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**The role of women in the utilization of *Enhalus acoroides*: livelihoods, food security, impacts and implications for coastal area management**

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## The role of women in the utilization of *Enhalus acoroides*: livelihoods, food security, impacts and implications for coastal area management

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**Abstract.** Coastal and island communities depend heavily on marine resources for their food and income. During the west monsoon (September to February), fishermen rarely go to sea, and their activities are limited to the small-scale fisheries, including gleaning the *Enhalus acoroides* fruits. Participants in this small-scale fishery sector are mainly women; with little or no skill required, these gleaners are often overlooked by the district level fisheries-related census. This case study focused on the role of coastal women with different levels of knowledge and utilization of *E. acoroides* in three cities/districts of South Sulawesi. This study aimed to determine the contribution of *E. acoroides* fruit collection to coastal community livelihoods and food security, to identify the impacts, and to seek alternative solutions for seagrass management. Qualitative methods were used to gather information on *E. acoroides* fruit collection, fishery knowledge, livelihood contributions, perceptions of seagrass condition, and alternative management solutions. Around 90% of *E. acoroides* fruit collectors were women aged between 30 to 80 years old. Women contribute greatly to livelihoods and food security in coastal areas because they play dominant roles in household affairs and the sale of fishery products. Unfortunately, the methods currently used for collecting *E. acoroides* fruit can be destructive and may have contributed to the decline in seagrass cover. However, prohibiting the collection of *E. acoroides* would not be an appropriate solution. A win-win solution is needed to empower women while simultaneously managing seagrass ecosystems sustainably.

### 1. Introduction

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In Indonesia, coastal communities still depend on coastal and marine resources to meet their livelihood needs; indeed, almost 100% of coastal households use sea products as the main source of protein [1]. In pursuit of faster and larger harvests, some use environmentally unfriendly methods [2]. When seafaring is restricted due to bad weather, coastal communities tend to switch to mainly land-based activities, with a clearly visible division of labor. Men spend more time repairing boats and fishing gear, tending plantations, and making coconut shell charcoal for sale. Meanwhile, wives and daughters glean along the shore at low tide, looking for edible commodities, including the seeds of the tropical



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seagrass *Enhalus acoroides* [3]. Mostly, these seagrass seeds are processed for household consumption, but any excess is sold in the market [4].

The contribution of coastal women's subsistence activities to household welfare and food security is too important to be ignored, as coastal women have long been involved in fisheries [5,6]. Around 19% of the primary fisheries sector workforce directly involved in fishing activities is female [7], while in the secondary fisheries sector (small scale fisheries) almost half of the workforce are women [8]. However, roles within fishing activities are often strongly gender-differentiated [9]. One form of small-scale fisheries is subsistence fishing activities in coastal areas, for example, the gleaning of shellfish and seagrass fruits [10–15]; these activities, which are generally carried out by women [5,13], are classified as unskilled or requiring a low skill level [5].

Despite the importance of their roles in the small-scale fisheries sector, the participation of coastal women is still often underestimated. Women who work in this sector are generally identified by the government as fishermen's wives or formally categorized as housewives or domestic workers [16]. This means they are not counted by the national government in the district level fisheries-related occupational census [11].

Coastal and island communities in South Sulawesi Province follow this paradigm of communities being highly dependent on marine and coastal resources as a source of income and food. These communities also still uphold traditional patriarchal systems that empower men to express their opinions while women are supposed to follow their lead. This situation causes women to be neglected in the coastal resource management policy process and development strategy and makes it difficult to assess their role in coastal resource management interventions.

In addition, the lack of information on women's participation in fisheries can deepen their marginalization in fisheries management in general [17]. This means that the recognition of the presence of women in the small-scale fisheries sector, specifically in the gleaning of *Enhalus acoroides* fruit, is a significant step towards the involvement of women in coastal resources management and policymaking. This study aimed to determine the contribution of the women who glean *E. acoroides* fruit to coastal community livelihoods and food security, as well as to identify the impacts of this gleaning and alternative solutions for seagrass ecosystem management.

