Local Uses of Mangrove Species in the Masao Village Satoumi, a Socioecological Production Landscape and Seascape of Butuan, Agusan del Norte, Philippines

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Abstract. Mangroves undergo degradation, thus reducing ecosystem services to coastal population. This study explored how local people use and conserve mangroves in Masao village *satoumi,* a socioecological production landscape and seascape (SEPLS) in Butuan, Agusan del Norte, Philippines. Mangrove species were identified, and interviews were conducted to determine mangrove local uses. Results found 21 mangrove species belonging to 12 genera in 10 families. The local uses include the following: 1) source of fuelwood (*A. alba*, *A. rumphiana*, *B. tersa*); 2) source of industrial compounds (*S. alba* and *C. tagal*); 3) source of medicinal or therapeutic compounds (*A. marina* and *X. moluccensis*); 4) shelter (*N. fruticans*), and 5) as ornamental (*L. racemosa*). Locals reported *N. fruticans* as endangered due to pest and diseases. Other mangrove species are vulnerable caused by development. Some locally useful mangroves are in the threatened category of IUCN, particularly, *A. rumphiana* (vulnerable) and *B. tersa* (nearly threatened). Based on interview results, the locals are not aware of any mangrove conservation practices. Hence, the need for the local government to streamline efforts in public awareness to facilitate participation of the community in mangrove conservation in the *satoumi* of Masao village and to regulate utilization of mangrove resources leading to mangrove conservation and resilience to storm surge and coastal flooding.

Keywords: Satoumi, Masao Village, Mangrove Diversity, Mangrove Species Conservation, People-Nature Interaction, Mangrove Sustainability

1 Introduction

Mangroves are prominent component vegetation of a typical coastal landscape in many parts of the tropics (Donato et al., 2012; Thorhaug et al., 2020). And usually, a village is just nearby, interacting and coevolving with the ecosystem with their benign indigenous and cultural practices harmonious with nature and the overall mangrove seascape. People depend on the mangrove ecosystem resources and the mangroves are

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also taken care of by the local community. In other countries, mangroves maybe absent but other vegetation types are abundant with similar dependency between local community and the coastal ecosystem. In other areas, only the seas and the creatures therein are closely interacting with the local people. This unique landscape or perhaps, more appropriately, seascape, has been existing for ages (Buot & Osumi, 2004: Gu & Subramanian 2014). In the recent book on seascape (Pungetti 2022), seascape has been defined in many different ways by different chapter authors. Buot & Buot (2022) defined it to include the water bodies and the surrounding vegetation connecting a land mass to the seas, forming a unique seascape interacting with local communities.

In Japan, this seascape is known as *satoumi*. The interaction in the *satoumi* landscape results to productivity and biodiversity through the cultural practices of the people, hence, the harmonized relationship of environment and people (Yanagi, 2006). An exemplar *satoumi* is characterized by the presence of conservation activities and resource management in coastal areas with immense involvement of estuarine communities. With the biodiversity problems we had experienced due to population pressure and related challenges, there was reduction or loss of biodiversity in *satoyama* and *satoumi*. In 2010, the International Partnership for the Satoyama (including *satoumi*) Initiative (IPSI) has been approved by the Conference of the Parties, Convention on Biological Diversity as a strategic approach to *satoyama* and *satoumi* or socioecological production landscape and seascape (SEPLS) conservation (www.satoyama-initiative.org). A *satoumi* approach to coastal management contributes to the achievement of Sustainable Development Goals (SDGs) as well as to the realization in the global visions of the Convention on Biological Diversity (CBD) (Kakuma & Sato, 2022). Coastal communities heavily rely on mangroves as source of food, shelter, and income. The provisioning ecosystem services that mangroves provide, keep the well-being of the local community at good condition (Quevedo et al., 2020). Other than these, mangroves serve as habitat for fish and other intertidal zone species, provide clean water, ecotourism and most importantly, protection from the impacts of climate change. *Satoumi* landscapes in the Philippines practice mangrove management as a means of water quality regulation and as protection from storm surge and flood damage (Primavera, 2006; Menendez et al., 2018).

