and supporting infrastructure; academics who provide data-driven analysis, methodologies, and evaluations to ensure the relevance and effectiveness of the program; the private sector that supports financially and technically through corporate social responsibility (CSR) initiatives; and civil society organizations (CSOs) that act as mediators among the needs of indigenous communities and other external actors (Kameswara & Suhirman, 2017). The participatory empowerment model is designed to solve various problems that indigenous communities often face, such as the lack of indigenous peoples' involvement in development policies that make the results irrelevant to local needs, inequality of access to resources and services, threats to cultural sustainability due to the influence of globalization, and dependence on external help without sustainable support. This approach provides some benefits, including the independence of indigenous communities in managing their resources, increased sustainability of relevant and sustainable programs, cultural preservation by respecting indigenous traditions and values, and improved well-being through better access to education, health, and economic opportunities (Taufik, 2020). However, the implementation of the participatory empowerment model also faces various challenges, such as power imbalances among external actors and indigenous communities that can hinder full participation, limited budgets, support staff, and infrastructure, internal resistance from communities that may resist change due to concerns or lack of understanding, as well as low administrative capacity at the community level. To ensure the success of this model, several important elements are needed, including capacity building through training and technical mentoring, inclusive policies that take into account the needs of indigenous peoples, effective collaboration among actors, and a robust monitoring and evaluation system to monitor the progress and sustainability of the program (Rahmani et al., 2023). The success of the participatory empowerment model can be measured through increasing the independence of indigenous communities in managing programs without dependence on external parties, improving welfare indicators such as health, education, and income of indigenous peoples, the sustainability of programs that continue to run and provide long-term benefits, and the high level of indigenous peoples' involvement in each stage of the program. By actively engaging them, this approach not only strengthens community self-reliance but also ensures that indigenous values remain an integral part of development (Sidiq, 2020).

The participatory empowerment model has been applied in various countries and contexts through studies that show its success in empowering communities. For illustration, Indonesia has developed a participatory-based education model in

disaster management, such as participatory mapping in scrape-prone areas in Sarang, Central Java. The results show that the active involvement of the community in this activity increases the capacity of community knowledge and attitudes, as well as produces scrape maps that are used for recommendations to local governments (Hamid, 2022). In the context of the creative economy, research in Indonesia shows that empowerment based on the creative economy is effective in increasing people's economic independence. These programs use a community asset-based approach to empower females MSMEs and village communities (Mushufa et al., 2024). In Panggang Island, Seribu Islands, the participatory empowerment of pregnant females for stunting prevention has been successfully carried out by involving the role of the family, especially husbands, midwives, and village heads. The results show that this model can explain up to 99% of the variability of data in reducing the risk of stunting (Sari & Hakim, 2023). In Asmat Regency, Papua, the empowerment program for remote indigenous communities use an evaluation approach based on the Stake model. This approach adjusts the needs of the community to local policies, despite challenges in the allocation of budget for non-physical activities (Wahyudin, 2019).

In South Africa, the apply the participatory empowerment model is manifested in various contexts through policies and legal mechanisms. One of the significant studies discusses the role of community participation in Integrated Development Plans (IDPs) in local governments. IDPs are policies designed to involve communities in integrated planning and delivery of public services. However, research shows that community participation is often passive and more formal. Citizens are usually only informed about what has been or will be done without real participation in decision-making. Existing mechanisms tend to be top-down and have not effectively empowered local communities. To improve effectiveness, research suggests the importance of a bottom-up participatory communication approach that advises "participation as the terminate goal" rather than just a tool to achieve administrative goals (Molale, 2022). In addition, another study highlights the importance of a collaborative governance model to integrate horizontal relationships among public officials as well as vertical relationships with communities. This model includes participatory interactions that allow the community to play a central role in the decision-making process. This approach helps South Africa transition from an elitist-based democracy based on dependency to a participatory democracy model in which communities work alongside the government to achieve national development goals, as formulated in the National Development Plans (NDPs) 2030 (Auriacombe & Meyer, 2020). Although South Africa has developed legal and policy frameworks to encourage community participation, the challenge in implementing this model lies in the need to change the approach from top-down to bottom-up and improve community empowerment through more meaningful collaboration among government and citizens.

In Hungary, the apply participatory empowerment models has been carried out in a variety of contexts, including in social housing design and desegregation policies. One study showed how participatory design methods are used in the construction of social housing for low-income groups. This process allows marginalized groups to participate in the initial decision-making related to the design of their living space. In this study, a "coding engine" based on the concept of "pattern languages" was developed to put the daily needs and experiences of residents at the center of design. As a result, about 45% of the initial design decisions were made with or by the participants, thus raising their awareness to adopt a sustainable lifestyle (Bukovszki et al., 2021). In addition, another study conducted in Szeged, Hungary, showed how participatory action research was used to explore the desegregation of Roma communities. The research focuses on the empowerment of Roma community leaders in a participatory framework to challenge existing power asymmetry. Although this approach has succeeded in increasing the recognition and influence of representatives of the Roma community, challenges remain as local government policies tend to maintain a neoliberal logic that distinguishes among the "decent poor" and the "unworthy". As a result, the poorest groups in the community are increasingly vulnerable even though several other members of the community benefit (Méreiné-Berki et al., 2021). Through these approaches, Hungary shows how participatory empowerment can improve policy inclusivity and social sustainability, although there are still challenges in changing existing power structures to truly empower marginalized groups.

In Finland, the implementation of the participatory empowerment model is carried out through various initiatives that involve the community directly in the public decision-making process. One significant illustration is the OmaStadi platform, a digital participatory budgeting mechanism in Helsinki that allows citizens to submit project ideas and choose city spending priorities. The study shows that OmaStadi opens up opportunities for communities to contribute to urban planning collectively, although it also faces challenges related to epistemic exclusion that limits citizens' knowledge in the decision-making process. Nevertheless, OmaStadi has become an important illustration of digital-based urban democracy that supports the involvement of the wider community in opposing privatization and promoting the preservation of cultural heritage (Tseng et al., 2024). In addition, another study highlights the endeavors of Finnish local governments in creating participatory arrangements that allow citizens to be involved in planning and decision-making, both in the public service sector and spatial planning. The study found that public participation in Finland combines two main approaches, the democratic value of participation and the instrumental value of improving service efficiency. However, some challenges remain, including tensions among strong bureaucratic traditions and the need for a more collaborative approach (Värttö, 2024). Other initiatives

highlight the involvement of children and youth in participatory budgeting, which aims to integrate the voices of young people into the decision-making process. The study highlights the importance of the "ownership" dimension in ensuring inclusion, by providing children and adolescents with real opportunities to contribute to local planning. However, it has also been identified that the risk of less substantial inclusion is if ownership is not balanced with endeavors to empower participants in a tangible way (Lehtonen, 2023). Finland shows how technology-based and collaborative participatory empowerment models can enhance the legitimacy of public policy by positioning the community as key partners, despite challenges in aligning the values of participation with traditional bureaucratic frameworks.

The apply participatory empowerment practices to indigenous peoples can help strengthen their rights, increase collaboration with governments, and ensure inclusion in decision-making processes. It is important to adapt these practices to the local culture, values and context of indigenous peoples for maximum results, some of which can be highlighted including transparency and public consultation, from Finland, transparency-based approaches and public consultation can be applied in indigenous peoples. By providing a digital platform or physical space for indigenous peoples to express their aspirations, communities can be more involved in decision-making that affects their lives. Mechanisms such as OmaStadi show that digital engagement allows for broader inclusion, although it must be adapted to the accessibility of technology within indigenous communities (Tseng et al., 2024). Ownership in the Process of Participation, a Hungarian study of participation in the design of social housing shows the importance of placing the community as the owner of the process. Giving indigenous peoples direct control over important decisions can increase their sense of responsibility for the outcome of a policy or project, such as how Hungarians participate in determining the allocation of space and resources in social housing design (Bukovszki et al., 2021). Strengthening Local Leadership, from the experience of the de-aggregation of Roma communities in Hungary, is important to strengthen the role of indigenous leaders in the participatory process. By empowering them to negotiate and represent communities, such as the leaders of Rome who play a central role despite facing structural challenges, indigenous peoples can be better able to advocate for their rights and needs before the government (Méreiné-Berki et al., 2021). Collaboration among government and community, South Africa provides lessons on the importance of close collaboration among government and community in IDPs. Although top-down approaches often reduce effectiveness, involving indigenous peoples at every stage, from planning to evaluation, can improve policy sustainability and ensure that they reflect the needs of indigenous peoples (Molale, 2022). Inclusion of the young generation, a Finnish practice that involves children and adolescents in a participatory budget highlights the importance of creating a space for indigenous young people to get involved. This

helps ensure cultural continuity and ensures that decisions are made in line with the cross-generational needs of indigenous communities (Lehtonen, 2023). As a result, active community participation not only increases a sense of ownership but also supports sustainable development at the local level (Kameswara & Suhirman, 2017).

2. Organizing the Community Gradually

Gradual community organizing is an integral strategy designed to empower communities through a systematic and sustainable approach. This approach involves several important stages, from community integration, mapping issues and potentials, to designing actions and evaluating success. Each stage is designed to ensure that community empowerment is effective by taking into account the local context, potential, and specific needs of the community concerned. This model aims to empower communities to actively participate in designing and implementing relevant programs, as well as improving social, economic, and environmental sustainability. Studies show that this model increases the capacity, independence, and participation of local communities in decision-making (Dushkova & Ivlieva, 2024). Key actors in this approach include local communities, local governments, non-governmental organizations (NGOs), and the private sector. Cross-sector partnerships are often key to success because they allow for more effective resource allocation and more holistic solutions (Rusch et al., 2021). This model can overcome various challenges, such as lack of access to education, basic services, and poor resource management. In the field of waste management, for illustration, an empowerment-based approach has been proven to increase community creativity in waste management and change community behavior related to waste (Pratama et al., 2021). Effective implementation can increase community independence, collaboration, and responsibility. This model can also support sustainable development by integrating local knowledge and community values (Kurniawan et al., 2023). The main challenges include a lack of local capacity, communication barriers among actors, and a lack of synergy among stakeholders. The lack of commitment from local leaders is also a significant obstacle (Foluke Ejitayo Adediran et al., 2024). The need for implementation requires inclusive policy support, sustainable funding, training, and adequate capacity for communities and stakeholder engagement from the beginning. The use of innovative technologies can also support better implementation (Rusch et al., 2021). Success can be measured through the level of community participation, improved welfare, and sustainability of the resulting programs. More indicators include efficiency in program implementation and measurable socio-economic impact (Dushkova & Ivlieva, 2024). With systematic and collaborative organization, this approach not only offers solutions to various community problems, but also creates an ecosystem that supports sustainable development. In practice, found in Indonesia, this model is applied to the management of the Karang Kiring Mangrove tourist attraction in Gresik. The stages of community

participation involve the contribution of ideas, energy, and skills, all of which are managed in stages. Through this approach, the community can make a significant contribution to the sustainable development of tourist attractions (Wirawan et al., 2023). Similarly, in the management program of the Paku River Dam in South Kalimantan, the community organizing approach has gradually been proven to increase active community participation. This program involves the preparation stage, goal formulation, needs identification, and evaluation, by involving all stakeholders in the process (Sidiq, 2020).

Community organizing has gradually been implemented in China to support community empowerment in various development programs, especially in the sectors of post-disaster reconstruction, community education, and local management. This approach focuses on systematic stages involving community integration, mapping potentials and issues, designing solutions, and evaluating to ensure program sustainability. This approach aims to create a community that is more self-reliant and able to manage local challenges effectively. In addition, this model advises the strengthening of civil society through increasing the capacity of citizens to participate in local governance. For illustration, after the 2008 Sichuan earthquake, this approach was used to rebuild communities by involving communities in decision-making related to the construction and management of public facilities (M. Hu & Zhu, 2021). Various actors are involved in community organizing in China, including NGOs, local governments, universities, and local community leaders. NGOs play an important role in facilitating dialogue among governments and communities, while local governments provide policy support and funding. A relevant illustration is the role of NGOs in increasing post-disaster community engagement in Sichuan and managing community capacity building through local participation (G. Hu et al., 2022). This model is used to address various challenges, such as lack of community participation in decision-making, weak local capacity in resource management, and dependence on external help. In a post-disaster context, this approach helps address issues such as lack of access to basic services and a low sense of community ownership of programs designed for them (Zhang & Perkins, 2023). The implementation of this model brings various benefits, including increasing the capacity of the community to manage their own needs, active participation in decision-making, and strengthening social cohesion. In the community education sector, this approach also helps create lifelong learning programs that are oriented to local needs (Zhang & Perkins, 2023). However, this approach faces challenges such as limited resources, NGOs' reliance on government funding, and political barriers in encouraging communities to be more actively involved. In some cases, community engagement is still low due to a lack of understanding of program objectives or lack of support from local governments (G. Hu et al., 2022). This model can be implemented well, clear policy support, ongoing funding, training to increase the capacity of local actors, and

a flexible framework to adapt to local needs. Collaboration among actors is also an important element to ensure the successful implementation of the program (M. Hu & Zhu, 2021). The success of this model is measured by the level of community participation, local capacity building, and the sustainability of the resulting programs. In addition, success can also be seen in people's reduced dependence on external help and their ability to solve problems independently (Zhang & Perkins, 2023). The gradual adoption of the community organizing approach in China shows that this model can be an effective tool for building local capacity and strengthening civil society, despite challenges that need to be addressed through broader support and commitment from various parties.

The approach of gradual community organizing in Japan is widely known, especially through initiatives such as Machizukuri, which play an important role in community empowerment and improving disaster resilience. This implementation involves a step-by-step process that includes community integration, mapping local issues, and evaluating success. An illustration can be seen in the answer to the 2011 Tōhoku earthquake and tsunami, where local communities and Machizukuri filled the void caused by the slow central government response (Siawsh et al., 2021). This approach aims to increase resilience, empower communities to make collective decisions, and ensure the sustainability of development programs. In the context of public health, this approach is used to identify key problems such as lifestyle diseases and improve access to health services through local cooperation (Haya et al., 2020). The main actors include local governments, community organizations such as Machizukuri, universities, and community individuals. Collaboration among these actors is crucial for the success of the program (Haya et al., 2020). This approach can address challenges such as lack of access to resources, demographic issues such as population aging, and the need to increase health and environmental awareness (Maeda & Kodate, 2024). Communities benefit from improved health, stronger collaboration, and more relevant locally-based programs. Projects such as "Healthy Akame" raise health awareness through the use of local assets and the adaptation of Japanese culture (Haya et al., 2020). Key barriers include resource constraints, generation gaps, and communication challenges among communities and local governments. For illustration, the Machizukuri program often faces obstacles in achieving effective coordination among government agencies (Siawsh et al., 2021). For successful implementation, training for community leaders, consistent policy support, and cross-sector collaboration are needed. The use of technology, such as community information systems, can also strengthen program implementation (Maeda & Kodate, 2024). Success measures: success can be measured through community participation rates, improved health indicators, and visible positive impacts on social well-being. In addition, efficiency in coordination among stakeholders is a key indicator of success (Haya et al., 2020). This approach shows

how community-based empowerment can have a profound impact in addressing local issues and creating sustainable solutions.

The gradual approach of community organizing in South Korea is carried out through a systematic strategy involving various actors to address local issues, increase community capacity, and ensure the sustainability of empowerment programs. Concrete illustrations of the apply this model are in smart city management, community-based forest management, and pandemic response. This model aims to encourage community empowerment through the active participation of citizens in planning and decision-making relevant to local needs. In the context of smart city management, the main goal is to create more inclusive and network-based governance among the government, society, and the private sector (Lim et al., 2023). Local governments, community organizations, universities, and the private sector are key actors in the implementation of this approach. In Seoul, for illustration, the city government established an intermediary organization to facilitate collaboration among the government and citizens in urban regeneration projects (J. Y. Kim et al., 2023). This approach is used to solve various problems, such as lack of access to resources, social inequality, and environmental challenges. In community-based forest management, this model helps solve the problem of exploitation of natural resources and improve the sustainability of local ecosystems (Purnomo et al., 2020). This model provides benefits in the form of increased cross-sector collaboration, improved quality of life, and increased regional competitiveness. For illustration, smart cities such as Songdo and Sejong have succeeded in improving technology accessibility and efficiency of public services through community-based management (Lim et al., 2023). Key challenges include complex coordination among actors, budget constraints, and capacity gaps at the local level. In urban regeneration, for illustration, intermediary organizations often face obstacles in ensuring inclusive participation and preventing dependence on government intervention (J. Y. Kim et al., 2023). Successful implementation requires strong policy support, consistent citizen participation, and community-based training. The use of digital technology and the establishment of collaborative networks are also very important, as is done in smart city projects (Lim et al., 2023). Success can be measured through improving the quality of life of the community, increasing citizen participation in the decision-making process, and positive impact on social and environmental sustainability. Urban regeneration studies in Seoul show that success is determined by the level of community participation and the outcomes directly perceived by the community (J. Y. Kim et al., 2023). This approach shows great potential to create adaptive and sustainable solutions, especially through effective participation and collaboration at various levels.

Community organizing is gradually being implemented in Italy in various community-based initiatives, such as renewable energy management and

community-based infrastructure development. This approach aims to improve community empowerment through active involvement in the planning, implementation, and evaluation of sustainable local projects. This approach aims to create more self-reliant, sustainable, and competitive communities through the management of local resources, especially in the context of renewable energy. In Italy, the development of Renewable Energy Communities (RECs) aims to reduce carbon emissions, improve energy efficiency, and strengthen social inclusion (Candelise & Ruggieri, 2020). The main actors in this implementation include local governments, community members, private companies, and CSOs. For illustration, REC involves collaboration among consumers, local energy producers, and the private sector to optimize renewable energy production and consumption (Zatti et al., 2021). This model helps address various problems, such as dependence on fossil energy, inequality of energy access, and lack of community involvement in the management of local resources. In the energy sector, community organizing aims to create energy independence and reduce operational costs for its members (Trevisan et al., 2023). The benefits of this approach include improved quality of life, energy efficiency, and social empowerment. For illustration, the development of RECs in Italy has succeeded in reducing carbon emissions by 38% and supporting more than 50 families through income from RECs (Cutore et al., 2023). Challenges include regulatory barriers, lack of funding, and resistance to change. Another challenge is to integrate the interests of the various parties involved in RECs without sacrificing sustainability goals (Grignani et al., 2021). Success requires strong regulatory support, adequate funding, and training and education for the community. The use of modern technology, such as digital-based energy monitoring systems, is also important to optimize the implementation of REC (Cielo et al., 2021). Success is measured through reduced carbon emissions, increased community participation, and positive economic impacts, such as a high return on investment (ROI). For illustration, REC in Italy shows an ROI of more than 11% with a 45% reduction in CO₂ emissions (Cielo et al., 2021). With this phased approach, Italy has shown how cross-sector collaboration can create sustainable solutions that have a significant social, economic, and environmental impact.

Indigenous peoples can learn that cross-sectoral collaboration—among communities, governments, and the private sector—can be an effective strategy for managing their resources. For illustration, the renewable energy community in Italy shows that the involvement of various actors helps create sustainable solutions that benefit all parties (Zatti et al., 2021). The energy community in Italy uses modern technologies, such as digital energy monitoring systems, to improve efficiency and transparency. Indigenous peoples can adapt relevant simple technologies to support natural resource management and protect their cultural heritage (Cutore et al., 2023). The community-based approach in Italy highlights the importance of collective

management to create mutual benefits. Indigenous peoples can apply these principles in the management of their customary lands, forestry, and water resources, strengthening internal solidarity and economic independence (Grignani et al., 2021). The Italian model shows that active community participation increases a sense of ownership toward the program. Indigenous peoples can learn to strengthen their cultural identity through active participation in the planning and implementation of local development programs that are in line with their traditional values (Trevisan et al., 2023). Indigenous peoples can learn how to fight for rights and supportive policies, as did the energy community in Italy that overcame regulatory barriers and advocated for policy support for the sustainability of their projects (Candelise & Ruggieri, 2020). The phased approach in Italy emphasizes data-driven evaluations, such as carbon emission reductions and ROI. Indigenous peoples can apply impact-based success measurement to demonstrate the benefits of their programs to stakeholders, both socially and environmentally (Cielo et al., 2021).

The gradual approach of community organizing implemented in Italy provides valuable lessons for indigenous peoples around the world. One important lesson is the need for cross-sector collaboration involving local communities, governments, and the private sector to manage resources effectively. This approach shows that modern technologies, such as digital-based monitoring systems, can support efficiency and transparency in the management of natural resources. In addition, collective management implemented in Italy can inspire indigenous peoples to strengthen solidarity and economic independence through similar models in managing indigenous lands, forestry or other resources. Active participation is also an important element to strengthen cultural identity while increasing the community's sense of ownership of development programs. Despite facing challenges such as regulatory and funding barriers, the Italian model shows that advocacy for supportive policies can open up new opportunities for program sustainability. Success measured through tangible impacts, such as reducing carbon emissions and improving community well-being, is proof that planned and data-driven management can strengthen sustainability. For indigenous peoples, this lesson is a guide to managing local resources in an inclusive and sustainable manner, while maintaining their cultural values. By adopting these principles, indigenous peoples can strengthen their capacity to face global challenges while protecting their cultural and environmental heritage.

3. Community-Based Human Resource Development

A relevant model of scientific approach in Community-Based Human Resource Development (CBHRD) to enhance indigenous peoples' knowledge, skills, and awareness is a community-based approach that integrates local knowledge and cultural values into development programs. This approach aims to empower indigenous peoples through strengthening local capacity, cultural preservation, and

improving their socio-economic well-being. This is achieved by integrating traditional knowledge into various education and skills development programs (T.M & Vijayanand, 2023). Key actors include indigenous peoples as core actors, governments as policymakers, educational institutions as facilitators, and NGOs that provide technical support and resources. Collaboration among these actors is critical to ensuring the program runs effectively (Root-Bernstein et al., 2023). This approach is designed to address cultural marginalization, loss of traditional knowledge, and educational gaps within indigenous communities. This model also aims to increase recognition of indigenous peoples' contributions to environmental conservation and sustainable development (Raul et al., 2021). Key benefits include strengthening cultural identity, increasing access to locally relevant education, and improving job skills that suit the needs of the community. Challenges include a lack of resources, resistance to change, and a lack of coordination among actors. The adoption of traditional knowledge into formal programs also faces technical and cultural constraints (U. Brownson et al., 2024). Strong policy support, active community involvement, and training for facilitators are needed to understand and respect local culture. Investment in the documentation and digitization of indigenous knowledge is also important (Menon et al., 2023). Success can be measured from increased community participation in the program, preservation of indigenous knowledge and culture, and measurable socio-economic impact. Another indicator is the integration of indigenous knowledge into policy and formal education (McAllister et al., 2023). This model offers a holistic solution for the empowerment of indigenous peoples, by placing local culture and knowledge at the core of human resource development. For illustration, in Indonesia, training on the use of information technology for public reporting has increased public participation in public decision-making in Palembang. This program shows that with the improvement of technical skills, the community can more actively participate in transparent governance (Kariem, 2021). Another relevant program is community help in the construction of tahfidz huts in Parepare, South Sulawesi. This help uses the Community-Based Research (CBR) method, which not only increases the capacity of human resources but also ensures the sustainability of physical development through improving the technical skills of the community (Rahmani et al., 2023).

CBHRD aimed at increasing the knowledge, skills, and awareness of indigenous peoples in Turkey reflects a global trend in engaging local communities to strengthen their capacities in a sustainable manner. This community-based approach focuses not only on individual development, but also on cultural preservation and empowerment of indigenous peoples. Several studies support the importance of this approach. For illustration, community-based intervention programs in Turkey have shown effectiveness in improving the readiness of children of vulnerable communities for formal education, through a skills-based curriculum that focuses on cognitive, language, and social-emotional development (Erdemir, 2022). Another study

highlights the importance of local community involvement in the preservation of traditional knowledge and the development of local knowledge-based curricula that can enhance the ecological awareness and self-reliance of indigenous peoples (Li & Shein, 2023). In addition, research on indigenous peoples' empowerment in resource management shows that knowledge sharing among indigenous communities and western knowledge systems can improve community welfare and improve the quality of information exchanged (Jarvis et al., 2021)). On the other hand, capacity building through distance training has also proven effective in equipping indigenous peoples with relevant technical skills, such as repair and maintenance of computer equipment (Navarrete et al., 2019). This community-based approach as a whole not only enhances individual capabilities but also strengthens the cultural identity and social solidarity of indigenous peoples. This effort can be a model of inclusive and sustainable human development.

CBHRD in South Africa, which focuses on increasing indigenous peoples' knowledge, skills, and awareness, shows progress through a variety of local tradition-based approaches and community collaboration. This practice uses indigenous knowledge as social capital to support sustainable development. Research shows that indigenous peoples' organizations in South Africa are successfully leveraging traditional knowledge for social innovation and entrepreneurship. For illustration, two organizations in the Mpumalanga and Limpopo regions use local knowledge to create economic opportunities and build collaborative networks involving local and international stakeholders (Moganoid et al., 2022). In addition, the integration of indigenous knowledge into the educational curriculum was also identified as an important step to enhance students' cultural identity and ecological awareness, although challenges such as lack of resources still exist (Mbeshu-Mhlauli, 2023). Other studies underscore the importance of a participatory approach to community-based development. Indigenous peoples in Mabheleni face challenges in utilizing their traditional knowledge due to the top-down approach by the government, which emphasizes the need to empower communities through a bottom-up approach (Mseleku, 2024). The digitization of indigenous knowledge is also considered a strategic step for the preservation and empowerment of communities in the long term (Masenya, 2023). This community-based development reflects a significant effort in strengthening the capacity of indigenous peoples, connecting local traditions with modern innovations to create inclusive and sustainable development.

CBHRD in Uganda that focuses on increasing the knowledge, skills and awareness of indigenous peoples demonstrates innovative approaches in engaging local traditions to support sustainable development. One illustration of an initiative is a community-based program to train and empower the Batwa indigenous people through lifelong education and decolonization programs. The study highlights the importance of entrepreneurship and life skills education, designed by local culture to

support the empowerment of indigenous communities in Uganda (Sekiwu et al., 2024). Another community-based program is "Obuntu bulamu," an intervention that combines local values of humanity and togetherness to support the inclusion of people with disabilities. The program involves children, parents, and teachers in training activities that increase awareness and acceptance of people with disabilities (Mbazzi et al., 2020). In addition, community-based goat breeding programs have been implemented in Uganda to preserve the genetic diversity of local livestock and increase the productivity of smallholders. The program engages farmers in pasture conservation, feed production training, and collective management, which shows positive results in increasing income and sustainability of the program (Kaumbata et al., 2021). This community-based approach integrates local traditions and modern methods to create sustainable solutions, whether in the areas of education, agriculture, or social inclusion, that help empower indigenous peoples holistically. These endeavors reflect the great potential of a community-based approach to address socio-economic challenges in Uganda.

CBHRD in Japan, particularly in the context of indigenous peoples, highlights the importance of location-based approaches and local traditions in supporting sustainability. A study of the Forest Community Outreach (FCO) project in Ena City, Japan, illustrates how location-based resources can be used in education for sustainable development. The project involves high school students and business consultants, who work together to leverage local resources and strengthen sustainability awareness. The results show that the use of these local resources can increase participants' creativity and learning outcomes, as well as support sustainability education goals (Hakeem et al., 2024). Other community-based educational programs in Japan also integrate local and traditional ecological knowledge into the curriculum to create a deeper sense of place for students. Through this location-based approach, students can understand sustainability issues in their local contexts and build a holistic perspective on environmental and cultural preservation (Li & Shein, 2023). This community-based approach to education based on local uniqueness shows great potential in increasing the awareness and skills of Japan's indigenous peoples to support long-term sustainability. This practice provides inspiration for creating human development programs that combine local traditions with modern educational innovations.

CBHRD in China focuses on the integration of local and indigenous knowledge to improve the skills, knowledge and awareness of indigenous peoples. A study in Mangba Village, Yunnan Province, highlights how the Bulang people use indigenous knowledge to conserve forests and wildlife through practices such as moral control, worship rituals, and oral knowledge inheritance. However, challenges arise when these practices are not by scientific guidelines, for illustration in bird observation ecotourism, which requires the integration of scientific knowledge with local wisdom

for more effective ecosystem protection (Su et al., 2020)). In addition, research in Guizhou shows how indigenous knowledge systems support the management of natural resources in mountainous agricultural landscapes. Through participatory mapping, it was found that local knowledge about water management, forests, and agriculture creates ecological sustainability as well as maintains cultural diversity. This knowledge has also been successfully passed on to the next generation, making it a model for sustainable resource conservation and use (Wang et al., 2021). On the policy side, the Chinese government has begun to integrate local and indigenous knowledge in nature-based solutions (NbS) to support climate change mitigation and biodiversity conservation. This approach involves education, community participation, and local knowledge preservation, but still requires more consistent implementation at the local level and long-term multi-stakeholder participation (Yu & Mu, 2023). A community-based approach that combines indigenous knowledge with scientific innovation in China has shown success in supporting sustainable development, although challenges in harmonizing the two approaches remain.

The CBHRD approach provides many important lessons in the sustainable development of indigenous peoples. The main goal of this model is to increase the knowledge, skills, and awareness of indigenous peoples to support economic well-being, environmental preservation, and cultural sustainability, while integrating local traditions with modern innovations. Its success involves a wide range of actors, including local communities, governments, NGOs, academia, and the private sector who contribute through funding, mentoring, and policy support. This approach successfully solves various challenges, such as environmental degradation, socio-economic disparities, loss of tradition, and lack of inclusivity in decision-making, while providing great benefits in the form of environmental conservation, improved economic well-being, strengthening cultural identity, and integration of local knowledge into modern policies and practices. However, this approach also faces some challenges, such as limited policy support and funding, tensions among indigenous and scientific knowledge, the threat of globalization, and a lack of infrastructure and human resources. To be successful, this approach requires supportive policies, cross-sector collaboration, long-term funding, community-based education, and monitoring and evaluation systems to ensure program sustainability. The measure of success can be seen from improving the quality of life of indigenous peoples, environmental sustainability, active participation in development initiatives, formal recognition of indigenous knowledge, and strengthening the capacity of local communities. As such, the model emphasizes the importance of empowering indigenous peoples through an approach that respects local traditions, supports ecological sustainability, and advises innovation to face global challenges in an inclusive manner.

The three key approaches to capacity building of indigenous communities—the participatory empowerment model, Progressive Community Organizing, and Community-Based Human Resource Development—provide a comprehensive framework for creating sustainable change. This approach is not only relevant but also complementary, especially when combined with the active engagement of various stakeholders. In the context of indigenous community-based development, collaboration among the government, academia, the private sector, and the community itself is the key to success. Consistent implementation of this approach ensures that traditional values are preserved, while promoting economic and social well-being.

The government plays a major role in creating an environment that supports the implementation of indigenous community empowerment approaches. One of the main ways the government contributes is through the provide funding and regulation. For illustration, Law Number 59 of 2024 explicitly emphasizes the importance of creating an inclusive collaborative mechanism for indigenous community-based development. These regulations provide the legal basis for programs designed to empower indigenous peoples, while ensuring that this approach is based on the principles of sustainability and social inclusion. Funding from the government can be used to support skills training, the provide basic infrastructure, and community capacity building programs. For illustration, funding can be directed to the development of key sectors such as fisheries, handicrafts, and product processing. In addition, regulations that recognize indigenous rights are also needed to ensure that community-based development does not conflict with the traditional values of indigenous peoples. The regulation could also include incentive policies for the private sector that partner with indigenous communities, thereby encouraging investment in indigenous territories.

Academics have a strategic role to play in ensuring that indigenous community empowerment programs are designed based on local needs and potentials. Academic research can help identify the skills most needed by indigenous communities, as well as economic opportunities that are appropriate to local conditions. In addition, academics can develop relevant training curricula, for illustration culture-based training to preserve traditions while increasing economic capacity. Through collaboration with communities, academics can also document local knowledge that is often unwritten. This knowledge can be the basis for designing programs that are not only economically beneficial but also preserve culture. For illustration, training in traditional-based forest management can combine local wisdom with a scientific approach, thereby increasing environmental sustainability while providing economic benefits. The private sector has an important role to play in creating economic opportunities for indigenous communities through strategic partnerships. One form of private sector contribution is through product processing

and marketing of traditional products. For illustration, Papuan handicraft products and local fishery products can be marketed nationally and internationally through logistics support and market access provided by the private sector.

Successful initiatives in these sectors have shown that cross-sector collaboration can significantly increase indigenous peoples' incomes. For illustration, cooperation among companies and indigenous communities in the fisheries sector not only increases income but also introduces environmentally friendly technologies that support the sustainability of natural resources. With incentives from the government, the private sector can be more encouraged to invest in indigenous community development programs, which ultimately creates a mutually beneficial symbiotic relationship. While this approach has great potential, some challenges remain. One of them is the lack of coordination among stakeholders, which can hinder the effective implementation of the program. In addition, limited resources, both in funding and infrastructure, are often the main obstacle. Solutions to these challenges involve improving cross-sectoral coordination through the establishment of forums or consultation mechanisms involving all stakeholders. In addition, long-term commitments from all parties are needed, including the provide sustainable funding and capacity building for indigenous communities. Education and training also need to be focused on skills relevant to local needs, while ensuring knowledge transfer to the next generation.

The success of this approach can be measured through several indicators. First, the improvement of the quality of life of indigenous peoples, which can be seen from more stable economic income and better access to basic services. Second, environmental conservation, which reflects the success of community-based natural resource management programs. Third, the active participation of indigenous peoples in development programs, which shows the community's sense of ownership and commitment to the initiative. Finally, the recognition of indigenous knowledge in public policy is a sign that traditional values have been integrated with modern development approaches. All three approaches—participatory empowerment model, Progressive Community Organization, and Community-Based Human Resource Development—form a robust framework for strengthening the capacity of indigenous communities. By involving governments, academia, the private sector, and indigenous peoples themselves, this approach can create relevant, sustainable, and inclusive solutions. The consistent implementation of these three approaches not only strengthens indigenous communities economically and socially, but also ensures that their traditional values are preserved in the midst of changing times. Close cross-sectoral collaboration, with strong policy support as stipulated in Law Number 59 of 2024, is the key to creating sustainable and effective indigenous community-based development.

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7.1. Key Pillars of Adaptive Innovation Systems

The design of innovation systems based on indigenous peoples' involvement, sustainability policy support, and local technology can be referred to systemic innovation theory, which integrates social, economic, and technological elements. This approach emphasizes the importance of knowledge co-production, transdisciplinary collaboration, and recognition of local knowledge as part of the innovation system. Traditional knowledge of indigenous peoples is the accumulation of experiences, practices, and beliefs that are passed down from generation to generation and used to manage the environment sustainably. This definition includes local insights into the flora, fauna, weather, and ecosystems on which their ecological and social practices are based (Bansal et al., 2024). The use of indigenous knowledge is starting to receive serious attention in the context of sustainability due to the global urgency to address climate change and environmental degradation. Basically, this theory comes from the view that local knowledge can complement modern scientific approaches.

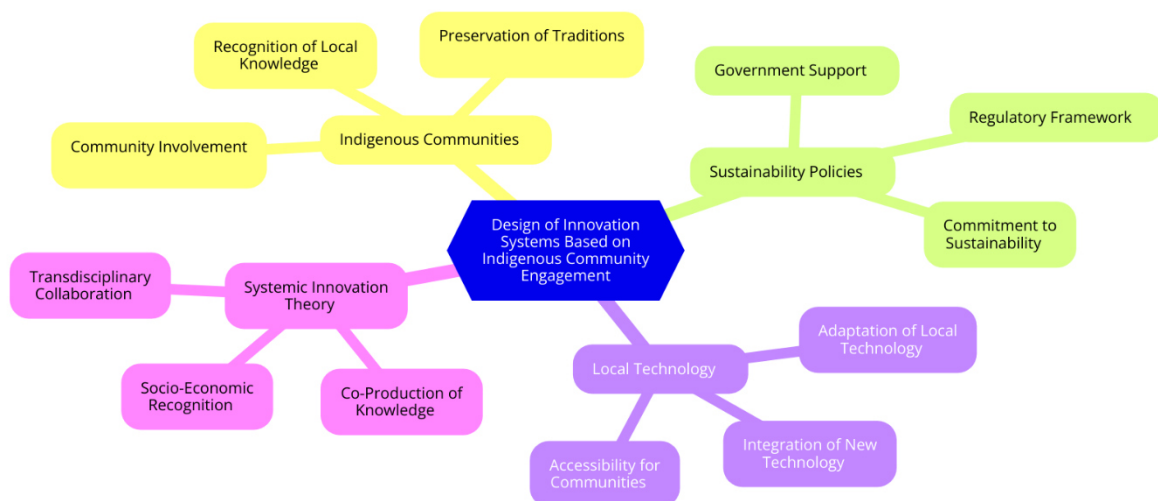


Figure 7.1. Design of Innovation Systems Based on Indigenous Community Engagement (source: author, 2024)

A study by (Bansal et al., 2024) shows that the role of indigenous peoples in the sustainable development goals (SDGs) is recognized in global agendas such as

the 2030 Agenda. In addition, the implementation of community-based monitoring (CBEM) introduced by (Sidorova & Virla, 2022a) aims to bridge the gap among indigenous knowledge and modern science in major infrastructure projects such as Canada's Northern Corridor. Key concepts include: co-production of knowledge, integration among traditional and scientific knowledge to produce more holistic insights. Community engagement: indigenous peoples are key actors in data collection, decision-making, and implementation. Socio-ecological sustainability: combining cultural and ecological aspects in resource management. This approach assumes that: Traditional knowledge is valid and relevant. Modern science and indigenous knowledge can complement each other. Local community involvement increases the effectiveness of sustainability projects. CBEM, as described by (Sidorova & Virla, 2022a), is a community-based model that combines: Environmental Monitoring: Communities are trained to collect scientific and local data. Multi-stakeholder Collaboration: Involving governments, scientists, and indigenous peoples. Implementation of Results: Data is used for evidence-based policies and local management. The purpose of this approach is to combine indigenous knowledge and modern science in addressing sustainability challenges. Its relevance is crucial, especially in major development projects that require a holistic approach to reduce environmental impacts and increase social acceptance. The advantage of this approach is that it uses local knowledge that is often more context-specific. Increase local acceptance of sustainability projects. Disadvantages: Inequality in the recognition of traditional knowledge compared to modern science. Challenges in building consensus among actors with different backgrounds. CBEM case studies demonstrate successful application in water quality management, caribou monitoring, and pollution prediction in Canada. The app not only engages indigenous communities in data collection but also in analysis and decision-making, resulting in more relevant and acceptable results for local communities. Indigenous knowledge plays a vital role in addressing global sustainability challenges, especially when combined with a modern scientific approach through meaningful community engagement.

Japan has implemented a sustainability approach rooted in local community involvement and innovative technologies to address environmental and social challenges. One illustration is the apply a biomass energy system on Tanegashima Island. This approach involves collaboration among researchers, local communities, and stakeholders through a five-year joint learning process. The project integrates technology assessment with socio-economic analysis to identify available local resources and appropriate technologies. Through more than 30 events, such as symposia, workshops, and seminars, as many as 1,400 participants were empowered to understand technology options and their impact on regional sustainability (Kikuchi et al., 2020). The project uses life cycle assessments and population preference

surveys to design technology-based solutions that are relevant to local needs. For illustration, the use of biomass to replace fossil-based energy improves local energy efficiency and advises community participation in the management of the energy system. In addition, changes in the mindset of the population toward sustainability are obtained through interaction with experts, strengthening collaboration and generating constructive alternatives for the implementation of the technology. The Tanegashima project demonstrates that coordinated multidisciplinary collaboration can help make effective use of local resources and support regional transformation toward sustainability. This approach is relevant in the context of Japan, which faces the challenges of depopulation and resource security, while also providing a model of practice that can be replicated in other regions with similar conditions.

In South Korea, a community-based sustainability approach has been implemented through the "Green New Deal" program that focuses on a sustainable economic transition. The program covers three main strategic areas, green city development, low-carbon decentralized energy, and green industrial innovation. The program is designed to reduce carbon emissions, promote energy efficiency, and increase social inclusion in the economic transition. One of his initiatives is to introduce a low-carbon energy policy that integrates local technologies and advises collaboration among the government and local communities (K. Y. Lee & Park, 2022). In addition, the "Living SOC" program has introduced community-based social infrastructure to support the development of rural and urban areas. This program includes educational, sports, and cultural facilities to improve accessibility and sustainability for people in metropolitan and provincial areas (Kim et al., 2020). Another effort is the integration of local communities in the development of culture-based tourism, as happened on Jeju Island. Studies show that collaboration with local communities improves cultural and economic sustainability by balancing the needs of tourism and the preservation of local traditions (Li et al., 2021). These practices show that the successful implementation of sustainability policies in South Korea is highly dependent on multi-stakeholder collaboration, green technology development, and local community empowerment to achieve an inclusive and sustainable economic transition.

In China, the implementation of local and community knowledge-based sustainability has been integrated through various approaches. One prominent practice is the integration of local and traditional knowledge in nature-based solutions (NbS). These policies leverage elements of local knowledge to address climate change, ecosystem damage, and biodiversity casualty. Through education, participation, and preservation of local knowledge, NbS in China facilitates the involvement of local communities in decision-making and implementation of ecological policies. Studies show that the success of this approach depends on central policy support and ongoing multi-stakeholder engagement (Yu & Mu, 2023). In

addition, the management of ethnic tourism in villages in China has used an indigenous knowledge-based approach to optimize environmental sustainability and people's livelihoods. Local knowledge is used to manage natural resources, increase people's cultural capital, and direct environmentally friendly livelihood strategies. This has been proven to improve community welfare and improve environmental management, making sustainability a top priority in the development of tourism communities (Shang et al., 2021). In mountainous agricultural areas such as the Jiabang Rice Terrace in Guizhou, traditional knowledge has become the cornerstone of sustainable natural resource management. This knowledge includes agricultural practices, water management, and forest management that produce landscapes that are not only environmentally friendly but also supportive of cultural diversity. Studies show that this knowledge transfer mechanism continues to be maintained across generations to maintain ecological and cultural balance (N. Wang et al., 2021). These practices reflect the importance of integrating local knowledge in China's sustainability strategy, with a focus on community participation, technological innovation, and complementary policy support to achieve SDGs.

