Scenario-Based Planning for Sustainable Conservation of Lake Limboto in Gorontalo Regency

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Abstract

Lake Limboto, the largest lake in Gorontalo Province, is rich in biodiversity and is a critical livelihood source for communities along its shores. Additionally, the lake supports a thriving aquaculture economy. However, if Lake Limboto's management remains unchanged, the degradation process will accelerate, threatening all activities that rely on its ecosystem. Therefore, Scenario planning is essential for managing Lake Limboto due to the range of issues arising empirically and normatively. Based on this context, the research problem can be formulated as follows: (1) What conditions threaten Lake Limboto's sustainability? (2) How can effective scenario planning be developed? This study employs a qualitative approach, with findings indicating that (1) the conditions threatening the sustainability of Lake Limboto in Gorontalo Regency include economic factors, climate change, and political shifts. (2) The development of effective scenario planning to achieve sustainable lake conservation in Gorontalo Regency involves five steps within the TAIDA approach and two additional steps relevant to sustainable development.

Keywords: Lake Limboto, Scenario Planning

INTRODUCTION

1. Background

Lake Limboto is facing severe challenges, primarily due to sedimentation that causes shallowing, a reduction in water volume, and a decrease in surface area. Data from the Watershed and Protected Forest Management Office (BPDASHL) in Gorontalo Regency indicates that much of the watershed area (DAS) surrounding Lake Limboto has been damaged due to land-use changes, such as deforestation for development and soil compaction for construction. Lake Limboto also faces other challenges, including the impacts of climate change, eutrophication, excessive growth of water hyacinth, increased river erosion rates, and the widespread presence of floating net cages. Although the government has implemented various policies to address these issues, the condition of Lake Limboto remains increasingly alarming, as evidenced by the continued shallowing and narrowing of the lake's waters. This presents a significant issue, given that many residents across 17 villages surrounding Lake Limboto are economically dependent on the lake, whether as fishers, fish farmers, fish vendors, or small business operators along the lake's shores.

Lake Limboto, the largest lake in Gorontalo Province, is rich in biodiversity, providing a crucial source of livelihood for communities along its shores. Furthermore, the lake supports a rapidly growing aquaculture economy. According to Hasim (2014), in his study on the political ecology of Lake Limboto's management policies, the lake has substantial economic

tourism potential and promising development prospects. One asset supporting tourism development is the historical site where President Soekarno, Indonesia's first president, landed upon visiting Gorontalo, adding significant value to the lake. However, Lake Limboto's degradation continues to worsen over time. Hasim's research (2014:84) on Lake Limboto's design highlights a significant reduction in the lake area suitable for aquaculture activities, decreasing by 8.03 hectares (0.36%). Based on ongoing sedimentation, Hasim's projections suggest that Lake Limboto may disappear by 2031.

Another frequent issue is the need for more alignment between policies and spatial planning (RTRW) across national, provincial, and district/city levels. This misalignment can lead to policy conflicts and difficulties in coordinating practical management efforts for Lake Limboto. Meanwhile, limited community participation in decision-making processes concerning the lake hinders the achievement of environmental sustainability, complicating broader awareness about the importance of protecting and managing this lake environment. Addressing these issues requires the application of Strategic Environmental Assessment (KLHS) in the management of Lake Limboto. KLHS can help identify potential environmental impacts, formulate more sustainable policy alternatives, and ensure community participation in decision-making. Furthermore, KLHS helps ensure that the lake's management aligns with environmental regulations under Law Number 32 of 2009 on Environmental Protection and Management (PPLH), which provides a crucial legal foundation for environmental sustainability in Indonesia.

When sustainable lake management is conceptualized within a scenario model, socio-economic activities in the lake's landscape will affect Lake Limboto's aquatic environment. To sustainably manage lake resources, it is essential to stimulate the effectiveness of integrated lake resource management. Consequently, Lake Limboto's management planning must be integrative, bridging the lake's terrestrial and aquatic environments. This requires a holistic view encompassing institutional arrangements, socioeconomic and cultural factors, and biophysical and technological factors used in the management process. Aryani et al. (2012) elaborate on three scenario approaches to simulate environmental conditions, referred to as (1) the existing scenario, (2) the moderate scenario, and (3) the optimistic scenario.

