

*Full-Length Research Article***Local Institutions Performance in Mangrove Forest Management on Small Islands: Case Study in Buano Island, Maluku Province, Indonesia**Messalina Lovenia Salampessy<sup>1,\*</sup>, Bramasto Nugroho<sup>2</sup>, Hariadi Kartodiharjo<sup>2</sup>, Cecep Kusmana<sup>3</sup><sup>1</sup> Doctoral Program, Graduate School, IPB University, Bogor, Indonesia<sup>2</sup> Department of Forest Management, Faculty of Forestry and Environment, IPB University, Bogor, Indonesia<sup>3</sup> Department of Silviculture, Faculty of Forestry and Environment, IPB University, Bogor, Indonesia\* Corresponding Author. E-mail address: [manisemessalina@apps.ipb.ac.id](mailto:manisemessalina@apps.ipb.ac.id)**ARTICLE HISTORY:***Received: 1 November 2023**Peer review completed: 28 December 2023**Received in revised form: 19 February 2024**Accepted: 13 March 2024***KEYWORDS:***Forest management**Local institution**Mangrove**Small island***ABSTRACT**

Mangrove forests on small islands play an essential role in the stability of island ecosystems. It is crucial to analyze the performance of local institutions in forest management to increase the community's active role in preserving mangrove forests. This research aims to analyze the performance of local institutions managing mangroves on small islands. The research was conducted on Buano Island, Maluku, Indonesia. In-depth interviews and participant observation were used to obtain data. Data analysis uses a Situation, Structure, Behavior, and Performance (SSBP) approach. The research results show that the community is very dependent on mangrove forests. Resources are owned by the clan group (*Soa*) but managed by members of the clan group (family). Thus, the phenomenon occurs when common pool resources are managed by private (*Dati/Nuru*) proprietors. The community regulates the utilization of potential forest resources by dividing management areas controlled by each *Soa/Nuru* group. The preservation of natural potential on Buano Island is supervised by *Kewang* and *Sasi* culture. Applying customary rules increases the community's active role in managing resources and supporting village management. However, mangrove forest logging activities continue to occur. This performance shows a very high decline in mangrove forest vegetation and regeneration of mangrove forests. Stakeholder support is needed to increase the knowledge and skills of the community, especially traditional leaders, in implementing sustainable forest management.

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**1. Introduction**

The preservation of forests is a crucial focal point in contemporary natural resource management. Furthermore, around 1.6 billion individuals rely on forests for subsistence. As stated in [Sustainable Development Goal \(2023\)](#) Life on Land, which highlights the importance of protecting forests, the focus is to manage forests sustainably to support inclusive economic development, including mangrove forest protection. Mangrove forests are distinctive ecosystems that play a crucial ecological role and sustain numerous lives by providing marine products, timber, and other forest resources ([Duke et al. 2014](#)). Mangrove resources in coastal settlements frequently serve as social protection for those facing hardship, offering sustenance and materials in financial instability ([Jost et al. 2003](#)).

Indonesia has seen the degradation and conversion of approximately 637,000 ha, which accounts for 10–33% of its mangrove habitats, throughout the previous few decades (Arifanti et al. 2022; Kusmana and Hikmat 2015). Most of these problems arise from coastal development activities, including aquaculture, logging, mining, reclamation, and pollution (Kusmana 2015). From a socio-economic perspective, sustainable mangrove management in Indonesia encounters several challenges. Firstly, different stakeholders have differing perceptions regarding the value and benefits of mangrove ecosystems and the urgency of rehabilitation efforts. Secondly, the involvement of local communities in mangrove management has not reached its full potential. Thirdly, the communities residing near mangrove ecosystems are predominantly low-income, meaning economic considerations take precedence. Fourthly, there is a lack of sustainable practices in utilizing mangrove ecosystems. Lastly, the rapid population growth and economic demands have led to changes in land use and land cover (Arifanti et al. 2022).

Climate adaptation is essential for Indonesia, which has many small islands ( $\pm 17,000$  islands) (Cheung et al. 2011). Efforts to manage sustainable mangrove forests in coastal areas are a form of climate adaptation (Brewer 2012). Indonesia has 3.3 million ha of mangrove forests, recognized for their exceptional biodiversity. These forests are distributed throughout 2.2 million hectares within forest areas and 1.3 million ha outside forest areas (Giri et al. 2011). The archipelago exhibits a wide range of mangrove species, with Java having the highest diversity (166 species), followed by Sumatra (157 species), Kalimantan (150 species), Papua (142 species), Sulawesi (135 species), Maluku (133 species), and the Lesser Sunda Islands (120 species) (Kusmana and Hikmat 2015). Multiple studies have demonstrated that coastal habitats play a crucial role in safeguarding coastal communities and can be utilized as effective and strategic measures to mitigate risks and offer various environmental benefits (Cheung et al. 2011; Spalding et al. 2014).

Community participation should receive significant attention from policymakers because local institutions' long-term success will only be with such involvement. Destructive resource utilization practices and social conflicts can be fostered and strengthened by weak government policies that fail to consider the complexity of local institutions and the limited participation of communities and local institutions in policy formulation and implementation (Kamoto et al. 2013). Social values and community desires built for biodiversity conservation management reflect the intentions and desires of the community in managing their natural resources (Stojanović et al. 2016). The sustainability of the conservation and management approach over an extended period is contingent upon the local populace's inclination to adhere to regulations and engage in mutual surveillance (Ostrom 2009).

Local institutions play a crucial role in the community by providing a solution to address deterioration and enhance efforts in rehabilitating mangrove forests. North (1990) said that institutions are rules (constraints) humans create to regulate and shape political, social, and economic interactions. These rules consist of formal and informal rules and the process of enforcing these rules (enforcement). According to Agrawal (2001), the success of policy initiatives and planning for managing mangrove forests relies heavily on the involvement and assistance of local communities, as well as the level of participation and support from the government. The community heavily influences the success of sustainable forest management (Locatelli et al. 2014). The reliance of coastal people on these ecosystems might incentivize their restoration and conservation by leveraging their indigenous knowledge (McCook et al. 2015; Salampessy et al. 2015). External support from the government can facilitate the emergence of symbolic power by

providing conditions that make it possible to emerge (Martuti et al. 2018; Suharti et al. 2016b). Thus, the success of coastal area protection depends mainly on the human dimension and social aspects of nature conservation management. The human dimension includes strong community leadership (Adelina et al. 2015) and local institutional support for conservation (Ostrom 2005).

Strengthening local institutions is crucial because they have not received clarity regarding their status or quality in light of the community's recognition and commendation of their accomplishments. Moreover, there is a lack of empirical studies that provide evidence for the efficacy of local institutions in aiding the governance of mangrove forests on small islands (Friess et al. 2023; Ruslan et al. 2022; Seeruttun et al. 2023). On the other hand, community collective action has faced challenges. However, community collective action has achieved significant achievement. Nevertheless, local institutions encounter obstacles in maintaining long-term viability. Hence, the objective of this study is to assess the performance of local institutions in the regulation of mangrove ecosystems. To ensure that mangroves are conserved for the benefit of all, expertise and comprehension in this subject will aid relevant stakeholders in formulating recommendations for equitable, prosperous, and sustainable mangrove management.

## 2. Materials and Methods

### 2.1. Research Location

The research was conducted from May to July 2023 on Buano Island, one of the small islands in Maluku Province. Geographically, Buano Island is located at  $2^{\circ} 58,818' S; 127^{\circ} 55,248' E$  and has an area of  $\pm 13,537$  ha or  $135.37$  km<sup>2</sup>, which is bordered by the territory of Ety Village in the Buano Strait for the east and south, and bordered by Luhu Village in the waters of the Seram Sea in the north and west bordering the waters of the Seram Sea. Administratively, this island is in Huamual Belakang District, Seram Barat Regency, Maluku Province. Buano Island comprises two villages: North Buano Village and South Buano Village. There are six hamlets: four hamlets in North Buano, namely Anauni, Kasuari Island, Huhua, and Naiselan, and two hamlets in South Buano, namely Huaroa and Pasir Panjang.

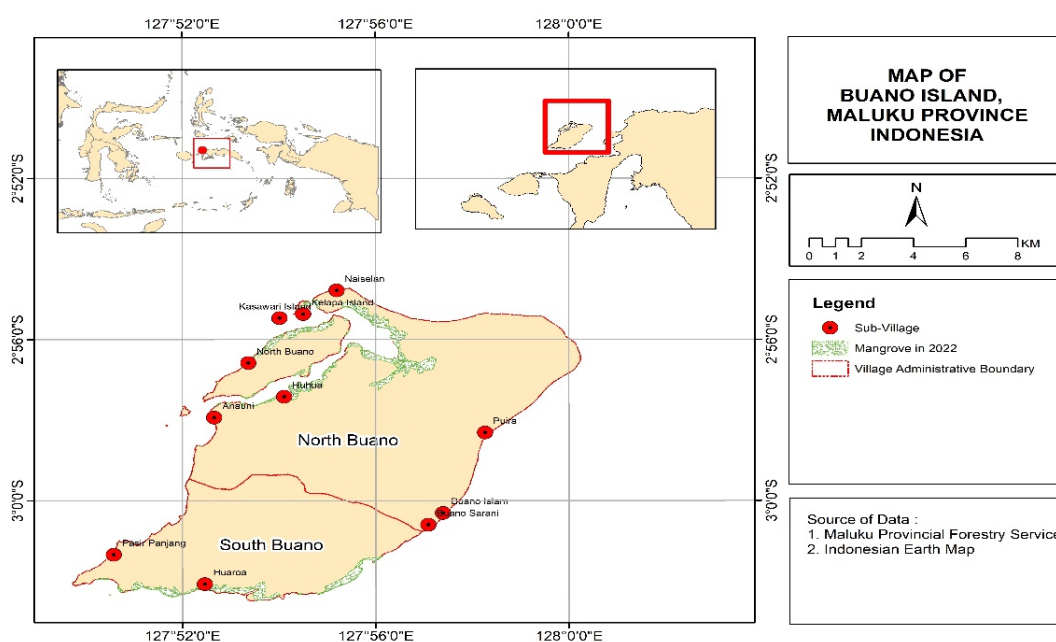


Fig. 1. Map of location research.

