Small-scale fisheries management policy based on sustainable access rights: A case of Lasolo Bay, North Konawe Regency, Indonesia

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Abstract. Rights-based small-scale fisheries management policies play a crucial role in supporting economic, social, and environmental sustainability. This research analyses the sustainability levels of such policies through a case study in Lasolo bay, North Konawe District. A qualitative analysis approach using the Quality Network Modelling System (QNMS) is employed to design scenarios that ensure the implemented policies have a positive impact on the sustainability of small-scale fisheries in the region. The analysis results indicate that the sustainability of these policies is significantly influenced by active community participation, fair rule implementation, and effective monitoring. This study provides insights for developing a more effective model of sustainable rights-based small-scale fisheries management policies in Lasolo bay and similar regions.

1 Introduction

Southeast Sulawesi Province is an archipelagic region with a maritime area of approximately 114,879 square kilometres or about 70% of its total area. Among a population of 2.7 million, 73,473 individuals or 2.8% have livelihoods from fishing activities. Most of them (97%) are engaged in small-scale fisheries with boats of less than 10 gross tons [1]. The significant portion of the marine areas and the potential of fish resources require the local government to protect and preserve these resources for long-term sustainable use. The current challenges faced by the fisheries sector in the area include declining catch due to overfishing, marine pollution, destructive fishing practices (such as the use of explosives and cyanides), and impacts of certain policies. Efforts to handle these issues have been made by the Provincial Government, but some problems remain.

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According to Article 18, paragraph (6) of the 1945 Constitution, Regional Governments have the authority to establish local regulations and other rules to implement autonomy and assistance tasks as stipulated in Law No. 31 of 2004 and Law No. 45 of 2009 on Amendments to Law No. 31 of 2004 concerning Fisheries. The Regional Governments are responsible for exploring, exploiting, conserving, and managing maritime areas within their jurisdiction. Law No. 7 of 2016 concerning the Protection and Empowerment of Fishermen, Fish Farmers, and Salt Farmers mandates the Regional Governments to allocate some areas and provide access to small-scale fishers within the Coastal and Small Islands Zoning Plan (RZWP-3-K). Accordingly, the Provincial Government of Southeast Sulawesi (PGSS) has initiated the Fisheries Access Area Management (Pengelolaan Akses Area Perikanan, PAAP), a program that promotes sustainable fisheries by granting fisher groups access and responsibilities in managing the fisheries in a defined management area. The responsibilities include sustainable utilization and conservation of fish resources, and participation in the fisheries management. This program is regulated by the Governor Regulation No. 36 of 2019 on PAAP and has been integrated into the Regional Medium-Term Development Plan of Southeast Sulawesi Province for 2018-2023. The PAAP is a priority instrument for small-scale fishers, local fishers, traditional fishers, and indigenous communities, as stipulated in the Regional Regulation No. 9 of 2018 on the Coastal and Small Islands Zoning Plan (RZWP3K) of Southeast Sulawesi Province. These provincial policies are legal foundation to address the challenges faced by the fisheries sector.

Fishing communities in Lasolo Bay, in the North Konawe Regency, Southeast Sulawesi Province face some issues including declining catch and fishers being forced to locate further fishing grounds. This issue significantly affects the social and economic conditions of the fishing communities. The issues are attributed to several factors, namely, excessive fish exploitation, use of cyanides, and marine pollution generated by land-based mining activities and barges traffic for nickel through their fishing grounds. The PPAP has been granted to the fishing communities to exercise management rights over their respective areas that promote the application of sustainability principles on the fish resources, i.e. long-term benefit for the local communities [2-3].

Complex interaction among factors that may govern the utilization of the resources in an area can be modelled with a social-ecological system (SES) in which social and ecological components are interconnected [4-5]. In several SES, implementing small-scale fisheries management can lead to more robust ecological and social outcomes, including increased fish abundance and catch [6]. Common-pool resource management solutions are necessary for building sustainable fisheries and addressing various social fisheries issues [7]. The resilience of the fisheries system to cope with various pressures requires institutional consolidation and change, which can be achieved through intervention [8-9]. Collaboration between social communities and governance conditions can lead to the effectiveness of fisheries resource reserves [10]. Territorial Use Rights in Fisheries (TURF) have the potential to sustain biodiversity across all typologies of ecosystem services [11].