In Russia, an indigenous community-based sustainability approach and local knowledge is applied mainly in the Arctic and Siberian regions. One of the significant practices is the use of indigenous knowledge to maintain the sustainability of the socio-ecological system in the Sakha Republic (Yakutia). Traditional knowledge is used to manage natural resources such as land and water, which are the main foundation in supporting the livelihood of indigenous peoples. Studies show that global changes, including climate change and resource extraction, affect the sustainability of indigenous peoples in the region. Therefore, integrating indigenous knowledge in environmental policies is crucial to maintaining the balance of local ecosystems and cultures (Ksenofontov & Petrov, 2024). Another initiative is the sustainable management of transport and communications along the Kolyma Road, which is the main infrastructure in Northeast Siberia. In this context, indigenous knowledge plays an important role in creating an inclusive and sustainability-based mobility and communication system. Through the recognition and integration of local ways of life and knowledge, these endeavors aim to increase the resilience of infrastructure to environmental changes, as well as ensure the sustainability of the well-being of local communities (Burnasheva et al., 2024). Indigenous culture-based environmental education is also implemented in Western Siberia through ethnic camps that introduce indigenous peoples' ecological policies to visitors. The program is designed to promote sustainable behavior and respect for nature, although its effectiveness in changing participants' behavior still needs to be improved. This approach shows the potential of tradition-based education in supporting the sustainable development agenda (Zakharova et al., 2021). These practices reflect the importance of recognizing and integrating local knowledge in resource policy and management in Russia, which

aims to support ecological and social sustainability while preserving indigenous traditions.

In Saudi Arabia, technology-based and policy-based sustainability approaches have become an integral part of the country's strategic vision to achieve sustainability. One prominent practice is the adoption of a circular carbon economy model, which is designed to reduce carbon emissions through the adoption of smart technologies, digitalization, and multi-stakeholder collaboration. This model allows the use of technologies such as blockchain and artificial intelligence to improve energy efficiency and waste management. Studies show that this approach not only helps stabilize carbon emissions but also promotes sustainable economic growth through integration among the public and private sectors (Yusuf & Lytras, 2023). Saudi Arabia has also adopted sustainable solutions in water resource management to address the challenge of water scarcity. The system includes rainwater harvesting, wastewater treatment, and renewable energy-based desalination. This policy supports the sustainability of the agricultural sector, which absorbs more than 80% of the country's water resources. The study recommends the use of advanced technologies and region-specific management plans to reduce dependence on non-renewable groundwater (Alotaibi et al., 2023). The apply renewable energy is also a major focus with massive investments in solar and wind power. As part of vision 2030, Saudi Arabia seeks to replace dependence on fossil fuels with clean energy technologies, including energy storage and smart grids, which accelerate the country's energy transition toward long-term sustainability (Al Gahtani & Carraher, 2024; Al-Gahtani et al., 2022). These practices demonstrate Saudi Arabia's commitment to technological innovation and inclusive policies to support economic, social, and environmental sustainability. It also strengthens the country's position on the global agenda for sustainable development.

Each country has a unique model or structure in implementing a sustainability approach. Japan uses a knowledge co-production approach with local communities through symposia and workshops to support locally relevant biomass energy solutions (Kikuchi et al., 2020). South Korea is integrating smart technologies in a circular carbon economy model to support low-carbon energy management (K. Y. Lee & Park, 2022). China combines traditional knowledge with NbS in the management of local ecosystems (Yu & Mu, 2023), while Russia uses CBEM to manage natural resources in indigenous territories (Ksenofontov & Petrov, 2024). Saudi Arabia is implementing technology-based models such as blockchain and artificial intelligence in the circular carbon economy to reduce carbon emissions (Yusuf & Lytras, 2023), while Germany is adopting agricultural management standards that are compatible with local practices to improve the sustainability of production processes (Hannus & Sauer, 2021). All of these approaches aim to address local sustainability challenges in contextually relevant ways. Japan aims to create a sustainable energy system

through locally relevant biomass, which is relevant to the regional energy transition. South Korea seeks to reduce carbon emissions by utilizing smart technology, supporting the relevance of a low-carbon economy at the global level. China integrates traditional knowledge to mitigate climate change and preserve ecosystems, relevant for biodiversity protection (Yu & Mu, 2023). Russia aims to maintain the socio-ecological sustainability of indigenous communities through CBEM, which is relevant to resource management in extreme regions (Ksenofontov & Petrov, 2024). Saudi Arabia is targeting net-zero carbon emissions to support a sustainable economy, while Germany is focusing on agricultural standards that can help the EU achieve its emissions targets and protect biodiversity (Virtanen et al., 2020). Japan's approach strengthens inclusivity and empowerment of local communities, but it takes a long time to implement. South Korea shows excellence in adopting advanced technologies but faces challenges in raising general public awareness of sustainability (J. H. Lee & Woo, 2020). China has successfully harnessed local knowledge for ecosystem preservation, although the integration of modern and indigenous technologies requires the management of epistemological conflicts ((Yu & Mu, 2023). In Russia, CBEM actively engages the community, but reliance on local resources can be a constraint on a large scale. Saudi Arabia demonstrates technological efficiency, but this approach requires large investments and technology transfer to the local sector. Germany offers compatibility with local practices, although its sustainability standards are still less attractive to some smallholders (Hannus & Sauer, 2021). These approaches provide valuable insights into the importance of integrating technology, local knowledge, and community-based policies to support global sustainability.

The involvement of indigenous peoples in local tradition-based innovations, such as in Papua, is an important approach to ensure social and environmental sustainability, this is relevant to customary-based forest management innovations, such as the sasi tradition, because the involvement of indigenous peoples as the main stakeholders, Innovation in customary-based forest management in Papua must be based on the full participation of indigenous peoples as the main stakeholders. The sasi tradition, which prohibits the use of resources in a specific period to allow for the regeneration of nature, is an illustration of a local practice that reflects the ecological knowledge of the local community. Research shows that this custom-based approach not only conserves biodiversity but also strengthens community sovereignty over their customary territories (Jokhu & Kutay, 2020). Innovation that Reflects Local Needs and Values so innovation to be successful, there must be the integration of traditions such as sasi into technology-based management. For illustration, community-based monitoring technology (CBEM) can be combined with sasi practices to track resource usage in real-time. This allows indigenous peoples to make data-driven decisions without neglecting their indigenous values (Sidorova & Virla, 2022b). The ecological and

social benefits of custom-based management, custom-based forest management that adopts local traditions such as sasi have dual benefits. Ecologically, it helps preserve forests and prevent overexploitation. Socially, strengthening customary traditions advises community inclusion in innovation and ensures that local wisdom remains alive, relevant, and respected. A similar illustration can be found in China, where local knowledge is used for ecosystem conservation through NbS (Yu & Mu, 2023). Integrative Approach to Long-Term Sustainability, Custom-based Forest management innovations that integrate technology and traditions, such as sasi, can create a more inclusive and sustainable management model. This requires collaboration among indigenous peoples, scientists, and policymakers. Research in Russia also highlights the importance of recognition of local knowledge in socio-ecological systems to increase resilience to global environmental change (Ksenofontov & Petrov, 2024). Custom-based approaches such as sasi have great potential to support environmental and social sustainability in Papua. Through the integration of this tradition into technological and policy innovations, the resulting innovations will better reflect the needs and values of indigenous peoples, while strengthening the sovereignty and preservation of local traditions.

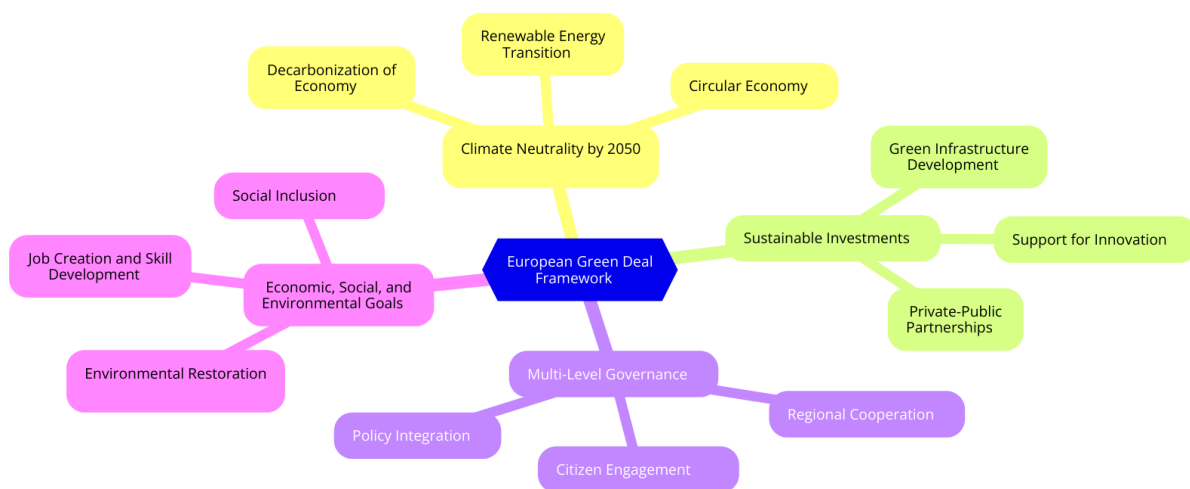


Figure 7.2. European Green Deal (source: author, 2024)

The European Green Deal (EGD) is a policy framework designed by the European Union to transform the economy into carbon neutrality by 2050. Its main essence is to integrate sustainability goals into every aspect of economic, social, and environmental policy through innovation, multi-level governance, and sustainable investment (McCann & Soete, 2020). The EGD was launched in 2019 in response to climate change and environmental degradation. This policy is inspired by the principles of sustainable development (Ashby, 2024) and the Paris climate contract. This transformation is intended to build an economy that is not only environmentally friendly but also supports inclusive and social growth (Fernández-Guadaño & Martín-

López, 2023). The main concepts of the EGD include multi-level governance, coordination among central, regional, and municipal governments to ensure sustainability at various administrative levels (McCann & Soete, 2020). Institutional capital, leveraging institutional networks to support innovation policies (Omelyanenko, 2020). Sustainable investment, directing private and public capital to environmentally friendly projects (Nyikos & Ermasova, 2022). The EGD assumes that sustainable development is the foundation of economic growth. Technological innovation is needed to achieve systemic sustainability. The participation of all stakeholders—governments, the private sector, and communities—is essential. The EGD leverages a multi-level governance model, where the EU provides a regulatory and incentive framework, while implementation is carried out at the national and local levels. Innovation hubs such as the Empower Eco Sustainability HUB, use a "triple helix" approach (collaboration of academia, industry, and government) to develop environmentally friendly solutions (Rowan & Casey, 2021). The goal is to achieve carbon neutrality by 2050, ensure a just economic transition, and integrate sustainability into all EU policies. The relevance of the EGD is immense in the context of the global climate crisis, while also offering innovation models for other regions facing similar challenges (McCann & Soete, 2020). The EGD has the advantage of encouraging cross-sector collaboration and green innovation and providing economic incentives for the adoption of clean technologies. While the downside is the risk of regional injustice if the implementation is uneven and the high initial costs for the green economy transition (Kirschenmann, 2022). EGD has been adopted through policies such as the Green Bond Standard to fund renewable energy and energy efficiency projects in the industrial and agricultural sectors. At the local level, a participatory approach has been implemented to increase community involvement in sustainability policies (Testi et al., 2023). With a systematic structure, the EGD offers a framework that can be a model of sustainability policy on a global scale.

For illustration, Japan implements a multi-level governance approach for sustainability through a green innovation-based policy framework, such as society 5.0. This model integrates collaboration among the central, local and community governments, with a focus on the use of advanced technologies for environmental and economic sustainability. An illustration is the construction of a Sustainable Smart Town in Fujisawa, which combines smart infrastructure, clean energy, and citizen involvement in decision-making. This project shows how multi-level governance structures can accelerate the transition to sustainable smart cities (Chang et al., 2022). The main goal of this approach is to achieve carbon neutrality by 2050 and improve the quality of life through inclusive green innovation. Its relevance can be seen in Japan's endeavors to address the challenges of climate change and declining economic productivity, by placing sustainability as a national priority. Initiatives such as the green growth strategy leverage the synergy among technological innovation

and public participation to create a development model that can be replicated at the global level (Chala, 2020). The advantages of the Japanese model lie in the integration of advanced technologies such as 5G, smart infrastructure, and community participation, which allows for a quick response to sustainability challenges. However, the main challenge is the digital divide and the capacity of local institutions to manage complex initiatives. The Sustainable Smart Town project, for illustration, faces obstacles in ensuring the direct involvement of residents in strategic decision-making (Tokoro, 2016). Projects such as the Sustainable Smart Town in Fujisawa reflect the concrete apply multi-level governance for sustainability. This policy adopts a cross-sectoral approach by involving stakeholders from the government, industry, and society to create an integrated green ecosystem. The project has succeeded in reducing energy consumption through solar panels and storage batteries, while encouraging more environmentally friendly citizens' behavior (Tokoro, 2016). The Japanese approach provides important insights into how multi-level governance and technological innovation can be combined to achieve terminate-to-terminate sustainability.

Meanwhile, South Korea uses a multi-level governance approach to encourage sustainability through the Green New Deal policy. This approach focuses on three strategic pillars, green city development, low-carbon decentralized energy, and green industrial innovation. This policy integrates the role of the central, local, and private governments to create an environmentally friendly innovation ecosystem. This model leverages cross-sector collaboration to support a balanced sustainable economic transition at the local and national levels (J. H. Lee & Woo, 2020). The main goal of this approach is to build a low-carbon and climate-neutral economy by 2050, while encouraging inclusive growth. Its relevance lies in the Green New Deal's capacity to address the climate crisis and create green jobs, making it an important solution in the context of post-COVID-19 pandemic economic recovery and global environmental challenges (J. H. Lee & Woo, 2020). The advantage of this approach is the integration of advanced technologies and policies that support the green transition, such as the digitalization of the energy sector. However, challenges arise in the form of a capacity gap among urban and rural areas to adopt green policies, as well as a high reliance on initial investment from the public and private sectors (Ryu et al., 2022). One illustration of a real application is the development of sustainable smart cities, such as in Songdo, where green technologies and smart infrastructure are applied to reduce carbon emissions and improve energy efficiency. In addition, the eco-friendly national school lunch program is also an illustration of how the education sector can be a tool to promote sustainability through community-based policies (Gaddis & Jeon, 2022). South Korea's approach shows that multi-level governance supported by innovative policies and green technologies can create effective and inclusive sustainability pathways.

Then China adopted a multi-level governance approach to promote sustainability through the development of low-carbon cities such as the Hongqiao Business District in Shanghai. This model combines interaction among the central government, local governments, and the private sector with a focus on flexible hierarchies and cross-regional cooperation. This low-carbon strategy leverages formal mechanisms such as regulation and informal mechanisms such as cross-actor cooperation to encourage sustainability innovation. The Hongqiao case shows that policies based on multi-level governance can strengthen the coordination and implementation of low-carbon policies across the board (Sun & Baker, 2021). The main goal of this approach is to achieve carbon neutrality by 2060 and reduce carbon emissions at the urban level through policy and governance innovation. Its relevance lies in China's role as the country with the largest carbon emitters, so the transition to a low-carbon policy is an important step to meet global commitments to climate change. This approach also serves as a model for other developing countries facing similar challenges in urban management (Liu et al., 2022). China's multi-level governance approach has advantages in the form of flexibility in coordination across regions and actors, as well as the ability to integrate technological and policy innovations. However, the challenges faced include a high reliance on directives from the central government and a capacity gap among more developed and disadvantaged regions. At the local level, implementation is often limited by a lack of resources and consistent policy support (Q. Song et al., 2021). Low-Carbon City Pilot programs in various regions, including Shanghai and Wuxi, are vivid illustrations of the implementation of this approach. This policy is designed to reduce carbon emissions through technological innovations such as smart grids and energy efficiency in transportation. In Wuxi, the local government successfully integrated economic and environmental strategies to increase the adoption of solar energy in urban management (Zhang et al., 2021). China's multi-level governance approach provides insights into how cross-sector governance and green innovation can be effectively used to support urban sustainability and meet global climate targets.

Furthermore, Russia implements a multi-level governance approach in various aspects of sustainable development, such as those applied to the SDGs. This approach involves the central government, local governments, and non-governmental actors in supporting the implementation of Environmental, Social, and Governance (ESG) policies. Case studies in the Perm region show two models of actor relationships, a coordination model that prioritizes collaboration and an implementation model that is more oriented toward self-management by local governments (Markova & Isobchuk, 2023). The main impartial of this approach is to strengthen the implementation of sustainability goals through flexible governance mechanisms, as well as ensure the active participation of different levels of government and private actors. Its relevance lies in the ability of multi-level

governance to address systemic and cross-sectoral challenges, such as climate change and environmental degradation in Russia's vast territory (Xi et al., 2024). The multi-level governance approach in Russia has the advantage of flexibility in involving various stakeholders, allowing for local innovations that are relevant to the needs of specific regions. However, the challenges faced include limited resources, institutional barriers, and high dependence on the central government. Policy fragmentation at the local level can also hinder the effective implementation of sustainability programs (Markova & Isobchuk, 2023). This approach has been applied in municipal waste management in Murmansk, an Arctic region, where interaction among local authorities and non-state actors, such as NGOs, plays an important role in solid waste management and climate change mitigation. However, the implementation of low-carbon policies in Murmansk shows that there are still limitations in the characteristics of multi-level governance, especially in integrating cross-sectoral policies (Gaol et al., 2021). The multi-level governance approach in Russia offers important insights into the importance of cross-sectoral coordination and cross-government collaboration in supporting sustainability innovation, although improvements are needed in aspects of coordination and institutional capacity.

Saudi Arabia has also integrated a multi-level governance approach through the Neom project, a future city based on sustainable innovation. This model incorporates the OECD's policy framework to support an innovation ecosystem that includes economic incentives, regulatory standards, and knowledge exchange networks. The goal is to create synergies among the public and private sectors to accelerate the adoption of green technologies, including renewable energy, green infrastructure, and sustainable mobility (Alhejaili, 2023). The main goal of the Neom project is to create a carbon-neutral city that supports Saudi Arabia's 2030 vision of achieving sustainable development. The relevance of this project is very high because Saudi Arabia as a global energy exporter faces the challenge of economic diversification to reduce dependence on fossil fuels and deal with climate change effectively (Alhejaili, 2023). This approach has the advantage of creating a holistic and inclusive policy framework, utilizing advanced technology to support green innovation. However, the implementation of projects such as Neom requires large investments, and the main challenge is to ensure the active participation of local communities and address the technological capacity gap among the urban and rural sectors (Alhejaili, 2023). The Neom project has implemented various technologies, such as smart infrastructure for green transportation and efficient management of water resources through Internet of Things (IoT)-based systems. In addition, community participation frameworks are implemented to increase awareness about sustainability and strengthen public involvement in urban decision-making (Alhejaili, 2023)). The multi-level governance approach implemented in Saudi Arabia through

projects such as Neom provides a clear illustration of how coordinated governance can support green innovation and sustainable development.

Australia implements a multi-level governance model for sustainability through cross-government cooperation in waste management. This model leverages collaborative mechanisms among federal, state, and local governments to address environmental challenges, such as solid waste management. This cooperation aims to create a more adaptive and coordinated approach, although there are still inconsistencies in policies among levels of government. Research shows that this model has great potential in driving sustainability innovation through closer coordination and stakeholder participation (Jones, 2020). The main goal of this approach is to create a more sustainable and adaptive waste management system, by reducing reliance on voluntary schemes and improving coordination-based regulation. Its relevance is very high considering that Australia is facing an environmental crisis due to an underorganized waste management system, which has an impact on the sustainability of local and global ecosystems (Jones, 2020). The advantages of this approach include improved coordination among actors and the use of adaptive governance principles, which allow for flexible solutions to complex environmental challenges. However, the main weakness is the lack of urgency and policy inconsistency among governments that can slow implementation. Another challenge is the dominance of the neoliberal paradigm which sometimes hinders cross-sector collaboration (Tobin & Zaman, 2022). This multi-level governance practice is applied to municipal waste management through inter-municipal partnerships across the country. For illustration, inter-municipal cooperative partnerships (IMC-WM) have been shown to be effective in creating social values such as trust and reciprocity among participants, although competition among local governments remains an obstacle. This approach also provides lessons on the importance of cultural elements in encouraging successful cross-level collaboration (Tobin & Zaman, 2022). Australia's approach to multi-level governance for sustainability offers important insights into how collaboration among government levels can strengthen green innovation and drive adaptive solutions to modern environmental challenges.

These countries adopt a multi-level governance model that involves the interaction of the central government, local governments, and the private sector. Japan implements the Sustainable Smart Town model that combines advanced technology with community participation to manage smart cities in a sustainable manner (Liu et al., 2022). South Korea uses the Green New Deal to develop green cities and decentralized energy, focusing on cross-sector collaboration (Liu et al., 2022). China is leveraging flexible governance for low-carbon city projects, such as in Hongqiao, which integrates technological innovation with flexible hierarchy-based policies (Sun & Baker, 2021). In Russia, a multi-level approach is applied to waste and natural resource management, despite facing policy fragmentation at the local level

(Markova & Isobchuk, 2023). Saudi Arabia through the Neom project created an OECD-based framework for green innovation and urban management by involving cross-sector actors (Alhejaili, 2023). Australia uses inter-municipal partnerships for waste management with a focus on adaptive governance and strengthening collaboration among governments (Tobin & Zaman, 2022). All of these models aim to drive sustainability with innovative approaches that are relevant to local and global challenges. Japan aims to improve the quality of life through smart cities based on green technology, while South Korea focuses on green job creation and low-carbon energy transition (Q. Song et al., 2021). In China, the relevance of this approach can be seen in the country's contribution to reducing global carbon emissions through urban innovation (Liu et al., 2022). Russia leverages a multi-level model to support the SDGs by adapting policies to regional needs (Markova & Isobchuk, 2023). Saudi Arabia aims to create a carbon-neutral city by utilizing projects such as Neom for economic diversification. In Australia, waste management is a priority to address environmental crises that are relevant to the sustainability of local and global ecosystems (Jones, 2020). This approach has advantages such as the ability to integrate technology, policy, and community participation. Japan, South Korea, and China have shown success in creating cross-sector synergies for green innovation. However, challenges such as capacity inequality among regions, policy fragmentation (Russia), and reliance on high investment (Saudi Arabia) remain significant weaknesses (Tobin & Zaman, 2022). Australia stands out for flexibility and cross-level collaboration, but the lack of policy urgency is an obstacle to achieving full sustainability (Jones, 2020). The multi-level governance model implemented in various countries provides important lessons on the importance of cross-sector collaboration, policy integration, and the use of technology to achieve global sustainability. Although each country faces unique challenges, this approach remains relevant as a solution to address the modern environmental and social crisis.

Law Number 59 of 2024 emphasizes the importance of sustainability in locally-based research and development, which is aligned with the multi-level governance model. In the context of Papua, this means involving coordination among the central government, regions, and local communities to maximize the potential of local resources. For illustration, custom-based research such as sasi forest management can be integrated with modern technology to develop adaptive resource management systems. This approach is similar to the practice implemented in Japan through Sustainable Smart Town, which combines local wisdom and advanced technology (Zhang et al., 2021). The purpose of this policy is to ensure that research and development in Papua not only promotes environmental sustainability, but also reflects the needs and values of the local community. The relevance of this law is very high considering the global challenge of maintaining sustainability while strengthening local sovereignty. This is in line with the Green New Deal approach in

South Korea which integrates national policies with green innovations to increase local participation (Q. Song et al., 2021). The advantage of this policy is its ability to integrate local wisdom in research and development, such as the sasi tradition that reflects the principle of sustainability. Enhance collaboration across sectors, including research institutions, governments, and local communities. However, there are several weaknesses, such as lack of local institutional capacity to implement policies effectively. Limited funding and research infrastructure in Papua, which can slow down policy implementation. This problem is similar to the challenge in Australia, where policy fragmentation and lack of coordination are obstacles in sustainable waste management (Tobin & Zaman, 2022). The implementation of this policy can be focused on the development of local-based research centers that involve indigenous peoples in the design and implementation of research programs. Development of local-based technologies, such as GIS-based technologies to map forest and land resources by considering customary values. A multi-stakeholder partnership, which connects the central government, academia, and local communities in sustainability programs. A similar illustration is applied in China through the Low-Carbon City Pilot program (Zhang et al., 2021). Law Number 59 of 2024 provides a strong policy basis to support locally-based sustainability in Papua. By integrating indigenous values and modern technology, these policies can create relevant, adaptive, and sustainable approaches. Multi-level governance support and strengthening local capacity are key to the successful implementation of this policy.

Information Technology and Indigenous Knowledge with Intelligence (ITIKI) is a technology-based decision support system that integrates indigenous knowledge with scientific data to help smallholders make better decisions in managing resources, such as when and how to plant. The system uses artificial intelligence algorithms, artificial neural networks, and fuzzy logic to predict droughts and provide accurate data to local communities (Masinde, 2020). ITIKI was developed in response to climate adaptation challenges in Africa affecting smallholders. Indigenous knowledge of climate, which has been used for centuries, is beginning to become endangered. The system aims to combine the predictive power of indigenous knowledge with the precision of scientific data to improve food security in Kenya, Mozambique, and South Africa. This need arises from the gap among local knowledge that is often undocumented and modern technology that is less adaptive to the local context (Masinde, 2020).

The main components of ITIKI include knowledge capture, indigenous knowledge about drought is gathered through interviews and local observations. Prediction and Monitoring uses data from weather sensors and artificial intelligence-based algorithms to predict weather patterns. Communication and Deployment, information is delivered to farmers through mobile apps, SMS, email, and web portals, allowing quick access to weather forecast data. The Community-Based Design

Approach, ITIKI is designed using thinking design methods, including brainstorming and prototyping, which ensure relevance to the needs of society (Masinde, 2020). It is based on the assumption that indigenous knowledge has high accuracy for short-term predictions, but requires technological support for long-term accuracy. Local community participation is key to successful technology adoption. The integration of modern technology with local wisdom can improve the efficiency of decision-making in the agricultural sector. The ITIKI system uses a three-step-based model, namely knowledge capture in the form of local and scientific data combined. Processing and Analysis: Data is analyzed using artificial intelligence to generate forecasts. Disseminate: Information is communicated locally through digital and non-digital media. This model shows the close relationship among technology, customs, and society. ITIKI's goal is to increase farmers' resilience to climate change by providing locally relevant weather information. This system is relevant in regions that rely on subsistence farming, where wrong decisions can result in significant losses. ITIKI also shows how the integration of indigenous and scientific knowledge can support global climate adaptation (Masinde, 2020).

ITIKI's advantages include combining local wisdom and modern technology, increasing relevance and reliability. Supports data-driven decisions, reducing reliance on intuitive predictions. Meanwhile, the disadvantage is relying on technological infrastructure that may not be available in remote areas. Requires training and community awareness to maximize system adoption. ITIKI has been successfully implemented in Kenya, Mozambique, and South Africa, helping more than 12,000 farmers increase crop yields by up to 11%. This application is used to support decisions about when and what type of crops are planted based on drought predictions (Masinde, 2020). Approaches like ITIKI show how technology can be used to bridge local wisdom with modern science, creating innovative systems that are locally relevant.

Japan has developed a data-driven agricultural framework that integrates traditional knowledge with modern technology through NARO-linked databases (Narolin DBs). This system connects data from various fields of agriculture, such as genome analysis, crop breeding, to food distribution. This data is processed using RDF format and artificial intelligence technology to support statistical analysis and machine learning, so that it can provide relevant insights to farmers and researchers in agricultural decision-making (Kawamura et al., 2022). The main goal of this approach is to accelerate sustainable agricultural innovation by integrating traditional Japanese knowledge with data-driven technology. Its relevance can be seen in supporting agricultural adaptation to modern challenges, such as climate change and global food security. This system also helps optimize crop yields by using resources efficiently, which is in line with the SDGs (Kawamura et al., 2022). Pros: Efficiency and Precision: The integration of data-based on AI technology allows for

more accurate analysis, assisting farmers in evidence-based decision-making. Local Empowerment: This system reinforces the use of traditional knowledge in modern agricultural management. Weaknesses: Technological Infrastructure: The implementation of this system requires high-tech infrastructure, which can be a challenge in rural areas. Digital Divide: The difference in ability among the younger and older generations to use technology may slow down the full adoption of these systems (Kawamura et al., 2022). The Narolin DBs system has been implemented throughout Japan to improve the efficiency of the agricultural supply chain, from crop breeding to food distribution. One real application is weather forecast optimization for land management, which blends historical and traditional data with advanced data analytics to help farmers adjust their planting patterns. This has improved efficiency and crop yields in many rural areas of Japan (Kawamura et al., 2022). This approach demonstrates how Japan has successfully integrated local knowledge and data-driven technologies to create innovative sustainable agriculture solutions.

South Korea has developed a data-based paddy field mapping system using deep learning technologies such as the Recurrent U-Net architecture. The system is designed to integrate satellite imagery with local datasets to produce more accurate forecasts and is compatible with domestic databases. This application uses chronological batch training and time-inversed padding techniques to improve the initial prediction of rice production and data compatibility with field surveys (Jo et al., 2023). The main goal of this approach is to support more efficient agricultural decisions by providing accurate preliminary forecasts regarding rice production. The relevance of this system can be seen in helping to manage food supply nationally while mitigating the impact of climate change on crop yields. This system is important for countries that rely heavily on rice production as a staple food (Jo et al., 2023). Pros: High Precision: Uses deep learning models to predict crop yields early with a high degree of accuracy. Data Compatibility: The system is designed to fit into existing domestic databases, making it easy to adopt and implement. Disadvantages: High-Tech Dependence: These systems require advanced technological infrastructure that may not be evenly available across regions. Adoption Limitations: Implementation at the local level can be hampered by a lack of training and understanding of technology among smallholders (Jo et al., 2023). This system has been used to support decision-making in the management of South Korea's national food supply. For illustration, the initial prediction of rice production helps the government in regulating the distribution of resources and controlling the supply of rice. This model is also applied to improve the efficiency of field surveys, reduce costs, and accelerate the data-driven decision-making process in the agricultural sector (Jo et al., 2023). The system demonstrates how South Korea has successfully combined advanced technology and local databases to support sustainability in the agricultural

sector, strengthen national food security, and drive efficiencies throughout the food supply chain.

In China, a sustainability approach that combines local knowledge with scientific data is applied to rice landscape management in Jiabang, Guizhou Province. This system uses indigenous knowledge-based resource management methods involving water, forests, and agriculture. Local data is combined with spatial-based participatory surveys to create a more integrated landscape management pattern. This system creates a close relationship among customary practices, natural resource management, and sustainable environmental outcomes (N. Wang et al., 2021). The main goal of this system is to preserve the biodiversity and sustainability of mountain ecosystems while preserving local cultural heritage. Its relevance is seen in its ability to prevent soil erosion, improve water use efficiency, and support agricultural sustainability in hard-to-reach landscapes. This system is also relevant to support ecosystem-based tourism that respects local traditions (N. Wang et al., 2021). Pros: Use of Local Resources: This system adapts to local conditions, strengthening the resilience of the ecosystem. Participatory Collaboration: A participation-based approach strengthens the relationship among communities and resource managers. Weaknesses: Reliance on Oral Traditions: Indigenous knowledge is largely passed down orally, making it difficult to fully document. Lack of Integration of Modern Technology: Lack of scientific guidance can reduce the long-term effectiveness of ecosystem management (N. Wang et al., 2021). This practice is applied in Jiabang's rice terraces to manage water resources, prevent environmental degradation, and increase crop yields. Local communities use customary rituals to guide resource management, which is integrated with spatial-based participatory mapping to identify conservation and production areas. This system also strengthens the preservation of local culture through the education of the younger generation and the promotion of community-based tourism (N. Wang et al., 2021). The approach in Jiabang shows how the integration of indigenous knowledge with scientific techniques can create locally relevant sustainable landscape management models, strengthening ecosystem resilience and cultural heritage.

Uganda is developing sustainability approaches through collaboration among local communities and other stakeholders to improve local knowledge-based food security. For illustration, research in the Teso region highlights traditional strategies for managing soil, crops, and post-harvest. This local knowledge combined with modern scientific practice through regular training and meetings, creates synergies that strengthen food security and reduce post-harvest yield casualty. This approach integrates field surveys, group discussions, and thematic analysis to map the linkages among traditional knowledge and modern practices (Kaddu et al., 2021). The goal of this approach is to optimize agricultural yields and maintain environmental sustainability through the integration of traditional and scientific practices. This

strategy is relevant in the context of food security in Uganda, which often faces challenges such as climate change, soil degradation, and lack of access to modern technology. This program provides an avenue for local communities to harness indigenous knowledge in supporting climate change adaptation and mitigation (Nkuba et al., 2021). Pros: Inclusivity: Involving local communities in decision-making, strengthening connectivity among communities and resource management. Contextual Relevance: Using custom-based methods that are relevant to local needs. Weaknesses: Documentation Limitations: Traditional knowledge is often poorly documented; risking being lost if not recorded immediately. Integration Difficulties: Challenges in combining indigenous knowledge with modern technology without compromising the essence of local culture (Kaddu et al., 2021). In the Teso region, traditional practices such as crop rotation, the use of natural fertilizers, and the storage of crops with traditional methods are used in conjunction with modern technology, such as GIS-based land mapping. The farmers received training from agricultural extension workers that combined traditional and scientific insights, enabling them to increase productivity and food security in the face of climate change (Nkuba et al., 2021). This approach reflects the importance of integrating local knowledge and modern technology to support sustainability in Uganda's agricultural sector, providing a model that can be adapted in other contexts.

South Africa is developing a model of integration of indigenous knowledge and modern technology to improve food security in smallholder communities. Research in Limpopo Province shows how farmers are leveraging weather predictions based on local knowledge, such as rainfall patterns and seasonal changes, which are then reinforced by satellite data and technical help from extension workers. The system combines tradition-based approaches with technology, such as mobile applications, to provide farmers with more accurate information about the weather and optimal planting time (Rankoana, 2022). The goal of this approach is to ensure sustainability in small-scale farming systems by blending local knowledge and modern innovations. Its relevance is very high in facing the challenge of climate change affecting smallholder crop yields. This system is also relevant to strengthen the autonomy of local communities in data-driven decision-making that supports food security (Rankoana, 2022). Pros: Farmer Empowerment: Provides better information to farmers through the apply technology relevant to local conditions. Locally-Based Adaptation: Leveraging indigenous knowledge to design contextual and sustainable solutions. Weaknesses: Limitations of Technological Infrastructure: Limited access to technology, especially in remote rural areas. Awareness and Training: Requires increased community capacity to understand and use new technologies effectively (Rankoana, 2022). In Limpopo Province, smallholder farmers use a combination of local knowledge and digital tools to predict the weather and determine the optimal planting time. With the support of extension workers and local governments, this

data-based application is used to increase crop yields and reduce the risk of losses due to climate change. In addition, local communities are involved in data collect improve the accuracy and relevance of the system, creating a more inclusive approach (Rankoana, 2022). This approach shows how the incorporation of modern technology and indigenous knowledge can be a relevant sustainability model for other regions facing similar challenges.

In Germany, the use of ontology-based technology is applied to support agricultural decision-making. An illustration is the decision support system for nitrogen fertilization in winter wheat farms in Bavaria. The system leverages Semantic Web technology and Linked Data to construct a new semantic structure that integrates local and scientific data. Data from regional and general sources that were previously not available in a structured format were converted into OWL (Web Ontology Language) ontology, which allows efficient use of data through SPARQL queries to provide recommendations to local farmers and consultants (Kessler et al., 2021). The main goal of this system is to optimize nitrogen fertilization appropriately to increase crop yields without damaging the environment. This system is relevant in addressing challenges such as excess nitrogen that can contaminate groundwater and the atmosphere. By leveraging local data and scientific knowledge, this approach also supports sustainability in modern agricultural practices in Germany (Kessler et al., 2021). Pros: Multi-Source Data Integration: This system allows the incorporation of data from various domains for more comprehensive analysis. Precision Recommendations: Provide data-driven recommendations that are relevant to local conditions, supporting evidence-based decision-making. Disadvantages: High Infrastructure Requirements: These systems require sophisticated and expensive technological infrastructure. Implementation Complexity: Requires specialized training for farmers and consultants to understand and use the system optimally (Kessler et al., 2021). This system has been implemented in Bavaria to support nitrogen fertilization decisions. By using a graphical interface (GUI), the system makes it easier for farmers to access specific information about fertilizer needs based on local soil and climate conditions. The system also leverages external web services to generate more detailed recommendations. As a result, agricultural practices in Bavaria have become more efficient and sustainable, with significant reductions in environmental impact (Kessler et al., 2021). This approach demonstrates how ontology-based technologies can support the integration of local and scientific knowledge to create more sustainable solutions in agricultural practices.

Denmark leverages an open data-driven approach and open-source software to support precision agriculture. The Future Cropping Partnership program is designed to increase crop production by utilizing topographic data, multispectral satellite imagery, and NDVI maps from Sentinel two. This approach integrates geospatial information with open-source software-based algorithms, allowing farmers to

analyze crop production patterns at the sub-land level to a regional scale. This project creates a flexible, integrated data system for better agricultural decision-making (Jacob Høxbroe Jeppesen et al., 2022). This approach aims to improve agricultural efficiency by reducing the use of resources such as water, fertilizers, and pesticides without sacrificing productivity. Its relevance is particularly high in Denmark, which has a commitment to achieving sustainable agriculture while maintaining environmental quality. This system is also relevant in supporting adaptation to climate change by maximizing the management of publicly available data (Jacob Høxbroe Jeppesen et al., 2022). Pros: System Flexibility: The open data infrastructure allows users to access and analyze information at various resolution levels. Environmental Efficiency: Reduces inefficient agricultural inputs, helping to lower greenhouse gas emissions and soil pollution. Disadvantages: Limited Access to Technology: Smallholder farmers who do not have access to advanced technology may be left behind. Data Integration Needs: Challenges in integrating various data formats from diverse sources can hinder the speed of system implementation (Jacob Høxbroe Jeppesen et al., 2022). The project has been implemented in winter wheat production, where NDVI maps are used to monitor crop health and identify areas that need special attention. This analysis helps farmers optimize irrigation and fertilization strategies, resulting in increased yields with lower environmental impact. The data generated is also used to build a predictive model for the next growing season (Jacob Høxbroe Jeppesen et al., 2022). The Danish approach shows how the use of open data and geospatial technologies can create more precise and sustainable agricultural systems, relevant to global challenges in the agricultural sector.

Models used in different countries show diversity in the integration of local knowledge with scientific data, but with interrelated elements. In Japan, the Sustainable Smart Towns model combines technology-driven data with community participation to create sustainable smart cities (Magd et al., 2023). South Korea uses deep learning algorithms for data-driven land maps, blending technology and local data (Jo et al., 2023). China integrates spatial-based participatory surveys with indigenous knowledge for natural resource management (N. Wang et al., 2021). In Uganda and South Africa, collaboration among agricultural extension workers and local communities leverages mobile app-based technology to optimize crop yields (Rankoana, 2022). Germany developed an ontology-based system that combines multipurpose data to support agricultural decisions, while Denmark leverages open data and open-source software to improve agricultural precision (Jacob Høxbroe Jeppesen et al., 2022; Kessler et al., 2021). The main goal of this approach is to optimize agricultural yields, support food security, and improve environmental sustainability. Japan and South Korea are prioritizing energy efficiency and resource management in smart cities and technology-based farmland. China and Uganda are focusing on biodiversity conservation and food security through the integration of

indigenous knowledge and modern technology. The relevance of this approach lies in the ability to tailor solutions based on local contexts, address global challenges such as climate change, and maintain the balance of local ecosystems (Rankoana, 2022; N. Wang et al., 2021). This approach has various advantages: Local Adaptation: Indigenous knowledge-based solutions are relevant to local communities and are more acceptable. Use of Technology: Data-driven systems allow for more precise analysis for decision-making. However, common drawbacks include: Technology Gap: High-tech infrastructure is often difficult to access for rural communities, such as in South Africa and Uganda. Integration Complexity: Combining local knowledge with modern technology requires significant coordination and resources (Jacob Høxbroe Jeppesen et al., 2022). Countries have shown that the integration of local knowledge with scientific data is an effective strategy for sustainability, especially in the face of climate change and food security challenges. However, successful implementation depends on the availability of infrastructure, cross-sector collaboration, and adaptation to local contexts. This practice provides valuable lessons for other countries in developing globally relevant data-driven and customary approaches.

The linkage of adaptive technology with the Papuan people in the context of Law Number 59 of 2024 and the Papua RPJPD 2025-2045 can be seen through an approach that allows the integration of modern tools with local traditions to support sustainability, natural resource management, and indigenous peoples' empowerment. Adaptive technologies for Papuans are designed to support sustainability based on local traditions, while leveraging modern tools. For illustration: Monitoring the quality of marine products: The use of Internet of Things (IoT)-based sensors to monitor seawater quality and fish stocks. The data generated allows indigenous peoples to combine traditional fishing schedules with scientifically based information. Produce processing: simple devices such as solar dryers to improve the quality of produce, such as sago or nutmeg, while maintaining traditional processing techniques. This model combines low-tech elements with traditional practices that have been used for generations. This technology is relevant to the Papua RPJPD 2025-2045 framework, which emphasizes the importance of custom-based development with the integration of modern technology to strengthen local wisdom. The main goal of this adaptive technology is to empower indigenous Papuans to improve productivity and quality of resources without sacrificing their traditions. This supports the agenda of Law Number 59/2024, which emphasizes locally-based sustainability, as well as the goals of the Papua RPJPD 2025-2045 to encourage community welfare through contextual development. The relevance of this approach is seen in: Increased Added Value: Technology helps improve the quality of produce and marine products to meet modern market standards. Sustainable Resource Management: Communities can manage natural resources more efficiently while maintaining ecological balance. Pros: Increased Local Capacity: The technology is designed to be easily operated by

indigenous peoples with simple training. Contextual suitability: these tools are tailored to local needs and practices, such as the use of Papuan seafood or produce. Economic Empowerment: Higher quality processed products have a higher selling value in the local and national markets. Weaknesses: Infrastructure limitations: The availability of electricity and network access in some remote areas of Papua is still an obstacle to supporting adaptive technology. Operational Continuity: Maintenance of the equipment requires technical support that may be difficult to access in remote areas. Marine Product Monitoring: Fishing communities in Cenderawasih Bay can take advantage of water quality sensors that combine scientific data with traditional knowledge to determine sustainable fishing sites. Produce processing: the use of simple solar dryers for sago allows society to produce more durable products without losing their traditional characteristics. Technology Education: Through community-based training programs, this technology is taught to the young generation of Papuans so that it can continue to be used sustainably. Adaptive technology supports the agenda of Law Number 59 of 2024 and the Papua RPJPD 2025-2045 by strengthening local wisdom through the integration of contextually relevant modern tools. This approach allows Papuans to leverage technology to improve their quality of life, productivity, and resource sustainability without abandoning their traditions. Policy support, training, and infrastructure are key to the successful implementation of this technology.

