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Coastal Resource Management: Fishermen's Perceptions of Seaweed Farming in Indonesia

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***Abstract*—**Seaweed farming is emerging as a viable alternative activity in the Indonesian fisheries sector. This paper aims to investigate people's perceptions of seaweed farming, to analyze its social and economic impacts and to identify the problems and obstacles hindering its continued development. Structured and semi-structured questionnaires were prepared to obtain qualitative data, and interviews were conducted with fishermen who also plant seaweed. The findings showed that fishermen in the Laikang Bay were enthusiastic about cultivating seaweeds and that seaweed plays a major role in supporting the household economy of fishermen. However, current seaweed drying technologies cannot support increased seaweed production on a farm or plot, especially in the rainy season. Additionally, variable monsoon seasons and long marketing channels are still major constraints on the development of the industry. Finally, capture fisheries, the primary economic livelihood of fishermen of older generations, is being slowly replaced by seaweed farming.

***Keywords*—**Coastal management, perception, seaweed development and livelihood diversification

I. Introduction

THE seaweed *Eucheuma cottonii* was introduced originating from the Philippines in 1974 and cultivated in Indonesia to supply raw materials for the rapidly growing carrageenan market [17]. The production of various seaweed products in the world is valued at $5.5 to 6 billion, of which $5 billion is used for human food products [14]. Seaweed products such as dried seaweed and semi-refined carrageenan from Indonesia, the Philippines and Malaysia have been exported mainly to the United States [20]. Since the 1980s, the development of seaweed farming in Indonesia has helped to change the mindset of coastal communities from the unsustainable exploitation of natural resource uses to productive seaweed mariculture that is both friendly to the environment and economically empowerment. Since 2005, Indonesia has become the largest producer of *Eucheuma* and *Gracilaria* species, with South Sulawesi as the largest producer at 690,385 tons/yr [15], [17]. The utilization of foreshore land for seaweed cultivation in Indonesia is still below its full potential, which currently is estimated to be around is 1,110,900 ha. Only 20% of that area or 222,180 ha, has been utilized so far. Most importantly, this activity aims to increase the income of many fishermen [16]. Moreover, seaweed farming in most developing countries is frequently suggested to not only improve economic conditions but also reduce fishing pressure [6].The development of seaweed farming in many developing countries such as Indonesia has led to radical changes in the socio-economic structure, particularly in the livelihood economic activities of traditionally improvised coastal communities. The change in the main livelihood activity in Laikang Bay from capture fisheries to seaweed farming is proof that seaweed cultivation has been able to improve the basic household economy in coastal communities. This transition is expected to have long-term ecological implications for the sustainability of the coastal environment and for behavioral changes among coastal inhabitants particularly those dependent on capture fishery for a long time. Seaweed cultivation can also be used to complement or even support the income of fishermen during times of low fish catch.Against the current situation, this study aims to determine people's perceptions of the development of seaweed farming in South Sulawesi, to analyze the social and economic impacts arising from the development of seaweed cultivation and to identify the problems faced by fishermen who participate in seaweed cultivation.

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II. Methodology

A. Study area

This study was conducted in South Sulawesi Province in the eastern part of Indonesia. Two districts, Takalar and Jeneponto, were intentionally selected for sampling. This study covers four villages, one village in Takalar District and three villages in Jeneponto District. These villages are representative of coastal communities on the Laikang Bay with active fishermen. Laikang Bay connects these two districts, which therefore influence one another (Figure 1).