## 2. Methodology

### 2.1. Study sites

This research was conducted in three districts/cities in South Sulawesi Province, Indonesia, with different regional characteristics. These were: Makassar City, representing the characteristics of small islands close to big cities (Barrang Lompo Island, Kodingareng Lompo Island, and Bonetambu Island); Bulukumba Regency, with characteristics typical of mainland/coastal areas (Tanaberu Beach, Tana Lemo Beach, and Panrangluhu Beach); and Selayar Islands District, representative of larger islands with limited accessibility from other districts (Parak Village, Mekar Indah Village, and Binanga Sombayya Village) (Figure 1).

In addition, the study sites were also selected based on geographical distribution, the presence of female gleaners, the number of seagrass fruit collectors, the intensity of extraction, and interest in participating in the study. Seaweed harvesting is generally carried out by women walking on seagrass beds at low tide. The presence of female gleaners depends on local traditions and the biophysical conditions of each location. About ten regular seagrass fruit collecting households were selected as respondents in each study location. Some of the gleaners only collected the seagrass fruit for household consumption, while others also sold a proportion of the fruits collected. Seagrass fruit is only harvested during the peak fruiting season (September–November), which coincides with the rainy season when fishermen rarely go to sea due to bad weather.

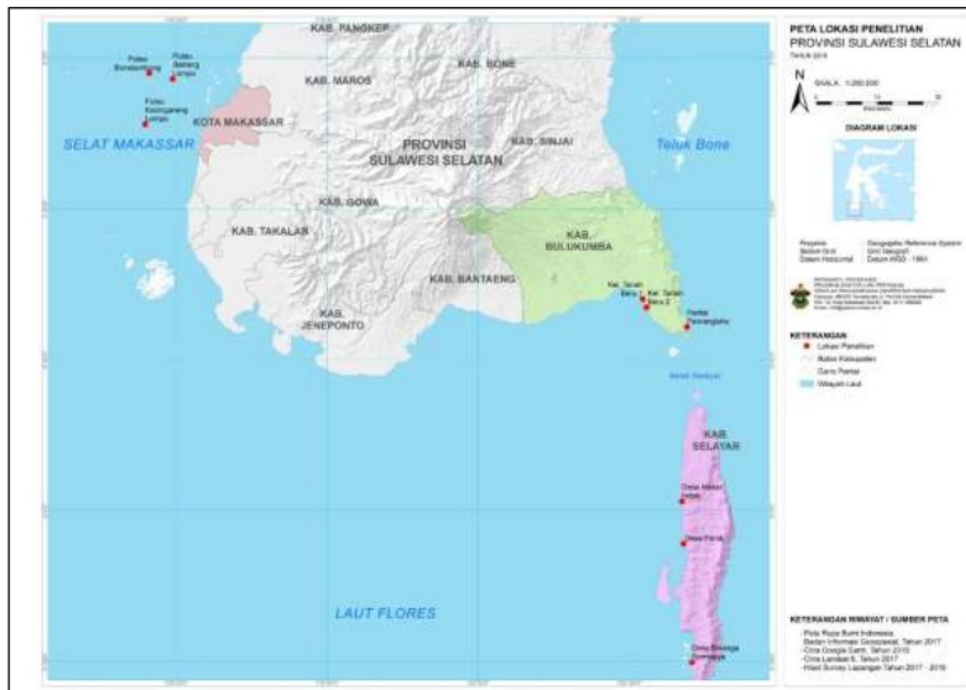


Figure 1. Map showing the study sites in South Sulawesi Province, Indonesia.

## 2.2. Approach and methods <sup>2</sup>

The initial phase identified potential study sites, determined interest in participation, and gathered information as a basis for compiling questionnaires. The next phase comprised visits to the local markets closest to each of the selected sites, interviews with each village head, and interviews with female gleaners at each of the nine selected sites. Additional activities included holding focus group discussions (FGD), respondent observation, and the compilation of seagrass fruit collection timesheets.

