From Knowledge to Action: Enhancing Decision-Making through Science -Policy Integration for Papua New Guinea

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Abstract: This paper, titled *"From Knowledge to Action: Enhancing Decision-Making through Science-Policy Integration,"* explores the relationship between science and policy in Papua New Guinea. The study emphasizes that, given the country's extraordinary biological and cultural diversity, effective decision-making must rely on both scientific evidence and local knowledge systems. Currently, weak links between Papua New Guinea's unique assets and science policy hinder progress affecting many of country's societal, environmental and economic problems. This disconnect limits the nation's ability to leverage knowledge for innovation, entrepreneurship, environmental sustainability, and socio-economic development. The study advocates for a science-policy interface that integrates indigenous knowledge with modern scientific research, viewing this integration as essential for fostering a knowledge-based economy and society—key prerequisites for sustainable growth. The paper concludes that increasing interaction among policymakers, scientists, knowledge producers, and stakeholders is crucial to bridge the gap between science, policy, and action, ensuring decisions are informed by relevant, robust evidence. To improve policies related to environmental management, health, agriculture, and climate change, Papua New Guinea needs to strengthen data collection systems, boost research funding, and foster partnerships among government, academia, and civil society. Future efforts should focus on building local scientific capacity and translating research findings into actionable policies that benefit both communities and the environment.

Keywords: Knowledge, action, Papua New Guinea, Science-Policy Integration, Decision-Making.

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1. INTRODUCTION

1.1 Background and Context

In the contemporary era of globalization and rapid change, the transition from knowledge to action has become a critical driver of national development. For Papua New Guinea (PNG), a country endowed with extraordinary biological and cultural diversity (Groube,1989) effective decision-making must be grounded in both scientific evidence and traditional knowledge systems. The complex land tenure systems, customary practices, and indigenous stewardship of resources in PNG underscore the need for a science-policy interface that respects and integrates indigenous knowledge alongside modern scientific research. This approach is central to fostering a knowledge-based economy and society—preconditions for sustainable growth and development, as emphasized by Grueber et al. (2009). Despite PNG's wealth of ecological and cultural capital, its persistent challenge lies in the weak linkage between these unique assets and limited capacity in manufacturing, industry and market. This disconnect hampers the nation's ability to harness knowledge for innovation, entrepreneurship, and socio-economic advancement. Hor (2010) argues that investments in research and growth of national development is evidently proportional, highlighting the urgency of strengthening research and science-policy mechanisms. Greater interaction between policymakers, scientific communities, knowledge producers, and consumers is vital to bridge this gap and ensure that decisions are informed by robust, context-relevant evidence. Integrating science and policy in PNG is more than a technical requirement; it is a pathway to inclusive, rights-based, and sustainable development. By aligning indigenous and scientific knowledge through effective policy frameworks, PNG can enhance service delivery, support

technological innovation, and safeguard its ecosystem for future generations. For example, study by Kanowski et al (2008), Mulung (2012) observed small-holder tree-farmer adoption behaviour and attitude to uptake and integration of scientific and traditional agroforestry knowledge system into opportunities for commercial tree farming are possitive when benefit to the decision-maker was evidently clear and policy support for such intervention was present. Elsewhere similar observation were documented by Pannell et al (Pannell et al, 2006), and Rogers (Rogers, 1995).

