

# *Abanfan matilon*, a local wisdom in marine ethnoconservation system on the coast of Liki Island, Sarmi District, Papua, Indonesia

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**Abstract.** Keiluhu HJ, Sujarta P, Suharno, Mailissa MG, Hadisusanto S, Yuliana S, Setyawan AD. 2023. *Abanfan matilon*, a local wisdom in marine ethnoconservation system on the coast of Liki Island, Sarmi District, Papua, Indonesia. *Biodiversitas* 24: 4693-4701. Liki Island is the outermost part of Sarmi District, Papua, Indonesia, which is directly facing the Pacific Ocean and bordering Papua New Guinea. This island is unique in its geographical features and is characterized by the local wisdom of the people known as *Abanfan matilon*. Therefore, this study aimed to document the knowledge, participation of people, and the role of the local wisdom of *Abanfan matilon* in the marine ethnoconservation system. The study was conducted from June to November 2022 using a survey method based on semi-structural interviews. The results of the study of 50 respondents showed that (i) the community knowledge about local wisdom of *Abanfan matilon*, possessed by the Liki Island village community, had transcended from one generation to another through oral stories from parents, (ii) the role of the community in implementing local wisdom was substantial, starting from the planning, preparation, and implementation up to the harvesting activities through local traditional ceremonies, and (iii) the implementation of local wisdom of *Abanfan matilon* was carried out by community leaders from various sectors, including traditional, church, or local government. In conclusion, local wisdom traditions in *Abanfan matilon* exhibited the characteristics of a marine ethnoconservation system.

**Keywords:** Ethnoconservation, Liki Island, local wisdom, marine, Papua, Sarmi

## INTRODUCTION

Environmental wisdom is a form of local wisdom existing in the social life of a particular region. It is an ancestral heritage in life values that are integrated into the form of religion, culture, and customs (Ban et al. 2017; Dharmawibawa 2019; Mulalap et al. 2020; Bloch 2021; Kadir et al. 2022; Rivers et al. 2023). Narratively, the local community consists of groups inhabiting a specific area, while indigenous people comprise individuals who have lived in an area for generations, possessing socio-cultural ties with their environment (Görg et al. 2014; Ban et al. 2017; Kelly et al. 2020; Ogar et al. 2020). The concept of traditional society incorporates communities predominantly guided by old customs, while traditional knowledge includes insight, innovation, and cultural activities from indigenous peoples and local communities. This includes the traditional ways of life and technology used in daily life from one generation to another (Teixeira et al. 2013; Zebua and Waluyo 2016; Huntington et al. 2017; Stori et al. 2019; Borelli et al. 2020; Yuliani and Aprilina 2020). All the traditional wisdom related to nature that has been practiced and inherited over generations by traditional societies and local communities around the world plays a major role in natural resource conservation.

The Papua region is renowned for its richness in natural resources, a diversity of local and traditional communities, as well as the socio-cultural values and institutions resulting from their interactions with nature. Subsequently, the socio-cultural values and institutions of the Papuan people in Indonesia became known as local wisdom, which was applied and practiced in many different aspects of life (Zebua and Waluyo 2016; Borelli et al. 2020; Sujarta et al. 2020; Sonbait et al. 2021). This local wisdom includes research on natural resource management using a traditional knowledge method in the Arfak Mountains Nature Reserve in West Papua (Sonbait et al. 2021), knowledge of sago ethnobotany by the Marind-Anim Merauke Tribe in Papua (Kadir et al. 2022), traditional knowledge of land management in the Maybrat District of West Papua (Sagrim 2022), and hunting of wildlife by the Saubeba community in Manokwari West Papua (Sawaki et al. 2022), and traditional harvesting of wild plants in a sustainable manner (Borelli et al. 2020; Merritt et al. 2021).

Liki Island is located in Papua Province, in the administrative area of Sarmi District, and has an area of approximately 13.18 km<sup>2</sup> (Christopel 2015). The results of initial observations showed that Liki Island has a good mangrove, coral reef ecosystem, and several species of seagrasses such as *Halodule pinifolia*, *Enhalus acoroides*, *Cymodocea rotundata*, and *Halodule uninervis* (Mailissa et

al. 2021). This island is also known as a habitat for approximately 63 species of gastropods, from 37 genera and 28 families, inhabiting the surrounding coast and shallow waters, with a range of 182-603 individuals in each observational site (Mailissa et al. 2021; Sujarta et al. 2022). The research further showed that the local community uses marine resources for various needs while possessing local wisdom and tradition of sustainable management, known as *Abanfan matilon*. Moreover, *Abanfan matilon* is a tradition of managing marine areas that are temporarily closed to catching shellfish (gastropods), particularly the Lola species (Mailissa et al. 2021). This local wisdom is almost similar to the tradition of communities in other coastal areas of Papua. Examples include *Sasisen* on Biak Numfor Island and *Tiyaitiki* on the coast of Depapre, both of which are models of marine ethnoconservation system owned by the people of Papua, illustrating their commitment to coastal conservation (Sujarta et al. 2021).