Regarding sustainable development, particularly SDG Goal 14, which aims to conserve and sustainably utilize marine and ocean resources for sustainable development, the Gorontalo Regency government has shown strong support by organizing the Lake Limboto Festival. This event is intended to promote conservation and sustainable use of water resources (seas, lakes, rivers). Critical missions of the Lake Limboto Festival include: (1) increasing both international and domestic tourism to Lake Limboto, (2) preserving the natural environment of the Lake Limboto area, (3) fostering cultural creativity and a creative climate within the Lake Limboto area, and (4) empowering the community to improve welfare.

The importance of scenario planning in development has been highlighted by Lindgren and Bandhold (2003:25), who describe it as a strategic planning tool practical for long-term planning under uncertain conditions. Using scenarios can help sharpen strategy, prepare for unexpected events, and maintain focus on the right direction and issues. Scenario planning provides a clear picture of the desired future by examining possible developments, which can be instrumental in the development process and helpful in identifying early warnings of undesirable outcomes. Lindgren and Bandhold (2003:48) outline a series of steps for scenario planning, forming the TAIDA model, which includes 1—tracking, 2—analyzing, and 3. Imaging, 4. Deciding, and 5. Acting.

RESEARCH METHOD

This study employs a qualitative approach selected to facilitate the discovery, understanding, explanation, and depiction of social and public phenomena related to the conservation of Lake Limboto. The focus of this qualitative research is closely tied to problem formulation, as the research problem guides the focus of the study. However, the research focus may evolve based on the research issues encountered in the field, aligning with the flexible nature of qualitative methods, which follow an empirically inductive reasoning pattern.

The study location is Gorontalo Regency, specifically the Environmental and Water Resources Agency of Gorontalo Regency, along with other relevant fields involved in program development, evaluation, and control within Gorontalo Regency. This research employs qualitative data analysis through an interactive analysis model, supported by SWOT and PEST analyses, to formulate a conservation scenario plan for Lake Limboto. The interactive analysis model is based on the approach developed by Miles, Huberman, and Saldana (2014:14), following a procedure that includes data condensation, data display, conclusion drawing, and verification.

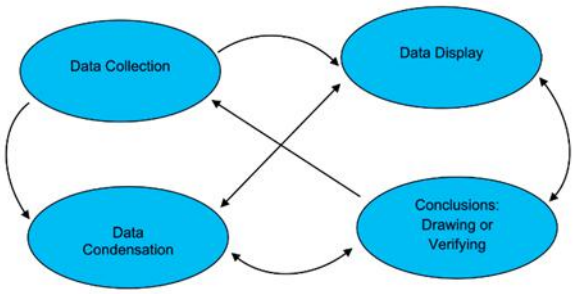


Figure 3.1: Components of Interactive Data Analysis

Source: Miles, M.B., Huberman, A.M., and Saldana (2014)

Qualitative Data Analysis

The researcher interprets the data presented in the display while concluding. Conclusions are drawn based on data presentation, with each conclusion serving as a topic for further discussion and analysis, demonstrating that conclusion drawing and verification are efforts to interpret data that have been tested for accuracy or validity. This qualitative data analysis is conducted continuously, encompassing data condensation, display, and conclusion/verification sequentially as interconnected analysis components. Conclusion drawing at this stage represents an interpretation of the data presented in the data display (Miles et al., 2014, p. 20).

