Competency and Performance of Seaweed Farmers in Bantaeng Regency, South Sulawesi

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ABSTRACT

Indonesia's marine area is around 70%, so seaweed is extensively cultivated in Indonesian waters. Although seaweed cultivation is thought to be simple, farmers confront numerous challenges. Poor farmer competence leads to low production quality, low product selling price, no negotiating position, inability to maintain production capacity, and lack of competitiveness. The purpose of this study was to assess seaweed farmers' production performance and competency. This study was undertaken in Bantaeng Regency, one of South Sulawesi Province's seaweed production centers. The Slovin algorithm was used to determine the number of respondents, which was 125 farmers. The method was Simple Random sampling. Descriptive analysis was used to describe seaweed farmers' performance and competence, whereas Kendall W Correlation analysis was used to determine the relationship between farmer attributes and seaweed farming competence. The results revealed an average dried seaweed yield of 3,390 kg per hectare. Seaweed farmers have a high level of technical competence in operating their farms, with a total score of 13,262, however managerial competence is poor, with a total score of 5,334. The association between farmer characteristics and agricultural competence demonstrates that age has a very strong relationship, as do education, farming experience, family dependents, and land area. To increase seaweed production and income, the government must develop an integrated extension program that improves farmers' technical and managerial skills.

INTRODUCTION

Indonesia is rich in natural resources, with oceans covering over 70% of its territory. Seaweed cultivation is one of the most common activities in coastal areas with abundant biological resources and a favorable atmosphere. This business not only generates foreign cash for the country but also offers income to coastal populations. Furthermore, seaweed is a marine commodity in high demand in the international market due to its numerous applications in daily life, including foodstuffs, pharmaceuticals, and industrial raw materials (Raj *et al*. 2018). Seaweed is a very promising commodity to develop because the cultivation technique is easy and low-cost, with minimal crop failure. This commodity is highly productive and can be harvested four times each year. One of the primary elements encouraging the development of this farming is the relatively high price of seaweed. Furthermore, the cultivation has the potential to absorb a large amount of work and have a substantial economic impact on the community (Hidayat and Safitri 2019; Maradhy *et al*. 2021; Novianty *et al*. 2022).

South Sulawesi is one of the provinces with the highest seaweed output in Eastern Indonesia. This item is grown in nearly every district in the region, with Bantaeng Regency producing the most. South Sulawesi's fishery exports are dominated by dried seaweed, accounting for 81.5%, with the remaining 6.7% coming from processed items such as carrageenan (Marine Service 2021). In Bantaeng Regency, many fishermen have shifted to seaweed farming as their primary source of income. This is because seaweed cultivation does not require any specific expertise and has a very quick planting season. Despite their perceived ease, farmers frequently encounter a variety of hurdles. Farmers' inadequate competence leads to inferior production quality, low product selling price, a weak bargaining position, trouble maintaining output levels, and a lack of competitiveness.

Individuals possess a fundamental attribute known as competence. These qualities are indicative of a deep and reasonably stable personality, and they can be used to predict a person's conduct in a variety of employment scenarios and tasks (Bahua 2018; Dewijanti *et al*. 2023). Competent seaweed farmers have a thorough understanding of growing techniques, agricultural technology, and business management. A competent farmer not only understands cultivation methods and agricultural technology, but can also function as a skillful manager, seek out new business prospects, manage capital and labor, communicate effectively, and promote his produce. Furthermore,

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skilled farmers can boost productivity, income, and family welfare (Fitrianti *et al*. 2023).

Seaweed producers must master two types of farming competencies: technical and managerial. Technical competence refers to the capacity to manage cultivation techniques and agricultural technology, whereas managerial competence encompasses skills in business management, finance, marketing, and strategic decision-making. (Wahyuni *et al*. 2023; Wandal *et al*. 2023). Technical competence refers to farmers' capacity to manage technical aspects of seaweed farming, such as land preparation, seed selection, planting process, pest and disease control, harvesting activities, and post-harvest handling. Meanwhile, managerial competence refers to the knowledge gained from mastering these procedures, such as the capacity to design a firm, raise finance, product marketing, and diversify the business.

There is an urgent need for research into the competency and performance of farmers producing seaweed in Indonesia. The findings are likely to be used in decision-making and policy formulation to maximize the potential of seaweed cultivation. This attempts to boost farmers' incomes and improve their welfare.