7.2. Strengthening Collaboration Among Indigenous Peoples, Academics, and Industry

Local wisdom-based innovation systems require a framework that integrates local and traditional indigenous knowledge with scientific approaches and economic capacities from industry. Successful collaboration models often use approaches that respect the traditional knowledge of indigenous peoples and strengthen their capacity to participate in research and decision-making. Studies in mountainous areas show that shared knowledge-based collaboration among indigenous communities and academia can improve community resilience and address the impacts of socio-economic and environmental changes (Ibarra et al., 2023). The research also highlights the importance of a decolonization approach in this collaboration, where power imbalances among the parties involved must be overcome to create a fair and inclusive dialogue (Gellman, 2021). Collaboration among indigenous peoples, academia, and industry not only provides innovative solutions that are locally and globally relevant, but also supports social, economic, and cultural sustainability. An approach that respects the traditional knowledge of indigenous peoples as well as integration with modern science and industrial commercialization are key to the success of this model. Collaboration among indigenous peoples, academics, and industry is at the core of an innovation system

based on local wisdom. Indigenous peoples impart rich traditional knowledge, while academics are responsible for documenting, analyzing, and developing this knowledge into relevant innovations. On the other hand, industry plays a role in commercializing the results of innovations, ensuring their economic sustainability.



Figure 7.3. Information Technology and Indigenous Knowledge with Intelligence
source: analysis authors, 2024

Scientific literacy highlights the importance of interdisciplinary dialogue to bridge differences in perspectives among indigenous communities, academia, and the industrial sector. Literacy also shows that the success of collaboration is greatly influenced by each party's ability to learn from each other and share responsibilities.

1. The role of indigenous peoples, the local knowledge possessed by indigenous peoples provides insight into the relationship among humans and the environment that has been proven sustainable for centuries. Research shows that collaboration with indigenous peoples can improve environmental conservation and support economic sustainability through the apply local values such as relationality and harmony with nature (Root-Bernstein et al., 2023).

Local knowledge is a collect knowledge, practices, and beliefs that are passed down from generation to generation by indigenous communities. This knowledge reflects a deep understanding of human relationships with the environment based on direct experience over the centuries. In the context of conservation, local knowledge includes how indigenous peoples maintain ecosystems through practices such as agroforestry, crop rotation, and water management (Abas et al., 2022). Local knowledge emerged in response to the need for indigenous communities to adapt to their environment, such as in traditional agricultural practices. This concept began to gain global attention when this knowledge was recognized as an important opponent of the international sustainability agenda, such as in the United Nations' SDGs. Increased awareness of the negative impacts

of modernization also drives recognition of local knowledge as a solution to environmental challenges (Hill et al., 2020).

The main concepts include Relationality: An emphasis on the interdependent relationship among humans and the environment. Relationality includes the concept of balance in ecosystems through sustainability practices such as forest management and water conservation (Kamakaula et al., 2023). Harmony with Nature: Integration of local cultures, rituals, and practices to maintain ecological sustainability. Indigenous peoples view nature as an integral part of their existence, not just an exploited resource (McAllister et al., 2023). Local knowledge is assumed to be adaptive, experience-based, and inherited knowledge through generations. This is based on the belief that traditional practices, such as crop rotation and agroforestry, are inherently more sustainable than modern methods that often ignore the local ecological context (Lam et al., 2020). Local knowledge is often modeled in the form of a biocultural approach, where biological and cultural sustainability is seen as a whole. For illustration, the kaitiakitanga model in Māori culture that integrates the principles of environmental and social preservation holistically (McAllister et al., 2023). The main goal of the integration of local knowledge is to support ecological, social, and cultural sustainability, as well as to increase community resilience in the face of climate change. This knowledge is relevant to fill gaps in modern scientific approaches that often ignore local contexts (Druker-Ibáñez & Cáceres-Jensen, 2022). Pros: Local knowledge offers more holistic and adaptive solutions to environmental challenges than modern approaches that are often fragmentary (Abas et al., 2022). Weaknesses: The main challenges are the lack of formal recognition in policy, the risk of knowledge casualty due to modernization, and the understanding gap among scientists and indigenous communities (Hill et al., 2020).

Local knowledge can be applied in: Nature Conservation: The use of local wisdom in forest management and biodiversity protection (Kamakaula et al., 2023). Sustainability Education: Integration of local knowledge in the educational curriculum to increase environmental awareness among students (Druker-Ibáñez & Cáceres-Jensen, 2022). Local knowledge-based conservation practices in Japan involve the integration of cultural traditions with modern approaches to maintaining environmental sustainability. One illustration is the use of the Satoyama method, which is a semi-natural landscape management approach that combines traditional practices with modern conservation. This approach emphasizes the importance of harmony among human activities and local ecosystems. In Satoyama's landscape, local communities manage natural resources sustainably through practices such as crop rotation, agroforestry, and wetland maintenance. This practice not only protects biodiversity, but also creates economic benefits for local communities. Studies show that the Satoyama

method plays an important role in preserving the habitat of local species while supporting the livelihoods of rural communities (Hill et al., 2020). In addition, this approach is supported by cooperation among local communities, academia, and the Japanese government. The researcher used an interdisciplinary method to analyze Satoyama's conservation success in promoting sustainable land management. A participatory approach also allows indigenous peoples to share their knowledge of resource management that has been tested over the centuries (Wheeler & Root-Bernstein, 2020). The Satoyama model is relevant not only for Japan, but also as an inspiration for other countries to integrate local wisdom with modern technology. This approach contributes to the achievement of the SDGs through environmental conservation, poverty reduction, and improved food security (Druker-Ibáñez & Cáceres-Jensen, 2022). The practice emphasizes that locally-based environmental management can be an innovative solution to global challenges, by blending traditional values and a scientific approach to sustainability.

Local knowledge-based practices in South Korea include ecosystem preservation endeavors that involve integrating local traditions with modern strategies. One of the significant approaches is wetland conservation through the use of traditional knowledge of local communities that has been passed down from generation to generation. An illustration of this practice can be seen in endeavors to preserve the Han River ecosystem, where local communities play an important role in preserving biodiversity through traditional methods of water resources and wetland management. This approach involves the use of traditional water management systems that are tailored to the needs of modern ecosystems. Research shows that the integration of local knowledge with modern policies can strengthen the sustainability of the ecosystem while creating socio-economic benefits for the surrounding community. For illustration, the use of local knowledge to prevent soil erosion and improve water quality has been shown to support the sustainability of aquatic ecosystems as well as promote adaptation to climate change (Wheeler & Root-Bernstein, 2020). In addition, collaboration among local communities and local governments in South Korea also plays an important role in implementing community participation-based policies for conservation. This effort involves empowering local communities in decision-making processes related to wetland conservation and ecosystems that support biodiversity. Related studies show that the success of this approach is strongly influenced by respect for local values and community inclusion in policy planning and implementation (Rosellón-Druker et al., 2023). Local knowledge-based approaches in South Korea are relevant to support the sustainable development agenda, especially in the context of critical ecosystem preservation and adaptation to global environmental challenges. This practice shows that the blend

of tradition and modernity can result in innovative solutions for sustainable environmental conservation.

Local knowledge-based practices in China can be seen in forest management and wildlife conservation by the Bulang community in Mangba Village, Yunnan Province. The Bulang community uses their traditional knowledge passed down from generation to generation to preserve forests and biodiversity. One of their unique practices is a respect-based protection system for banyan trees and the Derbyan Parakeet bird, which is considered the core of their local ecosystem. These practices are based on unwritten religious rituals and customary rules, such as moral restrictions and public opinion, which are effective in controlling the use of natural resources without the need for formal punishment mechanisms. The system reflects the deep connection among local communities and nature, with knowledge passed down through oral traditions. However, challenges arise when modernization introduces practices such as artificial feeding of birds for bird-watching tourism, which risks damaging ecosystems if not guided by modern ecological science (Su et al., 2020). In addition, local knowledge-based sustainability practices are also applied to the Jiabang rice terrace landscape in Guizhou. Local communities use their knowledge systems to manage natural resources such as water, forests, and land in an integrated manner. Studies show that the integration of these systems results in spatial diversity and conserves biodiversity, as well as being a means to maintain sustainable cultural traditions. This mechanism advises the mutual relationship among humans and nature which is the basis for the preservation of the ecosystem in the region (N. Wang et al., 2021). These practices emphasize the importance of integrating local knowledge with scientific approaches to protect biodiversity and support sustainable development. Collaboration among indigenous peoples, scientists, and governments is key to ensuring that traditional knowledge remains relevant in facing modern environmental challenges.

Local knowledge-based practices in Finland are centered on sustainable forest management by the Sámi people, an indigenous community living in the Lapland region. The Sámi people use a traditional approach to managing boreal forest ecosystems that include deer grazing practices, land management, and biodiversity conservation through the principle of harmony with nature. This practice is supported by a hereditary tradition that focuses on the preservation of natural resources. One of the key elements in this approach is the integration of local knowledge with modern policies. Research shows that collaboration among the Sámi community, academia, and the Finnish government has resulted in community-based conservation programs that maintain the sustainability of the ecosystem while preserving the Sámi culture. This model involves mechanisms for the protection of customary territories as well as respect for traditional rights to

use natural resources. This approach also contributes to climate change mitigation through the use of forest ecosystems as carbon sinks (Root-Bernstein et al., 2023)). In addition, traditional methods such as land rotation management and adaptive grazing have shown effectiveness in maintaining species diversity and reducing the risk of soil erosion. This practice is based on a deep understanding of the dynamics of local ecosystems owned by indigenous peoples, which allows them to adapt their management methods to changing environmental conditions (McAllister et al., 2023). These practices emphasize the importance of collaboration among local knowledge and modern science in ensuring social, cultural, and environmental sustainability. They are also illustrations of how local traditions can provide effective solutions to global challenges such as biodiversity conservation and climate change adaptation.

Local knowledge-based practices in Hungary involve the tradition of herding cattle in the forest, which has been going on for centuries. Although this practice was legally banned in the period 1961–2017, some pastoralist communities still retain this traditional knowledge. They practice grazing in both native and non-native forests, using an approach that is in harmony with the local ecosystem to maintain the sustainability of natural resources. One of the key elements of this practice is the control of the shrub layer using livestock. The results showed that grazing of livestock can reduce the dominance of shrubs and improve the palatability of grasses, which ultimately creates more hospitable conditions for certain plant species. Although there is a risk of damage to tree seedlings due to grazing activities, careful management allows this practice to become an integral part of sustainable forest management. Herders in Hungary use their in-depth knowledge of forests to determine the optimal grazing time, location, and intensity (Varga et al., 2020). Collaboration among local pastoralists, ecologists, and forest managers is key to the success of this practice. The research highlights the importance of involving herders as traditional knowledge holders in decision-making processes related to forest management. This step not only supports ecological sustainability but also strengthens the role of local communities in safeguarding their ecosystems. These practices contribute to biodiversity conservation, soil erosion control, and ecosystem resilience in the face of environmental change (Varga et al., 2020). This practice reflects the importance of synergy among traditional knowledge and modern policies to support sustainable management of natural resources. In addition to being a model of local sustainability, this practice is also a global inspiration in creating a community-based approach to environmental conservation.

Local knowledge-based practices in Romania include forest management through agroforestry traditions rooted in the wisdom of rural communities. One of the main methods used is grazing in forest areas, which combines the functions of

agricultural land management and ecosystem conservation. This practice, which is still ongoing in various rural areas, involves integrating traditions with biodiversity conservation endeavors to support environmental sustainability. Studies show that grazing in forests helps maintain ecosystem balance by controlling the growth of certain vegetation, supporting flora diversity, and preventing the spread of invasive species. However, this practice often faces the challenge of modern regulations that lack recognition of its potential ecological and social benefits. The research highlights the importance of collaboration among local communities, academics, and policymakers to optimize the positive impacts of this agroforestry management (Varga et al., 2020). In addition, Romanian rural communities have a traditional knowledge system in planting and caring for land sustainably. Techniques such as crop rotation and the use of organic fertilizers based on natural ingredients are used to maintain soil fertility and reduce dependence on chemicals. The practice also reflects cultural values that respect the relationship among humans and nature and the importance of preserving the environment as a legacy for future generations (Sharma et al., 2020). This local knowledge-based approach shows how traditions can contribute significantly to the sustainable management of natural resources. With the support of supportive research and policy, these practices can be adopted more widely as part of a global strategy to address environmental and social challenges.

Local knowledge-based practices in Norway are evident in the natural resource management carried out by the Sámi indigenous community, especially in the sustainable management of deer herding. This management uses traditional Sámi knowledge passed down from generation to generation to maintain the balance of tundra ecosystems, protect biodiversity, and ensure the sustainability of livelihoods. One of the key aspects of this practice is grazing rotation, which is designed to prevent land degradation due to overpressure on grasslands. Sámi's approach is based on an in-depth knowledge of deer migration patterns and seasonal changes. Research shows that this practice can maintain the sustainability of the Arctic ecosystem by preventing soil erosion and maintaining habitat for other species in the region. It also reflects the principle of sustainability that is integrated with the local culture and daily life of the Sámi people (Root-Bernstein et al., 2023). Collaboration among the Sámi community, scientists, and the Norwegian government has strengthened this traditional practice by incorporating modern technologies for ecosystem monitoring. This integration allows Sámi to maintain traditional methods while adopting innovations that support adaptation to environmental challenges such as climate change. These measures have been recognized as an important part of conservation policy in Norway and provide illustrations of how local knowledge can contribute to

sustainable resource management (Hill et al., 2020). These Sámi practices not only help maintain ecological sustainability, but also protect their cultural heritage. The success of this model shows that the integration of traditional knowledge with modern science can create innovative solutions for environmental conservation.

2. The role of academics, responsible for documenting, analyzing, and developing local knowledge into innovations that can be applied in modern contexts. The study mentions the importance of a policy-based dialogue approach, where academics and indigenous peoples learn from each other to create solutions that are relevant to the needs of local communities (Moreno-Cely et al., 2021).

The policy-based dialogue approach is a collaborative method among academics and indigenous peoples that emphasizes mutual learning to understand, document, and develop local knowledge into innovative solutions relevant to the needs of local communities. This approach aims to integrate local wisdom and scientific knowledge through equal dialogue. This approach emerged in response to the need for the decolonization of science, which has often ignored or marginalized local knowledge. This theory was developed in the context of the interaction of academics with indigenous communities to face global challenges such as environmental sustainability and social justice (Hill et al., 2020). The key concepts of this approach include: Dialogism: An equal process of interaction that respects the perspective of each party (Sarquis Soares, 2023). Cultural Accountability: Recognition of the right of indigenous communities to protect and use their knowledge independently (Windchief & Cummins, 2022). Decolonization: Endeavors to build a framework for collaboration based on justice and respect for local knowledge (Datta & Starlight, 2024).

Basic assumptions that can be argued such as the existence of local knowledge have the same value and relevance as scientific knowledge. The success of collaboration depends on the respect, trust, and active participation of all parties (Root-Bernstein et al., 2023). The structure of this approach is often described in the form of a dialogue cycle that includes: Engagement: Starting a dialogue by listening to the needs of the community. Exploration: Exploring how knowledge is integrated. Co-Creation: Create an applicative shared solution. Evaluation: Evaluating the results and their impact on the community (Pesambili, 2021). The goal is to create innovative solutions that reflect local needs, empower indigenous communities, and enrich the global knowledge base. This approach is relevant in the fields of sustainability, social justice, and inclusive education (Urquhart et al., 2020). The advantage is to increase the sustainability of the solution, providing recognition of cultural rights. The weakness is that it requires a lot of time and resources and is vulnerable to power imbalances in dialogue (Bolton et al., 2023). This approach is applied in research, Community-based scientific collaboration. Policy: Inclusive and locally-based policymaking. Education: Culture-based

curriculum to preserve indigenous traditions (Rieger et al., 2020). The policy-based dialogue approach is an important tool for creating meaningful collaborations among academics and indigenous peoples, which are relevant in a variety of social, cultural, and ecological contexts.

In Japan, the practice of dialogue-based collaboration among academics and local communities can be seen through a participatory approach in environmental sustainability. One illustration is a workshop held in a forest region in central Japan, involving academics, local communities, and other stakeholders. The workshop focused on local forest management through a collaborative approach, where academics acted as facilitators in disseminating and integrating knowledge among local communities and global scientists (Goi et al., 2022). The workshop used a communication model that respected each other and involved all participants in an open dialogue. Academics play a key role as "Bridging academics" by facilitating recognition of knowledge gaps among participants, while creating shared values for sustainability. The interactions that are built generate a collective awareness of the importance of cross-knowledge collaboration to manage resources sustainably. The results of this approach include increasing the awareness of local communities about their role in environmental conservation and the formation of a multi-nodal model as a collaboration mechanism. The practice highlights how a well-structured dialogue can create a mutually beneficial relationship among modern science and local wisdom, thus supporting sustainability goals at the regional and global levels. Models like this demonstrate the relevance of a dialogical approach in strengthening the relationship among local and scientific knowledge, as well as providing a framework for further development in community-based resource management in Japan.

In South Korea, the integration of traditional knowledge into education is realized through a place-based approach on Jeju Island. For illustration, Haenyeo (traditional female divers) and traditional home cultural landscapes are part of place-based civic education endeavors. The program aims to combine traditional and modern geographical knowledge, while emphasizing local cultural values for future generations (W. Song & Cho, 2023). This approach is carried out through collaboration among academics, educators, and local communities. By utilizing traditional practices such as diving conducted by Haenyeo, the program aims to preserve cultural and ecological values while promoting a strong local identity. This method creates culturally relevant learning experiences and advises the younger generation to value their heritage. The program also demonstrates how dialogue among local knowledge and academia can provide a more inclusive and sustainable educational framework. By integrating traditional elements in formal

education, this initiative provides a model of how local traditions can be part of modern solutions in education and cultural preservation.

In China, the apply local knowledge and customs in environmental management and sustainability is seen in the conservation of forests and wildlife in the village of Mangba, Yunnan Province. The Bulang community uses their indigenous knowledge, which is passed down orally, to protect the local ecosystem. This approach involves practices such as moral control, nature worship rituals, and public opinion-based restrictions on the exploitation of natural resources (Su et al., 2020). This local knowledge forms a unique forest protection system, with banyan trees and Derbyan Parakeet birds as core symbols of conservation. However, challenges arise when local practices such as feeding birds to attract tourists are not by the scientific principles of conservation. This indicates an urgent need to align indigenous knowledge with scientific guidance to achieve more effective ecological sustainability. This local knowledge-based intervention demonstrates the importance of collaboration among local communities and ecologists in integrating indigenous methods with scientific approaches. This approach not only conserves biodiversity but also maintains a harmonious relationship among people and nature, which is at the core of their local cultural values.

In Germany, the approach of integrating local knowledge with academia is applied through multidisciplinary collaboration in environmental management and cultural value-based education. One illustration is transdisciplinary research that involves local communities and researchers in supporting sustainability practices through the integration of traditional ecological knowledge with modern scientific approaches (Root-Bernstein et al., 2023). The program uses location-based educational methods to support student learning, emphasizing a respect for cultural diversity and the reciprocal relationship among humans and the environment. This is realized by adapting local knowledge for a more relevant curriculum, increasing students' understanding of sustainability, and building global awareness of ecological and social issues. The results of the collaboration demonstrate the effectiveness of combining traditional and scientific knowledge to support innovative and community-based sustainability solutions. This approach strengthens the relationship among local communities, scientists, and educational institutions in creating a more inclusive model of education and resource management.

In Romania, collaboration among universities and local communities adopts a traditional knowledge-based approach to encourage innovation and creativity. One of its main practices is the university's collaboration with the business world, which aims to create a collaborative framework in resource management and cultural preservation. Research shows that this kind of collaboration can improve knowledge transfer and encourage innovation relevant to local needs (Miricescu

et al., 2021). The practice involves a transdisciplinary approach, where universities and the business community share information to develop solutions that support sustainability and promote social awareness. The results include strengthening local capacity to face economic and environmental challenges through the integration of traditional knowledge with modern technology. These programs also encourage the active participation of the community in decision-making, ensuring the relevance and sustainability of the resulting solutions. This collaboration makes an important contribution to the development of local innovation capacity while supporting the preservation of traditional culture. Through this approach, Romania shows great potential in connecting academic knowledge with local wisdom to produce far-reaching positive impacts.

From a variety of practices in Japan, South Korea, China, Germany, and Romania, the wisdom-based dialogue approach features a common model of transdisciplinary collaboration. The main elements in this model include: (1) Local Community Participation, which serves as a provider of local knowledge and partners in implementation, (2) Academics or Educational Institutions, who act as facilitators and providers of scientific frameworks, and (3) Dialogical Interaction, where local and scientific knowledge are contextualized with each other. This structure is designed as a cycle that includes the stages of exploration, integration, implementation, and evaluation. For illustration, in China, the Bulang community uses this approach to manage custom-based forest conservation (Su et al., 2020). The main goal of this approach is to create sustainable solutions that are relevant to the local context, such as cultural preservation, environmental conservation, or education improvement. This approach is relevant in a variety of fields, including education, ecology, and sustainable development. In Japan, this approach aims to preserve local cultural values such as the practice of Haenyeo diving, which also serves as an educational tool for environmental sustainability (W. Song & Cho, 2023). In Romania, collaboration among universities and local communities is used to encourage innovation and strengthen the relationship among science and the needs of society (Miricescu et al., 2021). This approach has significant advantages, such as: Increasing Local Relevance: The resulting solutions are more contextual and relevant to the needs of local communities. Encouraging multiactor collaboration: combining local and scientific perspectives enriches solutions. Strengthening cultural preservation: traditional knowledge is gaining recognition as an important asset. However, this approach has drawbacks, such as: Operational complexity: it takes time and resources to build an equal relationship. Power Inequality: The potential dominance of academics in the dialogue process can weaken local community participation. Limitations of integration of science and customs: in some cases, such as in China, the customary approach is not fully aligned with the scientific principles of conservation (Su et al., 2020). This

approach shows great potential to create innovative community-based solutions, although it requires refinement in harmonizing methods and relationships among controllers.

Asmat's handicraft development approaches, such as wood carving, can be integrated with a cross-sector collaboration model involving academics, local communities, and the industry sector to create a sustainable innovation ecosystem. Based on inspiration from practices in different countries, this development can be implemented by taking into account the following elements: The development of Asmat handicrafts can use a model involving three main elements, Asmat indigenous community as the owners of traditional knowledge, they become centers for the development of carving designs that represent cultural heritage. Academics and educational institutions, instrumental in providing a touch of modern technology, such as the use of 3D design software to create innovative product variations, as well as documenting carved patterns for cultural preservation. Industrial sector, responsible for mass-producing and marketing products to national and international markets with a branding strategy that highlights the unique value of Papuan culture. This structure can be set up in a continuous collaboration format that begins with design research, prototype trials, mass production, and market evaluation. The main goal of this development is to create cultural-based products that are globally competitive while improving the economic well-being of the Asmat community. By integrating modern design, wood carving products can be expanded in use, such as being an element of interior decoration, furniture, or contemporary art collections. The relevance of this approach lies in the sustainability of Papua's creative economy, which is in line with the vision of the Papua RPJMD 2025-2029 (Bapperida Provinsi Papua, 2024) in encouraging cultural and innovation-based economic growth. Advantages in the form of increased Added Value: The combination of traditional art and modern technology can create high-value products. Local Empowerment: Providing economic opportunities for indigenous communities through their involvement in the entire production process. Global competitiveness, products with traditional elements and modern designs can attract international markets. While the weakness is the potential for over-commercialization, the risk of losing cultural authenticity if it is too market-oriented. Technology gap, requires intensive training to introduce modern technology to local communities. Dependence on external partners, local communities can loss control of the outcome and direction of development. To ensure success, this ecosystem can start with a pilot project supported by the local government and universities. Academics can provide training to the Asmat community on modern design and production technology, while the industrial sector facilitates marketing and distribution. Local governments can also play an important role in creating regulations that support

cultural preservation while ensuring economic sustainability. This approach can be a clear illustration of how local culture-based development can create an innovation ecosystem that not only preserves cultural heritage but also spurs Papua's economic growth and competitiveness.

3. The Role of Industry, industry plays an important role in commercializing the innovations resulting from these collaborations, ensuring economic sustainability. A study shows that collaboration among universities and industry can create a stronger innovation ecosystem through knowledge and technology transfer, especially in the context of regions with low levels of innovation (Parmentola et al., 2021).

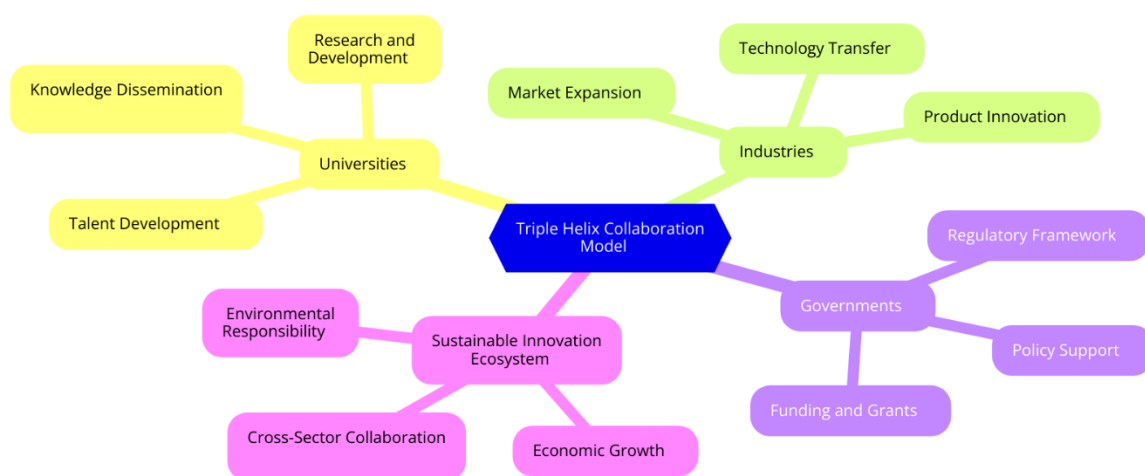


Figure 7.4. Triple Helix Collaboration Model

Source: Author's Summary, 2024

University-industry collaboration (U-I) is an interaction among the higher education system and industry with the main goal of encouraging the exchange of knowledge and technology. This collaboration plays a central role in facilitating innovation through joint research, technology transfer, and skills development (Parmentola et al., 2021). The concept of U-I collaboration first emerged in the innovation literature when researchers realized the importance of synergy among academic research and the need for industry to accelerate innovation. In the modern era, the need to address innovation gaps in regions with low innovation capabilities further emphasizes the role of this collaboration. For illustration, in the Campania region of Italy, this collaboration was adapted to overcome the challenges of the high- and low-tech sectors (Parmentola et al., 2021).

The main components of the U-I collaboration (figure 7.4.) include knowledge transfer, the process of sharing scientific research into practical applications in industry. Absorptive capacity, the ability of the industry to absorb and use new knowledge. Collaboration infrastructure, involving joint research centers and

innovation incubators (Yi & Zhang, 2022). The U-I collaboration assumes that: The involvement of academia and industry can result in more practically relevant innovations. Regions with low innovation capacity can take advantage of policy support and funding to improve innovation capabilities (Y. Song et al., 2020). U-I collaborations often use a triple helix model that includes universities, industry, and government. These elements interact with each other to create a sustainable innovation ecosystem (L. Wang et al., 2024). The main goal of this collaboration is to improve innovation capabilities through applied research, create new jobs, and support local economic growth. Its relevance is high, especially in low-innovation regions that require new economic growth drivers (Costa & Matias, 2020).

In Japan, university-industry collaboration has evolved into a strategic model that advises massive innovation in various sectors. One notable illustration is a large-scale collaboration project among Osaka University and Chugai Pharmaceutical Co., Ltd., which focuses on drug development. The project involves an investment of 10 billion yen over 10 years, demonstrating a long-term commitment to producing research-based innovation (Kuwashima, 2020). A key factor in the success of this collaboration is the initial support from the Japanese government through the World Premier International Research Center Initiative (WPI). This initiative strengthens the university's research infrastructure so that it can attract investment from the private sector, as demonstrated by Chugai Pharmaceutical's decision to engage in this project. The project became a model for the transition from government support to industry funding, integrating universities as innovation centers relevant to market needs (Kuwashima, 2020). In addition, the University of Tokyo has developed an innovation ecosystem oriented toward the formation of entrepreneurial clusters. This approach involves technology transfer, revenue from patents, and entrepreneurship education for undergraduate and graduate students. The system builds a support network for alumni working in financial institutions, large corporations, and government institutions, creating relationships that support sustainable innovation (Nakano, 2021). This collaborative practice shows that Japan not only harnesses the power of internal innovation, but also actively facilitates an environment where universities and industry can work together strategically to address economic and demographic challenges. As it evolves, this model serves as a global illustration of how to create a sustainable innovation ecosystem.

In South Korea, university-industry collaboration has become a key strategy in creating a sustainable innovation ecosystem. One prominent illustration is the application of the concept of "Living Labs," which allows companies and universities to work together in an environment that supports the development of technological innovation. This structure facilitates dynamic interaction among industry players and academics to promote joint innovation. Studies show that although this

ecosystem is still in its infancy, its impact on innovation networks is very positive, creating a closer relationship among the elements of innovation (Shvetsova & Lee, 2021). In the field of materials research, South Korea has created a strong research ecosystem through alliances among universities and industry. An illustration is a collaboration program in the field of advanced materials involving the country's largest industrial partners. The program not only prioritizes the development of cutting-edge technologies but also supports the transfer of technology to the market. The alliance is supported by a vision to expand research in the field of materials, which is a key pillar in overcoming the country's resource limitations (Nam et al., 2023). In addition, the strategy implemented through the Creative Technology Solution (CTS) by the Korea International Cooperation Agency (KOICA) is an illustration of how technological innovation can contribute to global economic growth. The program connects tech startups with opportunities in developing countries, expanding the impact of South Korean innovation on the international stage. This approach allows startups to leverage technology in solving social problems while encouraging cross-border collaboration (Hong, 2024). With these various approaches, South Korea has shown how collaboration among universities and industry can be a key driver for innovation, both in domestic and global contexts.

In China, university-industry collaboration is a key opponent in supporting the innovation ecosystem, especially through the triple helix model that integrates government, universities, and industry. A real illustration is the Jiangsu Industrial Technology Research Institute (JITRI), which plays a key role in supporting technology transfer from academia to the industrial sector. With a multilayer structure involving cores, platforms, and supporting elements, JITRI facilitates innovation through applied research and creates an efficient ecosystem for the commercialization of technology (L. Wang et al., 2024). In addition, research collaboration in the field of biomedicine in Fujian Province shows the importance of a social network-based approach (Social Network Analysis). The university plays a central role in building a collaborative sub-network, which gradually develops into a core-edge structure. This approach not only expands the scale of innovation, but also strengthens cross-sector collaboration that includes industry, universities, and research institutions (Guo, 2023). On the other hand, endeavors to build a green innovation ecosystem in China involve environmental regulations and government incentives to improve the stability of multi-agent collaboration. These policies, which include penalties for violators and subsidies for innovation, have proven effective in encouraging innovation efficiency and reducing the negative externalities of green technology activities (Yang et al., 2021). These practices demonstrate how China is leveraging synergies among universities,

industry, and government to drive innovation-based technology growth, support economic sustainability, and enhance global competitiveness.

In Indonesia, university-industry collaboration has been implemented through various approaches to support a sustainable innovation ecosystem. One illustration is the development of the Bandung Techno Park (BTP) at Telkom University. BTP acts as a hub for technology transfer and innovation, connecting academics with industry needs. However, the main challenges are the quality of research that is less relevant to the market and weak government regulations in supporting domestic technological innovation. Therefore, it is necessary to strengthen the role of BTP to align academic research results with industry needs (Choeriyah & Noviaristanti, 2021). Another initiative involves the implementation of Industry-Based Learning (IBL) implemented in various universities. Through this program, students are given the opportunity to learn directly in industry, integrating the theory they learn with field practice. This not only improves student skills but also strengthens the relationship among universities and the industry sector, creating synergies in the development of applicative innovations (Rajibussalim et al., 2016). In Kudus, a quadruple helix approach involving the government, academia, the business sector, and civil society has been used to develop innovations in small and medium industries (SMEs). This approach shows the importance of intensive communication among related parties to create a collaborative innovation ecosystem, helping to overcome problems in production and marketing in SMEs (Widjajanti et al., 2020). Another prominent strategy is the establishment of an entrepreneurship-based ecosystem at the University of Indonesia (UI). Although research awards are given more for publications than practical innovations, UI began to develop a research funding system that supports patent development and social innovation. This is important to increase the relevance of research to market needs and improve the quality of teaching in universities (Hutapea et al., 2020). The practices in Indonesia reflect ongoing endeavors to address challenges in university-industry collaboration, with a focus on market relevance, cross-sector communication, and better policy support to strengthen the innovation ecosystem at the national level.

The model applied in these countries is generally based on triple helix or quadruple helix. In Japan, Living Labs created an interactive structure that connects industry and universities through a project-based approach, resulting in hands-on innovation through real collaboration (Shvetsova & Lee, 2021). South Korea uses a cluster-based innovation approach, where universities and industries operate within a government-managed ecosystem to ensure coordination among research and commercialization (Nam et al., 2023). China adopts the JITRI model, a multilayer structure that includes core (technological innovation), platform (research collaboration), and support (government and policy) to accelerate

technology transfer (L. Wang et al., 2024). In Indonesia, BTP integrates academia, government, and industry, but still faces obstacles in aligning research with market needs (Choeriyah & Noviaristanti, 2021). The main goal of this model is to improve innovation efficiency through structured collaboration among universities and industry. In Japan, the goal of Living Labs is to develop environmentally friendly technologies that are practical and useful, making them relevant in the development of green technologies (Kuwashima, 2020). South Korea uses the cluster model to support advanced materials research, relevant to strengthen the national high-tech industry (Nam et al., 2023). In China, the JITRI model is designed to accelerate the commercialization of the technology, making it essential for innovation-based economic growth (L. Wang et al., 2024). Indonesia, through the BTP, aims to accelerate the growth of technology-based startups although the relevance of research to market needs still needs to be improved (Choeriyah & Noviaristanti, 2021). The advantage of this model is its ability to create a collaborative innovation ecosystem. In Japan, Living Labs enables the development of practical and environmentally friendly technological solutions, although ecosystem stability remains a challenge (Shvetsova & Lee, 2021). South Korea has shown success in creating cluster-based innovation centers, but gaps in public funding are still an obstacle (Nam et al., 2023). China, through the JITRI model, has succeeded in accelerating technology transfer, but has faced criticism related to government dominance in ecosystem management (L. Wang et al., 2024). In Indonesia, BTP has great potential, but the lack of coordination among actors is a significant obstacle (Choeriyah & Noviaristanti, 2021). Learnings from this model can be adapted to strengthen the global innovation ecosystem, especially in increasing the relevance of research to market needs, improving regulations, and supporting the sustainability of technology-based innovation.

In the context of Papua, the development of Asmat wood carving can use a quadruple helix structure involving academics, government, industry, and the community. Academics can play a role in the research and development of technology-based modern design, such as the use of 3D design software to create carving motifs that still respect Asmat cultural values but have global market appeal. The government acts as a facilitator by providing supporting policies, training, and infrastructure. The industry can process products into higher value and market them to national and international markets. The community, especially local artisans, is the main actor in maintaining the authenticity of cultural products (Widjajanti et al., 2020). The purpose of this collaboration is to create Papuan handicraft products that have high economic value while maintaining local cultural values. With this approach, Asmat carvings are not only a cultural symbol but also a superior product that can improve the welfare of the local community through increasing income from the creative industry. The

relevance of this approach is very high because it creates an innovation ecosystem that leverages local uniqueness to answer global challenges, such as economic diversification and indigenous peoples' empowerment (Choeriyah & Noviaristanti, 2021). Pros: Blends traditional values and modern innovations to create broad market appeal. Providing new economic opportunities for local communities through access to a wider market. Support the development of technical and design capabilities among local artisans through training and academic support. Weaknesses: Limited infrastructure and access to technology in Papua can be an initial obstacle. Difficulties in maintaining cultural authenticity in the face of international market pressure for design modifications. Dependence on consistent government policies to support the sustainability of the innovation ecosystem (Shvetsova & Lee, 2021). To make this happen, the following steps can be taken, local innovation center, establish a culturally based innovation hub in Papua that connects academics, industry, and indigenous peoples to create value-added products. Training and Technology Transfer: Provide modern design and production technology training for local craftspeople. Global Marketing: Developing a global marketing strategy through a digital platform that highlights the Papuan cultural narrative as an added value of the product. Policy Collaboration: Integrate the vision of the Papua RPJMD 2025-2029 (Bapperida Provinsi Papua, 2024) with national policies to support the development of a sustainable innovation ecosystem. This approach has the potential to not only improve the local economy but also preserve Papua's cultural heritage in a globally relevant format.

7.3. Integrating Local Traditions in the Modern System

The integration of local traditions with modern innovations in Papua is a process of adaptation and incorporation of traditional values of Papuan society into a framework of contemporary technology and management. The main goal of this approach is to support cultural preservation while encouraging global competitiveness through an inclusive and sustainable approach (Novie Wurarah et al., 2023). This approach was born as a response to the need to preserve Papuan cultural identity in the midst of modernization. With the implementation of special autonomy, Papua has become the focus of development that integrates local wisdom with modern innovations, such as customary law harmonized with national law (Arsensius, 2023). In addition, international endeavors also contribute to aligning ecological sustainability with local economic development in Papua (Mollet & Silo, 2024). The main concepts in this integration include resource management and cultural arts. The management of customary lands and customary forests is supported by monitoring technologies such as drones to ensure sustainability and efficiency in natural resource management (Novie Wurarah et al., 2023). On the other

hand, cultural arts such as Noken carvings are used as a form of economic empowerment of local communities, expanding the market for cultural products through modern marketing strategies (Avianto et al., 2021). The basic assume this approach is that local cultures have values that are aligned with the principles of sustainability, and that modern technologies can be accepted by indigenous peoples if they are designed to be inclusive and involve them in the process (Prasetyo et al., 2020). This integration model includes collaboration of customary law with formal policies and cultural-based economic empowerment. In legal collaboration, endeavors to balance customary law with formal policies aim to protect the customary rights of indigenous peoples while supporting sustainable management (Sokoy, 2022). Meanwhile, economic empowerment is carried out through community-based cultural and ecotourism festivals that integrate art and tradition in tourism activities, so that it can improve community welfare . This approach has advantages and disadvantages. Its advantages include the ability to maintain cultural and environmental sustainability, as well as support inclusive and locally-based development (Nurhasan et al., 2022). However, the complexity of harmonizing traditions with modern systems remains a challenge that requires an adaptive approach and intensive dialogue among stakeholders (Arsenius, 2023). Applications of this model include tradition-based ecotourism that integrates cultural arts to increase international appeal (Prasetyo et al., 2020) and technology-supported management of customary forests for transparency and efficiency (Mollet & Silo, 2024). This model is a strategic step to preserve Papua's local culture while increasing global competitiveness.

The model of integration of local traditions with modern innovations in Papua is based on a harmonious multidimensional approach, combining traditional values with contemporary technology. One such model is the collaboration among customary law and formal government policies, which allows customary land management to be carried out by combining traditional practices and modern technologies such as GIS for mapping. This approach is important to ensure the recognition of indigenous peoples' rights and the preservation of local culture (Sokoy, 2022). In addition, local product-based economic empowerment is also an important part of this model. Traditions such as UNESCO-recognized Noken crafts are integrated with digital marketing technology to expand the market. Ecommerce training for local artisans allows them to market their products globally while still maintaining traditional cultural values. This shows that the development of local culture-based products has great potential to increase the income of indigenous peoples (Avianto et al., 2021). Tradition-based ecotourism is also an integral part of this model, where Papuan carving, dance, and hunting traditions are adapted in tourism programs. Technologies such as augmented reality (AR) are used to create immersive cultural experiences for tourists, while local communities act as key actors in tourism

management. A successful illustration is the integration of the sasi laut tradition in ecotourism that not only preserves local culture but also improves the economic well-being of the community (Prasetyo et al., 2020). Technology is also used in the management of customary forests to ensure transparency and ecological sustainability. The use of drones and satellite-based monitoring apps assists indigenous peoples in managing their forests, while also documenting traditional practices that contribute to environmental conservation. This creates community-based and sustainable management of natural resources (Novie Wurarah et al., 2023). Education based on local wisdom is also an important element in this integration model. Problem-Based Learning that integrates traditional Papuan values, such as forest resource management, has been proven to improve students' conservation attitudes and understanding of cultural and environmental conservation. Collaboration among indigenous peoples, governments, and technological innovation is key to the success of this approach.