RESULTS AND DISCUSSION

1. **Critical Conditions Threatening the Sustainability of Lake Limboto**

1.1 Economic Conditions

To address the complex challenges in the development of Lake Limboto, especially those arising from a lack of synergy among agencies, programs, and stakeholders involved in lake management, scenario planning is essential to drive improvements in economic conditions. This approach aligns with Lindgren and Bandhold's (2003) perspective, which emphasizes that improvement can be achieved through effective scenario planning. A well-developed scenario planning framework helps identify critical aspects such as resource management, economic sector development, environmental quality enhancement, and local community empowerment. Active participation from all stakeholders, including local communities, regional governments, NGOs, and private sectors, is crucial in this process. Through collaboration and synergy among all parties, scenario planning can effectively support the

sustainable improvement of Lake Limboto's economic conditions. According to Theresia et al. (2015), several strategies can be used for community economic empowerment, such as motivation, awareness-raising, skills training, and resource mobilization. This idea is rooted in the belief that every individual possesses resources that, when pooled, can significantly improve socioeconomic conditions. Developing resource collection, allocation, and utilization systems should be carefully planned to ensure equal opportunities for all members, guaranteeing sustainable ownership and management. This view is consistent with the Directorate General of Aquaculture (2007), which emphasizes the urgency of aquaculture development in public waters due to rising demand for fish as a source of animal protein amid population growth. Additionally, unbalanced fish capture practices without support from aquaculture and restocking efforts can gradually threaten the sustainability of public water resources.

1.2 **Climate Change**

Research findings indicate that many are concerned about the potential negative impacts of rising temperatures on Lake Limboto's condition. Extreme heat threatens water quality, potentially leading to a lake crisis. Activities reliant on the lake's ecosystem, such as shoreline agriculture, capture fisheries, aquaculture, tourism, genetic resource conservation, and habitats for vital flora and fauna, may be at risk. This aligns with Germadan's (2009) assertion that lake ecosystems can suffer from both natural factors and human activities. Naturally, lake damage may result from climate change, volcanic activity, tectonic earthquakes, and floods. Human-induced damage often includes pollution from agriculture, aquaculture, industrial activities, tourism, domestic waste, land-use changes, hydrological system alterations, the introduction of non-native species, and the development of settlements near the lake. Without appropriate management efforts, Lake Limboto could experience significant environmental issues. Current issues include erosion, sedimentation, and water pollution, raising concerns among locals who depend on the lake for their livelihoods.

The study highlights climate change threatens Lake Limboto, potentially leading to degradation, lake shrinkage, and diminished ecosystem activity. Local concerns focus on erosion, sedimentation, and pollution. Lakes, formed naturally or by human intervention, collect and store water from rain, springs, and rivers. They serve crucial roles as freshwater protein sources and irrigation supplies for agriculture and plantations. The Regional Medium-Term Development Plan (RPJMD) of Gorontalo Regency, presented by the Regent of Gorontalo, recognizes climate change as a key focus in developing the Strategic Plan of Regional Government Organizations (Renstra OPD). Strengthening climate change mitigation and adaptation in regional planning is essential to disaster prevention efforts. It is concluded that lakes primarily stabilize water flow and hold significant economic value, especially aquaculture. The impact of climate change, including rising temperatures, is indeed worrisome for local ecosystems.

1.3 **Political Change**

To address the challenges of implementing the Strategic Environmental Assessment (SEA), the Indonesian Ministry of Environment (2014) outlines several vital steps. First, information transparency must be improved so the public has better access to information about lake management. Second, independent monitoring mechanisms involving active participation from local communities and civil society organizations should be strengthened. This will ensure effective oversight of SEA implementation through robust social control. Additionally, it is essential to develop clear technical guidelines for conducting SEA. The Strategic Environmental Assessment (SEA) is significant in political ecology theory, which

provides a theoretical framework for understanding the interactions between political power, decision-making, and environmental issues related to SEA. According to Hasyim (2018), who researched the political ecology of lake management, political ecology theory aids in comprehending the complex political dynamics inherent in SEA. Through this theoretical framework, more holistic, participatory, and sustainable strategies and approaches can be developed for environmental management using the SEA.

2. Developing Effective Scenario Planning for Sustainable Lake Conservation

2.1 Tracking

Tracking in development scenario planning for lake management involves monitoring and evaluating the progress and outcomes of various strategies and management interventions to preserve and protect the lake ecosystem. This approach allows assessment of the effectiveness of different scenarios and helps guide future management decisions. Lake Limboto offers sustainable economic and ecological benefits to the surrounding communities and regions, which can be managed and developed through scenario planning.