METHODS

This study was undertaken in Bantaeng Regency, one of South Sulawesi Province's seaweed production centers. Primary data was collected from seaweed farmers using questionnaires and interviews, which covered factors of production performance, technical competence, and managerial competence. The Slovin method was used to calculate the number of respondents from a total population of 182 farmers in Lamalaka Village, Bantaeng District, yielding a sample of 125 farmers (68%). The sampling strategy was basic random sampling, with the assumption that all seaweed producers had similar features.

Descriptive analysis was used to describe farmer attributes, seaweed productivity, and farmer proficiency in seaweed cultivation. Indicators of farmers' technical ability include land preparation, seed selection, planting, pest and disease control, harvesting, and post-harvest handling. Meanwhile, farmers' managerial competency was tested using variables such as business planning, capital search, product marketing, and business diversification. Competency was assessed using a Likert scale with four levels: extremely proficient (score 4), mastered (score 3), undermastered (score 2), and not mastered (score 1). The calculating steps using the Likert scale were carried out in the following manner:(Santika *et al*. 2023).

In this study, the minimum score was one, and there were 31 questions on technical competence and 18 on managerial competence, with 125 seaweed farmers

participating. To determine the minimal score, the following calculation was performed: The minimum overall technical skill is equal to $1 \times 31 \times 125$, or 3,875. The minimum total managerial competency is $1 \times 18 \times 125$, which equals 2,250.

Calculate the maximum total of technical competence and managerial competence. In this investigation, the maximum score is 4. To acquire the highest score, the following calculation was performed: The highest overall technical competence was calculated as $4 \times 31 \times 125$, which equals 15,500. The highest total managerial competence was $4 \times 18 \times 125$, or 9,000.

Specifying a range. The range was determined as follows: Range was calculated by subtracting the total max from the total minimum and dividing by the number of categories. The range of technical competence was calculated as $(15,500 − 3,875)/4 = 2,907$. The range of managerial competencies comes from $(9,000 − 2,250)/4 = 1,688$.

To interpret the technical competency score, the Likert score index interval is constructed as follows: 3,875–6,782 (very low); 6,783–9,689 (low); 9,690–12,596 (medium); and 12,597–15,500 (high). The managerial competency score can be interpreted as 2,250–3,938 (very low), 3,939–5,629 (low), 5,627–7,314 (medium), and 7,315–9,000 (high).

Kendall's W Correlation Analysis was used to identify the relationship between independent variables (farmer characteristics) and dependent variables (farmer competence in seaweed cultivation). Kendall W correlation is a non-parametric statistical method used to test the relationship between more than two variables. This method does not require assumptions about the normal distribution of data and is ordinal, which means that the data used in this analysis have a certain order or ranking (Sugiono 2011).

RESULTS AND DISCUSSION

Socio-Economic Characteristics of Seaweed Farmers

Farmers' attributes describe their situations, circumstances, and socioeconomic standing. This study relies on data from a survey of seaweed producers in Bantaeng Regency, South Sulawesi Province. The variables include age, education level, number of family dependents, farming experience, and land area handled. Table 1 displays the socioeconomic characteristics of seaweed producers, which serve as the foundation for subsequent analysis. Many respondents (49.6%) were between the ages of 39 and 55, with a median of 45 yrs. This age group is still considered productive for seaweed production. Age is a factor that influences a person's physical abilities, both in thinking and at labor, which can affect performance and success in agriculture (Mulyasa

Table 1 Socio-economic characteristics of seaweed farmers based on age, education, family dependents, farming experience
and planting area (N = 125)

Variable	Group	Percentage (%)	Average
Age (yr)	22–38	38.4	45
	39–55	49.6	
	56–72	12.0	
Education	No schooling	25.6	Elementary
	Elementary	42.4	
	Junior High	18.4	
	Senior High	13.6	
Number of family dependent (person)	1–3	49.6	3
	4–6	32.8	
	> 6	17.6	
Farming experience (yr)	1–7	31.2	9
	8–14	51.2	
Land area (m²)	15–19	17.6	
	1,000–2,066	27.2	2,237
	2,067–3,133	56.8	
	3,134–4,200	16.0	

2004). People's cognitive abilities tend to improve as they age. In general, younger, healthier farmers have better physical abilities than older farmers. Young farmers are also more adaptable to change, so they adopt technologies faster. Older farmers, on the other hand, are more cautious when it comes to absorbing new advances because they value caution in decision-making.