Fig. 1Map of Laikang Bay South Sulawesi Province

Takalar District is located at the south side of South Sulawesi Province. This district has a land area of 566.51 km^2 and is located between S 5^{o}3' and S 5^{o}38' and from E 119^{o}22' up to E 119^{o}39'. It is bounded by Gowa District on the north, Gowa District and Jeneponto District on the east, Flores Sea on the south and Makassar Strait on the west [13]. It is about 42 km

from Makassar City, the capitol city of South Sulawesi Province. Interviews and data collection were conducted in Laikang Village, in Managarabombang Sub-district in Takalar District, 16 km from the central district and 63 km from Makassar City. Laikang Village is one of the 12 villages of Mangarabombang Sub-District in Takalar District. It has an area of 19.6 km^2, equaling about 19.57% of Mangarabombang Sub-District (±100.14 km^2). Administratively, Laikang Village consists of six sub-villages: Laikang, Puntondo, Boddia, Turikale, Pandala, and Ongkoa.

Jeneponto District is located in the western part of South Sulawesi Province, and it is also a coastal area that stretches for about 95 km in the southern part, covering an area of 74,979 hectares or 749.79 km^2. South Sulawesi is located between S $5^0$16'13" and S $5^0$39'35" and between E $12^0$40'19" and E $12^0$7'51". It is bounded by Gowa District on the north, the Flores Sea on the south, Takalar District on the west and Bantaeng on the east. Jeneponto District consists of 9 districts and 105 villages, and the population in Jeneponto District in 2004 was 324,927, consisting of 158,043 men and 166,884 women. There were 18,943 fishermen, fish farmers and seaweed farmers.

B. Data collection and Samples

Data collection was conducted in August and September 2010 from a total sample of 200 farmers who cultivated seaweeds. Samples were obtained from four villages with 100 samples from Laikang Village, 40 samples from Garassikang Village, as many as 40 from LP Bahari Village and 20 from Ujunga. The samples were selected randomly. Interviews were conducted by using structured and semi-structured questionnaires, and in-depth, face-to-face interviews were carried out to obtain more detailed information from seaweed farmers and middlemen. Group discussions were also conducted to explore the perceptions of fishermen of the development of seaweed farming, particularly in Laikang Bay.

C. Analysis

The data collected was analyzed using simple statistical methods of descriptive statistics to derive percentage, arithmetic mean, number and standard deviation. A significance level of $p>0.05$ was set for the statistical analysis in this study. A Likert-type scale was used when the respondents were asked to point out their perceptions.

III. Results and Discussion

A. Demographic Characteristics of Seaweed Farmers

All seaweed farmers involved in this study were male (100%) with an average age of 37.04 years. Their level of formal education was low, averaging only 2.42 years. This is typical of coastal communities which frequently have inhabitants with low education level. In this study, 22.5% of seaweed farmers had never received a formal education. The seaweed farmers in Laikang Bay are of the Makassar ethnic group.

In Laikang Bay, fishermen rely on a variety of livelihood activities, including capture fisheries, seaweed farming, seaweed cultivation combined with fishing, seaweed farming in combination with public services and a combination of seaweed farming with a non-fishing activity. Le Tixerant et al.[12] stated that 'human activity in maritime areas depends on the socioeconomic context in which the activity evolved'. Some seaweed farmers (46%) conducted seaweed farming as a single activity. Meanwhile, other farmers (37%) combined seaweed farming and fishing, which is possible because the farming method does not require much time after planting. The farmers checked the farm 3-4 times a week after fishing was finished. This agrees with the observation of Carneiro [3] who stated that 'livelihood interventions are a supplementary form of income that enhances a household's economic resilience'.

However, most fishermen still earn minimal incomes from their activities. Most fishermen (57.5%) earned incomes below 500,000 Indonesian rupiah (IDR) per month, whereas others (41.5%) had incomes between 501,000 and 1,000,000 IDR per month. These figures represent the total income derived from all livelihood activities of these fishermen. Seaweed farmers in Laikang Bay in both Takalar and Jeneponto Districts have 1.32 seaweed plots on average, where the size of one plot is equal to 100 m x 30 m. Most of the farmers (68.5%) have less than two plots. However, farm ownership is highly variable among farmers, depending on the economic means of the individual farmer.