This research aims to identify the components of the social-ecological system (SES) in the implementation of PAAP in Lasolo Bay and assess alternative policies for scenarios of the fisheries management that can influence the sustainability of fisheries resources and the well-being of the local community in the region. The system is defined by (Orstrom 2009) being formed by four main components, namely resource unit (RU), resource system (RS), actors (A), and governance (G). Analysis will be directed to identify consequences of the scenarios on the needs of policy required to promote sustainable rights-based fisheries management.

2 Methods

2.1 Study area

The research was conducted with data collection and analysis activities from February to November 2022. Data collection was carried out in the PAAP area of Lasolo Bay, North Konawe Regency, South Sulawesi Province (Figure 1).

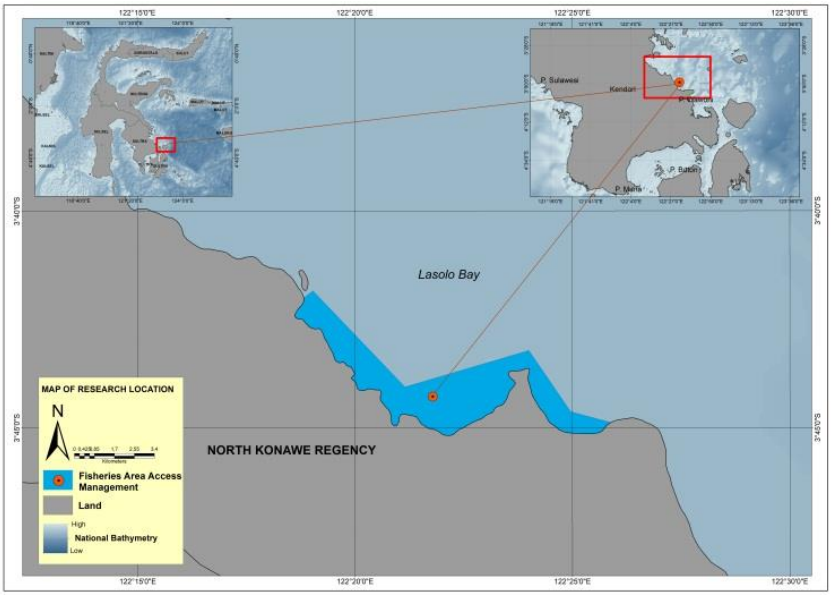

Fig. 1. Location map of the research area, PAAP in Lasolo bay, North Konawe Regency

2.2 Data collection

The data for this research were obtained through interviews using questionnaires and a focus group discussion (FGD) with respondents selected on the basis of comprehensive understanding on the actual conditions of the research objects, i.e. the PAAP. The respondents consisted of 224 respondents from fishers affiliated with PAAP (members of fishers group) and fishers who are not members PAAP fisher groups. The interviews were conducted to build understanding on the potential SES that will be used to formulate an initial network model. Literature studies on relevant documents, reports, and literature were carried out.

The FGD was attended by representatives of the local government, non-governmental organizations (NGOs), universities, both PAAP and non-PAAP fishermen. The initial model was introduced in the FGD, the participants were invited to comment and give inputs to improve the initial network model that can be used to develop policy scenarios or appropriate solutions for the PAAP in the North Konawe Regency.

2.3 Data analysis

Data analysis was conducted using the Qualitative Network Models (QNMS) described by the Melbourne-Thomas [12] framework using the R software package QPress. This qualitative model framework translates the fundamental concept of SES into pairwise relationships within the SES, with values of +1 (positive relationship), -1 (negative relationship), and 0 (no relationship), visualized through signed digraphs. The analysis aims

to identify, analyze, and simulate the best policy implementation scenario (PAAP) at the study location.

