

Improvement Strategy of Seaweed Farmer Community for Increasing Capabilities in the Dry-seaweed Supply Chain in Takalar District, Indonesia.

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Abstract

The common problems of seaweed farmers are caused by low human capital, farmer's performance and supply chain capabilities, resulting in a low bargaining position in the dry-seaweed farmer's supply chain business. This study aims to identify and formulate strategies to increase farmer capabilities in the supply chain from the perspective of human capital, farmer's performance and supply chain management using a fish-bone and AHP approach. The research was conducted by direct observation and interviews with respondents from stakeholders. The research results show that most influencing factor is the supply chain management (70.5%) with the most influencing sub factor, post-harvest (63.7%). The second order factor is human capital (21,9%) with the dominant sub-factor is skills (44%). The third order factor is farmer's performance (7.46%) with the dominant sub-factor is process innovation (29.8%). The results of the respondents' decisions on alternative solutions to farmers' capabilities in the supply chain are: Improvement Training Program (46.3%), Implementation of Policies and Programs (26.6%), Improving Farmer's Competence and Management (16,6%), and Changing the Farmer's Work-Ethic (10,5%). These results can be used as a reference for government policies in public decision making.

Keywords: Improvement strategy, seaweed farmer, dry-seaweed, supply-chain



INTRODUCTION

Globally, the major use for seaweed has been for human consumption (McHugh 2003; Cottier-Cook et al. 2016) with calls for increasing consumption of seaweed as a sustainable food source (Forster and Radulovch 2015) and for use in developing functional foods (Mendis and Kim 2011)

Indonesia's total seaweed production reaches 11.3 million tons or 38% of the total world production of 29.4 million tons. Of this amount as much as 98.8% is produced from the genera *Saccharina*, *Undaria*, *Porphyra*, *Gracilaria*, *Kappaphycus* and *Sargassum* (FAO-a, 2018). China is the largest producer of seaweed (47% of world production), but Indonesia and the Philippines are the main producers of *Kappaphycus* and *Eucheuma* seaweed for the carrageenan industry. Indonesia is a major exporter of seaweed in the world, but exports are still dominated by raw material products (KKP, 2017).

Takalar Regency, South Sulawesi Province, has a 10 hectare cultivation potential area and 3,773 hectare has producing seaweed. In 2021, it is production reached 195,399.03 tons or around 32% of the total production of seaweed in Takalar Regency and still processed in the dry form. In general, the processing of seaweed just carried out by exporters or industries (KKP, 2021). However, these conditions have not been able to provide maximum added value for farmers due to: 1) the quality of production has not been standardized for industry / export quality, which still requires further processing to enter the market, 2) low bargaining power due to low skill, and limited access for utilizing the equipment (technology), 3) continuity of production does not guarantee supply to industry / exports, and 4) farmers are generally formed in farmer groups base on family relations and have low competitiveness in seaweed production (Busthanil et al., 2019). Solving these problems requires a re-orientation of the farmer's strategy in managing their activities at the upstream level (involving farms) involving stakeholders with their respective roles and interests, which are accommodated in joint decisions with the main goal of solving the problem of the economic weakness of seaweed farmers in Takalar.

The main farmer problems in seaweed farmer in Takalar is the decreasing of capacity of the community in providing seaweed product to the exportir. This is related to the complexity of interrelated problems between supply chains, resources and human capital, and this requires a real insight that is able to solve these problems. Supply chain issues are important as one of the main considerations in determining the success of farmers in the distribution and marketing of



agricultural products. Supply chain is a system of series of activities that includes coordination, scheduling and control consisting of organization, human resources, activities, information and other resources for the procurement, production, supply and delivery of products or services from a supplier to customers. Strong national supply chains are critical cornerstones of well-functioning public welfare systems and a driving force toward the achievement of the Sustainable Development Goals and advancement of the 2030 Global Health Security agenda.

The seaweed supply chain process involves several players, including fishermen, collectors, entrepreneurs and exporters. In the scope of supply chain activities, fishermen are an important factor in providing quality seaweed products and can enter the supply chain according to end consumer standards. Therefore, farmers as human capital, determine the quality and continuity of the supply chain. Farmers' performance is commonly determined by their knowledge, skills and competencies (Baron & Michael, 2013). These factors have a positive effect on the competitive advantage of farmers (Hsu, 2006).