B. Fishermen's Perceptions of Seaweed Farming Development

The eastern parts of Indonesia like Bali, Nusa Tenggara, Maluku and Papua, with their extensive coral reefs and clean water, are promising areas for developing the cultivation of seaweed, abalone, fish, coral and pearl oysters[19]. As such, it is important to ascertain the fishermen's perceptions in order to prevent any unwanted changes in these conditions. Cinner et al. [4] stated that 'people who live in coastal communities have multiple levels of knowledge about the marine activities that evolved there'. Rochet et al. [22] emphasized that 'fishermen's perceptions have great potential to serve as early warning signals of recent changes in the environment'. In this study, the perceptions of fishermen and seaweed farmers of seaweed farming development in Laikang Bay are divided into four categories: 1) perception of farming activity, 2) perception of environmental management, 3) perception of harvesting and 4) marketing activity (Table 1).

1. Farming Activity

Indonesian mariculture involves the cultivation of seaweed, grouper, lobster and abalone. *Eucheuma*, as one of the most established species of seaweed, is recognized as a strategic commodity [24]. Seaweed farming in South Sulawesi is spread throughout the west coast (Makassar Strait) and the east coast (Gulf of Bone). Low income and production levels and traditional technology are characteristic of these farmers.

Essentially, seaweed farming in Laikang is distributed into two places in the Laikang Bay side (60%) to the west and the Flores Sea side (40%) to the south. Seaweed cultivation has become a major source of income for fishing communities along the coast of Laikang Bay, improving the household economy of fishermen for at least the last 10 years and which may have contributed towards a stable and sustainable way of life. Gaillard et al. [7] state that the concept of sustainability implies that basic needs are met on a quotidian basis. On the other hand,

production scarcity influences the way in which people adopt alternative opportunities [21]. In this study, the processes of planting, maintaining and harvesting were conducted mainly by the husbands or heads of household, who was sometimes assisted by the children. Meanwhile, the wife and daughters provided support in the process of seeding. The labor contributions of women and family were found to be key factors in the success of seaweed farming [5].

The entire process of seeding and planting including maintenance is done by the fishermen (76%) for 45 days. Most of the fishermen (71%) employ extra labor in the planting process obviously the most laborious portion of seaweed farming. After the planting is finished, the next step is maintenance. In this study, fishermen (91%) checked their farm plots 2-4 times per week (Table 1). Many times, seaweed lines are detached by strong waves and currents, or floating debris get entangled in the lines causing significant crop losses.

One of the reasons fishermen choose seaweed farming as an alternative livelihood is its introduction by the government through livelihood and income augmentation projects that aim to improve the general economies of coastal communities. Secondly, according to the respondents, seaweed farming involves relatively low operational costs. Thirdly, seaweed farming requires only easy maintenance that will allow some time to engage in other income generating activity, and finally, farmers can realize more profit from farming than from fishing. Almost all the seaweed farmers interviewed (97.5%) agreed that seaweed farming provided more economic benefits than catching fish alone, and 77.5% of farmers believed that seaweed farming is on an increasing trend in their communities. However, 71.5% of the farmers still use old seaweed seed stock, which is becoming an undesirably inferior strain. Because of this, 77% of farmers expressed their desire to construct a breeding hatchery for creating new and improved seaweed strain without realizing the technological complexities that go into seed stock selection. Clearly, government intervention is needed here to accomplish this goal.

There are several methods of seaweed farming as explained by Salayao et al. [23]. Various submerged and floating methods are already in use in countries like the Philippines and Indonesia. The method used by seaweed farmers in Laikang Bay is the long line floating system. This method is used for several reasons, including suitability to dynamic water conditions, easily maintenance and monitoring, low investment and operational cost requirements, durability and repeated use of infrastructure. The number of lines in this method varies depending on the availability of seeds and farmland, spacing between each line, spacing between seedling attachment points and the economic status of the farmer.

Differences in environmental conditions between these two districts affect the productivity of seaweed farming. During December to April, Takalar side has high production of seaweed because water condition was low wave and low salinity and remain months has low production. Meanwhile, Jeneponto has high production from May to November because water wave was low and low salinity in this area. Such condition has been used by some fishermen to find a good area condition (Takalar – Jeneponto sides) in order to get maximum production of seaweed following those period in each area.