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8.1. Regulations that Support the Sustainability of Local Research

Policies that support locally-based innovation are regulatory frameworks that aim to strengthen the capacity of local communities through the integration of customary values and sustainability principles in activities such as agroindustry and ecotourism. Custom-based customary land management includes the apply traditional values to provide legal protection to indigenous peoples and ensure socio-ecological sustainability. This policy arises from the increasing global awareness of the importance of the role of indigenous peoples in preserving natural resources. Research shows that recognition of local knowledge, such as in agroindustry and ecotourism studies, can improve landscape governance and empower local communities (Kusumastuti et al., 2022; Williams et al., 2020). The main concepts of this policy include sustainability, respect for indigenous values, and local innovation. Sustainability aims to preserve natural resources, while traditional respect ensures that local traditions and culture are preserved. Local innovation allows the development of technologies and practices based on local wisdom to improve the economy of indigenous communities (Sangha et al., 2019). This policy is also based on the assumption that local knowledge has high value for sustainability, indigenous peoples have rights to customary land, and that locally-based development can improve welfare without damaging tradition or the environment (Huambachano & Cooper, 2021). Structurally, these policies are often implemented through multi-stakeholder collaborations such as governments, indigenous peoples, and the private sector. The co-management approach allows responsibilities to be shared fairly, creating synergies among traditional values and modern development goals (Burgos Ochoa et al., 2020). Its main objectives are to protect the rights of indigenous peoples, promote sustainability, and empower local innovations relevant to sustainable development, especially in economic, social, and environmental contexts (Bansal et al., 2024).

The advantages of this policy include the preservation of local traditions, increasing the economic independence of the community, and improving natural resource governance. However, there are weaknesses such as resistance from external parties or investors and implementation obstacles due to differences in

interests among parties (Dasgupta et al., 2023). In practice, this policy is implemented through custom-based spatial planning, community conservation, and the integration of local wisdom in ecotourism and agro-industry projects. An illustration can be seen in sustainable agricultural practices in Ghana which show the success of integrating local values with modern policies (Nyantakyi-Frimpong, 2020). This policy provides a holistic solution that respects local wisdom while supporting sustainable development and empowerment of indigenous peoples. With this approach, social, economic, and environmental goals can be achieved in a balanced manner.

In Japan, sustainability-based land management approaches and local innovations have been realized through policies such as Community-Based Payment for Ecosystem Services (CB-PES). This approach aims to prevent the abandonment of agricultural land, especially in mountainous and remote areas that face the challenges of depopulation and population aging. The program advises collective management at the community level, which includes the active participation of farmers in mapping and caring for their land. Based on a study in the Noto Peninsula, the results of the implementation show that direct payments through CB-PES are able to improve collective management and prevent the increase in abandoned land.

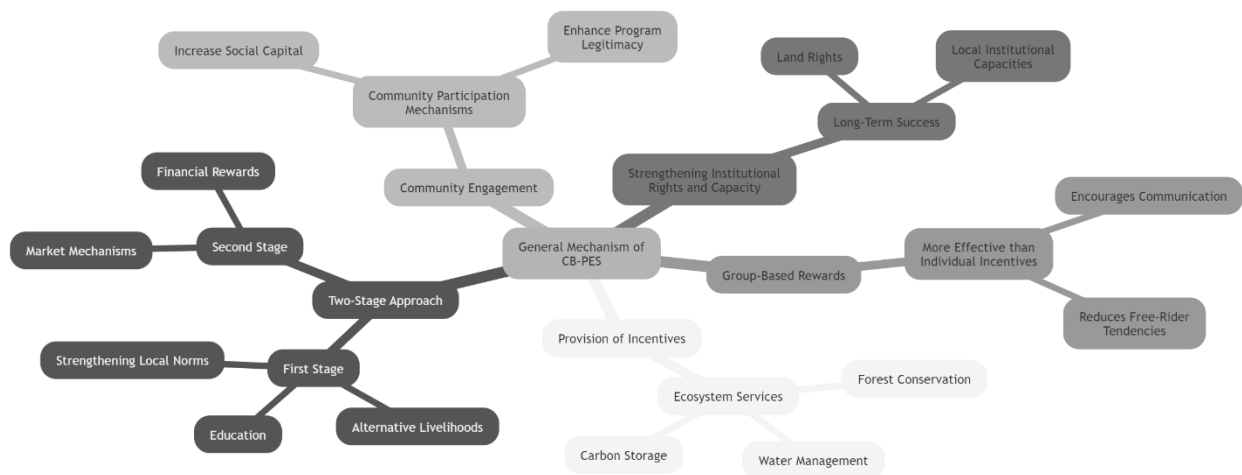


Figure 8.1. General Mechanism of CB-PES

Source: Author's Summary, 2024

CB-PES is a mechanism that involves local communities in the PES scheme to support environmental conservation while improving community welfare (figure 8.1). This mechanism works by providing incentives to communities to manage and maintain natural resources in a sustainable manner, for illustration through forest conservation, water management, or carbon storage (Jacka et al., 2008). The CB-PES approach often involves two stages, namely building a social context first with education, strengthening local norms, and providing alternative livelihoods to support

conservation behaviors. Thereafter, market mechanisms are applied to reinforce conservation behavior in exchange for financial rewards (Cranford & Mourato, 2011). The success of CB-PES often depends on the level of community participation, which can increase social capital, community assets, as well as the legitimacy of the program, thereby strengthening local support for the PES scheme (Brownson et al., 2019). In addition, group-based incentives are considered more effective than individual incentives because they encourage coordination among community members and reduce the tendency of free-riders (Salk et al., 2017). However, challenges such as environmental outcomes that are not always optimal and often uneven distribution of benefits remain obstacles that need to be overcome (Brownson et al., 2019; Ingram et al., 2014). CB-PES is an innovative approach that can improve environmental conservation and the well-being of rural communities. However, its success requires strengthening land rights, local institutional capacity, and designing incentives that take into account the social and economic context of the community.

Socio-economic factors, such as geographical conditions, income dependence outside of agriculture, and the scale of farmland, contribute to the success of this program (Shoyama et al., 2022). In addition, land management policies in Japan also include a consensus approach in repurposing less productive farmland for purposes such as renewable energy. For illustration, the conversion of farmland to renewable energy sites, known as "land-use conversion for a newly found impartial," aims to integrate environmental conservation with productive activities. This move highlights the importance of scientific and political evidence-based decision-making to balance conservation with production activities, especially in the agriculture and forestry sectors (Kohsaka & Kohyama, 2022). Another relevant approach is the implementation of community-based mountain agriculture policies to maintain the sustainability of agricultural ecosystems. This practice relies on co-management among communities and demonstrates its effectiveness in maintaining ecosystem functions, such as soil and water retention, as well as cultural services associated with the local landscape. Community participation on a cross-village scale allows for more effective collective management, thereby improving the sustainability of socio-ecological functions in the area (Shoyama et al., 2022). These practices demonstrate how Japan has successfully integrated local innovation, community-based land management, and sustainability approaches to address the challenges of modernization and demographic change in rural areas. Implementations that focus on sustainability and community empowerment are models that can be applied in other countries facing similar challenges.

In South Korea, a community-based resource management approach has been implemented through the Collaborative Forest Management (CFM) program. The program provides access to rural communities to use national forests, particularly for the collect non-timber forest products, in exchange for their contribution to forest

management. A study conducted in 17 villages showed that participation in the CFM program encouraged diversification of livelihood strategies and increased the income of participating households. CFM is a forest management mechanism that involves partnerships among governments, local communities, and other stakeholders to achieve the goals of conservation, resource management, and sustainable development (figure 8.2). This mechanism relies on the collaboration of various parties, where each shares responsibility in forest management. CFM strengthens collaboration capacity through community organizing, shared decision-making processes, collective learning, and participatory evaluation of outcomes (Cheng & Sturtevant, 2012). In this mechanism, local communities get greater access to forest benefits such as timber, non-timber forest products, and ecosystem services, while maintaining resource sustainability (Wollenberg et al., 2004). In addition, CFM values Traditional Ecological Knowledge (TEK) as an important element to strengthen the socio-ecological resilience of forests (Tagliari et al., 2021).

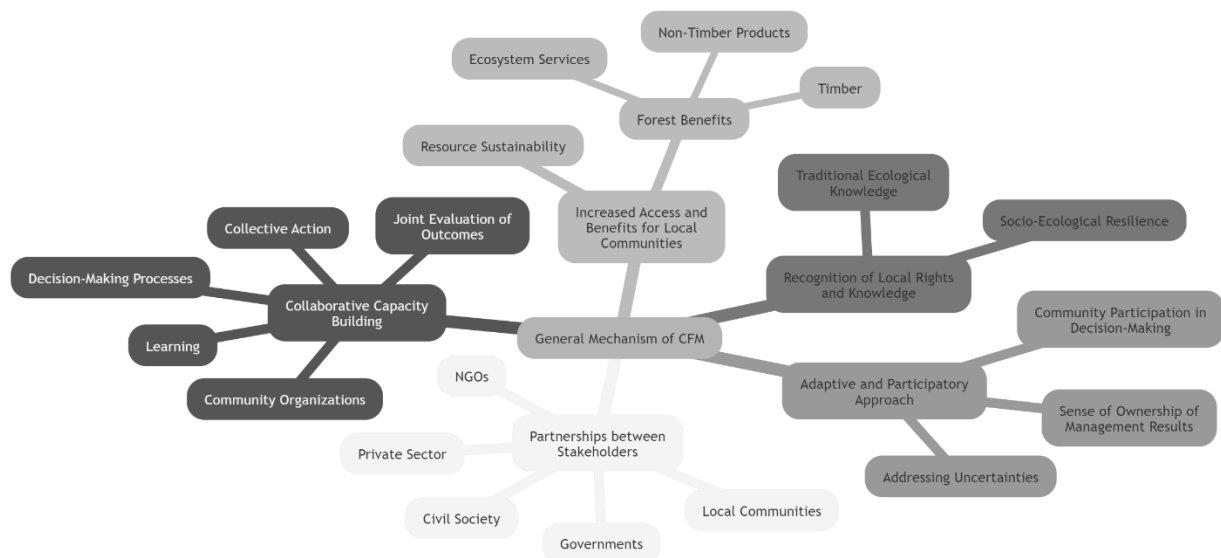


Figure 8.2. Mechanisme CFM

Source: Author's Summary, 2024

The management process in CFM is often carried out adaptively to deal with uncertainty in the forest ecosystem, with community participation that is important to build a sense of ownership of the management results ("The Complex Forest: Communities, Uncertainty, and Adaptive Collaborative Management," 2006). This approach provides significant benefits, such as improved forest sustainability, community well-being, and stronger social relationships among stakeholders (Mohammed et al., 2017). However, challenges remain, especially in overcoming the power inequality among the government and the community, limited institutional capacity, and the lack of incentives to maintain public interest in long-term

management (Desmiwati et al., 2020). Therefore, the success of CFM requires strengthening local capacity, equality in decision-making, and recognition of the rights and contributions of local communities as key stakeholders.

However, challenges such as an aging population and limited access for female-headed households underscore the importance of innovations in forest governance to achieve a more equitable and sustainable distribution of forest services (Park & Yeo-Chang, 2021). In addition, South Korea has also utilized technology and data analysis for land management and resource conservation. The use of models such as CA-Markov has been applied to analyze the impact of local regulations on water resource quality and land-use change. The simulation results show that regulations such as Total Maximum Daily Load (TMDL) have succeeded in reducing over-urbanized areas and maintaining grassland ecosystems, thereby reducing the pollution burden. This method provides significant insights for the development of sustainability-oriented local policies (Song, 2021). Another initiative in South Korea is village revitalization through community-based social innovation programs, such as the Youth Village Program in Mungyeong. This program aims to attract young people to rural areas to start new businesses, thereby helping to prevent the decline in environmental quality due to urbanization. Case studies in Mungyeong show that factors such as cultural differences and regional conditions play an important role in the success of these social innovations. Specially designed local strategies have helped create jobs and address population decline in rural areas (Thamjamrassri et al., 2023). These approaches demonstrate how South Korea successfully integrates local innovation, technology, and community-based collaboration to achieve the goals of sustainability and empowerment of local communities. This strategy provides a model of best practices that can be applied in other regions with similar challenges.

In China, a local knowledge-based approach to resource management is applied to the agricultural landscape of rice terraces in Jiabang, Guizhou. Indigenous Knowledge Systems (IKSs) play an important role in the management of natural resources such as mountains, forests, water, and agricultural land. Studies show that these local farming methods not only create landscape diversity but also support ecological and cultural sustainability. This system is continuously transmitted among generations, ensuring the sustainability of resource management patterns that support healthy agrarian ecosystems. This rice terrace landscape is a model of local community-based sustainability, providing a reference for resource conservation, protection of mountainous areas, and tourism development in mountainous agricultural areas (Wang et al., 2021). On the other hand, innovation-based land-use transitions are also carried out to reduce industrial pollution emissions. In China's 30 provinces, a land-use shift focused on innovation is improving environmental efficiency. Four dimensions, namely human capital, material capital, urban function,

and government policy, are identified as key elements in supporting this innovation strategy. This study shows that an innovation-based approach can create a "triple-win" economic development model that includes environmental protection, land-use optimization, and economic development (Meng et al., 2021).

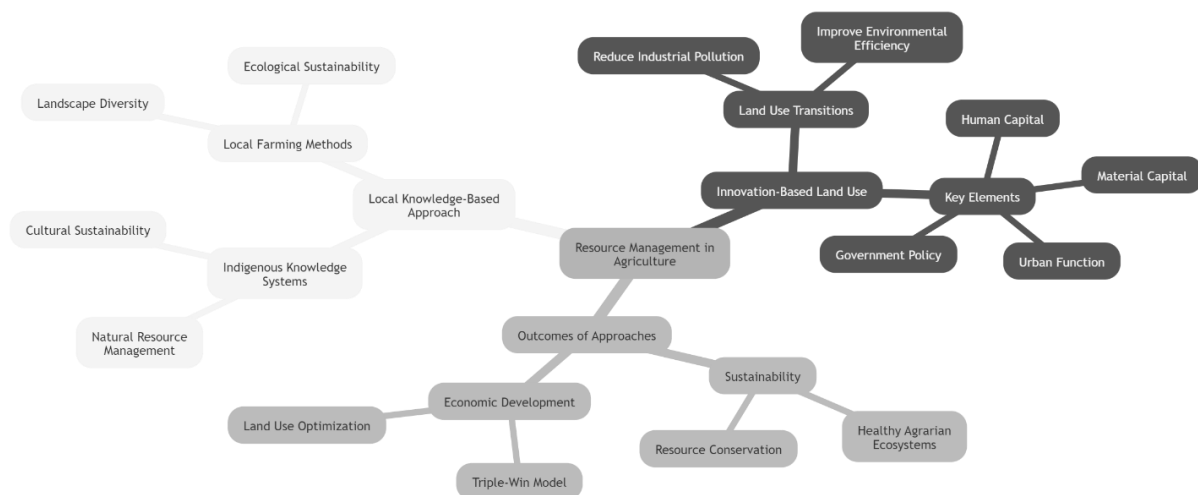


Figure 8.3. Local Knowledge-Based Approach in Agricultural Resource Management
Source: Author's Summary, 2024

The interaction among key elements and the results achieved through the apply the approach. The local knowledge-based approach includes the use of local agricultural systems and traditional indigenous knowledge to achieve ecological sustainability and cultural sustainability. Elements such as landscape diversity and natural resource management are key components that support the achievement of sustainability. In addition, the diagram also highlights the importance of innovative land-use transitions to reduce industrial pollution and improve environmental efficiency. This is supported by key elements, such as government policies, human capital, material capital, and the integration of urban functions that play an important role in the successful implementation. The results of this approach include land-use optimization, economic development that focuses on a triple-win model, namely social, economic, and environmental benefits, and resource conservation that supports the sustainability of healthy agrarian ecosystems. Through this mechanism, local knowledge-based approaches and land-based innovations can be important strategies in ensuring the sustainability of the agrarian system and holistic resource management.

Another approach is ecosystem services-based ecosystem management for sustainable landscape planning in Beijing. Analysis of ecosystem service distribution patterns is used to identify functional zones such as ecological conservation areas, food production, and urban development. With land-use optimization scenarios, ecosystem services such as habitat, recreation, and food supply are successfully

conserved, providing a reference for ecosystem conservation and landscape sustainability in other metropolitan areas (Sun et al., 2022). These practices demonstrate how China integrates local knowledge, innovative transitions, and ecosystem-based management to achieve sustainable development. This holistic approach can serve as a model for other countries facing similar challenges.

In Morocco, a community-based management approach is applied through participatory land resource planning in the Souss-Massa region. The process aims to address land degradation that affects about 19% of the country's total area. Within this framework, degradation zones are identified to implement sustainable land management (SLM) practices. Through the involvement of local stakeholders, a "Territorial Planning Pact" was born that guided the planning and implementation of a three-year regional development program. This approach integrates biophysical and socio-economic information to ensure the sustainability of natural resources while improving the well-being of local communities (Ziadat et al., 2022). In Morocco's Southeast oasis, land-use transformation is showing a significant impact on ecological sustainability. Studies show that traditional knowledge, which previously maintained ecological balance, is increasingly eroded by modern practices that are risky to the environment. Communities that rely on traditional agriculture are better at conserving resources than those that adopt modern entrepreneurship-based development models. The study highlights the need to reintegrate ecological balance and develop actions that take into account local specifications as well as ecosystem rehabilitation (Akdim et al., 2023). Innovations in oasis agriculture are also applied to improve food security and adaptation capacity to climate change. Technologies such as smart irrigation management and agro-ecology are beginning to be implemented to reduce social and environmental vulnerabilities, while promoting community resilience through increased land productivity and agroecosystem sustainability (Mrabet, 2022). These approaches demonstrate how Morocco leverages community participation, local knowledge, and innovation to achieve sustainable development. The strategy provides illustrations of best practices that can be adapted by other countries with similar conditions.

In Venezuela, community-based sustainable natural resource management practices are seen in land management in the Orinoco Mining Arc (OMA) region. OMA covers a strategic area of 111,843 km², which includes tropical forests with high biodiversity as well as important water resources such as the Caroni Basin. The region is also home to more than 55,000 indigenous peoples from 22 ethnic groups. Although OMA was established to harness the economic potential of mining activities as an alternative to oil resource management, the initiative has often faced criticism for its impact on fragile ecosystems and local communities. These activities cause environmental degradation, decreased water quality, and land conflicts with indigenous peoples. The study concludes that a sustainability-based approach

involving indigenous peoples in land and resource management is needed to address these challenges (Rivero & Liu, 2020). In addition, the experience of natural forest management in Venezuela shows the potential for natural regeneration as a core component in silvicultural practices. After selective logging, techniques such as enrichment planting are applied to restore forests. However, the success of these approaches is often limited by the lack of robust technical guidelines and institutional barriers. This practice highlights the importance of further research to support sustainable forest management by paying attention to various ecosystem functions, climate change mitigation, and the socio-economic needs of surrounding communities (Vilanova, 2021). To support community-based innovation, integrated knowledge management and innovation strategies have been implemented in several regions of Venezuela. This process involves local actors, universities, and productive sectors through discussion groups to design management strategies that can address local challenges. The results show that social, economic, and environmental potential can be optimized through integrated collaboration from various parties. This strategy is an illustration of how community-based management can promote sustainable development by leveraging local knowledge and innovation (Lopez et al., 2022). These practices underscore the importance of a community-based approach to resource management in Venezuela, which involves local collaboration to strike a balance among economic development and environmental conservation. This strategy can be an inspiration for other regions facing similar challenges.

In Romania, a community-based resource management approach is applied through a traditional communal system known as *composessorates* in the Olt Land region of Transylvania. These systems play an important role in the sustainable management of forests and grasslands, with a focus on regeneration, balanced exploitation, and forest conservation. After being discontinued during the communist regime, *composessorates* were re-enacted after 1989 with the aim of preserving the tradition of community-based land management. Studies show that *composessorates* have significant social potential and economic efficiency, but the challenges of communication and collaboration with environmental organizations require attention to strengthen the sustainability of these programs (Sorea et al., 2022). In addition, in the mountainous region of the Subcarpathians, soil conservation endeavors using a scenario-based approach have been undertaken to reduce high soil erosion rates. This approach includes practices such as forest restoration on eroded slopes, grazing management, and mulch use. The results of the study show that human intervention through vegetative measures can reduce the rate of soil casualty by 50-70%, providing an optimal solution to protect soil fertility and support the sustainability of local communities (Mihai et al., 2019). The practice of agritourism in Romania's mountainous regions also reflects endeavors to diversify the economy that

integrates local and traditional resources with tourism activities. This approach aims to revive the rural economy and improve people's living conditions. With the right strategy, agritourism has the potential to improve economic and environmental well-being, while supporting sustainable development in rural areas (Adamov et al., 2020). This approach demonstrates how Romania integrates local traditions, resource conservation, and innovation to achieve sustainability goals. This model provides inspiration for resource management in other regions with similar challenges.

In Indonesia, one of the practices managements based on local wisdom is the development of a smart agroforestry system (SAF) to support social forestry programs. SAF integrates silviculture and crop cultivation techniques to increase land productivity while conserving biodiversity, addressing climate change, and maintaining soil and water conservation. This approach also aims to reduce deforestation while providing solutions to food crises and adaptation to climate change. SAF leverages technological innovation and collaboration among stakeholders to ensure sustainable landscape management. In this context, SAF is implemented as a strategy to revive the rural economy and improve community welfare through the optimization of local resources (Octavia et al., 2022).

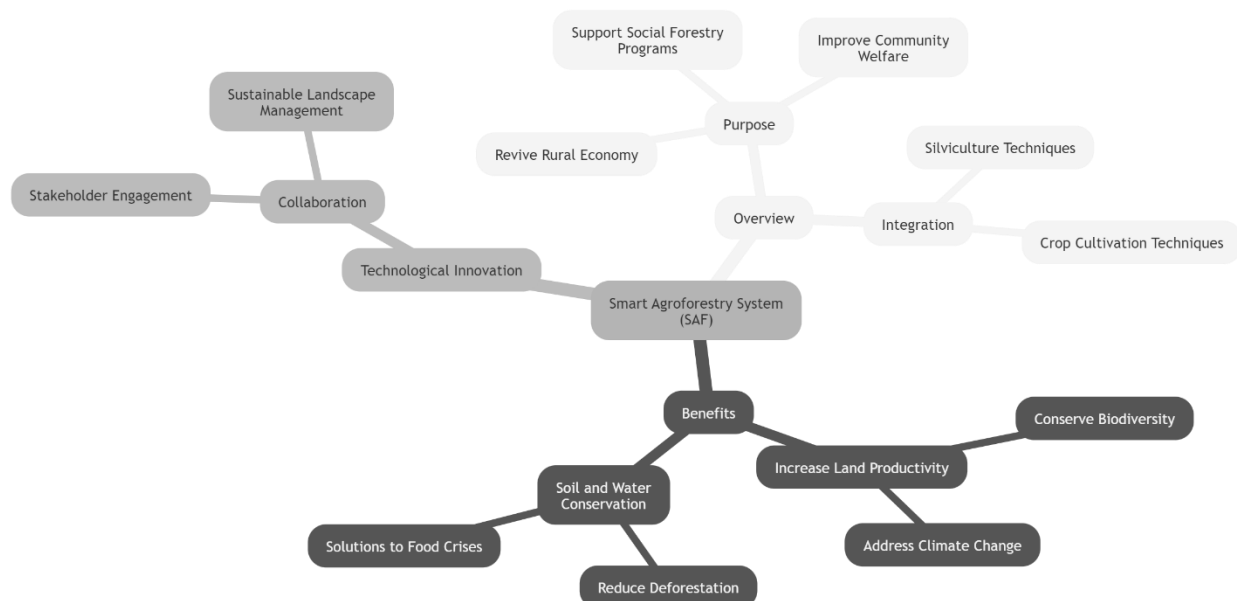


Figure 8.4. Intelligent Agroforestry System

Source: Author's Summary, 2024

SAF as an integrative approach to address environmental, economic, and social sustainability challenges (figure 8.4.). The main objectives of the SAF are to support social forestry programs, improve community welfare, and revive rural economies. SAF combines silviculture techniques (forest management) and crop cultivation techniques as an effective integrated approach to natural resource management. This approach is driven by technological innovation and collaboration among

stakeholders through sustainable landscape management. This collaboration involves the active involvement of stakeholders in utilizing modern technology to strengthen ecological functions, while supporting rural economic development. Technology plays a role in creating innovative solutions to increase land productivity without damaging the environment. The benefits of SAF include biodiversity conservation, increased land productivity, soil and water conservation, deforestation reduction, and solutions to food crises. In addition, SAF also plays an important role in addressing climate change through ecosystem protection, as well as helping to maintain the long-term sustainability of natural resources.

In West Kalimantan, the Iban Dayak indigenous community manages their customary forests using traditional knowledge passed down from generation to generation. These customary forests provide important ecosystem services such as carbon sequestration, water source protection, and habitat for wild species. This community applies customary law in forest resource management to ensure the sustainability and welfare of the community. Studies show that formal recognition of customary forests can significantly reduce tenure conflicts and support more sustainable forest management (Leo et al., 2022). Another approach is the implementation of participatory co-design in Sabrang Village, Central Java, to revive traditional values and local agricultural practices. Through the philosophy of *niteni* (tradition-based observation), the village community together with academics and local governments redeveloped the tradition of planting local rice varieties such as *Rojolele Delanggu*. This approach not only strengthens the connection among people and nature, but also supports regional identity through local product branding. The results show that this culture-based strategy can increase community resilience and agricultural sustainability (Utami et al., 2022). These three practices reflect Indonesia's endeavors to integrate local wisdom, technology, and community-based collaboration to achieve sustainability goals. This model is an inspiration for resource management in other countries with similar challenges.

Various countries in the world have implemented approaches based on local wisdom and innovation in sustainable natural resource management. These practices reflect adaptation to local environmental, social, and economic challenges. The following is a summary of the approaches implemented in Japan, South Korea, China, Morocco, Venezuela, Romania, and Indonesia in table 8.1.

From table 8.1., it can be seen that the approach based on local wisdom has similarities in involving community participation and environmental conservation. This approach focuses on the synergy among environmental sustainability, resource management, and the well-being of local communities. Some of the key findings are Focus on Ecosystem Conservation, Practices in Japan, China, and Morocco highlight ecosystem conservation-based land management by involving local communities. Local knowledge is at the core of ensuring long-term sustainability. Economic

Diversification: In South Korea and Indonesia, innovation-based practices such as agroforestry and collective forest management increase livelihood diversification, thereby helping communities address economic and social challenges. Implementation Challenges, in Venezuela and Romania, sustainability depends on strengthening institutional capacity and legal recognition of the rights of indigenous communities. Land conflicts and governance weaknesses are the main obstacles. Global Adaptability, practices in these countries demonstrate flexibility in dealing with local challenges, which makes them relevant to apply in a variety of other geographical and cultural contexts. Approaches based on local wisdom and innovation can be a model for sustainable development, provided there is adequate recognition, collaboration, and policy support.

Table 8.1. Resource Management Practices Based on Local Wisdom in Various Countries

Country	Pendekatan	Key Results
Japan	CB-PES (Shoyama et al., 2022)	Improve collective management in rural areas and prevent abandoned land.
South Korea	CFM (Park & Yeo-Chang, 2021)	Diversification of livelihoods and increase of rural household income.
China	Management of Jiabang Rice Terraces (Wang et al., 2021)	Preserving agrarian ecosystems through local knowledge transmitted across generations.
Morocco	Participatory Land Resource Planning in Souss-Massa (Ziadat et al., 2022)	Integrate biophysical and socio-economic information for regional development planning.
Venezuela	Land Management in OMA (Rivero & Liu, 2020)	It requires the participation of indigenous peoples to overcome environmental degradation and land conflicts.
Romania	Sistem Tradisional <i>Compossessorates</i> (Sorea et al., 2022)	Sustaining community-based forest and grassland conservation in Transylvania.
Indonesia	Pintar Agroforestry System (SAF) (Octavia et al., 2022)	Increasing productivity, environmental conservation, and community welfare through the integration of silviculture and plant cultivation.

Source: Author's Analysis, 2024

The main lesson that can be learned from the various local wisdom-based management practices in these countries is the importance of integrating local knowledge, community collaboration, and innovation to achieve sustainability. Each country shows that the involvement of local communities not only increases the effectiveness of natural resource conservation but also provides solutions to economic and social challenges. For illustration, approaches in Japan and China affirm the value of ecosystem conservation through traditional practices, while innovations such as smart agroforestry in Indonesia and South Korea show that technology can help improve community well-being without sacrificing the environment. In addition,

experiences in Venezuela and Romania underscore the importance of legal recognition of the rights of indigenous communities to ensure fair and sustainable management. However, challenges such as tenure conflicts, governance weaknesses, and resistance to change highlight the need for institutional capacity building, inclusive regulation, and cross-stakeholder collaboration. From these various conditions, clearly solutions based on local wisdom and innovation are not only relevant for environmental problems but also to support sustainable socio-economic transformation.

8.2. Integration of Local and National Policies for Papua

The integration of local and national policies refers to the process of aligning strategies, goals, and resource allocation among central and local governments to ensure the success of local innovations that support national development goals. The essence of this concept is the synergy among local wisdom and national priorities to create sustainable solutions. The need to bridge the gap among central policies and regional needs has prompted the development of this concept. For illustration, research by (Noor et al., 2023) shows that the lack of collaboration among local actors hinders sustainable innovation, so a collaborative forum involving various stakeholders is needed. The main concept of this integration includes multi-actor collaboration involving governments, academia, communities, and the business sector in designing policies, as well as policy synergies among local and national levels. For illustration, research in Germany by (Ruhrmann et al., 2020) highlights the importance of a regional context-based policy approach to support local innovation. The basic assumption is that national policies can be the main guideline, while local adaptation ensures relevance and sustainability. This integration model involves a top-down approach from the central government and a bottom-up approach from local governments, as demonstrated by (Shi et al., 2023), who found that national and local programs can complement each other in facilitating research and development (R&D). The main goal of this integration is to create effective policies that support local innovation, improve regional competitiveness, and advance national development. This is relevant in a variety of contexts, including economic transformation as demonstrated in the urban innovation program in the UK by (Cowley & Joss, 2022). However, while this approach has advantages, such as resource efficiency and strengthening cross-sectoral collaboration, there are weaknesses that include conflicts of interest among local and national levels as well as limited regional capacity to implement central policies effectively. The apply this approach is seen in various innovation programs that support "smart specialization" strategies, such as those proposed by (Wanzenböck et al., 2020), which emphasize the importance of formulating innovation policies that are appropriate to local contexts. With closer collaboration among national and local policies and the active participation of all

actors, locally-based innovation can develop better, providing significant benefits to society and national development as a whole.

The practice of integrating local innovation policies in Japan shows how local R&D subsidies can be designed to support innovation at the city level. Based on research by (Okamuro & Nishimura, 2020), R&D subsidies in Japanese cities are designed with both demand-side and supply-side factors in mind. Supply-side factors, such as local government conditions, have a significant influence on the implementation of subsidy programs, while demand-side factors affect program design, including flexibility and subsidy limits. This research highlights the importance of local context in determining the effectiveness of innovation policies. Another study conducted by (Takano & Okamuro, 2021) shows that local R&D support has different impacts based on the industrial structure and geographical position of the region. In Japan, areas with large industrial agglomerations tend to show more significant diversification of business networks as a result of local subsidy policies. This confirms that innovation policies need to be tailored to the economic structure and specific needs of each region. In practice, R&D subsidies also support the development of local workforce skills and capabilities, as discussed in the research of (Matsuzaki et al., 2021). In Hyogo Prefecture, a special training program organized by the local government enhances the capacity of human resources in small and medium-sized enterprises (SMEs), thereby encouraging the improvement of technological innovation and their business strategies. Programs like these are designed to meet the specific needs of SMEs, which often face challenges in accessing innovation resources. Through R&D subsidy policies that are based on local needs and tailored to regional contexts, Japan shows how integration among national and local policies can help a more inclusive and sustainable innovation ecosystem. This emphasizes the importance of a data-driven approach in the design and implementation of innovation policies to achieve optimal results.

In South Korea, R&D subsidy policies play an important role in encouraging local innovation and improving the competitiveness of SMEs. Research by (W. H. Kim et al., 2021) shows that although R&D subsidies provide a boost to the development of certain projects, their effectiveness varies depending on the characteristics of the project. In particular, the duration and number of subsidies have a positive impact on SMEs' ability to pursue innovation, but are less effective in increasing their long-term innovation capacity. This indicates the need to redesign the support system to be more responsive to the needs of SMEs. In addition, R&D subsidy policies in South Korea have been shown to increase innovation collaboration. A study by (Ahn et al., 2020) reveals that subsidies encourage companies to expand their collaboration networks beyond traditional value chains and regional geographical boundaries. However, the impact follows an inverted U-shaped curved pattern, where large subsidies have less influence compared to simpler subsidies, suggesting that a more cautious approach

is needed in distributing funds. From the perspective of regional efficiency, research by (Min et al., 2020) highlights that the efficiency of innovation in regions with large collaboration networks is higher compared to regions with small networks, even when public R&D dominates. This shows that the combination of public investment and the construction of innovation networks can improve technological efficiency and commercial value. Overall, the R&D subsidy policy in South Korea demonstrates the importance of local needs-based adjustments, building collaborative networks, and balanced investment strategies to foster sustainable and competitive innovation. This approach reflects how the integration of national and local policies can increase innovation capacity, especially for SMEs.

In China, R&D subsidies play an important role in supporting local innovation through a variety of approaches tailored to regional needs. Research by (Gaol, 2023) shows that local subsidies have a greater impact than subsidies from the central government in encouraging exploration innovation, especially in areas with high industrial agglomeration. This impact is amplified by the context of regional innovation that allows subsidized companies to learn and improve their technological capabilities. In addition, R&D subsidies also play an important role in driving sustainable innovation performance in strategic companies. A study by (Yao & Huang, 2022) found that R&D subsidies help build a wider network of external collaborations, which in turn improves the performance of sustainable innovation. This effect occurs through greater R&D investment and active participation in open innovation. However, the study also notes the need for more sophisticated policy tools to coordinate these networks and align subsidies with the specific needs of the industrial sector. In the manufacturing sector, R&D subsidies make a significant contribution to green process innovation, as shown by (Liu et al., 2020). The study reveals that government subsidies have a positive leverage effect on green innovation, but the impact depends on the level of environmental regulation and the level of economic development of the region. This emphasizes the importance of synergy among environmental policies and subsidies to encourage effective green innovation. Overall, R&D subsidy practices in China reflect an integrative approach among national and local policies, with a focus on regional context-based adjustments. This includes empowering specific sectors, improving collaboration networks, and integrating with environmental policies to create a sustainable and competitive innovation ecosystem.

In the UK, the R&D subsidy approach has been used effectively to encourage innovation in various sectors, including green technology and manufacturing. Research by (Foreman-Peck & Zhou, 2022) shows that R&D subsidy policies in the UK play an important role in boosting workforce productivity, especially through support for projects focused on regional technology diversification. The study highlights that national subsidies often have a greater impact than local subsidies in encouraging market-oriented innovation. In addition, research by (Mewes & Broekel, 2020) notes

that R&D subsidies in the UK contribute to regional technology diversification, by encouraging collaboration among various actors, including companies and research institutions. Joint subsidies for collaborative R&D projects have a greater effect on expanding access to new technologies than individual subsidies, demonstrating the importance of integrated policy support to strengthen innovation networks. Support for green innovation is also an important focus. A study by (Wu & Li, 2022) shows that government subsidies help encourage in-depth cooperation among producers and research institutions in developing green technologies. This approach not only improves environmental performance but also integrates green technologies into the local economic value chain. Through strategic, collaboration-focused subsidy policies, the UK has created an innovation ecosystem that supports sustainable growth at both local and national levels. This approach reflects the importance of synergy among local actors and central policies in facilitating the development of new technologies and increasing regional competitiveness.

In Turkey, the R&D subsidy policy has had a significant impact on increasing innovation capacity in various regions. Research by (Ezanoğlu & Çetin, 2022) shows that government support for R&D, both in direct form and through fiscal incentives, plays an important role in supporting research and innovation. The study also underscores the need for a local needs-based approach tailored to the social and economic structure of a particular region to improve policy effectiveness. In addition, research by (Karahasan, 2024) highlights the role of new companies in driving innovation at the regional level. The study shows that the presence of new companies makes a significant contribution to the development of local innovation ecosystems, although the impact is heterogeneous depending on geographical characteristics and economic sectors. Therefore, policies that encourage the formation and growth of new companies are important in the local innovation strategy in Turkey. Furthermore, research by (Satrovic et al., 2021) shows a two-way relationship among public spending on R&D, capital formation, and innovation. The Turkish government has increased its budget for education and research as part of endeavors to increase human capital that plays a crucial role in innovation capacity. However, the study also underscores the importance of improving the management and allocation of funds to ensure that these investments have an optimal impact on technology development. The practice of subsidizing R&D in Turkey reflects an integrative effort involving government actors, the private sector, and academia to encourage innovation at the local level. This approach emphasizes the importance of policy adjustments based on region-specific needs, while maximizing the potential for technology-based economic growth.

In Saudi Arabia, the R&D subsidy policy has become an integral part of a national innovation strategy focused on economic diversification. Based on a study by (Akinwale, 2022), investment in R&D plays an important role in driving economic

growth, particularly in the context of Saudi Arabia's Vision 2030. The study found that there is a long-term link among R&D investment, innovation, and economic growth, demonstrating the importance of increasing budgets for research and innovation across various sectors. In the energy sector, innovation policies in Saudi Arabia are also directed to support renewable energy research. According to the results of analysis by several studies, subsidies for low-carbon technologies and clean energy show a significant impact on the sustainability of innovation, especially in the energy industry. This is in line with Saudi Arabia's strategy to reduce dependence on oil and switch to sustainable technology. In addition, the development of the innovation ecosystem is driven by collaboration among the public, private, and academic sectors. The policy allows for synergies among the development of new technologies and the needs of local industries, providing direct financial support as well as training programs to increase local capacity in high-tech fields. Through a combination of R&D subsidy policies and multi-actor collaboration, Saudi Arabia has demonstrated a strong commitment to fostering locally relevant innovation while still supporting national development goals. This shows that an integrated policy-based approach can provide significant results in building innovation capacity and global competitiveness.

In Indonesia, the R&D subsidy approach is used to support increased innovation through policies such as super tax deduction (STD) for research and development activities. Research by (Kristanti & Saptono, 2024) evaluates the effectiveness of this policy, which aims to encourage the participation of the industrial sector in R&D activities. The discrepancy in the recognition and recording of R&D costs among accounting and taxes is one of the main obstacles. In addition, research by (Yusoff, 2020) highlights the importance of private sector participation in encouraging national innovation. The low level of industry sector participation in R&D activities is a concern, although national innovation policies have provided incentives to improve the performance of knowledge-based economies. The study also shows that collaboration among the government and the private sector is essential to achieve Indonesia's long-term innovation targets, as stated in the aspiration to become one of the world's 15 strongest countries by 2045. Furthermore, innovation policies in Indonesia show developments in the institutional structure and implementation of innovation programs. A study by (Simatupang et al., 2022) found that innovation regulations in Indonesia continue to evolve to improve coordination among researchers and industry as users of innovation products. These institutional changes aim to support innovation financing and ensure better coordination among innovation actors. Through an integrated subsidy approach and institutional improvements, Indonesia seeks to strengthen the innovation ecosystem to support technology-based economic development and encourage global competitiveness.

This strategy reflects the importance of innovation policies that are adaptive to local and national needs.

Table 8.2. Comparison of R&D Subsidy Policies in Different Countries

Country	Key Approaches	Key Impact	Challenge
Japan	Design subsidies based on demand and supply. Focus on diversifying innovation networks.	Improving regional collaboration and local innovation efficiency.	Lack of resources in certain areas to use subsidies optimally.
South Korea	Subsidies encourage innovation collaboration across sectors and regions.	Diversification of innovation networks and increasing the productivity of SMEs.	The effectiveness of subsidies with too large amounts decreases.
China	Synergy of local and national policies with a focus on exploration innovation and collaboration networks.	Strengthening green innovation and sustainability of strategic innovation in the energy sector.	Challenges in coordination among national and local policies.
English	Support for multi-actor collaboration and R&D subsidies for green technologies.	Increased technology diversification and green innovation in various sectors.	The need for a more focused subsidy strategy for certain regions.
Turkey	Support for SMEs and start-ups, focusing on developing local innovation capacity.	Improving the regional innovation ecosystem and the contribution of SMEs to national innovation.	Limited resources for the implementation of innovation policies in underdeveloped regions.
Arab Saudi	Collaboration among the public and private sectors in the Vision 2030 strategy for economic diversification.	Increasing renewable energy innovation and reducing dependence on oil.	Lack of local capacity to make effective use of subsidies.
Indonesia	Implementation of STD and increased private participation in R&D.	The potential to increase industrial sector innovation and collaboration among researchers and industry users.	Low private sector participation in R&D and inconsistencies in tax management related to subsidies.

Source: Author's Analysis, 2024

Table 8.2. shows that each country has a unique approach to integrating R&D subsidy policies with local and national priorities. For illustration, Japan and the UK stand out in cross-sector collaboration to boost regional and green innovation, while China and South Korea are focusing on national and local policy synergies to support the sustainability of innovation. On the other hand, countries such as Turkey and Indonesia still face challenges in increasing private participation and the effectiveness of their subsidy policies. However, there is a common pattern in which the integration of local and national policies, as well as collaboration among various actors, is a key success factor. Countries such as Saudi Arabia that leverage cross-sector collaboration strategies in their long-term development visions show the potential to

accelerate innovation-based economic transformation. To overcome the existing challenges, it is necessary to design policies that are more adaptive and responsive to the specific needs of each region.

8.3. Implementation Evaluation and Strategic Recommendations

Policy implementation evaluation is a systematic process to assess the effectiveness of public policies in achieving the set goals by identifying obstacles and opportunities during their implementation. This process is important to ensure the relevance of policies to the needs of communities, especially in remote areas and indigenous communities. In a global context, for illustration, research in Canada shows the importance of a co-creation approach to digital policies with indigenous communities to address limited infrastructure and digital literacy challenges (McMahon, 2020). In Brazil, although indigenous health policies are supported by a strong legal framework, the uneven distribution of resources remains a major obstacle to the implementation of such policies (Dantas et al., 2024). The evaluation focuses on three main concepts, local participation, infrastructure strengthening, and policy harmonization. Local participation can be done through the establishment of a consultative forum involving indigenous peoples, governments, and other stakeholders to ensure policies that are relevant to local needs. Strengthening infrastructure is needed to improve internet access and establish local research centers in remote areas, which is one of the prerequisites for the success of digital policies (McMahon, 2020). In addition, the harmonization of national policies with local cultural values is important to prevent conflicts among modernity and tradition, as seen in infrastructure projects in the Amazon region (Pereira Leite, 2020). However, the evaluation of policy implementation has its challenges, such as the need for significant resources and political or cultural resistance. Even so, community-based approaches have proven to be able to increase policy effectiveness, especially in the context of indigenous communities that have unique and complex needs (Bhawra et al., 2022). Therefore, integrated evaluation, including local participation, infrastructure strengthening, and policy harmonization, is the key to successful inclusive and sustainable policy implementation.