The general description in the field regarding the problem of farmer's competence, it contains of skills, abilities and knowledge element that has been passed down through generations. Therefore, that is required to increasing capabilities of farmer in their performance. In this research, an analysis was carried out on the parameters of the human capital of farmers that affect the improvement performance of the farmer in the seaweed supply chain or distribution to the market or final consumers. The analysis used a fishbone diagram to identify the root causes of problems and the Analytical Hierarchy Process (AHP) to determine the right strategy to improve farmer's performance. This research is expected to provide solutions to farmers' problem solving in the dry-seaweed supply chain.

METHOD

The research was conducted in Laikang, Takalar Regency, South Sulawesi. Field research was started from March 2022 to June 2022. The observed data were in the form of primary and secondary data. Secondary data was obtained from documents, literature, scientific journals, the relevant previous study reports, as well as from various sources from relevant agencies and relevant parties. Primary data was obtained through direct observation and interviews with 5 experts who were considered to know the most about the research area, namely the head of the Maritime Affairs and Fisheries Service, the Head of Port, Extension Officers, Academics, Entrepreneurs. Interviews were also conducted with farmer and related groups and parties. The



sampling method is based on a survey technique approach, in which the collection of information and knowledge from respondents uses a purposive sampling method (directed sampling). The fishbone diagram is used to analyze the root causes of the problem and it is limited to seaweed farmers. Analysis of farmer's performance is limited to productivity, profitability and innovation. Analysis of the seaweed product supply chain is limited to aspects of how to handle it, starting from cultivation, processing and storing. AHP is used to formulate strategies to improve farmer's performance, limited to an analysis of the roles and functions of five institutional sectors, namely the Head of the Takalar's Maritime Affairs and Fisheries Service, the Head of Fishery Ports, Extension Workers, academics, and entrepreneurs.

DISCUSSION

The distribution structure of the supply chain for seaweed products is generally similar to other fishery products. The supply chain concept is a system for distributing production goods and services to customers and is a new concept in looking at logistics issues in a company (Lina, 2008). Linkages within supply chains can be beneficial for small-scale producers, but skilled management is needed for organizations to successfully achieve the intended economies of scale and increased bargaining power (Engle et al. 2016).

The flow of the seaweed supply chain distribution channel has three flow structure patterns that have been applied so far in Laikang (Figure 1).

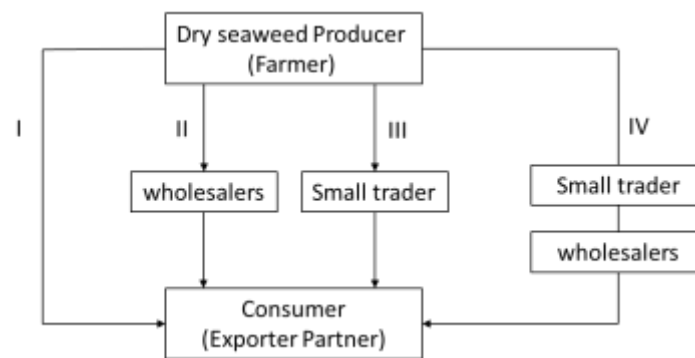


Figure.1 Supply chain of seaweed production in Takalar

Based on the results of the questionnaire on 20 farmer groups, the distribution of seaweed production as the supply chain model in Figure 1 is divided in to: (I) farmers-consumers (10%), (II) farmers-wholesalers-consumers (35%), (III) farmers -small traders-consumers (15%) and (IV) farmer-small scale traders-wholesalers-consumers (40%). It shows that the wholesales have greater access to consumers (exportier partners) than small traders, as well as small traders' access to consumers (exporter partners) is lower than the farmers, indicating the low bargaining power position of farmers in the seaweed market chain.

One of the weaknesses of farmers in general is limited market information and lack of technological expertise (Pomeroy et al. 2017), and the impact of high costs on small scale businesses (van Senten and England 2017) and lack of management skills that reduce farmers' bargaining position (Engle et al. 2016). The most important thing else is the margins earned upstream in Indonesia's commercial seaweed supply chains are generally small and the farmer's motivation for business is low (Purnomo *et al.*, 2021).