2. Environmental Management

For seaweed farming as well as other food production systems, carrying capacity is an important factor for maintaining the sustainability of the activity. According to MMAF [16], there are some techniques to optimize the carrying capacity of seaweed farm. Among these techniques are setting enough buffer space between farms, reducing the number of farms in dense cultivation areas, and using the right cultivation method that is suitable to the environmental conditions of a given area. Risk factors such as security, conflicts of interest, accessibility and environmental concerns also deserve serious attention. Ariza [1] emphasized that 'planning for an integrated management approach is an influential factor and attractive for coastal areas'.

According to the respondents (81.5%), environmental conditions in Laikang Bay still need to be further developed for optimizing seaweed culture. The fishermen/farmers (82.5%) reported that the current farming areas are already crowded, and most of them (89%) stated that they need to reconfigure their seaweed plots and to identify farm ownership in a more judicious way. Some plots had been abandoned for a long time, and meanwhile there are farmers who want to use these plots (Table I).

The environmental conditions of Laikang Bay are always changing because of the seasons. Unfortunately, public awareness of the importance of environmental quality is still low among the respondents. Table 1 shows that while environmental awareness is low, there is a growing but vague awareness of the link between environment and seaweed growth. One condition is their continued argument that seaweed farms in the area are too dense and the situation requires a reordering of seaweed farms in Laikang Bay. There are inconsistencies in fishermen's answers when addressing environmental conditions and capabilities. Farmers' outlooks are often short-term. As long as the seas are capable of producing seaweed, farmers will continue to add plots as dictated by their economic capabilities. Fishermen who have identified or planted in ideal of fertile areas usually do not want to move to other less fertile areas, even if their farms have been left idle for a long time adding to the already worsening crowded farm problem.

Idle seaweed farms are also expected to add to the problems in the environment over several years. Their negative effects can be seen when equipment like rope and anchors become dirty and disorganized. Many cases like these are observed if the owner gives up seaweed farming and goes into town to look for other jobs, or if the owner no longer have enough capital to continue cultivating seaweed. However, there are also other fishermen who want to use their capital to start planting seaweed but do not have available planting area. From the above, it is clear that a more defined system of marine farm tenure is needed to avoid conflicts as well as to maximize productivity.

3. Harvesting Activity

Seaweed age and weather conditions are two major considerations for timing seaweed harvest. Seaweed age is "key" because it is associated with the quality of the product,