According to Hadi (2012), involving the community in conservation provides various benefits, including economic, awareness, and shared evaluation aspects.

1. **Availability of Human Resources**: The area surrounding Lake Limboto has available human resources that can support management and development efforts. Local knowledge about the lake, fishing skills, and other expertise can be utilized to support effective monitoring, research, and management.
2. **Community Awareness**: Communities around Lake Limboto have demonstrated high awareness of the need for lake conservation. This awareness helps foster sustainable conservation efforts.

2.2 Analyzing

Several aspects of environmental management, including the analysis of integrating PEST Plus aspects into environmental planning and natural resource management in Lake Limboto, face issues requiring analysis, notably the inadequate integration of environmental, social, economic, political, and technological aspects in lake management planning. Analyses often focus more on economic or technical aspects, while environmental and social aspects are often overlooked. This is reinforced by Pratiwi et al. (2012), who emphasize that the PLES Plus analysis serves as a supporting tool in scenario planning, incorporating critical dimensions in natural resource planning and management, such as that of lakes. The need to integrate environmental, social, economic, political, and technological aspects in lake management planning can be analyzed using the PLES Plus Theory, which helps identify how physical aspects are frequently neglected in such analyses. Challenges in lake conservation analysis include limited financial, technical, and human resources, which can hinder comprehensive analysis and solution implementation. For data collection, research, and conservation actions, sufficient funds and expertise are required. This is further supported by Hedrick (2003), who explains that analytical weaknesses stem from differing interests, as lake conservation often involves diverse stakeholders with varied priorities. Conflicting interests can obstruct analysis and effective decision-making, highlighting the need for robust collaborative efforts to reach consensus.

2.3 Imaging

Involving relevant stakeholders in managing environmental impacts is essential for achieving sustainable and consensus-oriented planning. Several perspectives from Faludi's (1973) planning theory shed light on interest-based planning, emphasizing the importance of understanding and accommodating various interests within planning. Managing

environmental impacts means identifying and including all stakeholders potentially affected by specific policies or projects. It also entails a deeper understanding of conflicts among different interests and striving for consensus. Faludi consistently emphasizes the importance of actively involving stakeholders in the planning process. This includes granting them access to decision-making, providing input, and contributing to formulating plans and policies.

2.4 Deciding

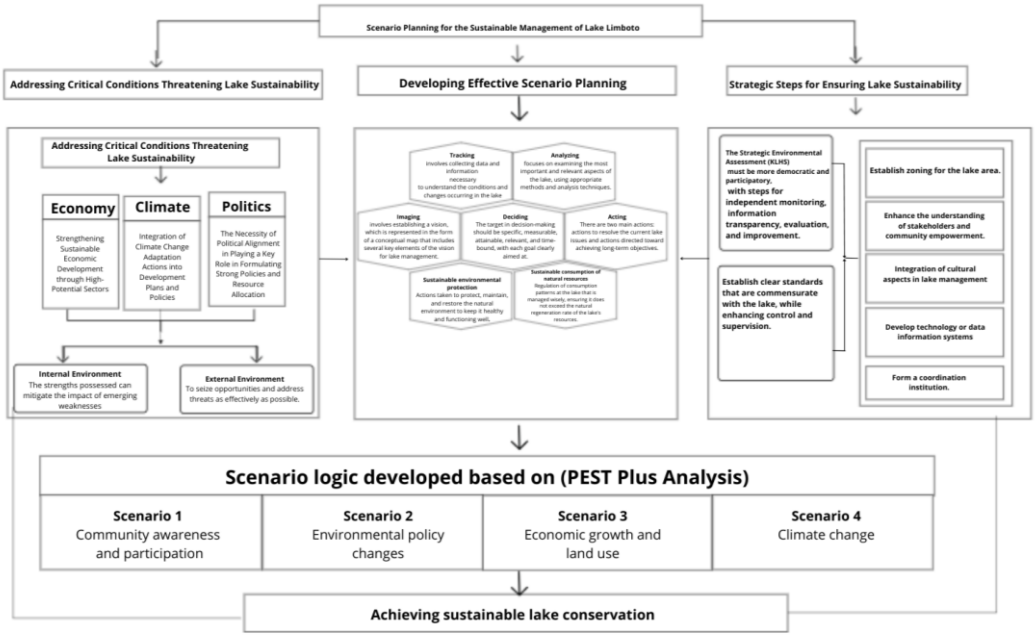
Community involvement in decision-making related to lake management can be enhanced through diverse scenario planning. Scenario planning serves as a tool to involve the public in decision-making by presenting options and potential consequences. As Bohensky et al. (2016) state, options in scenario planning should encompass various alternatives resulting from public or consultation group meetings. These scenarios aim to reflect community aspirations and interests while considering environmental, social, and economic factors. In developing scenario planning, it is vital to consider community aspirations and interests as well as environmental, social, and economic factors, as discussed by Bohensky et al. (2016). These scenarios reflect the needs and aspirations of the communities involved in lake management and consider the impacts on the natural environment and social and economic aspects. Through the scenario planning mentioned earlier, communities can actively participate in the decision-making process regarding lake management. In this process, they can provide input, express preferences, and contribute to final decisions through discussions, public meetings, or consultation groups. This approach fosters a more inclusive, accountable, and sustainable decision-making process that aligns with the needs and aspirations of the communities involved in lake management.