Data were collected from March to November 2017 on the role of coastal women in the management and practice of seagrass fruit collection. The study used qualitative methods to gather information on *E. acoroides* fruit collection, local knowledge about fisheries, livelihood contributions, perceptions of seagrass conditions, and alternative management solutions.

Snowball sampling was used to identify female gleaners as potential respondents. In the six sites in Bulukumba and Selayar District, 19 female gleaners were identified who had more than 10 years of experience. However, at the Makassar City sites, there were no female gleaners because seagrass fruits are not collected at these sites. The women in these fishing communities do, however, assist their husbands in processing and selling the fish they catch. They were unaware of the benefits of seagrass fruits and did not know how to process them as a food source.

Interviews were conducted using a semi-structured questionnaire designed to elucidate the insights of female gleaners. The questionnaire focused on the practices used in collecting and selling seagrass fruits, changes in seagrass condition over time, and household livelihoods. The questionnaire also included questions relating to the impact of seagrass fruit harvesting on seagrass beds, the importance of seagrass fruits for consumption and household income, and the participation of female gleaners in the management of seagrass ecosystems.

The FGD meetings held at each site were attended by female gleaners and discussed issues related to seagrass ecosystem management. Seagrass fruit collection timesheets were distributed to each female gleaner, to be filled in on a daily basis. Respondent observations involved visits to the homes of female gleaners and local markets, as well as participation in gleaning in order to better understand the techniques employed as well as cultural aspects of seagrass collection that would be difficult to explain verbally during interviews. This participatory aspect of participant observation was very important for documenting the various seagrass fruit harvesting techniques used by each female gleaner.

### 3. Result and discussion

#### 3.1. Profile of the female gleaners

The gleaners were generally women between 30 and 50 years of age, although in Selayar, some gleaners were up to 75 years old. The gleaners were sometimes assisted by children if the gleaning was done in the afternoon after the children had returned from school. Gleaners were not all from the coast, and some also came from communities living in the mountains. Although the main aim of seagrass fruit collection was to contribute to household subsistence (food and income), the activity was also considered enjoyable (recreational) by many. For many coastal communities, gleaning is a hereditary activity passed down from their elders. They had been taught about marine weather conditions, marine species and habitats, and knowledge regarding the behavior of plants and animals found on the beach and in the intertidal areas. Intergenerational knowledge transfer regarding gleaning was both verbal and practical (learning by doing). While gleaning, parents show children how to collect seagrass fruit and other edible resources.

The coastal communities of Bulukumba and Selayar Districts differed from those in Makassar City. The coastal communities of Bulukumba and Selayar, especially women and people over the age of 50, are heavily dependent on marine resources because of low levels of education and skills and the limited opportunities for employment. Gleaning, for example, the collection of *E. acoroides* fruit, is an easy alternative for them because it does not require any special tools or skills. In contrast, the coastal communities of Makassar City, especially those living on islands close to Makassar City, are much less dependent on marine resources. They have access to various alternative employment options on the Sulawesi mainland and often have opportunities to receive training to improve their skills. In addition, Makassar coastal communities can access a wide variety of foods sold in Makassar City, including vegetables and protein sources such as eggs and meat.

#### 3.2. *Enhalus acoroides* fruit collection practices

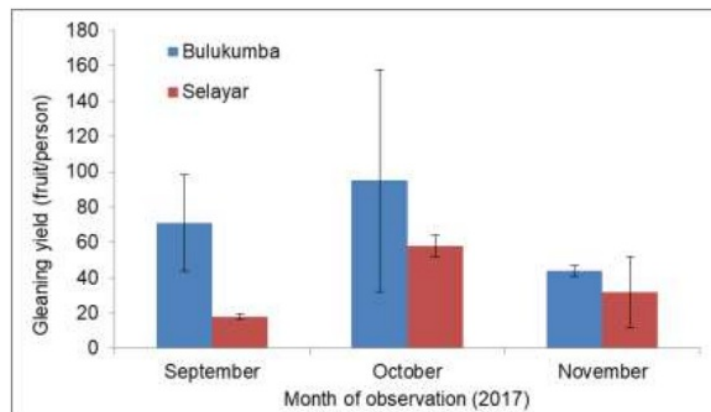
Seagrass fruit was separated from the seagrass stems without using tools, and the only equipment generally used was a bucket to contain the collected fruit. The fruits were collected while still young or immature (one month old). Seaweed fruits were mostly collected in the mornings when the tide was low for 3 or 4 hours (6 to 10 a.m.). However, if the tides were low, then the fruits were also sometimes collected in the afternoon (3 to 6 p.m.). The collection period only lasted for 5-7 days per week and two weeks per month during the peak *E. acoroides* fruiting season (September-November). The average gleaned area was around 2-10 hectares/person/trip.