In Japan, the approach of community participation in policy implementation is especially seen in the development of smart cities under the concept of "Society 5.0." This approach aims to integrate technological and institutional innovations to address challenges such as climate change, energy needs, and population aging. Smart cities in Japan are designed through multilevel collaboration involving local, national, and community governments. These projects leverage 5G networks to create intelligently connected infrastructure to improve the efficiency of public services, including transportation and healthcare (Barrett et al., 2020). In addition, multigenerational participation at the community level has become a key element in regional

development. Programs such as "Cha-no-Ma" in Niigata encourage cross-generational interaction with local culture-based activities. Studies show that a high frequency of meetings and a focus on local culture-based activities, such as festivals and traditional foods, can improve connections among community members as well as strengthen their involvement in local development (Morita et al., 2021). After the Fukushima nuclear disaster, Japan also tried to implement public participation in energy policymaking. However, the implementation of this participation is often dominated by expert committees, which ultimately limits the influence of the community in the decision-making process. Nevertheless, these endeavors reflect the intent to democratize decision-making in the midst of a shift in power from bureaucracy to civil society (Saito, 2021). Japan's experience shows that a combination of technological innovation, culture-based activities, and effective community participation mechanisms can support inclusive and sustainable policies.

In South Korea, the implementation of community participation in policies can be seen in various urban regeneration and infrastructure development projects. One illustration is an urban regeneration project in Seoul that focuses on the flexibility of community planning. This approach allows for the involvement of local communities to create community-based public facilities designed with residents and local governments. This project shows that flexibility in accommodating community needs can improve social sustainability and infrastructure in urban areas (Baek & Kwon, 2020). In addition, the South Korean government is also adopting a community-based social infrastructure approach, called a "Living SOC." This policy aims to create equitable facilities among metropolitan cities and provincial areas. Research shows that although the distribution of facilities such as education and local communities is sufficient, the need for arts and cultural facilities is still under-noticed. Therefore, this approach tries to integrate infrastructure development with the needs of the wider community (Y. Kim et al., 2020). In the context of digital transition, South Korea has successfully implemented digital government transformation that involves active citizen participation. This implementation not only uses technology to improve the efficiency of government, but also creates a platform that allows citizens to participate in decision-making related to local policies. The president's leadership plays a crucial role in the success of these digital policies, ensuring continuity despite changes in political administration (Chung et al., 2022). These approaches reflect South Korea's endeavors to ensure that infrastructure development and public policy not only involve the government, but also provide space for the active participation of local communities to support social, cultural, and economic sustainability.

In China, community participation in policy implementation is seen in the management of national parks and endeavors to regenerate historic areas. For illustration, the pilot project of Mount Qilian National Park involves local residents to ensure the harmonious management of the area among humans and nature. Studies

show that local participation is influenced by perceptual behavioral controls, subjective norms, and attitudes toward participation. This approach aims to increase community awareness to play an active role in the development of national parks, which includes training and community capacity building (Jia et al., 2022). In addition, the historic area regeneration project in Beijing's Baitasi district is an interesting illustration. The local government uses a community participation approach that is claimed to be inclusive and innovative. However, research shows that community involvement occurs more at the implementation stage, with their lack of influence in the decision-making process. This has led to criticism that the approach serves more to secure the official agenda than to actually meet the needs of local communities (Wei, 2022). China is also promoting the integration of local and indigenous knowledge in nature-based solutions to address environmental challenges and climate change. This approach includes education, monitoring, preservation, and adoption of local knowledge through long-term multi-stakeholder engagement. Studies show that policy support from the central government is essential for the successful implementation of local knowledge integration at the community level (Yu & Mu, 2023). These practices reflect how China seeks to combine policy innovation with community participation to achieve social and ecological sustainability goals.

In Indonesia, the community participation approach is seen in various development programs that involve local communities as the main actors. One illustration is the Reducing Emissions from Deforestation and Forest Degradation Plus (REDD+) program in Meru Betiri National Park, East Java. This program involves the surrounding community in the management of forest resources for climate change mitigation. Although community participation is at the conciliation stage, where there is minimal support for government decisions, measures such as community involvement in decision-making and law enforcement are still needed to strengthen their involvement (Dirgantara, 2021). In addition, in East Kalimantan, Dayak indigenous communities are involved in the adoption of agricultural technology as part of an adaptation strategy to increase productivity. However, the adoption rate of this technology is relatively low due to barriers such as a lack of visual and material support from extension workers. To overcome this, the government is advised to provide cultural-based training and visual aids to increase the capacity of extension workers and make it easier for indigenous peoples to understand (Imang, 2020). In Papua, the construction of the Trans-Papua Road is another illustration of the integration of local community participation in major infrastructure projects. The program involves indigenous peoples in various stages of project development, from perception discussions to alternative planning. This participation aims to reduce social conflicts, preserve the environment, and ensure the sustainability of infrastructure development (Kambu et al., 2022). These practices reflect the importance of integrating community participation in various development projects in Indonesia to

ensure policy relevance to local needs, reduce conflict, and support social and ecological sustainability. Table 8.3. summarizes the practice of community participation in policy implementation in several countries: Japan, South Korea, China, and Indonesia. Table 8.3. compare approaches, key sectors, challenges, and outcomes achieved in each country.

Table 8.3. Comparison of Community Participation Practices in Policy Implementation

Country	Key Approaches	Primary Sectors	Challenge	Result
Japan	Co-creation through multilevel society	Smart cities and community regeneration	Lack of community influence in early decision-making	Increased efficiency of public services and multigenerational engagement
South Korea	Community-based social infrastructure ("Living SOC")	Urban infrastructure and energy	Imbalance in the distribution of arts and cultural facilities	Improvement of community-based public facilities and social integration
China	Integration of local knowledge (ILK) in nature-based solutions	Environment and regional regeneration	Lack of continuous implementation and lack of involvement in decision-making	Raising awareness of local communities about conservation
Indonesia	REDD+, the adoption of indigenous technologies, and community participation in infrastructure projects	Forestry, agriculture, infrastructure	Low rate of technology adoption, lack of involvement of indigenous communities in environmental policies	Improving social conflict mitigation and community-based natural resource management

Source: Author's Analysis, 2024

Each country adapts different approaches to encourage community participation according to their respective social, economic, and cultural contexts. Japan focuses more on smart cities and community regeneration by engaging people through a multilevel approach, while South Korea emphasizes the importance of equitable distribution of social infrastructure. On the other hand, China leverages local knowledge in environmental conservation, but still faces challenges in sustainable implementation. Indonesia offers a unique approach through the integration of indigenous communities in REDD+ programs and infrastructure development, although the rate of technology adoption is still low. The successes of each country show that community participation can produce significant positive impacts, such as the efficiency of public services, conflict mitigation, and environmental conservation. However, challenges such as inequality in the distribution of facilities or lack of

community involvement in the early stages of policies are still obstacles that require further attention. A holistic approach tailored to local needs is key to achieving better sustainability in the future.

From the various practices of community participation in policy implementation in Japan, South Korea, China, and Indonesia, there are several important lessons that can be learned. First, the importance of adapting policy approaches to local contexts. Japan, for illustration, shows that multilevel involvement, including multigenerational communities, can increase the effectiveness of urban regeneration policies. Second, the success of community participation is highly dependent on equitable distribution of resources and equitable access, as seen in the social infrastructure approach in South Korea. Third, the integration of local and indigenous knowledge, such as in China and Indonesia, can make a significant contribution to environmental preservation and social sustainability. However, another key lesson is that community participation not only involves formal involvement but also requires real empowerment through training, access to information, and involvement in decision-making from the early stages of policy. The challenges faced, such as unequal access or lack of transparency, highlight the need for a more inclusive and collaborative approach to ensure sustainability and the relevance of policies to the needs of society.

An evaluation of policy implementation in Papua that highlights the lack of supporting infrastructure, the lack of participation of indigenous peoples, and limited access to technology are closely related to lessons learned from international practice. In the context of increasing local participation, the establishment of a regular consultative forum in Papua can draw inspiration from collaborative approaches such as REDD+ in Meru Betiri National Park, East Java. Studies show that the participation of local communities in the planning and decision-making stages increases the relevance of policies to local needs (Dirgantara, 2021). On the other hand, strengthening infrastructure and access to technology, such as those implemented in South Korea through the "Living SOC initiative," emphasizes the importance of infrastructure investment in remote areas to support the needs of the community. This implementation shows how internet access and technology can improve connectivity and public services, which are relevant to be implemented in Papua (Y. Kim et al., 2020). In addition, the harmonization of national policies with local socio-cultural values, such as that done in China through the ILK in nature-based solutions, is an important strategy to prevent conflicts among modernity and tradition. National policies such as Law Number 59/2024 in Papua can be a legal framework to ensure the relevance of policies to the unique conditions of local indigenous peoples (Yu & Mu, 2023). In addition, Indonesia's experience in Papua through the Trans-Papua Road project shows the importance of indigenous peoples' involvement to minimize social conflicts and ensure the sustainability of infrastructure development (Kambu et al.,

2022). By adopting this holistic approach, policies in Papua can be optimized to increase local participation, improve infrastructure, and bridge modernity with traditional indigenous values. This approach not only addresses existing challenges, but also ensures inclusive and sustainable policies.

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9.1. Papua's Vision as a Center for Sustainable Innovation

A sustainable innovation hub is an ecosystem that integrates local wisdom and modern technology to create innovative solutions that are relevant to local and global needs. The goal is to optimize cultural, geographical, and natural resources to support inclusive and sustainable development. This concept is important because it supports indigenous peoples as key actors in the development process, thus ensuring their traditions are respected and become an integral part of innovation (Stojanova et al., 2022). This concept arose from the need to bridge the gap among the rich local traditions and modern challenges such as digitalization, climate change, and social inequality. For illustration, in Europe, this approach supports the Green Deal policy for sustainable innovation-based development (McCann & Soete, 2020; Stasiškienė et al., 2021). Key elements of this concept include the integration of local wisdom—such as indigenous peoples' cultural values and traditions—with modern technologies, such as IoT AI, and renewable energy, to create efficient and sustainable solutions (Bauermann et al., 2024; Pratama et al., 2024).

The basic assume this concept is that local traditions have great potential as a source of innovation, while modern technologies can strengthen sustainability if used in an inclusive and adaptive manner (Nweke, 2024). This conceptual structure is often embodied in a triple-helix model that involves collaboration among academia, industry, and government. An illustration is the "Empower-Eco Hub" in Europe, which is a living laboratory for green innovation with a focus on cross-sector collaboration (Rowan & Casey, 2021). The main goal of the sustainable innovation center is to create solutions that are able to address social, environmental, and economic challenges in a sustainable manner. This is relevant in the midst of rapid urbanization, climate change, and global digital transformation (Xu, 2024). The advantages of this concept include increased social inclusion, strengthening local identity, and support for environmental sustainability. However, challenges include technology compatibility, high initial costs, and potential digital inequality (Bauermann et al., 2024). In practice, sustainable innovation centers are applied in various fields. For illustration, in sustainable tourism, local cultural values are used as tourist attractions to improve the local economy and environmental preservation (Andari et al., 2020). In environmental management, the preservation of natural resources is carried out

through community-based practices involving local wisdom values (Pratama et al., 2024).

Japan has implemented various approaches to integrate local wisdom and modern technology in sustainable development, especially through the "Society 5.0" policy. This approach is designed to create a superintelligence society that addresses social challenges such as population aging and social inequality, while leveraging technological advances to meet the Sustainable Development Goals (SDGs). Through Society 5.0, Japan combines the use of technologies such as the Internet of Things (IoT), artificial intelligence, and robotics to improve social welfare and environmental sustainability (Narvaez Rojas et al., 2021). In the apply this concept, Japan has also promoted the development of smart cities that are oriented toward sustainability. Japan's smart cities are designed to address climate, energy, and demographic challenges through a cross-sectoral collaborative approach and the apply digital technologies. Projects like this not only create sustainable infrastructure but also encourage community engagement and cross-government coordination, all of which fall under the framework of Society 5.0 (Barrett et al., 2020). In addition, Japan also utilizes local wisdom in globally recognized agricultural systems, such as through the Globally Important Agricultural Heritage Systems (GIAHS) program. The program supports the preservation of traditional agricultural practices that integrate cultural values and ecological sustainability. The challenges faced, such as rural-urban migration and declining peasant populations, are addressed by local community engagement endeavors and the development of indicators to monitor the preservation of these systems (Reyes et al., 2020). This Japanese practice reflects a holistic approach that blends traditional wisdom with modern technological innovation, proving that sustainability can be achieved through cross-sector collaboration and recognition of unique local values. This approach provides a model for other countries that want to integrate local traditions with technology for sustainable development.

Society 5.0 is a concept developed by Japan to build a society based on advanced technologies such as artificial intelligence (AI), IoT, robotics, and Big Data, aiming to create a balance among economic development and solving social challenges. This policy focuses on building a human-centered superintelligence society, where technology is not only used for efficiency but also to improve the quality of life. Introduced in the 2017 Japan innovation Strategy, Society 5.0 aims to address challenges such as an aging population, low birth rate, and social inequality, while supporting the achievement of the SDGs. By integrating economic development and social solutions, the concept leverages technology to address global issues such as climate change, urbanization, and inequality. Illustrations of applications include the development of smart cities with efficient infrastructure, the use of AI to support the health care of the elderly population, and automation in the

industrial sector to increase productivity and reduce environmental impact. Society 5.0 provides a new paradigm that combines modern technology with a human-based approach for more inclusive sustainability (Barrett et al., 2020; Narvaez Rojas et al., 2021).

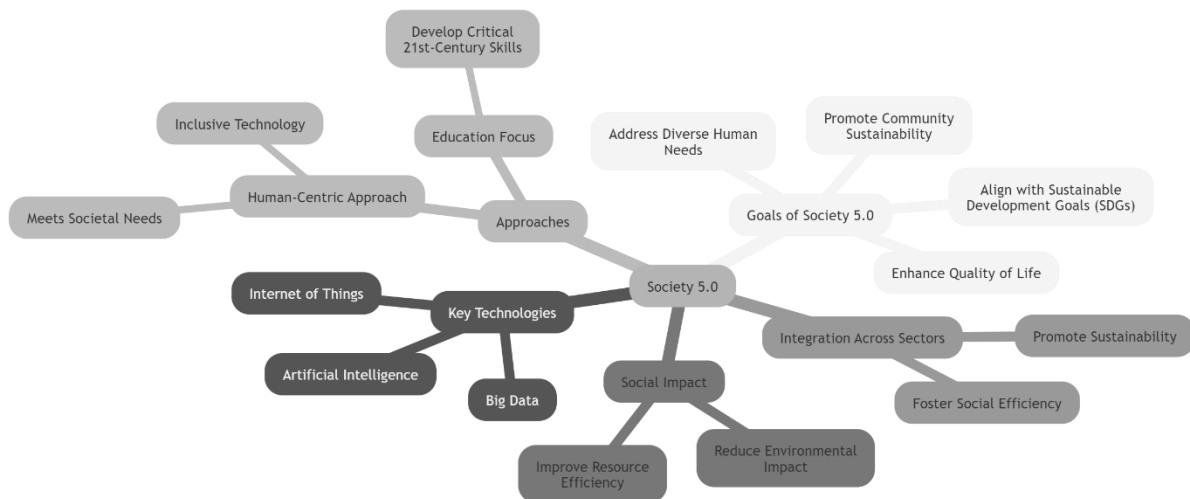


Figure 9.1. Society 5.0 Indicators

source: analysis author, 2024

Society 5.0 is a community concept that focuses on the integration of smart technology to improve the quality of life and sustainability. Key indicators of its implementation include improving the quality of life through technology-based services that meet human needs in detail regardless of age, gender, or location (Deguchi & Murase, 2023). Technologies such as the IoT, Artificial Intelligence (AI), and Big Data are the main foundations in overcoming social challenges and supporting sustainability (Roblek et al., 2020). In addition, Society 5.0 directly contributes to the achievement of the SDGs by supporting the efficiency of material and energy use and reducing environmental impacts (Trstenjak et al., 2022). This concept emphasizes a human-centric approach, by ensuring that technology is designed to meet the needs of society in an inclusive manner and improve social well-being (Salgues, 2018, 2022). Education is also an important indicator, where the curriculum is designed to improve 21st century competencies such as critical thinking, creativity, and collaboration to prepare future generations to face new technologies (Jayadi et al., 2023). In addition, the integration of social systems and technology through digitalization in various sectors, including smart transportation and healthcare, strengthens the efficiency and sustainability of society (Roring & How, 2022). Thus, Society 5.0 offers a vision of an inclusive, sustainable, and human-centered society.

South Korea has implemented the Society 5.0 approach in various sectors, including energy and smart cities, as part of its endeavors to achieve sustainable development. One of the important implementations is the development of the

"Smart Grid," which is the foundation for the integration of renewable energy with advanced technologies such as the IoT and artificial intelligence. This technology was first applied on Jeju Island to efficiently manage energy by optimizing electricity resources, including renewable energy such as wind and solar power. This project is a model of success that not only improves energy efficiency, but also contributes to environmental sustainability (Stanislav, 2023). In addition, South Korea also utilizes the Society 5.0 approach in the development of smart cities through the integration of digital technology. One of the main focuses is to improve the user experience and efficiency of public services by adopting technology-based solutions. An illustration is the implementation of a digital platform for city management that enables integrated traffic, water, and waste management, as well as supporting more efficient energy use (Kwak & Lee, 2023). South Korea is also expanding this approach to the education sector through its continuous education innovation program. The Regional Center for Expertise in Tongyeong, for illustration, has transformed the education system to be more value- and practice-oriented, supporting collaborative learning that is aligned with global challenges such as climate change (Jung Hee & Choi, 2022). The implementation of Society 5.0 in South Korea shows that the integration of advanced technologies with human values can support inclusive and sustainable development, making it a relevant model for other countries facing similar challenges.

China has implemented the Society 5.0 approach through green digital innovation that integrates advanced technologies such as artificial intelligence (AI), IoT, and information systems to support sustainability in the manufacturing and transportation sectors. Digitalization in the supply chain enables operational efficiency and carbon footprint reduction by leveraging information technology to manage resources effectively. Research shows that information integrated with sustainable development practices can drive broader digital green innovation in the manufacturing industry in China (Huang et al., 2022). In addition, the development of smart cities in China is another illustration of the implementation of Society 5.0, where IoT and artificial intelligence technologies are used to monitor and manage city infrastructure in real-time. These cities are designed to improve the quality of life through more efficient management of transportation, water, and energy. Projects like these show that the Society 5.0 approach can help answer the challenges of rapid urbanization and the need for sustainability in urban environments (Drozdova & Ignatushko, 2024). In the energy sector, China has also adopted Society 5.0-based technologies to support carbon neutrality initiatives. The use of technologies such as energy storage and smart grids allows for the optimization of renewable energy resources such as solar and wind power, which reduces greenhouse gas emissions and improves national energy sustainability (Li et al., 2023). The implementation of Society 5.0 in China proves that the integration of digital technology with

sustainability principles can create innovative solutions to economic, social, and environmental challenges. This approach provides a relevant model to accelerate the achievement of the SDGs at the national and global levels.

Australia has implemented a Society 5.0 approach with a focus on green technology and sustainability, especially through the development of IoT to address environmental and economic challenges. IoT is used in various sectors to improve energy efficiency, resource management, and carbon footprint reduction. Studies show that although IoT implementation in Australia faces challenges such as low awareness and infrastructure limitations, these technologies bid significant solutions for operational efficiency in the energy and transport sectors, while helping to meet national sustainability targets (Sheikhmiri & Issa, 2020). In addition, Australia is also focusing on the use of green technology in the education sector to increase public awareness about sustainability. Educational programs integrated with digital technology are designed to encourage behavior change toward more environmentally friendly practices. This step is considered important in building the mindset of the younger generation that supports economic, social, and environmental sustainability (Saber, 2020). Smart city management is also an important part of the implementation of Society 5.0 in Australia. Digital technology is used to optimize traffic, energy, and water management, while increasing citizen engagement through interactive platforms. These smart cities are designed to create a more inclusive and sustainable environment, supporting the improvement of the overall quality of life of urban communities (Adel & HS Alani, 2024). The implementation of Society 5.0 in Australia demonstrates a commitment to digital transformation that is balanced with sustainability values, making it a relevant adaptation model amid today's global challenges.

Switzerland has implemented the Society 5.0 approach through initiatives in the health and sustainability sectors that focus on integrating advanced technologies with humanistic values. One illustration is the development of artificial intelligence (AI)-based technology to support a more adaptive and efficient health system. This technology is used to improve the quality of diagnosis and integrated management of patient data, helping to create a more personalized and humanist approach to healthcare (Papadimou et al., 2024). In addition, the sustainability sector in Switzerland is leveraging the IoT to support efficient resource management. IoT is applied in integrated energy and waste management systems, reducing carbon emissions and promoting the use of renewable energy. This practice is in line with Switzerland's commitment to the SDGs, especially in creating smart cities that are environmentally friendly (Papadimou et al., 2024). Switzerland is also actively promoting education that supports sustainability through digital technology. The program is designed to raise awareness among the younger generation about the importance of green innovation and social inclusion. These educational initiatives are

integral in supporting the transition to a human-centered super-intelligent society, as illustrated by the concept of Society 5.0. The implementation in Switzerland shows that cross-sector collaboration, the use of advanced technology, and a commitment to sustainability values can create a more inclusive and adaptive society in the face of global challenges.

The link among Society 5.0 and Papua's vision as a center for sustainable innovation lies in the basic principles of both concepts that both emphasize the integration of smart technology and local values to create inclusive, sustainable, and people-centered development. Society 5.0 utilizes technologies such as the IoT, Artificial Intelligence (AI), and Big Data to support efficient resource management and improved social welfare. This is in line with Papua's development approach that places indigenous peoples as the main actors and integrates local wisdom, such as sustainable forest and marine management, into modern innovations that are nationally and globally relevant (RPJPD Papua 2025-2045) (Bapperida Provinsi Papua, 2024b). Papua's vision emphasizes the importance of harmonization among modern technology and traditional wisdom. For illustration, the apply tradition-based technology in natural resource management reflects a human-centered Society 5.0 approach with respect for ecological and cultural sustainability. In this context, development based on a unique innovation ecosystem can strengthen Papua as a development model that optimally integrates cultural diversity, geographical advantages, and natural resources. Thus, Society 5.0 can be a strategic framework to realize Papua's vision through the development of technology that is inclusive and relevant to local needs, while supporting Papua's role in national and global innovation.

Implementing the concept of Society 5.0 in Papua's vision as a hub for sustainable innovation requires a strategic approach that combines modern technology, local wisdom, and the active participation of indigenous peoples. The first step is to integrate technology with local traditions, such as using AI-based monitoring systems for sustainable forest and marine management, while documenting indigenous knowledge through Big Data so that it can be leveraged in modern innovations. Education is also a key element by designing a curriculum that includes 21st century skills, such as critical thinking and the use of technology, as well as providing community-based training to strengthen indigenous peoples' skills. In addition, digital infrastructure needs to be improved through the provide internet access in remote areas and the construction of innovation centers that combine technology laboratories with discussion rooms for local wisdom. Indigenous peoples' participation should be a priority by involving them in all stages of development and supporting community-based cooperative business models, such as locally managed ecotourism. Multisectoral collaboration is also needed, involving governments, the private sector, and academia to support funding, research, and the implementation

of Society 5.0-based innovations. Monitoring and evaluation should be carried out by establishing indicators of success, such as improving community welfare, preserving traditions, and environmental sustainability, while involving indigenous peoples in policy evaluations. Concrete illustrations of this implementation include forest management based on IoT technology, promotion of ecotourism through AI applications, and the development of sustainable food systems with precision agriculture technology. With these steps, Papua can become a model of development based on Society 5.0 that harmonizes modern technology and local wisdom, relevant both at the national and global levels.

9.2. Indigenous People-Oriented Implementation Strategies

The implementation strategy of innovation-based development in Papua is focused on empowering indigenous peoples. This approach involves three main steps. Strengthening education and training, an educational program that combines local traditions with modern skills, such as technology-based agriculture and seafood processing, is a priority. The Papua RPJMD 2025-2029 emphasizes the need for community-based training centers to support communities in adopting technology without abandoning their cultural values. An innovation-based development approach focused on empowering indigenous peoples in Papua has a strong foundation both practically and scientifically. This strategy seeks to integrate modern technology with local wisdom to create an empowered, adaptive, and innovative society without sacrificing cultural values. The main proposed steps include strengthening education and training, relevant to the Papua RPJMD 2025-2029, by emphasizing the importance of community-based training centers to skill development.

Strengthening Education and Training: Integration of Local Traditions and Modern Skills, education that combines local traditions with modern skills is a key pillar in the empowerment of indigenous peoples. Programs such as technology-based agriculture training and seafood processing are not only economically relevant but also provide opportunities for indigenous peoples to compete in the modern economy. This approach is in line with research findings that show that technology applied contextually and community-based is more effective in increasing local productivity without eliminating cultural identity (Roblek et al., 2020). In addition, community-based training allows for a more inclusive transfer of knowledge. For illustration, a training center designed to integrate indigenous values and modern technology can be a learning platform that empowers communities to use technologies such as the IoT and artificial intelligence (AI) in natural resource management. This not only supports community independence but also supports environmental sustainability, which is an integral part of Papuan local wisdom (Jayadi et al., 2023).

Community-Based training centers as a Catalyst for Change, RPJMD Papua 2025-2029 (Bapperida Provinsi Papua, 2024a) emphasizes the need for community-based training centers to ensure that communities can adopt technology while still respecting their cultural values. This approach is in line with the concept of Society 5.0, which places humans at the center of innovation and integrates technology to create a sustainable society (Salgues, 2018, 2022). These training centers can include facilities for training in appropriate technologies, natural product processing, and indigenous innovations, enabling indigenous peoples to contribute to national and global development. Research also shows that the involvement of local communities in the design and implementation of training programs increases the success rate of such programs. By giving the community an active role in the management of the training center, they not only feel belonging but also motivated to continuously improve their skills. This is important in the context of Papua, where cultural and geographical diversity requires a flexible and locally-based approach (Deguchi & Murase, 2023).

Integration of technology and local values, this approach is supported by the theory of sustainable development which emphasizes the importance of synergy among technology and local cultural values. The implementation of technology in local contexts has been shown to improve economic and social sustainability, especially in areas rich in natural resources such as Papua (Trstenjak et al., 2022). For illustration, precision agriculture training programs that use IoT technology can help local farmers improve productivity and efficiency without harming the environment. Furthermore, processing seafood based on modern technology can increase the added value of local products, which ultimately increases the income of indigenous peoples. By integrating traditional knowledge in marine resource management, this program not only conserves ecosystems but also makes indigenous peoples the main actors in the economic value chain. An innovation-based development strategy in Papua that focuses on empowering indigenous peoples through strengthening education and training is a comprehensive and sustainable approach. By integrating modern technology and local wisdom, this strategy not only improves the well-being of indigenous peoples but also ensures that cultural values remain an integral part of development. Community-based training centers are a key catalyst for achieving this goal, while creating relevant development models at the national and global levels. Thus, Papua has a great opportunity to become an illustration of successful sustainable and inclusive development. The implementation strategy of innovation-based development in Papua that focuses on the empowerment of indigenous peoples requires a holistic, integrated, and locally-based approach. These strategic measures must include capacity building for indigenous peoples, strengthening local institutions, and sustainable resource management. In the following table, the annual

plan is detailed along with relevant indicators to evaluate the progress of implementation (Table 9.1).

Table 9.1 Innovation-Based Development Implementation Strategy in Papua with a Focus on Indigenous Peoples Empowerment

Year	Main Programs	Implementation Strategy	Success Indicators	Note	Actors Playing Roles
1	Mapping Local Potential and Problems	- Hold a focus group discussion (FGD) with indigenous peoples to identify needs.	- A list of specific needs of indigenous peoples is compiled based on the results of the FGD.	Ensure inclusivity through the participation of indigenous females and youth.	- Indigenous peoples, indigenous leaders, local NGOs, local academics.
		- Conduct field surveys to map the potential of local resources (agriculture, tourism, etc.).	- Potential area mapping data complete with recommendations for priority sectors.	The use of GIS technology for data accuracy.	- Local governments, GIS experts, local university students.
		- Forming a collaborative team for cross-sector data collection.	- Compile a collaborative report involving many parties.	Engaging local labor for data collection.	- Local governments, academics, indigenous peoples' organizations.
2	Strengthening the Capacity of Indigenous Peoples	- Organizing training based on local potential such as modern agricultural techniques, agricultural product processing, and handicrafts.	- The number of trainees increased by 20% compared to the previous year.	Focus on the involvement of vulnerable groups, such as females and indigenous youth.	- Training institutions, traditional leaders, indigenous females' organizations.
		- Integrate participatory learning methods based on local traditions to ensure the relevance of the material.	- 80% of participants reported skill improvement based on post-training surveys.	Training materials are created in local languages for accessibility.	- Academics, vocational education institutions, indigenous community leaders.
		- Digital literacy program to support the marketing of local products through digital platforms and social media.	- 50% of trainees started using digital technology for product marketing.	Post-training mentoring for 6 months to ensure sustainability.	- Technology providers, digital trainers, successful local entrepreneurs.
		- Creation of a community learning center that focuses on skills and technology.	- Learning centers are located in at least three strategic areas	The location was chosen based on accessibility for	- Local governments, international donors, NGOs,

Year	Main Programs	Implementation Strategy	Success Indicators	Note	Actors Playing Roles
			with adequate facilities.	indigenous peoples.	and local technicians.
3	Strengthening Local Institutions	- Establish innovation-based customary cooperatives, such as agricultural, handicraft, or ecotourism cooperatives.	- Cooperatives are formed in 80% of the traditional villages that are the target of the program.	The cooperative structure is adjusted to local customary values.	- Local governments, traditional leaders, NGOs, and SOEs.
		- Provide training on cooperative management and simple accounting for cooperative administrators.	- 90% of cooperative administrators reported an improvement in management skills after training.	The program is organized with practical training modules.	- Vocational education institutions, cooperative consultants, regional banks.
		- Connecting cooperatives with national and international markets through strategic partners.	- 70% of cooperatives have market partners who are active in product marketing.	Strategic partners involve the private sector and state-owned enterprises.	- NGOs, state-owned enterprises, ecommerce platforms, and local entrepreneurs.
	Involvement of customary institutions in decision-making	- Involving customary institutions in development deliberation forums at the village and district levels.	- Participation of indigenous institutions in decision-making increased by 50% compared to the baseline.	Providing advocacy training for representatives of indigenous organizations.	- Local governments, civil society organizations, traditional leaders.
		- Increasing the capacity of indigenous institutions through governance training and program planning.	- Customary institutions prepare at least two programs based on community needs every year.	Focus on transparency and accountability of indigenous institutions.	- Academics, governance consultants, local governments.
4	Innovation-Based Infrastructure Development	- Construction of production support facilities such as agricultural product storage warehouses, handicraft workshops, etc.	- There are 10 supporting facilities available in five target districts.	Priority is given to the design of environmentally friendly and efficient infrastructure.	- Local governments, local contractors, environmental NGOs, international donors.
		- Involving indigenous peoples in design and construction to ensure relevance to local needs.	- 90% of local people feel that the facilities are built according to their needs.	Involving local workers as part of economic empowerment.	- Indigenous leaders, local communities, engineers, and infrastructure technicians.

Year	Main Programs	Implementation Strategy	Success Indicators	Note	Actors Playing Roles
		- Distribution of electricity based on renewable energy, such as solar panels or microhydro in remote areas.	- 70% of the target customary areas get access to electricity based on renewable energy.	A feasibility study is conducted to ensure the technology is appropriate.	- Renewable energy technology providers, energy NGOs, local technicians.
		- Construction of a clean water distribution network using solar pump technology innovations.	- 60% of indigenous villages have access to stable and affordable clean water.	Focus on areas that had difficulty accessing clean water before.	- Hydrologists, public health organizations, local governments.
		- The use of local material technology to reduce development costs and support the local economy.	- At least 50% of construction materials come from local resources.	Local material processing training for the local community.	- Academics, local contractors, local building materials entrepreneurs.
5	Sustainable Resource Management	- Development of custom-based ecotourism with a focus on culture, environment, and local wisdom values.	- 5 new ecotourism areas are in operation with a 20% increase in visit rates every year.	Community empowerment as the main manager of ecotourism.	- Traditional leaders, local communities, Tourism Office, tour operators.
		- Training for local communities in ecotourism management, tour guides, and digital marketing.	- 80% of the trainees actively contribute to the operation of ecotourism areas.	Ensure inclusive training for females and youth.	- Academics, tourism coaches, environmental organizations.
		- Ecotourism marketing through digital platforms and partnerships with national/international travel agents.	- Ecotourism areas have active websites and social media.	Forming a dedicated team for local-based digital promotion.	- Technology platform providers, tourism promotion agencies, business actors.
	Formulation of customary forest protection policies	- Conducting advocacy and legal help for legal recognition of customary forests.	- 90% of customary forests in the target area receive legal protection.	Ensure consultation with indigenous peoples at every stage.	- Local governments, environmental NGOs, legal organizations, traditional leaders.
		- Involving indigenous peoples in forest patrols and reporting unlawful activities.	- Reports of unlawful forest activity decreased by 50% in the first two years.	A simple technology-based reporting system like SMS/WhatsApp.	- Indigenous peoples' organizations, forestry police, environmental NGOs.

Year	Main Programs	Implementation Strategy	Success Indicators	Note	Actors Playing Roles
		- Preparation of a zoning system to ensure a balance among conservation and economic use.	- The zoning of customary forests is completed and agreed upon by indigenous peoples in the target area.	Using a participatory approach in zoning preparation.	- Conservation experts, traditional leaders, local governments, local universities.

Source: Author's Analysis, 2024

The annual strategy for the implementation of innovation-based development in Papua demonstrates a comprehensive, inclusive, and sustainability-oriented approach. A participatory approach that involves indigenous peoples in every stage of planning and implementation ensures the relevance of the program to local needs, while empowering them as active actors in development. The focus on sustainability, such as the development of green infrastructure, renewable energy, and the protection of customary forests, shows awareness of the environmental challenges facing Papua. Innovative programs, such as digital literacy, custom-based ecotourism, and local cooperatives, bid great opportunities to increase the economic independence of indigenous peoples while respecting their traditional values. However, significant challenges remain, including reliance on cross-sectoral coordination, local institutional capacity that needs to be strengthened, and the complexity of technology implementation in remote areas. Regulatory barriers, such as legal recognition of customary forests, and the risk of reduced external funding support can also threaten long-term success. Therefore, increasing local institutional capacity, diversifying funding sources through the development of self-financing mechanisms, and regular evaluation of success indicators need to be a priority. This strategy has great potential to create positive social, economic, and environmental impacts for indigenous Papuans, if these challenges can be managed effectively.

The second step is that supporting infrastructure for innovation, the construction of local research centers and access to technology in remote areas are the keys to driving innovation. In addition, the provide supporting facilities such as the internet and simple technology for resource management is also part of this strategy. Empowerment of indigenous peoples in Papua through the development of infrastructure to support innovation is a strategic step that has a strong scientific foundation in supporting sustainable development and improving the welfare of people in remote areas. Infrastructure such as local research centers play a crucial role in developing solutions that are relevant to the geographical and cultural needs of local communities. Research shows that access to technology, such as the internet and simple technology, can increase the economic productivity of indigenous peoples. For illustration, simple agricultural technologies can help improve the efficiency of

crop management, thereby contributing to the improvement of their economic and social welfare (Widiastuti et al., 2021). In addition, a community-based approach in building local research centers advises the active involvement of indigenous peoples in the innovation process. This ensures that the solutions developed are tailored to local needs, while increasing the sense of ownership and sustainability of the program. Improving digital connectivity is also a key factor in the transformation of an innovation-based economy. The internet and information technology help access to markets, knowledge sharing, and cross-regional collaboration that were previously difficult to reach. Thus, the development of infrastructure to support innovation not only strengthens the capacity of the community in managing local resources but also opens up opportunities for participation in a wider innovation-based economy ((Herlambang & Ayu, 2021; Purnomo & Solikhah, 2021). To support the empowerment of indigenous peoples in Papua through the development of infrastructure to support innovation, a structured and sustainable agenda is needed over a period of five years. This agenda includes strategic steps, indicators of success, and collaboration with various stakeholders. The main focus is on increasing local capacity, strengthening digital infrastructure, and developing community-based research centers (Table 9.2).

Table 9.2. Agenda for Indigenous Peoples Empowerment in Papua through Innovation Infrastructure

Year	Main Programs	Implementation Strategy	Success Indicators	Note	Actors Playing Roles
1	Mapping local needs and regional potential	- Holding consultations and group discussions with indigenous peoples and indigenous leaders.	- A complete report on the needs of indigenous peoples.	It is necessary to involve traditional leaders to build public trust.	- Local government (social service, regional development).
		- Conduct socio-economic surveys using participatory methods.	- Thematic maps of regional potential based on geographical and socio-economic data are available.		- Traditional leaders and community leaders.
		- Mapping natural and cultural resources with GIS technology and field observation.			- Researchers from local universities or research institutions.
		- Data processing and report creation.			- NGO in the field of indigenous people's empowerment.
					- GIS technology providers and survey tools.
2	Development of custom-based local	- Involving indigenous peoples in the planning of the design and	- Local research centers operate with	The location of the research center must	- NGOs that focus on indigenous peoples' empowerment.

Year	Main Programs	Implementation Strategy	Success Indicators	Note	Actors Playing Roles
	research centers	function of the research center.	adequate facilities.	be strategic and easily accessible to indigenous peoples.	
		- Building physical facilities for environmentally friendly research.	- 50% of local communities are actively involved in research activities.		- Universities and research institutes for scientific support.
		- Train local communities as participatory researchers.	- Publication of locally-based research results of at least two reports per year.		- Customary institutions as a guide to local cultural values.
		- Provide basic technology for local research (equipment, internet connectivity, etc.).			- Local government for funding and licensing.
		- Integrate traditional knowledge with modern scientific approaches.			
3	Implementation of simple technologies in key sectors (agriculture, fisheries, and crafts)	- Identify simple technology needs in each sector through consultation with local communities.	- 20% increase in the use of simple technologies in key sectors.	Focus on technology that is suitable for the geographical and socio-cultural conditions of the local community.	- Ministry of Agriculture, Ministry of Marine Affairs and Fisheries, Ministry of Industry.
		- Provide relevant tools and technologies, such as energy-efficient irrigation equipment, fishery product processing equipment, and modern handicraft equipment.	- The economic productivity of indigenous peoples increased by at least 15%.		- Simple technology provider.
		- Community training in the use and maintenance of technology.	- Public satisfaction with technology reaches 80%.		- NGO local economic empowerment.
		- Monitoring and evaluating the impact of technology on productivity.			- Traditional leaders and local communities for information dissemination.
		4	Community training and		- Identify training needs based on

Year	Main Programs	Implementation Strategy	Success Indicators	Note	Actors Playing Roles
	capacity building	previous mapping results.	in the training.	hands-on to help innovation adoption.	
		- Develop a training curriculum based on local needs (technology, business management, resource management).	- 30% of people are starting to adopt trained innovations.		- Local communities for socialization.
		- Conducting community-based training in strategic locations.	- Minimum of two routine training programs per year.		- Traditional leaders as mediators.
		- Involving traditional leaders as facilitators to build public trust.			- Local government for funding.
		- Provide post-training support through mentoring or technical help.			- NGOs that focus on capacity building.
5	Digital connectivity integration	- Conducting surveys and mapping areas without internet access.	- 70% of the region has internet access.	Digital infrastructure must be adapted to the geographical conditions of Papua, such as mountainous or coastal areas.	- Telecommunication operators for the provider networks.
		- Cooperate with telecommunication operators to build network infrastructure in remote areas.	- Increase in digital-based economic transactions by 20%.		- Central government for funding and regulation.
		- Providing digital literacy training for local communities.	- 50% of people understand and use digital applications.		- Local government for local coordination.
		- Develop local digital platforms to help economic transactions and knowledge sharing.			- NGOs and local communities for digital literacy training.
		- Encouraging collaboration among regions through digital platforms.			

Source: Author's Analysis, 2024

The indigenous people's empowerment program in Papua through the development of infrastructure to support innovation is designed in stages with a holistic approach, ensuring the sustainability of each stage. Starting with mapping

local needs and regional potential (year 1), this program builds the foundation for the development of custom-based local research centers (year 2). The results of the research then support the implementation of simple technologies in key sectors such as agriculture, fisheries, and crafts (year 3), followed by training and community capacity building (year 4) to help the adoption of innovations. The final stage is the integration of digital connectivity (year 5), which expands economic opportunities and collaboration through access to information technology. Indigenous peoples' involvement is an important element in every stage, both through consultation, active participation in research, and community-based training. This strategy not only increases the community's sense of ownership of the program, but also ensures the relevance and sustainability of the results. Simple technology and digital connectivity are pillars of innovation, allowing for increased economic productivity as well as access to a wider market. Clear indicators of success, such as 70% of the region having internet access or 50% of the community attending training, help monitor the progress of the program. However, challenges such as Papua's difficult geographical conditions, digital literacy gap, and funding sustainability need to be managed properly. A collaborative approach involves a wide range of actors, including governments, indigenous institutions, universities, NGOs, and the private sector, ensuring the program is supported by diverse resources. To strengthen results, the program needs to emphasize capacity building, consistent monitoring, and close coordination among stakeholders. With a mature strategy and proper implementation, this program has great potential to improve the welfare of indigenous Papuans in a sustainable manner, while maintaining local cultural values and wisdom.