The Melbourne-Thomas framework is a modification of loop analysis [13]. The dynamics of n interacting components (ecological, actors, resources, government agents) and the rate parameters can be described in equation 1.

$$\frac{dx_i}{d_t} = f_i\ (x_i, x_2, \dots, n;\ c_2) \qquad (1)$$

Where: $\frac{dx_i}{d_t}$ = the rate of change of variable x_i which is a function of f_i of n-1 other variables and the rate of change of its parameters [14]. Melbourne-Thomas introduced sensitivity analysis in loop analysis using a Bayesian framework and simulation.

3 Results and Discussion

The analysis of the Policy Scenario for Fisheries Access Area Management (PAAP) in Lasolo Bay, North Konawe Regency, is based on the identification of the SES components involved, which are key elements in small-scale fisheries management in Lasolo Bay, North Konawe Regency. Subsequently, the results of this identification are used to create a basic model to be analyzed using QNMS. This analysis aims to develop scenarios or policy models for fisheries access area management (PAAP) in the region.

3.1 Policy scenario for PAAP in Lasolo bay, North Konawe Regency

The basic network model illustrates the SES components involved in Fisheries Access Area Management (PAAP) in Lasolo Bay, North Konawe Regency, based on the identification of these SES components that have the most dominant influence in Lasolo bay (Figure 2). The identification of key elements in these SES components was conducted to develop policy scenarios of the management model in the PAAP area of Lasolo Bay, North Konawe Regency.

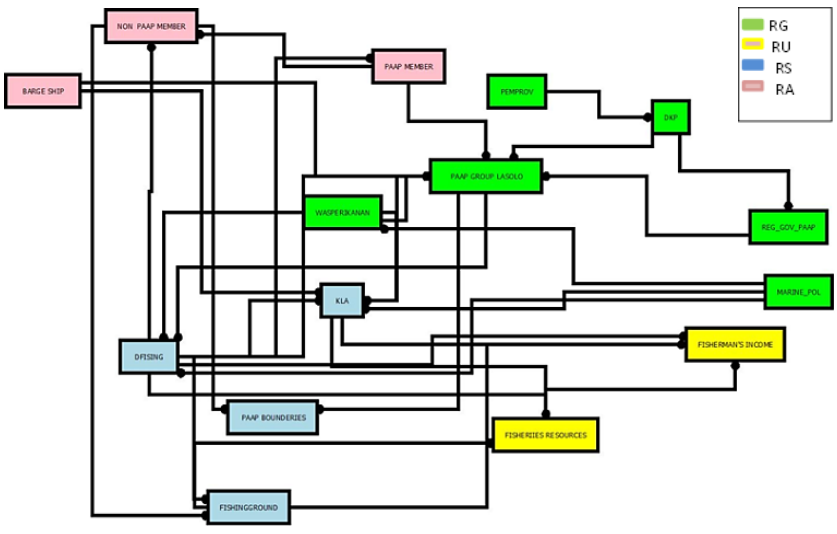

Fig. 2. Basic network model of SES relationships in the PAAP Area of Lasolo bay, North Konawe Regency. The four components of the system: 1) Resources Unit (Fish Resources and Fishermen's Income), 2) Resources Actors (Tugboats, Non-PAAP Members, PAAP Members), 3) Resources System (KLA, Fishing Ground, PAAP Boundaries, Dfishing, KLA), and 4) Resources Governance (Fisheries Surveillance, Water Police, PAAP Lasolo Group, Provincial

Government, Department of Marine and Fisheries, Regulation No. 36 of 2019 on Fishermen Groups (PAAP).

Based on the basic network model, four scenarios cover social-ecological sustainability aspects, including the well-being of fishermen and the sustainability of fisheries resources (Table 1). Actors in PAAP consist of PAAP Members and non-PAAP members, and governance refers to Governor Regulation No. 36 of 2019 regarding PAAP.

