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Research Article

Integrating Systems Thinking and Islamic Principles for Sustainable Development: A Case Study of South Papua, Indonesia

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ABSTRACT

This study explores the use of a systems thinking approach to analyze the interactions between economic, social, and environmental factors in achieving sustainable development in South Papua, a newly established province in Indonesia. The research aims to address the primary issue of fragmented policy approaches that fail to account for long-term impacts and intersectoral linkages. Using a qualitative exploratory design, primary data was collected through Focus Group Discussions (FGDs) with local stakeholders, while secondary data was obtained from government reports and academic literature. Thematic analysis and causal loop diagrams (CLD) were employed to identify dynamic interactions and leverage points for policy interventions. Key findings highlight that economic growth is contingent upon sustainable natural resource management and human resource development, with feedback loops revealing the potential for synergies and trade-offs between Sustainable Development Goals (SDGs). System archetypes such as "Shifting the Burden" and "Tragedy of the Commons" were identified, underscoring the need for policies that consider long-term impacts and equitable resource distribution. The integration of Islamic principles of justice and responsibility offers additional guidance for addressing these systemic challenges. The study concludes by providing holistic policy recommendations for sustainable development in South Papua, contributing both to academic literature and practical policymaking.

1. INTRODUCTION

Sustainable development has become a primary focus of global policy, especially following the adoption of the 2030 Agenda by the United Nations, which encompasses 17 Sustainable Development Goals (SDGs). The current state of SDG achievement worldwide demonstrates a dominant synergy between global and local actions across most SDG indicators, although some areas exhibit trade-offs (Bandari et al., 2024). South Papua, as one of the three new autonomous regions resulting from the division of Papua Province in Indonesia, with its abundant natural resources, faces unique challenges in achieving sustainable development.

Sustainable development in Papua must integrate local and national interests, particularly in customary territories, as the top-down approach often overlooks the needs of indigenous communities. This has led to significant disparities in development across regions, as seen in the projected Human Development Index (HDI) in Mappi, which is far lower than in Sorong (Lefaan et al., 2021). Additionally, while the Trans Papua Road project improves accessibility and reduces logistics costs, it raises environmental concerns regarding deforestation and biodiversity loss in sensitive areas such as Lorentz National Park (Kambu et al., 2022). The fisheries sector in Fakfak also faces sustainability challenges due to limited infrastructure, capital access, and management capacity (Utami et al., 2020). Traditional fragmented approaches to resource management and development often fail to address the complexity of interactions among economic, social, and environmental factors (Meadows, 2008). In this context, systems thinking approaches offer a holistic framework for understanding and managing these complex interactions.

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Previous research has shown that systems thinking approaches can provide critical insights into managing sustainable development. For instance, a study by Grover and Singh (2023) demonstrated that systems thinking models could identify interactions between various SDG targets, thereby facilitating more informed decision-making. Additionally, Moallemi et al. (2021) emphasized the importance of understanding feedback and interconnections within systems to achieve sustainable outcomes. These studies assert that systems thinking approaches are not only relevant but essential for comprehending the complexities of sustainable development in South Papua.

The primary challenge in achieving sustainable development in South Papua lies in the inadequate understanding of the intricate interactions between economic, social, and environmental factors. Existing policies tend to be sectoral, overlooking long-term impacts and the complex intersectoral linkages necessary for comprehensive development. As a strategic solution, the application of systems thinking offers a robust framework for modeling and simulating various policy scenarios. This approach enables policymakers to holistically evaluate the potential impacts of different interventions, ensuring more informed and sustainable decision-making processes. Systems thinking underscores the interconnectedness of economic, social, and environmental dimensions, which is vital for the formulation of effective policies (Sanneh, 2018; Williams et al., 2017). As noted by Williams et al. (2017), this approach facilitates the exploration of complex interdependencies between these dimensions, thereby promoting more integrated and sustainable management practices. This perspective is echoed by Ashraf et al., who argue that an integrated approach to public planning is crucial for balancing social, economic, and environmental goals (Ashraf et al., 2019). Furthermore, Cai (2023) emphasizes that advancements in economic, social, and environmental aspects are mutually reinforcing, further substantiating the importance of adopting a systems-based approach in policy development. In line with this, Chen et al. (2011) argues that systems thinking can be instrumental in designing management frameworks that enhance sustainability in land use and resource management, helping to forecast long-term outcomes and reveal critical intersectoral linkages.

