Preliminary study on community’s perception of seagrass restoration on Pari Island, Seribu Islands Regency

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Abstract. Pari Island is one of the islands located in the Seribu Islands Regency. Seagrasses on this island are scattered almost around the island. However, development on this island is overgrowing, so there is a decrease in the seagrass area. This study aims to determine the community’s perception of the possibility of seagrass restoration on the island. Data collection was conducted in May 2021 through a questionnaire. Respondents were local people of Pari Island. The number of respondents was 104 people consisting of fishers, housewives, government employees, tourism actors, students, and entrepreneurs. The results showed that, in general, people in Pari Island know the existence of seagrass (99%), understand the functions and benefits of seagrass (100%), and use the biota that lives in the seagrass ecosystem for their lives, as household food needs. Almost all respondents agreed with the seagrass restoration in Pari Island (96%) and voluntarily participated in restoration activities (91%). A total of 90% of respondents agree that there is a regulation on protecting seagrass meadow and say that restoration efforts must involve local communities, Non-Government organizations (NGOs), Research Institutes or Universities, and the Government. Our finding shows that the local community in Pari Island has a deep concern for seagrass restoration.

Keywords: community perception; Pari Island; restoration; seagrass ecosystem

1. Introduction
The seagrass ecosystem is one of the coastal ecosystems that is spread almost throughout the coastline. These ecosystems provide ecosystem services for coastal communities [1] and small islands [2-3]. Some of the ecosystem services provided by the seagrass ecosystem are habitats for economic biota [4-6], coastal protection, reducing water current [7-8], reducing pathogens [9] as well as carbon sinks[10].

The seagrass ecosystem tends to decrease in an area due to various pressures. The primary pressure comes from anthropogenic activities, such as dredging, stockpiling, water pollution, oil, hot water waste, and inorganic solids from upstream watersheds, the primary cause of seagrass degradation [11]. In Indonesia, development in coastal areas such as beach reclamation, dredging, and sand mining, land cover changing, and pollution causes the decline of seagrass meadows [12]. Indeed reduce the seagrass ecosystem’s ability to provide ecosystem services [13-14]. However, restoration efforts are needed and have been tried in Indonesia. For example, Lessy and Ramili [15] have been attempting to restore Enhalus acoroides in the waters of Kastela, Ternate City using the Spring Anchored, Peat Pot, and Turf methods. At the same time, Riniatsih and Endrawati [16] observed the growth of Cymodocea rotundata in Teluk Awur, Jepara.

Pari Island Cluster is one of a group of 105 small islands in the waters of the Thousand Islands. The Pari Island cluster united by coral reefs on the outside and consists of Pari Island, Tengah Island, Burung Island, Kongsis Island, and Tikus Island. At the same time, there are sandy flats, shallow heat, coral reefs, and a lagoon in the interior.

Mangrove, seagrass, and coral reef are found along the coast and shallow waters of Pari Island. The condition of the mangrove community is in the excellent category, with a high percentage of canopy
cover and stand density [17]. In contrast, the coral reef condition tends to decline but still can survive and recover [18].

Seagrass ecosystems on Pari Island tend to run into relatively high pressure [19]. Resort development and reclamation for tourism purposes occur in the Pari Island group [17, 18]. The growth of tourism causes tourism activities on the coast to increase. Usually tourists walk along the coast, these activities can trample seagrass directly. The collection of biota such as fish and shellfish is also growing [20] in line with tourist demand for food when traveling. On the other hand, the water quality in Pari Island is relatively lower than in the northern part of the Seribu Islands due to the flow of water from the mainland.

The width of seagrass beds on Pari Island during the period 2004-2016 showed fluctuations. During this period, there was a decrease and increase in the width of the seagrass area. Finally, they concluded that the condition of seagrass beds on Pari Island was relatively stable [19]. However, the pressure from tourism activities increases the number of tourists coming [20]. These facts confirmed the homestay management association, which stated that the number of tourist visits reached 2000 people on weekends. This situation will undoubtedly affect seagrass ecosystems on Pari Island; therefore, restoration efforts are urgent.

Seagrass restoration will be carried out on Pari Island by involving the community. According to Rogers et al. [21], seagrass restoration that were carried out by the community will be cheaper than that done by experts. So far, the limitation in seagrass restoration is the high labor cost associated with the collection of restorative material and placement of the transplant unit. That costs can be reduced significantly by involving volunteers [22]. In our cases, we plan to engage the local community in Pari Island. Therefore, before we do restoration, it is necessary to know how the community perceives the activity.