## 2.2. Data Collection

This research is qualitative research that uses case study research strategies as its research methodology. Data collection involves deep interviews, participation observations, and analysis of relevant documents (Asante et al. 2017; Ntibona et al. 2022). Social data collection methods were used: key informant interviews and participant observation. Interviewees were selected based on their roles and experience and determined using the snowball technique and purposive sampling to obtain key informants. Twenty-five key informants were engaged in conducting in-depth interviews. The representatives of the local community include the village heads/kings of North and South Buano (two people), head of clan or *Soa/Nuru* (two people), *Kewang Laut* (two people), head of hamlet (two people), fisherman figure (two people), women figure (two people), and Village Consultative Board (*Badan Permusyawaratan Desa/BPD*) of North Buano (one person) and head of community groups for marine monitoring (*Kelompok Pengawas Masyarakat* or POKMASWAS) (one person). The representatives from the government, local NGOs, and academics, each represented by one person, include: Forestry and Environment Service of Maluku Province (*Dinas Kehutanan dan Lingkungan Hidup/DKLH* Provinsi Maluku), Seram Barat Forest Management Unit (*Kesatuan Pengelolaan Hutan Kabupaten Seram Bagian Barat/KPH SBB*), Fisheries and Marine Service of Maluku Province (*Dinas Kelautan dan Perikanan/DKP* Provinsi Maluku), Director of Coastal and Small Island Utilization Ministry of Marine Affairs and Fisheries Republic of Indonesia (*Kementerian Kelautan dan Perikanan/KKP*), Regional Development Planning Agency of Maluku Province (*Badan Perencanaan Pembangunan Daerah/BAPPEDA*), Natural Resources Conservation Agency of Maluku Province (*Balai Konservasi Sumberdaya Alam/BKSDA*), Social Forestry and Environmental Partnership Agency (*Balai Perhutanan Sosial dan Kemitraan Lingkungan/BPSKL*), Environmental Governance and Forest Area Gazettement Agency of Maluku Province (*Balai Pemantapan Kawasan Hutan/BPKH*), Director of local NGOs *Lembaga Partisipasi Pembangunan Masyarakat/LPPM*, Tourism Service of Maluku Province (*Dinas Pariwisata/ DISPAR* Provinsi Maluku) and Pattimura University Ambon (UNPATTI).

## 2.3. Data Analysis

Data analysis uses the institutional framework Situation, Structure, Behavior, and Performance (SSBP) Analysis developed by Schmid (2004) and Nugroho (2016). Research data obtained from interviews were processed using Nvivo 12 Plus software tools. One form of this software data visualization is presented in Fig. 2 in the form of a project map, which explains that interview data explain the activities of the community in the mangrove forest, customary rules, and mangrove management situation that influence the structure, behavior, and performance of mangrove forest management in Buano Island.

This software creates coding from data from interviews with resource persons (Table 1). Schmid (2004) and Nugroho (2016) say that *situation conditions describe the characteristics of resources, the characteristics of resource provision and consumption, and the transactions carried out. Structure* defines the rules regulating interrelationships between actors, considering physical characteristics and resource provision. *Behavior* describes actors' responses to the institutional structure that surrounds them and the characteristics of the resources they use. *Performance* describes who gets what, social interrelations between actors in the institutional structure, and characteristics. Specific resources will produce particular performance. The structural analysis section is equipped with property rights which refer to the Bundle of Rights Theory (Ostrom 1999),

and 7 (seven) types of rules from the rule-in-use concept (Ostrom 2005): position rules, boundary rules, authority rules, aggregation rules, information rules, scope rules, and pay-of rules as well as 8 (eight) principles that ensure the sustainability of Common-Pool Resources (CPRs) institutions (Ostrom 1990): Clearly defined boundaries, Proportional equivalence between benefits and costs, Collective choice arrangements, Monitoring, Graduated sanctions, Conflict resolution mechanisms, Minimal recognition of rights to organize, the principle of linkage in management systems, there must be appropriate coordination among relevant groups. To analyze the results of the development of mangrove forest conditions, which are displayed based on vegetation cover using the Normalized Difference Vegetation Index (NDVI) (Liu 2019). This research uses two types of satellite imagery, Landsat 7 and Landsat 8, to describe each image period from 2018 to 2022.

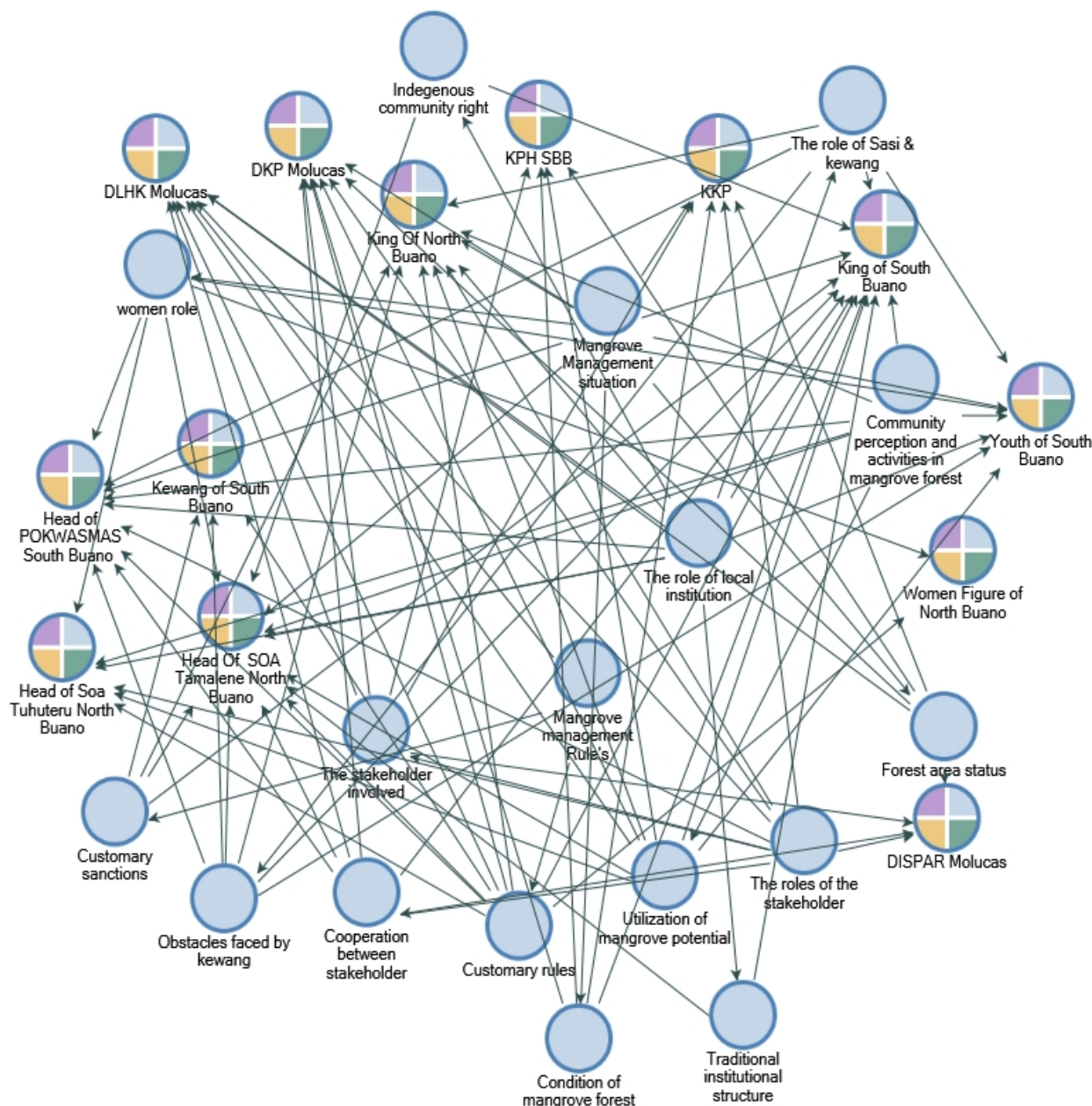


Fig. 2. Project Map of the mangrove forest management based on stakeholder interviews.