This comprehensive approach aligns with the imperative to move beyond isolated, sector-specific strategies toward a more holistic model of sustainable development in South Papua, one that effectively addresses the complexity of its socio-economic and environmental challenges. This integration of various factors into policy-making, as discussed by these studies, aligns with the need to shift from sectoral approaches to more holistic evaluations of sustainability in South Papua. The study by Moallemi et al. (2021) used the iSDG model to analyze interactions among SDG targets in various countries. They found that this model could identify synergies and trade-offs among different targets, facilitating more effective planning. Meanwhile, research by Grover and Singh (2023) showed that using causal loop diagrams (CLD) could help understand feedback and interactions in complex systems. These models can be applied to identify leverage points that can be intervened upon to achieve optimal outcomes.

Although much research has been conducted in a global context, few studies have specifically focused on applying systems thinking approaches to sustainable development in South Papua. The studies by Moallemi et al. (2021) and Grover and Singh (2023) provide a strong foundation, yet their application to the local context of South Papua remains largely unexplored. This gap indicates the need for more in-depth research to understand the specific dynamics in South Papua.

This study aims to develop a system thinking model capable of mapping and analyzing the interactions between economic, social, and environmental factors in South Papua, to provide holistic and sustainable policy recommendations. The novelty of this research lies in the application of systems thinking approaches, which have not been previously applied in the specific context of South Papua, as well as the integration of Islamic principles to address systemic challenges in sustainable development. Additionally, integrating Islamic values into the sustainable development framework, as proposed in the Islamic Sustainable Development Planning (ISDP) model, emphasizes spiritual development alongside economic and social progress, ultimately aiming for the pleasure of Allah SWT (Dariah et al., 2019). The study's scope includes primary and secondary data collection, thematic analysis, causal loop diagram construction, and public consultations to ensure the relevance and validity of findings, with a focus on identifying trade-offs, problem archetypes, and policy scenario recommendations that support sustainable development.

Thus, this research not only contributes to the academic literature but also offers practical insights for policymakers in designing more effective and sustainable interventions.

2. RESEARCH METHODS

2.1 Research Design

This research design is exploratory and descriptive, with the primary aim of identifying, analyzing, and understanding the dynamic interactions among various factors influencing sustainable development in South Papua. The study employs a qualitative approach with a systems thinking model to comprehend and analyze the complex interactions between economic, social, and environmental factors in the context of sustainable development in South Papua. A qualitative approach is chosen because it allows for an in-depth exploration of complex and interactive phenomena that cannot be fully explained through quantitative methods.

The systems thinking approach in sustainable development studies enables a holistic analysis of the complex interactions among various elements within social, economic, and environmental systems. Through modeling with Causal Loop Diagrams (CLD), systems thinking can reveal patterns of cause-and-effect relationships and feedback loops that demonstrate how interventions in one part of the system can impact the entire system. This approach is particularly useful in aligning national development plans with the 2030 Agenda, as it helps capture, analyze, and prioritize strategies and goals for comprehensive SDG implementation.

Although this study is qualitative, the systems thinking approach provides a robust framework to support future quantitative analysis, which will require accurate data and standard systems thinking tools to understand the complex correlations within the sustainable development system (Meadows, 2008; Senge, 1990; Collste et al., 2017).

2.2 Data Collection

2.2.1. Primary Data

Primary data was collected through interviews with various stakeholders, including local government officials, local communities, NGOs, and academics. These interviews aimed to gain insights into their perspectives on sustainable development issues, the challenges they face, and potential solutions. The interviews were conducted through Focus Group Discussions (FGD) with the stakeholders. Each FGD lasted approximately four hours and was conducted both online and offline between July and December 2023. A total of 30 participants took part in these FGDs.

2.2.2. Secondary Data

Secondary data was obtained from various sources such as government reports, academic journals, books, and other relevant documents related to the research topic. This secondary data is used to strengthen and complement the findings from the primary data.