Mangrove species are also extracted by locals as source of medicine and for therapeutic purposes which have been passed on through traditional practices (Goloran et al., 2020). It is also used as construction materials and source of tannins or industrial compounds. Overall, the benefits that mangrove ecosystem offered to humans are important to the community's well-being, hence, it must be sustainably managed. The relationship between human and mangrove community, needs to be in harmonious to keep both flourishing. However, due to the human overconsumption with undermanagement and lack of conservation, mangroves are declining and currently under threat. Human activities in coastal areas coupled with the local economic development poses risks to the mangrove ecosystem of *satoumi* landscapes in the Philippines.

Mangrove species that thrives in the Philippines is at least half of the 65 species around the world (Kathiresan & Bingham, 2001: Garcia et al., 2014: Cabuga et al., 2022). It was recorded in 2009 by Primavera & Dianala that there are 36 species of

mangroves in the Philippines, considered one of the highest among global records. However, despite many mangrove studies in the Philippines, research on local uses of mangrove species in Masao village, Butuan, Agusan del Norte is wanting (Jumawan, 2012; Almadin et al., 2020).

The Masao village is an ideal location where activities such as fishing and farming are practiced by the local people. Local communities interacted with each other through knowledge sharing of uses of plant-based medicine or basic cooking ingredients, from relatives to neighbouring communities (Omac et al., 2021). This study has the following specific objectives: 1) to identify the local uses of the mangrove species present in the *satoumi* landscape of Masao village, Agusan del Norte, Philippines; 2) to determine the conservation status of the mangroves based on the IUCN red list of threatened species; and 3) to determine the current mangrove conservation practices of the locality. The result of this study will be used as basis for planning and enhancement of sustainable management practices as well as local policies on mangrove biodiversity conservation.

2 Methods

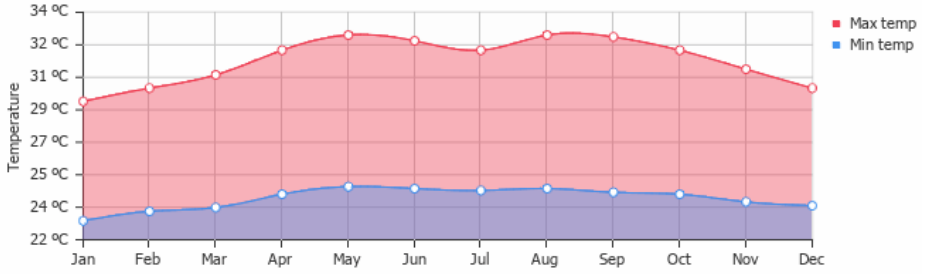
2.1 Description of the Study

The numicipality of Butuan within the province of Agusan del Norte is located at the Northeastern portion of Mindanao island in the Philippines (8°59′ N, 125°29′ E). Masao village is situated at the lower portion of the Agusan River, in close proximity to the Butuan bay, Figure 1. It is one of the villages where fishing activities is prominent (Almadin et al., 2020).

Fig. 1. Location map of the study site. (Masao village is highlighted in red color)

2.2 Climate type, rainfall and storm history

The province of Agusan del Norte belongs to Type II Climate. It is characterized as having no dry season with a very pronounced maximum rain period from December to February (PAGASA, 2022). Due to the geographical location of Butuan which is situated in an area below sea level, incidence of sea level rise and storm surge are higher compared to nearby towns (FAO, 2005; NEDA, 2017; Apdohan et al., 2021). The nearest climate station is Surigao which is about 90 kilometers from Butuan, recorded a maximum temperature of 33 degree Celsius and a minimum of 23 degrees Celsius (Figure 2). Annual precipitation is 2,364.5 mm, per year, with an average of 197.0 mm. Given the climate and weather condition of Butuan, presence of mangroves is important as source of protection from climate change impacts such as sea level rise and storm surge along the Butuan Bay.



Source: 2022 weather-and-climate.com

Fig. 2. Average minimum and maximum temperature in Butuan Philippines

2.3 Masao Village as *Satoumi*

Masao village has a total area of roughly 1,748.4 hectares, as seen in Table 1. The small village is mostly covered with fishponds, comprising 75.1%, with an area of 1,313.6 hectares. It is managed for both community consumption and commercial purposes. While perennial croplands, totalling to 57.2 hectares are observed to be adjacent to residential or built-up areas. As seen in the map (Figure 3), Masao village situated is along the coast of Butuan Bay and is an example where community depends on the estuarine and coastal resources as well as mangroves to sustain basic livelihood needs. However, it can be seen in the map that there are few covers of mangroves in the village. It is only covered with an estimate of 11.2% or 196.6 hectares.

