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Collaborative Governance in Environmental Protection and Management: Evidence From Lake Maninjau, Indonesia

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A B S T R A C T

Environmental degradation in Lake Maninjau, West Sumatra, Indonesia, has become a complex governance challenge driven by the expansion of floating net cages (KJA), water pollution, and fragmented institutional coordination among stakeholders. Despite regulatory interventions and restoration programs, environmental management remains ineffective due to competing interests and weak coordination among government institutions, private actors, and local communities. This study analyzes the dynamics of collaborative governance in environmental protection and management in Lake Maninjau. This research employs a qualitative case study between August and November 2024. Data were collected through purposive sampling involving 11 key informants from local government institutions, private sector actors, and community groups. Data collection included in-depth interviews, field observations, and document analysis, which were analyzed using thematic analysis based on the collaborative governance framework proposed by Ansell and Gash. The findings show that collaborative governance develops through four interrelated dimensions: initial conditions shaped by ecological pressures and economic dependence on aquaculture; institutional design reflecting stakeholder roles in lake management; leadership exercised by the Agam Regency Government in coordinating initiatives; and collaborative processes developed through dialogue, trust building, and joint programs such as Save Maninjau. Strengthening institutional coordination, stakeholder participation, and regulatory enforcement is essential for sustainable lake governance.

INTRODUCTION

Environmental issues have become one of the most pressing challenges faced by many countries today. Environmental degradation and pollution increasingly threaten ecological sustainability as well as social and economic welfare. Various forms of environmental damage such as deforestation due to illegal logging, degradation of productive agricultural land caused by illegal mining, marine ecosystem damage resulting from illegal fishing, and water pollution in rivers and lakes illustrate the growing complexity of environmental governance (Bhakti et al., 2022; Konkovs & Raimonds, 2020; Saptawartono et al., 2019; Anggraini et al., 2023). However, environmental degradation should not only be understood as an ecological problem but also as a governance challenge. Recent studies highlight that environmental management failures are often linked to weak coordination among multiple actors, fragmented institutional responsibilities, and collective action problems in managing shared natural resources (Ulibarri et al., 2023; Biddle & Koontz, 2021). In this context, collaborative governance has increasingly been recognized as an important approach for addressing complex environmental issues that involve multiple stakeholders and overlapping institutional authorities (Emerson & Nabatchi, 2015; Ansell & Gash, 2008).

The damage to Lake Toba, stemming from the use of this lake for various multi-functions, such as water sources, energy, tourism, and fisheries production, has caused serious problems, especially in terms of pollution. Waste from the tourism, household, livestock, agricultural, and mining industries, along with the activities of companies operating around the lake, has caused significant water pollution. A similar problem also occurs at Rawapening Lake in Central Java, which is currently experiencing a decline in water quality due to eutrophication which damages the aquatic ecosystem. Cage fish cultivation in Lake Rawapening is thought to be the cause of the entry of organic materials, especially phosphorus, into the lake waters. The greater the number of cages used, the greater the amount of organic material that enters the lake, which then triggers eutrophication. Limboto Lake in Gorontalo is also not free from environmental problems. This lake has experienced heavy sedimentation due to illegal logging upstream of the river and erosion of the river cliffs which empty into Lake Limboto. Apart from that, the presence of eutrophication and pollution caused by the high content of free chlorine in Lake Limboto is an indication of pollution by pesticides. Lake Batur in Bali has also experienced a decline in water quality caused by domestic activities, agriculture, household waste, and cage fish cultivation. High concentrations of Chemical Oxygen Demand (COD) and phosphate in waters cause rapid growth of water hyacinth, which in turn causes eutrophication and damage to aquatic ecosystems (Sasangka, 2011).

Several lake ecosystems in Indonesia illustrate how environmental degradation is closely related to governance challenges. Environmental damage in lakes such as Lake Toba, Lake Rawapening, Lake Limboto, and Lake Batur has been associated with pollution, eutrophication, and sedimentation caused by aquaculture activities, domestic waste, agricultural runoff, and land-use change (Pakpahan et al., 2023; Lamangida, 2019; Agustin & Aprinica, 2022). While these environmental problems are often described in ecological terms, they are also linked to institutional fragmentation and limited coordination among stakeholders responsible for lake management. Studies on environmental governance indicate that ineffective coordination

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between government agencies, local communities, and private sector actors frequently results in policy implementation gaps and weak regulatory enforcement (Ulibarri et al., 2023; Morrison et al., 2022). Such conditions reflect collective action challenges in managing common-pool resources such as lakes, where multiple actors depend on the same ecosystem for economic and social activities

Damage also occurred at Lake Maninjau, Agam Regency. Floating net cages (KJA) are one of the main causes of damage to Lake Maninjau, with the number of KJA exceeding the lake's capacity. KJA farmers experience large economic benefits, but also the risk of mass fish deaths due to various factors such as sulfur deposits and sedimentation (Endah & Nadjib, 2017). From data from the Agam Regency Food Security and Fisheries Service, it was recorded that since mid-May 2023, there were 23,359 KJA in Lake Maninjau, compared to the ideal of only 6,000 KJA with a total of 1,678 owners. This KJA is spread across eight Nagari in Tanjung Raya District (ANTARASumbar, 2022). This condition is exacerbated by the presence of a hydroelectric power plant with a capacity of 68 MW which uses water sourced from Lake Maninjau. Unfortunately, waste disposal from the lake does not go through the outlet of the Batang Antokan River but is released through the input (Intake) of the hydropower turbine. This results in changes in sedimentation in the lake which is detrimental to the lake ecosystem (SumbarSatu, 2015).