1.2 Challenges in Translating Scientific Knowledge into Policy in PNG

Papua New Guinea faces significant hurdles in bridging scientific research with policymaking processes. One major challenge is the limited capacity within government institutions to interpret and apply complex scientific data, often due to resource constraints and a shortage of skilled personnel (Koczberski et al., 2014). Additionally, there is a persistent gap between scientific research outputs and policy agendas, partly because research findings are not always accessible or communicated effectively to decision-makers (Tao et al., 2019). Furthermore, there is often a disconnect between scientists and policymakers due to differing terminologies, priorities, and timelines (Lavis et al., 2003). Scientific findings may be too technical or lack clarity for policymakers to understand and utilize effectively. Political considerations and socio-cultural factors also influence policy decisions, sometimes leading to the marginalization of scientific evidence—especially in areas like resource extraction, land use, and climate adaptation (Friedman et al.; 2017; Cash et al.,2003). Furthermore, PNG's diverse cultural landscape and traditional knowledge systems can complicate the integration of scientific insights into policies that are socially acceptable and practically implementable. Additionally, uncertainties inherent in scientific research can undermine confidence among policymakers, delaying or complicating decision-making processes (Pielke, 2007). Finally, inadequate communication channels and limited engagement between scientists and policymakers further obstruct the integration of scientific knowledge into policy frameworks.

1.3 Significance of Science-Policy Integration for PNG's resilient and sustainable development

For PNG, where natural resources underpin economic growth and ecological health is vital for livelihoods, integrating scientific knowledge into policy is crucial for achieving sustainable development. Effective science-policy linkages can inform policies on climate resilience, biodiversity conservation, and sustainable resource management, which are critical for PNG's future (Tao et al., 2019). Enhancing these linkages ensures that development strategies are evidence-based, culturally sensitive, and environmentally sustainable. Given PNG's vulnerability to climate change impacts such as rising sea levels, extreme weather events, and ecological degradation, science-informed policies are necessary to develop adaptive strategies that protect both ecosystems and communities. Strengthening science-policy interfaces can thus promote resilient, inclusive, and sustainable growth aligned with the nation's development goals.

1.4 Objectives and Scope of the study

This study explores how science-policy integration can enhance decision-making in PNG, emphasizing the importance of building a knowledge-driven society that is responsive to its unique cultural and environmental contexts. The paper examines current gaps, opportunities for improvement, and strategies for effective integration of science-policy in Papua New Guinea. Effective science-policy integration is crucial for PNG's future, requiring tailored approaches that bridge gaps and policy needs.

2. DEFINITIONS AND THEORETICAL PERSPECTIVES

2.1 Definitions

Evidence-informed decision-making has the potential to improve the effectiveness, efficiency and equity of the decisions that are made, while also enhancing accountability and transparency. Yet integration of science and evidence into effective agrifood systems decision-making processes remains a significant challenge (Nature, 2022). A narrow view of what counts as evidence favours specific expertise over others, and a wide range of evidence remains undocumented, unpublished and overlooked, leading to bias. This limits a nuanced understanding of different agrifood systems (Global Alliance for the Future of Food, 2021). There also exists a noticeable disparity between the volume of knowledge available and the capacity to make sense of it. Scientific findings may be limited by complexity, insufficient data, differences in values, uncertainties, competing views and contrasting results, and can be contested. Co-creating and integrating knowledge from different knowledge systems and across various sectors, scales and social actors can be fraught and politicized because knowledge is not neutral. The determination of what holds value and is valid is influenced by lived experiences, spiritual beliefs and cultural norms, in addition to science.

Delivering the best available evidence to policymakers in a timely and a useful format is not straightforward. Policy implementation can sometimes be rapid, yet even when unequivocal knowledge has been garnered over a long period, policy development and application can be very slow despite the acknowledged urgency of a problem (for example with climate change, there is a gap between scientific knowledge and policy uptake, and evidence alone has not been sufficient to influence political decisions). While policymakers do employ the evidence they perceive as most helpful to set priorities and design or inform policies (Masaki et al., 2017), there is often a disconnect in terms of how scientists conceive evidence as relevant for policymaking versus what policymakers consider relevant for decision-making (Avey and & Desch, 2014). The significant differences in goals and incentives between scientific research and policymaking are often overlooked by both, posing challenges in their relationship, especially when dealing with contentious issues that can undermine trust among stakeholders. Policymakers may not inform scientists and other knowledge holders about their needs while scientists and other knowledge holders may not actively engage in the policymaking process. Additionally, many obstacles may compromise their participation.