**Table 1.** Key informant identity coding

No	Informant	Coding
1	BAPPEDA	IN1
2	DKP	IN2
3	LPPM	LP
4	King of South Buano	BS
5	Head of <i>Soa</i> Sinohi	SS
6	Head of Huaroa Hamlet	DH
7	North Buano female figure	PU

### 3. Results and Discussion

#### 3.1. Situation

##### 3.1.1. Activities for utilizing mangrove resource potential

Buano Island has a mangrove forest area of 619.98 ha, consisting of a primary mangrove forest of 362.77 ha and a secondary mangrove forest of 257.21 ha. The diversity of mangrove species identified includes 7 (seven) major mangrove species, 3 (three) minor mangrove species, and 2 (two) association mangrove species. The 4 (four) dominant species, found on Buano Island include *Rhizophora mucronata*, *Rhizophora apiculata*, *Rhizophora stylosa* and *Bruguiera gymnorhiza*. The Government of Maluku Province has classified Buano Island and its surrounding waters as a Small Island Conservation Area based on Maluku Province Regional Regulation Number 1 of 2018, as a conservation area so that efforts to preserve the surrounding ecosystem, including mangrove forests, are significant (**Table 2**).

**Table 2.** Species of mangroves on Buano Island

Scientific name	Local name	Family	Species of mangroves	Location	
				Huaroa	Huhua
<i>Rhizophora mucronata</i>	<i>Akar Tinggi</i>	<i>Rhizophoraceae</i>	Major	√	√
<i>Heritiera littoralis</i>	<i>Kulit Buaya</i>	<i>Sterculiaceae</i>	Minor	√	√
<i>Sonneratia alba</i>	<i>Kerapat</i>	<i>Sonneratiaceae</i>	Major	√	√
<i>Rhizophora stylosa</i>	<i>Akar Tinggi</i> <i>Daun Kecil</i>	<i>Rhizophoraceae</i>	Major	√	√
<i>Rhizophora apiculata</i>	<i>Akar Tinggi</i> <i>Bunga Merah</i>	<i>Rhizophoraceae</i>	Major	√	-
<i>Derris trifoliata</i>	<i>Mata Buta</i>	<i>Fabaceae</i>	Association	√	√
<i>Bruguiera gymnorhiza</i>	<i>Koli-Koli</i>	<i>Rhizophoraceae</i>	Major	√	√
<i>Ceriops tagal</i>	<i>Lamutasi</i>	<i>Rhizophoraceae</i>	Major	√	√
<i>Aegiceras corniculatum</i>	<i>Pisang-Pisang</i>	<i>Primulaceae</i>	Minor	√	-
<i>Lumnitzera racemosa</i>	<i>Tabaku</i> <i>Pante</i>	<i>Combretaceae</i>	Association	√	-
<i>Xylocarpus granatum</i>	<i>Kira-Kira</i>	<i>Meliaceae</i>	Minor	√	√
<i>Nypah fruticans</i>	<i>Nipa</i>	<i>Areaceae</i>	Major	√	-

Notes: √ = found, - = not found.

Buano Island is designated as a conservation area, so efforts to conserve the surrounding ecosystem, especially mangrove forests, are essential. Including mangroves on small islands significantly enhances the ability of these fragile islands to adapt, as indicated by Poti et al. (2022) and Techera (2023). Small islands are very vulnerable and fragile. The presence of mangrove ecosystems may enhance small islands' adaptability. Mangroves play a crucial role in safeguarding coastlines against storm waves and tsunamis that result from submerged waves (Worthington et al. 2020).

The history of utilizing the potential of mangrove wood started from the time of Buano's ancestors and intensified around the 1960s. The ancestors of Buano Island sent mangrove wood as cast wood for construction in the city of Ambon. Forests are being cut down on a large scale to meet this need. Besides that, people use mangrove wood as a building material, especially as a firewood source. The mangrove forest area is a natural resource with characteristics of CPRs, and the Buano community has a high interaction with it in utilizing the potential of the mangrove forest. Currently, various community activities in exploiting the economic potential of the mangrove ecosystem:

1. Logging wood. Logging for wood for firewood and *Barau*, especially in North Buano Village, the community still depends on using mangrove wood as firewood for daily needs and *Barau* activities (postpartum care for women). The wood often cut is the *Rhizophora apiculata*, which, according to the community, is very good as firewood and *Barau* because it produces stable heat;
2. *Bameti* is a form of community activity utilizing aquatic resources, carried out when sea water recedes, including collecting mollusks. The types of mollusks found and used by the community include several kinds of resources taken in the form of types of snails or sea snails (*bia*). Types of mollusks found and often consumed in mangrove locations include *bia dara* (*Anadara sp.*), *bia garu* (*Tridacna gigas*), and *bia jala* (*Strombus sp.*). The shellfish obtained are then cooked for consumption by the family. This *Bameti* activity is among people who consume shellfish whether during the wave season or not, but in general, it is carried out during the "east season" when it is difficult for people to get fish. Hence, the community uses it for family consumption and sale;
3. Fishing and crabbing. Fishing activities in mangrove areas during low tide occur in many small ponds where fish are in these ponds. Fish caught are for consumption only. The fish caught was the *bubara* (*Charanx sp.*). The community provides several traditional traps (*bubu*) for crabs around the mangrove roots. There is potential for crabs to give additional income to the community where certain parts of the forest are rented out by *Soa/Nuru* for people from outside to harvest crabs. The rental period is one year with a fee of IDR 2,000,000 per year, according to the agreement made;
4. Sand mining. Buano Island residents exploit the mangrove ecosystem by extracting sand and stone from the mangrove area, particularly in the mangrove forest area known as *Labuan Sinohi*. This activity is undertaken to fulfill the demand for construction materials. The extraction of sand occurs almost daily, and the materials are subsequently sold.

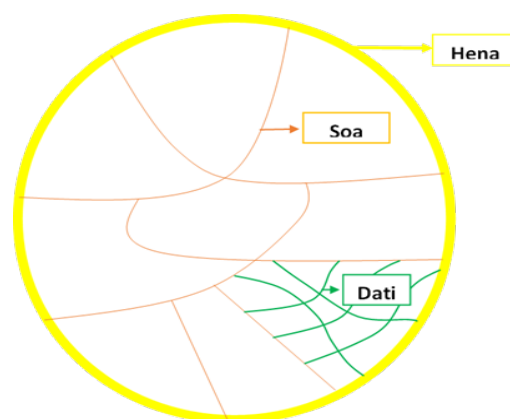
Community activities such as *Bameti*, looking for fish and crabs, and cutting wood show that mangrove forests have provided economic benefits for the community. Mangrove forests are essential breeding grounds for crabs, shrimp, and various species of fish, and promote the maintenance of fisheries and populations offshore (Kumar et al. 2016) and provide social functions to coastal communities (Salampessy et al. 2015), for example, *Bameti* activities by women in small

groups to strengthen relationships with each other and build cooperation in collecting *Bia*. Activities carried out by the community to utilize the potential of mangrove forests emphasize that the community is very dependent on the existence of these forests. Local communities depend on forests due to a lack of alternative economic livelihoods. So far, this activity has yet to be large-scale, but it is a threat for the years to come, so in its management, there must be restrictions on this activity to prevent coastal erosion. Informants stated, “People are active in the forest to look for wood burn and use wood for “Barau.” People often look for fish and crabs by installing “Bubu.” Mangrove forests are also a place for “Bameti” women.” DH, PU (In-depth interviews and FGDs of Buano Women figures). This aligns with what Roy (2016) stated: mangrove forests are an essential breeding ground for crabs, shrimp, and various types of fish, and individuals utilize the forest and its resources due to established customs and traditional practices (Badola et al. 2012).

### 3.1.2. History of development and typology of provision and consumption on Buano Island

North Buano Village has a mangrove forest area in Huhua Hamlet and Lapuan forest, which *Soa Tamalene* and *Soa Tuhuteru* manage. In contrast, South Buano Village has a mangrove forest area in Huaroa Hamlet, which is managed by *Soa Laut* and *Labuan Sinohi*, which *Soa Sinohi* manages. The mangrove forests in Huhua and Huaroa Hamlet are primary mangrove forests. Before the 1960s, this mangrove forest was in the form of a green belt. Then, intensive logging or clearing of mangrove forests was carried out in 1970 to build materials and meet the community's and surrounding islands' firewood needs. Each *Soa* has a sacred forest in the mangrove forest, and its preservation is very well preserved. Mangrove forests around residential areas tend to experience change. In 2019-2021, efforts were made to rehabilitate mangrove forests by local NGOs (LPPM) and DKP Maluku Province. Rehabilitation efforts have succeeded in restoring forest conditions in both hamlets.

The social system of the people of North and South Buano was built and strengthened by traditional institutions. They are united in traditional institutions for community life, and societal leadership is regulated by conventional institutions, which are divided into *Hena*, *Soa*, *Nuru*, or *Dati*. In addition, there is an institution called *Mulut*. It can be explained in Fig. 3.



**Fig. 3.** Description *Hena*, *Soa*, and *Dati*.

*Hena* is the entire community on Buano Island. *Hena Puan* is known and occupied by the community today as *Negeri Buano*. *Negeri Buano* is the name of the village government system in Buano. *Soa* is a community of 3–10 clans, families, or a combination of *Dati/Nuru* groups. One *Soa* consists of several *Dati* (households or clans). *Soa* head is called *Ina Ama* or Head of *Soa*.