![Figure 1. Map of Pari Island.](image-url)
2. Methodology

2.1. Study area

Pari Island is part of the Thousand Islands Regency (Figure 1). Geographically, Pari Island lies between 05° 50' latitude to 05° 53' latitude and 106° 34' east longitude to 106° 38' east longitude. Pari Island is part of South Thousand Islands Sub-district, Seribu Islands Regency, DKI Jakarta Province. This island is inhabitant by 2975 people. Most of them work as fishers and tourism sector. Residential areas are located in the southern, while the western, eastern, and northern parts of the island marine vegetation were dominant. Meanwhile, the seagrass area on Pari Island was measured using Advanced Land Observing Satellite (ALOS) imagery estimated at 1,641 km² [23]. The most common types of seagrass found were Enhalus acoroides, Thalassia hemprichii, and Cymodocea rotundata [23].

2.2. Data collection and analysis

The seagrass restoration survey on Pari Island was conducted in May 2021. The number of respondents involved in this study was 104 people who live in Pari Island. We used a structured questionnaire to assess (1) the basic knowledge of the local community regarding the functions and benefits of seagrasses (2) Perceptions of the seagrass restoration plan. The questionnaire consists of four parts (A, B, C, and D). Part A contains information about age, gender, and occupation. Parts B and C is a list questions related to understanding and utilization of seagrass. Part D consists of several questions to assess the community’s perception of the seagrass restoration plan in Pari Island and identify the potential actors involved in seagrass restoration. The obtained data be tabulated, validated, and summarized using frequency distributions and percentages [24]. In the end, we tried to find out the strengths, weaknesses, opportunities, and threats to seagrass restoration efforts.

3. Result and Discussion

3.1 Respondent profile

The survey results show that most of the respondents in this study were male 61% and 39% were females (Figure 2). Respondents’ age was dominated by the age range of 30-50 years (61%), over 50 years, 16%, and under 30 years, 23% (figure 2).

These illustrate that most of the respondents are in the productive age category, where the age criterion is a factor that affects productivity and success in a program [25].

Based on the main livelihood, the respondent’s profession consists of five, namely: fishers, housewives, government employees, students, tourism actors, and entrepreneurs (Figure 3). The survey results show that the majority of respondents are fishers (40%), followed by housewives (29%), government employees (13%), while the rest are tourism actors, entrepreneurs, and students. Activities at sea are not only carried out by respondents who work as fishers but are also by respondents other than fishers. These activities include looking for shellfish and fishing. Generally, people on Pari Island used the catch to provide household food needs [20]. This situation often occurs in people living on small islands to get animal protein needs due to limited mobilization to the mainland [3,26]. Besides having the main livelihood, some respondents also have additional jobs. The survey results show that 81% of respondents have other jobs, including tour guides, catering, renting bicycles, ‘bentor’, planting mangrove seedlings, and homestay workers (figure 4).

3.2 Knowledge about the functions and benefits of the seagrass ecosystem

Community knowledge of ecosystem functions and benefits is an essential component in restoration efforts [27]. This knowledge correlates with the benefits received from an ecosystem, and in the end, can help preserve the existence of the ecosystem. The people of Pari Island know seagrass very well. Almost all respondents (99%), both housewives, fishers, or government employees, find out the location of seagrass in the Pari Island Cluster (figure 5). Fishers are the largest group of respondents who recognize the area of seagrass in the Pari Island Cluster, followed by housewives and government employees, respectively. Knowledge of the location of the seagrass area correlated with the profession. Fishers are the respondents who know best where the site of seagrass is because seagrass is related to
their main activity, while housewives only look for shellfish as a daily food in the seagrass area around their live.

According to respondents, seagrass ecosystems are spread in the south and north of Pari Island, west of Kongsi Island, west and east of Kudus Island, north of Tikus Island, and west of Tengah Island. This situation illustrates that the people of Pari Island are very familiar with the Pari Island area. This knowledge can become social capital in supporting the implementation of the seagrass restoration program on Pari Island.

The level of knowledge of respondents about the function of seagrass ecosystems is relatively high. Almost all respondents know that the seagrass ecosystem is a habitat for juvenile biota, shellfish, sea cucumbers, and seahorses (figure 6).