A similar situation occurs in Lake Maninjau in Agam Regency, West Sumatra. The rapid expansion of floating net cages (Keramba Jaring Apung/KJA), combined with erosion, sedimentation, and pollution, has created serious ecological pressures on the lake ecosystem. Data from the Agam Regency Food Security and Fisheries Office recorded more than 23,000 KJA units operating in the lake, far exceeding the ecological carrying capacity estimated at around 6,000 units. This condition illustrates the complexity of governing lake resources, where economic dependence on aquaculture intersects with environmental sustainability concerns (Endah & Nadjib, 2017). The presence of the Maninjau hydropower plant and increasing human activities around the lake further contribute to environmental pressures that require coordinated governance responses involving multiple stakeholders.

To overcome the problem of damage to Lake Maninjau, the Agam Regency Regional Government issued Agam Regency Regional Regulation Number 5 of 2014 concerning the Sustainability Management of the Lake Maninjau Area. Management of the sustainability of the Lake Maninjau area is a systematic and integrated effort carried out to preserve the Lake area which includes planning, utilization, restoration, preservation, mitigation, control, and supervision. The Agam Regency Government has also issued other policies related to the preservation of Lake Maninjau. One of the implementations of Regional Regulation Number 5 of 2014 is the Save Lake Maninjau program.

The Save Lake Maninjau program is a joint activity carried out in cooperation to clean and at the same time preserve Lake Maninjau, one of the activities is cooperation activity to clean water hyacinth, logistics waste and clean up marine cages that no longer meet the requirements. This activity is carried out in several villages that utilize Lake Maninjau to improve the community's economic sector. The government is also collaborating with various stakeholders in the form of utilizing CSR funds from several regional companies by collaborating with PT. Semen Padang and PT. PLN, to follow up on the revitalization of Lake Maninjau. The collaboration carried out is the creation of a conservation area in the form of a wetland accompanied by training in processing handicrafts from water hyacinths (SumbarKita, 2022).

At the central level, the Central Government also issued Presidential Regulation Number 60 of 2021 concerning Saving National Priority Lakes. This regulation establishes fifteen national priority lakes that require special protection and management. This list includes Lake Toba (North Sumatra), Lake Singkarak (West Sumatra), Lake Maninjau (West Sumatra), Lake Kerinci (Jambi), Lake Sentani (Papua), Lake Tempe (South Sulawesi), Lake Poso (Central Sulawesi), Lake Tondano (North Sulawesi), Lake Limboto (Gorontalo), Lake Towuti (South Sulawesi), Lake Matano (South Sulawesi), Lake Matana (North Maluku), Lake Sentarum (West Kalimantan), Lake Jempang (Central Kalimantan), and Lake Rawapening (Central Java). This step shows the government's seriousness in maintaining these lakes so that they remain sustainable and provide economic, social, and environmental benefits for the community.

To address environmental degradation in Lake Maninjau, the government has introduced several regulatory and policy initiatives. At the local level, the Agam Regency Government issued Regional Regulation No. 5 of 2014 concerning the Sustainable Management of the Lake Maninjau Area. At the national level, the Indonesian government issued Presidential Regulation No. 60 of 2021 on Saving National Priority Lakes, which identifies fifteen lakes requiring special protection and management, including Lake Maninjau. These policies emphasize the importance of integrated environmental governance involving collaboration between government institutions, private sector actors, and local communities in addressing complex ecological challenges.

Efforts to protect and manage the environment are not only the responsibility of the government but also involve various stakeholders, including the community, the private sector, and non-governmental organizations. In the context of Lake Maninjau, collaboration between government, society, and the private sector is very important. Programs such as the Save Lake Maninjau Program have been initiated to overcome environmental problems in this lake.

Previous studies on collaborative governance have widely emphasized the importance of stakeholder participation in addressing complex environmental problems (Ansell & Gash, 2008; Emerson & Nabatchi, 2015). Research by Bhakti et al. (2022) highlights how environmental governance is often constrained by limited institutional capacity and policy implementation gaps, while Bitterman and Koliba (2020) focus on the design of collaborative governance networks in water resource management. Although these studies provide important insights into collaborative governance arrangements, limited research has examined how collaborative governance operates in the context of lake ecosystem management, particularly in national priority lakes within developing countries.

In Indonesia, many studies on lake ecosystems tend to focus primarily on environmental degradation, pollution, or ecological impacts (Pakpahan et al., 2023; Lamangida, 2019), while governance dynamics among multiple stakeholders remain relatively underexplored. Therefore, this study contributes to the literature by analyzing how collaborative governance is implemented in the environmental protection and management of Lake Maninjau. Specifically, this research examines the interaction of four key dimensions of the collaborative

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governance framework proposed by Ansell and Gash—initial conditions, institutional design, leadership, and collaborative processes—within the context of lake governance in Indonesia

This program involves various parties who play a role in preserving the lake. Although various efforts to protect and manage the environment have been carried out, the complex challenges of addressing environmental problems in lakes, including Lake Maninjau still require more comprehensive thinking. In this context, this study aims to examine how the collaborative governance model is used in efforts to protect and manage Lake Maninjau. Specifically, this research aims to analyze the roles of government actors, the private sector, and local communities in building collaboration, and to assess how the four core elements of the Ansell & Gash model—initial conditions, institutional design, leadership, and collaborative processes—are implemented within the ecological challenges of Lake Maninjau.