2.5 Acting

The National Water Resources Council (2010) has issued recommendations for integrated lake management. Several vital principles are adopted when implementing integrated lake management. First, catchment area management in lakes is integrated into water resource management strategies at local, regional, and national levels. Second, support is provided for developing sustainable lake management institutions that are community-based and capable of linking local and national institutions. Sulistyarini (2013) also proposed strategies in "The Condition of Lakes in Indonesia and Management Strategies," including building information systems, enhancing comprehensive understanding and perception among stakeholders, and establishing lake management institutions. Implementing these strategies is expected to mitigate or even prevent lake ecosystem degradation within the ecological carrying capacity essential for human sustainability on Earth.

Implementing the acting phase in lake management is only sometimes smooth and faces various challenges, such as resource limitations, lack of stakeholder participation, and technical constraints. Implementing the acting phase in lake management requires the right strategies and approaches. Waluya (2010) suggests several strategies for implementing actions, including collaboration among relevant parties, community participation, monitoring and evaluation, education, and socialization. Close collaboration between stakeholders is crucial for optimizing resources and overcoming shared challenges. Involving local communities in decision-making and action implementation fosters a sense of ownership and enhances the sustainability of lake management programs. An effective monitoring and evaluation system is needed to track progress and identify obstacles, while educational and socialization activities raise awareness and community knowledge. By applying these strategies, lake management can be carried out sustainably with solid support from all relevant parties.

3. Recommended Model for Sustainable Scenario Planning in the Management of Lake Limboto



Scenario 1: Enhancing Community Awareness and Involvement

This scenario involves government efforts to build awareness and facilitate community involvement in decision-making related to the lake. It also considers resource allocation, investment in lake-related infrastructure and technology, and economic incentives for communities and industries participating in lake conservation efforts. Community awareness of the importance of lake preservation and the social norms influencing lake-related behaviour are critical factors. Technology can also increase community awareness through online platforms, social media, or mobile applications. Additionally, considering the natural environmental conditions and the impact of human activities on the lake is highly relevant.

Scenario 2: Environmental Policy Change

This scenario involves environmental policy changes focusing on lake protection and stricter enforcement against pollution. In economic terms, the government provides incentives and financial support for lake restoration projects and encourages investment in sustainable tourism development around the lake. Increased public awareness of the importance of maintaining water quality and the lake ecosystem also leads to active participation by local communities in lake management programs. Advances in water treatment technology can provide innovative solutions to address lake pollution. The lake's environmental conditions and the impact of human activities are also essential factors in this scenario.