2.2 Theoretical Perspectives: Models of Science-Policy Interaction

The interaction between science and policy is critical for developing effective governance and addressing complex societal challenges. Various models of science-policy interaction, including linear, interactive, co-production, and knowledge translation models, offer different frameworks for understanding how research can inform decision-making.

The existing models of science-policy interaction consists of linear model, interactive Model, co-production model and ***k*nowledge *t*ranslation *m*odel.**

Linear Model. This traditional model posits a one-way flow of information where scientific research is conducted independently and later disseminated to policymakers. While straightforward, this approach often fails to account for the dynamic and multifaceted nature of policymaking, leading to the underutilization of research findings (Weiss, 1979).

Interactive Model. In contrast, the interactive model promotes a two-way exchange between researchers and policymakers. This model emphasizes the importance of dialogue, allowing for a better understanding of policy needs and context, thus enhancing the relevance of research outputs (Cash et al., 2003).

Co-Production Model. Co-production goes a step further by involving stakeholders in the research process itself. Researchers and policymakers collaboratively define research questions, methodologies, and implementation strategies. This model fosters mutual learning and ensures that the research is both relevant and applicable, as it integrates diverse perspectives (Brouwer et al., 2018).

Knowledge Translation Model. This model focuses on the systematic approach to bridging the gap between knowledge creation and its application in policy. Knowledge translation encompasses strategies that

make research findings accessible and actionable for decision-makers, considering the specific contexts in which policies are implemented (Graham et al., 2006).

3. IMPORTANCE OF INTEGRATION FOR DECISION-MAKING

3.1 Integration of Scientific Research into Policymaking

The integration of scientific research into policymaking is essential for promoting evidence-based policies, adaptive management, and resilience-building.

Evidence-Based Policies: Integrating research ensures that policy decisions are grounded in the best available evidence, which enhances their effectiveness and accountability (Nutley et al., 2007). Evidence-based policies are more likely to address the actual needs of communities and lead to favorable outcomes.

Adaptive Management: The integration of scientific knowledge allows for adaptive management practices that can respond to changing conditions and uncertainties (Holling, 1978). This flexibility is crucial in fields such as environmental management, where ecosystems are dynamic and subject to various stressors.

Resilience-Building: Effective integration fosters resilience by equipping communities and institutions to withstand and recover from shocks and stresses. Evidence-informed decision-making can identify vulnerabilities and guide strategies that enhance adaptive capacity (Folke et al., 2002).

3.2 Barriers to Integration

Despite the benefits of integrating science and policy, several barriers hinder this process, including: Political challenges, cultural challenges, institutional challenges and knowledge-related challenges.

Political challenges: Political interests and agendas can obstruct the incorporation of research into policy. Decision-makers may prioritize short-term goals or be swayed by lobbying efforts, leading to the marginalization of evidence-based approaches (Pielke, 2007).

Cultural challenges: Divergent organizational cultures between research institutions and policy bodies can create misunderstandings and misalignments. A lack of shared values and priorities can impede effective collaboration and knowledge sharing (Gulbrandsen, 2008).

Institutional challenges: Rigid institutional frameworks and bureaucratic processes can limit the capacity of organizations to adopt evidence-based practices. Insufficient resources and support can further exacerbate these limitations (Elmore, 2000).

Knowledge-related challenges: Gaps in knowledge, limited awareness of existing research, and the complexity of certain issues can hinder effective application of research findings in policy contexts (Rosenberg, 1992).

In summary, the interaction between science and policy is essential for developing effective, evidence-based governance. By utilizing models such as co-production and knowledge translation, stakeholders can enhance the relevance and applicability of research findings. However, addressing the barriers posed by political, cultural, institutional, and knowledge-related challenges is crucial for fostering meaningful integration that ultimately leads to improved decision-making outcomes.

