Niqosiya: Journal of Economics and Business Research
P-ISSN: 2798-6373, E-ISSN: 2807-7660
Vol. 4 No. 2, Juli-Desember 2024
https://ejournal.iainponorogo.ac.id/index.php/niqosiya

Institutional Management of Mangrove Ecosystems on Small Islands to Support Sustainable Utilization

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Article Info

Article history:
Received September 5, 2024
Revised October 12, 2024
Accepted October 29, 2024
Available online November 3, 2024

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Keywords:
Institutional Management, Mangrove Ecosystem, Tanakeke Island

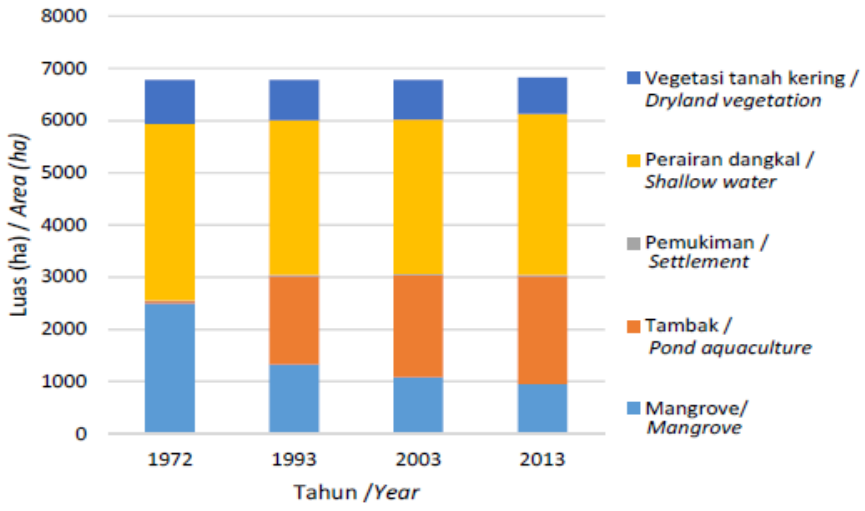
Abstract

Introduction: *Tanakeke Island is one of the small islands in Indonesia that features mangrove ecosystems. In the 1980s, the area of mangroves on Tanakeke Island was approximately 1,770 hectares. However, between the 1980s and the 2000s, the mangroves were reduced by 60 percent due to uncontrolled exploitation and environmental changes. This paper aims to analyze the institutional linkages related to the current management of the mangrove ecosystem on Tanakeke Island and its impact on the sustainability of mangrove utilization.* **Research Methods:** *The analysis utilizes the concept of the dynamics of institutional resource management development (Ostrom, 1990) to assess the state of institutional management of the mangrove ecosystem and its relationship to sustainable use.* **Results:** *At the time of this research, Tanakeke Island had established rules governing mangrove utilization and rehabilitation activities. The mapping results indicate that the mangrove ecosystem management institutions on Tanakeke Island are currently in an "institutional self-governing period," as defined by Ostrom (1990) framework for the dynamic development of natural resource institutions.* **Conclusion:** The findings suggest that these management institutions are progressing toward self-governance, as they have demonstrated the ability to manage mangrove resources independently. At the time of this research,

	the institutions responsible for managing the mangrove ecosystem on Tanakeke Island support the sustainable utilization of mangroves.
DOI: 10.21154/niqosiya.v4i2.4104 Page: 249-260	

INTRODUCTION

In 2001, Indonesia was recorded as a country with mangrove areas covering one-fifth of the global total, highlighting its significance as a vital habitat for mangroves worldwide (Spalding et al., 2010; Giri et al., 2011; Ilman et al., 2016; Friess, 2016). South Sulawesi, one of Indonesia's provinces, boasts a substantial mangrove ecosystem encompassing approximately 12,821.5 hectares (Bakosurtanal, 2009). A notable mangrove ecosystem in South Sulawesi is Tanakeke Island. Surrounded by extensive mangrove forests, which serve as a green belt that provides ecological protection against ocean waves and other natural factors while economically supporting the local community's daily needs. According to a study by the Yayasan Konservasi Laut Sulsel (2015), the estimated area of mangrove forest on Tanakeke Island in the early 1980s was around 1,770 hectares. Unfortunately, this area has significantly declined, with only 500 to 700 hectares remaining.