The third step is partnerships with the private sector, partnerships with the private sector can encourage the development of high value-added locally-based products, such as Papuan coffee and handicrafts. This approach ensures that innovation is not only locally relevant but also competitive in the global market (RPJMD Papua 2025-2029) (Bapperida Provinsi Papua, 2024a). Partnerships with the private sector are a strategic step in encouraging innovation-based development in Papua, especially in empowering indigenous peoples. This approach allows the development of local-based products that have high added value, such as Papuan coffee and handicrafts, which have great potential to compete in the global market. Scientifically, collaboration among local communities and the private sector can help the transfer of knowledge and technology, improve production efficiency, and strengthen market access (Michael E. Porter, 1998). For illustration, partnerships in Papuan coffee processing can help adopt modern processing technologies that improve product quality while maintaining local characteristics. In addition, the private sector has the capacity to provide the capital, marketing networks, and expertise necessary to support sustainable innovation. Research shows that a

partnership-based approach can increase the competitiveness of local products by up to 30% through improved quality standards and product diversification (Smith et al., 2023). As such, these partnerships not only optimize the potential of local resources, but also ensure that indigenous peoples benefit directly through increased income and involvement in global value chains. On the other hand, the local relevance of the resulting innovations is maintained because indigenous peoples are actively involved in the product development process, both through the provide raw materials, the apply local wisdom, and as production partners. This is in line with the principle of sustainable development which emphasizes the empowerment of local communities while maintaining environmental and cultural sustainability.

9.3. Success Indicators for Local Innovation

The success of Papua's innovation-based transformation includes measurable social, economic, and environmental impacts through various key indicators. First, increasing the income of indigenous peoples is an important priority, given their dependence on local natural resources. The study on the economic development of indigenous Papuans emphasizes the importance of protecting customary land rights and developing economic capital based on local wisdom, such as traditional agriculture and ecotourism, which can improve community welfare (Sokoy, 2022). Furthermore, access and use of technology by indigenous peoples can strengthen their economic sustainability. The apply technology, such as satellite-based mapping for resource planning and local food management, has been proven to support agricultural sustainability and food security in Papua (Indow et al., 2021). Other research shows that a green economy approach based on local wisdom also promotes sustainable development, combining economic benefits with the conservation of natural resources (Mollet & Silo, 2024). From the environmental aspect, ecosystem preservation is the main pillar in Papua's transformation. Studies show that a combination of modern technology and traditional practices such as agroforestry can reduce deforestation and increase biodiversity in this region (Laurance et al., 2012). In addition, sustainable economic strategies for tropical forest management also provide great benefits to local communities through conservation programs involving indigenous communities (Visser, 2014). The active participation of indigenous peoples in decision-making is key in ensuring development inclusivity. This can be seen in the participatory approach to community development in West Papua, where local governments and indigenous peoples work together to create equitable and sustainable solutions (Nurhasan et al., 2022). Innovation-based transformation of Papua requires synergy among economic development, technology use, environmental conservation, and indigenous people's empowerment to achieve sustainable and inclusive outcomes. Within five years, the achievement of innovation-based transformation of Papua requires a systematic and directed approach.

Each key indicator should be planned with realistic targets, involving various stakeholders to support implementation and evaluation. Here is a table detailing key indicators, five-year targets, achievement strategies, and related stakeholders (Table 9.3). Achieving the indicator within five years requires synergy among stakeholders and consistent policy implementation. Increase Indigenous Peoples' Income: This target can be achieved through optimizing local potential, such as crops and cultural products, with the support of digital marketing. Key stakeholders such as cooperatives and MSMEs have a strategic role in improving market access and competitiveness of local products.

Table 9.3. Innovation-Based Papua Transformation Achievement Plan

Key Indicators	5-Year Target	Achievement Strategy	Stakeholders
Increase in Indigenous Peoples' Income	30% increase in indigenous household income in the target area	- Business development based on local resources	Local governments, local NGOs, traditional cooperatives, MSMEs
		- Provide entrepreneurship training	
		- Support access to the market through digital technology	
Increased Access and Use of Technology	50% of indigenous communities adopt technology in economic activities	- Distribution of technological devices (internet, modern means of production)	Ministry of Communication and Informatics, technology companies, educational institutions
		- Technology usage training	
		- Provide technological infrastructure in remote areas	
Environmental Sustainability	25% reduction in deforestation rate and 15% increase in biodiversity	- Implementation of agroforestry	Central government, environmental organizations, indigenous peoples
		- Community empowerment in forest management based on local wisdom	
		- Environmental awareness campaigns	
Strengthening Indigenous Peoples' Participation in Decision-Making	70% of indigenous peoples are involved in local development planning	- Regular consultation forums among indigenous peoples and the government	Local governments, traditional leaders, civil society organizations
		- Strengthening the law on the protection of customary rights	
		- Involvement of indigenous peoples in strategic project management	

Source: Author's Analysis, 2024

Increased access and use of technology: government programs such as the provide village internet infrastructure can be the main foundation. Collaboration with the private sector is needed to deliver affordable and relevant technology. Environmental Sustainability: Success in environmental conservation depends on the implementation of community-based conservation models and the support of modern technology. The active participation of indigenous peoples in natural

resource management can mitigate the threat of deforestation. Strengthening Indigenous Participation: Communication forums and legal mechanisms that recognize indigenous rights are key to success. The active involvement of indigenous peoples in the planning and management of strategic projects will ensure inclusive and sustainable development. With strong strategies and collaborations, innovation-based transformation can be a key driver of sustainable development in Papua in a relatively short period. To achieve the target of increasing indigenous peoples' income by 30% in five years, detailed planning is needed every year. The following table presents a yearly breakdown for key indicators, with measurable annual strategies and targets (Table 9.4.).

Table 9.4. Main Indicator of Increase in Indigenous Peoples' Income

Year	Annual Target	Achievement Strategy	Key Indicators	Stakeholders
1	Identify local economic potential	- Mapping the potential of local resources - Socialization of programs to indigenous peoples - Formation of community business groups	Mapping completed in 100% of target areas	Local governments, local NGOs
2	5% increase in initial revenue	- First stage of entrepreneurship training - Provide initial capital for business groups - Start product integration into local markets	50% of the group received training and capital help	Customary cooperatives, MSMEs
3	10% increase in total revenue	- Market expansion through digital technology - Implementation of modern production tools - Monitoring business effectiveness	70% of business groups are connected to digital platforms	Technology companies, local NGOs
4	20% increase in cumulative revenue	- Diversification of local products - Strengthening national and regional market access - Follow-up business help	50% of business groups have diversified products	Local governments, customary cooperatives
5	30% increase in cumulative revenue	- Technology-based business optimization - Collaboration for the export of superior products - Program evaluation and replication	30% of business groups have access to international markets	MSMEs, central government, export organizations

Source: Author's Analysis, 2024

The first phase will focus on identifying local economic potential and establishing the basis of the program, with the mapping of local resources as a foundation to develop businesses that are by the conditions of indigenous peoples.

Furthermore, in the initial implementation stage, training and provide business capital will be carried out to build a solid economic foundation for indigenous groups, with a target of increasing income by 5% as a realistic step in this phase. In the next stage, attention will turn to market expansion and the use of digital technology to expand access, which is expected to drive a cumulative revenue increase of up to 10%. In the advanced phase, product diversification will be the main focus to create more revenue streams, with intensive mentoring to ensure business sustainability and increase revenue by 20%. Finally, technology-based business optimization and collaboration for exports will be the main strategy to achieve the target of increasing indigenous household income by 30%, supported by structured planning, clear performance indicators, and active stakeholder engagement to ensure the success of the program.

Table 9.5. Key Indicators of Increased Access and Use of Technology

Year	Annual Target	Achievement Strategy	Key Indicators	Stakeholders
1	Identify community technology needs	- Survey of technology needs in indigenous communities	100% of the target areas have identified their technology needs	Ministry of Communication and Informatics, educational institutions
		- Determine priority areas		
		- Planning the distribution of technology devices		
2	10% of communities are starting to adopt technology	- Distribution of the first stage of technological devices	10% of communities use basic technology	Technology companies, local governments
		- Basic training on the use of technology for early communities		
3	25% of communities adopt technology	- Provide internet infrastructure in remote areas	25% of communities have internet access and devices	Ministry of Communication and Informatics, educational institutions
		- Second stage of training: integration of technology in economic activities		
4	40% of communities adopt technology	- Distribution of enhancements to expand access	40% of communities are actively using technology	Local governments, technology companies
		- Community help in the apply technology		
5	50% of communities adopt technology	- Optimization of technology in production and marketing	50% of communities are integrated with digital platforms	Educational institutions, community organizations
		- Evaluation of the impact of technology on economic improvement		

Source: Author's Analysis, 2024

I Increasing access to and use of technology by indigenous communities is a strategic step to support innovation-based transformation. Here is a five-year annual

breakdown plan to achieve the target of 50% of indigenous communities adopting technology in economic activities (Table 9.5.).

The early stages of the program, the main focus will be surveys to understand the needs of the technology, which will ensure the distribution of devices and infrastructure is carried out in a targeted manner. The data obtained from this survey will be the basis for further implementation steps. In the next phase, the adoption of the technology begins with a focus on basic training as well as the distribution of devices to communities that have been identified as priorities. A technology adoption target of 10% is a realistic achievement to start this change. Furthermore, endeavors to provide internet infrastructure in remote areas are a crucial step in increasing access to technology. At this stage, further training will be provided to support communities in utilizing technology, especially in their economic activities. Thus, it is hoped that technology will commence to be used more widely in people's productive activities. In the next phase, access to technology will be further expanded through the distribution of more tools and intensive mentoring to more communities. This move aims to ensure that more and more community groups can integrate technology into their activities, both in production and marketing. The help provided will help the adaptation of technology in daily life and increase the efficiency of economic activities. Finally, optimizing the use of technology will be focused on economic activities such as production and marketing, which will support the sustainability of technology adoption in the long term. Periodic evaluation of the program's impact will be carried out to formulate better policies and necessary follow-up measures. The success of this program is highly dependent on close collaboration among relevant ministries, technology companies, and educational institutions. Synergy among various stakeholders will be a key factor in achieving the goals and ensuring the sustainability of this program.

Environmental sustainability is an important indicator in the transformation of Papua based on innovation. The target of reducing the rate of deforestation by 25% and increasing biodiversity by 15% can be achieved through an approach that integrates modern technology with local wisdom. Here is a five-year annual plan to achieve this target (Table 9.6.). In the first stage, the main focus is to map deforestation areas to identify critical areas that require restoration endeavors. The information obtained from this mapping will be the basis for designing agroforestry programs as well as relevant biodiversity conservation initiatives. The mapping provides an in-depth understanding of the condition of degraded ecosystems, as well as providing the information needed to formulate appropriate measures in endeavors to improve and protect the area. The next stage will lead to the initial implementation of agroforestry programs in areas that have been identified as priorities. At this stage, local communities will be provided with training on forest management based on local wisdom, as part of a strategy to reduce the rate of deforestation. By utilizing

existing traditional knowledge, it is hoped that the community can manage natural resources in a sustainable manner. In this context, the deforestation reduction target of 5% is a realistic first step to reduce forest destruction and promote more environmentally friendly management methods. Furthermore, this program will focus on the implementation of the first phase of biodiversity restoration, which will be carried out in conjunction with strengthening community empowerment programs.

Table 9.6. Key Indicators of Environmental Sustainability

Year	Annual Target	Achievement Strategy	Key Indicators	Stakeholders
1	Mapping and identification of critical areas	- Mapping of high-deforestation areas - Identify local species for biodiversity restoration	100% of critical areas mapped	Central government, environmental organizations
2	Reduction in deforestation rate by 5%	- Implementation of agroforestry in priority areas - Community training on forest management	Agroforestry is implemented in 20% of priority areas	Indigenous peoples, environmental organizations
3	Reduction in deforestation rate by 15%	- Strengthening empowerment programs based on local wisdom - First phase of biodiversity restoration	50% of priority areas are involved in the program	Local governments, indigenous peoples
4	Reduction in deforestation rate by 20%	- Sustainable help for forest management - Expand biodiversity restoration	70% of priority areas have restored biodiversity	Central government, environmental organizations
5	Reduction in deforestation rate by 25%	- Widespread environmental awareness campaigns - Optimization of monitoring through satellite technology	25% reduction in deforestation rate achieved	Environmental organizations, indigenous peoples

Source: Author's Analysis, 2024

This empowerment includes increasing the capacity of the community to be actively involved in environmental management and protection. It is hoped that with increased community involvement, this program will achieve a 15% reduction in deforestation. Success at this stage is highly dependent on the level of active community participation in each phase of implementation, from planning to evaluation of results. In the next stage, continuous help will be provided to communities that have started forest management based on local wisdom. This mentoring aims to ensure that the community has the technical and non-technical support needed to overcome the challenges in the implementation of the method. In addition, the expand restoration areas will be a top priority to expand the scope of forest management and protection. The help provided not only focuses on the technical aspects of forest management, but also emphasizes the importance of

sustainability in nature restoration and conservation endeavors. In the final stage, environmental awareness campaigns will be encouraged to increase public understanding of the importance of forest conservation and biodiversity. In addition, monitoring using satellite technology will be carried out to monitor the progress of restoration and changes that occur in the ecosystem. With this technology-based approach, the sustainability of the program can be more assured, with the target of reducing deforestation by 25% and increasing biodiversity by 15% expected to be achieved. The success of this program relies heavily on close collaboration among the government, environmental organizations, and indigenous peoples. The synergy among these stakeholders is a key factor in achieving the goals and ensuring the continuity of the program in the long term.

Strengthening the participation of indigenous peoples in decision-making is an important aspect to achieve inclusive and sustainable development. In an effort to achieve 70% involvement of indigenous peoples in local development planning, a comprehensive and sustainable approach is needed. First, the empowerment of indigenous peoples must commence by increasing their understanding of rights and participation mechanisms in the development process. This can be achieved through educational and socialization programs that emphasize the importance of their role in decision-making that affects their environment and social life. Furthermore, building the capacity of indigenous peoples in technical skills, such as budgeting, development planning, and project management, is crucial. Relevant training will strengthen their ability to engage effectively in development planning, allowing them to make a significant contribution in designing programs that suit their local needs. It is also important to create participatory platforms or forums that allow indigenous peoples to interact directly with governments and other stakeholders. The forum should be an open space for discussion and consultation, where the aspirations, needs, and perspectives of indigenous peoples can be heard and considered in the decision-making process. The use of technology can also expand the space for participation, especially for indigenous peoples in remote areas. Information and communication technology (ICT) can be used to help remote consultations, accelerate access to information, and enable more transparent and inclusive decision-making. In addition, evaluation and monitoring of indigenous peoples' participation in each stage of development planning must be carried out to ensure the sustainability and effectiveness of the program. Through this approach, it is hoped that the involvement of indigenous peoples in local development planning can increase significantly, bringing a positive impact in creating a more just, sustainable, and by local wisdom (Table 9.7). In the initial stage, mapping indigenous communities will be carried out to gain a better understanding of the needs and potentials of each community. This process will involve the formation of a planning working group consisting of indigenous leaders, which will be an important foundation in designing the next

strategic steps. In the next stage, through policy consultation and socialization forums, it is hoped that around 30% of indigenous communities can start participating directly in local development planning. Their involvement in the forum will open up opportunities to include the perspectives and aspirations of indigenous communities in development planning. In the third stage, strengthening the legality of customary rights will be focused on the establishment of local regulations that support the recognition of these rights. In addition, the involvement of indigenous communities in small projects will provide them with the opportunity to contribute more significantly to local development. The target of achieving 50% engagement this year is the main focus in endeavors to increase their participation.

Table 9.7. Key Indicators of Strengthening Indigenous Peoples' Participation in Decision-Making

Year	Annual Target	Achievement Strategy	Key Indicators	Stakeholders
1	Identify indigenous communities and local needs	- Indigenous community surveys and needs mapping	100% of indigenous communities in the target area are identified	Local governments, traditional leaders
		- Establishment of a planning working group		
2	30% of indigenous peoples are getting involved	- Launch of regular consultation forums in the early stages	30% of indigenous communities are involved in consultation forums	Civil society organizations, indigenous leaders
		- Socialization of customary rights protection policies		
3	50% of indigenous peoples involved	- Strengthening the legality of customary rights through local regulations	50% of communities have representation in planning	Local governments, legal institutions
		- Community involvement in small development projects		
4	60% of indigenous peoples are involved	- Evaluation and development of consultation forums	60% of communities involved in decision-making	Central government, civil society organizations
		- Intensive involvement in strategic project management		
5	70% of indigenous peoples are involved	- Establishment of permanent regulations for the protection of customary rights	70% of communities are represented in strategic planning	Local governments, traditional leaders, NGOs
		- Full integration of indigenous peoples in local development		

Source: Author's Analysis, 2024

In the fourth year, an evaluation of the implementation of the consultation forum will be carried out to assess the effectiveness and intense the participation that has been established. Increased involvement of indigenous communities in strategic projects is expected to increase their participation rate to 60%. This evaluation will help in identifying areas that need to be strengthened so that the participation process becomes more inclusive. In the final stage, the establishment of regulations

that regulate the permanent protection of indigenous rights will be an important step in ensuring the sustainability of indigenous peoples' participation. Full integration of indigenous peoples into the development planning system is expected to be achieved with 70% involvement. The success of achieving this target depends heavily on effective collaboration among governments, indigenous leaders, and civil society organizations, which will be a key element in realizing inclusive and sustainable development.

The success of innovation-based transformation of Papua requires careful planning, strategic implementation, and continuous evaluation. Through an analysis of key indicators such as increased indigenous peoples' incomes, access and use of technology, environmental sustainability, and strengthening indigenous peoples' participation, strategic measures have been designed to ensure sustainable outcomes over a five-year period. One of the main steps to improve the welfare of indigenous peoples is to encourage an increase in their income through the development of local resource-based businesses. For five years, the target of increasing income by 30% can be achieved by utilizing existing local potential, such as agricultural products, handicrafts, and natural resources. The strategy designed includes mapping local potential, entrepreneurship training, providing business capital, and marketing support through digital technology. Collaboration among local governments, customary cooperatives, and MSMEs is the key to the success of this program. Planned implementation, starting from needs identification to technology-based business optimization, will result in significant economic impacts for indigenous communities.

Access and use of technology is an important indicator in innovation-based transformation. Within five years, the target of 50% of indigenous communities adopting technology in economic activities can be achieved through the distribution of technology devices, training in the use of technology, and the provide infrastructure in remote areas. The first year focuses on mapping the community's technology needs, followed by device distribution and basic training in the second year. In the third year, internet infrastructure began to be provided in remote areas to improve accessibility. The fourth and fifth years are focused on optimizing technology in economic and marketing activities. Collaboration with the Ministry of Communication and Informatics, technology companies, and educational institutions will ensure the sustainability of this program. This technological capacity building not only expands economic opportunities but also accelerates the integration of indigenous communities into the modern economy. Environmental sustainability is one of the top priorities in Papua's transformation. The target of reducing the rate of deforestation by 25% and increasing biodiversity by 15% can be achieved by the implementation of agroforestry, community empowerment in forest management based on local wisdom, and environmental awareness campaigns. In the first year, mapping critical

areas is the first step to determine priority areas. The second to fourth years include the implementation of agroforestry, community training, and gradual biodiversity restoration. In the fifth year, the program is optimized through satellite technology monitoring and impact evaluation. The central government, environmental organizations, and indigenous peoples have an important role to play in the success of this program. With a community-based approach, this transformation can maintain ecological balance and improve the sustainability of natural resources. Strengthening the participation of indigenous peoples is a strategic step to ensure development inclusivity. Within five years, the target of 70% of indigenous peoples involved in local development planning can be achieved through regular consultation forums, strengthening customary rights protection laws, and involvement in strategic project management. In the first year, the main focus is on identifying indigenous communities and their needs. The second to fourth years include the establishment of a consultation forum, strengthening the legality of customary rights, and intensive involvement in development planning. In the fifth year, indigenous peoples are fully integrated in strategic decision-making. Local governments, indigenous leaders, and civil society organizations play a role as facilitators in this process. As a result, indigenous peoples are not only the objects of development, but also active actors who contribute to the sustainability and relevance of development. Through the implementation of a structured strategy, the innovation-based transformation of Papua has the potential to create significant social, economic, and environmental impacts. Increased income, access to technology, environmental sustainability, and active participation of indigenous peoples support each other to create inclusive and sustainable development. Collaboration among stakeholders, including governments, indigenous peoples, civil society organizations, and the private sector, is key to success in achieving this five-year target. With a holistic and community-based approach, Papua's transformation will not only improve the welfare of indigenous peoples but also preserve cultural and environmental heritage for future generations.

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10.1. Tradition-Based Excellence Programs and Multi-Party Collaboration

The flagship programs are designed to strengthen the role of tradition in supporting sustainable development in Papua. One of the main programs is the development of custom-based ecotourism, which takes advantage of Papua's unique culture and natural beauty to attract local and international tourists. This ecotourism not only involves indigenous peoples as managers, but also becomes a means to promote Papuan cultural values globally. Other flagship programs include processing natural products, such as coffee and seafood, into high-value-added products through skills training and the use of simple technologies. The Papua RPJPD 2025-2045 states that the development of this tradition-based product can increase the income of indigenous peoples while preserving their culture (Bapperida Provinsi Papua, 2024). The success of flagship programs in development requires strong synergies among various stakeholders, comprising governments, indigenous institutions, the private sector, and academia. This collaboration is crucial because each party has a unique role that complements each other in supporting the sustainability and effectiveness of the program. The government is responsible for providing supportive policies as well as funding for infrastructure such as road access and digital technology. On the other hand, indigenous institutions play a crucial role in ensuring that traditional values remain respected and integrated in every innovation. The private sector contributes through strategic investments in the creative and agro-industrial sectors, which can unlock economic opportunities while supporting sustainability. Meanwhile, academics act as a catalyst for innovation through research and development of locally-based technology that is relevant to the needs of the community. In the context of this complexity, a systematic and integrated approach is needed to bring together various perspectives, interests, and goals. Systems thinking can be a relevant scientific framework, as it helps to understand the relationships among elements in a system and how synergies among elements can have a greater impact. Close and effective collaboration among stakeholders is not only a requirement for success, but also key in creating inclusive, sustainable, and far-reaching innovations.

The systems thinking approach is a method of understanding that sees phenomena as part of a complex system, where elements are interrelated and mutually influencing. The focus of this approach is to understand the relationships among components in a system and how changes in one component can affect the

entire system (Lamont, 2021). This approach first emerged in response to the limitations of linear analysis methods that often ignore the complexity of relationships in systems. In the 20th century, Ludwig von Bertalanffy through General Systems Theory became one of the pioneers of this approach. In the modern context, systemic approaches have been adopted in areas such as management, public health, education, and sustainable development to confront complex challenges such as climate change or multistakeholder collaboration (Chen-Levi et al., 2021). The systemic approach is rooted in some key concepts, such as holism, which emphasizes the importance of understanding the system as a whole rather than just analyzing individual parts. Another concept is interconnectivity, which shows that each element in a system affects each other, as well as system dynamics which describes system changes due to interactions among elements. Processes in systems also often involve feedback, both positive and negative, that affects the stability of the system (Talley & Hull, 2023). This approach is based on the assumption that a system is a unit greater than the sum of its parts, that relationships among elements are more important than elements themselves, and that the complexity of a system can be understood through mapping relationship patterns rather than linear analysis (Wami et al., 2016). Models of systemic approaches are often illustrated through diagrams, such as the Causal Loop Diagram (CLD), which maps the causal relationships among elements in a system. This diagram includes key components, feedback relationships, and system dynamics over time (Devi et al., 2023). The goal of a systemic approach is to understand, predict, or change the behavior of complex systems to achieve specific outcomes. Its relevance extends to various fields, comprising multistakeholder collaboration management, continuing education, and risk mitigation in complex projects (Bouyaud & White, 2021). The systemic approach has some advantages, such as its ability to provide a holistic understanding, identify the root cause of problems, and effectively handle complexity. However, this approach also has limitations, such as the need for comprehensive data, the difficult implementation without special training, and the tendency not to provide direct solutions (Hasannizadeh & Jafari, 2023). In its application, a systemic approach has been used to help teams understand the dynamics of collaboration in project management, train students to understand complex relationships in sustainable development, as well as improve the effectiveness of public policy in cross-sector collaboration (Talley & Hull, 2023). By understanding the interaction of elements in a system, this approach enables more inclusive, sustainable, and wide-impact problem-solving.

The systemic approach to custom-based ecotourism development sees each element, such as indigenous peoples, local cultures, natural beauty, governments, and the private sector, as part of an interconnected system. The focus of this approach is to ensure the sustainability of ecotourism through understanding the relationship among these elements and their impact on the overall ecotourism system. For

illustration, research in Misool, Raja Ampat, Indonesia, shows how the traditional practice of sea sasi can be integrated into ecotourism to protect biodiversity while maintaining the cultural values of local communities (Prasetyo et al., 2020). One of the key elements of this approach is community-based management, in which indigenous peoples are actively involved in all stages of ecotourism, from planning to implementation and supervision. An illustration is the Padang Tegal indigenous people in Ubud, Bali, who play an active role in the management of the Monkey Forest as an ecotourism destination based on local culture. This includes the preservation of nature and culture as well as the economic empowerment of the community through involvement in decision-making (Suacana et al., 2023). In addition, a systemic approach also requires the principles of sustainability and resilience to address ecological and social challenges. A study in Nakdong Estuary, South Korea, emphasizes the importance of integrated governance that integrates diversity, connectivity, and active participation to minimize ecological conflicts as well as strengthen environmental protection (Y. E. Choi et al., 2021). Environmental education for local communities and tourists is also an important component. For illustration, an integrated environmental education curriculum in Pelalawan, Indonesia, has been shown to increase public awareness of the importance of conservation and encourage community involvement in responsible ecotourism management (Nawari et al., 2022). Furthermore, the effectiveness of this approach relies heavily on cross-stakeholder collaboration, as seen in a study in Bukit Tigapuluh, Indonesia, where the empowerment of indigenous peoples through training and involvement in the management of ecotourism destinations has succeeded in increasing their participation in the ecotourism value chain (Musadad et al., 2022). The apply a systemic approach requires conflict management and integrated planning. The study in Bhutan highlights the importance of inclusive governance and equity-based natural resource management to improve the socio-ecological well-being of indigenous communities involved in ecotourism (Karst & Nepal, 2022). By empowering indigenous peoples, involving cross-sector collaboration, and applying sustainability principles, a systemic approach can optimally use cultural uniqueness and natural beauty. This not only protects the environment, but also improves the well-being of local communities, creating a sustainable and inclusive ecotourism model.

The systemic approach to the development of custom-based ecotourism in Japan emphasizes the importance of integration among traditional cultural preservation, natural beauty, and environmental sustainability. Japan has great potential in the development of ecotourism due to the uniqueness of its rich local culture and beautiful natural landscapes. This approach allows collaboration among the government, local communities, the private sector, and tourists in creating tourism experiences that are not only engaging but also beneficial to the local environment and culture. For illustration, research shows that ecotourism in Japan is

used as a medium to promote and learn about traditional Japanese culture, such as arts, crafts, and traditional practices through activities at tourist sites (Baiquni & Wiyatasari, 2023). One of the key elements of this systemic approach is the importance of collaboration among various stakeholders. Another study in Japan highlights the role of ecotourism guides in environmental conservation through tourist education, monitoring of visitor activities, and collecting data on environmental conditions to support the management of national parks and other conservation areas (TAKE, 2021). In this context, the role of local communities is also very important. By integrating traditional values and local customs in ecotourism programs, local communities can play an active role in maintaining a balance among cultural preservation and tourism exploitation. It is also important to create an environmental education-based approach that supports sustainability. Research in Japan underscores the importance of ecotourism-based philosophical education methods, known as Field Environmental Philosophy (FEP). This method aims to reconnect people with nature through experiential tourism activities that support biocultural conservation, such as in the Cape Horn Biosphere Reserve. This method is beginning to be adopted in various regions of Japan to integrate education and ecotourism into the global sustainability framework (Tauro et al., 2021). The apply a systemic approach to the development of custom-based ecotourism in Japan shows that cross-sector collaboration, integration of environmental education, and active involvement of local communities are key steps to create ecotourism that not only preserves the uniqueness of Japanese culture but also protects its natural beauty in a sustainable manner.

FEP is an environmental education method that focuses on reconnecting humans with nature through biocultural ethical principles. This approach emphasizes the importance of vital relationships among habitats, inhabitants (humans and other living things), and their Habits (3Hs: Habitats, Co-inhabitants, Habits). With the aim of shifting biocultural homogenization toward biocultural conservation, FEP integrates social, economic, and environmental dimensions to support sustainability at the local and global levels (Tauro et al., 2021). The concept was first developed in 2000 in the Omora Ethnobotanical Park, Cape Horn Biosphere Reserve, Chile, in response to the biocultural crisis caused by urbanization, cultural homogenization, and the exploitation of natural resources. In the process, FEP combines experiential education with the conservation of local ecosystems and cultural diversity. This approach has since begun to be adopted in other countries such as Germany, Japan, and Mexico, to support global sustainability initiatives. FEPs are important because they bid a holistic approach to addressing sustainability challenges, emphasizing the relationship among biodiversity and culture. This method not only supports ecological conservation but also pays attention to the social and economic well-being of local communities. In addition, FEP bridges science, education, and conservation practices

through a deep philosophical approach, allowing for a change in perceptions of the importance of biological and cultural diversity at various social and spatial scales (Tauro et al., 2021). The implementation mechanism involves integrating biocultural ethics into education through direct experience in the field, transdisciplinary collaborations that connect environmental science, philosophy, and ecotourism, as well as increasing global awareness through the adoption of FEP-based conservation practices. By providing participants with an in-depth experience in local ecosystems, FEP strengthens the relationship among humans and nature while supporting sustainability endeavors in different parts of the world.

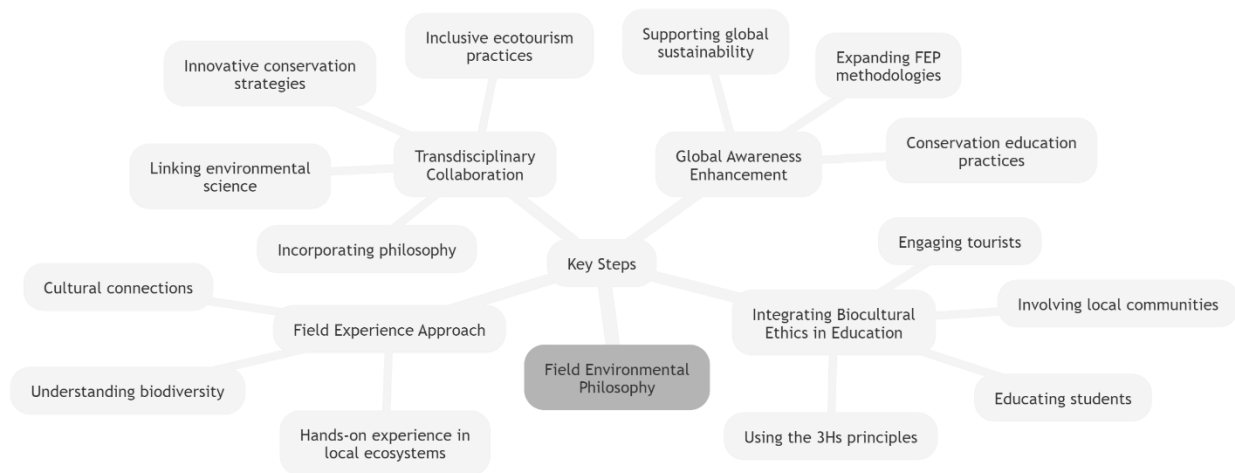


Figure 10.1. Field Environmental Philosophy

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The 3Hs principle in FEP consists of three main elements, namely habitats, Co-inhabitants, and Habits, which are interrelated to support environmental education and sustainability. Habitats refer to living places or ecosystems that are home to living things, comprising soil, water, air, and biological components such as plants and animals. Habitat is seen not only as a physical space, but also as a shared home that must be maintained for the sustainability of the lives of all its inhabitants. Co-inhabitants include other living things, such as flora, fauna, microorganisms, and humans who share habitats. This element emphasizes the importance of interdependent relationships among humans and other living things, so that co-inhabitants are considered vital components of ecosystems that need to be valued. Meanwhile, Habits refers to patterns of human behavior in interacting with habitats and other inhabitants. These Habits include daily actions, traditions, and ways of life that can affect the balance of the ecosystem. In FEP, human Habits must be directed to support sustainability, such as reducing waste, changing consumption patterns, and participating in conservation activities. These three elements are interconnected; Habitat provides space for co-inhabitants, who interact through their Habits. The 3Hs principle teaches students, tourists, and local communities about the importance of collective responsibility to maintain harmonious relationships among humans, the environment, and other residents for the sake of ecosystem sustainability (Tauro et al., 2021).

FEP offers a systemic approach based on biocultural ethics that is highly relevant for the development of custom-based ecotourism in South Korea. This approach focuses on preserving habitats, co-inhabitants, and Habits of local communities by educating tourists and local communities through hands-on experience on the ground. Studies on ecotourism in the Jeungdo and Upo Wetland areas in South Korea show that the involvement of local communities in the management of tourist destinations is essential to increase ecological awareness, preserve biodiversity, and support the sustainability of the local economy (M. A. Choi, 2020; C. K. Lee et al., 2021). The implementation of FEP in South Korea can be started by using the 3Hs principle. Habitats are identified through the management of natural areas such as Jeju Island and Upo Wetland which are known to have high habitat

quality. These endeavors include improving environmental quality through biodiversity conservation and reducing the impact of human activities on local habitats (Kim & Ryu, 2022). Co-inhabitants, such as flora, fauna, and local indigenous peoples, are involved through environmental education programs that aim to raise awareness about the importance of harmonious relationships among humans and other living things. Studies in Upo Wetland show that hands-on experiences in the field, such as birdwatching activities and introduction to wetland ecosystems, can enhance visitors' pro-environmental behavior while supporting local communities (C. K. Lee et al., 2021). Habits are applied through the development of sustainable Habits in ecotourism activities. This includes the involvement of local communities in the provide tourism services, waste management, and environmentally friendly practices in tourist areas. Studies on Jeju Island show that the implementation of zoning policies to limit tourism activities in ecologically sensitive areas can help preserve biodiversity, while attracting tourists who appreciate the quality of the local environment and culture (J. H. Lee & Iwasa, 2020). In addition, FEP-based field education can be applied through collaboration with local tour guides to provide tourists with in-depth cultural and ecological interpretations. By implementing FEP, custom-based ecotourism in South Korea can serve as a tool for cultural and environmental preservation, while improving the economic well-being of local communities through sustainable tourism. This approach not only supports local sustainability but also contributes to biocultural conservation globally.

The FEP approach can be applied to the development of custom-based ecotourism in China by utilizing the uniqueness of local culture and natural beauty to support environmental conservation and socio-economic sustainability. FEP, which is based on the 3Hs (habitats, Co-inhabitants, Habits) principles, focuses on habitat conservation, co-inhabitants, and changing Habits toward sustainability. In the context of China, ecotourism areas such as the Xixi National Wetland Park and Qilian Mountains have shown great potential to implement this approach through biodiversity conservation and strengthening the cultural values of indigenous peoples (Du et al., 2024; Qian, 2022). In the implementation of FEP, habitats in China includes the preservation of natural areas such as the Qilian Mountains, which have vulnerable but important ecosystems for biodiversity. The evaluation of environmental carrying capacity is carried out to manage the pressure caused by tourism activities and ensure the sustainability of the ecosystem. For illustration, increasing the carrying capacity of ecotourism in the Qilian Mountains involves managing socio-economic pressures and tourism activities to preserve its natural environment (Du et al., 2024). Co-inhabitants, i.e. co-inhabitants such as flora, fauna, and local communities, are involved in the management of tourist areas. Studies in the Xixi National Wetland Park show the importance of ecological justice and integration of local communities in protecting ecosystems while supporting social sustainability through education and

community empowerment programs (Qian, 2022). The implementation of Habits involves changing the behavior patterns of visitors and local communities to support sustainability. Environmental education is an important component, such as the one implemented in the Qilian Mountains, where ecotourism education programs help raise environmental awareness among visitors and local communities. In addition, environmentally responsible tourist behavior can be encouraged through increasing the perceived values of authenticity and sustainability, such as those found in the management of the Huangshan tourist area, which involves strengthening tourists' emotional connection with nature and local culture (Yang et al., 2023). The apply FEP in the development of custom-based ecotourism in China has the potential to strengthen biodiversity conservation, empower local communities, and encourage more responsible tourist behavior. This approach allows China's tourist areas to become not only attractive tourist destinations, but also a tool for sustainable cultural and environmental conservation.

The FEP approach can be applied in the development of custom-based ecotourism in Indonesia by utilizing the uniqueness of culture and natural beauty to support environmental conservation and the welfare of local communities. FEP, which focuses on the 3Hs (habitats, Co-inhabitants, Habits) principles, enables the integration of ecological conservation with local cultural engagement through experiential education. Studies in areas such as Misool, Raja Ampat, show that traditional practices such as sasi laut (customary management of marine resources) have been successfully integrated with community-based ecotourism management, thereby preserving biodiversity and cultural values while increasing local participation in ecotourism (Prasetyo et al., 2020). In the implementation of FEP in Indonesia, habitats include the preservation of ecosystems such as forests, wetlands, and marine areas that are habitats for flora and fauna. For illustration, the management of Tangkahan Ecotourism in North Sumatra has succeeded in transforming an area that was previously damaged by unlawful activities into an ecotourism destination that supports ecosystem preservation and provides economic benefits for the local community (Purwoko et al., 2022). Co-inhabitants involve the participation of indigenous peoples, such as in Wasur National Park, Papua, where local cultures such as totems and sacred sites are part of tourist attractions while maintaining indigenous traditions that support conservation (Phoek et al., 2021). The implementation of Habits involves changing the behavior of people and tourists to support sustainability, such as waste reduction and responsible resource management. For illustration, in Sukunan Tourism Village, Yogyakarta, waste management is part of ecotourism that supports community environmental awareness and improves local quality of life standards (Apriliyanti & Randelli, 2020). In addition, experience-based environmental education can also be carried out through programs such as educational tours in the Ubud monkey forest, Bali, where tourists

are taught the importance of ecological conservation and local culture (Suacana et al., 2023). The apply FEP in the development of custom-based ecotourism in Indonesia can be an effective strategy to conserve biodiversity, empower indigenous peoples, and support sustainable development. By integrating ecological conservation, cultural preservation, and environmental education, FEP creates an ecotourism model that not only conserves nature but also strengthens human relationships with their ecosystems. The FEP model is designed to increase the added value of local natural products such as coffee and marine products in Papua. Through simple skills and technology training, the program aims to empower local communities, improve economic well-being, and maintain environmental sustainability.

Table 10.1. FEP Model for Coffee and Seafood Processing in Papua

Year	Program Focus	Activities for Coffee.	Activities for Marine Products.	Expected Results
1	Potential Identification and Basic Education	- Identify the best coffee-producing regions.	- Mapping of superior types of marine products (fish, seaweed).	- Public awareness has increased.
		- Basic training in coffee processing (sorting, manual roasting).	- Basic training in processing (drying, fermentation).	- Data on the potential of natural products is available.
				- Simple starter products are available.
2	Capacity and Production Strengthening	- Advanced roasting training.	- Training in making simple products (salted fish, fish crackers).	- Production increased.
		- Education on environmentally friendly coffee farming practices.	- Education on efficient catch management.	- Small business groups are starting to become active.
				- The product is more consistent in quality.
3	Simple Technology Application	- Introduction of simple tools (coffee grinders, small-scale roasting machines).	- Procurement of simple tools (vacuum machines, seaweed processing tools).	- High value-added products commence to be produced.
				- Reduction of processing waste.
4	Product Diversification and Local Branding	- Product diversification training (instant coffee, premium ground coffee).	- Training on diversification of marine products (shredded fish, seaweed dodol).	- The variety of products increases.
				- Branding of local products began to be introduced in the regional/national market.
5	Marketing and Market Expansion	- Digital marketing workshops.	- Marketing of seafood in environmentally friendly packaging.	- Papuan products are starting to penetrate markets outside the region.
		- Cooperation with cooperatives and local distributors.	- Promotion at exhibitions and digital platforms.	- Community income increased significantly.

Source: Author's Analysis, 2024

In the early stages of the program (table 10.1.), the main focus is to identify the local potential owned by the Papuan people, especially in coffee and marine products. This process involves mapping areas with high potential for quality coffee production, such as in highland areas, as well as collecting data on the types of marine products that are abundant in coastal areas, such as fish, shrimp, and seaweed. Once the potential is identified, the community is engaged in a series of basic trainings designed to build their understanding of the processing of natural products into value-added products. For illustration, coffee processing training includes simple manual coffee bean sorting and roasting techniques, while training for seafood includes fish drying and fermentation techniques for products such as salted fish. Sustainability education is also a key component at this stage. The community is taught the importance of maintaining local ecosystems, such as coffee farming practices that do not destroy forests and sustainable fishing methods to maintain fish populations. The main goal of this stage is to raise public awareness of the economic potential of their local resources while providing an early understanding of the importance of protecting the environment. The expected results at this stage include the availability of data on the potential of natural products, the formation of small business groups, and the ability of the community to produce basic products that can be marketed locally.

Once the community has a basic understanding and starts producing simple products, the strengthening stage is carried out to improve the efficiency and quality of the product through the introduction of simple technology. The technologies introduced at this stage are practical and easy to use, such as manual coffee grinders, small-scale roasting machines for coffee products, as well as vacuum tools and simple processing for seafood such as salted fish or fish crackers. Through training that focuses on the use of these tools, people are able to increase their productivity without the need for large investments or reliance on complicated technology. In addition, this training is also equipped with guidelines regarding product quality control. For illustration, people are taught to produce coffee beans with a consistent roasting rate or seafood products that have a longer shelf life through better packaging. At this stage, the expected results include an increase in production volume, more standardized product quality, as well as a reduction in waste generated during the production process. The diversification stage aims to expand the types of products produced based on coffee and marine products. This diversification is important to increase the competitiveness of local Papuan products in the wider market. For coffee, people are taught to make derivative products such as instant coffee, premium ground coffee, or other coffee-based preparations such as coffee-based snacks. Meanwhile, diversification for seafood includes innovative products such as shredded fish, seaweed dodol, or fish crackers with various flavor variants. At this stage, the community is also given training on production waste management. The waste produced, both from coffee processing and marine products, is taught to

be reused, for illustration as organic fertilizer or additives for other products. The purpose of this stage is to ensure that not only the type of product increases, but also the economic value of each unit of natural products processed by the community. The expected results are a more varied variety of products, improved community innovation skills, and better waste management.