Table 1. Land Cover Types of Masao Village

Land Cover Type	Area (Ha)	Percentage (%)
Built-up	68.4	3.9%
Fishpond	1,313.6	75.1%
Grassland	7.8	0.4%
Inland Water	92.1	5.3%
Mangrove Forest	196.6	11.2%
Open/Barren	12.8	0.7%
Perennial Crop	57.2	3.3%

Grand Total	**1,748.4**	**100.0%**

Source: National Mapping and Resource Information Authority (NAMRIA), 2015

2.4 Survey Assessment of Mangrove Species

Total of 10 key informants were selected from the residents of Masao village. They must be residents in or near the coastal area and must be knowledgeable in plant resources and local uses. Data collection was conducted through field observations and interviews of the selected informants. Majority of the respondents are fisherfolks with age ranging from 42 to 66 years old. The respondents were consulted about the mangroves and other species that were surveyed in the area. They were asked of the local name and their uses. The mangrove species and other coastal vegetation species surveyed in the area were identified by their scientific name and grouped according to families.

3 Results and Discussion

3.1 Mangrove species composition and local uses

From among the sampling plots established, 21 species were identified, belonging to 11 families (Table 2). Majority of the species collected were native in the Philippines, while one species, Kulasi (*L. racemosa*), was known to be naturalized. The local uses were generally from the traditional knowledge of the locals, obtained through interviews. Results identified fuelwood or firewood as main uses by local people of Masao village (Figure 4). This is done through small-scale wood harvesting. The next common use among the identified species is for therapeutic purposes. Recent studies show traditional uses of Rhizophora species in fighting against diabetes and has been used as well for its anti-inflammatory properties (Biswal et al., 2020; Prabhu & Guruvayoorappan, 2012; Barik et al., 2016). Figure 5 shows some of the actual photos of the mangrove species found in the established plots in the *satoumi* area of Masao village.

Table 2. Mangrove Species and Their Local Uses in Masao Village

Scientific Name	Local Name	Family Name	Local uses
***Avicennia alba* Blume.**	Bungalon	Avicenniaceae	Fuelwood, Industrial compound
***Avicennia marina* (Forssk.) Vierh.**	Miapi	Avicenniaceae	Fuelwood
***Avicennia officinalis* L.**	Api-api	Avicenniaceae	Therapeutic use
***Avicennia rumphiana* Hallier f.**	Apiapi	Avicenniaceae	Timber
***Nypa fruticans* Wurmb.**	Nipa	Arecaceae	Shelter, Firewood, Industrial compounds
***Lumnitzera racemosa* Willd.**	Kulasi	Combretaceae	Decorative/Ornamental
***Excoecaria agallocha* L.**	Lipata	Euphorbiaceae	Fuelwood

***Brownlowia tersa* (L.) Kosterm.**	Maragomon	Tiliaceae	Fuelwood, Therapeutic use
***Heritiera littoralis* Dryand.**	Dungon	Sterculiaceae	Timber, Ornamental
***Xylocarpus granatum* J.Koenig**	Tabigi	Meliaceae	Fuelwood
***Xylocarpus moluccensis* (Lam.) M.Roem.**	Piag-ao	Meliaceae	Therapeutic use
***Aegiceras corniculatum* (L.) Blanco.**	Saging-saging	Primulaceae	Fuelwood
***Bruguiera cylindrica* (L.) Blume.**	Pototan-lalaki	Rhizophoraceae	Fuelwood, Therapeutic use
***Bruguiera parviflora* (Roxb.) Wight & Arn. ex Griff.**	Langarai	Rhizophoraceae	Therapeutic use
***Bruguiera sexangula* (Lour.) Poir.**	Busain	Rhizophoraceae	Fuelwood, Shelter
***Ceriops tagal* (Perr.) C.B.Rob.**	Tangal	Rhizophoraceae	Fuelwood, industrial compound
***Rhizophora apiculata* Blume**	Bakauan-lalaki	Rhizophoraceae	Fuelwood
***Bruguiera gymnorrhiza* (L.) Lam.**	Pototan	Rhizophoraceae	Therapeutic use
***Rhizophora mucronata* Lamk.**	Bakauan-babae	Rhizophoraceae	Therapeutic use
***Morinda citrifolia* L.**	Noni	Rubiaceae	Therapeutic use
***Sonneratia alba* J. Smith.**	Pagatpat	Sonneratiaceae	Industrial compounds