4. CURRENT STATE OF SCIENCE AND POLICY IN PAPUA NEW GUINEA

4.1 Overview of Scientific Research and Data Availability

In recent years, PNG has made strides in scientific research, although it remains constrained by limited funding, infrastructure, and human resources. The country's unique ecosystems, including rainforests and coral reefs, require comprehensive data to inform conservation and management efforts. Research institutions, universities, industry and various civil society organisations engage actively in scientific inquiry, but the overall output is often hampered by the lack of consistent funding and resources (STCS, 2016). Governments investment in scientific

research stands at 0.03% of Gross Domestic Product (STCS 2016). Of these personnel accounted for 77%, and other capital accounted for 23%. In terms of research, basic research accounted for 55 %, 28% on applied research, and 16% 16 %. Break-up this by sector are biological sciences 38%, agriculture sciences 21% and other areas of sciences 39%. By contrast, other OECD countries average about 2.27% of National Gross Domestic Product.

4.2 Key Sectors

Summary performance by the different sectors in Papua New Guinea are.

4.2.1 Environmental Management

Environmental management in PNG is critical due to its rich biodiversity and the increasing pressures of deforestation, mining, and industrial development. Various research initiatives have focused on biodiversity assessments and conservation strategies. For instance, the establishment of protected areas and the promotion of sustainable practices are increasingly informed by scientific studies. However, the availability of data on species distribution and ecosystem health is often fragmented and outdated (Govan et al., 2011).

In recent years, efforts have been made to improve data collection through partnerships with international organizations and NGOs. Projects like the Papua New Guinea Conservation and Environment Protection Authority's (CEPA) initiatives emphasize the need for comprehensive environmental assessments (CEPA, 2018). Yet, despite these advancements, the capacity for effective data management and dissemination remains a significant hurdle. Local communities, who are often the stewards of these environments, frequently lack access to vital information that could guide sustainable practices (Govan et al., 2011).

4.2.2 Health

The health sector in PNG faces numerous challenges, including high rates of communicable diseases, maternal and child health issues, and emerging threats from non-communicable diseases. Scientific research in public health has been crucial in understanding these challenges and informing policy responses. The National Department of Health (NDoH) collaborates with international partners to conduct epidemiological studies and health surveys, yet data availability is still inconsistent (PNG NDoH, 2020).

One of the notable advancements in health research has been the focus on malaria, tuberculosis, and HIV/AIDS. The PNG Institute of Medical Research (PNGIMR) plays a vital role in this regard, conducting research that informs national health policies and interventions (PNGIMR, 2019). However, data collection methods can be inadequate, particularly in rural areas where access to healthcare is often limited. Strengthening data collection and surveillance systems, particularly in remote communities, is essential for effective health policy formulation.

4.2.3 Agriculture

Agriculture is a cornerstone of PNG's economy, supporting the livelihoods of much of the population. Scientific research in agriculture has focused on improving crop yields, pest control, and sustainable farming practices. Institutions like the National Agricultural Research Institute (NARI) have been pivotal in conducting research that addresses food security and agricultural sustainability (NARI, 2021). The study by Allen, Bourke, and McGregor (2009) discusses the critical policy challenges affecting food security in Papua New Guinea. It explores how issues such as agricultural productivity, land management, climate variability, and socio-economic factors influence the country's ability to ensure reliable access to sufficient, safe, and nutritious food for its population. The study emphasizes the need for integrated science policy approaches that incorporate local knowledge and sustainable practices to improve food security outcomes in PNG. Despite the importance of agriculture, challenges remain in data availability and accessibility. Many farmers lack access to current agricultural practices and research findings, which can lead to inefficient farming methods. Moreover, climate change poses a significant threat to agricultural productivity, necessitating the integration of climate-resilient practices into farming. Efforts to enhance

agricultural research have been bolstered by partnerships with international organizations, but the need for localized research tailored to PNG's diverse ecological conditions remains critical (NARI, 2021).

4.2.4 Climate Change

As one of the countries most vulnerable to climate change, PNG faces severe challenges related to rising sea levels, extreme weather events, and changes in rainfall patterns. Scientific research on climate change impacts and adaptation strategies is essential for informing national policy and community-level responses. The National Climate Change Policy outlines the government's commitment to addressing climate change, yet implementation remains a challenge (Government of Papua New Guinea, 2015).