The final stage of this program is the expand marketing and distribution of local Papuan products. At this stage, people are trained in modern marketing strategies, comprising the use of digital platforms to sell their products to a wider market. The digital marketing workshop was held to teach the public how to use social media and ecommerce as a promotional and sales tool. In addition, the branding of local Papuan products is strengthened by creating a visual identity and compelling brand story, which depicts the uniqueness of Papua's culture and natural beauty. Cooperation with cooperatives, local distributors, and national marketing agencies was also built to expand the distribution reach of products. In addition, the public is encouraged to showcase their products at various exhibitions and promotional events both at the regional and national levels. With this strategy, coffee-based products and seafood from Papua are expected to penetrate markets outside the region, create long-term economic impacts, and increase people's incomes. At the terminate of this stage, the expected results are an increase in the scale of product distribution, the introduction of the Papuan brand as a symbol of quality, and the creation of an economically independent society.

10.2. Monitoring and Sustainability Enhancement Mechanism

The programs that have been designed to run effectively; a strong monitoring mechanism is needed. This monitoring involves collecting data periodically to evaluate the achievement of performance indicators, such as increasing indigenous peoples' incomes, community participation in programs, and impacts on environmental sustainability. This monitoring mechanism must also be transparent and involve indigenous peoples as supervisors to ensure that the program runs according to their needs. Law Number 59 of 2024 emphasizes the importance of data-based evaluation and the involvement of local communities in decision-making as a step to strengthen the sustainability of development programs in Papua (Law Number 59/2024). To ensure that development programs run effectively and have a real impact, the apply the Results-Based Monitoring and Evaluation (RBM&E) approach is very relevant. RBM&E is a method that focuses on achieving results by monitoring progress against predetermined performance indicators and evaluating success based on the impact achieved, not just on outputs or activities. This approach emphasizes the importance of transparency, accountability, and the use of evidence-based data to support better decision-making.

In the context of development, RBM&E allows for a systematic evaluation of the success of the program, such as improving the welfare of indigenous peoples, active participation in development activities, and environmental conservation. In addition, this approach advises the involvement of indigenous peoples as part of the monitoring mechanism, thereby creating a more inclusive and adaptive process to local needs. Using RBM&E, program implementation can be measured not only quantitatively through key performance indicators, but also qualitatively through its impact on society and the environment. This makes RBM&E a strategic framework that ensures development programs are not only efficient, but also sustainable. RBM&E is a systematic approach to measuring and evaluating the results of a particular program or project. The main focus is to ensure that each intervention produced a real, measurable impact, beyond just the implementation of the activity. RBM&E combines monitoring as systematic data collect track progress, as well as evaluation as an in-depth analysis of the relevance, effectiveness, efficiency, and impact of implemented programs or policies (Bhattarai, 2020). The concept of RBM&E emerged in 1997, when the United Nations system adopted it in support of the Millennium Development Goals (MDGs) and is now an important part of supporting the Sustainable Development Goals (SDGs). This approach arises from the need for international organizations and governments to improve the efficiency of the use of public resources and show tangible results in development programs (Khan et al., 2020). RBM&E is based on a logical framework that involves five main steps, assessing the initial context, designing a strategy (think), planning activities and indicators (plan), implementing interventions (Do), and evaluating the results for corrective action (review). Other key components include outcome-based planning, continuous monitoring, and focused evaluation on the terminate result (Lainjo, 2021). The fundamental assume RBM&E is that consistent measurement of outcomes can increase accountability and encourage data-driven decision-making, if high-quality data is available and enough capacity for analysis (Okullo Awany et al., 2024). The main objectives of RBM&E are to ensure efficiency in the use of resources, increase transparency, and make a significant impact through evidence-based decision-making. This is particularly relevant in the development, public health, and education sectors, especially in developing countries, as seen in the project to increase childhood vaccination in Egypt which has successfully increased coverage by up to 40% through a data-driven approach (Shultz et al., 2024). However, RBM&E implementations often face obstacles such as weak organizational culture, technical limitations, and inaccurate or inadequate data (Kengera, 2023). RBM&E has proven to be an effective tool in a variety of sectors, comprising economic development, health, and education, by providing a results-oriented framework to improve the efficiency and effectiveness of programs.

The implementation of a participation-based monitoring mechanism and strengthening sustainability can be carried out through several integrated strategic steps. The first step is to develop a comprehensive monitoring plan, starting with identifying key performance indicators (KPIs) that include economic, social, and environmental dimensions. In addition, the roles of indigenous peoples, governments, and other stakeholders must be mapped from the outset to ensure monitoring plans are aligned with local needs, with realistically defined data collection schedules according to resource capacity. Furthermore, data collection must be carried out in an inclusive and participatory manner by involving indigenous peoples through basic training on interview, record-keeping, and documentation techniques. Simple technologies, such as mobile-based applications, can be leveraged to help real-time data logging, while a combination of qualitative and quantitative methods is used to produce more holistic data. Once the data is collected, a rapid analysis is carried out to identify obstacles or initial successes, followed by transparent reporting of results in a format that is easy for indigenous peoples and other stakeholders to understand. Feedback from indigenous peoples through regular meetings can help improve program implementation strategies. In addition, community-based oversight is essential to maintain accountability, by forming a local supervisory team involving community leaders and youth groups. A self-reporting system also needs to be provided to allow the public to submit problems or complaints directly. To ensure sustainability, the results of monitoring should be used as a basis for adjusting program strategies, such as optimizing high-impact activities or changing approaches to less relevant activities. Incentive systems can also be applied to encourage community success in achieving sustainability indicators, such as increased community participation or environmental conservation success. Finally, the integration of monitoring results into regional policies will strengthen the sustainability of the program in the long-term. Through these measures, monitoring mechanisms can be an effective tool to ensure the success and sustainability of inclusive and need-based development programs of local communities.

In Romania, the implementation of the RBM&E approach has been implemented in the socio-economic sector, as seen in the experience of the CONCORDIA Humanitarian Organization. The organization designs and implements the RBM&E framework to measure the social impact of their initiatives, comprising social business operations such as CONCORDIA Bakery. By using a Theory of Change-based approach, they are able to integrate monitoring and evaluation into the organization's daily activities to ensure measurable social and economic contributions. This process includes periodic data collection, impact analysis through relevant indicators, and strategy adjustments based on evaluation results. Challenges include limited internal capacity and the need to standardize evaluation practices to align with local contexts. The results show how RBM&E can support socio-economic

organizations in Romania in understanding their contribution to social and economic sustainability, as well as increasing accountability to stakeholders (Opincaru & Crangasu, 2019).

In Japan, the implementation of the RBM&E approach is seen in the preservation of traditional agricultural systems through the Globally Important Agricultural Heritage Systems (GIAHS) initiative. The program is designed to preserve traditional agricultural practices that reflect the harmonious relationship among humans and nature. One study noted that the implementation of GIAHS in Japan is mainly aimed at addressing the decline in the aging rural population and the migration of young people to cities, which has led to the neglect of traditional agricultural practices and resources. RBM&E is used to monitor the sustainability of these systems with indicators that include biodiversity conservation, traditional farming practices, and local community engagement. This process includes regular data collect evaluate the success of the program based on these indicators, while ensuring the involvement of various stakeholders, comprising traditional farmers and local communities. In addition, the program introduces new indicators for documenting the cultural, social, and economic elements of preserved agricultural systems. This approach has proven effective in blending traditional and modern knowledge to improve the sustainability of agricultural systems while preserving cultural heritage and local ecosystems. The study also demonstrates the importance of collective action in planning and implementation, which allows the program to continue to evolve despite the demographic and social challenges. These findings support the increased use of RBM&E to manage and improve future conservation action plans (Reyes et al., 2020).

RBM&E practices in indigenous peoples in South Korea can be identified through an approach to community-based forest management and the strengthening of local institutions. A study discusses the successful community-based forest management (CBFM) in South Korea thanks to strong local institutional strategies, so it can be an illustration for other countries such as Indonesia. This success is supported by government policies that ensure the sustainability of forest management and the implementation of local-based strategies that actively involve communities in planning and implementation. This study recommends that local policies should pay attention to the strategies of community institutions and active participation to achieve natural resource sustainability (Purnomo et al., 2020). In the context of traditional village management or Maeulsoop, research shows that the sustainability of this area is greatly influenced by local ownership, independent management, forest size, and village population. Villages that have forests with their own governance tend to be more sustainable. However, challenges such as depopulation and privatization of the region also threaten this sustainability, so collaboration among communities and external organizations is needed to manage

the region sustainably (Kweon & Youn, 2021). The RBM&E approach used in South Korea provides important lessons on the importance of integrating local values and community participation in policies and practices designed to support the sustainability and well-being of indigenous peoples. This approach can be replicated by other countries to improve the effectiveness of policies based on measurable results.

Practices involving indigenous peoples in China with an RBM&E approach can be seen in several contexts, comprising natural resource management and the preservation of traditional knowledge. A study conducted in Yunnan showed that the Bulang indigenous people succeeded in preserving forests and wildlife through a combination of traditional knowledge, collective morals, and religious rituals. This system is based on respect for nature and is preserved for generations. However, the limitations of scientific guidance in this practice sometimes pose challenges to the effectiveness of ecological conservation. This emphasizes the importance of integration among traditional and scientific knowledge to protect biodiversity in a sustainable manner (Su et al., 2020). Another approach is community involvement in landscape management in Guizhou through the Jiabang rice terrace farming system. The study found that the system is based on local knowledge about the management of natural resources such as forests and water, which significantly shapes landscape patterns and improves ecological sustainability. This knowledge is passed on to the next generation, demonstrating success in engaging indigenous peoples in outcomes-based monitoring to ensure environmental sustainability (Wang et al., 2021). The integration of indigenous knowledge in natural resource management in China shows that an outcome-based approach can provide significant ecological benefits if implemented taking into account local contexts and actively engaging various stakeholders.

Practices involving indigenous peoples in Australia with an RBM&E approach are widely applied in natural resource management, health and community development programs. For illustration, the Indigenous-led Monitoring and Evaluation approach in Arafura Swamp, Australia, shows success in integrating the Bi and Yolju indigenous knowledge systems with Western-style adaptive management frameworks. The project includes the development of specific indicators, data management systems, and seasonal monitoring calendars that strengthen the relationship among customary systems and Western governance systems for sustainable environmental conservation and management (Campion et al., 2023). In addition, community-based health projects in Northern Australia demonstrate the importance of community involvement in the development and evaluation of programs to support the well-being of indigenous peoples. This study found that the indigenous culture-based evaluation model can provide more relevant results for local communities. This highlights the need for culturally relevant evaluation tools to

improve the effectiveness of health interventions (Bailie et al., 2021). The RBM&E approach is also applied in the evaluation of indigenous peoples' specific health programs through community events. This method is effective in increasing community participation in preventive health screenings, by tailoring programs to the specific needs of communities and engaging indigenous health workers to create culturally safe experiences (Miller & Walke, 2024). RBM&E's practice in Australia shows that the incorporation of indigenous values with modern evaluation frameworks can have a significant impact in a range of sectors, from environmental management to indigenous peoples' health.

The RBM&E approach in Canada is widely applied to improve the well-being of indigenous peoples by integrating traditional and modern knowledge in various sectors, comprising the environment, health, and natural resource management. For illustration, the Indigenous Community-Based Monitoring (ICBM) approach in Alberta's oil sands region integrates indigenous knowledge with Western scientific methods to evaluate the impact of industrial activities on the environment. ICBMs not only help monitor ecological change but also strengthen indigenous peoples' connections with their traditional lands and encourage the revival of indigenous languages and practices (Beausoleil et al., 2022). In the context of health, community-based programs that combine traditional healing practices with harm reduction approaches have shown effectiveness in addressing cross-generational trauma and substance use disorders. This study provides evidence that combining indigenous practices with science-based principles such as Seeking Safety can improve treatment outcomes and strengthen indigenous peoples' spiritual connections (Marsh et al., 2021). The RBM&E approach is also applied in forest management in British Columbia, where forestry policies are beginning to consider customary rights reflected in the principles of the United Nations Declaration on the Rights of Indigenous Peoples. This integration seeks to integrate the environmental, economic, and social needs of indigenous peoples with inclusive sustainability goals (Caverley et al., 2020). RBM&E practices in Canada show that collaboration among indigenous and modern knowledge can strengthen the social and ecological sustainability of indigenous peoples, while supporting national reconciliation endeavors.

Table 10.2. Identify key elements that can be learned from each country, comprising sector focuses, key approaches, outcomes, and challenges faced. An analysis of various RBM&E implementations in countries such as Romania, Japan, South Korea, China, Australia, and Canada shows that the success of this approach is highly dependent on the integration of local and modern knowledge, community involvement, and the use of culturally relevant indicators. In all countries, the combination of traditional knowledge with modern scientific approaches has been shown to support social and ecological sustainability, as seen in the preservation of traditional practices in Japan and CBFM in South Korea. Local community

involvement in program planning, implementation, and evaluation is also an important element that strengthens the relevance of outcomes and increases accountability, as in programs in Australia and Canada. However, challenges such as limited internal capacity, funding, and demographic pressures often hamper program effectiveness, as observed in Romania and Japan. On the other hand, the use of indicators that take into account local cultural values, such as conservation indicators in China and Japan, provides illustrations of how this approach can be tailored to the unique needs of each community. Overall, the implementation of RBM&E not only supports environmental and social sustainability but also strengthens the rights and connections of indigenous peoples to their cultures, providing inspiration for the development of more inclusive outcome-based policies at the global level. Development programs to run effectively, a strong monitoring mechanism is needed, which involves periodic data collection and results-based evaluation.

Table 10.2. Lessons from RBM&E Implementation

Country	Sector Focus	Key Approaches	Result	Challenge
Romania	Social Economy	The use of Theory of Change for the integration of monitoring in daily activities.	Increased social and economic impact, as well as organizational accountability.	Internal capacity is limited, evaluation practice standards are not optimal.
Japan	Traditional agriculture	Sustainability monitoring with cultural, social, and economic indicators.	Conservation of biodiversity and traditional practices, preservation of cultural heritage.	Declining rural population, demographic challenges.
South Korea	Forest management	CBFM with the strengthening of local institutions.	Active participation of the community, sustainability of forest management.	Village depopulation, the threat of privatization of the area.
China	Natural resources	A combination of traditional and scientific knowledge, community involvement in landscape management.	Increasing ecological sustainability, preserving local culture.	Limited scientific guidance, knowledge gap.
Australia	Natural resources and health	Custom-based monitoring for environmental conservation and community-based health.	Specific indicators of culturally relevant and improved health of indigenous communities.	Lack of culture-based evaluation tools, limited funding.
Canada	Environment and health	ICBM dan pendekatan harm reduction berbasis adat.	Better ecological monitoring, stronger indigenous connections, and improved health outcomes.	Distrust of previous research, gaps in the implementation of customary rights.

Source: Author's Analysis, 2024

The RBM&E approach offers a logical framework consisting of five main steps, as shown in Figure 10.2. These measures are designed to ensure the effectiveness, inclusion, and sustainability of development programs, especially in the context of regions such as Papua. One of the important steps in this framework is Assess (Initial Context Assessment), which is the initial stage to understand the initial conditions and needs of the community as a whole.

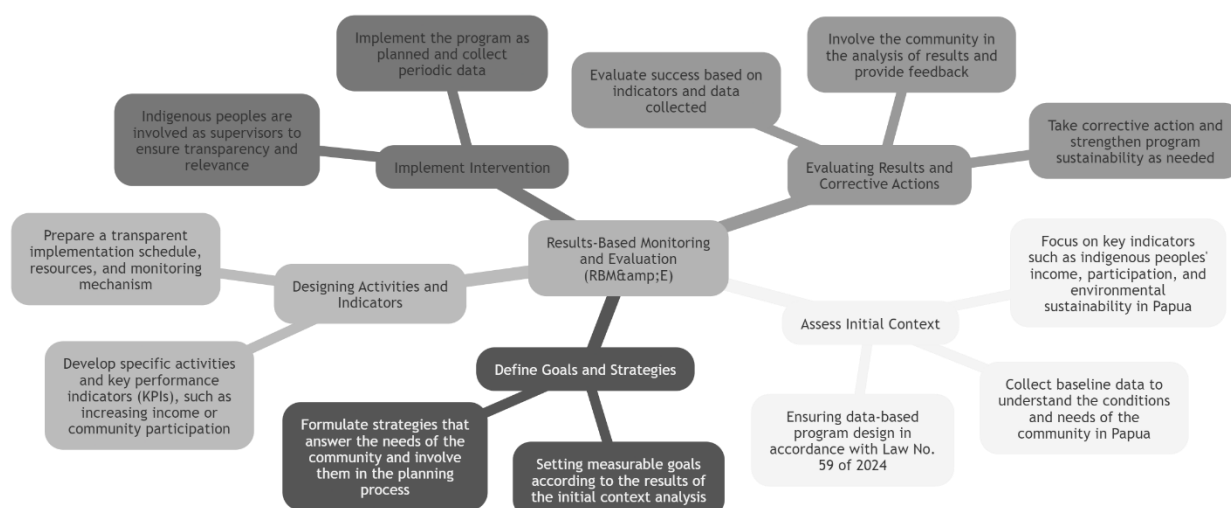


Figure 10.2. Mechanism of Approach RBM&E

The Assess stage aims to understand the initial conditions of the community and their actual needs, comprising indigenous peoples, as well as the factors that affect the success of the program. This approach is oriented toward collecting baseline data to produce a comprehensive picture of the initial situation. This data includes a variety of key indicators, such as community income levels, program participation rates, and environmental conditions. Data collection at this stage is carried out using a participatory method involving local communities. This approach not only provides an in-depth understanding of the needs of the community but also ensures programs are designed based on the realities of the field. Thus, the resulting program is more relevant and has a greater chance of success. The RBM&E framework, in particular the Assessment measure, is particularly relevant to national policy, as set out in Law Number 59 of 2024. This law emphasizes the importance of data-driven evaluation as the basis for planning and implementing development programs, especially in Papua. This approach is in line with the government's endeavors to increase accountability and program effectiveness through measurable and accountable data. In addition, this approach pays special attention to indigenous peoples as an integral part of the evaluation process. Involving them in data collection and needs analysis ensures that the designed programs are not only inclusive but also

useful in the local context. This is crucial to create a development program that is by the social, cultural, and environmental conditions of indigenous peoples in Papua. Using data as the basis for planning, the Assess step helps map potential risks and opportunities in the implementation of the program. The baseline data obtained also provides a tool to monitor and evaluate the success of the program at the next stage. This approach creates a continuous feedback cycle, where the results of the evaluation can be used for continuous improvement and improvement of the program. Assess within the framework of RBM&E ensures that the designed programs are not only relevant but also have a strong foundation for achieving the development goals. By prioritizing basic data collection and involving local communities, this approach provides solutions oriented to the real needs of communities, by the principles of inclusive and sustainable development.

The Think step is an important phase in the RBM&E framework. This stage includes setting clear and measurable objectives based on the results of the initial context analysis conducted in the Assessment step. Goal setting at this stage is the foundation for the strategy to be formulated, ensuring that the program is designed to answer the real needs of the community and achieve the desired results. The goals formulated in the Think stage must have Specific, Measurable, Achievable, Relevant, Time-bound characteristics (SMART). This goal setting is based on data and analysis conducted previously, so that the program can directly address the identified problem or need. Illustrations of goals that can be formulated at this stage include improving the economic welfare of indigenous peoples, preserving the environment, or increasing access to education and health. Specific objectives provide a clear direction for program implementation. Meanwhile, measurable goals allow the success of the program to be evaluated objectively. By ensuring that the goals are relevant to local needs and realistic to be achieved within a given time, this step creates a solid foundation for program planning and execution. Once the goals are set, a strategy is formulated to achieve them. This strategy is designed by considering relevant social, economic, and environmental factors in the local context. For illustration, to improve the economic welfare of indigenous peoples, strategies that can be used include skills training based on local wisdom, strengthening market access for traditional products, or developing community-based businesses. In the context of environmental conservation, strategies that can be implemented include community-based conservation programs or sustainable management of natural resources. This strategy is designed to have a long-term impact and ensure that the program has strong sustainability. The involvement of indigenous peoples in the Think phase is critical to ensure that the program is designed in line with their priorities and needs. This process is carried out through inclusive consultation, where indigenous peoples are given space to express their views, inputs, and aspirations. By actively involving them in the formulation of goals and strategies, the program can gain legitimacy and

support from the local community. In addition, the involvement of indigenous peoples also provides an opportunity to use local knowledge in program planning. This knowledge is often a valuable source of information, especially in the context of environmental conservation and natural resource management. By integrating local knowledge in the formulated strategy, the program has a greater chance of success and acceptance by the community. The participatory approach applied at the Think stage creates a sense of belonging among indigenous peoples. This not only increases the effectiveness of the program but also ensures long-term sustainability. When people feel that the program reflects their needs and aspirations, the level of participation and support for program implementation tends to be higher. By paying special attention to the involvement of indigenous peoples, Think's steps within the framework of RBM&E ensure that the programs designed are not only relevant but also inclusive and sustainable. This process places the community as the main partner in development, which ultimately supports the creation of positive and useful results. Think's steps play a strategic role in ensuring the success of development programs. By setting clear and measurable goals and formulating relevant strategies, this stage creates a strong foundation for the implementation and evaluation of the program. The involvement of indigenous peoples in this stage not only increases the relevance of the program but also creates a shared commitment to support sustainability. Through a participatory approach, Think's steps make a real contribution to inclusive development and based on the real needs of local communities.

The Plan stage (Designing Activities and Indicators) in the framework of RBM&E is a critical step that ensures the program is systematically designed to achieve the set objectives. At this stage, specific activities are designed based on previous analysis, and key performance indicators (KPIs) are formulated to measure the success of the program's implementation. The resulting plan includes an implementation schedule, resource allocation, and monitoring mechanisms involving indigenous peoples as the main supervisors. Once the goals and strategies are determined at the Think stage, the Plan stage focuses on translating those goals into specific operational activities. Each activity is designed to make a direct contribution to the achievement of the goal. For illustration, if the goal of the program is to improve the economic well-being of indigenous peoples, the activities designed may include job skills training, community-based business development, or facilitating access to local and international markets. In the context of environmental conservation, relevant activities may include conservation of customary forests, reforestation, or sustainable management of natural resources. By designing specific activities, programs can ensure that every step taken has a real and measurable impact. Key Performance Indicators (KPIs) are formulated to measure the success of the program objectively. This indicator includes both quantitative and qualitative aspects, such as: Increase in the percentage of indigenous peoples' income as a result of training or

business development programs. The number of people participating in program activities, reflects the level of community involvement. The area of conservation areas that are maintained or restored through environmental conservation endeavors. KPIs provide tools to monitor program progress on an ongoing basis. Well-designed indicators not only allow for accurate evaluation but also provide the necessary feedback for corrective action if needed. The Plan stage also includes the preparation of a detailed implementation plan. This plan includes: Implementation Schedule, determine time for each activity, ensuring that all the designed steps can be carried out according to the specified time frame. Resource Allocation, Efficient use of human, financial, and material resources to support program activities. Monitoring Mechanism, A monitoring system designed to involve indigenous peoples as supervisors. This engagement provides transparency and accountability, and ensures that programs remain relevant to local needs. One of the key elements in the Plan stage is the involvement of indigenous peoples in the monitoring mechanism. As supervisors, they have an important role in ensuring that the program runs according to the plan and goals that have been set. This approach not only increases transparency but also creates a sense of ownership of the program. By engaging them directly, programs can leverage local knowledge and increase acceptability in the community. The plan step in the framework of RBM&E is an important stage that bridges strategic planning with operational implementation. By designing specific activities, setting clear performance indicators, and involving indigenous peoples in monitoring, this stage ensures that the program is designed to achieve tangible and sustainable results. This approach creates a strong foundation for the success of the program, while supporting inclusive and local needs-based development.

The Do (Implementing Intervention) stage in the framework of RBM&E is the implementation step of the previously prepared plan. At this stage, the program is implemented systematically to achieve the goals that have been set, with a focus on data collection and empowerment of indigenous peoples to ensure transparency and accountability. In the Do stage, the program is carried out according to the statute and resource allocation that has been formulated in the plan step. Each previously designed activity is implemented by taking into account the local context and the needs of the community. Implementation by this plan ensures that the program stays on track to achieve the goals that have been set. For illustration, if the program includes job skills training, this stage involves the implementation of the training, comprising the provide instructors, training materials, and supporting facilities. In the context of environmental conservation, reforestation programs can start with tree planting, growth monitoring, and training of local communities to manage conservation areas. During the implementation, data collection is carried out periodically to track progress against the indicators that have been set. The data collected includes quantitative aspects, such as the number of trainees, the increase

in income, or the area reforested. In addition, qualitative data was also taken to measure the level of community satisfaction with the program and its impact on their lives. This data collection not only serves as an evaluation tool but also provides the necessary information for corrective action. By tracking progress in real-time, the implementation team can identify emerging challenges on the ground and adjust strategies if needed. This approach ensures that programs remain relevant and responsive to the needs of the community. One of the important elements in the Do stage is the empowerment of indigenous peoples to monitor and report on developments in the field. As supervisors, indigenous peoples are given training to monitor the implementation of the program, identify problems, and provide direct input to the implementation team. This involvement provides several key benefits: Transparency, by involving indigenous peoples, programs become more open and accountable. Every step in the implementation can be directly supervised by the local community. Increased Acceptability, when indigenous peoples play an active role in surveillance, they feel they own the program, which in turn increases their participation and support levels. Utilizing Local Knowledge, indigenous peoples have a deep understanding of the environment and local needs, so that they can provide valuable insights to improve program implementation. The implementation process involving indigenous peoples as supervisors creates a strong transparency mechanism. Any progress of the program is reported regularly to stakeholders, comprising local communities, governments, and donor agencies. This approach not only ensures that the program runs according to plan but also builds trust among all parties involved. In addition, the involvement of indigenous peoples in monitoring helps identify problems or challenges that may not be visible to the implementation team. For illustration, they can report potential conflicts, gaps in implementation, or logistical bottlenecks that need to be addressed urgently. The Do phase within the framework of RBM&E is at the heart of the implementation of the program, where the plan that has been drawn up translates into concrete action. By collecting data on a regular basis and empowering indigenous peoples as supervisors, this stage ensures that the program is transparent, accountable, and responsive to local needs. This approach not only supports the achievement of the program's objectives but also creates a strong sense of belonging among indigenous peoples, thereby improving the sustainability of the program in the long run.

The Review stage (Evaluating Results and Taking Corrective Action) in the framework of RBM&E is an evaluation step that aims to Assess the effectiveness of the program based on the data collected during implementation. At this stage, the results of the program are analyzed in-depth to evaluate the achievement of key performance indicators (KPIs) that have been set. This process is carried out with high transparency, involves local communities, and results in corrective actions to improve the program. The evaluation begins with an analysis of the results-based on

quantitative and qualitative data that has been collected during the Do stage. Quantitative data provides an overview of the achievement of numerical targets, such as the percentage increase in community income, the number of participants participating in the training, or the area of conservation areas that have been successfully protected. Meanwhile, qualitative data, such as people's satisfaction levels and the impact of programs on their lives, provide deeper insights. This analysis process uses an evidence-based approach to ensure that the evaluation is carried out objectively and systematically. Performance indicators that have been formulated at the Plan stage are the main reference in assessing the success of the program. If there is a gap among the results achieved and the targets set, this evaluation helps identify the causes, whether technical, operational, or contextual. One of the important aspects of the Review stage is the involvement of local communities, comprising indigenous peoples, in the evaluation process. Their active participation provides several benefits, comprising: Relevant Feedback, the local community can provide input based on their first-hand experience during the implementation of the program. This perspective helps identify aspects of the program that are successful and those that need to be improved. Increased Transparency by involving the community, the evaluation process becomes more open, thereby building trust among the implementation team and the local community. Legitimacy of evaluation results, when the public participates in evaluating the results, they are more receptive to the findings and recommendations produced. Community engagement is done through discussion forums, satisfaction surveys, or in-depth interviews. In this way, the community is not only the legatee but also an active partner in improving the quality of the program. If the evaluation finds shortcomings or obstacles in the implementation of the program, corrective action is immediately taken to improve the program. This action is designed based on the analysis of the cause of the problem that has been previously identified. For illustration, if the evaluation shows low community participation, the implementation team can Review the communication approach or engagement strategy used. Corrective actions also include adjustments to performance indicators, resource allocation, or implementation methods. By making these corrections, the program can return to running as planned and be more effective in achieving its goals. The Review stage not only focuses on evaluating results, but also creates a feedback cycle that supports continuous improvement. The results of the evaluation are used as a basis for improving ongoing programs and for designing future programs. This cycle ensures that any learnings from previous programs are applied to improve the effectiveness and sustainability of the program. The Review step within the framework of RBM&E is a very important stage to ensure that the program runs by the set objectives. By analyzing results-based on data, engaging local communities, and taking corrective action, this stage ensures that the program continues to evolve and has a sustainable positive impact. This approach

creates programs that are responsive, transparent, and relevant to the needs of communities, while supporting the achievement of inclusive and effective development goals.

The results of the evaluation are also used as a basis to strengthen the sustainability of the program by the mandate of Law Number 59 of 2024. This mechanism provides a structured framework to ensure that the program is not only effective but also sustainable, by actively engaging indigenous peoples at all stages. This creates synergies among results-based management, local participation, and environmental conservation to support inclusive and effective development in Papua.

Table 10.3. Key Performance Indicators (KPIs) in the RBM&E Framework

Step	KPI Indicators	Information
Assess	- Percentage of baseline data collected and verified.	Measure the extent to which the initial condition of the community is understood thoroughly.
	- The level of community participation in surveys and initial context discussions.	Reflects the involvement of indigenous peoples in the initial assessment process.
	- The number of relevant preliminary indicators, such as average income and environmental conditions.	Provides a basis for program planning.
Think	- The number of goals formulated in a specific, measurable, and relevant manner.	Indicates clarity and suitability of program objectives.
	- The number of strategies involving indigenous peoples.	Measuring the level of inclusion of indigenous peoples in the formulation of strategies.
	- The level of alignment of the strategy with the needs and priorities of indigenous peoples.	Ensuring the program focuses on the key needs of the community.
Plan	- The number of performance indicators formulated for each impartial.	Measure the program's ability to identify measurable outcomes.
	- The level of suitability of the implementation schedule with the capacity of indigenous peoples.	Avoid schedule conflicts or excessive burdens on local communities.
	- Adequate allocation of resources for each activity.	Ensure the efficient use of resources in supporting program objectives.
Do	- Percentage of activities carried out according to the statute.	Measure the effectiveness of program implementation.
	- The number of monitoring reports submitted by indigenous peoples.	Reflecting the level of participation of indigenous peoples in monitoring.
	- The level of achievement of targets on KPIs during the implementation of the program.	Assess the direct impact of the interventions carried out.
Reviews	- Percentage of performance indicators achieved based on evaluation results.	Measure the effectiveness of the overall program.
	- The number of corrective actions identified and implemented.	Indicates responsiveness to obstacles and shortcomings.
	- The level of satisfaction of indigenous peoples with the results of the evaluation and follow-up process.	Measure community acceptance and trust in the program.

Source: Author's Summary, 2024

Table 10.3. Summarize the Key Performance Indicators (KPIs) for each step within a logical framework of RBM&E. This table is designed to measure the effectiveness of these approaches in supporting inclusive and sustainable development in Papua. Table 10.3 highlights how each step in the RBM&E framework has specific indicators designed to ensure the effectiveness, inclusion and sustainability of the program. This approach is not only oriented toward achieving results but also pays great attention to the involvement of indigenous peoples in each stage. Assessment Step: Understanding the Real Needs of the Community, The Assessment Step prioritizes the collect initial data to understand the real needs of the community. Baseline data collection is carried out to get an overview of initial conditions, such as income levels, participation in programs, and environmental conditions. This data is the foundation for designing programs that are relevant to local needs. In the context of indigenous peoples, this process involves them directly to ensure that their unique needs are accommodated. The emphasis on accurate data collection allows programs to be designed based on real evidence, rather than mere assumptions. With this approach, assess steps ensure that every development program has a strong foundation to support relevance and sustainability.

Think Step: Formulation of Relevant and Inclusive Goals, the Think step focuses on the formulation of relevant and inclusive goals. Success indicators at this stage include the extent to which the goals formulated reflect the needs of the community in general, as well as vulnerable groups such as indigenous peoples. The process involves dialogue among stakeholders, comprising governments, local communities, and non-governmental organizations, to ensure that the goals set are acceptable to all parties. An inclusive approach at the Think stage ensures that the designed programs are not only relevant to local needs but also prioritize the principles of social justice. Thus, the goals formulated have a strong foundation to support sustainable development. Plan Step: Developing Performance Indicators: In the Plan stage, the main focus is on the preparation of clear and measurable performance indicators to monitor the achievement of goals. This indicator includes quantitative aspects, such as the number of beneficiaries, as well as qualitative aspects, such as the level of public satisfaction with the program. The formulation of good indicators provides a framework for effective and accountable evaluation. This step also considers the sustainability of the program by setting relevant indicators in the long-term. In the context of indigenous peoples, performance indicators are designed to ensure their involvement in the implementation of the program and its positive impact on their lives. Step Do: Implementation with Indigenous Peoples' Involvement, The Do Phase emphasizes the importance of indigenous peoples' involvement in program implementation. Key indicators of success at this stage include the extent to which indigenous peoples are involved as implementers, supervisors, and beneficiaries. This

approach creates a sense of ownership of the program, which in turn increases sustainability and accountability. In addition, the transparency of the implementation process is an important indicator at this stage. By actively engaging the community, the program can run by the local context, while building trust among stakeholders.

The final step in the RBM&E framework is the Review, which aims to measure the success of the program and encourage corrective action for continuous improvement. The evaluation is carried out based on the indicators formulated at the Plan stage, by involving indigenous peoples as an integral part of the evaluation process. The results of the evaluation are not only used to Assess the achievement of goals but also to identify areas that need improvement. This approach creates a feedback cycle that ensures that the program continues to evolve and provides maximum benefits to the local community. The RBM&E framework offers a systematic approach to ensure that development programs are not only effective but also inclusive and sustainable. By involving indigenous peoples as supervisors and decision-makers, each stage within this framework is designed to meet local needs in real terms. This approach creates development programs that are relevant, effective, and can have a positive long-term impact. Through specific indicators and participatory processes, RBM&E becomes an effective tool to support data-driven development and actual needs. By putting communities as key partners, the framework not only supports inclusion but also ensures the sustainable success of the program.

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11.1. Reflection on Key Findings and Key Points

Papua, a province located in the eastern part of Indonesia, has tremendous potential to become a center of innovation-based on local wisdom. During its history, this potential has not been used optimally due to various structural challenges. Based on the discuss in this book, theoretical analysis and empirical studies bid comprehensive insights into how Papua can harness its natural and cultural wealth for inclusive and sustainable development. Here is a summary of the three chapters linked to reflections on key findings and key points. The first chapter discusses a multidimensional perspective in understanding Papua, especially through dependency theory, cultural pluralism, and community empowerment. The dependency theory shows how the exploitation of Papua's natural resources by outsiders has created significant economic dependence (Araujo et al., 2021; Chitsove & Madebwe, 2024). For illustration, gold and copper mining by multinational corporations makes a major contribution to the national economy but has little impact on the well-being of local communities. In the context of cultural pluralism, Papua displays extraordinary cultural diversity with more than 250 ethnic groups. Local traditions such as customary land ownership often clash with modern policies, creating challenges for social and economic integration (Gyunter & Molchanova, 2023; Tortorella et al., 2021). However, cultural pluralism also provides an opportunity to create harmony through a local culture-based approach that respects Papua's unique traditions and identity. The theory of community empowerment is a relevant solution to overcome structural inequality in Papua. Local asset-based approaches, such as ecotourism development, have shown success in increasing local capacity while preserving the environment. An important finding in this chapter is the need for a holistic approach that integrates the three theories to create inclusive and sustainable development.

The second chapter delves deeper into the geographical and cultural advantages of Papua (Bapperida Provinsi Papua, 2024b). With an area of 131,582.85 km², Papua has natural resources that include marine resources, tropical forests, and minerals. Papua also has ethnic and cultural diversity that reflects the close relationship among the people and nature. Traditions such as Asmat carving and religious rituals are important elements in Papuan identity. Geographical advantages,

such as marine areas rich in biodiversity and tourism potential, bid great opportunities for economic development. Areas such as Raja Ampat (Tebaiy et al., 2021) have recorded a growth of foreign tourist visits of up to 15% in the last three years. However, the management of these resources faces major challenges, such as the lack of modern technology and limited infrastructure. Another important point is the importance of the role of customary territories in sustainable management of natural resources. Customary areas such as Mamta/Tabi and Saireri practice conservation based on local wisdom (Arfelina Iskandar et al., 2021; Nasrah & Siraj, 2023) that supports the preservation of marine and terrestrial ecosystems (Oliveira Filho, 2024). The main reflection of this chapter is the need to strengthen the capacity of indigenous peoples through locally-based education and active collaboration among communities, governments, and the private sector to ensure sustainable development.

The third chapter highlights the importance of a local community-based research ecosystem (Liu et al., 2023; Snihur & Bocken, 2022) that integrates local wisdom with scientific innovation. In the context of Papua, community-based research is very relevant because indigenous peoples have rich local knowledge. Illustrations of successful practices include sustainable management of natural resources through tradition-based technologies. Multi-stakeholder approaches such as the Penta Helix concept play an important role in strengthening regional innovation (Adisaputra, 2023; Simanjuntak et al., 2024). The concept involves five main actors: government, academia, the private sector, society, and the media. The government acts as the main facilitator, providing regulations and infrastructure that support innovation. Academics create new knowledge relevant to local needs, while the private sector helps commercialize the results of innovation. Indigenous institutions play an important role as guardians of traditional values and a link among modern innovation and local culture. The main reflection of this chapter is that multi-stakeholder collaboration can create inclusive and sustainable innovation. A community-centered, community-based research model not only increases the relevance of research results, but also ensures acceptance and implementation by local communities. The picture that Papua has great potential to become a center of innovation-based on local wisdom. However, some key challenges need to be addressed.

1. **Infrastructure and Technology Gaps**, Papua faces limitations in access to technology and infrastructure, especially in rural areas. The construction of roads, educational facilities, and health services is a priority to support regional development.

Papua, as a region with tremendous natural and cultural resource potential, faces major challenges in infrastructure and technology, especially in the interior. These limitations hinder the socio-economic development of local communities and widen the development gap among regions (Faidi & Olechowski, 2020). To address

these issues, a focus on development is needed on accessibility, education, health, and technology. Road Infrastructure and Transportation, Road infrastructure is one of the urgent needs to improve connectivity among regions in Papua. Many inland areas are isolated due to the lack of adequate road networks. This condition is exacerbated during the rainy season, when existing roads become difficult to pass. Projects such as the Trans-Papua development are expected to be a solution, but their implementation often faces obstacles, such as budget constraints, geographical challenges, and lack of involvement of local communities (Kambu et al., 2022a, 2022b). Good transportation access not only opens up economic opportunities through the distribution of produce and trade, but also provides people with access to basic services such as schools, hospitals, and markets. Therefore, investment in quality and sustainable road construction needs to be a top priority, by involving local communities in the planning and implementation of projects to increase relevance and sustainability. Educational Facilities, the limitation of educational facilities in Papua is a major obstacle in endeavors to improve the quality of human resources. Many schools in the interior lack teaching staff, books, and other learning facilities. In addition, access to formal education is often hampered by distance and poor infrastructure conditions. This has led to low school participation rates, especially at the middle and upper levels. Solutions that can be applied are the construction of new schools in strategic areas, the provide incentives for teachers who are willing to teach in remote areas, and the development of local culture-based education methods (Pusporini et al., 2019; Sarquis Soares, 2023). Integrating traditional values with modern curricula can help indigenous peoples receive education without losing their cultural identity. In addition, scholarship and skills training programs for Papuan youth need to be expanded to create a generation that is ready to compete at the national and global levels. Health Services, Papua also faces major challenges in health services. Shortages of medical personnel, health facilities, and access to basic medicines are major problems, especially in remote areas. Many people have to travel long distances to get medical care, often through difficult terrain. The construction of health centers and clinics in remote areas needs to be a priority, accompanied by the provide competent medical personnel. Community-based health worker training programs can be a short-term solution to address this shortage. In addition, telemedicine technology can be used to provide remote medical consultations, so that people in remote areas can still access basic health services. Technology and Digitalization (Aleksandrova et al., 2022; Amelia & Munim, 2023), Limited access to technology is a major obstacle in encouraging innovation and modernization in Papua. Most rural areas do not have adequate internet access, leaving people behind in information and digital economic opportunities. This technology gap also has an impact on the education and health sectors,

where technology can play a major role in improving the quality of services. The installation of internet networks in remote areas must be an important agenda. Cooperation with telecommunication service providers and international organizations can accelerate the provide affordable internet access. In addition, digital literacy training for local communities needs to be carried out so that they can use technology to improve their quality of life, such as entrepreneurship through online platforms or obtaining health and education information. Addressing infrastructure and technology gaps in Papua requires an integrated and sustainable approach. Some of the steps that can be taken include: Integrated Infrastructure Development (Gabbar, 2022): Projects such as Trans-Papua should be accompanied by the construction of supporting facilities such as schools and clinics, as well as involving local communities to ensure sustainability. Capacity Building for Education and Health: Provide incentives for teaching and medical staff, as well as the use of technology such as telemedicine and e-learning. Digitalization and Technology (Cartelli et al., 2023; Thomson, 2022): accelerating the provide internet access and digital literacy training to empower the community. Multi-stakeholder Collaboration: Involving governments, the private sector, international organizations, and indigenous peoples in the planning and implementation of development projects. With these measures, Papua can narrow the infrastructure and technology gap, open up new economic opportunities, and improve the quality of life of its people. Development that focuses on local needs and involves multiple stakeholders will ensure the sustainability and relevance of the solutions implemented.

