

Sustainable Conservation Planning Strategy for Limboto Lake in Gorontalo Regency: Towards Ecosystem Maintenance and Sustainable Development

Rifka S. Akibu¹, Soesilo Zauhari², Sarwono³, Lely Indah Mindarti⁴

^{1,2,3,4}Student of Doctoral Degree, Doctoral Program of Administration Science, Universitas Brawijaya, MT Haryono 163 Malang, Indonesia

Abstract

This dissertation will explore and formulate sustainable conservation planning scenarios for Limboto Lake. This research focuses on understanding the challenges and several opportunities that maintain the ecosystem while promoting sustainable development in the region by considering the KLHS previously created by the government under real conditions. This research will examine ecological, social, economic, and several relevant policy aspects, as well as develop practical recommendations to achieve conservation and sustainable development goals. This research uses qualitative research methods. Thus, it will provide valuable guidance for stakeholders and policymakers to protect this precious lake and improve the quality of life of local communities.

Keywords: Scenario Planning, Lake Conservation, Lake Limboto, Sustainability

1. Introduction

Limboto Lake, located in Gorontalo Regency, Indonesia, is a natural resource with its great ecological and socio-economic value. This lake not only serves as an important freshwater ecosystem but also plays a significant role in local people's lives. However, in recent decades, Lake Limboto has faced increasing ecological pressure due to environmental change, degradation of natural resources, as well as population growth, and increasingly intensive human activities around it. Lake Limboto is one of 15 national priority lakes in critical condition is expected to turn into land. Therefore, scenario planning is needed to overcome this phenomenon. Climate change, deforestation, and changes in land use patterns have a negative impact on the water quality and ecosystem of Lake Limboto. Water pollution, decreased water quality, and loss of biodiversity in the lake have become serious problems that threaten this lake's ecosystem sustainability. Apart from that, the community's need for natural resources around the lake, such as fishery products and freshwater also puts additional pressure on the environment. The Gorontalo district government has prioritized Lake Limboto as a priority development area for the development of tourism, fisheries, an economic center, and meeting the needs of communities around the lake. In this context, sustainable and integrated conservation planning is a must to protect Lake Limboto, maintain biodiversity, and at the same time ensure the welfare of local communities. To achieve this goal, a holistic

approach involving stakeholders, science, and wise decision-making is needed to solve this problem. Therefore, this dissertation aims to formulate a sustainable conservation planning strategy for Limboto Lake by considering various relevant ecological, social, economic, and policy aspects. Through a deep understanding of the existing complexity of challenges and opportunities, hopefully, this dissertation contribute a valuable study to efforts of lake preservation and development in the Gorontalo Regency region in a sustainable manner. This research study would become the basis for sustainable development policies that focus on the protection of natural ecosystems and community welfare.

2. Theoretical Basis

This chapter describes the theoretical basis for developing a sustainable conservation planning strategy for Lake Limboto in Gorontalo Regency. This theoretical basis includes relevant various concepts and principles in understanding the context of conservation planning, natural resource management, and sustainable development. The concepts discussed are:

2.1 Climate change and its impact on lakes

Global climate change influences an important lake ecosystem factor. This study will discuss the impact of climate change on water temperature, rainfall patterns, and water quality in Lake Limboto. These changes will be analyzed in the context of seasonal changes, shifts in rainy season patterns, and increases in average temperatures. Several theories raised in this discussion, such as Schindler (2001) highlight how climate change and human factors can affect water quality and lake ecosystems. This research shows the importance of understanding the impact of climate change on Lake Limboto. Andrian et al (2009) describe the role of the lake as an indicator of global climate change and water temperature. Sharma Er. Al (2016) provides a Holocene analysis of the impacts of climate change on lakes. Those studies illustrate how climate change has affected history in different regions.

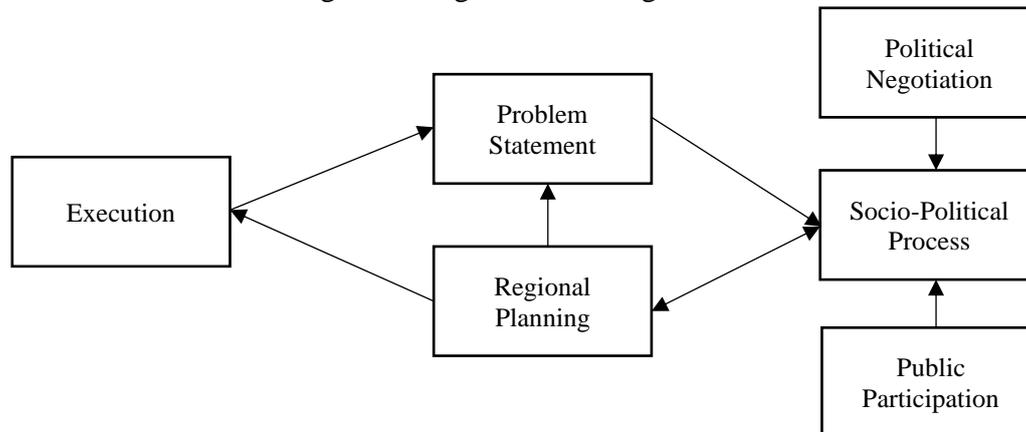
2.2 The role of forests and land use in lake conservation.