Source: Akbar, 2014

Figure 1. Land Cover Change Trends on Tanakeke Island from 1972-2013

Figure 1 illustrates the dynamic land cover trends on Tanakeke Island from 1972 to 2013. During this period, the mangrove cover showed a decreasing trend, while the area designated for fishponds continued to expand. The most significant rate of mangrove degradation occurred between 1993 and 2003. Generally, the loss of mangroves on Tanakeke Island can be attributed to human activities, including the conversion of mangrove areas into fishponds, large-scale logging for charcoal production, and mangroves for domestic purposes (Akbar, 2014). Yuliasamaya et al. (2014) highlighted that while mangrove ecosystems offer

numerous benefits to the community, excessive utilization—particularly for economic reasons—can lead to ecosystem damage. This concern is particularly relevant to Tanakeke Island, where more than half of the mangrove ecosystem has been lost due to unsustainable practices and ignored long-term consequences. The environmental changes caused by mangrove degradation have resulted in various community setbacks, such as increased vulnerability to abrasion and tidal surges during the wet seasons, due to the reduced protective functions of the mangrove ecosystem. There is growing concern that if the mangrove ecosystem on Tanakeke Island continues to deteriorate, the village on the island might threatened by the waves generated during the western monsoon (Denun, 2017).

The utilization of mangroves, besides providing economic benefits, also contributes to the emergence of losses for the community. According to Nugroho (2009), institutional aspects are one of the important factors in the management of mangrove ecosystems in a region. A weak and ineffective institutional structure can lead to unexpected management-related issues, such as jurisdictional boundary problems, property rights, and representation rules. These issues can be addressed by making changes to the institutional structure, for example, by revising boundary markers (zoning) to ensure they do not overlap with community lands.

Additionally, improving the social contract through conservation agreements that state that the community is allowed to cultivate shrimp in existing ponds, but is also obligated to maintain the preservation of the mangrove forest ecosystem in the related locations. The intercropping system between mangroves and shrimp ponds (sylvofishery or wanamina) can also be a solution. Good performance indicators of mangrove institutions include a sustainable natural environment (mangrove ecosystem), improved socio-economic conditions of the community, and low potential for social conflict with low enforcement costs. Poor institutional performance due to ineffective institutions can lead to issues such as a high potential for social conflict, degraded natural environments, and poor socio-economic conditions in the community. Institutional frameworks also play a role in promoting the economic aspects of resource management related to the rules of the game, thereby enabling collaboration in every activity within the utilization of the ecosystem, coordination among related parties (stakeholders), and efforts to control environmental impacts (Sobari et al., 2006).

Specifically, this research aims to analyze the institutional conditions of mangrove ecosystem management on Tanakeke Island at the time of the study to determine whether it can support the sustainable utilization of the mangrove ecosystem. This research hypothesizes that the institutional management of the mangrove ecosystem on Tanakeke Island already supports sustainable utilization. The urgency of this research is to map the institutional conditions of mangrove management at the time of the study to see whether it can support the sustainable utilization of the mangrove ecosystem on Tanakeke Island or not so that the results of this research are expected to provide additional information for future management.

RESEARCH METHOD

The research was managed on Tanakeke Island, which consists of five villages: Mattiro Baji, Maccini Baji, Balangdatu, Rewatayya, and Tompotana (see Figure 2). Data collection took place in February 2017. This study utilized both primary and secondary data. The primary data, which served as the main source of information, were gathered through in-depth interviews with 22 key informants who are stakeholders involved in the utilization and management of the mangrove ecosystem on Tanakeke Island. These interviews focused on the institutional aspects of mangrove ecosystem management. Secondary data was collected from relevant agencies and institutions including the descriptions of their main duties and functions, activity reports, and other pertinent documentation, as well as findings from previous research related to the study.

Source: Blue Forests, (2010)

Figure 2: Image of Tanakeke Island, South Sulawesi

Institutional Analysis Method for Mangrove Management on Tanakeke Island

The institution in question encompasses not only the organization involved in the management and utilization of mangroves but also the ideology, laws, customs, norms, and rules that are intrinsically linked to the environment. This study employs qualitative descriptive analysis to evaluate the institutions in place at the time of the research, aiming to determine their capacity to support the sustainable utilization of the mangrove ecosystem on Tanakeke Island.