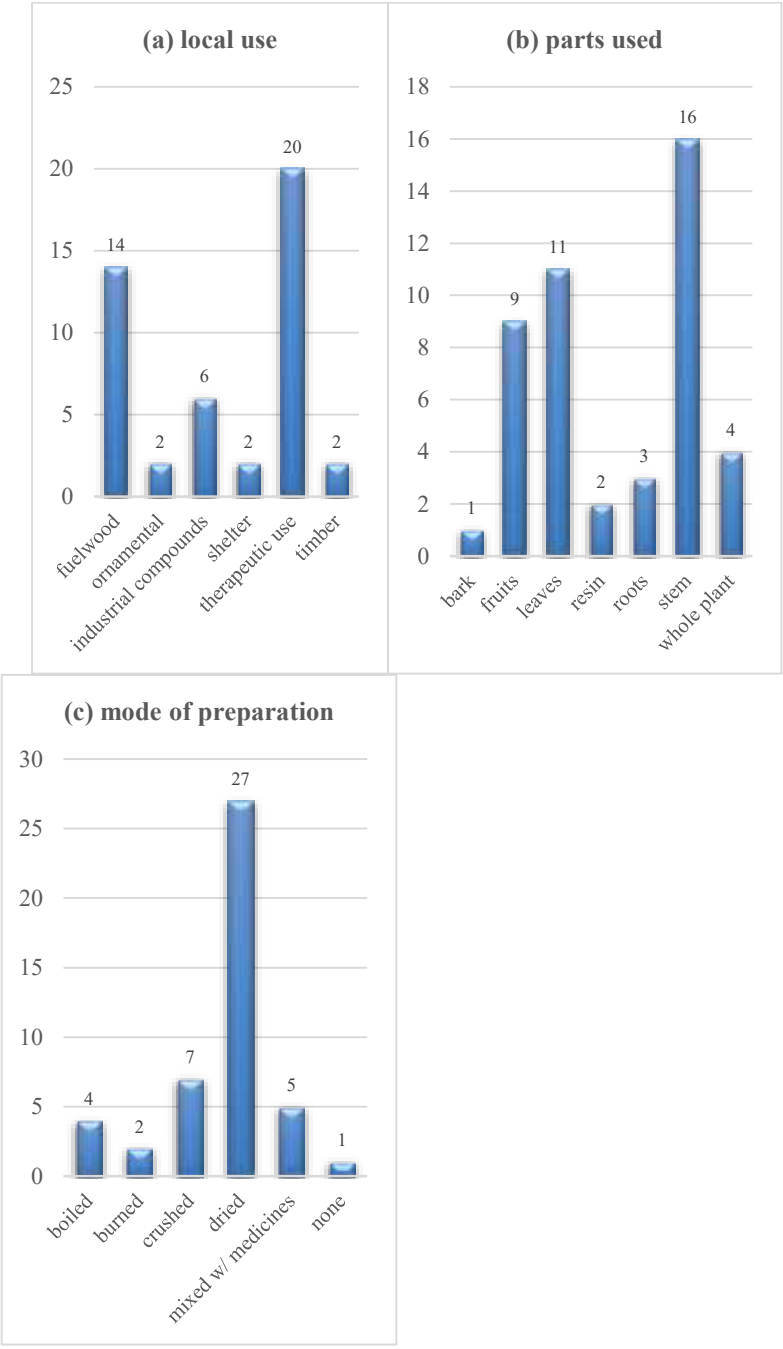


Fig. 2. Graphs showing the frequency count of local respondents regarding the local uses (a); parts used (b) and mode of preparation (c) of mangrove species in the satoumi of Masao village

Photo credit: JJJ Ruales and UPOU EIDR Project 1

Fig. 3. Photos of some mangrove species in the satoumi in Masao, Butuan: (a) Aegiceras corniculatum (b) Avicennia marina (c) Avicennia officinalis (d) Rhizophora apiculata (e) Xylocarpus granatum.