The knowledge of respondents about the seagrass ecosystem as a place for dugong feeding is relatively low. Based on in-depth interviews, most of the respondents stated that there was no information about the appearance of dugongs around Pari Island waters. A small number of respondents answered that they knew because they heard dugongs are looking for food in the seagrass area. Almost half of the respondents recognize the function of seagrass as a substrate stabilizer, and they say that the dense roots of the seagrass can hold the sand so that the substrate becomes stable. Socialization about the functions and benefits of seagrass is an essential point for restoration efforts [28]. Community knowledge about the roles and benefits of seagrass ecosystems on Pari Island has been supported by socialization. According to respondents, 70% of them have participated in the socialization provided by various institutions, including LIPI, IPB, and NGOs.

3.3. Utilization of seagrass ecosystem on Pari Island

The existence of the seagrass ecosystem provides benefits for the people of Pari Island [20]. Almost entirely respondents (95%) stated that the seagrass ecosystem had provided benefits for daily life
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Figure 7. Benefit from seagrass ecosystems

Figure 6. Knowledge of respondents regarding the function of seagrass

Figure 5. Knowledge of respondents regarding the location of seagrass in Pari Island

Figure 8. Activities of respondents in the seagrass ecosystem

(figure 7). Fishers are the largest respondents who say that seagrass has provided benefits, followed by housewives and government employees. The benefits include a place to look for shellfish, fishing for fish, and a place for seaweed cultivation (figure 8). The high honors of the seagrass ecosystem for Pari Island people correlated with the community's high interaction with the ecosystem. As many as 80% of respondents stated that activities in the seagrass ecosystem are the main activities (figure 9). However, the frequency of activities in the seagrass ecosystem is only occasional (Figure 10), with the direct economic income derived from seagrass ecosystem ranging from 500,000 – 1,000,000 IDR (figure 11). This situation provides an opportunity to protect seagrass ecosystems from the pressure of community activities by enacting regulations and restoration efforts

### 3.4. Community acceptance of seagrass restoration efforts

Community involvement in seagrass restoration efforts is necessary. The community will play a role in planting, maintaining, and monitoring seagrass growth during restoration. Based on this, knowing how the community accepts seagrass restoration efforts on Pari Island is needed. The survey shows that most of the respondents (96%) agreed with the restoration (figure 12); even 91% of the respondents were willing to participate independently in the activity (figure 13).

The productive age group (30-50) was the most significant respondent who agreed with the restoration effort and stated that they were willing to be independently involved in the action. Their statement will be one of the keys to success in supporting restoration efforts in Pari Island. Respondents also say that local communities should play a role in restoration (36%), government and universities/research institutes (24%), and NGOs (16%). The other main point is that 91% of respondents agree if there are regulations on seagrass protection.
4. Conclusion
Seagrass restoration activities on Pari Island received a good response from the community. Regarding seagrass restoration efforts in Pari Island, we have identified strengths, weaknesses, opportunities, and threats to the success of the seagrass restoration efforts (table 1). The main forces that can support seagrass restoration efforts in Pari Island consist of two points: community understanding and acceptance. First, the level of community understanding about seagrass ecosystems’ functions, benefits, and distribution is relatively high because they have an advantage over the seagrass ecosystem, which means that the community depends on the seagrass ecosystem. This dependence is an important point to encourage a sense of belonging and a desire to preserve the seagrass ecosystem of Pari Island Second,
the level of acceptance and willingness to volunteer seagrass restoration efforts is relatively high. Which means they are willing to engage in seagrass restoration activities voluntarily.

Another factor that can support the success of seagrass restoration efforts in Pari Island is the willingness and agreement productive age group to be involved in the restoration efforts. In addition, the attendance frequency from various stakeholders to Pari Island is an opportunity to collaborate in guiding the community in independent restoration efforts. However, the success of the restoration efforts in Pari Island is strongly influenced by the development planning of Pari Island, especially as a tourist destination. Therefore, strong support from policymakers and local government regulation in managing seagrass ecosystems is indispensable because the seagrass ecosystem on Pari Island provides significant benefits for the local community.

Our study concludes that the people of Pari Island are very familiar with the location of seagrass and have used the ecosystem in their daily lives. They also know about the functions and benefits of seagrass and realize that if the ecosystem is damaged, it will impact their lives. Regarding restoration efforts, the communities welcome this and are willing to be involved voluntarily. Besides the points above, seagrass restoration in Pari Island seems to be done since the acceptance and willingness of the productive age population are relatively high to the activities.