The *E. acoroides* fruit collecting activities were spatially limited. The fruit is only collected in shallow waters with *E. acoroides* dominated seagrass beds, where the leaves float on the surface of the water when the tide recedes. However, one area of concern with respect to the fruit collection technique is that this gleaning activity involves walking (trampling) on the seagrass, causing the breakage of seagrass leaves and stems and sometimes even the uprooting of seagrass plants. Seagrasses are very susceptible to damage from trampling [15,18] and require a long time to recover [19,20]. Female gleaners tend to have considerable direct contact with seagrasses because seagrass fruit collection generally involves walking in large groups. Studies conducted by E2rich and Holmquist (2002) show that seagrass degradation can be reduced if trampling activity is limited and restricted to smaller areas with hard substrate [19].

### 3.3. *Enhalus acoroides* gleaning yields

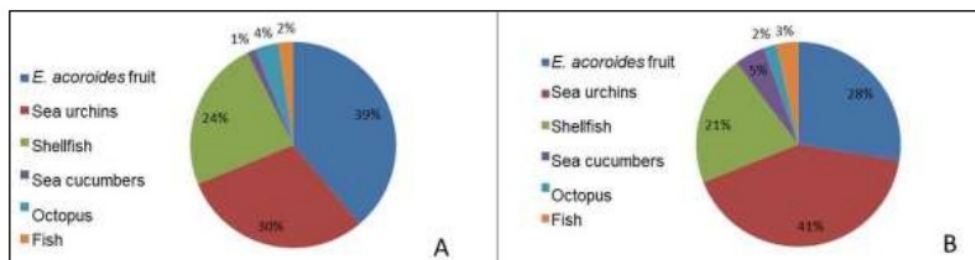
The number of *E. acoroides* fruit collected each month in Bulukumba District was greater than that collected in Selayar District. This was most likely due to the geographical situation of Bulukumba District, which can be accessed from various directions and is a marine tourism location. In Selayar, there were more visiting gleaners than regular gleaners; in addition to subsistence, gleaning was also considered a leisure activity.

In September, the average *E. acoroides* gleaning yield was 71 fruit/person in Bulukumba and 18 fruit/person in Selayar. In October, which is the peak of the fruiting season, the average *E. acoroides* yield was 95 fruit/person in Bulukumba and 58 fruit/person in Selayar. In November, the average *E. acoroides* yield began to decrease and was 44 fruit/person in Bulukumba and 32 fruit/person in Selayar (Figure 2).



**Figure 2.** Yield from gleaning *E. acoroides* fruit in Bulukumba and Selayar Islands Districts.

The proportion of the various gleaning commodities collected differed between Bulukumba and Selayar Districts. In Bulukumba, *E. acoroides* fruit (39%) were the top gleaning commodity, while in Selayar *E. acoroides* accounted for 28% of gleaning yield, less than sea urchins (41%). The Selayar community collected *E. acoroides* as a vegetable substitute, whereas sea urchins and shellfish were considered as a source of income as well as being complementary foods often eaten together with seagrass fruit (Figure 3).



**Figure 3.** Proportions of gleaned commodities in (A) Bulukumba District (n = 6) and (B) Selayar Islands District (n = 13).

