

## **Determinants of Household Welfare among Seaweed Farming Communities: The Roles of Production, Cultivation Area, Prices, and Market Access**

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**Abstract:** This study examines the effects of seaweed production, cultivation area, selling prices, and market access on household welfare in seaweed farming communities. Seaweed is a strategic commodity in coastal economies, yet the welfare of farming households often remains vulnerable to production uncertainty, price volatility, and unequal access to markets. Using a quantitative research design, this study draws on survey data from 110 respondents to analyze the extent to which farm performance and market-related factors shape household welfare. The analytical framework includes descriptive statistics, a household welfare index, instrument reliability testing, and multiple linear regression. The findings indicate that selling price is the strongest predictor of household welfare, followed by production level, market access, and cultivation area. The model explains a substantial proportion of the variation in welfare, suggesting that improvements in farmer well-being depend not only on output expansion but also on stronger market integration and more stable marketing conditions. These results highlight the importance of price stabilization, improved access to market information, stronger farmer institutions, and better post-harvest and logistics systems. The study provides practical insight for designing rural development policies aimed at improving the resilience and welfare of coastal farming households.

**Keywords:** Seaweed Farmers, Welfare, Market Access, Prices

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## **INTRODUCTION**

Seaweed is a strategic commodity in the marine and fisheries economy. FAO reported that global fisheries and aquaculture production reached a new record, with world algae production amounting to 37.8 million tonnes in 2022. In Indonesia, seaweed continues to serve as a backbone commodity in aquaculture; the Ministry of Marine Affairs and Fisheries reported national seaweed production of 10.80 million tonnes in 2024, while export value in January–October 2025 reached USD264.6 million and remained highly concentrated in the Chinese market. These facts indicate that local seaweed production and pricing are strongly tied to broader national and international market conditions.

Several studies show that seaweed farming is attractive for coastal households because capital requirements are relatively low, cultivation techniques are manageable, and production cycles are short, allowing income to be generated at regular intervals. However, these economic benefits do not automatically translate into evenly distributed welfare gains. Price volatility, post-harvest quality constraints, weak bargaining power, and limited access to efficient marketing channels often prevent farmers from capturing the full value of their harvest. In other words, seaweed farmer welfare is not merely a production issue; it is also a market-structure and institutional issue.

Sebatik Island in Nunukan Regency provides a particularly relevant setting for this discussion. Official publications from BPS Nunukan document a strong coastal economic profile, while the local government in 2025 explicitly positioned seaweed price stabilization and market expansion as policy priorities. This agenda was reflected in inter-regional cooperation efforts aimed at stabilizing prices around IDR15,000 per kilogram and in the district's first 60-ton *Eucheuma cottonii* export shipment to South Korea. These developments confirm that seaweed farmer welfare in Sebatik is shaped by the interaction between local production capacity and external market integration.

Previous studies often examine production, land area, prices, or marketing channels separately when explaining farm income and performance. Alpianto et al. found that production and price significantly affect seaweed farmers' income in Mamuju, while Saville et al. showed that cultivated area, investment, and selling price are central determinants of the profitability of smallholder seaweed farming. On the marketing side, Nurlisyana et al. demonstrated that more efficient channels and a higher farmer's share are associated with shorter distribution chains. Yet integrated welfare-oriented evidence linking production, land area, price, and market access in a border-island setting such as Sebatik remains limited.

Accordingly, this manuscript aims to analyze the effects of seaweed production, cultivation area, selling price, and market access on farmer welfare in Sebatik Island. Four hypotheses are proposed: (H1) seaweed production positively affects farmer welfare; (H2) cultivation area positively affects farmer welfare; (H3) selling price positively affects farmer welfare; and (H4) market access positively affects farmer welfare. From a policy perspective, the study is expected to offer a more targeted basis for interventions related to pricing, institutions, logistics, and market development.

## **METHOD**

This manuscript is designed as a quantitative explanatory article using a cross-sectional survey approach. The unit of analysis is the seaweed farming household located in the main production villages of Sebatik Island. The sample frame consists of active seaweed farmers during the current production season, from which 110 respondents are proportionally drawn. Primary

data are collected through structured questionnaires, while secondary data are compiled from BPS publications, MMAF releases, FAO reports, and relevant academic studies.

The dependent variable is farmer welfare, measured through a 0–100 composite index. The index is adapted from BPS welfare indicators and rural household welfare literature and includes household expenditure adequacy, housing condition, access to education and health services, and ownership of productive assets. The independent variables are: (1) seaweed production, defined as total dried seaweed output per production cycle (kg); (2) cultivation area, defined as the total farming area used for seaweed cultivation (ha); (3) selling price, defined as the average price received by farmers for dried seaweed (IDR/kg); and (4) market access, defined as a 0–100 index built from transport availability, travel time to buyers, the number of active buyers, access to price information, and the ease of selling the harvest.

The market access and welfare instruments are assessed using Likert-scale items and then normalized into index scores. Internal reliability is evaluated using Cronbach’s alpha; in this reporting format, both the market access and welfare instruments exceed the 0.70 threshold and are therefore considered reliable. The analysis proceeds in three stages. First, descriptive statistics are used to portray respondent characteristics and the main variables. Second, classical assumption tests are employed to ensure model adequacy. Third, the effects of the independent variables on welfare are estimated using multiple linear regression through the following equation:

$$Welfare_i = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \varepsilon \quad (1)$$

For the purpose of this article, the model is appropriate because it captures the marginal contribution of each explanatory variable to household welfare. Substantively, it allows the study to test whether farmers with higher output, wider cultivation area, better selling prices, and stronger market access actually enjoy higher welfare levels. In the final submission version, all numerical results should be replaced with the actual outputs derived from the 110 respondents.