To achieve this objective, we conducted a mapping of the dynamics of institutional development concerning the mangrove ecosystem management on Tanakeke Island, utilizing the concept of institutional dynamics in resource management as developed by Ostrom (1990). This mapping seeks to illustrate the phases of institutional development related to the management of the mangrove ecosystem under current conditions and its implications for the sustainability of the mangrove ecosystem's utilization on Tanakeke Island. According to

Ostrom (1990), there are three phases in the dynamics of institutional development for a resource, namely:

1. *Institutional Inertia Period:* This is the initial phase in which local institutional conditions have not yet developed or become operational. During this period, there was a lack of collective action from the community to manage resources, resulting in institutional conditions that did not support sustainable resource management.
2. *Institutional Working Period*: This phase follows the inertia period and marks the beginning of the development and operation of local institutional conditions. In this stage, the community starts to take collective action to manage resources effectively. The institutional conditions in this phase are sufficiently supportive of sustainable resource management.
3. *Institutional Self-Governing Period*: This is the final phase, characterized by increasingly stable and robust local institutional conditions that facilitate independent resource or ecosystem management. At this point, institutions support sustainable resource management. However, this phase tends to be lengthy. For this research, this condition is divided into two parts along a timeline: the current state at the time of the research and the expected future condition.

RESULT AND DISCUSSION

Mangrove Ecosystem in Tanakeke Island

Tanakeke Island is the largest island in the Tanakeke Islands archipelago, situated within the Mappakasunggu District of Takalar Regency in South Sulawesi Province. Geographically, it lies in the waters of the Southern Strait. The island has significant potential for mangrove ecosystems, which greatly contributes to the local economy and underscores the community's dependence on these resources (Setiawan and Larasati, 2016). Unlike in other regions, all the mangrove forests on Tanakeke Island are claimed as privately owned. This situation leads the community to feel they have full rights to manage and utilize these mangrove forests according to their preferences, including decisions about preservation or conversion.

The residents of Tanakeke Island recognize that mangroves offer numerous economic and ecological benefits (Setiawan et al., 2017). Generally, the advantages provided by mangroves include goods and services such as protecting the coast from natural disasters (by stabilizing beach conditions and preventing erosion and saltwater intrusion), serving as a source of biodiversity for both aquatic and terrestrial species, providing forest products that can be consumed by the community, and contributing to pollution reduction, among others (Sandilyan & Kathiresan, 2012; Yuliasamaya et al., 2014).

Institutional Framework and Its Relation to the Sustainable Utilization of Mangrove Ecosystems on Tanakeke Island

The people of Tanakeke Island rely heavily on the mangrove ecosystem for their livelihoods. Previous studies (Blue Forests, no date; Mutmainnah, 2004; Brown, 2007; Rauf,

2008; Akbar et al., 2014; Hermawan & Setiawan, 2018) indicate that this ecosystem provides significant economic benefits to the community. These positive economic impacts are likely the result of rehabilitation activities that have been actively pursued on Tanakeke Island for several years to restore the mangrove ecosystem. As the environment improves, the benefits derived from the mangrove ecosystem for the community are expected to increase.

Rehabilitation efforts have become essential for the sustainable management of the mangrove ecosystem on Tanakeke Island, with regulations supporting these initiatives. The implementation of these regulations has been well-received in the villages. Given the critical importance of mangrove resources for the survival of the Tanakeke Island community, it is crucial to establish institutions that promote the sustainable use of these resources.

The Dynamics of Institutional Development in Mangrove Ecosystem Management

According to Ostrom (1990), every resource experiences changes in the development of local institutions, particularly in the formulation of its management system. The management of the mangrove ecosystem on Tanakeke Island needs to be mapped to analyze the dynamics of the local institutional development processes that are taking place. By mapping these dynamics, we can assess the state of mangrove ecosystem management on Tanakeke Island at the time of the research, determining whether it continues to support the sustainable utilization of the mangrove ecosystem. The mapping of these dynamics in local institutional development will be conducted using Ostrom's (1990) framework.