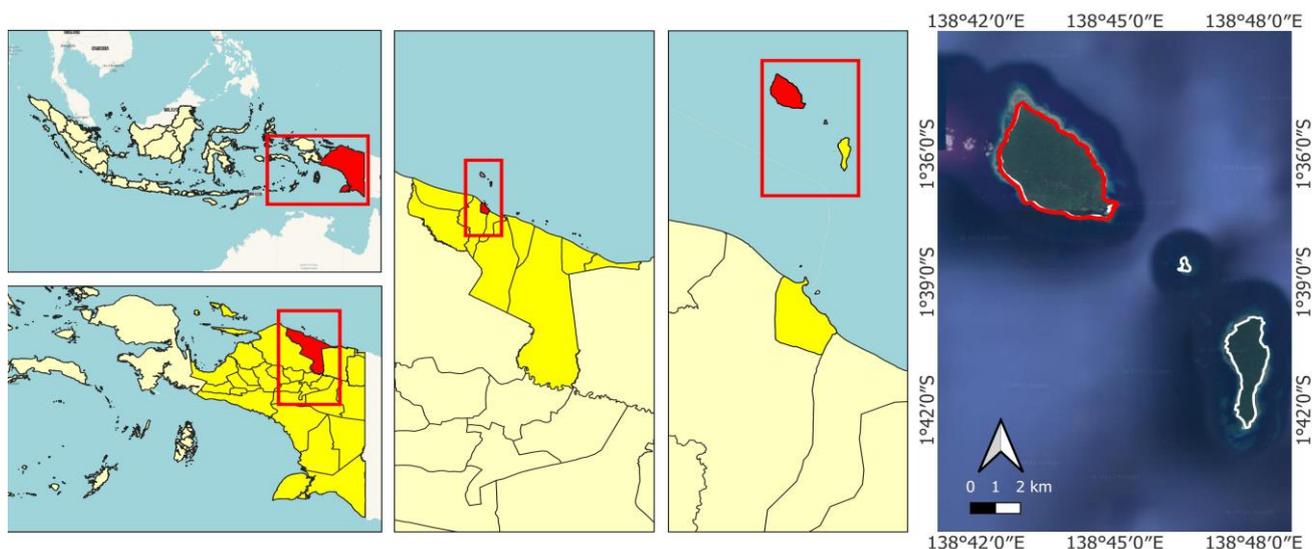
Aquatic ecosystems, particularly those in coastal areas, play a major role in maintaining the condition of the surrounding environment and contributing to the local economy (Ferreira et al. 2014; Lepofsky and Caldwell 2013; Kamat 2014; Muhl et al. 2020; Matsushita et al. 2023; Petza et al. 2023). These natural resources offer the potential for the development of marine ecotourism to become an attraction for recreation, such as marine ecotourism in coastal Villages of Tablasupa and Tablanusu, Depapre Jayapura District (Sujarta 2015; Sujarta and Indrayani 2016; Sujarta et al. 2020). This phenomenon is essential because natural resources, beautiful beaches, and conservation activities with local wisdom can improve all economic aspects of the surrounding community (Rudnev 2015; Sujarta et al. 2020, 2021). Moreover, studies on the relationship between local and traditional knowledge of the sustainable use and preservation of marine natural resources have been carried out in several places globally, including Indonesia (Friedlander et al. 2013; Mataitini 2014; Deb 2015; Ban et al. 2017; Abdillah et al. 2019; Alexander et al. 2019; de Sousa et al. 2022; Kitolelei et al.

2021, 2022). Most of these studies show a close relationship between the sustainability of benefits and the enforcement of traditional rules governing marine resources management within local communities. This phenomenon mainly describes the relationship between resources, local society, and sustainable management, culminating in ethnoconservation practice. Ethnoconservation is a novel nature conservation method currently being developed in several tropical nations. This method is based on interdisciplinary collaboration, the experiences of the traditional peoples as well as their expertise in natural resource management methods (Diegues 2014). Locally known and practiced, *Abanfan matilon* needs to be identified and categorized as an ethnoconservation practice in Papua based on its integral connection between nature and local society. Therefore, this research aims to identify community knowledge in the form of local wisdom, the participation of people in natural resource management, and the implementation of *Abanfan matilon* in the marine ethnoconservation system. Another indirect contribution includes supporting environmentally sustainable development, particularly in the Sarmi District area of Papua, Indonesia.

## MATERIALS AND METHODS

### Study area

This study, which started with planning, preparation, sampling, data analysis, and reporting, was carried out for six months, from June to November 2022. It was conducted on the coast of Liki Island, Sarmi District, Papua Province, Indonesia within 01°34'40"-01°37'30"S and 138°42'30"-138°45'0"E, as illustrated in Figure 1. The majority of the people of Liki Island are fishermen who have territorial waters or areas that can be used as marine ecotourism locations. Each area has natural resources that are managed independently by indigenous community groups under the rule of *Abanfan matilon*.



**Figure 1.** Map of the Liki Island sampling location, Sarmi District, Papua Province, Indonesia

### Data collection and analysis

The study was conducted using the semi-structural interview method on 50 respondents from the coastal community of Liki Island, Sarmi District, Papua, with an area of 1318.54 ha, or 13.18 km<sup>2</sup>. The materials used included the results of field surveys and community interviews in the Liki Island region of Sarmi District, Papua, Indonesia. The respondents were selected based on the representation of coastal communities on island. In-depth interviews were also conducted with key respondents, elders, community, and traditional leaders. The survey was directed to collect data on (i) the general information of respondents, (ii) the knowledge of *Abanfan matilon*, (iii) the role of the community related to *Abanfan matilon*, and (iv) *Abanfan matilon* as marine ethnoconservation system.

The general information of respondents was based on their age, education, and occupation. Meanwhile, the measurement of local wisdom included community knowledge about *Abanfan matilon*, owned by the people of Liki Island. The role of the community in *Abanfan matilon* measured community participation in the implementation of local wisdom, including planning, implementation, and harvesting processes. The explanations and knowledge from the key respondents were used to compare, complement, and collaborate on implementing the traditional wisdom of *Abanfan matilon*, determining its viability as marine conservation system.

The results of interviews and observation were categorized in pictures, graphs, and tables. Subsequently, the data were qualitatively and descriptively analyzed, with an emical method based on culture or local knowledge owned by the respondents. This also included the ethical or scientific method based on knowledge (Markee 2013).

## RESULTS AND DISCUSSION

### Profile status of Liki Island indigenous community respondents

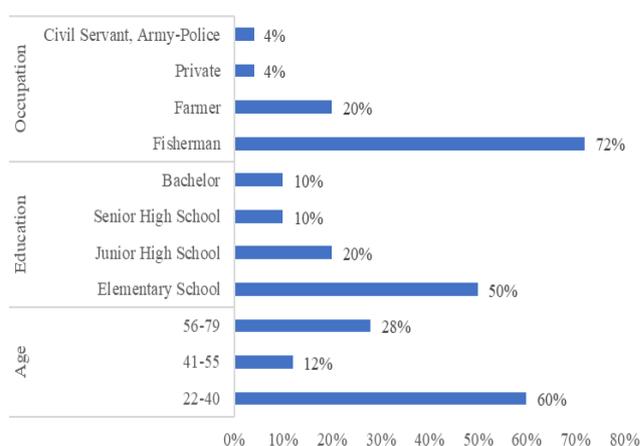
The village of Liki Island, Sarmi District, is inhabited by 105 heads of households, with the majority of residents working as fishermen, a few as traders, and state civil servants. The structure of the indigenous people consists of Teno, Kiman, Weirau, Esris, Bibin, Morohis, Morsau, and Warou tribes. The study results from interviews with the indigenous people showed that 50 respondents were willing to be interviewed. Based on the results, the condition of the distribution of age, educational status, and employment showed the characteristics of coastal communities whose livelihoods were fishermen (72%), farmers (4%), and government employees (4%), as presented in Figure 2.

Most of the respondents who successfully filled out the questionnaire were between the ages of 22 and 40. Among these respondents, 60% were categorized as productive and active in youth activities, while 28% aged 56 to 79 were community leaders. Meanwhile, 50% had an elementary school education, indicating that the respondents possessed moderate knowledge. Most respondents (72%) were fishermen, which were closely related to their residence in coastal areas.