2.3 Data Analysis

The data collected through interviews were analyzed using thematic analysis techniques. This process involved coding the data, where interview transcripts were read thoroughly to identify recurring themes and patterns. These codes were then grouped into major themes relevant to the research. Based on the coding results, Causal Loop Diagrams (CLD) were created to visualize cause-and-effect relationships and feedback loops within the complex system (Kim and Andersen, 2012). These diagrams help identify leverage points that can be intervened upon to achieve optimal outcomes. The causal loop diagrams were then refined during public consultations with stakeholders. Participants in the public consultations were asked to confirm the relevance of each variable, validate or revise their connections, and suggest additional variables related to the pathways. Feedback from the participants was iteratively integrated into the CLDs.

3. RESULTS AND DISCUSSIONS

We begin the results of this study with a brief introduction to the regional profile and then present the themes that emerged from the analysis. This is followed by an integrative analysis that notes the relationships and trade-offs between the SDGs and identifies system archetype patterns.

3.1. Regional Profile

The South Papua Province, officially established in 2022, is a result of the division of Papua Province. It spans an area of approximately 93,695 km^2 and has a population of around 800,000 people. Located in the southern part of Papua Island, it borders Papua New Guinea to the east, the Arafura Sea to the south, the regencies of Nduga, Yahukimo, and Star Mountains to the north, and the Mimika Regency and Aru Sea to the west. The geographical conditions are varied, with lowland topography and numerous swamps and large rivers facilitating water access. The province consists of

four regencies: Merauke, Boven Digoel, Mappi, and Asmat. Ecologically, the region is rich in biodiversity, featuring extensive tropical rainforests and endemic species such as the Bird of Paradise and tree kangaroos.

The population of South Papua comprises over 250 tribes with diverse cultures and languages, including the Asmat, Dani, Biak, and Marind tribes. Most of the communities still rely heavily on natural resources and practice traditional customs in their daily lives. The local economy is predominantly based on agriculture, forestry, and fisheries, with Merauke serving as the largest economic center. However, the region also faces challenges such as deforestation and land conversion, which threaten biodiversity. Environmentally, the water and air quality indices in South Papua still need improvement, although some progress has been made.

South Papua faces several crucial strategic issues. Massive deforestation and land-use changes due to forestry and palm oil plantation concessions threaten the preservation of tropical forests and biodiversity. The division of the province has increased pressure on the environment due to the need for infrastructure development, often neglecting ecological aspects. Additionally, the socio-economic conditions of the population lag, with education and health levels requiring significant improvement. The sustainability of the economy heavily depends on sustainable natural resource management and environmental conservation (Center for Land Resource Management Studies, 2023).

3.2. Emerging Themes

The participants of the Focus Group Discussions (FGD) and Public Consultations identified several dynamics characterizing sustainable development in South Papua, as illustrated in Figure 1. One of the main dynamics is the reinforcing loop R1, which plays a key role in driving economic growth in the region. Investment in key potential sectors increases capital, which, in turn, stimulates production growth. This economic growth generates more capital for infrastructure development, leading to improved accessibility. Enhanced accessibility, exemplified by the rise of processing industries—particularly agricultural processing industries—adds value to the agricultural sector, thereby fostering further economic growth.

In loop R2, better accessibility also helps reduce regional disparities, decreasing vulnerability among impoverished communities and ultimately promoting inclusive economic growth. However, economic growth in key sectors remains highly dependent on natural resource utilization. Investment in these sectors is constrained by the limited availability of natural resources, linking the positive loop R1 with the balancing loops B1, B3, and B7. For example, if the environmental carrying capacity—such as land and water—is insufficient, it will impede economic growth. Furthermore, climate change exacerbates disaster risk due to land cover reduction driven by regional economic expansion. Therefore, proper land resource management is essential to minimize disaster risk and community vulnerability, as shown in the balancing loop B7.

The reinforcing loops R3 and R4 depict the social and economic benefits communities gain from the economic growth in loop R1. These benefits include increased economic value, which is expected to elevate household incomes and enable communities to meet their basic needs—such as food, education, healthcare, and other social services. By meeting these needs, community vulnerability, particularly among impoverished groups, will decrease. Disaster risk also influences community vulnerability, but if communities have strong economic capacity, they will be better able to mitigate disaster impacts. A major challenge in increasing economic value is the quality of human resources (HR). Therefore, economic growth must be accompanied by HR development through education, particularly for indigenous Papuans.