2. Lack of Indigenous Peoples Involvement: Indigenous Peoples are often not involved in decision-making that affects their territory. This creates social tensions and hinders the implementation of locally-based policies.

Papuan indigenous peoples have a very important role in maintaining the sustainability of natural resources and cultural preservation. However, they are often not involved in decision-making that affects their region, whether in the context of infrastructure development, natural resource management, or social policy. This situation creates social tensions, land conflicts, and the lack of effectiveness in implementing local-based policies. Social tensions often arise because indigenous peoples feel marginalized in the development process (Cusdiawan & Mudiayati Rahmatunnisa, 2023; Pelupessy, 2017). For illustration, many major projects such as mines, road construction, or land clearing for plantations are carried out without adequate consultation with local communities. Customary land ownership systems, which are based on collective values and traditions, often contradict the concept of individual ownership applied in national policies. As a result, indigenous peoples lose access to their land which has high economic, spiritual, and cultural value. The absence of indigenous peoples in decision-making

also creates conflicts among them and the government or companies involved in development projects. Customary lands taken without permits or fair compensation not only damage relations among the parties concerned, but also spark protests that slow down the implementation of the project. Therefore, an inclusive consultation mechanism that respects the rights of indigenous peoples is essential to reduce these tensions. The lack of involvement of indigenous peoples also hinders the implementation of local-based policies that have the potential to be more effective and sustainable. Indigenous peoples have rich traditional knowledge about natural resource management, such as environmentally friendly farming techniques, forest conservation, and fisheries management. When policies do not engage them, the results are often irrelevant or cannot be effectively implemented in the field. For illustration, forest reforestation or conservation programs that do not involve indigenous peoples tend to fail due to a lack of understanding of local conditions. In contrast, programs designed with local wisdom in mind, such as the use of endemic plants for land restoration, have shown higher success. This emphasizes the importance of collaboration among the government, indigenous peoples, and other actors in every stage of policy, from planning to implementation.

To increase the involvement of indigenous peoples in decision-making, an inclusive and respect-based approach to indigenous rights is needed. Some steps that can be taken include: recognition and protection of customary rights (Carpenter, 2020; Fromer, 2023): the government needs to provide legal recognition of indigenous territories and indigenous peoples' rights to their land. This could include the establishment of officially recognized maps of customary territories as well as legal protection of customary lands from outside expropriation. Inclusive consultation (Blomkamp, 2022; Clarke et al., 2022): any project or policy that affects indigenous peoples must go through a transparent and participatory consultation process. These consultations should be carried out from the earliest stages of planning to ensure that the voices of indigenous peoples are heard and respected. Multi-stakeholder Partnerships: Collaboration among governments, the private sector, and indigenous peoples can create more sustainable solutions. For illustration, companies operating in indigenous territories can partner with local communities to develop corporate social responsibility (CSR) programs that are relevant to their needs. Capacity Building of Indigenous Peoples (Martin & Vold, 2018; Paiva et al., 2022): Training and education for indigenous peoples about their rights, technology, and resource management can improve their ability to participate in decision-making. Thus, they can be equal partners in development. Improving locally-based policies (Okamuro & Nishimura, 2020; Simatupang et al., 2022): policies designed with local wisdom in mind and involving indigenous peoples can be more effective in addressing challenges on the ground. An

illustration is a conservation program that uses traditional knowledge to preserve biodiversity (Gregor et al., 2024; Remans et al., 2019) and local ecosystems. The lack of involvement of indigenous peoples in decision-making in Papua is one of the main obstacles to achieving inclusive and sustainable development. Social tensions, land conflicts, and policies that are irrelevant to local conditions are direct impacts of this problem. By implementing approaches that respect indigenous rights, enhance consultation, and strengthen the capacity of local communities, these challenges can be addressed. Indigenous peoples' involvement is not only a moral obligation, but also an effective strategy to create relevant and sustainable development in Papua.

3. Locally-Based Education (Fredella & Zecca, 2020; Vidal, 2015), an education system that integrates local traditions with modern skills is urgently needed to create a young generation that can bridge the traditional and modern worlds.

The locally-based education system is one of the keys to creating a young generation of Papuans who are able to bridge the traditional and modern worlds. Integrating local traditions with modern skills in education not only maintains cultural identity, but also prepares indigenous peoples to face global challenges. Today, the biggest challenge is how to create a relevant curriculum, adequate educational facilities, and ongoing training for teaching staff. Locally-based education in Papua plays an important role in preserving cultural heritage and preparing communities to face the modern world. This system allows for teaching that is relevant to local needs, such as natural resource management, traditional arts, and agricultural techniques based on local wisdom. Thus, Papuan children not only get a formal education but also understand the cultural values inherited by their ancestors. For illustration, the tradition of cultivating sago or Asmat's typical carving skills can be used as part of the educational curriculum. This not only enriches the learning experience of students but also advises the preservation of traditions that have the potential to improve the local economy. In addition, locally-based education can also help overcome the problem of cultural isolation that indigenous peoples often face when faced with a homogeneous education system. Integrating local traditions with modern skills in the educational curriculum is a major challenge. This process requires a deep understanding of local values as well as the ability to adapt modern technology and knowledge into the context of the local culture. For illustration, the teaching of traditional farming techniques can be combined with modern agricultural technology (das Nair & Landani, 2020; Ndauka & Matotola, 2023) to increase productivity without damaging the environment. In addition, subjects such as English and information technology can be taught with approaches that are relevant to the Papuan people, such as using local themes in the subject matter. This approach not only makes learning

more engaging but also increases students' confidence to interact with the outside world without losing their cultural identity.

Teachers have a central role in the success of local-based education. Therefore, special training for teaching staff to understand local cultural traditions and values is very important. Teachers must also be trained to integrate modern teaching methods with culture-based approaches (Hu & Ngai, 2021). For illustration, training on storytelling techniques that raise Papuan folklore can be used to teach moral values while improving students' literacy skills. In addition to training, incentives for teachers who are willing to teach in remote areas also need to be increased. Many rural areas in Papua face a shortage of qualified teachers, so this incentive program can help ensure that quality education is accessible to all Papuan children, regardless of their geographical location. The availability of adequate educational infrastructure is a key prerequisite for supporting locally-based education. Many schools in Papua, especially in remote areas, do not have adequate facilities, such as classrooms, textbooks, and teaching aids. In addition, access to technology such as the internet and computers is still very limited in many regions. Investment in the construction of new schools, renovation of existing facilities, and provide educational technology need to be a priority. Cooperation with the private sector and international organizations can also help provide the resources needed to improve the quality of education infrastructure in Papua.

To optimize locally-based education in Papua, several strategic steps can be taken: contextual curriculum development (Doyle et al., 2022; Fredriksson et al., 2020): designing a curriculum that integrates local wisdom with modern skills, such as tradition-based agricultural techniques combined with modern technology. Teacher Training, provides specialized training to teachers to understand local traditions and use teaching methods relevant to the local culture. Infrastructure Improvement: building and improving educational facilities, including the provide access to technology such as the internet in schools. Partnership with local communities, involving indigenous peoples in the planning and implementation of educational programs to ensure local relevance and acceptance. The Scholarship and skills training program (Gholizadeh & Gorji, 2024; Irwansyah et al., 2021), provides access to scholarships for Papuan children as well as skills training to prepare them for the modern world of work. Locally-based education is a strategic solution to create a young generation of Papuans who are able to bridge tradition and modernity. By integrating local cultural values into the education system, Papua can not only maintain its cultural identity but also empower its people to compete at the national and global levels. Through collaboration among the government, indigenous peoples, and the private sector, locally-based education can be the foundation for inclusive and sustainable development in Papua.

4. Multi-stakeholder Collaboration, the apply concepts such as Penta Helix is needed to combine the roles of the government, academia, the private sector, indigenous institutions, and communities in local-based innovation.

Multi-stakeholder collaboration is an effective approach to promoting inclusive and sustainable development in Papua. The apply concepts such as Penta Helix, which involves governments, academia, the private sector, indigenous institutions, and communities, allows the combined forces of each party to create innovations relevant to local needs (Cabrera-Flores et al., 2020; Sudiana et al., 2020). This approach not only increases the effectiveness of development programs but also ensures sustainability and acceptance by local communities.

The role and contribution of each government party (Sanaa Maswadeh Jadara, 2021; Swinnen, 2010): the government has a role as the main facilitator in creating policies that support locally-based innovation. This includes the provide regulations that encourage collaboration, budget allocation for research and development, and oversight of program implementation. For illustration, the government can help the creation of legally recognized maps of customary territories, thus ensuring that the rights of indigenous peoples are protected in every development project. Academics: Academics play a role in producing research and innovations that are relevant to the local conditions of Papua. Collaboration with indigenous peoples can help integrate local wisdom into science-based solutions, such as the development of environmentally friendly agricultural technologies or forest conservation based on local traditions. In addition, universities can become training centers to increase the capacity of local communities. Private Sector: The private sector, through investments and CSR programs, can contribute to the implementation of technology and locally-based product development. An illustration is partnerships with indigenous peoples to develop Papuan natural resource-based products, such as essential oils, forest honey, or handicrafts that have high economic value in the international market. Customary institutions: customary institutions have a key role as guardians of traditional values and a link among modernization and local culture (Frans Reumi, 2018; Leo et al., 2022). They can ensure that any innovations implemented do not conflict with the customs and traditions of the local community. In addition, customary institutions can also be mediators in resolving conflicts related to land use or natural resources. Communities: Indigenous peoples are the main subjects in this collaboration. Their active participation in every stage, from planning to project execution, is essential to ensure that the development program is truly tailored to their needs and aspirations. This involvement also increases the sense of ownership of the program, so that sustainability can be guaranteed. The apply the Penta Helix concept in Papua provides many benefits, including: Increased Program relevance: by involving various parties, development programs can be

designed according to local needs and regional potential. Local capacity building: academics and the private sector can provide relevant training and technology to empower indigenous peoples. Environmental conservation (Saikanth et al., 2023; U. Brownson et al., 2024): collaboration with indigenous institutions ensures that natural resource management is carried out in a sustainable manner. Local economic development (Basuki, 2023; Sadeh et al., 2021): Partnerships with the private sector create new economic opportunities based on local resources and products. Although it has many benefits, the implementation of multi-stakeholder collaboration also faces challenges. One of them is the difference in perspectives and priorities among the parties. For illustration, the private sector tends to focus on economic benefits, while indigenous peoples place more emphasis on cultural and environmental preservation. In addition, the lack of effective communication and coordination is often a barrier to achieving common goals. Solutions to these challenges include: Open dialogue (Moreno-Cely et al., 2021; van Mansvelt & Mulder, 1993): opening up a transparent dialogue space to align the vision and mission of each party. Clear framework: develop guidelines and collaboration frameworks that ensure all parties have an equal role. Coordination capacity building (Martin & Vold, 2018; Paiva et al., 2022): using digital technology and platforms to help communication and monitoring of program implementation.

To strengthen multi-stakeholder collaboration in Papua, several strategic steps can be taken: Building a Collaboration Forum: Establishing a forum that involves all parties to discuss program planning and evaluation on a regular basis. Strengthening the Role of Indigenous Institutions: Providing support to indigenous institutions to play an active role in decision-making and implementation of development programs. Focus on Education and Training: Provide relevant training for indigenous peoples to increase their participation in development projects. Use of Technology: Using digital technology to help communication, monitoring, and evaluation of multi-stakeholder collaboration. Multi-stakeholder collaboration with the Penta Helix approach is a strategic solution to encourage locally-based innovation in Papua. By combining the roles of government, academia, the private sector, indigenous institutions, and communities, development can be designed and implemented in an inclusive, sustainable, and relevant manner to local needs. Through close cooperation and good coordination, Papua has great potential to become a successful model of collaboration-based development in Indonesia.

5. Inclusive and sustainable policies (Cisilino & Monteleone, 2020; Secundo et al., 2020): policies that support locally-based research and the development of traditional products need to be implemented to ensure sustainable development.

Inclusive and sustainable policies are an important foundation for development in Papua, especially to support locally-based research and the development of traditional products. With this approach, development can accommodate the

needs of indigenous peoples, preserve cultural traditions, and create a positive impact on the environment. Such policies should be designed to ensure that all elements of Papuan society, including marginalized groups, benefit equally from development. Locally-based research is a key element in designing relevant and impactful policies. By utilizing the traditional knowledge of the Papuan people, research can produce solutions that are appropriate to the local geographical, social, and cultural conditions. For illustration, research on forest management based on local wisdom has shown effectiveness in maintaining ecosystem sustainability while increasing community economic outcomes. Policies that support locally-based research can include allocating budgets for research, providing research facilities in remote areas, and partnerships with universities or research institutes. In addition, the involvement of indigenous peoples in the research process is essential to ensure that the results are truly beneficial to them. Traditional Papuan products, such as handicrafts, local food, and non-timber forest products, have great economic potential. However, this potential is often not fully exploited due to limited access to markets, technology, and funding. Inclusive policies can play an important role in addressing these challenges by: Strengthening local product value chains (Parrilli et al., 2013): policies that support the improvement of the quality and diversification of traditional products will help them compete in national and international markets. For illustration, the development of attractive packaging and by export standards can increase the attractiveness of traditional Papuan products. Market access facilitation (S. Shima Kuma et al., 2023; Xiao et al., 2021): the government can create a dedicated ecommerce platform to market local Papuan products or support the participation of local artisans in national and international exhibitions. This will open up wider market opportunities for traditional products. Financing support (Hartopo et al., 2024; Tripathi & Tripathi, 2018): providing microfinance schemes for small entrepreneurs in Papua can help them develop traditional product-based businesses. This policy can be implemented through cooperation with financial institutions or CSR programs. Sustainable environmental policy (Di Vaio et al., 2018; Fajri & Munawaroh, 2023), the aspect of environmental sustainability must also be a priority in every development policy in Papua. Uncontrolled exploitation of natural resources can damage ecosystems and threaten the sustainability of indigenous peoples' lives. Therefore, sustainable environmental policies must integrate the following principles: ecosystem conservation (Ririhena et al., 2024; Sari & Muslimah, 2020), policies that support the conservation of Papua's forests, seas, and biodiversity need to be designed by involving indigenous peoples. For illustration, community empowerment in the management of conservation areas can increase the effectiveness of ecosystem protection. Wise Use of Natural Resources: Policies must encourage the use of natural resources that are oriented

toward sustainability, such as ecotourism development and the use of non-timber forest products. Environmental Impact Reduction: Development projects should be equipped with rigorous environmental impact analysis to minimize ecosystem damage.

To ensure the success of inclusive and sustainable policies in Papua, several strategic steps can be taken: developing participatory policies (Cisilino & Monteleone, 2020; Palmer et al., 2020), engaging indigenous peoples in policy formulation to ensure local relevance and acceptance. Increasing Local Capacity: Providing training to local communities on natural resource management, technology, and marketing of traditional products. Strengthening multi-stakeholder cooperation (Drozdova & Ignatushko, 2024; Matinheikki & Liinamo, 2022): integrating the roles of governments, academia, the private sector, and indigenous institutions in policy implementation. Monitoring and Evaluation: Implementing monitoring and evaluation mechanisms to ensure that policies run as planned and provide the expected impact. Inclusive and sustainable policies are the foundation needed to create relevant and impactful development in Papua. By supporting locally-based research and the development of traditional products, this policy can improve people's welfare while preserving the environment. Collaboration among various parties, as well as a strong commitment from the government, is key to realizing the vision of inclusive and sustainable development in Papua.

With an integrated and community-based approach, Papua has a great opportunity to optimize its wealth. Locally-based education, multi-stakeholder collaboration, and inclusive policies are key steps to achieving sustainable development. Papua can be a model of development based on local wisdom that is not only relevant for Indonesia, but also for other regions in the world that are facing similar challenges.

11.2. Strategic Recommendations for Local Policies and Actions

Papua faces major challenges that hinder the development of its region, especially in infrastructure, technology, and indigenous peoples' participation. Inequality of access to basic infrastructure such as roads, electricity, and the internet creates significant barriers to the distribution of local products and reduces the competitiveness of indigenous peoples in national and global markets. In addition, the marginalization of indigenous peoples in decision-making and land tenure conflicts further exacerbates the situation. Governance policies that often ignore local values lead to low representation of indigenous peoples in development. Good governance principles, such as accountability and transparency, are also poorly applied, especially in the management of village development funds. This exacerbates social inequality and weakens public trust in the government. However, Papua also has

extraordinary strategic potential that can be used for sustainable development. Local wisdom, such as customary forest management systems and community-based traditions, can be integrated into global innovation. For illustration, customary forest-based ecotourism can be developed through the active participation of indigenous peoples in tourism management, environmental education, and digital promotion. Customary forests not only function as ecological conservation, but also as a local economic base through the development of agro-industry and craft arts. This strategy can increase Papua's competitiveness at the national and international levels. In addition, partnerships with international travel agencies and digital platforms can expand the market for Papuan cultural products, providing significant economic benefits to local communities.

To realize this potential, strengthening the capacity and education of indigenous peoples is a priority. Culture-based education, which integrates local values with modern skills, such as Project-Based Learning (PjBL) models (Hu, 2024; Zhao, 2024), can provide great benefits to the young generation of Papuans. With this approach, students are invited to be directly involved in projects that are relevant to the needs of their communities, such as the preservation of local traditions or product innovation-based on local wisdom. This culture-based education not only helps preserve traditional values, but also opens up new economic opportunities through the development of skills relevant to the modern market. In addition, increasing technological capacity at the local level is also key in empowering indigenous peoples. Technologies adapted to local contexts, such as geographic information systems (GIS) for ecotourism management or mechanized agricultural tools relevant to local ecosystems, can have a great positive impact. The implementation of this technology must be supported by ongoing training to ensure its success. Participatory approaches such as Participatory Rural Appraisal (PRA) and Asset-Based Community Development (ABCD) can be used to identify local needs before adopting specific technologies (Auerbach, 2020; Chambers, 1994; Fikri Latief Adrian et al., 2023). With this method, indigenous peoples can be actively involved in the planning and implementation process of technology projects, ensuring their relevance and sustainability.

Collaboration among various parties is one of the main keys in supporting the sustainable development strategy in Papua. Synergy among governments, indigenous institutions, the private sector, and academia is essential to ensure that the policies and programs implemented are truly relevant to the needs of indigenous peoples. This approach not only increases the effectiveness of development programs, but also strengthens the involvement of all stakeholders in creating inclusive solutions. The government has a major role in creating supportive regulations and ensuring adequate budget allocation for priority programs. As key partners, indigenous institutions can serve as a bridge among the government and

local communities, by providing relevant cultural perspectives and local values in the policy planning and implementation process. Meanwhile, the private sector can contribute through investments in infrastructure, technology, and marketing of local products, which can open up wider market access for indigenous peoples. Academics also have an important role to play in providing research and data that supports evidence-based decision-making. Academic research can help identify key challenges and the most effective solutions to implement. In addition, this collaborative approach also opens up opportunities to integrate modern technology in various aspects of development, such as the management of customary forest-based ecotourism and digital promotion for Papuan cultural products. Partnerships with international organizations can strengthen these initiatives, especially in technology access, capacity building, and promotion of local products to global markets. International organizations can provide the necessary technical help, funding, and networks to expand the reach of Papuan local products (Brogaard, 2021; Joniškienė et al., 2020). Through this collaboration, products such as handicrafts, agricultural products, and typical Papuan crafts can be known more widely, both at the national and international levels. A collaboration-based approach must also be accompanied by a transparent and participatory monitoring mechanism. Indigenous peoples must be involved in the evaluation process to ensure that the programs they run actually provide direct benefits to them. Technologies such as GIS can be used to monitor the impact of these initiatives in real-time, so that governments and other partners can make adjustments if needed. This cross-sector collaboration not only creates productive synergies but also ensures the sustainability of development programs in Papua. With the active involvement of all stakeholders, Papua has a great opportunity to achieve development that is inclusive, sustainable, and by respected local values. Effective collaboration will help indigenous peoples not only preserve their cultural heritage but also empower them to actively participate in the modern economy.

Strengthening local policies is one of the important steps to protect indigenous rights and optimize the potential of the tradition-based economy in Papua. Regulations that support the management of customary forests, ecotourism, and craft arts need to be adopted urgently to create a social, economic, and ecologically sustainable framework (Karst & Nepal, 2022; Suacana et al., 2023). With this approach, indigenous peoples can be empowered to preserve their traditions while contributing to inclusive economic growth. One of the key steps is to ensure legal protection of indigenous rights, including land ownership and access to natural resources. Clear legal recognition will reduce agrarian conflicts that are often a barrier to sustainable development. These regulations also need to be designed to be aligned with the needs of local communities, ensuring that policies are not only aimed at economic growth but also respect the cultural values of indigenous peoples. In addition, customary forest management can be a tradition-based economic model that

supports ecological sustainability. By actively involving indigenous peoples, customary forest-based ecotourism can be a significant source of income. This can be achieved through training and strengthening the capacity of local communities to become direct managers of this sector, including promoting ecotourism destinations through digital platforms. Craft arts also have great potential to be developed as superior cultural products that can compete in the national and international markets. The principles of good governance must be the basis for the implementation of local policies. Accountability and transparency in the management of development funds are essential to ensure that budget allocations are actually used by the planned objectives. Clear reporting mechanisms and public involvement in the evaluation process can increase public trust in the government. In addition, a fair distribution of funds must be prioritized so that all levels of society, including those in remote areas, can experience the benefits of development. Data-driven monitoring and evaluation are also key elements in strengthening local policies. Modern technologies such as GIS can be used to monitor the impact of implemented policies (Calancie et al., 2021; Oliveira et al., 2020). With this approach, governments can make adjustments quickly if needed, ensuring that policy objectives remain relevant to the needs of indigenous peoples. Strengthening local policies that prioritize the protection of indigenous rights, tradition-based economic management, and the implementation of good governance will create more inclusive and sustainable development. With this step, Papua can be an illustration of how tradition and modernization can go hand in hand to create broad benefits for local communities and the environment.

Data-driven monitoring and evaluation are key elements in ensuring the success of development strategies in Papua. Transparent and participatory monitoring mechanisms, involving indigenous peoples directly, are an important step in evaluating the effectiveness of ongoing policies and programs. The active participation of indigenous peoples in this process not only increases trust in government programs but also ensures that policies are taken by local needs and aspirations. One approach that can be implemented is the use of modern technology such as GIS (Jo et al., 2023). This technology enables real-time monitoring of the impact of development programs, such as customary forest-based ecotourism, on the environment and communities. With GIS, the data collected can provide a comprehensive picture of the condition of the region, thus assisting the government and other stakeholders in making more accurate and evidence-based decisions. For illustration, GIS can be used to track changes in forest cover, biodiversity distribution, and tourist visit patterns, so that the positive and negative impacts of ecotourism can be identified early. In addition, this monitoring mechanism can be designed to be inclusive, where indigenous peoples are not only the object of monitoring but also play an active role as partners in data collection and analysis. With adequate training, indigenous peoples can be involved in various stages, from collecting field data to

interpreting monitoring results. This approach not only strengthens the capacity of indigenous peoples but also ensures that local perspectives are always taken into account in every step of the evaluation. Periodic evaluations are also important to measure the extent to which development policies and programs achieve their goals. The results of this evaluation can be the basis for making improvements and adjustments, ensuring that existing programs remain relevant to dynamic local conditions and needs. For illustration, if the data shows a decline in environmental quality due to certain activities, mitigation measures can be taken immediately to minimize the negative impact. Data-based monitoring and evaluation can also be used to increase accountability in the management of development programs (Campion et al., 2023; Sellera et al., 2019). With transparent and accessible data to various parties, the public can more easily monitor whether budget allocations are used effectively and according to their objectives. This approach not only increases public trust but also advises the government to continue to improve the quality of development governance. Monitoring and evaluation mechanisms that are data-based, transparent, and involve indigenous peoples are an important foundation to ensure sustainable development in Papua. By leveraging technologies such as GIS and empowering indigenous peoples in this process, governments can create more effective, inclusive, and evidence-based policies, thereby supporting the achievement of sustainable and equitable development.

Strategic steps to support development in Papua include strengthening infrastructure and technology, capacity building for indigenous peoples, cross-sector collaboration, strengthening local policies, and implementing data-based monitoring mechanisms. The strategy is designed to address the challenges facing Papua while maximizing its potential in a sustainable manner. With an inclusive and evidence-based approach, Papua can move toward development that not only respects local wisdom, but also empowers indigenous peoples as agents of change in their communities. Strengthening infrastructure and technology is the main foundation in reducing regional inequality in Papua. The development of basic infrastructure such as roads, electricity, and the internet in remote areas will open up wider access for indigenous peoples to participate in the modern economy. In addition, the apply technology that is by local needs, such as GIS and mechanical agricultural tools, can support the efficiency and productivity of indigenous peoples. These endeavors must be complemented by technical training to ensure that the community can make the most of the technology. Capacity building of indigenous peoples is a priority to increase their role in development. Local culture-based training, such as the project-based learning (PjBL) model, can help young Papuans develop skills relevant to market needs (Zhao, 2024). These programs not only strengthen cultural identity but also create new economic opportunities that support the self-reliance of local communities. This approach must be designed in an inclusive manner, involving

stakeholders from different sectors to ensure the sustainability of the program. Cross-sectoral collaboration among governments, indigenous institutions, the private sector, and academia is needed to ensure the relevance and sustainability of policies. This synergy allows the creation of more innovative and effective solutions in facing development challenges. Partnerships with international organizations can also play an important role in promoting local Papuan products to the global market through digital technology. This collaboration provides a dual benefit, namely improving the economic welfare of indigenous peoples while expanding recognition of Papuan cultural heritage. Strengthening local policies is an important element in creating a framework that supports social, economic, and ecological sustainability. Regulations that protect indigenous rights, such as customary forest management and ecotourism, must be adopted consistently to promote inclusive development. The principles of good governance, including accountability, transparency, and fair distribution of funds, must be applied in every development program. This not only increases public trust in the government but also ensures that the benefits of development are felt by all levels of society, including those in remote areas. Data-driven monitoring mechanisms play an important role in evaluating the effectiveness of development policies and programs. By actively involving indigenous peoples, the monitoring process can be carried out in a transparent and participatory manner. Technologies such as GIS can be used to monitor the impact of development on the environment and the sustainability of programs. For illustration, monitoring of customary forest-based ecotourism can help identify positive and negative impacts that may arise, so mitigation measures can be taken immediately if needed. Within this framework, Law Number 59/2024 and the Papua RPJMD 2025-2029 are important references to realize a comprehensive monitoring system (Bapperida Provinsi Papua, 2024a; Biro Hukum Provinsi Papua, 2013). By implementing this strategy consistently, Papua can move toward more inclusive and sustainable development. An approach that integrates local wisdom with modern technology and good governance will empower indigenous peoples to become agents of change, ensuring that they are not only beneficiaries but also key drivers in the development of their communities.

11.3. Building the Future of Papua Based on Local Wisdom and Innovation

Papua has great potential to become a model of sustainable development in Indonesia, by integrating local wisdom and modern innovation. Locally-based policies play a key role in strengthening the capacity of indigenous peoples as key actors in development. This approach not only respects traditional values but also supports social, economic, and ecological sustainability. One of the important elements of this policy is the management of customary-based resources, such as agroindustry and ecotourism. This approach ensures that local traditions remain sustainable while

encouraging inclusive economic growth. For illustration, traditional practices in land and natural resource management can be used as a basis for creating innovative technologies that are relevant to local needs. This provides an opportunity to develop local products with higher added value, while preserving the environment. Multi-stakeholder collaboration is a strategic element in realizing development based on local wisdom in Papua. The government plays a role in providing a supportive policy framework, such as legal recognition of customary rights and the provide basic infrastructure. On the other hand, the private sector can provide strategic investment in the development of sustainable creative sectors and agroindustries. Academics also have an important role as a catalyst for innovation through research and development of relevant locally-based technologies. Most importantly, indigenous peoples need to be empowered as guardians of tradition as well as key innovators who adapt modern technology to their needs. Best practices from other countries demonstrate the relevance of this approach. In Japan, Community-Based Payment for Ecosystem Services (CB-PES) has succeeded in improving collective land management with the active participation of local communities (Jacka et al., 2008; Sangha et al., 2024). Meanwhile, in South Korea, Collaborative Forest Management (CFM) provides access to indigenous peoples to use national forests in a sustainable way (Park & Yeo-Chang, 2021). These illustrations underscore the importance of empowering local communities to achieve a balance among environmental conservation and economic growth. Development based on local wisdom in Papua also requires the integration of modern technology that supports sustainability. Technologies such as the Internet of Things (IoT) and artificial intelligence (AI) can be used to monitor and manage natural resources efficiently, without neglecting traditional values (Hanafizadeh et al., 2021; Silva et al., 2023; Wanasinghe et al., 2020; Ziyad Mohammed, 2019). For illustration, IoT-based forest monitoring can be used to detect ecosystem changes, while traditional data of indigenous peoples becomes the basis for more informed decision-making. By integrating local wisdom, modern innovation, and multi-stakeholder collaboration, Papua can knit a harmonious future among tradition and modernity. This approach is not only relevant to the local context but also makes a significant contribution to the achievement of the sustainable development goals globally.

Innovation-based transformation of Papua places the vision of Papua as a center of sustainable innovation that integrates modern technology with local wisdom. This approach aims to create an innovation ecosystem that can optimize the cultural, geographical, and natural resource potential of Papua to support inclusive and sustainable development. The development of this ecosystem involves cross-sector collaboration with indigenous peoples as the main actors, so that the resulting innovations are socially, economically, and environmentally relevant. One of the strategic steps in this transformation is the implementation of the Society 5.0 model

that combines intelligent technologies such as the IoT and AI with local traditions (Magd et al., 2023; Narvaez Rojas et al., 2021). This model allows for more effective management of natural resources through continuous monitoring, while leveraging the traditional knowledge of indigenous peoples for informed decision-making. For illustration, IoT-based technology can be used to monitor the health of Papua's forest and marine ecosystems, while traditional data from indigenous peoples can be used as a reference in determining conservation measures that are in line with local cultural values. Community-based education and training are key pillars in ensuring indigenous peoples can adapt to modern technology without losing their cultural identity. Contextual training programs, such as smart agriculture technology training or simple technology-based seafood processing, not only increase productivity but also open up new economic opportunities for indigenous peoples. This approach integrates modern technology with traditional values, thus creating solutions that support social and environmental sustainability. In addition, the development of digital infrastructure in Papua is an important element to support the innovation ecosystem. Providing internet access in remote areas, building community-based innovation centers, and integrating technology in local education are some of the concrete steps to support this transformation. Community innovation centers can serve as spaces for collaboration among indigenous peoples, academia, and the private sector, creating innovative solutions that are relevant to local needs. Cross-sector collaboration is also needed to ensure the success of this innovation-based transformation. The government plays a role as a facilitator in providing supporting policies and infrastructure funding. Academics can contribute through research that supports the development of local technologies, while the private sector can provide strategic investments in relevant sectors such as agroindustry and ecotourism. Indigenous peoples, as guardians of local traditions and innovators, have an important role to play in integrating cultural values with modern technology to achieve sustainable development. Innovation-based transformation in Papua also emphasizes the importance of ecological sustainability. The use of environmentally friendly technologies, such as renewable energy and technology-based waste management, can support the preservation of Papua's biodiversity-rich ecosystem (Benfica et al., 2023; Rad et al., 2021). In addition, a community-based approach in ecotourism can promote the uniqueness of Papuan culture while preserving nature. By making indigenous peoples the main managers, ecotourism can provide direct economic benefits to local communities without damaging the local ecosystem. Through this integrated approach, Papua has a great opportunity to become a sustainable development model that harmonizes local wisdom with modern innovation. This transformation not only supports the welfare of the Papuan people but also makes a significant contribution to the achievement of sustainable development goals nationally and globally.

The action agenda for Papua's development emphasizes the importance of concrete steps in making Papua a model of sustainable development that integrates local wisdom with modern innovation (Saputra et al., 2021). One of the flagship programs is the development of custom-based ecotourism, which optimizes the uniqueness of Papua's culture and natural wealth to attract local and international tourists. By involving indigenous peoples as the main managers, this program not only supports the preservation of local culture but also introduces Papuan cultural values in the global arena. Traditional practices such as "sasi laut" are a concrete illustration of how indigenous values can be integrated in ecotourism management to preserve biodiversity while maintaining the continuity of local culture (Prasetyo et al., 2020). "Sasi laut" is a form of local wisdom that regulates the sustainable use of marine resources, which if applied in ecotourism can be a special attraction for tourists who are looking for an authentic experience. This approach not only protects the ecosystem but also increases the participation of indigenous peoples in the tourism economic value chain. In addition to ecotourism, diversification of local products is also a priority in this development agenda. Superior products such as coffee and seafood can be further developed through simple technology training and digital marketing. This training is designed to improve the skills of indigenous peoples in processing local products into goods with higher added value. For illustration, coffee processing using modern techniques can produce premium products that are competitive in regional and international markets. On the other hand, processing marine products such as fish and seaweed into high-quality processed products such as shredded fish or seaweed chips can expand market access while increasing people's income. Digital marketing is one of the important elements in diversifying local products. Through digital training, indigenous peoples can leverage online platforms to promote and sell their products to a wider market. The use of social media and ecommerce allows Papuan products to be known more widely, even to the international market. This step not only increases the income of indigenous peoples but also strengthens Papuan cultural identity through traditional branding of local products. The development of custom-based ecotourism and the diversification of local products cannot run without solid cross-sector collaboration. The government plays a role in providing basic infrastructure such as roads and internet access, as well as creating policies that support cultural and environmental preservation. The private sector can provide strategic investments, particularly in the tourism and product processing sectors, while academics can help through research and development of locally-based technologies relevant to the needs of the community. Indigenous peoples, as the custodians of tradition and key actors in resource management, play an important role in ensuring that every step of development remains aligned with local cultural values. The success of this action agenda also depends on a sustainable approach that pays attention to ecological, social, and economic aspects in a

balanced manner. The use of environmentally friendly technologies, such as renewable energy to support ecotourism operations or community-based waste management, can support the sustainability of Papua's biodiversity-rich ecosystem. By ensuring that economic activities do not harm the environment, Papua can be a clear illustration of how sustainable development can be implemented effectively. Through these steps, Papua has great potential to become a sustainable development model that integrates local wisdom with modern innovation (Arfelina Iskandar et al., 2021; Nasrah & Siraj, 2023). These community-based programs not only support local well-being but also make a significant contribution to the achievement of sustainable development goals nationally and globally.

The success of sustainable Papuan development is highly dependent on synergies among various stakeholders, including the government, academia, the private sector, and indigenous peoples. Close collaboration among these actors is key to creating an innovation ecosystem that is harmonious and relevant to local needs. The government has an important role in creating a policy framework that supports sustainable development. This policy includes the recognition of customary rights, the provide basic infrastructure such as road access, digital facilities, and communication networks that allow innovation to grow well. In addition, the government must also provide incentives to encourage the participation of the private sector and indigenous peoples in various development programs. By ensuring that the policies and infrastructure provided are aligned with local needs, governments can create a solid foundation for the success of local-based innovation programs. Academics play a role as a catalyst in the development of innovation-based Papua. Through research and development of locally-based technologies, academics can help create innovative solutions that are relevant to Papua's challenges and potential. Research on natural resource management based on local wisdom, for illustration, can provide deep insights into how modern technology can be adapted to preserve Papua's unique ecosystem while increasing economic productivity (Fajri & Munawaroh, 2023; Mehmood et al., 2024). In addition, academics can also be facilitators in training indigenous peoples, helping them master new skills that support inclusive and sustainable development. The private sector has a significant contribution in providing strategic investments in the creative, agroindustry, and tourism sectors. This investment not only opens up new economic opportunities but also creates jobs for the local community. For illustration, the private sector can support the development of custom-based ecotourism by providing the capital and technology needed to build environmentally friendly facilities. In agroindustry, the private sector can work with indigenous peoples to improve the processing of local products such as coffee and seafood, so that these products have competitiveness in the global market. It is important for the private sector to ensure that the investments made support the social, economic, and environmental sustainability of Papua. Indigenous peoples, as

guardians of traditional values, have an equally important role. With in-depth knowledge of local ecosystems and cultural traditions, indigenous peoples can become key innovators in adapting modern technologies that are appropriate to local contexts. Their role in environmental conservation, such as forest and marine management based on local wisdom, is crucial to ensure that sustainable development does not damage existing ecosystems. In addition, the involvement of indigenous peoples in every stage of development, from planning to implementation, ensures that the programs implemented are by local needs and values. Synergy among governments, academia, the private sector, and indigenous peoples also requires an approach based on active collaboration and open communication (Savage-Knepshield et al., 2021; Xu, 2024). For illustration, a multi-stakeholder discussion forum can be a forum to align the vision and goals of each actor in Papua's development. This approach allows each party to contribute according to their role, creating a greater impact than if they were working separately. By building strong synergies among stakeholders, Papua can become a model of sustainable development that integrates local wisdom and modern innovation. This approach not only supports the well-being of indigenous peoples but also contributes significantly to the achievement of sustainable development goals at the national and global levels.

The implementation of a sustainable Papuan development approach requires a deep understanding of the relationships among elements in the development system. The systems thinking approach is a relevant framework for managing the complexity of multi-stakeholder collaboration, including governments, indigenous peoples, the private sector, and the environment. With this approach, the relationships and interactions among key elements in the system can be understood thoroughly, resulting in more inclusive and sustainable solutions. The systems thinking approach allows for the identification of patterns of interaction and dynamics among elements, which are often overlooked in conventional approaches. For illustration, in the development of custom-based ecotourism, indigenous peoples can be actively involved in planning, implementing, and supervising tourism activities. This approach not only increases community participation but also ensures that tourism activities are carried out responsibly toward the local environment and culture. For illustration, traditional practices such as "sea sasi" can be integrated in ecotourism management to protect biodiversity and preserve local cultural values (Prasetyo et al., 2020). A community-based approach is at the core of an inclusive management system. By giving indigenous peoples a central role in decision-making, development programs can be more relevant to local needs. Additionally, this approach strengthens the capacity of indigenous peoples to manage their natural resources sustainably, ultimately improving their well-being. Through a community-based management system, indigenous peoples have greater autonomy to maintain a balance among

environmental conservation and economic development. The systems thinking approach also integrates various perspectives to create more comprehensive solutions. The government, as a provider of policies and infrastructure, can ensure that the policies implemented support the sustainability of the ecosystem and involve indigenous peoples directly. Academics can provide research-based insights into best practices in natural resource management, while the private sector can contribute through investments that strengthen environmental stewardship and open up new economic opportunities. This interaction among stakeholders strengthens the synergies needed to create sustainable development. The systems thinking approach also includes monitoring and evaluation mechanisms to ensure the sustainability of development programs. Success indicators can include improving the welfare of indigenous peoples, preserving biodiversity, and strengthening multi-stakeholder collaboration. By involving indigenous peoples in the evaluation process, development programs can be dynamically adapted to local needs and emerging challenges. The importance of community-based education and training cannot be ignored in this approach either. Educational programs designed with a systems thinking approach can teach indigenous peoples new skills, including modern technologies relevant to their resource management (Sekiwu et al., 2024; Widiharti et al., 2019). For illustration, training in the use of technologies such as the IoT to monitor local ecosystems can help indigenous peoples make better decisions in managing their environment. By applying a systems thinking approach, Papua has a great opportunity to become a sustainable development model that integrates local wisdom with modern innovation. This approach not only creates inclusive and sustainable solutions but also strengthens the capacity of indigenous peoples to play a key role as innovators in development. The synergy among the government, indigenous peoples, the private sector, and academia creates a solid foundation to realize the vision of Papuan development that harmonizes tradition and modernity.

The integration of modern technology with traditional values is an important foundation for creating a prosperous and sustainable future for Papua. This approach aims to use technology to support the effective management of natural resources, while maintaining the local wisdom that is the identity of the indigenous Papuan people. By combining modern innovations and traditional values, development in Papua can become a relevant model for national and global contexts. One illustration of a relevant implementation is the use of IoT technology to monitor the health of Papua's forest ecosystem (Kawasaki et al., 2020). This technology allows for the collect real-time data, such as changes in forest cover, which can be helpful in detecting damage or threats to biodiversity. This data can then be combined with indigenous peoples' traditional knowledge of sacred sites that must be protected, resulting in a more comprehensive management strategy. This approach not only conserves the environment but also strengthens the role of indigenous peoples as the

main guardians of forest ecosystems. Community-based training is also a key component in the integration of modern technology with local wisdom. Training programs designed to teach skills such as coffee processing using simple technology provide a double benefit. On the one hand, people can improve the quality and added value of their local products, such as premium coffee or other processed products. On the other hand, this training ensures that the processing practices remain environmentally friendly and do not damage the ecosystem. For illustration, the use of energy-efficient drying technology can improve efficiency without leaving a large carbon footprint. In addition to coffee processing, simple technology can also be applied in marine product management. Training in seaweed or fish processing with modern but easily accessible techniques can open up new market opportunities for indigenous peoples. Diversifying local products, such as shredded fish or seaweed chips, can make a significant contribution to community income while expanding market access. With technology that is appropriate to the local context, indigenous peoples can increase their competitiveness without sacrificing traditional values. The development of digital infrastructure in Papua is also an important element in the integration of technology and traditional values. The provide internet access in remote areas allows indigenous peoples to connect with a wider market, both nationally and internationally. Through digital platforms, local Papuan products can be promoted as part of a unique cultural identity. This approach not only increases people's income but also strengthens Papua's position as a hub for locally-based innovation. Collaboration among the government, the private sector, and academia is essential to support the success of this integration. The government can provide a policy framework and incentives that support the development of environmentally friendly technologies. The private sector can invest in infrastructure and technology training, while academics can provide relevant research to improve the effectiveness of development programs. Most importantly, indigenous peoples must remain at the center of every initiative, ensuring that every step of development is aligned with their traditional values and local needs. By integrating modern technology and traditional values, Papua can become a harmonious development model among innovation and local wisdom. This approach is not only relevant to improve the welfare of indigenous peoples but also contributes to the achievement of the sustainable development goals (SDGs) (Jayasooria & Yi, 2023). Papua can be an inspiration for other regions in Indonesia and the world in creating locally-based solutions to global challenges.

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