Education is one of the determining factors for the quality of human resources, and it has a significant impact on the thinking of company managers. A person's educational level indicates their intellect, which is closely tied to their capacity to think, evaluate, and make better business judgments. Farmers with higher levels of education are more open to new ideas and can employ technology and processes more efficiently in their business. According to Slamet (2003), education is an effort to modify human behavior. Most respondents in this study had a low level of education, with the average having barely completed elementary school. Only 13.6% have completed high school. This situation has the potential to reduce seaweed farming output since farmers with lower levels of education may have limited access to information, technology, and more efficient cultivation techniques.

Experience is one method of acquiring knowledge through practice or direct participation in an activity over a set length of time. This experience can help a person build competence since it allows them to enhance their understanding, improve their abilities, and learn from the challenges and mistakes they encounter. Farmers with experience in seaweed cultivation can improve their technical and managerial skills in running farming companies (Suparno 2000). Experience is a critical aspect that cannot be overlooked in seaweed farming company activities. Some individuals have been active in seaweed cultivation from an early age, either by assisting their parents or neighbors. The average farming experience

of respondents was 9 years, with 51.2% having 8 to 14 yrs of experience. Farmers manage a limited land area, with an average land size of 2,237 m², or 0.22 hectare.

Seaweed Production

Seaweed output is the amount of dried seaweed produced by farmers in a single production period (in kg). The amount of production is usually determined by the number and length of the farmer's stretch of seaweed. In general, seaweed can be grown with five harvest seasons each year, with the best harvest time being between 40 and 45 days after planting. This harvest period was determined by the seaweed's growing conditions and the size at which it is suitable for harvest.

Farmers produce an average of 3,390 kg dried seaweed per hectare. This figure was higher than those obtained in prior studies, which could imply an increase in farming practices or other productivity-boosting variables. This rise in productivity could be attributed to improved farmer expertise, more efficient use of technology, or favorable environmental circumstances (Fatonny et al. 2023). In Takalar Regency, South Sulawesi, the dried seaweed production per cycle per ha was 1,141.6 kg. The output of this seaweed varied according to the treatment used, such as varied seedling weights and planting distances. Variations in these treatments can have an impact on production yields because these elements are critical to maximizing seaweed development (Fanni et al. 2021). According to Arizal and Bakhtiar (2023), the primary factor contributing to farmers' maximum production is their high competence or technical capacity in operating their farming companies. Good technical skills include efficient cultivation techniques, seed selection, good land management, and effective pest and disease control. Farmers who excel in these areas are better equipped to maximize production and obtain higher yields than farmers who are less skilled at managing their farms.

Seaweed cultivation in Bantaeng Regency is typically done using the basic free-to-fly method, which involves cultivating seaweed near the water's surface with a rope extended from one place to another. These ropes form loose or strung walkways, while buoys and anchors assist hold the plants in place. Farmers cultivate the seaweed *Eucheuma cottonii*. The yield of wet to dry seaweed conversion varies per farmer, with an average yield of roughly 10:1. This means that 10 kg of wet seaweed will produce 1 kg of dried seaweed, for a yield of 10%.

Competence of Seaweed Farmers

A farmer's competence in farming is a type of behavior that comprises the capacity to organize and execute a series of tasks to accomplish the intended result. In the context of seaweed farming, farmer competency is classified into two types: technical competence and managerial competence. Technical competency comprises the ability to manage technical aspects of cultivation such as seed selection, land management, and pest control. Meanwhile, managerial competences include the ability to design a business, manage capital, product marketing, and manage people and financial resources to improve farming firms' efficiency and profitability.

Technical Competencies

Technical competence refers to farmers' capacity to master the technical components of seaweed farming. These activities include land preparation, seed selection, planting, pest and disease control, harvesting, and post-harvest handling. In general, competence can be defined as an individual's characteristics or capacity to perform certain tasks in a work environment that is handled responsibly. Technical skills are required in seaweed farming to ensure that the production process operates smoothly and generates high-quality products (Batoa *et al.* 2008). Table 2 shows the technical capability of Bantaeng Regency's seaweed producers. The farmers had a total technical competency score of 13,262, indicating that they have a high level of technical ability to manage seaweed farming activities. Overall, seaweed growers in this region excel at technical expertise, beginning with land preparation. They can choose a spot that is safe from large waves, has good water movement, is easily accessible, and has clean,

pollution-free water. Farmers also recognized the need to assess the salt level of saltwater.