The reinforcing loop R1 is further influenced by the balancing loops B2, B3, and B5. Environmental carrying capacity and absorptive capacity affect community vulnerability. Poorly managed economic growth, amidst changing environmental capacities, can lead to threats such as declining food availability, increasing food insufficiency risks. Similarly, limited water availability and declining water quality—due to pollution from mismanaged domestic waste—pose health risks and can slow economic growth. If community vulnerability is high, productivity will decline, undermining sustainable economic growth.

Additionally, the reinforcing loop R2 is affected by the balancing loop B6. Without effective governance, rapid economic growth may create new disparities. As a small group controls more capital due to production growth, inequality deepens, particularly affecting indigenous Papuans. These disparities will exacerbate community vulnerability, hindering economic growth.

A key challenge to economic growth in loop R1 is the balancing loop B4. Economic expansion will attract non-indigenous Papuan migrants, creating disparities between indigenous and non-indigenous groups due to differences in accumulated capacity. Unequal access to economic resources can result in social conflict, particularly with indigenous communities, jeopardizing security and ultimately slowing economic growth.The main challenge of economic growth in loop R1 is the negative loop B4. Economic growth will attract non-indigenous Papuan migrants,

creating natural disparities between non-indigenous and indigenous Papuans due to accumulated capacity differences. Unequal access to economic resources can lead to social conflict, particularly with indigenous communities. This social conflict will affect security stability, ultimately impeding the pace of economic growth.