Table 1. Policy scenario models for PAAP in Lasolo bay, North Konawe Regency

Scenarios	Social-ecological sustainability		PAAP actors		Regional government
	Fisher's well being	Fishery resources	Members	Non-members	
S1	+	+	+	+	+
S2	+	+	-	-	+
S3	+	+	+	+	-
S4	+	+	-	-	-

The simulation results for Scenario 1 indicate both positive and negative impacts on the elements within the fisheries access area management system in the PAAP area of Lasolo Bay (Figure 3). Positive impacts (+) are observed on fish resources and fisher's income, while negative impacts (-) occur in fishing activities (Dfishing), fishing grounds, and PAAP boundaries. This scenario reflects effective management, leading to an increase in fisheries resources and, in turn, improved fishermen's income. The implementation of this policy also has a positive effect in reducing damaging fishing activities (Dfishing), increasing the utilization and area of fishing grounds, and facilitating access to the PAAP area due to abundant fisheries resources. Moreover, the stringent rules, protection, and legal certainty provided open access to the PAAP area.

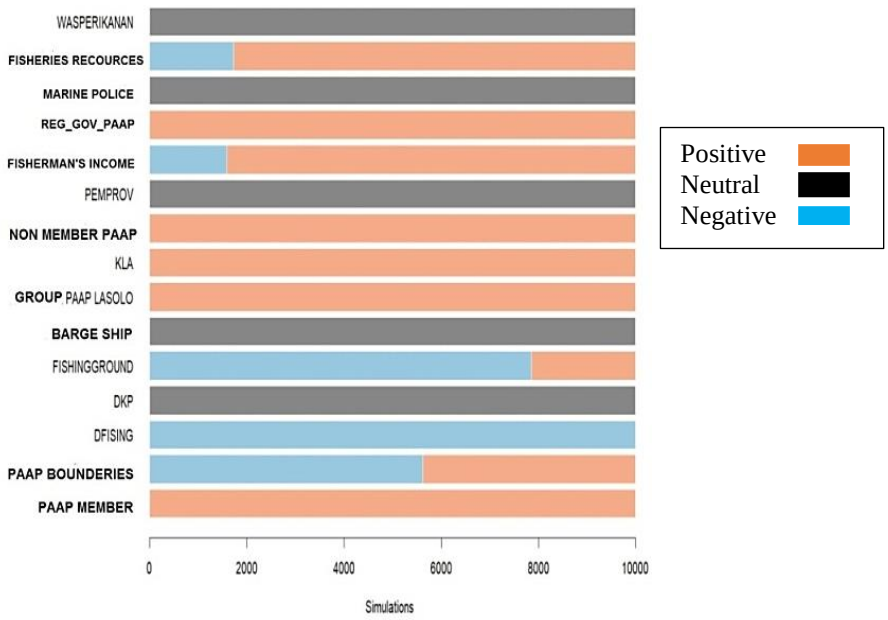

Fig. 3. Simulation results using the qualitative network modelling approach for scenario 1

The scenario 2 assumes the PAAP Actor components (PAAP and Non-PAAP members) have negative (-) values or that these components do not exist within the management system

in the PAAP area of Lasolo bay. Scenario 2 demonstrates various components that have both positive and negative impacts on the PAAP (Figure 4). Based on the analysis, the positive impacts (+) are identified for fish resources, fisher's income, fishing grounds, and PAAP boundaries. Meanwhile, negative impacts are identified for the Dfishing component. Nevertheless, the PAAP Governor Regulation policy still manages to provide positive benefits to fishers or the community in the area, even in the absence of PAAP members and non-PAAP members. Additionally, the impact of the PAAP policy can reduce or mitigate damaging fishing activities (Dfishing).