TABLE I
FISHERMEN'S PERCEPTIONS OF SEAWEED FARMING DEVELOPMENT

Factor/Statement	Perceptions (N=200)			Mean	S.D
	Agree	Disagree	Neutral		
Seaweed Farming Activities					
Benefits of seaweed farming are better than those of capture fisheries	195 (97.5)	2 (1)	3 (1.5)	1.04	0.26
The number of seaweed farms has increased	155 (77.5)	23 (11.5)	22 (11)	1.34	0.667
The seaweed farmer uses the old type of seed	143 (71.5)	53 (26.5)	4 (2)	1.3	0.503
The seaweed seed could be obtained from another farmer easily	191 (95.5)	7 (3.5)	2 (1)	1.06	0.269
Breeding plots are needed to produce new generations of seaweed	154 (77)	35 (17.5)	11 (5.5)	1.28	0.562
Checking The farm every day	32 (16)	162 (81)	6 (3)	1.87	0.417
Checking time to the farm is checked 2-4 times per week	182 (91)	8 (4)	10 (5)	1.14	0.471
The harvesting time is 45 days of growth	152 (76)	20 (10)	28 (14)	1.38	0.72
Laborers are involved in farming activities	142 (71)	39 (19.5)	19 (9.5)	1.38	0.655
Environmental Management					
Conflict has occurred in farm management	45 (22.5)	140 (70)	15 (7.5)	1.85	0.528
Environment of the coastal area is still suitable for seaweed farming	163 (81.5)	15 (7.5)	22 (11)	1.3	0.656
The coastal area for seaweed farming is already populated	165 (82.5)	30 (15)	5 (2.5)	1.2	0.459
Farm areas need to be rearranged	178 (89)	19 (9.5)	3 (1.5)	1.12	0.374
Marine pollution has increased due to seaweed farming	85 (42.5)	113 (56.5)	2 (1)	1.58	0.514
Harvesting					
Seaweed is dried by using a rack	124 (62)	68 (34)	8 (4)	1.42	0.57
Some seaweed was used to produce value-added products	50 (25)	138 (69)	12 (6)	1.81	0.525
The value-added technology is needed	167 (83.5)	26 (13)	7 (3.5)	1.2	0.481
Seaweed farmers take significant losses during rainy seasons	191 (95)	8 (4)	1 (0.5)	1.05	0.24
Marketing					
The dried seaweed is kept at home before being sold	163 (81.5)	33 (16.5)	4 (2)	1.2	0.452
The price of dried seaweed conforms with the expectations of farmers	139 (69.5)	56 (28.5)	5 (2.5)	1.33	0.522
The marketing system for dried seaweed is still useful	130 (65)	57 (28.5)	13 (6.5)	1.42	0.612
The price of dried seaweed is always fluctuating	138 (69)	25 (12.5)	37 (18.5)	1.5	0.789

Source: Primary data processed 2010

TABLE II
OBSTACLES TO DEVELOP SEAWEED FARMING IN LAIKANG BAY

Factor/Statement	Rating scales (N=200)					Mean	S.D
	1	2	3	4	5		
Changes in the two monsoon seasons	0 (0.0)	0 (0.0)	5 (2.5)	8 (3.9)	187 (91.7)	4.91	0.364
Seed availability at the farm level	0 (0.0)	0 (0.0)	179 (87.7)	11 (5.4)	10 (4.9)	3.16	0.482
The quality of seaweed seeds	0 (0.0)	0 (0.0)	166 (81.4)	7 (3.4)	27 (13.2)	3.3	0.696
Occupation of seaweed farms by farmers	0 (0.0)	0 (0.0)	112 (54.9)	77 (37.7)	11 (5.4)	3.5	0.601
Development of coastal areas	145 (71.1)	33 (16.2)	18 (8.8)	4 (2.0)	0 (0.0)	1.4	0.737
Predators and/or diseases	16 (7.8)	22 (10.8)	141 (69.1)	21 (10.3)	0 (0.0)	2.84	0.714
Financial capital	0 (0.0)	2 (1.0)	59 (28.9)	133 (65.2)	6 (2.9)	3.72	0.534
Farming method	172 (84.3)	15 (7.4)	13 (6.4)	0 (0.0)	0 (0.0)	1.2	0.543
Post-harvest processing	4 (2.0)	25 (12.3)	141 (69.1)	30 (14.7)	0 (0.0)	2.98	0.597
The price of dried seaweed	9 (4.4)	122 (59.8)	52 (25.5)	17 (8.3)	0 (0.0)	2.38	0.707
Marketing channel for dried seaweed	0 (0.0)	0 (0.0)	17 (8.3)	123 (60.3)	60 (29.4)	4.22	0.584

1: No obstacle 2 : Slight obstacle 3 : Moderate obstacle 4 : Significant obstacle 5 : Extreme obstacle
Source : Primary data processed, 2010

including its *carrageenan* content. Big waves and continuous heavy rainfall also need to be considered in the harvesting decision. Strong wave can cause seaweed lines to break a way, or even whole plots to be carried away incurring significant losses. On the other hand, dilution of the seawater with rainwater can affect seaweed growth and quality especially in areas near river mouths where freshwater influence is more pronounced. Under these situations, fishermen/farmers will harvest the seaweed even if the seaweed has not reached harvestable size and age.It was found that, seaweed was harvested following several steps. The process started by removing each line of seaweed and bringing it to the beach. Then, the seaweed was cut free from the main rope. The next process involved drying the seaweed under sunshine. In one farming operation, people using bamboo racks for drying the wet seaweed. The seaweed does not dry well during the rainy

season, and requiring more time to dry, thereby affecting the quality of the dried seaweed and its water content ranges from 30-35% [15]. At this level, the content of carrageenan could be expected to decrease. Therefore, the respondent declared that they have suffered many losses during the rainy season.