### Knowledge of *Abanfan matilon*

The results of a survey on the Liki Island village community knowledge of *Abanfan matilon* are respondents' opinions about local wisdom based on the distribution of age, educational status, and employment. As shown in Table 1, some of the questions raised could be answered according to respondents' ability. The results showed that the community had information about related *Abanfan matilon* local wisdom for a long time (74%), after adulthood (18%), and since school age (8%). Most of this information came from their parents (88%), traditional elders (12%), and civil servants (4%). This knowledge came from personal stories that were recorded from one generation to another (84%) and orally spoken (96%), while the role of scientific meetings and outreach was only 8% each.

Local community knowledge about *Abanfan matilon* was extensive, indicating that the majority of respondents understood the benefits and regulation of using marine resources by region (58%), marine resources for specific biota (32%), and ecosystem-related issues (4%). Furthermore, the majority used this local wisdom to regulate the use of marine resources related to all marine biota (86%) and marine animals (14%). To understand the use of local wisdom, most respondents reported that the setting of *Abanfan matilon* must be carried out within >1 year (72%), some within one year (8%), while the rest of the arrangements can be made in six months (10%). The majority of the people were aware of this local wisdom, which had been known for a long time through personal stories told orally by parents. According to respondents, *Abanfan matilon* was incorporated in the activity of closing and opening a sea area, determined as customary law to regulate the use of marine natural resources and the protection of ecosystems, including marine biota. This kind of management system was carried out by indigenous peoples in some coastal areas to manage natural resources, ensuring availability throughout the year and longer (Friedlander et al. 2013; Mataitini 2014; Singeo 2014; Sujarta et al. 2020; Kitolelei et al. 2022).



**Figure 2.** Distribution of age, educational status, and occupation of respondents

### The role of *Abanfan matilon*

This study showed that all members of the community (100%) played an active role in the implementation of *Abanfan matilon*, from planning (54%) to preparation (40%) and implementation (68%) activities. In planning activities, 78% of the community was engaged in determining the location, 28% in planning activities, and 38% in preparing customary rules. At the time of preparation for activities, the community engaged in preparing the location reached 80%, while 10% prepared tools and materials, and 36% arranged traditional ceremonies. As shown in Table 2, every community member has directly carried out activities starting from planning, preparation, and implementation. However, community participation varied, where 60% were engaged in 60-80% of activities, 24% engaged in 30-50% of the process, and a small number of respondents carried out 10-20% of the general activity.

The results also showed that the participation of the community leaders was significant in the activity of *Abanfan matilon*, including traditional (100%), religious (88%), and village officials (88%). The participation of community was important because it provided the same motivation and sense of care, which directly impacted a sense of responsibility and cared for the engagement of people (Camargo et al. 2009; López-Angarita et al. 2013; Raymond-Yakoubian et al. 2017; Friedlander 2018; Le Heron et al. 2019; Sujarta et al. 2020; Peer et al. 2022).

### *Abanfan matilon* as marine ethnoconservation system

Geographically, Liki Island is bordered by the Pacific Ocean on the north, east, and west, as well as the Sarmi and Armo Seas on the south side. The marine waters of Liki Island have a diverse substrate, from sandy to rocky, consisting of a mixture of sand and gravel, as well as sand and rocks. This island also has good coral reefs, mangroves, and several species of seagrasses, such as *H. pinifolia*, *E. acoroides*, *C. rotundata*, and *H. uninervis* (Mailissa et al. 2021). The people of Liki Island rely on fulfilling their daily needs from the surrounding marine resources using various gastropods. According to Sujarta et al. (2022), most people from this island use gastropod meat as food and shells for accessories such as bracelets, necklaces, brooches, wall-hanging decorations, curtains, and home decorations, including traditional events. The species of gastropods that people on Liki Island usually consume include *Conus litteratus*, *C. abbas*, *C. virgo*, *C. stercusmuscarum*, *S. imperialis*, *C. leopardus*, *C. eburneus* (family Conidae), *Gibberelus gibberelus*, *Canarium mutabile*, *Conomurex luhuanus* (family Strombidae), *Tectus niloticus* (family Tegulidae), and *Turbo chrysostomus* (family Turbinidae). Gastropod meat is edible and widely used to meet food needs due to its high nutritional value (Abdillah et al. 2019). Gastropod shells have been used for various decorations (Galan et al. 2015; Saleky et al. 2016; Persulesy and Arini 2018; Slamet et al. 2021). The gastropod species that are mainly used include *Monetaria moneta*, *M. annulus* (family Cypraeidae), *Nerita albicila*, *N. polita* (family Neritidae), *Engina zonal* (family Pisaniidae), *Bull ampulla* (family Bullidae), *Strigelata retusa*, *Partner partner* (family

Mitridae), *Oxymeris crenulata*, *O. dimidiata* (family Terebridae), *Prunum javi* (family Marginellidae), and *T. niloticus* (family Tegulidae).

In this study, the knowledge and information about *Abanfan matilon* from the key respondents, the elders, and leaders of Liki Island, showed that local wisdom was inherited through stories from elders and parents to young generations, namely their children. These stories made the community aware of the importance of *Abanfan matilon* in regulating the use and protection of marine resources. Additionally, as protection to the sea, the practice of *Abanfan matilon* included all surrounding marine waters and products such as fish, sea cucumbers, lobsters, and gastropods, including commercial snails (*bia lola* in local name), as stated by the informants. This kind of practice was identified as *sasi* in other places in Indonesia. Moreover, *Sasi* is a type of prohibition to take or harvest the products of specific natural resources as a conservation effort to maintain the quality and population of these natural (plant and animal) resources (Adrianto et al. 2011; Zaen 2017). Marine areas where the *Sasi* system or prohibition-specific area is applied will have a high diversity of macrobenthos (Singeo 2014; Deb 2015; Jentewo and Lazuardi 2021; Kitolelei et al. 2021).