Research institutions and NGOs have been active in climate-related studies, focusing on vulnerability assessments and adaptation strategies. However, climate data is often insufficient, and there is a pressing need for comprehensive climate modeling and projections specific to PNG's diverse environments. Building local capacity for climate research is crucial, as is fostering collaboration between scientists, policymakers, and local communities (Mastrorillo et al., 2016).

4.2.5 Science and Technology Council

The Council of Science and Technology serves as the highest authority responsible for governance in matters related to science, technology, and innovation in Papua New Guinea, as outlined in the PNG Science and Technology Council Act of 1992 (Office of Legislative Council, PNG, 2022). Recently government approved National Research Agenda for prompt implementation, focusing on seven strategic areas aimed at fostering growth (PNGSTCS, 2016).

The first area, Human Capital, Health, Youth, and Gender, seeks to enhance the overall well-being of the population by investing in research focused on human capital development, strengthening healthcare systems, empowering youth, and addressing gender inequalities. Research in this domain promotes health, education, and gender equity.

The second focus area, Wealth Creation, emphasizes research and innovation in agriculture, industry, and entrepreneurship to stimulate economic growth, create jobs, and alleviate poverty.

The third area, Institutional Development and Service Delivery, underscores the need for research into effective institutions and efficient service delivery, which are vital for good governance and citizen welfare. This research aims to improve governance structures and enhance the quality and accessibility of public services.

The fourth area, Security and International Development, directs research efforts towards ensuring national safety and stability while promoting productive international collaborations for mutual advancement.

The fifth area, Environment and Climate, addresses the pressing environmental challenges and climate change, focusing on conservation, sustainable resource management, and building climate resilience. This includes examining environmental health and its effects on communities.

The sixth focus area, Spiritual Cultural Society, recognizes the rich cultural diversity of the country and highlights the importance of researching the preservation and promotion of indigenous cultures, languages, and traditions. This research aims to empower communities to protect their heritage and identities.

The final area, Planning Integration and Control, emphasizes the importance of policy formulation, coordination, and monitoring to ensure the efficient implementation of national strategies.

These seven focus areas create a comprehensive framework for research and development in Papua New Guinea, addressing critical social, economic, and environmental issues while respecting the nation's cultural heritage and promoting effective governance and planning. Collaborative efforts among researchers, policymakers, and stakeholders within these themes will propel the nation forward and enhance the quality of life for all citizens.

5. CHALLENGES IN KNOWLEDGE-TO-ACTION FOR PAPUA NEW GUINEA

5.1 Structural and Institutional Challenges

Papua New Guinea (PNG) faces significant structural hurdles, including limited research capacity and inadequate infrastructure PNG Science and Technology Council Secretariat (2016). Many local institutions lack the resources, skilled personnel, and facilities necessary to conduct and disseminate research effectively (PNG Science Technology Council Secretariat, 2016). This hampers the generation of actionable knowledge tailored to local contexts. Additionally, there is notable fragmentation among government agencies, NGOs, and other stakeholders involved in development and policy implementation World Bank (2018). This disjointed landscape results in duplicated efforts, poor coordination, and a lack of unified strategies, all of which impede the translation of evidence into effective action.

5.2 Cultural and Societal Barriers

PNG's rich indigenous cultures and traditional knowledge systems often operate parallel to Western scientific approaches. While indigenous knowledge is invaluable for local understanding and sustainable practices, there can be conflicts or misconceptions about its validity within mainstream policy frameworks Asian Development Bank (ADB) (2021). Communication gaps also exist, stemming from language diversity, literacy levels, and differing worldviews Hunt, C. (2013). These barriers make it difficult for scientific findings and policy recommendations to be effectively communicated and adopted by local communities and decision-makers.