The significance of this study lies in its contribution to providing empirical insights into how collaborative governance can be applied to the management of lakes experiencing high environmental pressure. This research is important because it offers an implementable model of collaborative governance that can serve as a reference for policymakers at both local and national levels in designing more effective, inclusive, and sustainable environmental management strategies. Furthermore, the findings provide practical recommendations for the restoration of other national priority lakes and strengthen the international literature on collaborative governance in developing countries, which remains limited

Collaborative governance according to (Jung et al., 2009) is a process of forming, driving, facilitating, operationalizing, and monitoring cross-sectoral organizational arrangements in resolving public policy problems that cannot be resolved by just one organization or the public alone . According to (Ansell & Gash, 2008), collaborative governance is a governing arrangement where one or more public agencies directly engage non state stakeholders in a collective decision-making process that is formal, consensus oriented, and deliberative and that aims to make or implement public policy or manage public programs or assets. The collaboration process in collaborative governance defined as process and structure in public policy decision-making and management decision-making and management that involves the community constructively within the boundaries of public institutions, levels of government and/or public institutions, levels of government and/or society, the private sector and civil society to public interest that cannot be achieved without involvement of the private sector and society (Emerson, Nabatchi & Balogh,2011: 2).

According to the collaborative governance regime framework (Emerson and Nabatchi 2015), which is based on one of the most comprehensive reviews of the collaboration literature, collaborative governance is composed of three interacting elements, or "dynamics," that together yield changes in the world, both proximate outputs like learning and managerial capacity and longer term effects on the environment. Seigler conveys eight main principles in implementing collaborative governance, namely (1) Citizens must be involved in the production of public goods, (2) The community must be able to mobilize resources and assets to solve public problems, (3) calm professionals must share their expertise to empower community members, (4) Policies must provide public deliberation, (5) Policies must contain sustainable collaborative partnerships, (6) Policies must be strategic, (7) Policies must change institutions for community empowerment and solutions. public problems, (8) Policies must contain accountability (Seigler, 2011).

The collaborative governance model according to Ansell and Gash consists of four main variables, namely initial conditions, institutional design, leadership, and collaborative processes (Ansell & Gash, 2008). The stages in the collaborative process include face-to-face dialogue, building trust, commitment to the process, mutual understanding, and interim results. All collaborative governance is built on face-to-face dialogue between stakeholders. As a consensus process, direct dialogue is needed between stakeholders to identify opportunities for mutual benefit (Handoko et al., 2019).

Collaborative governance can support collective decision making, help stakeholders develop shared policies or priorities, improve coordination among relevant stakeholders, and find ways for stakeholders to work productively together (Emerson & Nabatchi, 2015; Milward & Provan, 2000; Wood & Gray, 1991). Collaborative governance serves a variety of purposes and is used around the world to address complex environmental problems. (Ulibarri et al., 2023). In particular on the part of privileged Global North institutions and scholars, more effort is required to facilitate collaborative and comparative research on equitable grounds to illuminate important shared trends and unique practices that can progress collaborative governance in environmental management (Ulibarri et al., 2023).

Existing research mostly discusses the causes of environmental pollution and problems caused by environmental damage in several lakes. There is still little research that discusses improving collaborative governance from the perspective of the involvement of local governments and local communities. This is the novelty of this research, how to model collaborative governance in protecting the environmental management of Lake Maninjau.

The bibliometric mapping generated through VOSviewer indicates that global research on environmental governance remains dominated by themes such as environmental protection, environmental pollution, natural resource conservation, and technically oriented environmental policies. Although the topic of collaborative governance has grown in recent years, the cluster remains general and does not specifically relate to lake management contexts. The absence of nodes or clusters associated with lake governance, lake management, and multi-actor collaboration in national priority lakes suggests that the integration of collaborative governance with lake ecosystem management is still underexplored in the international literature. The research gap of this study is clearly visible from this pattern, showing that collaborative governance has not yet been connected to lake management issues within developing-country contexts.

Furthermore, the overlay visualization shows that recent issues such as governance approaches, stakeholder participation, and sustainability have gained prominence between 2023 and 2024, but they are not linked to case studies on lakes in developing countries. The research gap of this study is also evident from the absence of empirical research assessing how collaborative governance is implemented in lakes experiencing high ecological pressure, such as Lake Maninjau. Therefore, this study offers an important contribution by providing empirical analysis of the application of the Ansell & Gash model within the context of Lake Maninjau's environmental management and presents a novel perspective within the broader literature on collaborative governance in developing-country settings.