Some elders and chiefs in Liki Island stated that the local wisdom of *Abanfan matilon* was instituted around 1987-1989, and interpreted as the practice of *pele* (a local term for covering) or closing marine areas from harvesting marine biota and allowing only catching fish. The marine area around island was temporarily closed to fishing for shellfish or gastropods, particularly commercial snail species, or *Lola* (local name) (Mailissa et al. 2021). This kind of local wisdom is similar to other regions in marine resource protection in Papua, such as *Sasisen* in Biak Numfor Island and *Tiyaitiki* in the coastal area of Depapre, north of Jayapura (Sujarta et al. 2021). *Sasi's* traditional wisdom and practice is a unique tradition of coastal communities to close a specific area at a particular time. When it is violated, certain sanctions will be given according to customary law (Ilahi 2021). This practice and sanction is also shown by the tradition of *Sawora* or *Sasi*, in the form of an oath, as a protection system for marine resources implemented in the community in Cenderawasih Bay Marine National Park (Rumengan 2017). According to *Sasisen swan* or *Sisen swan* in Biak Island, it indicates a prohibition set and enforced to protect certain areas for particular periods in marine waters to fulfill community needs and efforts to preserve the sea traditionally. All the traditions are models of marine ethnoconservation systems owned by the people of Papua in carrying out coastal area conservation (Korwa 2011).

The entire local community of Liki Island plays a significant role in the practice of *Abanfan matilon*, without any written plan. The planning stage was carried out in a joint meeting between the customary chiefs and or traditional leaders, the village government, and local religious or church leaders. In these joint meetings, decisions are made to close, prohibit, open, or allow fishing and harvesting marine biota in a particular area for two years, such as *bia lola* (local name for commercial snail species), as shown in

Figure 3. These leaders and community representatives are fully included, necessitating the important of implementing *Abanfan matilon*. The preparation and practice stages begin with traditional leaders providing areca nut and bettle eaten by the traditional elders *kunyah pinang* in local terms. The commercial snails (*bia lola*) are taken to the church and placed under the pulpit for prayers. Subsequently, the village government oversees enforcing the rules or protecting the decisions of the meeting. The practice of customary marine rights is intrinsically linked to the concept of exclusive fishing grounds attributed to a particular social unit based on aspects of customary law (Laksono and Ali 1995).

Almost all Liki Island villagers know about *Abanfan matilon* and its underlying purposes. This widespread

understanding is cultivated by bringing the practice to the church for ceremonial prayer. There is awareness that the penalty is death when anyone violates the practice. Marine products are profitable for the community when the *Sasi* has been opened. However, certain marine areas has been proposed to be closed for 2023, mainly from harvesting commercial snail species of *Rochia nilotica (lola)*, species with high sales value and enthusiasts, as shown in Figure 4. Research on the people of Liki Island by Mailissa et al. (2021) showed that 74.8% of respondents used gastropods as additional food, while shells were used for wall decorations or accessories. Furthermore, 73.8% of respondents understood the economic value of gastropods to improve the economy of local community.

**Table 1.** Respondent's knowledge of *Abanfan matilon* local wisdom

Statement	Response (%)		
	Understand	Uncertain	Do not understand
Community understanding of <i>Abanfan matilon</i> local wisdom	100	0	0
Knowledge of <i>Abanfan matilon</i> is the activity of "closing" and "opening a specific sea area for use	100	0	0
Community understanding of the regulatory system <i>Abanfan matilon</i> is clear and understandable	96	0	4
<i>Abanfan matilon</i> local wisdom is determined as customary law to regulate the problem of violence in society	76	0	24
<i>Abanfan matilon</i> is determined as customary law to regulate the use of marine natural resources	100	0	0
<i>Abanfan matilon</i> is determined to regulate the protection of marine natural resources	100	0	0

**Table 2.** Implementation of *Abanfan matilon* local wisdom

Statement	Response (%)		
	Understand	Uncertain	Do not understand
The community knows the location of <i>Abanfan matilon</i> practice	100	0	0
The community knows the purpose and benefits of <i>Abanfan matilon</i>	100	0	0
Knowing the rules and sanctions for violators of <i>Abanfan matilon</i>	96	4	0
People obey the rules of <i>Abanfan matilon</i>	100	0	0
Playing an active role in maintaining and reporting violations of <i>Abanfan matilon</i>	96	4	0
The practice of <i>Abanfan matilon</i> in your area can be followed and obeyed by the community	100	0	0
Communities tasked with implementing <i>Abanfan matilon</i> need special education	32	0	68
The community in charge of implementing <i>Abanfan matilon</i> must be able to read, write, and count (sufficiently literate)	24	4	72
Management of <i>Abanfan matilon</i> is influenced strongly by the level of education of the fishermen or officers	38	0	62
The setting of <i>Abanfan matilon</i> is based on wisdom and not the academic ability of the fishermen or the group	94	0	6
People who have good knowledge and experience of traditional customs are better suited to manage <i>Abanfan matilon</i>	92	0	8
Management of <i>Abanfan matilon</i> is still currently implemented	86	14	0
Management of <i>Abanfan matilon</i> needs to be maintained or improved	100	0	0



**Figure 3.** One of the locations of *Abanfan matilon* traditional conservation on Liki Island, Papua, Indonesia, to protect commercial snail *lola* (local name)



**Figure 4.** Commercial snail species of *Rochia nilotica*

The stages of implementation *Abanfan matilon* is a type of marine conservation initiated and practiced by the local community. The practice of local knowledge is essential in the development system and conservation, from various simple sciences to multidisciplinary (Diegues 2014; Görg et al. 2014; Wiener et al. 2015). On Liki Island, *Abanfan matilon* is an activity in the management of marine areas that are temporarily closed to catching shellfish, particularly types of *Lola* (gastropods) (Mailissa et al. 2021). The community expects this management model to maintain the survival of gastropods in marine waters throughout the existence of the community. When there is a scarcity of gastropods and damage to coastal ecosystems'

habitats, it will require considerable cost and time to repair. Furthermore, the use of large gastropods without considering the sustainability of gastropods leads to a reduction in individual and species abundance, diversity, and uniformity (Saleky et al. 2019). The recovery cost will be higher than the need to maintain a conservation area (Hunter and Gibbs 1996; Bräuer 2003). This form of *Sasi* tradition can be used as a master plan for empowering local communities, specifically in the Cenderawasih Bay Marine National Park area, which affects the welfare of the local community (Ilahi 2021).

Marine ethnoconservation practices, as shown by the local people of Liki Village and their *Abanfan matilon*, represent at least three essential elements capable of building resilience in a sustainable social-ecological system. The first element is the existence of specific natural resources that are managed traditionally, known, valued, and used sustainably with adherence to customary rules. On a broader spatial scale throughout the global coastal and marine areas, these resources include a variety of species with diverse climatic conditions and habitats (Ramachandran and Mohamed 2015; Carrasquilla-Henao et al. 2019; Baker and Constant 2020; Mulalap et al. 2020; Jesus et al. 2021; Matsushita et al. 2023).