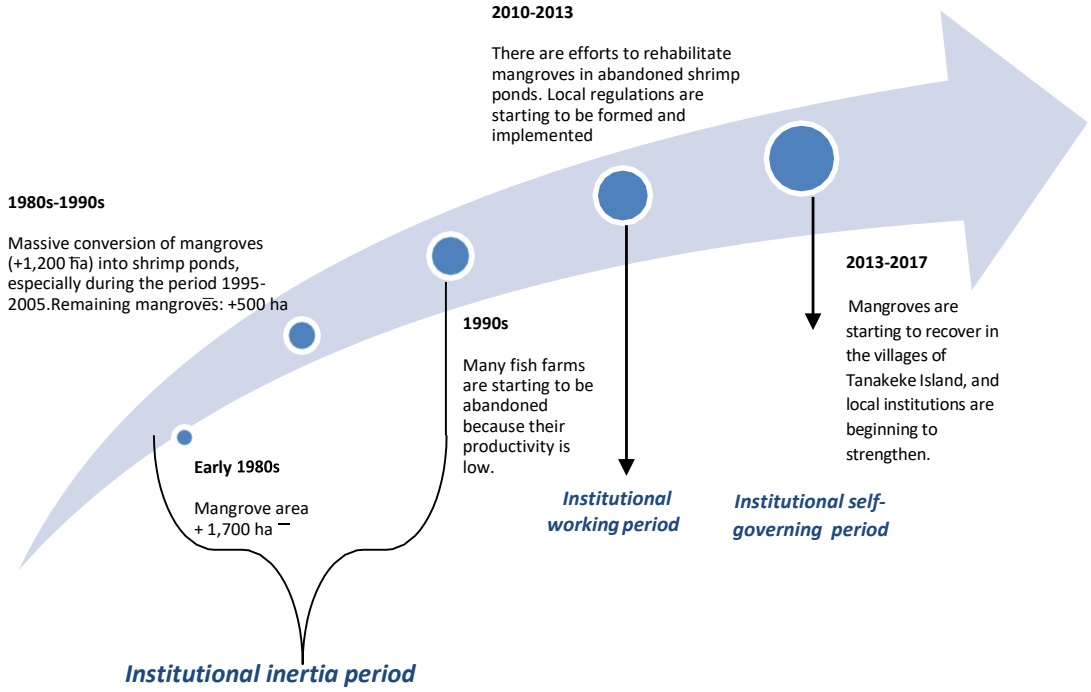


Figure 3. The dynamics of institutional development in the mangrove ecosystem on Tanakeke Island based on the concept of institutional development dynamics and resource management by Ostrom (1990)

According to Ostrom's concept of institutional dynamics in resource management (1990), the development of a resource can be divided into three phases: (1) the institutional inertia period, (2) the institutional working period, and (3) the institutional self-governing period. In summary, the dynamics of institutional development in the mangrove ecosystem of Tanakeke Island are illustrated in Figure 3.

1. *Institutional Inertia Period*

   According to Ostrom (1990), the period of institutional inertia marks the initial phase of institutional development in the management of common pool resources. During this phase, the community has not yet taken collective action to manage their resources. As a result, the condition of these resources often becomes unsustainable, as existing management practices do not consider the common interests of the community. Therefore, it can be said that institutions during this period were unable to support sustainable resource management.

   In the case study of mangrove management on Tanakeke Island, this period lasted from the 1980s to 2010. In the 1980s, the area of mangrove forest on Tanakeke Island covered 1,776 hectares (YKL Sulsel, 2015a). At that time, the mangrove forests began to be divided into plots and claimed as private property by the residents. In response, the government initiated the People's Pond Intensification Program (INTARA) nationally to boost the productivity of newly opened fishponds. The program aimed to increase the country’s foreign exchange earnings from fishery exports by providing subsidies for fish farming development. Consequently, the mangrove forests in the coastal area of Tanakeke Island were increasingly cut down to make way for fishponds (Brown 2007, Blue Forests no date.).

   The implementation of the program has led to a significant conversion of mangrove forest land on Tanakeke Island, especially between 1995 and 2005. Unfortunately, the exploitation of the mangrove ecosystem has not been matched by adequate conservation and rehabilitation efforts, resulting in the loss of approximately 1,200 hectares of mangrove, which have been converted into shrimp ponds (YKL Sulsel, 2015).

   The Tanakeke community holds mixed views on this issue, creating a dilemma. On one hand, the community requires economic resources for survival; on the other, they need mangroves to protect their village. There is a prevailing belief among the people of Tanakeke Island that mangroves are akin to grass, meaning they assume that if mangroves are cut down, they will naturally regenerate just like grass. This mindset may hinder the community's incentive to engage in conservation or rehabilitation efforts after clearing the mangroves.