There are 54 clans, 30 in North Buano and 18 in South Buano. *Dati* or *Nuru* or *Numatau* consists of several families with each family head and is the basic structure for the formation of social structure in society because everyone must be in *Numatau* to form a kind of family network that is connected and lives together with values. *Mulut* is a legislative body whose members are representatives of *Soa*. *Mulut* plays a conduit for the aspirations of the *Soa* people. In the modern government system, the function and role of the *Mulut* are the same as the *Badan Permusyawaratan Desa/Village Consultative Board* (BPD). BPD/*Mulut* member comes from *Soa*. The government system in North Buano and South Buano is run by the respective *Upu Latu/Raja*, with *Mulut* assisting each *Soa*.

Before being separated into two villages, the Buano community used to be one community unit known as *Hena Puan Buano*. At the beginning of the Dutch colonial period, the tribes of *Dati/Nuru* still lived and had moved to their current location. The process of *Nuru*'s descent did not occur simultaneously but gradually. There are some *Dati/Nuru* who have decided to stay in their old village, and there are also those who have decided to move. Moving *Dati/Nuru* from the old villages to *Hena Puan* (the current southern and northern villages/states of Buano) has strengthened kinship ties, built brotherhood mutual respect, and formed a strong alliance. The *Upu* (ancestors) formed *Soa*, which oversees clan groups and natural resource management areas. Separating the governments of North and South Buano has occurred since the Dutch arrived in Buano. The highest government leader in Buano Village is called the *Raja* but traditionally is called *Latu*. When Buano separated into North Buano and South Buano, the highest government leader in North Buano was still called *Raja*, and in South Buano, he was called *Patti*.

To avoid wider war and create peace between communities, the *Upu* (as the first ancestors), who then led the old *Hena-hena* (old villages/settlements), decided to form a new village. Then, a system of ownership of land, sea, rivers, forests, and even mangrove forests was formed based on communal property rights, namely the rights belonging to clan groups known as *Soa*. This property right can become a use right for anyone in *Soa* or another *Soa* by first asking permission from the *Soa* owner. Management of resources that were owned and managed together (*communal property*), but then due to increasing productivity and population growth, there was an initiation from ancestral figures to each person group until 9 *Soa* were formed. Resource ownership is distributed as each *Soa*'s property and managed by each clan within the *Dati/Nuru*. Thus, the phenomenon is that mangrove forests are joint resources (CPRs) managed by the *private property* (families within *Dati/Nuru*) as owners. This private property will provide guarantees for managing existing natural resources based on the characteristics of the types of provision and consumption managed by *Soa*. Each *Soa* cannot exclude each other's *Dati* members from managing existing resources (*non-excludability*). However, it can exclude other parties (outside *Soa*) who have no interest in managing the resource (*excludability*), and managed mangrove forests are limited resources so that use by one *Dati/Nuru* will reduce the use of other *Dati/Nuru* (*sub-tractability*). The informant stated: "Each *Soa* manages a region. Its *Dati* members organize and utilize it. If it is to be rented or inherited, it is regulated by *Soa*'s decision. For people outside *Soa* to gain access to *bia*, fish, and crabs, they must ask for permission from the *Soa*. The point is to wisely use all existing potential, manage the hamlet well, participate in planting damaged forests, and maintain their security." SS (In-depth interview). The characteristics of shared resource management (CPRs) with the Private Property typology require mutual understanding and cooperation between the *Dati* and the clans within it. Apart from that, strong norms, vision, and the right attitude are needed to make decisions for managing available natural resources. Clarity regarding ownership

and access rights to coastal resources can result in more effective management of mangrove resources through local institutional arrangements (Phong et al. 2023).

The indigenous community on Buano Island has been legalized as the *Nusa Puan* Buano Island customary law community or *Masyarakat Hukum Adat* (MHA) based on West Seram Regent Regulation Number 3 of 2023 concerning the protection and management of coastal and marine resources based on the *Nusa Puan* Buano Island customary law community in the Huamual Belakang District. This regulation strengthens the community's right to gain access to the management, protection, and utilization of water areas, and the community is also obliged to safeguard, protect, and preserve coastal and marine areas, including mangrove forests. Recognizing the Buano Island community as a *Hena Pua* customary law community further strengthens the sense of togetherness (Kusters et al. 2022). It emphasizes supporting regional policies for community forests since they significantly impact forest performance more than national (formal) regulations. Successful management, conservation, and restoration require the commitment of local, State, and national level government and local communities (Romañach et al. 2018).

In addition to the local population, Buano Island is inhabited by migrants from the Buton Tribe in Southeast Sulawesi. The migratory community settled on this island 300 years before the independence of Indonesia. The historical presence of these ethnic immigrants, commonly called “*orang dagang*” is closely intertwined with the history of warfare and economic expansion. In general, the immigrant community is well-received and is considered an inseparable part of today's Buano society. The migrant community occupies several hamlets called *Petuanan*, located on the west-to-north coast of Buano Island, and currently, administratively, they have into hamlets. Immigrants are given land management rights around the hamlet, and the process of obtaining rights is done by granting permission by the *Dati* owner and *Soa*. Permits given to migrant communities include permits to create gardens or permits to build houses. However, it is prohibited to illegally exploit areas that are the rights of certain *Soa* from North Buano Village and South Buano Village. People have the same preference for mangrove forests. The community will decide together and through a deliberation mechanism regarding what actions should be taken, especially managing the potential natural resources in the surrounding area. The sustainable exploitation, restoration, and management of mangrove resources can be achieved by implementing local customary rules and institutional frameworks to regulate the rate of mangrove extraction and regeneration (Aheto et al. 2016).

### 3.2. Structure

The *Nusa Puan* Island Buano Buano community is part of the Maluku traditional community, which has the philosophy of “*Tunun Manan Hatu Putih*,” which is interpreted as a form of togetherness in one community unit that protects and looks after each other in the context of *Hena Puan*. Various customary rules have been established for the management of natural resources in Buano, including (1) prohibition on carrying out activities in the Sacred Forest; (2) prohibition on causing damage to existing natural resources, forests including mangroves; (3) prohibition on taking excavations (stones or sand) around mangrove forests; (4) need permission from the head of *Soa/Nuru* as the owner of the area if you want to take natural potential (wood, fish, shrimp, crab, bia); (5) prohibition on logging of mangrove forests (only implemented in the last five years).

According to Ostrom (2005), individuals in certain action situations will only carry out legitimate actions based on applicable rules, and there are 7 (seven) types of rules from the rule-in-use concept, which can be used to identify issues and problems in Buano, among others:

1. *Position rules* regulate the number of positions and how many partitions a seat can be occupied at every position side of an action arena. It is clear of the role of the *Dati/Nuru* head, *Soa* head, and clan members in resource management;
2. *Boundary rules* exist; here are the rules regarding requirements and how participants enter or leave a specific position in an arena action. Community access for clan members of the *Soa/Nuru* is permitted to enter customary rights areas. However, for different *Soa/Nuru* communities, notification and permission from the relevant *Soa/Nuru* head is required. Immigrant communities are allowed to access and utilize resources by following the rules set by *Soa/Nuru*. Each *Soa* fully controls the utilization of forest potential according to customary rules. It can be seen that there is a mechanism for the entry and exit of individuals that is adapted to their rights to their customary territory in managing resources;
3. *Authority rules*. Regulations regarding several legal actions are given to participant according to their position in each decision-making stage. There is a division of duties and authority for each figure's position in managing forest resources;
4. *Aggregation rules* are rules about transformation functions, a specific type of action on the final or intermediate results for the group at every decision-making stage. There are rules for decision-making procedures starting from the clan, *Dati/Nuru*, to the *Soa* level through joint deliberation. The authority to make decisions at the clan level lies with the *Dati* leader or is determined through the collective discussion and consideration of clan members. The head of the *Dati* typically exercises direct decision-making authority regarding the ownership or utilization of the *Dati*'s land. Meanwhile, through deliberation, for example, regarding the restoration of heritage houses. Likewise, at the *Soa/Nuru* level, decision-making can be done directly, for example, by prohibiting the use of *Soa* land. Meanwhile, collaborative discussions can take place about government initiatives, such as the distribution of rice or the appointment distribution of rice for traditional elders (*Saniri Negeri*) or mosque leaders. The *Raja* holds the authority to make decisions at the village level. The village staff do not have the primary authority to make choices; their role mainly involves managing bureaucratic processes. However, they work in collaboration with *Soa* to make several decisions on land use. In addition, decisions concerning the interests of the *Soa* community must be made in partnership with the leader of the *Soa* through the *Saniri Soa* Meeting (a gathering of all members of the *Soa*);
5. *Information* regulations govern levels of available information, authorize information channels, set obligations, permissions, or prohibitions to communicate with participants on position at a particular decision stage, and set the language used in communication. Not yet available, information on resource management is still limited to the *Dati/Nuru* and related *Soa* levels and their wang. The next challenge is how to make this information understandable, then create understanding and foster "inter-*Soa*" motivation to manage sustainably;
6. *Scope rules* are rules governing actions or circumstances that influence an outcome variable (results) that "must," "should not," or "may" affect the results of the actions taken in a situation. The scope of management areas that do not yet have clear boundaries and the scope of mechanisms regulating norms for sustainable resource management;

7. *Pay-off* rules are rules about how necessary benefits and costs are banned, prohibited, and distributed to the participants. There are rules for sharing the results of adequate resource management through profit-sharing portions at the *Dati/Nuru* level to *Soa* and *Soa* contributions to support village development.