The second element is the existence of traditional knowledge and customary rules regarding the use of natural resources. These regulations are not only widely recognized and accepted but are also adhered to diligently accompanied by rules of sanctions. Traditional knowledge and rules that are generally recognized include, (i) temporal restrictions, (ii) closure and protection of certain habitat areas, (iii) protection of certain age classes and species, and (iv) use of fishing gear, understanding of seasons, and implementation of certain rituals. Another critical factor is

the transmission of this traditional knowledge and rules from one generation to another, ensuring the continuity of the existence of resources and benefits. These customary rules are often elevated to be holistic and recognized by the official and higher levels of government (Gaymer et al. 2014; Stephenson et al. 2014; Wiener et al. 2015; Aswani 2019; Ravikumar et al. 2016; Ross et al. 2019; Sakurai and Uehara 2020; Karnad 2022)

The third element is the existence of people and a party that manages and enforces mutually agreed-upon customary rules. In ethnoconservation, the acknowledgment of the rights of traditional communities to inhabit their lands is a prerequisite for adequate nature protection. This is because the acknowledgment of cultural variety and ecological diversity can be conserved, indicating the importance of traditional knowledge and processing methods for conserving biodiversity, which people carry out traditionally. On a local scale, such as Liki Island, several main parties have implemented these customary rules, including community members who comply with the rules and receive benefits. Furthermore, traditional customary leaders organize agreements and lead the implementation of rules and sanctions, as well as religious leaders and village authority holders who supervise and enforce agreed-upon customary rules. Traditionally recognized natural resource management by all parties is often the best method to maintain the sustainable benefits of important natural resources in coastal and marine areas (de Oliveira 2013; Gaymer et al. 2014; Abreu et al. 2017; McLeod et al. 2018; Alexander et al. 2019; Bennett et al. 2021; de Sousa et al. 2022; Smallhorn-West et al. 2023). This is because local community wisdom based on conservation can be a reference for continuous practice in all aspects (Le Heron et al. 2019; Ogar et al. 2020; Saputra 2021; Matsushita et al. 2023). Moreover, it is also considered that conservation based on local knowledge and wisdom is more readily accepted by communities.

In conclusion, this study showed that *Abonfan matilon* practice in Liki Village engaged natural resources, traditional knowledge, local community, and customary rules, categorized as marine ethnoconservation. This practice ensured the continuity of resources and benefits by acknowledging cultural and ecological diversity. The active participation of local community members, traditional customary and religious leaders, and village authority holders played a crucial role in implementing these rules, ensuring sustainable management of coastal and marine resources. The results indicated the significance of coastal, socio-cultural, and management development in managing natural resources directly used by the community. This study served as a basis for determining policies and implementing a marine ethnoconservation system, particularly in the marine waters of Papua.

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## REFERENCES

- Abdillah B, Karnan K, Santoso D. 2019. Community structure of mollusks (gastropods and bivalves) in the intertidal area in the Poton Bako coastal waters of East Lombok as a source of learning biology. *Jurnal Pijar MIPA* 14 (3): 208-216. DOI: 10.29303/jpm.v14i3.1619. [Indonesian]
- Abreu JS, Domit C, Zappes CA. 2017. Is there dialogue between researchers and traditional community members? The importance of integration between traditional knowledge and scientific knowledge to coastal management. *Ocean Coast Manag* 141: 10-19. DOI: 10.1016/j.ocecoaman.2017.03.003.
- Adrianto L, Al Amin MA, Solihin A, Hartoto DI. 2011. Local Construction of Fisheries Resource Management in Indonesia. IPB Press, Bogor. [Indonesian]
- Alexander SM, Provencher JF, Henri DA, Taylor JJ, Cooke SJ. 2019. Bridging indigenous and science-based knowledge in coastal-marine research, monitoring, and management in Canada: A systematic map protocol. *Environ Evid* 8 (1): 15. DOI: 10.1186/s13750-019-0159-1.
- Aswani S. 2019. Perspectives in Coastal Human Ecology (CHE) for marine conservation. *Biol Conserv* 236: 223-235. DOI: 10.1016/j.biocon.2019.05.047.
- Baker S, Constant NL. 2020. Epistemic justice and the integration of local ecological knowledge for marine conservation: Lessons from the Seychelles. *Mar Policy* 117: 103921. DOI: 10.1016/j.marpol.2020.103921.
- Ban NC, Eckert L, McGreer M, Frid A. 2017. Indigenous knowledge as data for modern fishery management: A case study of dungeness crab in Pacific Canada. *Ecosyst Health Sust* 3 (8): 1379887. DOI: 10.1080/20964129.2017.1379887.
- Bennett NJ, Katz L, Yadao-Evans W, Ahmadi GN, Atkinson S, Ban NC, Dawson NM, de Vos A, Fitzpatrick J, Gill D, Imirizaldu M, Lewis N, Mangubhai S, Meth L, Muhl E-K, Obura D, Spalding AK, Villagomez A, Wagner D, White A, Wilhelm A. 2021. Advancing social equity in and through marine conservation. *Front Mar Sci* 8: 711538. DOI: 10.3389/fmars.2021.711538.
- Bloch LJ. 2021. No gods, no masters: Indigenous environmental knowledge in Mississippian art. *Southeast Archaeol* 40 (4): 248-265. DOI: 10.1080/0734578X.2021.1983119.
- Borelli T, Hunter D, Powell B, Ulian T, Mattana E, Termote C, Pawera L, Beltrame D, Penafiel D, Tan A, Taylor M, Engels J. 2020. Born to eat wild: An integrated conservation approach to secure wild food plants for food security and nutrition. *Plants* 9 (10): 1299. DOI: 10.3390/plants9101299.
- Bräuer I. 2003. Money as an indicator: To make use of economics evaluation for biodiversity conservation. *Agric Ecosyst Environ* 98 (1-3): 483-491. DOI: 10.1016/S0167-8809(03)00107-5.
- Camargo C, Maldonado JH, Alvarado E, Moreno-Sánchez R, Mendoza S, Manrique N, Mogollón A, Osorio JD, Grajalas A, Sánchez JA. 2009. Community involvement in management for maintaining coral reef resilience and biodiversity in southern Caribbean marine protected areas. *Biodivers Conserv* 18: 935-956. DOI: 10.1007/s10531-008-9555-5.
- Carrasquilla-Henao M, Ban N, Rueda M, Juanes F. 2019. The mangrove-fishery relationship: A local ecological knowledge perspective. *Mar Policy* 108: 103656. DOI: 10.1016/j.marpol.2019.103656.