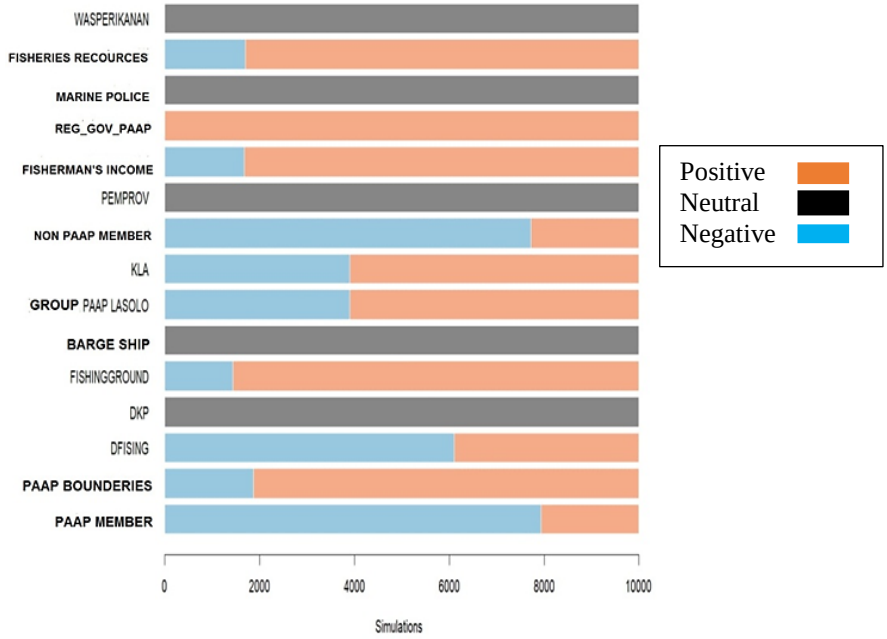

Fig. 4. Simulation results using the qualitative network modelling approach for scenario 2

The scenario 3 assumes that the PAAP Governor Regulation (Pergub PAAP) component has negative (-) values or this component does not exist within the PAAP area of Lasolo bay (Figure 5). Scenario 3 demonstrates various components that have both positive and negative impacts on PAAP in Lasolo bay, North Konawe Regency. In this case, the components that have a positive impact (+) are PAAP boundaries, Dfishing, and Fishing Ground. Meanwhile, there are negative impacts (-) on fish resources and fishermen's income. The PAAP policy initiated by the Southeast Sulawesi Government in the form of Governor Regulation No. 36 of 2019 on PAAP has an influence on the sustainability of fisheries in the PAAP area of Lasolo bay, North Konawe Regency. The absence of this policy results in negative effects on fisheries resources and fishermen's income. Without regulations, the livelihoods of fishermen worsen in the coastal area. This is reflected in the increase in damaging fishing activities (Dfishing), leading to resource depletion in the area. Distant fishing activities and limited access to fishing grounds force fishermen to search for new fishing grounds or spots.

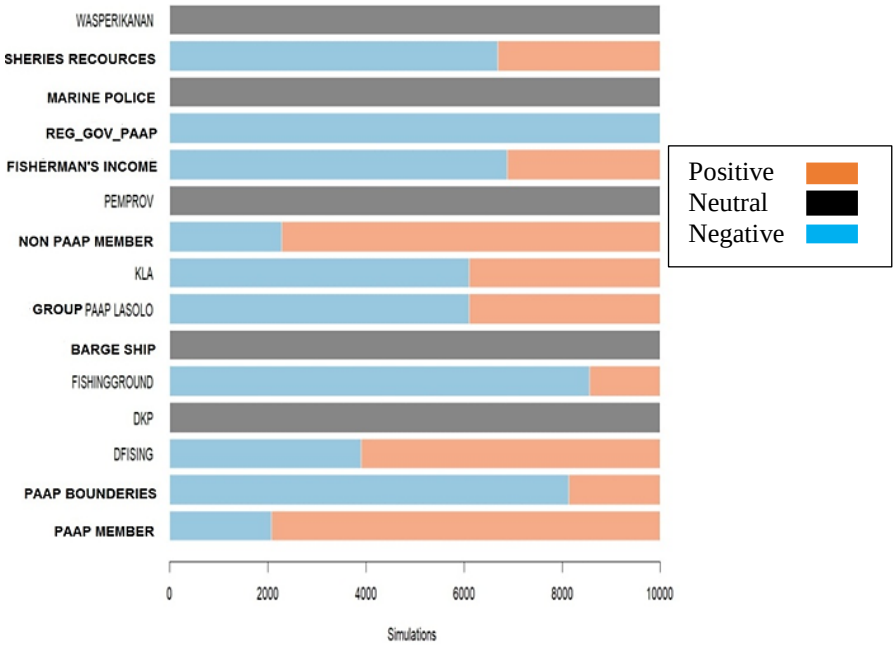

Fig. 5. Simulation results using the qualitative network modelling approach for scenario 3