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References
[1] Nordlund, L M, Jackson E L, Nakaoka M, Samper-Villarreal J, Beca-Carretero P and Creed J C 2018 Seagrass ecosystem services – What’s next? Marine Pollution Bulletin 134 145-151.
[2] Unsworth R K F, Hinder S L, Bodger O G and Cullen-Unsworth L C 2014 Food supply depends on seagrass meadows in the coral triangle. Environ. Res. Lett. 9: 094005.

Table 1. Strengths, weaknesses, opportunities, and threats of seagrass restoration in Pari Island.

| Strength | Weakness |
|----------|----------|
| a. Community knowledge about the functions and benefits of seagrass relatively high | a. Lack of attention from local government to seagrass ecosystems |
| b. Community knowledge about the location of seagrass in Pari Island relatively high | b. No local regulation for seagrass protection |
| c. Community acceptance of seagrass restoration relatively high | |
| d. The willingness of the community to be involved in restoration activities independently | |
| e. The age of the population is in the productive age | |

| Opportunities | Threats |
|---------------|---------|
| a. The existence of LIPI as a research institution | a. Resort development |
| b. IPB often conducts field studies on Pari Island | b. A huge number of tourists on the weekend |
| c. NGOs are working on Pari Island | c. Taking biota for tourism purposes |
[3] Sjafrie, N D M, Rahmadi P, Kurniawan F, Triyono and Supriyadi I H 2021 Socio-Ecological System perspective of seagrass ecosystem in Wakatobi IOP Conf. Series: Earth and Environmental Science 744.

[4] De la Torre-Castro M. and Ronnback P 2004 Link between human-seagrasses – an example from Tropical East Africa Ocean and Coastal Management 47 361–38.

[5] Tuya F, Haroun R, Espino F 2014 Economic assessment of ecosystem services: Monetary value of seagrass meadows for coastal fisheries Ocean and Coastal Management 96: 181-187.

[6] Kurniawan F, Adrianto L, Arkham M N, Rustam A, Rahayu Y P, Adi N S and Damar A 2020 An ecosystem services perspective of the economic value of seagrass production supported by seagrass ecosystems: An exercise in Derawan Island, Indonesia IOP Conf. Series: Earth and Environmental Science 414.

[7] Manca E, Caceres I, Alsina J M, Stratigaki V, Towned I and Amos C L 2012 Wave energy and wave induced flow reduction by full-scale model Posidonia oceanica seagrass Continental Shelf Research 50-51 100-116.

[8] Jhon B M, Shirilal K G and Rao S 2015 Effect of Artificial Sea Grass on Wave Attenuation- An Experimental Investigation Aquatic Procedia 4 221–226.

[9] Lamb J B, van de Water J A J M, Bourne D G, Altier C, Hein M Y, Fiorenza E A, Abu N, Jompaj and Harvell D 2017 Seagrass ecosystems reduce exposure to bacterial pathogens of humans, fishes, and invertebrates Science 355 731–733.

[10] Wahyudi A J, Rahmawati S, Irawan A, Hadiyanto, Prayudha B, Hafizt M, Afdal, Adi N S, Rustam A, Hernawan U E, Rahayu Y P, Iswari M Y, Supriyadi I H, Soliuhdin T, Ati R N A, Kepel T L, Kusumaningtyas M A, Daulat A, Salim H L, Sudirman N, Suryono D D and Kiswara W 2020 Assessing carbon stock and sequestration of the tropical seagrass meadows in Indonesia Ocean Science Journal 55 85-97.

[11] Quiros T E A L, Croll D, Tershy B, Fortes M D and Rajmondi P 2017 Land use is a better predictor of tropical seagrass condition than marine protection Biological Conservation 209 454-463.

[12] Sjafrie N D M, Hernawan U E, Prayudha B, Supriyadi I H, Iswari M Y, Rahmat, Anggraini K, Rahmawati S dan Suyarso 2018 Status Padang Lamun Indonesia 2018 Ver.02. Jakarta: Puslit Oseanografi - LIPI 40 pp.

[13] Wawo M, Adrianto L, Bengen D G, and Wardiiano Y 2014 Valuation of Seagrass Ecosystem Services in Kotanai Bay Marine Nature Tourism Park, Western Seram, Indonesia. Asian Journal of Scientific Research 7 591-600.

[14] Campagne C S, Salles J M, Boisserey P, Deter J 2015 The seagrass Posidonia oceanica: Ecosystem services identification and economic evaluation of goods and benefits, Marine Pollution Bulletin 97 391-400.