The roles of several important figures in mangrove forest management were identified, including *Raja/village head*, *Soa Head*, *Dati Head*, *Kewang*, and *Guru Mahu*: (a) the king or leader of the village is involved in organizing the village government, executing village development plans, supporting the growth of the village community, and empowering its members. The village's essential function is to spearhead endeavors aimed at resolving the challenges encountered by *Soa*; (b) the head of the *Soa* whose role is to lead and manage all the resources owned by the *Soa* and protect the group of clans/*Dati*; (c) the *Dati* chief who organizes and protects his clans; (d) *Kewang* is an important figure who plays a vital role because he is an element of the government whose job is to protect the environment both on land and at sea from the hands of irresponsible people; (e) another influential actor in the village, especially the North Buano Village, is the spiritual leader/figure called *Guru Mahu*, a highly respected figure who teaches *Soa* about cultural values to determine behavior, rules, ceremonies, and religious activities. *Guru Mahu*'s figure is respected and obeyed by the *Dati/Nuru* chiefs and the community. *Guru Mahu* will mediate the problems faced by the community.

A series of confirmations of duties from the Head of *Soa* regarding the Management of his customary areas in mangrove forests include: (1) each *Soa* regulates activities utilizing various potential natural resources within its customary rights, including mangrove forests; (2) the *Soa* community members can access, manage, and utilize forest potential for their needs; (3) *Kewang/forest police* are assigned to monitor, report, and enforce rules in managing natural resources by their customary rights. The duties of the *Kewang* in the two villages are slightly different. The role of the *Kewang* in South Buano village is to guard and supervise sea and land areas, provide reports/information on monitoring results to the village government and *Soa*, and provide services for their duties from the village income and expenditure budget retribution in South Buano Village by the Head of *Soa*. The role of the *Kewang* in the village of North Buano, apart from the duties of guarding, monitoring, and reporting, is also the task of collecting income/retribution for the results of natural resource management managed by each *Nuru* and depositing it to the head of the *Nuru* as well as the salary of the *Nuru* concerned; (4) the Head of *Soa* can expel stakeholders without rights or violating the agreement; (5) the Head of *Soa* will provide economic and spiritual sanctions for any violations of access or use of resources without permission. The position of *Kewang* in Buano is usually appointed by the *Soa* Chief and determined by the King through a Decree. This decree becomes legal for *Kewang* to act against perpetrators of violations. The role of traditional leaders in supporting efforts to manage sustainable natural resources is in line with what was stated by previous researchers (Ostrom 1998; Reinikainen et al. 2016) and argues that in rural communities, the ownership of natural resources is a social institution that establishes the community's connection with land and natural resources, as well as the interaction between community members and outsiders in terms of rights.

In addition to the regulations set forth by the community. The management of mangrove forests on Buano Island is governed by various government regulations that specifically address mangrove management in Indonesia, including Law Number 41 of 1999, which addresses the management of mangrove ecosystems, specifically focusing on forest management. It emphasizes the need for rehabilitation and reclamation to restore damaged areas of mangroves. The Law

Number 27 of 2007 deals with managing the coastal regions and small islands, specifically managing mangrove forests within these areas. The objective is to protect, preserve, and utilize these areas and their ecosystems to ensure the continued existence, availability, and sustainability of coastal and small island resources.

Additionally, the aim is to maintain and enhance these resources' quality, value, and diversity. The Law Number 32 of 2009 addresses environmental protection and management, specifically conserving natural resources in vital ecosystems, such as coastal and marine habitats. These statutory laws highlight the significance of endeavors to safeguard, preserve, and harness the potential of coastal regions and affirm that the community possesses the same comprehensive rights and possibilities to participate actively in environmental preservation and management. The community's success in managing mangroves sustainably needs to be supported by providing legal access to the community (Suharti et al. 2016a).

In the utilization of resources on Buano Island, there are divisions of several rights, or bundles of rights, according to (Ostrom 1998), namely access, *withdrawal*, *management*, *exclusion*, and *alienation*. Rights to resources or property rights explain a person's relationship with others through the recognition of resources. **Table 3** describes a series of local community rights to natural resources on Buano Island.

The *Soa/Nuru* community has the right to access, withdraw, and manage various potential resources available in the mangrove forest, exclude parties who have no interest, and pass it on to future generations. Different *Soa/Nuru* groups are given access rights and withdrawal rights to enjoy the results of the resources with permission from the relevant *Soa/Nuru* head. The migrant community (Bugis/Buton tribe) who live in certain *Soa/Nuru* customary hamlets have the right to access, withdraw, and manage resources, subject to *Soa/Nuru* regulations and paying utilization and management fees under the agreement made. For land tenants, individuals/groups inside and outside Buano Island are given access and withdrawal rights according to the agreement with *Soa/Nuru*.

**Table 3.** A series of local community rights to natural resources

Set of rights	Description of rights
Access Rights	The community can enter and enjoy the beauty of the available resources
Withdrawal Rights	<ul style="list-style-type: none"> <li>- Utilization of wood, especially for firewood and building materials, for public utilities and local community needs</li> <li>- Use of land around mangroves for gardens</li> <li>- Utilization of wood for Barau (postnatal care for mothers)</li> <li>- Harvesting marine products (fish, shrimp, crabs, and mollusks)</li> </ul>
Management Right	<ul style="list-style-type: none"> <li>- Regulation of the use of natural resources</li> <li>- Carry out rehabilitation of open hamlet land</li> </ul>
Exclusion Right	<ul style="list-style-type: none"> <li>- Carry out forest patrols and monitor forest conditions</li> <li>- Exclude parties who do not have the right to use resources</li> <li>- Provide sanctions against parties who violate the agreement</li> </ul>
Alienation Right	<ul style="list-style-type: none"> <li>- Transferring rights</li> <li>- These rights cannot be transferred but can be inherited or leased based on a <i>Soa/Nuru</i> agreement</li> </ul>

**Table 4** describes the allocation of rights to represent critical parts involved in managing and utilizing the potential of the mangrove forest on Buano Island.

**Table 4.** Type of right

Type of right	<i>Soa/Nuru</i> (Full owner)	<i>Dati/Nuru</i> (Proprietor)	Other <i>Soa/Nuru</i> communities (Authorizer user)	Immigrant community/ Bugis Tribe (Claimant)	Land tenant (Authorizer user)
Access	✓	✓	✓	✓	✓
Withdrawal	✓	✓	✓	✓	✓
Management	✓	✓		✓	
Exclusion	✓				
Alienation	✓	✓			

From the types of rights depicted, the *Soa/Nuru* group has a complete bundle of rights and has the authority/power to make rules for forest management activities. This complete ownership right can incentivize each *Soa/Nuru* to manage forest resources sustainably. Each party involved in forest management can be regulated to manage rights controlled by customary agreements. Nugroho and Tiryana (2013) said that forest benefits are closely related to property rights, namely the rights owned by individuals, communities, or villages over resources to be managed, obtain benefits, or even their length. Property rights are fundamental in managing natural resources. The utilization of natural resources within a specific area is contingent upon the property rights that regulate these resources.

The customary rules with visible positive implications include (1) regulations regarding granting access to utilize forest potential for community needs. The potential utilization carried out by the *Soa/Nuru* group is a form of community behavior in utilizing forest potential in their area according to their needs; (2) the behavior of communities around the mangrove forest area is using mangrove forest land for the needs of mangrove wood, *Bameti*, fishing and crabs, and *Barau*, which are for each family's needs; (3) with an automatic access and management permit based on an agreement between *Soa/Nuru*, the community is focused on maintaining and preserving the forest to obtain sustainable results; (4) the community retains the security of its forests through the role of *Kewang*, which represents a form of responsibility for the existence of the forest from excessive use by parties who have no interest, and (5) the efforts of each *Soa/Nuru* to develop its institutions. The *Soa/Nuru* group is well organized. It often holds internal meetings, mainly discussing the management efforts carried out.

### 3.3. Behavior

The examination of the behavior and how sustainable mangrove forest management is carried out by the Buano community can be studied using the 8 (eight) principles that ensure the sustainability of the CPRs institution developed by Ostrom (1990) as follows:

1. Clearly defined boundaries: The group's identity and the shared resource's boundaries are delineated. The two villages have agreed on the boundaries of their customary areas based on natural boundaries determined since their ancestors established them. Still, there are no boundary markers for each *Soa*, so there are often mutual claims between *Soa* or *Dati/Nuru*. However, the use of rights has been regulated according to the allocation: *Soa* rights (*full*