   During the period when the Tanakeke community focused on developing shrimp farms, which were viewed as more economically viable, the practice of utilizing mangrove wood for firewood and charcoal significantly declined. However, the high productivity of shrimp ponds typically lasts only 5 to 10 years (Brown 2007, Blue Forests, no date). As a result, many farmers have ceased operations on their ponds, leading to

the emergence of abandoned or inactive ponds on Tanakeke Island. These abandoned ponds do not provide economic benefits to the community and offer limited environmental advantages (Blue Forests, no date). Ultimately, the program has not been successful in enhancing productivity or supporting the poor and vulnerable local communities in the long term (MAPI, 2011).

The popularity of shrimp farming has been replaced by the rapidly growing seaweed cultivation on Tanakeke Island after many shrimp farming ventures suffered losses, while the mangroves have dwindled to a small number. As the concentration of the community's economic activities shifted to seaweed cultivation, the mangrove ecosystem began to have the opportunity to recover naturally. Abandoned ponds become supportive habitats for mangrove seedlings. Mangrove seeds that fall into the water are carried by the ebb and flow of tides and spread into the abandoned ponds through the damaged and breached dikes. When they find a suitable place, the seeds can grow into mangrove seedlings, leading to natural land rehabilitation (Blue Forests no date).

Since 2012, seaweed cultivation has started facing problems such as the emergence of viruses that damage seaweed growth and often cause a decrease in harvest yields. Another cause is the decreasing mangrove cover. The mangrove ecosystem is beneficial in protecting the lagoon where seaweed cultivation takes place, especially during the western season. These conditions have triggered the cycle of mangrove ecosystem exploitation on Tanakeke Island to begin anew. Because the seaweed harvest has decreased, the logging of mangroves for charcoal and firewood has increased again, primarily in the following six locations: Balangdatu, Pulau Bauluang, Rewatayya, Kalukuang, Lantangpeo, Kampung Beru, and Balangdatu Pesisir. Tanakeke Island, as a low-lying small island, is increasingly threatened by rising sea levels, land subsidence, and saltwater intrusion (Blue Forests, no date).

The high level of community demand encourages the cutting of mangroves at a young age (around 8-16 years), followed by replanting five seedlings for each tree that is cut down. From this management pattern, the community has replaced almost all natural species with two preferred types of Rhizophora for planting. (one of them is, Rhizophora apiculata). This is in line with the statement by the Director of Blue Forests, Massa (2017), that "the mangrove forest on Tanakeke Island is currently a secondary forest and it is very difficult to find a primary (natural) forest." Improper mangrove silviculture practices have also resulted in irregular coverage, with some areas being empty while others are overcrowded with small mangrove trees of the same species.

Since the early 2000s, the community has complained that the weather has become increasingly extreme. The damage to the mangrove ecosystem due to uncontrolled exploitation in previous decades has caused environmental changes that negatively impact the community. Because the community felt the impact of the damaged mangroves, they began to realize the important role of the mangrove

ecosystem for their village. This condition became a turning point in the community's awareness of the importance of the existence of mangroves.

The history of institutional conditions for mangrove management on Tanakeke Island from the early 1980s to 2010 reflects a period of institutional inertia, during which local institutions were not functioning effectively. During this time, no collective action was taken to address the issues related to mangrove utilization, despite the community's desire to act. Rehabilitation efforts by the community were minimal, primarily driven by individual initiatives rather than coordinated efforts among community members. Additionally, the lack of agreed-upon regulations for the sustainable management of the mangrove ecosystem has led to negative consequences for the community. Consequently, it can be concluded that the management of the mangrove ecosystem during this period did not support sustainable resource management practices.

2. *Institutional Working Period*

The next stage in the dynamics of local institutional development is the institutional working period. According to Ostrom (1990), this stage is a subsequent period where the local institutional conditions have begun to be established and operational, marked by the initiation of actions taken by the community in jointly managing resources. In the case study on Tanakeke Island, this period was from 2010 to 2013, during which the community successfully formulated mutually agreed rules to manage the mangrove ecosystem on Tanakeke Island. This condition indicates that local-level institutions have begun to function. In this period, two things began to emerge as variables indicating that the institutional management of the mangrove ecosystem on Tanakeke Island was starting to take shape. It is shown by the issue of regulations and rehabilitation at the village level.

a. The Issuance of Village Regulations for Mangrove Management

There is a growing awareness within the community about the importance of mangroves, but this awareness has not yet translated into meaningful collective action. The community has expressed a desire to improve management practices to restore the protective mangrove ecosystems around their village, much like they experienced in the past before shrimp farms proliferated on Tanakeke Island. However, the community lacked the necessary knowledge to act and there were no collective actions initiated until non-governmental organizations arrived on Tanakeke Island in early 2010.