The high *E. acoroides* fruit collection rate in Bulukumba District (Figures 2 & 3) was due to the longer amount of time spent gleaning and the higher selling price. In Bulukumba, the *E. acoroides* fruit collection period lasted 10-14 days per month, while in Selayar only lasted 6-10 days each month. In Bulukumba District, the fruit was sold for IDR 5,000 per 20 seeds, while in Selayar District, they

sold for IDR 5,000 per 30 seeds. Unfortunately, the annual gleaning production and sales figures could not be calculated due to the unavailability of data on gleaning commodities in the relevant government departments.

#### 3.4. Trends in seagrass cover

The interviews revealed that 75% of respondents considered that there had been a decrease in seagrass cover in gleaning locations over the past 20 years. In addition, all (100%) respondents stated that there had been a decrease in the abundance of *E. acoroides* fruit and 80% that *E. acoroides* fruits had become smaller in size. These conditions indicate that gleaning *E. acoroides* fruit can contribute to the decrease in seagrass cover. In addition, it could cause knock-on effects such as a decrease in the number and size of the fruit, which in turn could change the structure of the seagrass habitat. Thus, intervention in the management of seagrass ecosystem and further studies are needed to determine the level and severity of the impact of *E. acoroides* seagrass extraction.

#### 3.5. Food and livelihood contributions

The fruit of *E. acoroides* is generally only used for family meals, helping to maintain food security. Many coastal communities utilize seagrass seeds as food, eaten raw, or boiled [21]. *E. acoroides* fruit can be used as a source of protein as a substitute for fish, even containing high carbohydrates and antioxidants that are very beneficial for health [21]. *E. acoroides* fruit has as high or even higher relative nutrient content as many other vegetables such as lettuce, carrots, and cabbage [4].

The collection of *E. acoroides* fruit as a source of income was limited to a small proportion of the people living in the coastal communities because *E. acoroides* only bears fruit during a limited season, and the fruit cannot be stored for long. There are still a number of other marine resources of economic value that can be collected by gleaning (Figure 3). Although their economic value is relatively small and is not continuous, some respondents still considered the sale of *E. acoroides* fruit as an important source of income.

If the yield of *E. acoroides* fruit exceeds the food requirements of the family, the fruit will be sold unprocessed (raw) or as ready-to-eat vegetables. The fruit is generally sold to neighbors or taken to the local market along with fish caught by the husband. Based on the interviews, around 30 years ago, the *E. acoroides* fruit had no economic value and were collected solely for consumption within the household. At the time of the survey, *E. acoroides* seagrass could be sold raw for IDR 5,000 per 20-30 seeds, while prepared *E. acoroides* fruit was sold at IDR 5,000 per 7-10 seeds, a quantity considered sufficient to feed two people.

Women and men have different patterns of dominance, even though they are both involved in all sectors. The definition of gender established by a given community creates identity and behavior patterns that influence the spatial and temporal use of resources. In the fisheries sector, men tend to have permanent identities as fishermen, while women have a variety of identities that are slowly evolving towards new roles. However, men generally have higher incomes than women, given the greater frequency of fishing activities and the greater spatial range that men can reach to exploit fishery resources [22].

In many coastal community households, the division of roles is based on gender, for example, in terms of household management and marketing [5,23,24]. This division drives women to prioritize work areas close to home. Small-scale fisheries, especially in shallow marine areas, are often the most rational and feasible alternative economic activity available to coastal women [22]. They can fulfill many of their basic household needs from the income generated from small-scale fishery activities, including the income of female gleaners from extracting *E. acoroides* seagrass. However, there is a tendency for their catches to be consumed within the home, while men's catches are more often used to generate income because of their larger catch volume, often comprised of higher-priced commodities in line with market demand. This tendency is one reason why income-generating gleaning by women is not counted as a job. The fact is that, as well as contributing to fisheries production, sometimes to a

sizeable extent [25], women often outperform men in fisheries processing and marketing all around the world [26,27].