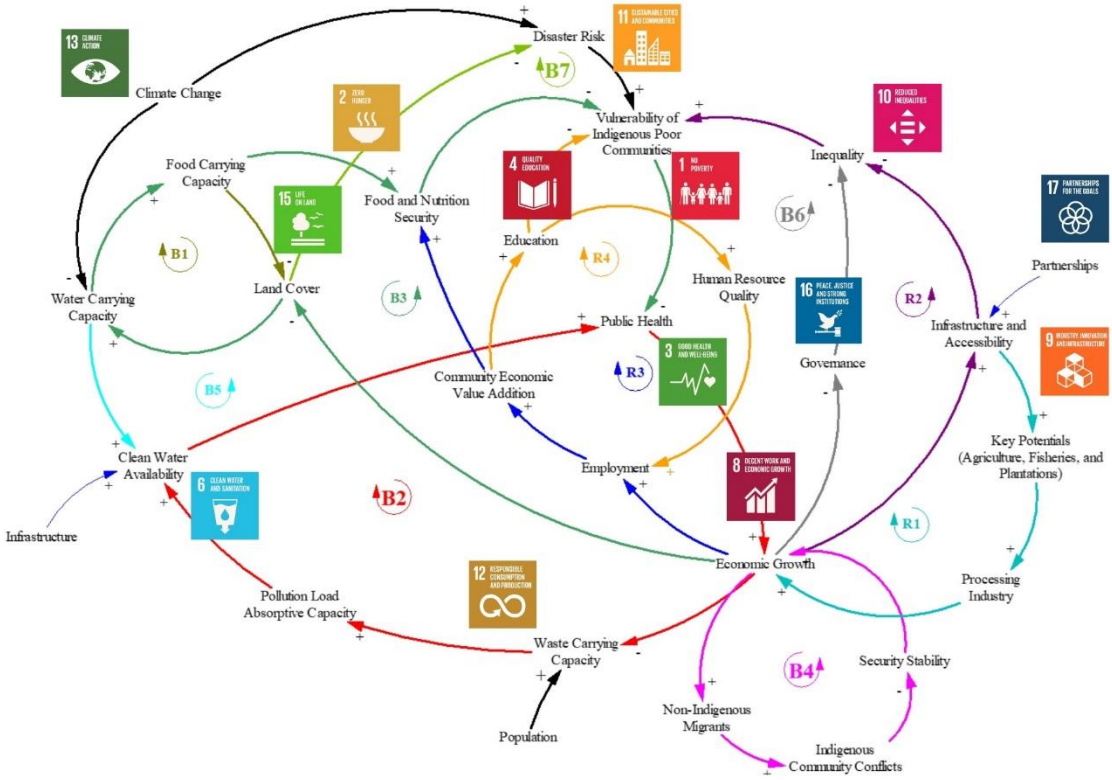


Figure 1. Causal loop analysis of sustainable development in South Papua

3.3. System-Based Integrative Analysis

A system-based analysis connects various elements of the priority Sustainable Development Goals (SDGs) with the concepts of environmental carrying capacity and absorptive capacity. This approach avoids silo thinking in formulating recommendations for each pillar of development, resulting in a comprehensive and integrated analysis. Sustainable development, as a phenomenon, consists of a system structure with interdependent elements forming feedback loops. The causal loop model of sustainable development in South Papua shows the complex relationships between various factors affecting sustainable development, leading to more holistic and effective policies to address development challenges while maintaining a balance between economic growth, environmental preservation, and social well-being.

According to Kunal Patankar (2014), a comprehensive framework using a systems thinking modeling approach can enhance sustainability and avoid unintended negative consequences. V. Grebenyuk (2013) emphasizes that systems must be sustainable when applied to sustainable development, while A. Sage (1997) highlights the key role of systems engineering and systems management in achieving industrial ecology and sustainable development through economic and environmental efficiency. Canh Truong Van (2020) demonstrates that the statistical relationships between various dimensions of sustainability can be used to measure balance and generate more effective policies. Denis Stijepic and H. Wagner (2017) develop a theoretical model analyzing the sustainability of economic growth and development, considering the interactions between economic and non-economic systems. Additionally, Polinpapilinho F. Katina et al. (2014) stress the importance of sustainability as a prerequisite for developing systems that enhance their capabilities through coordination and integration of complex systems.

The interactions between SDG indicators reveal the complexity of achieving sustainable development goals. In South Papua, the causal loop analysis of the SDGs shows synergies between economic growth (SDG 8) and health services (SDG 3), education services (SDG 4), and food provision (SDG 2). However, there are significant trade-offs, such as economic growth (SDG 8) leading to increased environmental pollution, particularly in water bodies (SDG 6), and land-use change (SDG 15) increasing disaster risk and the vulnerability of impoverished communities (SDG 1).

Additionally, economic growth can create new disparities due to the unequal distribution of economic benefits through unaccountable and non-transparent governance.

Other studies show that a systems thinking approach to modeling interactions between health (SDG 3), education (SDG 4), and gender equality (SDG 5) in India can strengthen economic growth and labor productivity (SDG 8). Increased public health spending directly contributes to economic growth by reducing absenteeism and improving productivity (Grover & Singh, 2023). On the other hand, the synergy between global and local actions in water use efficiency and agricultural productivity shows a positive impact on several SDG indicators simultaneously, such as SDG 2 (reducing hunger) and SDG 6 (clean water and sanitation) (Moallemi et al., 2021). However, there are significant trade-offs, such as sustainable agricultural development increasing production but reducing agricultural land, affecting local ecosystems (SDG 15) (Moallemi et al., 2021). A participatory and systems thinking approach helps identify and manage these synergies and trade-offs, ensuring that the implemented policies support the holistic sustainable development goals (Grover & Singh, 2023; Moallemi et al., 2021).

3.4. Identifying System Archetypes

In understanding the complex challenges faced in South Papua, system archetypes offer a valuable framework for identifying recurring patterns that help explain system behavior and inform more effective interventions (Wolstenholme, 2004). One such archetype, "Shifting the Burden," is evident when short-term solutions are prioritized, resulting in a temporary alleviation of issues but failing to address their root causes. For instance, economic growth policies may offer immediate relief but lead to environmental degradation, which, in turn, worsens public health outcomes in the long run. Aisyah (2023) notes that infrastructure projects in South Papua have frequently prioritized economic gain without adequately considering their environmental impact, exacerbating the very issues they are intended to alleviate. This pattern emphasizes the importance of long-term planning that incorporates both economic and environmental considerations. Kaya (2023) further argues that policies must be adaptive and responsive to local needs, highlighting the need to address the core issues rather than merely applying superficial fixes.