At research sites, seaweed is not yet used to produce value added goods. Local and central governments have launched projects such as small-scale natural resources management (SNRM), economics of coastal community empowerment project (PEMP), IFC's (International Finance Cooperation)-PENSA (Program for Eastern Indonesia Small-Medium Enterprise Assistance) and even a coral reef rehabilitation and management program (COREMAP) that included some training for the processing of seaweed products by fishermen's wives and young women, although these effort did not develop fully. In this study, 25% of the farmers stated that they incorporated some seaweed into traditional products such as toffee (lunkhead), candy and jelly. The seaweed production is increasing every year, and some fishermen/ farmers (1.2) wanted the appropriate technology to process the dried seaweed into value added goods.

However, the dried seaweed produced by most farmers do not meet the standards. Lack of quality control mechanisms is one of the problems causing the poor product quality. Moreover, farming areas that are scattered in many different areas had different harvesting times, and lack of cooperation among the districts is still a major obstacle towards developing seaweed farming. At this time, traders and middlemen buy all types of seaweed products, and do not pay much attention to product quality. They buy seaweed generally based on price and according to quality.

4. Marketing Activity

The market chain of dried seaweed, which extends from producers to consumers, is still a long one. These systems provide employment opportunities at very step for the communities and facilitate marketing for producers, but the producers mostly receive low prices. Market channels at the local level start with seaweed farmers and then go on to include traders, wholesalers, warehouse/exporters and the factory and processing industries.

Dried raw-material seaweed and hydrocolloids such as agar, alginate and carrageenan are widely traded in the international market [20]. Seaweed farmers in Laikang Bay mostly sell in the form of dried seaweed. They store their dried seaweed before selling to middlemen after two to three harvests. The farmers do not directly sell the seaweed after each harvest, which allows them to wait for favorable pricing to some degree [18]. The price of seaweed shows some fluctuations within one year depending on different market price [9]. The price decreases 10% during the peak season, increases 20% in the low season and is usually stable during the medium season. These prices serve as the high and low boundaries for the asking and bidding prices of middlemen when capacity cost is sufficiently high [11].

However, seaweed farmers (1.33) think that the market prices have been in accordance with their wishes and are acceptable to them. At the farm level, traders have a strong influence on price. Market participants such as seaweed farmers, traders/middlemen, wholesalers and processing companies/warehouses have close relationships. These ties are due to the presence of debt, kinship and friendship relations between the parties. However, Perez-Sanches and Muir [21] argued that 'although organization has an important effect on the local market, middlemen frequently tend to monopolize the market' and exert a dominant force.

C. Some Constraints on Seaweed Farming

Areas of seaweed growth that stretch across the Indonesian maritime region provide not only opportunities for the development of seaweed cultivation but also the great challenge of developing sustainable seaweed cultivation. Gelcich et al. [8] stated that this could be achieved if the local community became involved in the management process. The absence of spatial planning is the main problem in the development of seaweed culture. Currently, the factors influencing the development of seaweed cultivation include the technical aspects of aquaculture such as the aquatic environment and seeds, in addition to social, economic, marketing, managerial, and human resource capabilities.