For coastal communities, the cessation of seagrass harvesting activities could cause loss of an important source of income and nutrition. In fact, this small scale fishery activity with women playing a central role appeared to make a significant contribution to poverty alleviation and food security. Through these gleaning activities, women have access to and control over some coastal resources. They are also empowered to determine selling prices and expected income levels, and they generally manage household finances even though they do not have specific knowledge and skills in financial management. Income derived from fishery activities, including gleaning, also contributes to the local economy and can be used as capital to increase productive assets [26].

### 3.6. Small-scale fisheries management

The current *E. acoroides* fruit gleaning practices involve gathering all the young fruits found during low tide. This practice does not leave young fruit to develop to maturity, and therefore does not allow for generative reproduction to occur. According to [28], reduced fruiting and seed dispersal can cause a long-term reduction in *E. acoroides* populations, and alter genetic relationships between *E. acoroides* populations and within in each individual group at a given site because of the limited dispersion ability (spread) of *E. acoroides* seeds.

It can be feared that such *E. acoroides* fruit gleaning practices that do not pay attention to sustainability will have direct negative impacts on seagrass ecosystems, in particular, the *E. acoroides* populations. This concern is also based on the responses of respondents, which were very consistent regarding the decrease in the quantity and quality of seagrass fruit and seagrass cover. Therefore, management interventions are needed; these should involve all concerned parties, and be designed and implemented with due regard to other potential impact factors (such as pollution, coastal abrasion, dredging, and shipping lanes).

One ecological intervention that could be implemented would be the closure of *E. acoroides* gleaning sites on a seasonal or rotational basis or the closure of certain areas within each site, which could function as a source of seeds. However, this type of intervention still requires further research on the effect of gleaning on seagrass cover. The research sites are recommended as pilot sites for assessing the feasibility of implementing various seagrass harvest management regulations to help restore seagrass cover. Table 1 shows a list of recommendations for management and research interventions that could be implemented, based on the results of the focus group discussions (FGDs) with female gleaners.

**Table 1.** Recommendations for seagrass ecosystem management at the study sites.

No.	Recommendation
1.	Establishing closed/no-take areas for seagrass fruit collection to maintain seed sources
2.	Establishing limits on the allowed seagrass seed collection volume
3.	Pilot sites to trial management systems. For example, through limiting collection volume or through spatial closures
4.	Innovation through aquaculture or biotechnology to produce high-quality seagrass seed
5.	Seagrass restoration to increase the number of new seagrass plants
6.	Identifying the economic, social, cultural and biological impacts of limiting or placing a moratorium on seagrass fruit collection by women gleaners

One effective approach to social management would be to involve female gleaners in discussions with fishermen regarding the conservation of seagrass ecosystems. This would give legitimacy to women who were previously marginalized so that they would be more receptive to strategies for the management of seagrass harvesting, which had been decided together. According to [27] gender inclusion has a positive effect on promoting marine/coastal sustainability because inclusive

management that integrates gender and the involvement of women can help overcome the degradation of marine and coastal resources.

In addition, coastal and marine management is still very androcentric, often causing a "blind spot", especially in coastal areas such as seagrass beds that are widely accessed by women. This androcentric paradigm needs to evolve towards inclusive management, with the participation of representatives from all relevant actors, taking into account their experience, knowledge, and interests [22,25]. Although women often tend to think more about future generations and care more about conservation [22], involving coastal women as one of the actors will, in many cases, certainly require capacity building such as training and the provision of specific skills, e.g., with regards to fisheries information and management systems.

In a governance approach, ideally, the government should establish a formal organization that can be used as a platform to collect gender-disaggregated data/statistics on the number of gleaners, their gender, the species harvested, and the economic structure of these fisheries. These data are very important for analyzing the contribution of women to the fisheries sector, especially in terms of the household and subsistence economy, to increase the visibility of their contribution to policymakers [29]. Strict management policies and regulations also need to be implemented to support sustainable fisheries resource management, including the development of alternative income strategies to reduce the pressures and dependence on coastal ecosystems.

Given the complexity of interactions between humans and nature in the management of seagrass ecosystems, the inherent problems are very path-dependent. The resolution of the problem will depend very much on how the parties apply lessons learned from past management failures [30].

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