- Christopel P. 2015. Liki, the Distinctive Charm of the Foremost Island in the Pacific Ocean. <https://www.mongabay.co.id/2015/12/28/liki-pesona-khas-pulau-terdepan-di-samudera-pasifik/>. Accessed 26 August 2021, 09.30 AM. [Indonesian]
- de Oliveira LP. 2013. Fishers as advocates of marine protected areas: A case study from Galicia (NW Spain). *Mar Policy* 41: 95-102. DOI: 10.1016/j.marpol.2012.12.024.
- de Sousa WL, Zacardi DM, Vieira TA. 2022. Traditional ecological knowledge of fishermen: People contributing towards environmental preservation. *Sustainability* 14 (9): 4899. DOI: 10.3390/su14094899.
- Deb AK. 2015. "Something sacred, something secret": Traditional ecological knowledge of the artisanal coastal fishers of Bangladesh. *J Ethnobiol* 35 (3): 536-565. DOI: 10.2993/etbi-35-03-536-565.1.
- Dharmawibawa ID. 2019. Kearifan lokal masyarakat Desa Seloto dalam pengelolaan sumberdaya alam di Danau Lebo. *Jurnal Abdi Masyarakat* 1 (1): 29-35. DOI: 10.58258/abdi.v1i1.941. [Indonesian]
- Diegues AC. 2014. The role of ethnoscience in the build-up of ethnoconservation as a new approach to nature conservation in the tropics. The case of Brazil. *Revue d'ethnoécologie* 6: 2014. DOI: 10.4000/ethnoecologie.1956.
- Ferreira HM, Reuss-Strenzel GM, Alves JA, Schiavetti A. 2014. Local ecological knowledge of the artisanal fishers on *Epinephelus itajara* (Lichtenstein, 1822) (Teleostei: Epinephelidae) on Ilhéus coast-Bahia State, Brazil. *J Ethnobiol Ethnomed* 10: 51. DOI: 10.1186/1746-4269-10-51.
- Friedlander AM, Shackeroff JM, Kittinger JN. 2013. Customary marine resource knowledge and use in contemporary Hawai'i. *Pac Sci* 67 (3): 441-460. DOI: 10.2984/67.3.10.
- Friedlander AM. 2018. Marine conservation in Oceania: Past, present, and future. *Mar Pollut Bull* 135: 139-149. DOI: 10.1016/j.marpolbul.2018.05.064.
- Galan GL, Ediza MM, Servasques MS, Porquis HC. 2015. Diversity of gastropods in the selected rivers and lakes in Bukidnon. *Int J Environ Sci Dev* 6 (8): 615-619. DOI: 10.7763/IJESD.2015.V6.668.
- Gaymer CF, Stadel AV, Ban NC, Cárcamo PF, Ierna J, Lieberknecht LM. 2014. Merging top-down and bottom-up approaches in marine protected areas planning: Experiences from around the globe. *Aquat Conserv Mar Freshw Ecosyst* 24 (S2): 128-144. DOI: 10.1002/aqc.2508.
- Görg C, Spangenberg JH, Tekken V, Burkhard B, Truong DT, Escalada M, Heong KL, Arida G, Marquez LV, Bustamante JV, van Chien H, Klötzbücher T, Marxen A, Manh NH, van Sinh N, Villareal BS, Settele J. 2014. Engaging local knowledge in biodiversity research: Experiences from large inter- and transdisciplinary projects. *Interdiscip Sci Rev* 39 (4): 323-341. DOI: 10.1179/0308018814Z.00000000095.
- Hunter Jr. ML, Gibbs JP. 1996. *Fundamental of Conservation Biology*. Blackwell Science, Cambridge.
- Huntington HP, Quakenbush LT, Nelson M. 2017. Evaluating the effects of climate change on indigenous marine mammal hunting in Northern and Western Alaska using traditional knowledge. *Front Mar Sci* 4: 319. DOI: 10.3389/fmars.2017.00319.
- Ilahi WA. 2021. What's up with Conservation, The Sasi Tradition: Ethnoconservation of the Sea in the Cenderawasih Bay National Park Area. <https://forestation.fkt.ugm.ac.id/2021/05/30/tradisi-sasi-etnokonervasi-laut-di-kawasan-taman-nasional-teluk-cenderawasih/>. Accessed on 5 June 2023. [Indonesian]
- Jentewo AY, Lazuardi EM. 2021. Pengaruh sasi pada keragaman jenis, komposisi dan kelimpahan megabentos di perairan Kabupaten Teluk Wondama. *Igya Ser Hanjop Jurnal Pembangunan Berkelanjutan* 3 (2): 139-148. DOI: 10.47039/ish.3.2021.139-148. [Indonesian]
- Jesus MD, de Luna Sales JB, Martins RS, Ready JS, Costa TAS, Ablett JD, Schiavetti A. 2021. Traditional knowledge aids description when resolving the taxonomic status of unsettled species using classical and molecular taxonomy: The case of the shallow-water octopus *Callistoctopus furvus* (Gould, 1852) from the Western Atlantic Ocean. *Front Mar Sci* 7: 595244. DOI: 10.3389/fmars.2020.595244.
- Kadir A, Suharno, Reawaruw Y, Komari, Mahuze A. 2022. Ethnobotanical knowledge of Marind-Anim tribe in utilizing sago (*Metroxylon sagu*) in Merauke, Papua, Indonesia. *Biodiversitas* 23 (1): 264-272. DOI: 10.13057/biodiv/d230132.
- Kamat VR. 2014. "The ocean is our farm": Marine conservation, food insecurity, and social suffering in southeastern Tanzania. *Hum Organ* 73 (3): 289-298. DOI: 10.17730/humo.73.3.f43k115544761g0v.