[15] Lessy M R and Ramili Y 2018 Restorasi lamun; studi transplantasi lamun Enhalus acaroides di perairan pantai Kastela, Kota Ternate Jurnal Ilmu Kelautan Kepulauan 1 40 – 47.

[16] Riniatish I dan Endrawati H 2015 Pertumbuhan lamun hasil transplantasi jenis Cymodocea rotundata di padang lamun Teluk Awur Jepara Buletin Oseanografi Marina 2 34 – 40.

[17] Darmawan I W E 2020 Kondisi Komunitas Mangrove terkini pada gugusan Pulau Pari, Kepulauan Seribu. In Gugusan Pulau Pari Kepulauan Seribu: Tijuan Aspek Bio-Ekologi, Sosial-Ekonomi-Budaya dan Pengelolaan Keberlanjutan (S Wouthuysen and M Abrar eds.) Jakarta: LIPI Press: 11-24.

[18] Abrar M, Siringoringo R M, Sutiadi R dan Dzumalex A R 2020 Kondisi Terumbu Karang Gugusan Pulau Pari, Kepulauan Seribu. In Gugusan Pulau Pari Kepulauan Seribu: Tijuan Aspek Bio-Ekologi, Sosial-Ekonomi-Budaya dan Pengelolaan Keberlanjutan (Jakarta:LIPI) Press pp 37-52.

[19] Rahmawati S, Hernawan U E dan Hafiz M 2020 Kondisi Padang Lamun di Pulau Pari Kepulauan Seribu: Telah Tiga Dekade. In Gugusan Pulau Pari Kepulauan Seribu: Tijuan Aspek Bio-Ekologi, Sosial-Ekonomi-Budaya dan Pengelolaan Keberlanjutan (Jakarta:LIPI Press) pp 25-36
[20] Rosmawati A dan Triyono 2020 Pemanfaatan Sumber Daya Alam dan Persepsi Penduduk Pulau Pari Atas Kondisinya. In Gugusan Pulau Pari Kepulauan Seribu: Tijauan Aspek Bio-Ekologi, Sosial-Ekonomi-Budaya dan Pengelola Keberlanjutan (Jakarta: LIPI Press) pp 281-294

[21] Rogers A A, Burton M P, Statton J, Fraser M W, Kendrick G, Sinclair E, Gorman D, Vanderklift M, Verduin J and McLeod I M 2019 Benefits and costs of alternate seagrass restoration approaches. Report to the National Environmental Science Programme, Marine Biodiversity Hub The University of Western Australia. pp 43

[22] Tan Y M, Dalby O, Kendrick G A, Statton J, Sinclair E A, Fraser M W, Macreadie P I, Gillies C L, Coleman R A, Waycott M, van Dijk K, Vergés A, Ross J D, Campbell M L, Matheson F E, Jackson E L, Irving A D, Govers L L, Connolly R M, McLeod I M, Rasheed M A, Kirkman H, Flindt M R, Lange T, Miller A D and Sherman C D H 2020 Seagrass restoration is possible: insights and lessons from Australia and New Zealand Frontiers in Marine Science 7 617.

[23] Shofa M I 2014 Pemetaan Padang Lamun dengan Citra ALOS dan Citra ASTER di Pulau Pari, Kabupaten Administratif Kepulauan Seribu. Undergraduate thesis. Institut Pertanian Bogor.

[24] Gomez R G and Baldago R M 2016 People’s resource utilization of mangroves and their awareness to its environmental importance EDKKUJ 39 35–45.

[25] Nainggolan R, Purwoko A dan Yuliarso M Z 2012. Faktor–faktor yang mempengaruhi produktivitas tenaga kerja pemanen sawit pada PT. Bio Nusantara Teknologi, Bengkulu Jurnal Agrisep 11 35–42.

[26] Unsworth R K F, McKenzie L J, Collier C J, Cullen-Unsworth L C, Duarte C M, Eklo¨f J S, Jarvis J C, Jones B L, Nordlund L M 2019. Global challenges for seagrass conservation. Ambio 48 801–815

[27] Bayraktarov E, Saunders M I, Abdullah S, Mills M, Beher J, Possingham H P, Mumby P J and Lovelock C E 2016 The cost and feasibility of marine coastal restoration Ecological Applications 26 1055–1074.

[28] Sinclair E A, Sherman C D H, Statton J, Copeland C, Matthews A, Waycott M, van Dijk K, Verges A, Kajlich L, McLeod I M and Kendrick G A 2021 Advances in approaches to seagrass restoration in Australia Ecological Management & Restoration 22 11-21.