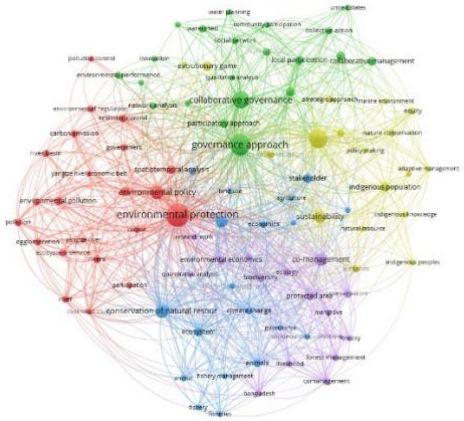

Figure 1. Netrwork Visualization

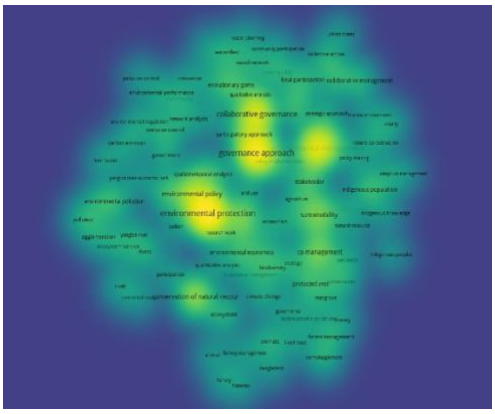

Figura 2. Density visualization

METHOD

This study was conducted in the Lake Maninjau area, Agam Regency, West Sumatra Province, between August and November 2024. The research employs a qualitative case study approach to examine the dynamics of collaborative governance in environmental protection and management. This approach allows for an in-depth understanding of complex governance interactions among multiple stakeholders involved in managing Lake Maninjau. The qualitative case study method was selected because it enables researchers to explore institutional relationships, stakeholder roles, and collaborative processes within a specific environmental governance context. Through this approach, the study seeks to capture the perspectives and experiences of key actors involved in the management of Lake Maninjau.

The study used both primary data (interviews, observations, and field documentation) and secondary data (official reports, regulations, environmental assessment documents, and media publications). Respondents were selected using a purposive sampling technique, considering their relevance, experience, and involvement in Lake Maninjau's environmental management. A total of 11 key informants participated, consisting of: 6 representatives from local government institutions (Regional Secretary, DPRD, Environmental Agency, Food Security and Fisheries Agency, Tanjung Raya Sub-district Head, and Wali Nagari Koto Kaciek), 2 individuals from the private sector (General Manager of PT PLN Sumbagsel and President Director of PT Semen Padang), 3 community representatives (Save Maninjau Movement Coordinator, youth leader, and a student researcher).

Table 2. Research Informants

No	Initial	Position	Location
1	EB	Local Governamnet	Agam
2	IA	Local Governamnet	Agam
3	AR	Local Governamnet	Agam
4	EN	Local Governamnet	Agam
5	HA	Local Governamnet	Agam
6	SY	Local Governamnet	Agam
7	JM	Private Sector	Agam
	AM	Private Sector	Agam
9	IM	Civil Society	Agam
10	SB	Civil Society	Agam
11	RS	Civil Society	Agam

The process of obtaining data begins with collecting data obtained directly or indirectly from informants (emic), the data is analyzed using ethical interpretation or from the researcher's view, the analysis is then cross checked again with triangulation of sources, namely environmental practitioners who are concerned with carrying out observation and assistance to the community at Salingka Lake Maninjau, this process was carried out to obtain valid data. The next process, data that has been analyzed through an ethical approach and source triangulation, is then combined with documents obtained in the field, such as analysis documents regarding environmental damage to the Lake Maninjau area, documents from various mass media containing news related to Lake Maninjau, including also photos obtained in the field.

Data collection began with gathering primary data directly from informants through semi-structured interviews and field observations. Additional supporting information was collected indirectly through documents, reports, and media coverage related to Lake Maninjau's environmental conditions. This combination allowed researchers to capture both emic (informants' viewpoints) and etic (researcher's interpretation) perspectives.

The data analysis followed several steps, data Reduction: organizing interview transcripts, observation notes, and documents. Thematic Analysis: identifying themes related to the four elements of the Ansell & Gash collaborative governance model (initial conditions, institutional design, leadership, and collaborative processes). Triangulation: validating findings through source triangulation with environmental practitioners working in the Salingka Lake Maninjau area and Interpretative Synthesis: integrating field data, document analysis, and triangulation results to draw conclusions aligned with the research objectives.

RESULTS AND DISCUSSION

Environmental management in the Lake Maninjau area, Agam Regency is a complex and important challenge. This lake plays a major role in the ecology and livelihoods of local communities, and therefore, effective protection and management are necessary to maintain the sustainability of the ecosystem and the welfare of

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the community. One approach that has emerged as a potential solution is collaborative governance. Collaborative governance is an approach that involves various interested parties in the decision-making, planning, and implementation of environmental policies. The stakeholders involved are the government, private sector, and civil society who work together to achieve common goals related to environmental protection and management. This approach certainly encourages inclusion, participation, and transparency, and can help create more holistic and sustainable solutions. This aligns with international evidence that collaborative governance is effective in handling complex ecological problems (Emerson & Nabatchi, 2015; Ulibarri et al., 2023).

In the context of Lake Maninjau, collaboration between various parties is very important. This lake is faced with various environmental problems, including water pollution by floating net cages (KJA), erosion, deforestation, and climate change. By implementing collaborative governance, the Regional Government of Agam Regency can overcome this problem more effectively and ensure the sustainability of the Lake Maninjau ecosystem. These findings directly respond to the research question regarding how collaborative governance emerges as a strategic framework for addressing ecological pressures in Lake Maninjau.