The scenario 4 model assumes that the PAAP Members, Non-PAAP Members, and PAAP Governor Regulation (Pergub PAAP) components have negative (-) values or that these components do not exist within the fisheries access area management system in the PAAP area of Lasolo bay (Figure 6). The scenario 4 shows positive impacts (+), especially on the Fishing Ground, Destructive Fishing, and PAAP boundaries components. However, there are also negative impacts (-) on fish resources and fishermen's income. Like in scenario 3, the scenario 4 also indicates similar results. Governor Regulation policies play a crucial role in rights-based fisheries management in Southeast Sulawesi Province. Additionally, the role of PAAP members within the PAAP group also contributes to sustainable fisheries management. Although this role is not as significant as the role of the PAAP Governor Regulation policy, PAAP members play an essential part in the implementation of this policy.

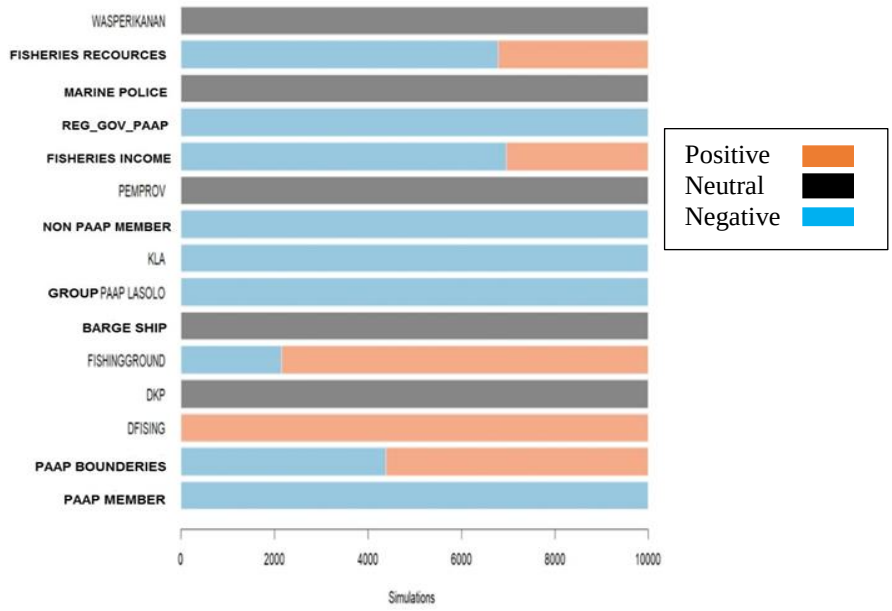

Fig. 6. Simulation results using the qualitative network modelling approach for scenario 4

4 Conclusion

1. There are components of the Social-Ecological System (SES) formed in the Lasolo Bay region, North Konawe Regency. These components consist of four elements: Resource Unit (Fishery Resources and Fishermen's Income), Resource Users (Barge Ships, Non-PAAP Members, PAAP Members), Resource System (Fishing Ground, PAAP Boundaries, Fishing, KLA), and Resource Governance (Fishery Supervision, Maritime Police, PAAP Lasolo Group, Provincial Government, DKP, Governor Regulation No. 36 of 2019 on PAAP). These identified components constitute the Social-Ecological System components that are involved and play a direct role in small-scale fisheries in the Lasolo Bay area, North Konawe Regency.
2. Based on the developed scenarios, scenario 1 and scenario 2 emerge are recommended to the Provincial Government of Southeast Sulawesi for the implementation of PAAP policies in the North Konawe Regency's Lasolo Bay area.

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