- owner), community rights between *Soa* (*Authorizer user*), rights of *Dati/Nuru* (*Proprietor*), rights of immigrants (*Claimant*) and tenants (*Authorizer user*);
2. Proportional equivalence between benefits and costs, the principle of suitability for a balanced distribution of costs, and rules regarding utilization time limits related to environmental and social conditions. Financial income from resource management is regulated based on an agreement, and each *Soa* governs the imposition of levies in the organized *Dati* group. The distribution of results obtained in existing management activities, and the community contributes to the development of the village through *Ngase/income/retribution* for the town where the results obtained by each *Soa/Nuru*; the profit-sharing percentage will be determined, namely 60:40, where 60% of the income received for the benefit of the *Soa* group and 40% of the revenue is a gift from *Soa* to support village development which into the village/state treasury. Forest management activities have directly supported the economy of the *Dati/Nuru* community. In addition, there is a specific time limit (1–2 years) for using resources for immigrants or renting land. To regulate the involvement of migrants, especially people from Buton/Bugis Tribe who live in hamlets, in managing existing natural resources, each *Soa* requires migrant communities to obey the enforced customary rules. Immigrants access to occupy hamlets, which are *Soa* customary areas, exploit existing potential, and provide retribution/income for the *Soa* concerned. For example, in the Huaroa Hamlet, South Buano Village, migrant communities from Buton/Bugis Tribe are welcome to occupy the hamlet area, maintaining and exploiting the existing potential by following directions from *Soa* Sea;
  3. In collective choice settings, group members must be able to create at least some of their own rules and make decisions based on consensus. People do not like being told what to do but will work towards group goals they have agreed upon, where individuals who depend on natural resources can participate in modifying operational rules. *Soa* has made operational rules for forest management through joint deliberation. Collective rules are set with the *Dati/Nuru* group, and each *Dati* is responsible to the *Soa* group. However, there are no regulations related to using large amounts of resources. If this is connected to the characteristics of CPRs (non-excludability and sub-tractability), it will have implications for competition for these resources, and forest destruction will continue to occur;
  4. Monitoring and managing the commons is inherently vulnerable to free-riding and active exploitation. Unless this debilitating strategy can be detected relatively cheaply for norm-abiding group members, a tragedy of the commons will occur. The village government and *Soa* do not specifically carry out monitoring functions. However, the role of *Kewang* is to monitor and report on the condition of forest areas in designated customary regions. *Kewang* is a traditional role performed by a conventional leader responsible for supervising the village's natural resources in the land environment (forest), the coast, and the ocean. In Buano Village, two *Kewang* people go to each *Soa*: the Forest *Kewang* and the Ocean *Kewang*. They work like forest police who guard, care for, supervise, reprimand on the spot, or report to the King, head of *Soa*, and *Saniri Negeri* if there are violations and destruction of customary land in the forest and marine environment. Monitoring in conjunction with potential resource utilization activities and a specific monitoring system has yet to be created, only in informal reports on forest conditions and community activities encountered. In line with Feka (2015), there is still no management system with good governance indicators to measure and encourage ecosystem health that can be implemented in forest management. Monitoring forest

management is entirely entrusted to the *Kewang*'s responsibility, but the *Kewang*'s role is not yet influential. Since the conflict in 1983, it has had implications for the figure of the *Kewang* in South Buano Village, who seems to have lost the power to enforce the rules and does not dare to reprimand those who break the rules. At this moment, *Kewang* feared past events that caused the conflict. However, on the contrary, the condition of the *Kewang* in North Buano Village was appointed by *Nuru*, and the chosen *Kewang* was also a traditional figure, so he was braver in acting and enforcing the rules. It is necessary to strengthen the role of *Kewang* figures, with the support of the village government and the commitment of *Soa* and the community to provide full support for the role and function of *Kewang*. This symbolic power goes beyond the type of resource (capital). It is an arena of struggle to "legitimize the stratification of the social order" of *Sasi*, which needs to continue to be carried out and monitored by the Management of mangrove forests by *Kewang* and "community monitoring groups." Currently, *Kewang* is assisted by *Kelompok Pengawas Masyarakat* (POKWASMAS), which the Fisheries and Marine Service of Maluku Province formed. This group is to help implement the Decree of the Ministry of Marine Affairs and Fisheries (Number 49 of 2021) concerning conservation areas in the waters of Buano Island in Maluku Province. This group helps the *Kewang*'s role by monitoring conservation areas and actively rehabilitating damaged mangrove forest areas. Apart from that, as a form of support for the role of *Kewang* by the South Buano State Government, South Buano Village Head Decree Number 01.03/SK/KD-BS/I/2022 concerning the Appointment of *Kewang* Officers in South Buano Village, Huamual Belakang District. This policy has confirmed the role of the *Kewang* to monitor and supervise all potential results both at sea and on land in the South Buano region, and there is financial support from the state/village income and expenditure budget to support the role of the *Kewang*. Responsibilities for the management and exploitation of natural resources. Rights are social controls that regulate the interdependence of society and pressure on who gets what (Schmid 2004);

5. Graduated sanctions. The principle of applying sanctions, apart from fines in the form of money, is a relatively heavy customary sanction, a social sanction due to customary trials for parties whom many people violate. Customary sanctions are imposed on those who commit violations, for example, wood whose average cubic capacity is IDR 100,000, or according to the agreement. The informant stated, "For example, if we cut wood without a permit, we calculate a fine for perturbation. According to the *Soa* agreement, he must pay 100 thousand or more, and if he commits a violation in the *Sinohi Soa* area, it means he pays the fine for that *Soa*." BS (in-depth interview). There is a hereditary custom of practicing nature protection on Buano Island, namely through supervision by the *Sasi* culture. *Sasi* means prohibiting extracting certain potential products with or without damaging the environment. *Sasi* is a tradition of Maluku that maintains specific potential results. In *Sasi*, individuals are forbidden from harvesting specific vegetation on land and extracting particular resources from the water for a duration specified by the local governing body. *Sasi*'s role is to facilitate the sustainable growth and development of natural resources. Preserving natural resources is necessary for a specific duration to revive progress and advancement and attain desirable outcomes. Although more significant policy decisions may influence the conservation of mangrove forest resources, their sustainable use largely depends on local people and their exploitation of its resources (Roy 2016). The implementation of *Sasi* is a combination of sacred customary rules and religion. Implementing *Sasi* always begins with prayers and



sanctions on those who violate the prohibition on *Sasi*. *Sasi* is also applied to areas around mangrove forests as an institutional system that regulates village communities, not to catch fisheries resources, not to cut down mangroves, and not to take *bia* or crabs within a certain period so that they can reproduce until they reach consumption size, and can sustainably. The sanctions provided aim to help enforce the law effectively. When opening *Sasi*, the entire village community determines the type of fishing gear and methods used to catch the fishery resources being *Sasi*. If there is a violation of customary rules, economic sanctions will be imposed, such as a penalty for converting fees according to these resources. Providing customary sanctions is a customary response to violations of customary rules. These sanctions are intended to restore the disturbed balance due to violation of customary rules (Limbong et al. 2021). However, the implementation of *Sasi* in North Buano and South Buano has stopped since 1983 due to a conflict incident that resulted in mutual attacks between the two villages. The conflict started because of a reprimand by the *Kewang* in the South Buano *Sasi* area, which was not accepted. The *Sasi* was stopped then, on the initiative of South Buano Village King/*Raja*, and assistance from a local NGO (LPPM); in 2022, it will be implemented again and tested for 1–3 years, the conditions of the people of the two villages. Obligations arising from “customary rights” include how customary law communities can manage natural resources sustainably by paying attention to environmental sustainability (Widowati et al. 2019);

6. Conflict resolution mechanisms. It must be possible to resolve conflicts quickly and in ways perceived as fair by group members. It has been agreed that conflict resolution will be carried out in stages from the *Dati/Nuru* and *Soa* levels, and if it has not been resolved, it will continue to the village/state level;
7. Minimal recognition of rights to organize, groups must have the authority to conduct their affairs. Externally imposed rules are unlikely to be adapted to local circumstances and violate principle 3. Community rights in resource management have been regulated and enforced at the *Dati/Nuru*, *Soa*, and migrant group levels. This *Soa* group has autonomous rights in decision-making and will be at risk if decisions ignore social functions and utilization externalities, which will have implications for resource damage. The *Soa/Nuru* group still has a selfish attitude in managing their resources and ignoring the rules and social functions of the mangrove forest. It is hoped that the complete rights owned by the *Soa* can be used to maintain the continuity of the function of the mangrove forest on Buano Island. Nugroho and Tiryana (2013) said that forest benefits are closely related to property rights. These property rights are fundamental in managing natural resources. The use of natural resources in an area depends on the property rights that govern those resources;
8. The principle of linkage in management systems, or groups that are part of a larger social system, must be good coordination between related groups. The indicators used for this principle are the linkage of rules at the operational, collective, and constitutional levels. The results of this evaluation show that there is a link between rules at the operational level and collective level, but constitutional rules do not support them. The Minister of Forestry and Environment’s decree Number 6604 of 2021 has designated several mangrove forest areas on Buano Island as other purposes areas (Areal Penggunaan Lain/APL) and convertible production forests (*Hutan Produksi yang dapat Dikonversi/HPK*). The informant stated: We are confused about whether APL mangrove areas exist. “While we have the *Folu Net zink* program, emission absorptions are large in mangrove forests” IN1 (In-depth interview).

*“This habitat, the mangrove forest ecosystem, will be threatened, including the endemic bird Kehicap Buano, often found around mangrove forests”* LP (in-depth interview). *“Damage to mangroves is likely to occur, considering that mangroves are fish spawning places and many functions must be maintained”* IN2 (in-depth interview).