From the research results it was found that there are several stakeholders involved in environmental protection and management, namely the local government of Agam district, and related OPDs such as the Agam District Environment Office, the Agam Food Security and Fisheries Office, the Tanjung Raya District Government, and the Nagari Government of the Maninjau Lake Area. Then there are the private sector, such as PT PLN and PT Semen Padang, and the community in the Maninjau Lake area, especially those who utilize the existence of Lake Maninjau.

Table 2. Stakeholders in the Collaborative Governance

Stakeholder Group	Institutions / Actors	Roles
Local Government	DLH, Fisheries Dept., District Gov., Nagari Gov.	Regulation, supervision, program coordination
Private Sector	PT PLN, PT Semen Padang	CSR support, livelihood transition programs
Community	Fishermen, KJA owners, youth, NGOs	Participation, local knowledge providers

Of the 4 stages of the collaboration governance model proposed by Ansal and Gers, researchers found that there were several models found, namely initial conditions, institutional design, leadership and collaboration processes between stakeholders with an interest in protecting and managing the environment in the Lake Maninjau area These findings confirm Ansell & Gash's (2008) model while also demonstrating its applicability in the context of developing countries, which remains underrepresented in current literature

There are 4 collaborative governance models in the protection and management of Lake Maninjau, namely initial conditions, institutional design, leadership, and collaborative processes.

Initial Conditions

The emergence of collaborative governance in the management of Lake Maninjau cannot be separated from the initial governance conditions that shaped stakeholder interactions. Prior to collaborative initiatives, environmental management in the lake area was characterized by competing interests among various stakeholders. Local communities, particularly floating net cage (KJA) farmers, depended heavily on aqriculture for their livelihoods, while government institutions faced increasing pressure to control environmental degradation caused by the rapid expansion of KJA units. This situation created tensions between environmental protection objectives and the economic interests of local communities.

In addition to stakeholder conflicts, resource asymmetry among actors also influenced the governance dynamics in Lake Maninjau. Government institutions possessed regulatory authority and policy instruments, while private sector actors contributed financial resources through corporate social responsibility (CSR) programs. Meanwhile, local communities held important local knowledge and direct dependence on lake resources but often had limited institutional capacity to influence policy decisions. These asymmetries shaped the distribution of roles and responsibilities in environmental management.

Despite these challenges, growing ecological pressures in Lake Maninjau created incentives for cooperation among stakeholders. The increasing frequency of environmental problems, including fish mortality, water pollution, and declining lake productivity, encouraged stakeholders to recognize the need for collective action. These conditions eventually facilitated the emergence of collaborative initiatives such as the Save Maninjau program, which brought together government institutions, private sector actors, and local communities in efforts to restore and protect the lake ecosystem.

The initial condition in the context of environmental protection and management in the Lake Maninjau area is the stage where various stakeholders, including the government, local communities, environmental NGOs, and the private sector, identify and analyze the environmental problems faced by the Lake Maninjau area. This initial step is very important in designing an effective action plan for environmental protection and management of the lake area. For example, in the Lake Maninjau Save program, the Agam Regency Environmental Service has collaborated with various stakeholders. There are eight efforts to protect and manage Lake Maninjau carried out by the Regional Government of Agam Regency, namely: stopping new KJA, cleaning the lake, suctioning out sediment, strengthening institutions, empowering the community, synchronizing programs or infrastructure procurement activities, and strengthening regulations. The Agam Regency Government together with the West Sumatra Provincial Government are collaborating with PT Semen Padang and PT. PLN to revitalize Lake Maninjau. This collaboration involving third parties was carried out by signing an MoU on June 17 2022 on the occasion of World Environment Day with the theme Only One Earth, with the theme Development and Development of Wetland Areas in the Context of Restoring Lake Maninjau. Creating a wetland is considered to be the right choice because it can provide a multiplier effect, including, biodiversity conservation, supporting regional tourism, reducing floating net cages (KJA), controlling pests, to providing alternative livelihoods for local communities through processing water hyacinth handicrafts. goiter (https://www.binews.id, n.d.). This is consistent with findings

from Rawapening and Singkarak lakes, where early consensus building is crucial in handling ecological degradation (Endah & Nadjib, 2017).

In addition to collaborating with third parties, DLH Agam Regency also invites the community around Lake Maninjau to make efforts to prevent damage to the Lake Maninjau area by carrying out cooperation efforts, where in this activity the community in the Nagari area of Lake Maninjau involved. The Agam Regency Government together with residents of Jorong Rambai, Nagari Koto Malintang, Tanjung Raya District held a cooperation action to remove water hyacinth in Talao Park. This activity is part of the "Goro Save Maninjau" program to clean the lake from weeds and rubbish. With these initial conditions, it is possible to develop an institutional design model in efforts to regulate and manage the Lake Maninjau area.

Institutional Design

Environmental protection and management in the Lake Maninjau area, Agam Regency, is an urgent necessity. Institutional arrangements play a critical role in structuring decision-making authority in the management of Lake Maninjau. In the current governance structure, regulatory authority primarily rests with government institutions, particularly the Agam Regency Government and related agencies such as the Environmental Agency and the Food Security and Fisheries Agency. These institutions are responsible for enforcing environmental regulations, monitoring lake conditions, and coordinating environmental management programs. One of the key regulatory issues concerns the control of floating net cages (KJA), where local government institutions play a central role in determining ecological carrying capacity and implementing policies aimed at limiting the number of KJA units operating in the lake.