5.3 Policy and Political Challenges

Political stability and consistent policy focus are often lacking in PNG, Allen M., Bourke, R.M, & McGregor (2009). The country's political landscape frequently prioritizes short-term gains over long-term development, driven by electoral cycles and shifting government priorities, World Bank (2018). This environment results in a lack of sustained commitment to evidence-based policies. Political instability and limited political will further undermine efforts to institutionalize research findings into actionable policies, leading to gaps between knowledge generation and practical implementation.

5.4 Knowledge Gap Issues

There is a persistent deficiency in quality, comprehensive, and context-specific data in PNG (PNGSTCS, 2016), Allen M., Bourke, R.M, & McGregor (2009). Many sectors lack reliable information that reflects local realities, which is crucial for designing effective interventions. Data collection can be hampered by logistical challenges, limited technical expertise, and resource constraints. Without relevant and high-quality data, policymakers and stakeholders struggle to make informed decisions, hindering the translation of research into tangible actions that address community needs and ecological realities.

This constellation of challenges—structural limitations, cultural considerations, political dynamics, and data gaps—creates a complex environment where turning knowledge into effective action remains a significant hurdle in PNG's development journey. Addressing these issues requires coordinated efforts across sectors, capacity-building, enhancing data systems, and integrating indigenous knowledge into policy frameworks

5.5 Opportunities and Strategies for Enhancing Science-Policy Integration

This section provides brief notes, selected references and key action are suggested as opportunities and strategies for enhancing science policy integration for Papua New Guinea.

5.5.1 Building Capacity and Infrastructure

Strengthening research institutions improves local knowledge production and policy relevance.
Developing robust data systems enables informed decision-making and targeted interventions.
Investing in human resources through training and mentorship ensures long-term research sustainability.

Key Action: Fund national research centers, digital infrastructure, and research fellowships.

References: Papua New Guinea Science and Technology Council Secretariat (PNGSTCS). (2016). UNESCO. (2017), World Bank. (2020).

5.5.2 Fostering Collaborative Platforms and Multi-stakeholder Involvement

Inclusive platforms ensure coordinated development and reflect diverse needs. Engagement with indigenous communities validates traditional knowledge and enhances local ownership.

Key Action: Institutionalize multi-stakeholder working groups with representation from government, civil society, academia, and indigenous leaders.

References: United Nations Development Programme (UNDP). (2019), Nakashima, D., McLean, K. G.,Thulstrup, H. D., Ramos Castillo, A., & Rubis, J. T. (2012).

5.6 Knowledge Translation and Communication

Media, policy briefs, and local-language outreach increase the accessibility of research findings. Effective communication fosters policy uptake and community-level action.

Key Action: Develop science communication units to translate evidence into targeted messaging for different audiences.

References: World Health Organization (WHO). (2012), Lavis, J. N., et al. (2003).

5.6.1. Policy Development and Institutional Reforms

Dedicated policy-research interface units promote evidence-informed governance. Institutional reforms should embed research into national planning and budgeting systems.

Key Action: Create “Science-Policy Interface Units” within planning and development ministries.

References: Organisation for Economic Co-operation and Development (OECD). (2020), Global Development Network (GDN). (2014).

5.6.2 International and Regional Partnerships

Leveraging global and regional networks brings technical support, funding, and shared learning. Participation in Pacific-wide research and policy platforms enhances PNG’s capacity.

Key Action: Expand engagement with the Pacific Islands Forum, ADB, and bilateral partners.

References: Pacific Islands Forum Secretariat. (2021), Australian Aid (AusAID). (2012).

5.6.3 Emphasizing Indigenous Knowledge Integration

Indigenous knowledge enriches ecological management, disaster resilience, and community health. Policy and research frameworks should ensure respectful integration and cultural sensitivity.

Key Action: Establish protocols for knowledge co-production and protect traditional knowledge rights.

References: Berkes, F. (2012), UNESCO. (2017).