Scenario 3: Economic Growth and Land Use

This scenario emphasizes the government's focus on economic development, which must consider the impact on the lake environment. Rapid economic growth may increase industrial activities around the lake, potentially leading to pollution and decreased water quality. Modern agricultural technology can increase land productivity but must also account for its negative impact on lake water quality. This scenario emphasizes the importance of considering the lake's environmental conditions and land use in sustainable lake management.

Scenario 4: Climate Change

By considering these four scenarios with a PEST Plus analysis, which includes political, economic, social, technological, and environmental aspects, sustainable lake management can be achieved for Lake Limboto. A scenario-based approach to lake management is essential,

involving a series of crucial management steps such as tracking, analyzing, imaging, deciding, and acting, known as the TAIDA approach, to form a comprehensive framework for planning and implementing conservation efforts for Lake Limboto. In this approach, it is essential to outline several realistic scenarios and select the most suitable one for implementation. Based on a realistic scenario logic, the four chosen scenarios are enhancing community awareness and involvement, environmental policy change, economic growth and land use, and climate change. To achieve a Sustainable Lake Management Plan, these four scenarios must consider sustainability dimensions, including ecological, economic, social, institutional, and technological aspects. Lake management can become more holistic and integrated by integrating sustainability dimensions and involving the community and relevant stakeholders. This approach will help balance human needs with ecosystem sustainability, preserving the lake and providing ongoing benefits for the communities that depend on it.

CONCLUSION AND RECOMMENDATIONS

1. Conclusion

This concluding section presents the key findings summarized from the research results and their discussion. These key conclusions explain the main focus of the study, as determined earlier.

1. The critical conditions threatening the sustainability of Lake Limboto in Gorontalo Regency are reflected through three crucial aspects that describe various strategies and actions for sustaining the lake and addressing the challenges faced. These three aspects are economic conditions, climate change, and political changes. Below is a more in-depth explanation of these aspects based on the research findings.

a. **Economic Conditions:** Lake Limboto faces several challenges that must be addressed, including the need for optimal development in economic sectors connected to the lake. Additionally, the community's high dependency on the lake has reached a significant level, causing lake productivity to decline as it is strained to meet economic needs. Furthermore, lacking empowerment and support in developing economic skills and capacities has hindered efforts to improve community welfare. Strengthening efforts are needed to address these issues. Training, education, and access to necessary information to develop related economic sectors still need to be improved. Therefore, developing economic sectors related to the lake is essential to enhancing market access and supporting the community in improving their skills and capacities. This way, the economic potential linked to Lake Limboto can be maximized while preserving the sustainability and balance of the lake's ecosystem.

b. **Climate Conditions:** Rising air temperatures have classified Lake Limboto as a hot zone, posing a severe threat to the lake. This threat impacts water quality and potentially triggers a regional water crisis. Although Gorontalo Regency's development plans have included climate adaptation measures, sensitivity to climate risks and disasters still needs to be improved. Consequently, the projected scenarios have yet to achieve the desired outcomes. To address this challenge, more comprehensive and mature scenario planning is required. This involves deeper climate risk analysis, identification of concrete adaptation measures to climate change, involvement of relevant stakeholders, and a continuous monitoring and evaluation approach. With this approach, Lake Limboto's sustainability can be more effectively preserved while improving the community's welfare.

c. **Political Conditions:** Political engagement in managing Lake Limboto needs to pay more attention to lake preservation. Political policies tend to prioritize economic aspects alone.

Some political policies are at odds with lake conservation efforts, and conflicts between various interests and authorities often arise during the formation of local regulations, which tend to be unsupportive and short-term in nature. Additionally, management plans and policies often change with each government transition. More substantial political commitment and adequate resource allocation are necessary to establish robust, sustainable policies for lake management. Community participation is also essential, making policies more responsive to the needs of the lake and the interests of the community that depend on it.