On the other hand, the Decree of the Minister of Maritime Affairs and Fisheries Number 49 of 2021 has designated the waters of Buano Island as a conservation area. This condition causes overlapping authority between the parties responsible for managing mangrove resources. Overlapping authority with different management objectives (APL and HPK versus conservation areas) risks management failure, resulting in increasing deforestation and forest degradation. Differences in interests and power between actors are a source of regional conflict in mangrove management. Each actor tries to utilize their power for their interests (Febryano et al. 2014). Apart from that, each *Soa* group needs attitudes and views that support sustainable management efforts. For example, logging activity needs to be carried out using a selective logging system, replanting needs to be carried out, and special norms need to regulate the use of significant resources to benefit the *Soa*/village. However, it is still visible that community behavior, prioritizing access to exploit the economic potential of mangrove forests, has not explicitly regulated rehabilitation efforts for the condition of damaged forests. It requires an active role from the community and obedience in adhering to the agreed rules. Institutions function to regulate and control community attitudes and behavior in forest management. Forest damage is still occurring, with large-diameter mangrove stands identified as being logged. Some people also admitted that they had used trees that had fallen because of the wind for their own needs, and some looked for firewood in the surrounding mangrove forests. The location of mangrove forests around community settlements, especially in the Huhua and Huaroa hamlets, causes forests to become the primary provider of community needs, and this causes community dependence on forests to increase. People in Buano are still very dependent on mangrove wood as firewood, especially during religious holidays. The need for wood is increasing. Each family must prepare 4–5 bundles of wood for 2–3 days of use for firewood needs.

For this reason, efforts to increase community knowledge and establish regulations for managing the potential of mangrove forests and continuous logging can disrupt the forest ecosystem. The utilization of mangrove forests is mainly carried out in unsustainable ways, such as cutting down trees unselectively. There are no specific regulations governing mangrove logging activities. Apart from that, in some parts of the mangrove forest, people take the sand as a building material, causing damage to that part of the forest. Ownership of mangrove resources by *Soa* groups tends to be under open access, especially for *Dati* group members of related *Soa* groups. If the Head of *Soa* cannot act decisively in arranging utilization permits. Even though there are regulations, they are usually violated with “impunity” by the head of the *Soa* or *Kewang*, who does not have the power to enforce the rules. Forest management by each *Soa* needs to be accompanied by sustainable management efforts, for example, if cutting needs to be sorted and required to be replanted. Kumi et al. (2016) said that ownership of mangrove land is mainly under the control of communities or individuals. Because it must meet several community needs, it can result in massive degradation. Like other coastal ecosystems, mangrove forests are unsafe for human interference and destruction. Sinery (2014) said there has been a change in the pattern of utilization of natural resources in communities around the forest, from basic needs to desires.

Apart from that, regulating the utilization of fisheries potential around mangrove forests is based on the Law of the Republic of Indonesia (Number 31 of 2004) concerning fisheries. Many

fish with high economic value spend part of their life in mangrove habitats. So, the presence of mangroves is closely related to the level of fisheries production. The fish caught are subsistence, and some to fulfill daily needs. The area around the mangrove also has several cages made by the community. Forest management by each *Soa* needs to be accompanied by sustainable management efforts, for example, if cutting needs to be sorted and required to be replanted. Kumi et al. (2016) said that ownership of mangrove land is mainly under the control of communities or individuals. Because it must meet several community needs, it can result in massive degradation. Like other coastal ecosystems, mangrove forests are unsafe for human interference and destruction. Although coastal communities traditionally manage mangrove forests sustainably, overexploitation can lead to degradation (Duke et al. 2014). Sinery and Manusawai (2016) said there has been a change in the utilization pattern of natural resources in communities around the forest, from basic needs to desires.

Regulations are essential for properly harnessing the potential of mangrove forests while preserving their condition. Furthermore, there is a lack of widespread awareness among the community regarding forest rehabilitation endeavors, necessitating support from multiple stakeholders. The LPPM NGO's presence has imparted fresh insights to the Buano community by educating them about the significance of mangrove forests and introducing them to advanced techniques for planting mangroves. The informant stated, "*Since 2016, LPPM has worked intensively through empowerment programs on Buano Island. Empowerment support is through strengthening the capacity of the government, traditional institutions, communities, and youth groups to manage traditional territories, register traditional communities, manage small-scale fisheries, and strengthen the community economy. Moreover, education to preserve mangrove forests plays a vital role for this island*" LP (in-depth interview).

### 3.4. Performance

The status of the mangrove forest area on Buano Island has been designated as other purposes area (*Area Penggunaan Lain* or APL) and conversion production forest (*Hutan Produksi yang Dikonversi* or HPK) based on the Decree of the Minister of Environment and Forestry (KEPMEN LHK No.6604/2021) concerning development map inauguration of forests in the Maluku Province area until 2020. Even though it is an APL area, from a spatial plan, it is a protected and conservation area based on the Decree of the Ministry of Marine Affairs and Fisheries (KEPMEN KP No.49/2021). In this research, the results of the development of mangrove forest conditions are analyzed using vegetation cover using the Normalized Difference Vegetation Index (NDVI). In line with what was stated by Liu et al. (2019) and Huang et al. (2021), NDVI analysis helps assess vegetation cover by analyzing multi-spectral data, thereby producing vegetation patterns. This research uses two types of satellite imagery, Landsat 7 and Landsat 8, to depict each image period covering 2018 to 2022. The criteria for the NDVI score are as follows:

- NDVI 0–0.10 = low density of vegetation cover,
- NDVI 0.11–0.2 = medium-density vegetation cover,
- NDVI 0.21–1 = high density of vegetation cover, and
- NDVI 1–0 = open area/air/cloud.

The analysis of trends from 2018 to 2022 reveals a significant decline in vegetation density, as shown by the NDVI ranging from 0 to 0.1. Similarly, in areas with moderate vegetation (NDVI

0.1–0.2). High density tends to remain constant due to the area’s status as a sacred forest, which is highly valued by the local community.

Vegetation with low density (NDVI 0–0.1) and medium (NDVI 0.1–0.2) was at its highest point during 2018 but slowly decreased drastically from 2021 to 2022. From 2018 to 2020, medium-density vegetation was around 845.22 ha, 832.54 ha, and 856.9 ha. This number will continue to decline to 70.04 ha in 2022. High levels of mangrove logging activity have been observed in the mangrove forest area in Lapuan, which *Nuru* manages (Fig. 4 and Fig. 5).