Within this institutional arrangement, decision-making power is distributed among several actors with different roles and capacities. Government agencies hold formal authority to establish regulations and enforce environmental policies. The private sector, including companies such as PT PLN and PT Semen Padang, contributes financial resources and supports environmental initiatives through corporate social responsibility (CSR) programs. Meanwhile, local communities, particularly fishermen and KJA farmers, are directly affected by environmental policies and participate in collaborative initiatives through community-based activities and consultation processes.

Although government institutions retain the primary regulatory authority, collaborative governance mechanisms enable the involvement of multiple stakeholders in environmental management. Community actors participate in consultation forums, joint environmental programs, and collaborative initiatives such as the Save Maninjau program. This institutional arrangement reflects a governance structure where regulatory authority remains within government institutions while collaboration mechanisms facilitate broader stakeholder participation in environmental protection efforts.

The Maninjau Lake area is a very important natural asset for the ecology and local communities, and maintaining the sustainability of this lake ecosystem is a collective task that requires good planning and management. One of the main keys in this effort is creating a strong and effective institutional design model. In creating an effective institutional design, the parties who have an interest in the protection and management of the Lake Maninjau area must first be identified, there are at least three parties who contribute to the institutional design, namely:

The first group is groups or individuals who are directly affected by changes in lake conditions. This group includes people in the nine Nagari surrounding Lake Maninjau (Nagari Maninjau, Bayua, Duo Koto, Paninjauan, Koto Kaciak, Koto Gadang, Koto Malintang, Tanjung Sani, and Nagari Sungai Batang), fishermen, KJA entrepreneurs, inn and restaurant owners, as well as the hydroelectric power plant at the Batang Antokan outlet. In general, local communities are direct beneficiaries of lake resources.

The next stakeholder group is at the level, namely, those who have an interest in Lake Maninjau but are not directly affected by changes or declines in the quality of the lake. Members of this group include the Agam District and Provincial Government, research institutions, universities, and outside investors. Even though this group suffered losses due to degradation of the lake ecosystem, this impact did not cripple the group's activities. Members of this group still have other alternatives. For example, local governments often have to spend more to clean lakes when there are cases of mass fish deaths, but government programs or tasks can still be implemented.

The third group is indirect stakeholders. This group indirectly benefits from Lake Maninjau and will also be indirectly affected by the decline in lake quality. This group is usually located quite far from the lake. Feed factories, for example, do not use the lake directly but rather through feed sold to KJA owners in the lake. Generally, the fish feed used by KJA owners in Lake Maninjau comes from feed factories in North Sumatra and West Java, some of the feed even comes from foreign producers. When there is pollution in the lake, these feed factories may experience a decrease in demand but it is not significant (Endah & Nadjib, 2017).

A large number of parties using Lake Maninjau of course has an impact on their activities, competing with each other to make the most of the lake and tending to ignore the environmental costs resulting from these activities. As an illustration, the attractive profits from KJA activities make KJA owners compete to increase the number of KJA without paying attention to the carrying capacity of the lake. This is further exacerbated by the pattern of excessive fish feeding (pellets) to harvest the fish more quickly, thus causing large amounts of sedimentation and degradation of water quality. This not only means the government has to spend extra money to clean the lake but also has the potential to kill the tourism industry due to the reduction in the lake's aesthetics.

Not only that, the decline in water quality means that people can no longer use water for consumption and bathing. Meanwhile, high sedimentation – due to piles of leftover food and feces at the bottom of the lake – causes additional costs for fishermen because fishermen have to look for pensi in the middle of the lake. The catch has also decreased significantly, causing a decrease in income. As a result, all parties suffer losses.

The results of research on lakes in Singkarak and Rawapening show that the function of the lakes, their benefits, and their values are still not fully realized by the community and policymakers (Endah & Nadjib, 2017). Lake Maninjau Management Pattern and the Role of Local Communities Traditionally, the people around Lake Maninjau strongly believe that there is only family customary territory for the Lake area. The outer boundary of Lake Maninjau over the family's customary territory is Sapambaian or a stone's throw from the edge. The people around Lake Maninjau

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only believe that family customary rights are limited to a stone's throw, beyond that they are common property resources. Such multi-layered institutional arrangements mirror global patterns found in lake governance studies in China and the United States (Biddle & Koontz, 2014).

Leadership

Leadership plays an important role in facilitating collaborative governance in the management of Lake Maninjau. The findings of this study indicate that the Agam Regency Government acts as the central actor leading collaborative initiatives related to environmental protection and lake management. Several local government institutions, particularly the Environmental Agency and the Food Security and Fisheries Agency, are responsible for coordinating environmental programs, monitoring lake conditions, and implementing policies related to floating net cage (KJA) management.

The leadership of the Agam Regency Government influences coordination among stakeholders by providing institutional direction and facilitating communication between different actors involved in lake governance. Government agencies organize coordination meetings, environmental programs, and collaborative initiatives that involve private sector actors and community groups. Through these mechanisms, the local government plays a key role in bridging the interests of multiple stakeholders who depend on the lake ecosystem.

However, the leadership dynamics in Lake Maninjau governance are not entirely free from institutional tensions. Differences in priorities sometimes emerge between environmental protection objectives and economic interests related to aquaculture activities. For instance, local communities relying on KJA farming often prioritize livelihood security, while government institutions emphasize environmental sustainability and regulatory compliance. These differences require continuous negotiation and coordination among stakeholders to maintain collaborative governance arrangements in the management of Lake Maninjau.