Findings have shown that the changing monsoon season is the biggest problem in the development of seaweed cultivation (4.91). Badjeck et al. [2] predicted that 'climate change will bring new challenges to fisheries in the coming decades', and the local communities should promptly adapt to this situation. The long market chain (4.22) is still a major problem in the seaweed business in Laikang Bay. Financial capital is another problem that is felt most often by seaweed farmers (3.72), especially at the start of the planting season. In addition, the availability of seaweed seedlings (3.16), the quality of the seed (3.3), the land tenure of seaweed (3.5), diseases that attack the plant (2.84), harvesting and post-harvest processing (2.98) are considered moderate cultivation problems. The seaweed farmers expressed some dissatisfaction with the fluctuating prices of dried seaweed (2.37), but this is manageable if there is no immediate solution (Table 2). Instead, the IFC's study stated that the important problems in seaweed farming are more on limited access to credit sources and the small number of buyers. Farming methods were not found to present a problem in seaweed cultivation [10]. Presently, farmers are still propagating seaweed using cuttings, setting aside the cultivated thallus, but the few seaweed nursery centers in Indonesia have created difficulty for farmers trying to optimize crop yields.

Furthermore, all stakeholders in seaweed farming anticipate a rise in farm ownership issues. In the field, the head of the village has the authority to determine the location of seaweed farms. This judgment is based on several factors, including the economic means of the farmers, the current seaweed farm distribution and the experiences with and observations of the coastal environment, including its currents, tides and depth. The

economic means of fishermen is considered because there are differences in production costs between locations in the shallows and those in the deeper areas. According to the respondents, areas located in deeper water entail greater production costs, though these areas have a richer environment compared with shallower locations. Considering these factors helps to ensure equitable farm distribution and to maintain a balance while accommodating the interests of the fishermen who conduct fishing and other activities in Laikang Bay.

In many cases, seaweed does not meet the quality standards specified by the processing industry in the country because there is a lack of control of the product that has resulted from farmers not paying attention to the quality of the product. On the other hand, buyers sometimes only pay attention to standards in terms of quantity and not quality. Profit taking on the part of seaweed farmers has contributed to the lack of attention to the quality of the product, a situation caused by a larger demand for seaweed than supply. Finally, seaweed of any quality would be accepted and bought by the middlemen further contributing to the overall low quality of products.

The price of dried seaweed is rising compared to prices 5-10 years ago. Nonetheless, farmers feel that low price is a significant problem in the business despite its fluctuations. In combination with the farmers' opinions that the marketing channel of dried seaweed in South Sulawesi is too long, this outlook is assumed that the long market chain influences prices at the farm level and that farmers will earn more benefits if the market chain of dried seaweed can be shorter. However, a comprehensive effort is necessary for the creation of simple market channels that are free from conflict and fosters an effective alternative marketing process.

IV. Conclusion

Fishermen in Laikang Bay practice standard methods of cultivating *Eucheuma cottonii*, utilizing the floating long line method commonly used in other seaweed-producing countries like the Philippines and in Africa. Fishermen can adapt to changes during the monsoon season and then plant seaweed during the year as an alternative activity. Fishing has been replaced by seaweed farming as the main income source, a trend that can be seen in the increasing number of seaweed farms along the coastlines of Laikang Bay. Awareness among fishermen of environmental productivity is still low. Rich farm locations tend to be under more pressure because of the increase in new plots and farms that are built in these locations. New drying technologies are needed during the rainy season, when there is an abundance of seaweed production. Nonetheless, seaweed farmers can still accept the low prices and long marketing chain of dried seaweed despite these problematic factors.Furthermore, there are constraints in the farming and marketing processes, including the shifting time of the monsoon season, the availability of financial capital, and access to marketing channels. The availability and quality of seaweed seeds, issues surrounding farm ownership, predators, diseases and limitations in post-harvest methods are also obstacles. However, farmers can generally overcome these obstacles. On the other hand, fishermen are unrestricted in terms of the development of coastal areas under the approval of village leaders, the availability of successful farming methods and the price of dried seaweed. To explore solutions to these problems, there should be a more open interaction involving not only farmers, fishermen, local leaders, local government and traders, but also representatives of other sectors.

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