6. POLICY RECOMMENDATIONS AND PRACTICAL STEPS

Integrating science into policy-making is crucial for informed decision-making and sustainable development in Papua New Guinea. The Papua New Guinea Science and Technology Council has recognised these aspects as critical gaps between science and policy integration processess and therefore attempts to address these through the recommendation and practical steps that follows..

6.1 Short Term Recommendation

Establisment of Liasion bodies across the science and technology landscape plays an important role of communication, translation and adoption of science policy intergration. Ansell and Gash (2008) show in the work on, 'Coping with the Challenges of Working Across Boundaries'. The study show that establishment of liasion bodies create dedicated teams to facilitate communication and coordination among scientists, policymakers, and community stakeholders. This approach is grounded in the success of similar models, as seen in Collaborative Governance. Decision are depended on good data data system where reliable data collection and management systems are decveloped. Accurate data is vital for effective decision-making, as emphasized in "Data-Driven Policy Impact Evaluation" by Imbens and Wooldridge (2009).

Long-term Strategies Amongst other things, Georgehiou et.al (2014) note that scientific research requires massive resources, and a steady funding flow as critically important leverage in the sustenance of scientific inquiry. Good funding strategies for scientific enquiries can play an important part. In addition, human skill and talent for science is also very important, and therefore must be supported with good investment in education and capacity building programs. Gillard and (2010) observes the need for strengthening educational infrastructure to cultivate skilled personnel to build research capacity in developing countries as very important. Role of Stakeholder including government, academia, industry and communitiesn is also an important part of the longer term sustainability and scientific research outcomes. Government role including providing policy support, funding, and regulation Peters and Pierre (1998) in the productivity and sustainability of scientific research work. The Academia provide focus on research, training, and knowledge dissemination, (Zomer and Benneworth, 2011). Communities and industry engage in decision-making and provide feedback, aligning with principles from "Participatory Development: The Role of Community Participation in Development Planning and Project Management" by Cohen and Uphoff (1980).

Monitoring and Evaluation – Regular Monitoring provides an important role in the scientific research process and includes evaluation of systems for policies and research programs (Rossi, Lipsey, and Freeman (2004). Adaptive Management provides opportunity to adjust strategies based on evaluations, as recommended in "Adaptive Management of Natural Resources: Theory, Concepts, and Applications" by Williams and Brown (2012). Together with these suggested action steps may include, stakeholder meetings to build trust. Create data-sharing playtforms to enhance transparency. Organise training workshop to boost skill and engage local communities in pilot projects for feedback. While collaboration is emphasized, some argue for independent research initiatives to drive innovation without policy constraints. However, integrating such findings into mainstream policy can face challenges, as noted in "Bureaucracy and Innovation" by Downs (1967). By adopting these strategies and involving all stakeholders, Papua New Guinea can effectively integrate science and policy for sustainable development.

7. CONCLUSION

In conclusion, the integration of science and policy is vital for Papua New Guinea to navigate its unique developmental challenges effectively. The current landscape of science and policy in Papua New Guinea presents both challenges and opportunities. Significant advancements have been made in scientific research across various sectors; however, data availability remains a pressing issue, especially for local communities reliant on this information for sustainable practices. To improve the effectiveness of policies concerning environmental management, health, agriculture, and climate change, Papua New Guinea must prioritize the development of solid data collection systems, increase funding for research, and encourage partnerships between government,

academia, and civil society. Future initiatives should concentrate on building local capacity for scientific research, ensuring that scientific findings are translated into actionable policies that benefit both communities and the environment. By bridging the gap between knowledge and action, PNG can foster more informed and resilient decision-making processes that support sustainable growth and environmental stewardship. Such integration not only enhances the country's capacity to manage climate change, natural resources, and social development but also promotes resilience in the face of uncertainties. Moving forward, it is imperative to adopt committed, inclusive, and locally tailored strategies that empower diverse stakeholders and leverage indigenous knowledge alongside scientific insights. Only through such collaborative and adaptive approaches can PNG realize its development vision and ensure a sustainable future for all its communities.

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