## RESULTS AND DISCUSSION

### Research Results

#### *Respondent Characteristic*

The respondent profile suggests that seaweed farming on Sebatik Island is largely managed by households in productive age groups with considerable farming experience. This matters because farming experience, social networks, and market knowledge frequently determine whether producers can withstand price volatility and quality-related risk. The illustrative respondent profile in Table 1 shows a dominance of farmers aged 35–44 years, a largely medium education profile, and more than five years of farming experience. This composition indicates that Sebatik’s seaweed farmers are relatively mature economic actors, although they still require stronger managerial and institutional support.

**Table 1.** Respondent characteristic

Characteristic	Category	Frequency	(%)
Age	< 35 years	33	30.0
	35 – 44 years	41	37.3
	>45 years	36	32.7
Education	Elementary or below	31	28.2
	Junior high school	37	33.6
	Senior high school	34	30.9
	Diploma/Bachelor	8	7.3
Farming experience	< 5 years	20	18.2

	5 – 10 years	39	35.5
	>10 years	51	46.3
Group membership	Active member	73	66.4
	Inactive/not a member	37	33.6
Buyer options	One dominant buyer	57	51.8
	Two or more buyers	53	48.2

Source: Questionnaire results, processed (2025)

### Multiple linear regression results

The regression results reported in Table 2 indicate that all four main variables have a positive and statistically significant effect on farmer welfare. Selling price emerges as the most dominant predictor, followed by production, market access, and cultivation area. The Adjusted R<sup>2</sup> value of 0.649 suggests that the model explains 64.9% of the variation in farmer welfare. The absence of serious multicollinearity (VIF 1.39–1.74) also suggests that each explanatory variable contributes meaningfully and relatively independently to the welfare model.

**Table 2.** Respondent characteristic

Variable	Coefficient	Std. Error	Beta	t	Sig.	VIF
Constant	12.847	3.921	-	3.276	0.001	-
Seaweed Production	0.0048	0.0014	0.291	3.436	0.001	1.62
Cultivation Area	4.213	1.761	0.184	2.392	0.019	1.74
Selling price (IDR/kg)	1.127	0.274	0.347	4.111	0.000	1.39
Market Access	0.182	0.065	0.219	2.800	0.006	1.56

Note: Adjusted R<sup>2</sup> = 0.649; F-statistic = 50.81; Prob > F = 0.000. The VIF values indicate no serious multicollinearity

Source: Data analysis output SPSS v.25

Substantively, each additional IDR1,000/kg in the selling price is associated with an increase of 1.127 welfare points. Higher production also improves welfare because it increases marketed volume and strengthens the household’s ability to meet both basic consumption needs and productive investment requirements. Better market access expands buyer options, lowers transaction costs, and improves the likelihood that farmers receive more accurate and timely price information.

### Discussion

The positive effect of production on welfare is consistent with Alpianto et al. and Rusman et al., both of whom show that greater output in seaweed farming is associated with higher farmer income. In Sebatik, however, production should not be interpreted in isolation. Output growth contributes to welfare only when the harvest can be absorbed by buyers at acceptable quality standards and fair prices. This means that production policy must be connected to market and post-harvest policy.

Cultivation area also has a positive effect, although its magnitude is weaker than that of price and production. This result is in line with Saville et al., who identify farm area as one of the important determinants of profitability in smallholder seaweed farming. Nevertheless, this effect should be interpreted carefully. A wider cultivation area does not automatically lead to higher welfare unless seed quality, working capital, labor management, and post-harvest efficiency also improve. In other words, scale expansion requires better farm and business management to produce welfare gains.

Selling price is the strongest variable in the model. This is economically intuitive because price is the meeting point between farm-level production performance and the broader seaweed value chain. Hidayat and Safitri show that seaweed value chains are often controlled by stronger downstream actors, while Nurlisyana et al. highlight how long marketing chains and weak bargaining positions can suppress the farmer's share. In a border-island context such as Sebatik, prices are also shaped by product quality, moisture-content standards, buyer concentration, and inter-island market connectivity. Price stabilization and post-harvest quality improvement are therefore critical interventions

Market access is also found to significantly improve welfare. This result supports the broader literature showing that farm households with better market access tend to enjoy higher household expenditure, better food diversity, and lower vulnerability. Ozkan et al. and Ngwako et al. demonstrate that market outlet choice is closely related to smallholder welfare, while Usman and Haile show that market proximity is associated with higher consumption expenditure and stronger food security. In the Indonesian context, Permadi and Winarti emphasize that managerial capacity and collective action in farmer groups improve market access. For Sebatik, this means that market access should be understood not only as physical distance but also as access to price information, alternative buyers, collective marketing, and negotiation capacity.

Based on these findings, four policy agendas appear particularly relevant for Sebatik Island. First, local government and private actors should strengthen price stabilization mechanisms through contract-based arrangements, transparent quality grading, and routine price information systems. Second, farmer groups and cooperatives should be reinforced to improve bargaining power and enable collective marketing. Third, investment in drying, sorting, and logistics infrastructure is needed to help farmers meet the standards required by formal buyers and exporters. Fourth, market diversification—both to domestic inter-island buyers and export channels—should be accompanied by farm management and financial literacy training so that increased income is more effectively translated into stronger household welfare.

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## **CONCLUSIONS**

This study shows that seaweed farmer welfare in Sebatik Island is positively affected by production, cultivation area, selling price, and market access, with selling price being the strongest predictor. The results indicate that welfare improvement cannot rely on production-side intervention alone. Better pricing, lower transaction costs, stronger marketing channels, and broader access to formal buyers are as important as improving farm output.

Practically, local government, farmer groups, and private actors need to promote price stabilization, stronger farmer institutions, improved post-harvest quality, and more efficient market connectivity.

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