Another archetype relevant to the region is the "Tragedy of the Commons," which illustrates how individual actors, driven by self-interest, overexploit shared resources at the expense of the broader community. In South Papua, this can be seen in the conversion of forest land for monoculture plantations, which benefits a select few but leads to environmental degradation and heightened risks of natural disasters for vulnerable communities. Manoby's (2023) research underscores the need for sustainable governance practices in forest management, arguing that the long-term impacts of such practices must be factored into policy decisions to ensure equitable resource distribution. Recognizing this archetype allows for the design of policies that prioritize sustainable resource use and promote the well-being of the entire community, rather than allowing the benefits to concentrate among a small group.

Finally, the "Success to the Successful" archetype highlights how unchecked economic growth can exacerbate social inequalities, especially when governance lacks transparency and accountability. Sidiq (2024) points out that rapid economic growth in South Papua has often led to a disproportionate concentration of wealth among elites, leaving marginalized groups further behind. This is compounded by governance structures that do not provide adequate checks and balances to ensure the fair distribution of resources. Christawan (2023) similarly argues that unless governance reforms are implemented to promote accountability and transparency, economic policies will continue to deepen social and economic disparities.

3.5. Integrating Islamic Principles

Understanding and addressing sustainable development issues in South Papua require a comprehensive and holistic approach. From an Islamic perspective, solutions to complex problems identified through system archetypes such as "Shifting the Burden," "Tragedy of the Commons," and "Success to the Successful" can be articulated by integrating the principles of justice, responsibility, and general welfare.

In the context of "Shifting the Burden," Islam teaches the importance of seeking solutions that not only address temporary symptoms but also tackle the root causes. Islamic principles emphasize the need for a holistic approach that considers the long-term welfare of humanity and the environment. Economic policies focusing solely on short-term growth without considering environmental impacts contradict the sustainability principles in Islam. Islam teaches that humans are stewards of the Earth responsible for maintaining natural balance (Hanifah, Tenaesah, Fadilah, Merliyana, & Esen, 2024). Therefore, development policies in South Papua should be designed with long-term environmental impacts in mind, ensuring that economic activities do not harm nature and public health.

The "Tragedy of the Commons" archetype, which illustrates the over-exploitation of natural resources, can be addressed through the principles of ownership and resource management in Islam. Islam emphasizes the importance of managing natural resources justly and wisely, prohibiting destruction and waste. Public ownership of natural resources, such as forests, should be managed by the state for the benefit of all society, not just for the profit of a few. The state must ensure that natural resource management policies are implemented transparently and accountably, involving public participation in decision-making (Alamsyah & Uddin, 2024). Thus, forest resource management in South Papua should focus on sustainability and the long-term welfare of the entire community.

To address the "Success to the Successful" archetype, Islam teaches the importance of fair and equitable wealth distribution. Economic inequality caused by unaccountable and non-transparent governance can be mitigated through the principles of zakat, infaq, and sadaqah. Zakat is an effective mechanism for wealth redistribution from the rich to the poor, helping to reduce social and economic disparities (Hanifah et al., 2024). Furthermore, Islam promotes good, transparent, and accountable governance in managing state resources and wealth. Strong governance reforms are needed to ensure that economic benefits are distributed equitably to all community segments, not just concentrated among a few. By implementing these principles, policies in South Papua can be directed towards creating greater social equity and justice.

4. CONCLUSION

Sustainable development in South Papua requires a holistic system thinking approach to understand and manage the complex interactions between economic, social, and environmental factors. The key findings indicate that economic growth is highly dependent on sustainable natural resource management and the improvement of human resource quality. Identifying systemic archetypes such as "Shifting the Burden," "Tragedy of the Commons," and "Success to the Successful" underscores the need for policies that consider long-term impacts, equitable resource distribution, and strong governance. Integrating principles of justice, responsibility, and general welfare from an Islamic perspective can help address these systemic challenges and support the achievement of sustainable development goals in South Papua. This research makes a significant contribution to academic and practical literature by offering comprehensive and effective policy insights and strategies.

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