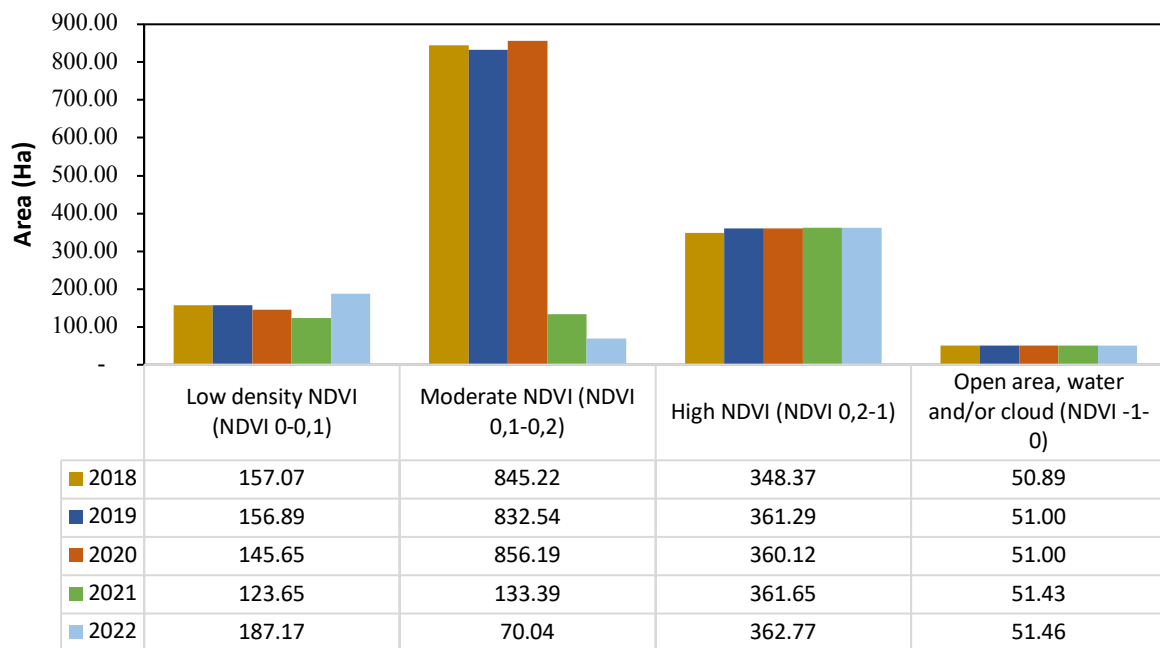


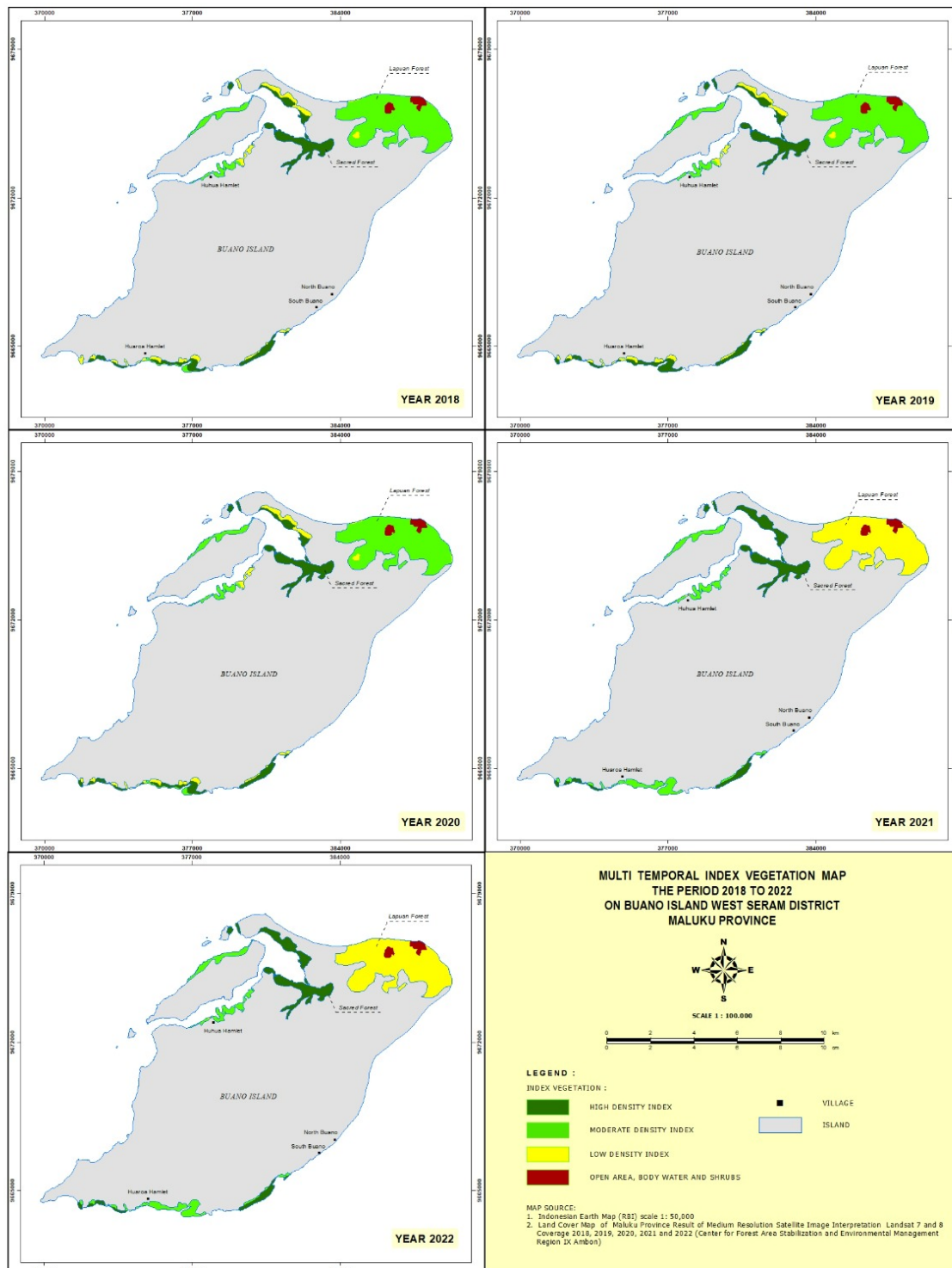
Fig. 4. The dynamics of vegetation coverage (ha) expressed in NDVI.

The condition of the mangrove forests in Huhua and Huaroa Hamlet and the sacred forest looks stable. Still, significant changes can be seen in the Lapuan forest location. Routine logging activities will be carried out throughout 2021. This logging is an agreement between *Nuru*, who has management rights. This logging was carried out to support the need for wood for the construction of places of worship and the firewood needs of the people who are members of *Nuru*. However, logging activities have not been properly regulated, especially to regulate the function of mangrove forests as island protectors. The mangrove ecosystem has several benefits and ecosystem services, but it still faces challenges and pressure due to activities in coastal areas (Tandio et al. 2023).

This contrasts with forest conditions in both hamlet. Communities are increasingly active in protecting their forests. Rehabilitation efforts were carried out with the assistance of the Fisheries and Marine Service of Maluku Province. The village government and the Head of *Soa/Nuru* need to build community perception about the importance of efforts to protect and utilize sustainable potential. Increasing understanding of mangroves, including their composition, ecological benefits, and methods of use, exploitation, and restoration, is essential to guide sustainable practices in their management and protection (Friess et al. 2023).

Since *Sasi* occurred, forests have existed. It is rare to find violations committed by the community. The vegetation analysis results in Huhua and Huaroa Hamlet show that forest performance in the two hamlets is relatively the same. At the tree level, the number of species

found at the Huaroa location was nine, while at the Huhua location, there were six species. The dominant species at the second location was *R. mucronata*, with a density of 131 individuals/ha and an Importance Value Index (IVI) of 127.85% at the Huaroa location and a density of 254 individuals/ha and an IVI of 160.17% at the Huhua location. At the Huaroa Hamlet location, ten plant species were at the seedling level, with the dominant species being *R. mucronata* (density 13,402 individuals/ha and IVI 103.27%).



**Fig. 5.** NDVI measures the dynamics of vegetation cover. This image was made based on the changing conditions of mangrove cover on Buano Island.

At the Huhua Hamlet location, the number of species found was less, namely five species, with the dominant species being *R. mucronata* (density of 18,888 individuals/ha and IVI of 130.22%). Many seeds indicate that mangrove ecological sustainability will run well. The density study results suggest that the growth pattern of the mangrove forest has an L-shaped trend. The mangrove tree population on Buano Island exhibits a trend towards a balanced forest structure, where trees of greater diameter are associated with fewer individuals. This situation is conducive to reaching death due to the plentiful rate of regeneration (small diameter) while maintaining continuity without significant disruption (Dewi et al. 2021).

Communities have realized that forest destruction will impact daily lives. These fishermen stated that the degradation of the mangrove ecosystem in recent years has reduced the volume of fish, shrimp, crab catches, and wood. Forest rehabilitation efforts began to be initiated by the community. The community is trying to increase understanding of mangrove rehabilitation techniques. “Sasi” activities are being promoted again for the sake of continuing the function of the area. Forest conditions that are in the recovery stage from damage require a solid institutional role. The role of the stakeholder is needed to increase community participation and empowerment in managing the potential and knowledge for mangrove forest rehabilitation. The community has activated the “Sasi” activity and has started rehabilitating damaged forest areas with the assistance of the Fisheries and Marine Service of Maluku Province and local NGOs. With their customary rules, local institutions must innovate related to community economic activities, forest protection efforts, and institutional strengthening against external and internal disturbances (Nelson and Chomitz 2011). Both excellent and effective institutions will ensure sustainable use and management. Local institutions have shown that the success of community forest management cannot be based on the strength of values and norms profoundly rooted and widely accepted by the community (Ostrom 1998; Sattayapanich and Janmaimool 2022). Steenblik (1998) stated that local communities possess the authority to establish regulations, execute judgments, and ensure adherence to rules in various domains of natural resource management.

Currently, mangrove forest regeneration is very high after disturbances caused by deforestation in the past. This data shows sufficient availability of tree seeds to produce propagules (Uche et al. 2023). Enforcement of customary rules by the community enables mangrove conservation because there is certainty of access, rights, and incentives to develop sustainable mangrove management. Local groups are at least as effective managers (Kusters et al. 2022). To mediate human interactions and the use of natural resources, they pay attention to local economic well-being, conservation interests, and recognition of local values (Agrawal 2001; Kamoto et al. 2013). What happens in managing mangrove forests on Buano Island illustrates natural resource management where the community as area managers can control resources and improve their performance. This gap can be caused by the correlation between situation, institutional structure, and actor behavior, impacting the performance of mangrove forest management on Buano Island. The roles played by each actor also show diverse attitudes and behaviors regarding the resources they have. Chiefs *Soa/Nuru* and *Kewang* can better protect their resources. Communities are needed to preserve forests and other living environments for the sake of the continued function of the area for future generations.

Coordination between stakeholders in managing mangrove resources is necessary so that management is carried out effectively and ensures the continuity of the area’s function. Society has a significant role in preserving resources, and there is a need to improve their performance. The need for government assistance to increase understanding and knowledge of the community,

especially the Head of *Soa*, to protect resources and the importance of structuring *Soa*'s institutional structure to regulate the necessary resource protection rules for the continued function of the area for future generations. The capacity of local communities to organize and establish norms for using local resources is an essential element in the sustainable development framework (Davenport and Hassan 2020). Support for increasing the knowledge and skills of the community, especially traditional leaders, in implementing sustainable forest management is essential. The role of various stakeholders is very much needed. The role of local NGOs is to help increase community knowledge about mangrove rehabilitation activities. Thompson et al. (2017) say that in low-income nations, coastal resource management has observed that relying solely on long-term support guarantees from local communities does not yield sustainable outcomes. Local communities usually need help managing coastal ecosystems due to limited capacity, limited budget, and local politics (Damastuti et al. 2022).

#### 4. Conclusions

The performance shows that local institutions have not been effective in managing mangrove forests. The situation influences this, showing forest management with Common-Pool Resources (CPR) characteristics managed with a private. The structure explains that the management of identified rules in use does not yet provide resource management information rules and management area rules, views behavior community is influenced by the lack of regulations for the use of large amounts of natural resources and regulations for sustainable management, monitoring processes that are not yet running well, *Soa*'s autonomy rights and overlapping management systems at the constitutional level. For this reason, intensified coordination between stakeholders and support from parties is needed to strengthen local institutional structures, especially utilization regulations, and improve resources for sustainable resource use.

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