Table 3. Identified Mangrove Plant Parts Utilized and Mode of Preparation by the Masao people

Scientific Name	Parts used	Mode of preparation before using/consumption
***Avicennia alba* Blume.**	stem, resin	Drying
***Avicennia marina* (Forssk.) Vierh.**	stem	Drying
***Avicennia officinalis* L.**	stem, leaves, resin	Burning, drying
***Avicennia rumphiana* Hallier f.**	stem	Drying
***Nypa fruticans* Wurmb.**	whole plant	Drying
***Lumnitzera racemosa* Willd.**	whole plant	none
***Excoecaria agallocha* L.**	stem, leaves	Drying
***Brownlowia tersa* (L.) Kosterm.**	stem	Drying
***Heritiera littoralis* Dryand.**	stem, leaves	Drying
***Xylocarpus granatum* J.Koenig**	stem, fruits	Crushing, drying
***Xylocarpus moluccensis* (Lam.) M.Roem.**	fruits	Crushing, drying

***Aegiceras corniculatum* (L.) Blanco.**	stem	Drying
***Bruguiera cylindrica* (L.) Blume.**	stem, fruits, leaves	Drying, crushing, mixed w/ medicines
***Bruguiera parviflora* (Roxb.) Wight & Arn. ex Griff.**	fruits, leaves	Crushing, mixed w/ medicines
***Bruguiera sexangula* (Lour.) Poir.**	roots, stem	Drying
***Ceriops tagal* (Perr.) C.B.Rob.**	leaves, stem	Drying, burning, mixed w/ medicines
***Rhizophora apiculata* Blume**	leaves, stem, bark, roots	Crushing, mixed w/ medicines, drying, boiling
***Bruguiera gymnorrhiza* (L.) Lam.**	fruits, leaves	Crushing, boiling
***Rhizophora mucronata* Lamk.**	leaves fruits	Crushing, boiling
***Morinda citrifolia* L.**	stem, fruits, leaves	Boiling, mixed w/ medicines
***Sonneratia alba* J. Smith.**	stem, fruits, roots	Drying

3.2 Current Mangrove Conservation Practices

Conservation Status of Species.

Table 4 shows the conservation status of the species collected in Masao village. The details are according to the International Union for Conservation of Nature or IUCN's red list of threatened species across the globe. Apiapi (A. rumphiana) and Maragomon (B. tersa) are recorded to be vulnerable (Duke et al., 2010) and nearly threatened (Kathiresan et al., 2010), respectively. And this is triggered by continuous expansion of anthropogenic activities. Figure 6 shows the actual field photos of threatened species in the satoumi of Masao village. IUCN (2022) noted that the population of the species are all in decreasing trends, excluding N. fruticans. Hence, this calls for urgent protection and conservation action.

Table 4. Conservation Status of Mangrove Species in Masao Satoumi

Scientific Name	Local Name	Conservation status (IUCN)*	Population trend
***Avicennia alba* Blume.**	Bungalon	LC	decreasing
***Avicennia marina* (Forssk.) Vierh.**	Miapi	LC	decreasing
***Avicennia officinalis* L.**	Api-api	LC	decreasing
***Avicennia rumphiana* Hallier f.**	Apiapi	VU	decreasing
***Nypa fruticans* Wurmb.**	Nipa	LC	unknown
***Lumnitzera racemosa* Willd.**	Kulasi	LC	decreasing
***Excoecaria agallocha* L.**	Lipata	LC	decreasing
***Brownlowia tersa* (L.) Kosterm.**	Maragomon	NT	decreasing
***Heritiera littoralis* Dryand.**	Dungon	LC	decreasing

***Xylocarpus granatum* J.Koenig**	Tabigi	LC	decreasing
***Xylocarpus moluccensis* (Lam.) M.Roem.**	Piag-ao	LC	decreasing
***Aegiceras corniculatum* (L.) Blanco.**	Saging-saging	LC	decreasing
***Bruguiera cylindrica* (L.) Blume.**	Pototan-lalaki	LC	decreasing
***Bruguiera parviflora* (Roxb.) Wight & Arn. ex Griff.**	Langarai	LC	decreasing
***Bruguiera sexangula* (Lour.) Poir.**	Busain	LC	decreasing
***Ceriops tagal* (Perr.) C.B.Rob.**	Tangal	LC	decreasing
***Rhizophora apiculata* Blume**	Bakauan-lalaki	LC	decreasing
***Bruguiera gymnorrhiza* (L.) Lam.**	Pototan	LC	decreasing
***Rhizophora mucronata* Lamk.**	Bakauan-babae	LC	decreasing
***Morinda citrifolia* L.**	Noni	NE	decreasing
***Sonneratia alba* J. Smith.**	Pagatpat	LC	decreasing