Farmers were also experts in seed selection, which includes distinguishing between young and old stems, selecting fresh seedlings, and separating seedlings that are diseased or polluted with manure. Farmers often employed the basic loose method for planting, which is to stretch the rope containing the seedlings and tie it to the main rope. In comparison to other seaweed growing methods, they excel at the basic free-to-base method.

Farmers are already familiar with the types of fish that are seaweed pests, can recognize seaweed that are attacked by pests, and are aware of the meteorological conditions that frequently trigger disease outbreaks. To combat pests, farmers adapt or adjust cultivation techniques so that plants remain in an optimal position on the water's surface.

Seaweed was harvested 40-45 days after planting. Harvesting in less than 45 days has the potential to reduce the quality of the carrageenan yield. The harvesting process involves lifting the stretch ropes one by one and storing them aboard the boat. The seaweed was then sundried for 2−3 days, depending on the intensity of the available sunshine. Proper drying procedures are required to create high-quality dried seaweed. Orilda *et al.*'s (2022) investigation found that oven drying at 70 °C reduces moisture content quickly, with a seaweed moisture content of 10.69%. According to Rauf *et al.* (2023), low water content can impede microbial development, extending shelf life.

Managerial Competence

Managerial competence refers to the information gained by seaweed farmers through technical competence in seaweed farming. Managerial competencies include the capacity to plan, raise capital, product marketing, and managing business branch combinations. Table 3 shows the level of managerial competency among seaweed growers in Bantaeng Regency. The managerial competency of seaweed farmers was rated low, with a total score of 5,334. Competence in farming business planning, which covers business development, expenditure, profit and loss forecasts, and output increases, remains in the medium competence range. Furthermore, competency in marketing seaweed products is limited, particularly in identifying market trends.

Table 2 Technical competence of seaweed farmers in Bantaeng Regency, South Sulawesi Province

Indicator	Total score	Category
Land preparation	2.352	High
Seed selection	2.062	High
Planting	2.374	Medium
Pest and disease control	2.146	High
Harvesting	1.827	High
Post-harvesting	2.501	High
Total	13.262	High

Farmers' ability to seek business finance is also relatively low, since they have not learned the procedures for borrowing capital and distinguishing between personal capital and loans. Farmers have restricted access to cash sources, which impacts their ability to carry out farming activities. Similarly, farmers continue to lack expertise in selecting the appropriate business branch to complement their seaweed cultivation operation.

Relationship between Characteristics and Farmer Competence

To investigate the association between farmer characteristics and competence in managing seaweed farming activities, the first stage was to gather and sort farmer competency score data. This information was then linked to farmer attributes such as age, education, farming experience, family dependents, and land acreage.

After sorting and compiling the farmer competency data, the next step was to conduct statistical analysis, specifically the Kendall W technique, to determine the link or correlation between these characteristic factors and farmer competence. The findings of this study can demonstrate the extent to which characteristics such as age, education, and farming experience influence farmers' level of competence in seaweed farming (Table 4). According to the study's findings, seaweed farmers in Bantaeng Regency prioritize six areas of competence while managing their farms. These include post-harvest handling, land preparation, planting, pest and disease management, seed selection, and harvesting. These sections demonstrate technical competencies directly relevant to the cultivation and production of seaweed. The other four lower-level categories were formulating plans, getting business finance, merging business branches, and product marketing. This demonstrates that, while farmers have strong technical skills in managing production issues, they nevertheless confront managerial challenges such as business planning, marketing, and capital allocation.

Overall, Bantaeng Regency's seaweed farmers were quite competent, with an average weighted score of 1,859 calculated from 10 areas of competence. However, there was still room for improving managerial skills so that seaweed farming can grow more sustainably and efficiently. Table 5 provides more information on the association between farmer characteristics and ability in managing seaweed farming. There is a strong correlation between age characteristics and seaweed producers' competency. This is reflected in the Kendall W Coefficient of 0.868, which is within the coefficient range of 0.800−1.00, indicating a very strong link. This suggests that the farmer's age has a considerable impact on their competency in managing seaweed farming. Meanwhile, education, farming experience, family dependents, and land acreage all have a significant impact on seaweed growers' competency. Although this association is not as strong as lifespan, the coefficient obtained indicated that these characteristics continue to influence farmers' level of competence in conducting seaweed farming business. These findings highlight the importance of enhancing understanding and skills through education and experience, as well as better resource management, in increasing the competence of seaweed farmers in Bantaeng Regency (Sidu *et al.* 2021), The study's findings revealed a favorable correlation between a farmer's age and his level of competence in seaweed production. This indicates that the more productive a farmer is in his old age, the greater his ability to manage the seaweed growing business. On the other side, the less productive a farmer becomes in his old age, the lower his degree of competence, both technically and managerially. This shows that expertise gained over