- Karnad D. 2022. Incorporating local ecological knowledge aids participatory mapping for marine conservation and customary fishing management. *Mar Policy* 135: 104841. DOI: 10.1016/j.marpol.2021.104841.
- Kelly R, Fleming A, Pecl GT, von Gönner J, Bonn A. 2020. Citizen science and marine conservation: A global review. *Phil Trans R Soc B* 375: 20190461. DOI: 10.1098/rstb.2019.0461.
- Kitolelei S, Lowry JH, Qaqara N, Ryle J, Veitayaki J, Piovano S. 2022. Spatial use of marine resources in a rural village: A case study from Qoma, Fiji. *Front Mar Sci* 9: 993103. DOI: 10.3389/fmars.2022.993103.
- Kitolelei S, Thaman R, Veitayaki J, Breckwoldt A, Piovano S. 2021. Na vuku makawa ni qoli: Indigenous Fishing Knowledge (IFK) in Fiji and the Pacific. *Front Mar Sci* 8: 684303. DOI: 10.3389/fmars.2021.684303.
- Korwa. 2011. *Indonesian Basic Biak Dictionary*. Yayasan Rumsram Biak, Biak, Papua. [Indonesian]
- Laksono DS, Ali S. 1995. *Maritime Communities Sea Customary Rights: Bindusi Village, East Biak District, Biak Numfor Regency, Irian Jaya*. Pusat Penelitian dan Pengembangan Kemasyarakatan dan Kebudayaan LIPI: Seri Penelitian PMB-LIPI No. 84/1995, Jakarta. [Indonesian]
- Le Heron E, Logie J, Allen W, Le Heron R, Blackett P, Davies K, Greenaway A, Glavovic B, Hikuroa D. 2019. Diversity, contestation, participation in Aotearoa New Zealand's multi-use/user marine spaces. *Mar Policy* 106: 103536. DOI: 10.1016/j.marpol.2019.103536.
- Lepofsky D, Caldwell M. 2013. Indigenous marine resource management on the northwest coast of North America. *Ecol Process* 2 (1): 12. DOI: 10.1186/2192-1709-2-12.
- López-Angarita J, Moreno-Sánchez RDP, Maldonado JH, Sanchez JA. 2013. Evaluating linked social-ecological systems in marine protected areas. *Conserv Lett* 7 (3): 241-252. DOI: 10.1111/conl.12063.
- Mailissa MG, Sujarta P, Keiluhu HJ. 2021. Keanekaragaman gastropoda dan pengetahuan masyarakat tentang gastropoda di Pulau Liki Kabupaten Sarmi Papua. *Jurnal Education and development* 9 (4): 140-147. DOI: 10.37081/ed.v9i4. [Indonesian]
- Markee N. 2013. Emic and etic in qualitative research. In: Chapelle CA (eds). *The Encyclopedia of Applied Linguistics*. Blackwell Publishing Ltd., Oxford, UK. DOI: 10.1002/9781405198431.wbeal0366.
- Mataitini A. 2014. The harvest of balolo: A Fijian delicacy. In: Lee S, Nabobo-Baba U, Kinikini-Kauvaka LL, Rehuher-Marugg K (eds). *Traditional Knowledge and Wisdom: Themes From the Pacific Islands*. ICHCAP, Jeonju, Korea.
- Matsushita K, Hori M, Yamane F, Asano K. 2023. Incorporating traditional ecological knowledge into holistic watershed management: Fishery forests in Japan. *Ecol Econ* 204: 107654. DOI: 10.1016/j.ecolecon.2022.107654.
- McLeod I, Schmitter J, Creighton C, Gillies C. 2018. Seven pearls of wisdom: Advice from traditional owners to improve engagement of local indigenous people in shellfish ecosystem restoration. *Ecol Manag Restor* 19 (2): 98-101. DOI: 10.1111/emr.12318.
- Merritt E, Peterson A, Evans S, Marston SA, Zuiker S. 2021. Learning about culture and sustainable harvesting of native plants garden-based teaching can foster appreciation of indigenous knowledge. *Teach Teach* 58 (4): 69-73. <https://www.nsta.org/science-and-children>.
- Muhl E-K, Dias ACE, Armitage D. 2020. Experiences with governance in three marine conservation zoning initiatives: Parameters for assessment and pathways forward. *Front Mar Sci* 7: 629. DOI: 10.3389/fmars.2020.00629.
- Mulalap CY, Frere T, Huffer E, Hviding E, Paul K, Smith A, Vierros MK. 2020. Traditional knowledge and the BBNJ instrument. *Mar Policy* 122: 104103. DOI: 10.1016/j.marpol.2020.104103.
- Ogar E, Pecl G, Mustonen T. 2020. Science must embrace traditional and indigenous knowledge to solve our biodiversity crisis. *One Earth* 3 (2): 162-165. DOI: 10.1016/j.oneear.2020.07.006.
- Peer N, Muhl E-K, Janna J, Brown M, Zukulu S, Mbatha P. 2022. Community and marine conservation in South Africa: Are we still missing the mark? *Front Mar Sci* 9: 884442. DOI: 10.3389/fmars.2022.884442.
- Persulesy M, Arini I. 2018. Keanekaragaman jenis dan kepadatan gastropoda di berbagai substrat berkarang di perairan pantai Tihunitu Kecamatan Pulau Haruku Kabupaten Maluku Tengah. *Biopendix* 5 (1): 45-52. DOI: 10.30598/biopendixvol5issue1page45-52. [Indonesian]
- Petza D, Anastopoulos P, Kalogirou S, Coll M, Garcia S, Kaiser M, Koukourouli N, Lourdi I, Rice J, Sciberras M, Katsanevakis S. 2023. Contribution of area-based fisheries management measures to fisheries sustainability and marine conservation: A global scoping review. *Rev Fish Biol Fish* 2023: 1-25. DOI: 10.1007/s11160-023-09780-9.