Source: International Union for Conservation of Nature (IUCN), 2022
**LC= Least Concern; VU= Vulnerable; NT= Nearly Threatened; NE= Not yet evaluated*

Photo credit: JJJ Ruales and UPOU EIDR Project 1

Fig. 4. Mangroves species included in the IUCN Red list of threatened species, Avicennia rumphiana (left) and Browlesia tersa (right)

Threats and Challenges.

Based on the interview of the residents of Masao village, there are some anthropogenic activities in the area such as house construction and fish pen expansion which threaten the mangrove forest and nearby vegetation (Figure 7). The urbanization in the satoumi area is caused by the need to accomodate the shipping and cargo activities at the nearby ports in the village (Cauba & Coniato, 2021). Informants

reported that Nipa (N. fruticans), a very important resource, is also exposed to pest and diseases, but there are no community initiatives done to address the problem. Mangrove planting activities were conducted to increase the population of mangroves, but community efforts on monitoring after planting are insufficient. The informants were also asked of locally existing mangrove or coastal vegetation conservation practices. Unfortunately, their responses varied from "not aware of any conservation practices" to "none". The respondents' unawareness of any conservation efforts poses threat to the mangrove and coastal vegetation resources. It was also observed that traditional cultural practices such as local use of local resources are declining, presumably due to the urbanization of the Masao village. Indeed, there is a need to enhance the harmony of people and nature interaction in the satoumi of Masao village.

Photo credit: JJJ Ruales and UPOU EIDR Project 1

Fig. 5. Photos of the Masao Village. (a) houses built from Nipa (Nypa fruticans); (b) fish pens along the estuarine; (c) houses along the Butuan Bay

The indigenous knowledge system linked to the natural resources management among satoumi landscapes/seascapes, guarantees the sustainable use and regulation of resource extraction and facilitates adaptation to climate and environmental changes among the local community residents (Cetinkaya, 2009; Dublin 2015). Satoumi approach just like the satoyama approach (Buot &Buhay, 2022) is anchored on the principle of "living in harmony with nature" (IPSI, 2012). This has been evident in age-old indigenous and cultural practices in terms of managing the environment (Gadgil et al.,1993; Bagarinao & Primavera, 2005; Berque & Matsuda, 2013). Some tribes in Agusan del Norte, such as the Higaonon and Manobo tribe, are traditionally coastal dwellers who were forced to settle into forested inland areas (ADB, 2002; Cruz & Adiong, 2020). Indigenous practices of Higanonon were documented in a study by Paredes in 1997. They practiced fishing, shifting cultivation, foraging and marine trade (Cruz & Adiong 2020). These activities are conducted in isolation by few families within certain areas of the mangrove forest. Since Higaonon tribe are nomadic people,

they tend to move from one place to another after each planting and harvesting season (Lynch, 1967) to allow the land to rest and regain fertility and microecosystem balance. Hence, coastal and inland forest resources are not overexploited. Their indigenous norms and practices developed through time have been linked with how they manage the natural resources. Their belief system such as that of punishment from gods' and ancestors' when they do not manage nature well, prohibits such natural resource exploitation (Bankoff, 2004).

4 Conclusion

The faraway Masao Village is not exempted from overexploitation of resources. The so-called development has started and destroy some of the important mangrove forests in the satoumi seascape. Results show 21 mangrove species are growing in the area and two are in the IUCN list of threatened species. Many members of the village are using the mangroves firstly for medicine and secondly for fuelwood source. The overconsumption without proper regulation is a contributing factor to the decreasing population of the mangrove species.

Hence, there is a need for the local government to streamline efforts in public awareness towards mangrove conservation. This will also facilitate participation of the community to strengthen harmony of people-nature interaction. It is recommended to have a mangrove conservation and management plan specifically in the satoumi seascape of Masao Village and to regulate utilization of the mangrove and coastal resources. Since the local community has been observed to be deeply attached and dependent on the mangrove ecosystem resources, such conservation and regulation activities will prevent mangrove forest degradation, hence helping sustain local mangrove seascape practices as well.

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