The organization named Blue Forests (formerly known as Mangrove Action Project-Indonesia or “Yayasan Hutan Biru”) launched a coastal livelihood improvement initiative called the Restoring Coastal Livelihoods Projects (2010-2014), in collaboration with The Good Planet Project (2014-2017) on Tanakeke Island. Blue Forests began actively building the community's capacity, focusing on strengthening local institutions. With the support of the NGO, the community participated in various capacity-building activities. According to the Director of Blue

Forests, who led the RCL program on Tanakeke Island, the community's low capacity at that time presented a significant challenge to fostering local institutions for mangrove management.

As a result of the NGO's efforts, joint actions within the community began to emerge, and local institutions started to develop and strengthen. This evolution was facilitated by a series of discussions, training sessions, and field studies aimed at drafting local regulations for mangrove management. The establishment of village regulations specifically focused on managing mangrove ecosystems indicates that local institutions are indeed beginning to take shape within the community.

b. Rehabilitation

In addition to the establishment of local regulations regarding the management of mangrove ecosystems, there are also rehabilitation activities on Tanakeke Island. Tanakeke Island became the site for two projects managed by Blue Forests, the first being the Restoring Coastal Livelihoods Projects (RCL) from 2010 to 2014. Through this program, the community was introduced to rehabilitation techniques that were more suited to local conditions, and the community carried them out collectively with facilitation and guidance from the relevant non-governmental organizations. The community has started to build coordination with each other to manage the mangroves, and joint actions are beginning to emerge to save the mangrove ecosystem on Tanakeke Island. The community's capacity to understand the local context of the mangrove ecosystem in their area is improving with the increasing understanding of the role of mangroves in their economic and ecological lives. The community's knowledge about the ecosystem's condition influences their willingness to participate in mangrove conservation and rehabilitation actions. This is in line with the study by Dimitrakopoulus et al. (2010), which states that knowledge and information factors also influence the level of community participation in efforts to address environmental issues.

During the RCL program period, 531 hectares of abandoned shrimp ponds have been successfully rehabilitated back into mangroves. Currently, the mangrove potential on Tanakeke Island consists of around 500 hectares that are ready for harvest (the remaining mangroves), 531 hectares that are developing (the result of rehabilitation), and an increase from 28% natural recovery to 58% (Blue Forests, no date).

The institutional framework for managing the mangrove ecosystem on Tanakeke Island between 2010 and 2014 began to take shape and operate effectively. During this period, village regulations were established to create jointly agreed-upon rules for managing mangroves, and coordinated rehabilitation efforts were initiated, although these efforts were limited to a few pilot locations as part of the Blue Forests initiative. According to Nugroho (2013), citing Eggertson (1990), institutions are fundamentally created to prevent opportunistic behavior, curb rent-seeking, and free-rider behavior, and enhance information exchange among

stakeholders, ultimately reducing coordination costs. Additionally, Ostrom (1990) noted that a key element determining institutional arrangements is the operational rules that govern resource utilization, which in this case are reflected in village regulations for mangrove ecosystem management. Therefore, it can be concluded that the institutional management of the mangrove ecosystem on Tanakeke Island during this period has begun to support sustainable management practices.

3. *Institutional Self-Governing Period*

According to Ostrom (1990), the final stage of the institutional development dynamics of resource management is the institutional self-governing period. This phase marks a transition towards a more stable and robust framework for overseeing resource management. During this period, the institution effectively supports sustainable resource management, although this phase can be lengthy. In the case of Tanakeke Island, this period began with the creation and implementation of village regulations, and it has continued to evolve since then.

CONCLUSION

The mangrove ecosystem plays a crucial role in supporting the lives of the community on Tanakeke Island. According to the analysis conducted, it was found that, at the time of this research, the dynamics of institutional development for mangrove ecosystem management on Tanakeke Island were in the self-governing stage. During this period, rules were already being implemented, and rehabilitation activities were underway. This indicates that the existing institutions are supportive of the sustainable use of the mangrove ecosystem on Tanakeke Island, characterized by management processes moving toward self-management.

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