- Ramachandran C, Mohamed KS. 2015. Responsible fisheries: Kerala fish workers open new path in co-governance. *Econ Polit Wkly* 50 (35): 16-18.
- Ravikumar T, Ram N, Krishnan P, Sankar RK, Sachithanandam V, Roy SD. 2016. Subsistence fishing methods of Nicobari tribes using traditional knowledge. *J Mar Isl Cult* 5 (1): 79-87. DOI: 10.1016/j.imic.2016.05.002.
- Raymond-Yakoubian J, Raymond-Yakoubian B, Moncrieff C. 2017. The incorporation of traditional knowledge into Alaska federal fisheries management. *Mar Policy* 78: 132-142. DOI: 10.1016/j.marpol.2016.12.024.
- Rivers N, Strand M, Fernandes M, Metuge D, Lemahieu A, Nonyane CL, Benkenstein A, Snow B. 2023. Pathways to integrate indigenous and local knowledge in ocean governance processes: Lessons from the Algoa Bay Project, South Africa. *Front Mar Sci* 9: 1084674. DOI: 10.3389/fmars.2022.1084674.
- Ross H, Adhuri DS, Abdurrahim AY, Phelan A. 2019. Opportunities in community-government cooperation to maintain marine ecosystem services in the Asia-Pacific and Oceania. *Ecosyst Serv* 38: 100969. DOI: 10.1016/j.ecoser.2019.100969.
- Rudnev V. 2015. Indigenous knowledge: Searching for a model of sustainable development for humankind. *Glob Bioeth* 26 (2): 46-51. DOI: 10.1080/11287462.2015.1038099.
- Rumengan I. 2017. Tempat-tempat sakral dan penerapan sawora dalam masyarakat kampung Isenebuai di Kawasan Taman Teluk Cenderawasih. *Sabda: Jurnal Kajian Kebudayaan* 12 (2): 146-154. DOI: 10.14710/Sabda.12.2.146-154. [Indonesian]
- Sagrim M. 2022. Traditional knowledge of land management in Maybrat District, West Papua Province, Indonesia: Implication for agriculture development. *Biodiversitas* 23 (8): 4144-4151. DOI: 10.13057/biodiv/d230836.
- Sakurai R, Uehara T. 2020. Effectiveness of a marine conservation education program in Okayama, Japan. *Conserv Sci Pract* 2 (3): e167. DOI: 10.1111/csp2.167.
- Saleky D, Leatemia SPO, Yuanike, Rumengan I, Putra ING. 2019. Temporal distribution of gastropods in rocky intertidal area in North Manokwari, West Papua. *Jurnal Sumberdaya Akuatik Indopasifik* 3 (1): 1-10. DOI: 10.46252/jsai-fpik-unipa.2019.Vol.3.No.1.58. [Indonesian]
- Saleky D, Setyobudiandi I, Toha HA, Takdir M, Madduppa HH. 2016. Length-weight relationship and population genetic of two marine gastropods species (Turbinidae: *Turbo sparverius* and *Turbo bruneus*) in the Bird Seascape Papua, Indonesia. *Biodiversitas* 17 (1): 208-217. DOI: 10.13057/biodiv/d170130.
- Saputra R. 2021. Konservasi alam berbasis kearifan lokal Suku Kokoda di kepulauan Ugar Kabupaten Fakfak Papua Barat. *Jurnal Bios Logos* 11 (1): 7-12. DOI: 10.35799/jbl.11.1.2021.30582. [Indonesian]
- Sawaki S, Taran D, Taran F, Bomoi R, Rumateray M. 2022. Hunting of wild animals by Saubeba Community in Manokwari, West Papua, Indonesia. *Biodiversitas* 23 (5): 2411-2416. DOI: 10.13057/biodiv/d230519.
- Singeo AK. 2014. Palau knowledge of the sea. In: Lee S, Nabobo-Baba U, Kinikini-Kauvaka LL, Rehuher-Marugg K (eds). *Traditional Knowledge and Wisdom: Themes from the Pacific Islands*. ICHCAP, Jeonju, Korea.
- Slamet R, Purnama D, Negara BFSP. 2021. Identification of types and abundance of Gastropode in the Beach of Sepang Beach, Bengkulu City. *Jurnal Perikanan* 11 (1): 26-34. DOI: 10.29303/jp.v11i1.216. [Indonesian]
- Smallhorn-West P, Allison E, Gurney G, Karnad D, Kretser H, Lobo AS, Mangubhai S, Newing H, Pennell K, Raj S, Tilley A, Williams H, Peckham SH. 2023. Why human rights matter for marine conservation. *Front Mar Sci* 10: 1089154. DOI: 10.3389/fmars.2023.1089154.
- Sonbait LY, Manik H, Warmetan H, Wambrauw YLD, Sagrim M, Djitmau DA, Wanggai J, Rettob BB, Murdjoko A. 2021. The natural resource management to support tourism: A traditional knowledge approach in Pegunungan Arfak Nature Reserve, West Papua, Indonesia. *Biodiversitas* 22 (10): 4466-4474. DOI: 10.13057/biodiv/d221040.
- Stephenson J, Berkes F, Turner NJ, Dick J. 2014. Biocultural conservation of marine conservation ecosystem: Example from New Zealand and Canada. *Indian J Tradit Knowl* 13 (2): 257-265.
- Stori FT, Peres CM, Turra A, Pressey RL. 2019. Traditional ecological knowledge supports ecosystem-based management in disturbed coastal marine social-ecological systems. *Front Mar Sci* 6: 571. DOI: 10.3389/fmars.2019.00571.
- Sujarta P, Indrayani E. 2016. Pengetahuan masyarakat lokal tentang keragaman teripang dan pemanfaatannya di Pesisir Tablasupa, Depapre, Kabupaten Jayapura, Papua. *Jurnal Biologi Papua* 8 (2): 62-67. DOI: 10.31957/jbp.53. [Indonesian]
- Sujarta P, Mailissa MG, Keiluhu HJ, Hadisusanto S, Yuliana S. 2022. Community distribution and utilization of gastropods in the coastal area of Liki Island, Sarimi District, Papua, Indonesia. *Biodiversitas* 23 (10): 5001-5011. DOI: 10.13057/biodiv/d231006.
- Sujarta P, Renyoet A, Dimara L. 2020. The Tiaitiki Tradition: Concepts of Application and Benefits. *Samudra Biru, Yogyakarta*. [Indonesian]
- Sujarta P, Renyoet A, Dimara L. 2021. Kajian sistem etno konservasi laut masyarakat pesisir Papua: Sasisen dan Tiyaitiki. *Jurnal Education and development* 9 (1): 103-110. DOI: 10.37081/ed.v9i1. [Indonesian]
- Sujarta P. 2015. Sistem konservasi tiyaitiki dengan pendekatan biologi di perairan Teluk Tanah Merah, Depapre, Jayapura. [Dissertation]. Universitas Gadjah Mada. Yogyakarta. [Indonesian]
- Teixeira JB, Martins AS, Pinheiro HT, Secchin NA, de Moura RL, Bastos AC. 2013. Traditional ecological knowledge and the mapping of benthic marine habitats. *J Environ Manag* 115: 241-250. DOI: 10.1016/j.jenvman.2012.11.020.
- Wiener CS, Manset G, Lemus JD. 2015. Ocean use in Hawaii as a predictor of marine conservation interests, beliefs, and willingness to participate: an exploratory study. *J Environ Stud Sci* 6 (4): 712-723. DOI: 10.1007/s13412-015-0272-6.
- Yuliani E, Aprilina M. 2020. Kearifan lokal masyarakat dalam upaya pengelolaan sumberdaya air Desa Lerep, Kecamatan Ungaran Barat, Kabupaten Semarang. *Jurnal Planologi* 17 (1): 114-125. DOI: 10.30659/jpsa.v17i1.9176. [Indonesian]
- Zaen LLI. 2017. The Dilemma of the Sasi Customary System and the Power of the Government to Protect the Natural Resources of Maluku Island. <https://id.wikipedia.org/wiki/Sasi>. Accessed on 3 June 2017 [Indonesian]
- Zebua LI, Waluyo EB. 2016. Pengetahuan tradisional masyarakat Papua dalam mengenali, mengklasifikasi dan memanfaatkan pandan buah merah (*Pandanus conoideus* Lam.). *Jurnal Biologi Papua* 8 (1): 23-37. DOI: 10.31957/jbp.42. [Indonesian]