This chapter discusses the role of forests and land use in influencing lake water quality around Lake Limboto and also explores the concepts of deforestation, land conservation, and increased vulnerability to erosion. Apart from that, the importance of protected forest areas and sustainable land management policies will be emphasized by several millennium ecosystem assessment theories (2005) discussing how changes in land use and deforestation, land conservation, Defries et al (2005) review the impact of land use on electricity flow and erosion in tropical regions. This study helps us understand how land management practices can affect lake water quality.

2.3 Regional development planning

Planning theory cannot stand alone to respond to these unexpected events. Planning is made based on existing and predicted future data. The planning position must be flexible when the future event experience is unexpected. Planning is changeable not carved in stone, so the evaluation function of planning becomes very important when future events are different from the plan. As seen in the picture below:

Figure 1: Regional Planning Process



Planning theory requires the contribution of other scientific disciplines as observation capital as well as explanatory media, such as social sciences, economics, culture, mathematics, statistics, environment, civil engineering, information systems, and others.

The emergence of the idea of regional development planning originates from view (1) which considers that national development planning is not effective enough in understanding the needs of citizens who live in an administrative area in the context of regional development. According to this view, regional development is only developed by the central government in the regions so that people in the regions are unable to access the public decision-making process to determine their destiny and (2) the emergence of national government policies which give wider authority to regional government administrators in the context of implementing decentralization policies. Sjafrizal (2014:26)

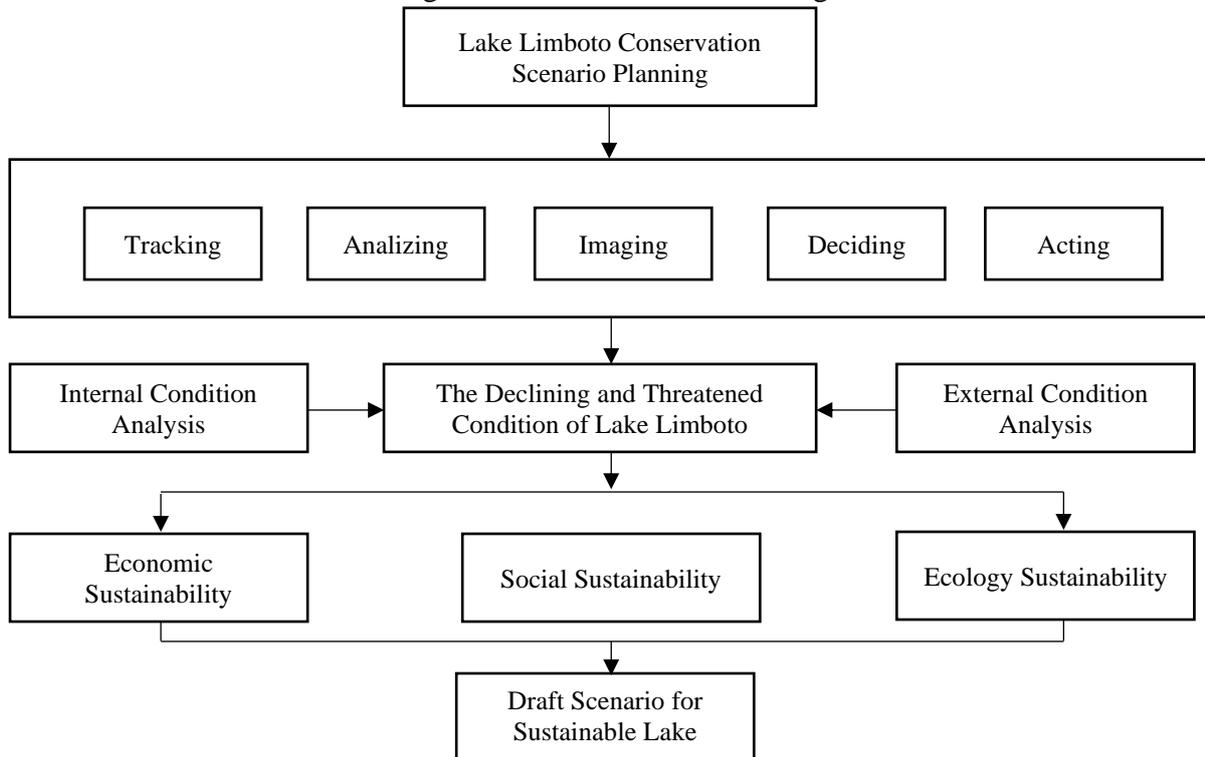
In the Training Module of Regional Development Planning published by the Ministry of Home Affairs (2007), regional development planning defines the planning spectrums. The community is the core or source of the entire spectrum of development planning. The three major categories in the scope of regional development are as follows:

1. Social Development is related to all development activities to improve humans/society in the social order with a spectrum of development planning, including education, worship, fitness, poverty, tradition, culture, transformation, communication, security, safety, ideology, politics, etc.
2. Economic Development is related to all development activities to improve humans/society in the economic order with a spectrum of development planning, including livelihood, business, work, production, added value, consumption, competition, protection, investment, monetary, fiscal, access to capital, access to markets, commerce, and so on.
3. Related to all building activities to improve livability with a spectrum of development planning, including fresh water, clean air, clean environment, convenience/technology, health, cleanliness, pollution, disaster vulnerability, global warming, climate change, etc.

From the explanation above, regional development planning must have a clear essential as stated by Dimitrios and Thomson (2007:52). The main essential of regional development is to change the condition of society to a better condition of society. Efforts to change the condition of the community must be carried out in a planned manner. With the planning, the deployment of resources will be aimed at realizing the plan. With good planning and the deployment of the right resources by the plan, the future conditions to be addressed can be realized Dimitrio and Thomson (2007:52).

The framework of thinking is as follows:

Figure 2. Framework of Thinking



4. Research Methods

This chapter will explain the research methods used to formulate sustainable conservation planning strategies for Limboto Lake. This research uses a qualitative approach through the process of discovering, understanding, explaining, and obtaining descriptions of social and public phenomena related to the conservation of Lake Limboto. The reason for using this approach is also based on the explanation by Lincoln and Guba (1985: 78) that qualitative research is carried out in the natural research field without being manipulated and regulated through experimentation. In Chapter 3, to evaluate data we will also elaborate on the analytical methods used and formulate sustainable conservation strategies, statistical approaches, modeling, and other relevant analytical tools.

5. Discussion

Lake Limboto is currently facing a series of serious threats, such as pollution, habitat degradation, climate change, and declining water quality. If appropriate protective measures are not taken, this threat could lead to further lake degradation and even threaten the viability of the ecosystem and the sustainability of water resources in the region. In Arifin's (2021) theory regarding environmental sustainability, it is important to ensure that the protection efforts taken are not only effective recently, but also do not harm the lake and the environment sustainability in the future. Therefore, some steps such as habitat restoration and adaptation to climate change aimed at achieving long-term sustainability.

Limboto Lake protection steps should consider how the lake's environmental conditions affect the lake's quality and sustainability. Environmental threats that occur are not only influenced by internal factors of the lake itself but also by interactions with the surrounding landscape. In the Ecological concept expressed by Khanna, Babu & George (1999), protection must not only focus on the lake itself but also consider the impact of human activities and environmental changes in the lake area.

In facing threats, it is important to manage natural resources wisely and sustainably. In the resource management perspective expressed by Roegers and Jalal (2008), it is important to involve local communities in the decision-making and implementation of environmental protection programs. Active community participation will increase awareness about the importance of protecting Lake Limboto and create joint agreements in resource management. In efforts to protect lakes, conflicts may appear to happen among different interests, such as fishermen, farmers, and the industrial sector. Resource Management Theory emphasizes the importance of finding fair and sustainable solutions to resolve conflicts and achieve environmental protection goals.

Efforts of Limboto Lake protection will focus more on achieving a balance among social, economic, and environmental aspects when all stakeholders adopt the concept of sustainable development, which maintains a balance among social, economic, and environmental dimensions in development efforts, as suggested by Rogers & Jalal (2008). This approach will ensure that lake protection not only has a positive impact on current conditions but also provides long-term benefits for society and the environment in the future. In this way, it will be easier to develop an action plan that accommodates the interests and needs of all parties.

Environmental protection is not only implemented with action plans but also involves a good monitoring system to measure the impact of lake protection programs. Regular evaluation will help identify the effectiveness of the steps taken and improve worse strategies. As expressed by Hakim (2007) in a journal on environmental sustainability evaluation emphasized that sustainable development, monitoring, and evaluation have an important role in ensuring the success and sustainability of efforts to protect Lake Limboto.