Leadership as a driver for collaborative governance effectiveness is widely documented in international environmental governance literature (Bodin, 2017). Effective leadership in this context is key in efforts to protect and manage environmental problems in the Lake Maninjau area and maintain the sustainability of the ecosystem.

The findings indicate that leadership in the collaborative governance of Lake Maninjau is primarily exercised by the Agam Regency Government through its coordinating role in environmental management programs. Local government institutions, particularly the Environmental Agency and the Food Security and Fisheries Agency, are responsible for initiating environmental programs, facilitating coordination meetings, and monitoring lake conditions. These institutions also play a central role in implementing policies related to floating net cage (KJA) management.

Empirical evidence from interviews with stakeholders shows that local government leadership helps facilitate coordination among various actors involved in lake governance. Government agencies often serve as mediators between community groups, private sector actors, and other institutions that utilize lake resources. Through coordination forums, environmental programs, and collaborative initiatives, the local government provides institutional support for joint environmental management activities.

However, the leadership process also involves negotiation among actors with different interests. Community members who depend on aquaculture activities often prioritize economic stability, while government institutions emphasize environmental sustainability and regulatory compliance. These differences require continuous coordination and negotiation among stakeholders to maintain collaborative governance arrangements in the management of Lake Maninjau.

Leadership models must involve multiple stakeholders, including local governments, local communities, environmental NGOs, and the private sector. Leadership in efforts to protect and manage the environment in the Lake Maninjau area is a key factor in maintaining the sustainability of this lake ecosystem. To create an effective leadership model, the Agam Regency local government and other stakeholders must understand the importance of environmental awareness, collaboration, education, and consultation. Concrete leadership programs, such as training, networking, environmental monitoring, and rewards, can help motivate and support leaders who are responsible for maintaining the sustainability of Lake Maninjau for the future. Even though there are challenges that must be overcome, strong and committed leaders can make a significant contribution to preserving the environment of the Lake Maninjau area.

Effective leadership in environmental protection and management in Lake Maninjau must begin with a high awareness of the importance of the environment. Leaders must have a deep understanding of lake ecosystems, the impacts of environmental change, and the key role that lakes play in the lives of local communities. A good leader must have a clear shared vision with other stakeholders about a sustainable future for Lake Maninjau. In addition, it must also promote strong collaboration between various stakeholders. This includes local governments, local communities, environmental NGOs, fish farming companies, fishermen, and the private sector. Leadership must support open and inclusive consultation in decision-making so that policies and actions taken reflect the interests of all parties.

The Agam Regency Regional Government has conducted training in managing environmentally friendly fisheries businesses for the Lake Maninjau Lake community. The leading sector of this training is the Agam Regency Fisheries Service. The aim of holding this training is to preserve the Lake Maninjau Lake area. The management of this fishery business is carried out so that it does not exceed the threshold of nature's ability to recover from the impacts caused, for this reason, the carrying capacity and capacity for KJA in the Lake Maninjau area is set at 1,500 units or 6,000 plots with a size of 5 x 5 M2 per plot. by environmentally friendly fisheries. To achieve the number limit for KJA of 1,500 units and 6,000 plots, gradual reduction efforts are needed over the next 5 years, namely in 2017, from the actual number of 5,625 units or 22,500 plots in 2012. But this does not disrupt the economy and income of the local community. in the fishing business.

For this reason, it is necessary to determine the carrying capacity and capacity of Lake Maninjau for the accumulation of pollution loads from all activities based on topics and water body quality standards for fisheries activities through Regent regulations, especially as this environmentally friendly fisheries program supports the Agam Regent's program.

Collaborative Process

The collaborative process in the management of Lake Maninjau is reflected in various formal and informal interactions

among stakeholders. One important mechanism is the organization of formal coordination meetings involving local government agencies, private sector representatives, and community leaders. These meetings serve as forums for discussing environmental conditions in the lake, evaluating ongoing programs, and coordinating policy implementation related to floating net cage (KJA) management and environmental restoration efforts.

Negotiation processes also play an important role in shaping collaborative governance arrangements in Lake Maninjau. Differences in interests frequently arise between government institutions seeking to reduce the number of KJA units to restore environmental conditions and local communities whose livelihoods depend on aquaculture activities. Through coordination meetings and consultation forums, stakeholders engage in dialogue to negotiate policy implementation, including gradual reduction strategies for KJA units and the development of alternative livelihood programs for affected communities.

In addition, collaborative governance mechanisms provide opportunities for conflict resolution among stakeholders. When disagreements emerge regarding environmental regulations or lake utilization, government institutions often act as mediators between community groups, private sector actors, and other stakeholders. These mediation processes are conducted through coordination forums and joint environmental programs such as the Save Maninjau initiative. Through these mechanisms, stakeholders are able to maintain communication, build trust, and sustain collaborative environmental management efforts in the Lake Maninjau area.

This collaborative process will only be explained in 3 stages, namely face-to-face dialogue, Trust Building, and Commitment to Process.

1. **Face To Face Dialogue.**

In this stage, there is a need for initial or face-to-face dialogue in the collaboration that occurs between the actors involved. In the collaboration process cycle, good communication is needed to carry out negotiations to reach an agreement. The form of negotiation communication that occurs between cooperating actors is face-to-face interaction, thereby creating equality of space in obtaining information. In face-to-face dialogue, this is carried out between the government and the community, between fellow governments, and the government and the private sector. The government-private dialogue was carried out with PT. PLN and PT. Semen Padang.