Table 3 Managerial competence of seaweed farmers in Bantaeng Regency, South Sulawesi Province

Indicator	Total score	Category
Planning	1.689	Medium
Looking for business capital	1.394	Low
Product marketing	1.087	Medium
Combining business branch	1.164	Low
Total	5.334	Low

Table 4 Seaweed farming competence in Bantaeng Regency, South Sulawesi Province

Areas of competence	Score	Level
Post-harvest handling	2.501	1
Land preparation	2.352	2
Planting	2.374	3
Pest and disease control	2.146	4
Seed selection	2.062	5
Harvesting	1.827	6
Planning	1.689	7
Looking for business capital	1.394	8
Combining business branch	1.164	9
Product marketing	1.087	10

Table 5 The relationship between farmer attributes and seaweed farming competence in Bantaeng Regency, South Sulawesi Province

Attribute	Kendall W coefficient	Category
Age	0.868	Very strong
Education	0.751	Strong
Farming Experience	0.708	Strong
Family Dependents	0.714	Strong
Land area	0.735	Strong

time is helpful in enhancing farmers' capacity to run farming business, yet older farmers may have a weaker ability to adapt and absorb new ideas than younger farmers.

The study's findings suggest that education has a Kendall W Coefficient of 0.751, indicating that education has a high association with the competence of seaweed farmers, since it falls within the range of 0.600 to 0.799. Farmer education, which is still inadequate, requires support from non-formal education to help farmers develop their technical and administrative skills. Non-formal education, such as training, counseling, and seaweed cultivation courses, can offer farmers with greater practical knowledge and abilities, allowing them to run their farms more efficiently. It can also assist farmers in adopting new advances in seaweed growing, which can increase their productivity and welfare. According to Jones *et al.* (2023), education is crucial in enhancing farmer motivation and performance in seaweed farming management. A higher level of education can be used to assess the quality of farmers' human resources, as more educated farmers are better able to manage their farms. Formal and non-formal education provide farmers with the necessary resources to acquire information through multiple media, allowing them to more quickly absorb changes or advances in agricultural operations. Furthermore, education can help farmers adapt to new technology and use more effective practices in seaweed growing, resulting in higher yields and better farmer welfare (Batoa *et al.* 2008).

Farming experience has a Kendall W Coefficient of 0.708, indicating that it has a high association with seaweed farmers' competency because it is within the coefficient interval of 0.600 to 0.799. According to Abdullah (2011), farming experience is a key factor in influencing the effectiveness of seaweed growing. Farmers with sufficient experience tend to be more competent, both technically and managerially, than farmers with less experience. Farmers can learn from their failures and triumphs, as well as better understand the environmental conditions and factors influencing seaweed production. Farmers with expertise may also more quickly recognize problems and discover the proper solutions, thereby boosting the efficacy and efficiency of agricultural activities and overall farm management.

The number of family dependents was strongly related to the competency of seaweed producers, with a Kendall W Coefficient of 0.714. This demonstrates that the more dependent a family has, the higher the motivation to improve output and revenue. Family dependents might motivate producers to work harder in seaweed farming. Farmers with several dependents are more focused on improving performance and production because they understand that the outcomes of their efforts will have a direct impact on the well-being of the family members who rely on them. This awareness improves farmers' motivation to improve their technical and management skills in managing seaweed cultivation (Purwanto and Taftazani 2018; Tsarwah and Sibuea 2022).

The land area has a Kendall W Coefficient of 0.735, indicating that it has a high association with the competence of seaweed farmers because it falls within the coefficient interval of 0.600 to 0.799. This is consistent with Mappigau and Halim's (2022) findings, which show that the land acreage has a major effect on farming production.

CONCLUSION

Seaweed farmers in Bantaeng Regency, South Sulawesi Province produce an average of 3,390 kg of dried seaweed per hectare. Seaweed farmers' technical skill in operating their farms was good, with a total score of 13,262, however management competence was low, with a total score of 5,334. The association between farmer attributes and farming competence reveals that age has a very strong relationship, as do education, farming experience, family dependents, and land acreage. The government must develop an integrated extension program to strengthen farmers' technical and managerial competencies, thereby enhancing seaweed growers' productivity and revenue.

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