Monitoring may include measurements of water quality, biodiversity, habitat conditions, and other environmental indicators. Good monitoring will provide accurate information about the lake's condition and the implementation of effectiveness measurements. Apart from that, monitoring and evaluation help to measure the impact of lake protection programs on the surrounding environment and the sustainability of lake ecosystems. Thus, the evaluation will help in developing further strategies and optimizing the desired results in the context of sustainable environmental protection of Lake Limboto.

Furthermore, Betaley & Meaning (1997) stated that the results of monitoring and evaluation should be the basis for improvements and changes in the Limboto Lake protection program. If any weaknesses or problems are identified, corrective action should be taken to overcome existing obstacles and increase the effectiveness of the protection program. By monitoring and evaluating continuously, the Limboto Lake protection approach with a sustainable development theory perspective becomes more adaptive and responsive to environmental changes and community needs. Continuous evaluation allows stakeholders to continuously adapt protection strategies according to environmental dynamics and evolving social demands. In addition, good monitoring will provide accurate and up-to-date information about lake conditions, so that decisions can be made based on strong data and evidence. This step can develop protection measures more efficiently and focus, also increasing the chances of achieving better protection of Lake Limboto.

Each stage in scenario planning should adopt urgency sustainable natural resource consumption. Lewis (2023) in the concept of sustainable development explains that managing wise consumption patterns to meet human needs without exceeding the regeneration capacity and availability of natural resources in lakes is an important step in maintaining the balance of the lake ecosystem and ensuring the sustainability

of the surrounding environment. Efforts are important to regulate wise consumption patterns in lakes to prevent the environment's permanent damage and ensure the sustainability of lakes' natural resources, providing benefits to human life and the surrounding biodiversity. By adopting sustainable consumption of natural resources, we can maintain the balance of lake ecosystems, minimize negative impacts on the environment, and provide effective protection of the lake and ecosystems.

The scenario planning approach aims to identify and anticipate risks and opportunities from uncontrolled land use change practices, overfishing, and the impact of climate change on residential growth. These imbalanced practices have led to unsustainable consumption of natural resources. Rojers & Jalal (2008) argue that the scenario planning approach has important value because it combines information from different parties. This makes it possible to design alternative scenarios that visualize the potential consequences of different actions. Discussions about overfishing practices and land use changes need to be evaluated in the context of achieving a balance between economic, social, and environmental aspects. In practice, an analysis can be carried out based on Brundtland's (1987) Sustainable Development theory, which emphasizes the importance of meeting current needs without compromising the ability of future generations to meet their needs.

Environmental Officials and River Basin II acknowledged that there were problems in Lake Limboto, such as water pollution, excessive fishing, changes in land use, and the impact of climate change. They are committed to overcoming this problem with concrete actions, such as implementing strict policies on waste management and implementing strict supervision overfishing. All of these actions reflect the principles of effective public administration and government responsibility, as outlined by Sugandy & Hakim (2007). The concept of environmental ecology analyzed by Beatley & Manning (1997) is also very relevant in helping to understand the relationship between humans and nature. By analyzing data regarding the decline in fish populations and the impact of water pollution, we can maintain the balance of the Lake Limboto ecosystem. These data can be analyzed in the context of the balance of the lake ecosystem. The above approaches help to understand the complex interactions between humans and the natural environment. By combining knowledge from various disciplines, such as public administration and environmental ecology, comprehensive steps can be taken to maintain the sustainability and balance of precious lake ecosystems.

More than that, wisely managing consumption patterns will also provide long-term benefits for the communities around the lake. By utilizing natural resources sustainably, we can ensure the availability of sustainable resources for future generations, so that Limboto Lake can remain a valuable and invaluable natural heritage for human life. Therefore, Hamdi (2012) operationally examines more deeply the sustainable consumption of natural resources. This includes conservation and good management of natural resources to maintain their sustainability. These efforts involve maintaining ecosystem balance, protecting natural habitats, and avoiding overexploitation of limited natural resources. Apart from that, Hemdi also highlighted the importance of adopting environmentally friendly technology and innovation as a new way to reduce pressure on natural resources and create sustainable ways of utilizing them. By applying this concept in scenario planning, we can be more effective in maintaining the sustainability of Limboto Lake as well as realizing the goals of conservation and environmental protection of natural resources and creating sustainable ways to use them.