2. Recommendations

1. The critical conditions threatening the sustainability of Lake Limboto in Gorontalo Regency must consider several crucial factors, including economic conditions, climate change, and political conditions while implementing relevant recommendations. In the economic context, conducting an in-depth analysis of the economic potential surrounding the lake is essential. This step aims to identify sectors with significant development potential. An evaluation is also needed to understand the impact of economic activities on the lake, enabling the implementation of appropriate and sustainable management measures. Furthermore, climate change is a critical factor that must be considered in scenario planning. A comprehensive evaluation of the impacts of climate change, particularly on vulnerable sectors, should be conducted. Climate risk analysis must be carried out carefully while identifying suitable adaptation strategies. Collaboration with relevant stakeholders is crucial in addressing climate change challenges.
2. Additionally, monitoring political changes and understanding their impact on lake management is essential. Anticipating political changes will help ensure the continuity and success of management efforts. Political solid support enables the government to formulate lake protection and sustainability policies. Reasonable regulations are also required to regulate human activities around the lake and ensure the availability of adequate resources for implementing management plans. Sustainable, adaptive, and responsive management to existing environmental and social dynamics can be realized by considering economic, climate, and political conditions in lake planning scenarios.
3. Developing effective scenario planning to achieve sustainable lake conservation requires recommendations related to scenario planning and sustainable development. Several suggestions must be considered in this scenario planning approach: First, effective tracking should be implemented using modern technologies such as sensors and remote sensing. This way, the lake's condition, including water quality, fish populations, biodiversity, and ecosystem changes, can be continuously monitored. The data collected through tracking becomes a critical foundation for identifying trends in changes that require further action. Next, analyzing the collected data is critical. This analysis identifies factors influencing the lake's health, patterns of change, and existing challenges and opportunities. With this understanding, appropriate solutions for sustainable management can be developed. Imaging also plays a vital role in formulating an innovative future vision for Lake Limboto. Innovative and sustainable management strategies can be designed by thinking creatively and progressively. Input from stakeholders, local communities, and relevant experts should be involved to generate better ideas and reach a consensus on better

management steps. The decision-making stage is also crucial, where decisions must be based on the data analysis and perspectives developed earlier. Involving experts, stakeholders, and local communities in decision-making will ensure that the management plan remains sustainable and prosperous. Finally, the scenario plan should be implemented into concrete actions. Continuous monitoring and periodic evaluation are essential to ensure that the actions taken are adequate and that improvements can be made if necessary. Additionally, in the context of sustainable development, environmental protection and considerations regarding the consumption of natural resources are critical. With cross-sector collaboration and local wisdom, we can preserve the lake as an integral part of the environment and the community's livelihoods.

4. Research Limitations

The limitations of this study aim to narrow the discussion to the core issues of the research. The scope determines the critical concepts of the issues so that the problems discussed in the research can be understood more easily and clearly. Defining the research limits is essential in focusing on the central issues to be discussed, avoiding confusion or ambiguity in interpreting the research results. In this context, the research limitations include:

1. Critical conditions threatening the sustainability of Lake Limboto:

   In the context of this research limitation, the focus is on aspects that may threaten the sustainability of Lake Limboto.

   a. Economic Conditions are limited to how economic factors can affect the lake, such as local economic activities, development, or economic policies that impact the management of lake resources.

   b. Climate Change in this study is limited to the effects of climate change on the Lake Limboto ecosystem, including changes in water temperature, altered rainfall patterns, and other changing factors that can affect the lake's sustainability.

2. Developing effective scenario planning to achieve sustainable lake conservation in Gorontalo Regency:

   The research limitation covers specific aspects related to scenario planning and sustainable lake conservation development. This includes:

   a. Scenario Planning:

      1. Tracking is limited to developing methods for tracking environmental changes in the lake.
      2. Analyzing is limited to analyzing relevant data and information to formulate compelling conservation scenarios.
      3. Imaging is limited to creating visual representations of conservation scenarios to understand the concepts better.
      4. Deciding is limited to the decision-making process based on the analysis and evaluation of the developed scenarios.
      5. Acting is limited to implementing conservation scenarios through concrete and practical steps.

   b. Sustainability:

      1. Environmental Protection is limited to understanding and implementing sustainable environmental protection practices in the context of lake conservation.

2. Natural Resource Consumption is focused on evaluating the impact of natural resource consumption on the lake's sustainability and developing strategies to mitigate potential adverse effects.

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