PT. PLN is one of the stakeholders with an interest in Lake Maninjau with the presence of the Maninjau Hydroelectric Power Plant in Batang Antokan, Tanjung Raya District, which is under the auspices of PT. PLN UPDK Bukittinggi. PT. PLN certainly must contribute to the current management of Lake Maninjau. This can be seen from several PTs. PLN UPDK Bukittinggi CSR programs in waste management and the transition of community businesses around Lake Maninjau. The assistance provided is in the form of efforts to shift community livelihoods, such as assistance to the MSMEs Rasani Coffee and TPS3R Waste Processing in Nagari Duo Koto, as well as assistance to the MSMEs of Salingka Lake Maninjau (SADAMA) in processing water hyacinth into handicraft products. There is a dialogue taking place between PT. PLN UPDK Bukittinggi and MSME SADAMA. MSME activities are oriented towards processing water hyacinth that grows around Lake Maninjau which is then used as material for making wallets, bags, and other souvenirs. This form of program is a program from CSR PT. PLN UPDK Bukittinggi where this program collaborates with the government and communities in the area around Lake Maninjau.

2. **Building Trust Between Collaborative Actors**

The form of coordination between DLH Agam Regency can be seen from the interdependence between agencies. Because PT. PLN is a stakeholder who also has an interest in Lake Maninjau in the form of the presence of the Maninjau Hydroelectric Power Plant and DLH has an interest in maintaining sustainability in Lake Maninjau, the collaboration process was carried out because both parties felt they would benefit equally. There are three programs from PT. PLN UPDK Bukittinggi in the form of CSR funding assistance to help transfer to new professions. In the form of assistance for SMEs Rasani Coffee, TPS3R waste processing, and assistance for SMEs SADAMA. The existence of waste management with TPS3R in Nagari Duo can reduce the spread of waste both on land and in water bodies.

3. **Building commitment between collaborative actors**

The form of implementation of the concept of commitment to the process is how stakeholders have the same interest in achieving certain goals, which must be based on the existence of a clear vision and mission in opposing existing problems. The commitment that has been built is to ensure that the lake is not polluted any further and can continue to be preserved for children and grandchildren. There has been a joint effort to preserve this through the Save Maninjau Lake Program and other joint activities. It just remains to be seen how the involvement and commitment of various government, private, and community parties work together.

CONCLUSION

A collaborative governance approach has emerged as a potential solution to the complex problems in the Maninjau Lake area. Through four stages of collaborative governance, face to face dialogue method shows a clear indication of stakeholders' collaboration. Agam Regency Government as the role actor presents more involvement than PT. PLN and PT. Semen Padang, and local society around Maninjau Lake. Save Maninjau Lake is one of the few programs that have been implemented as an initiative solution to maintain lake sustainability. Laws and regulations also support environmental protection and management efforts to preserve the lake's environment. However, these efforts still need to be improved and maintained comprehensively. Stakeholders must commit to working together in the long term, following the principles of collaborative governance, and continuing to monitor developments in the lake environment. In lake management, environmental and economic issues are commissioned by governance approaches and legislation improvement issues

The findings of this study demonstrate that collaborative governance plays a crucial role in addressing the complex environmental challenges of Lake Maninjau. The interaction of four key elements, initial conditions, institutional design, leadership, and collaborative processes—shows that multi-actor collaboration can provide more coherent and sustainable solutions compared to sectoral or top-down approaches. The initial conditions reveal a shared awareness of ecological degradation, which serves as a foundation for collective action. Institutional design clarifies stakeholder roles, ensuring that local governments, private actors, and communities operate within

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coordinated structures. Leadership, particularly from the Agam Regency Government, has facilitated policy alignment, training initiatives, and regulatory enforcement, while the collaborative process has been strengthened through face-to-face communication, trust building, and joint commitments embedded in programs such as Save Maninjau.

These findings align with international scholarship emphasizing the effectiveness of collaborative governance in managing socio-ecological systems facing multi-stakeholder conflicts (Ansell & Gash, 2008; Emerson & Nabatchi, 2015; Ulibarri et al., 2023). The study's implications highlight the need for continuous strengthening of institutional collaboration, expansion of community-based initiatives, and enhancement of private sector involvement to ensure long-term ecological resilience and equitable resource management.

This study has several limitations that should be acknowledged. First, the findings are based on a qualitative case study with 11 purposively selected informants, which may not fully represent the broader spectrum of stakeholders involved in Lake Maninjau's governance. Second, the study relies heavily on self-reported perceptions, which may introduce respondent bias or subjective interpretations of collaborative processes. Third, the absence of quantitative environmental data (e.g., water quality trends, sedimentation rates, or fish mortality statistics) limits the ability to directly correlate collaborative governance practices with ecological outcomes.

Future research should incorporate mixed-methods approaches combining qualitative interviews with quantitative measurements of environmental indicators to provide a more comprehensive analysis. Comparative studies with other national priority lakes—such as Lake Toba or Lake Rawapening—could also offer deeper insights into what collaborative governance models work best in different ecological and institutional contexts. Additionally, longitudinal studies would help assess the long-term effectiveness and sustainability of collaborative initiatives such as Save Maninjau.

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