Meanwhile, Turner (1988) also presents several aspects that need to be considered, that the roles of government and society cannot be separated in supporting sustainable consumption of natural resources. The government has an important role in establishing policies and regulations that support sustainable

consumption of natural resources. They ensure that these policies not only aim to meet current needs but also pay attention to the sustainability of the natural resources of Lake Limboto in the future. The community also has a crucial role in protection efforts. Public education and awareness about the importance of sustainable consumption of natural resources will increase their participation and support in protecting Limboto Lake. Community participation in conservation and natural resource management programs will help create mutual understanding and achieve environmental protection goals. Thus, collaboration between the government and the community is the main key to achieving sustainable consumption of natural resources in Lake Limboto.

The application of the green economy adopted by the Gorontalo Regency government can be fully implemented in the management of Lake Limboto. This will help achieve a balance between economic development and environmental sustainability, especially in the overconsumption of natural resources. Scones (1993) stated that green economic strategies based on efficient and environmentally friendly use of resources should be encouraged. This approach will help create long-term sustainability in the economy and natural environment. In this way, human consumption patterns of nature can be improved.

While striking a balance between economic development and sustainability, climate change also greatly influences sustainable consumption patterns. Mason (1993) emphasized that by implementing energy-saving devices and environmentally friendly transportation systems, we can reduce the use of fossil energy and its impact on climate change. Through the use of more efficient and renewable energy-based technology, we can reduce greenhouse gas emissions and carbon footprint. Additionally, adopting wiser and more sustainable consumption practices in daily life will also help reduce pressure on the environment and natural resources.

The important role of government in regulating and encouraging change towards sustainable consumption cannot be ignored. Policies supporting the use of renewable energy, incentives for environmentally friendly technologies, and regulation of environmental pollution will be important steps in accelerating the transition to sustainable consumption. By adopting more sustainable consumption patterns and efforts to reduce the impact of climate change, we can maintain a balance between economic development and environmental sustainability. This will keep Limboto Lake and its environment sustainable, and pass it on to future generations as an invaluable natural heritage.

6. Conclusions and Recommendations

6.1 Conclusion

Important conditions that threaten the sustainability of Lake Limboto in Gorontalo Regency are reflected in three crucial aspects. Those describe various possible strategies and actions to maintain sustainability and overcome the challenges. These three aspects are economic conditions, climate change, and political change.

6.2 Suggestion

Comprehensive scenario planning plays an important role as an instrument in lake management. By using scenario planning, we can identify possible future lake developments and their possible impacts. Lingrend and Benhold (2003) recommended the tracking, analyzing, imaging, deciding, and acting approach as a sustainable framework for planning and implementation. This approach enables continuous monitoring, in-depth understanding, creative thinking, evidence-based decisions, and implementation of effective actions in the conservation of Lake Limboto.

Acknowledgment

We express our gratitude to the Institute for Research and Community Service, the informant in the field, head of environmental service, the informant from district and village head and all the parties that makes this research carried out well.

References

1. Adrian, R., et al., "Lakes as Sentinels of Climate Change", *Limnology and Oceanography*, 2009, 54(6), 2283-2297.
2. Ahmad, Jamaluddin, 2015 *Public Administration Research Methods Theory and Application*, Yogyakarta, Gava Media
3. Alkire Sabina. 2010. *Writing in Morris*, Christopher (Ed). Amartya Sen *Contemporary Philosophy in Focus*. New York: Cambridge University Press
4. Anggara, Sumantri, 2014, *Development Administration Theory and Practice*, Yogyakarta, Student Library
5. Arifin. 2001. *Management of Indonesian Natural Resources*. Jakarta: Erlangga Publishers
6. Arsyad, Lincoln. 2010. *Introduction to Economic Planning and Development*. Yogyakarta: UPP STIM YKPN
7. DeFries, R.S., et al., "Hydrologic Modeling of the Role of Land Use Change in the Runoff Response of Tropical Watersheds", *Water Resources Research*, 2005, 41(9), W09410.
8. Ellison, D., et al., "Trees, Forests, and Water: Cool Insights for a Hot World", *Global Environmental Change*, 2017, 43, 51-61.
9. Millennium Ecosystem Assessment. 2005. *Ecosystems and Human Well-being: Synthesis*. Island Press.
10. Schindler, D. W., "The Cumulative Effects of Climate Warming and Other Human Stresses on Canadian Freshwaters in the New Millennium", *Canadian Journal of Fisheries and Aquatic Sciences*, 2001, 58(1), 18-29.
11. Sharma, S., et al., "Impact of Climate Change on Lakes in the Northern Hemisphere: A Synthesis of Holocene Records", *Journal of Paleolimnology*, 2016, 56(3-4), 161-176.