Identification the low bargaining power of farmers

The low bargaining power of seaweed farmers can be seen from the aspect of human capital, performance and supply chain activity of the farmer (Figure 2) and respondents' perceptions to these parameters is showed in Table 1.

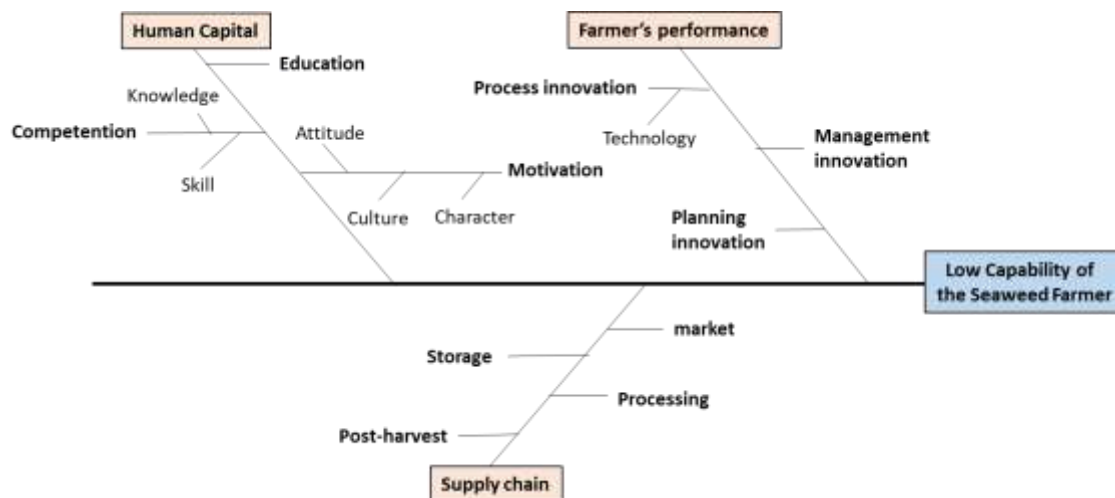


Figure 2 Fishbone Diagram of the Low Bargaining Power of the seaweed Farmer

The root of problems related to farmer's human resources is the low education level of seaweed farmers on average from elementary to high school graduates. Data shows the average school age is 6.91-7.29 years (2018-2020) (BPS, Takalar 2021). The culture of seaweed farmers relatively works only to meet daily needs, so that the character of working without a specific target. However, the behavior of mutual cooperation among farmers is relatively high. This culture, character and behavior greatly influence motivation as a dry-seaweed producer. Farmers' competence is strongly influenced by skills, then knowledge and abilities. This competency is obtained by farmers from a learning process that is hereditary as farmers so that this competency can still be improved better. Skills in managing seaweed cultivation are the main factors influencing seaweed production and the ability to use modern equipment (Budiman, Yuliana and Rahmayati, 2023).

Table 1. Data on Respondents' perceptions to the parameters of human capital, farmer's performance and supply chain which influence low capabilities of the farmer

Responden	Priority Local Factor value										
	Human Capital (21.98%)			Farmer's Performance (7.46%)					Supply Chain (70.56%)		
	Know-ledge ^{*)}	Compe-tence ^{*)}	Skill ^{*)}	Produc-tivitas ^{*)}	Profita-Bilitas ^{*)}	Mana-gement Innova-tion ^{*)}	Planning Innova-tion ^{*)}	Process Innova-tion ^{*)}	Post-harvest ^{*)}	Storage ^{*)}	Processing ^{*)}
Maritime Affairs and Fisheries Service (39.8%) ^{**)}	0.627	0.218	0.155	0.521	0.094	0.031	0.19	0.164	0.605	0.241	0.154
PT. GLC (6.5%)	0.644	0.068	0.288	0.044	0.485	0.095	0.251	0.125	0.742	0.075	0.183
Head of Port (9.3%)	0.077	0.172	0.751	0.062	0.088	0.161	0.305	0.384	0.774	0.091	0.135
Extension Officers (26.7%) ^{**)}	0.077	0.577	0.346	0.049	0.084	0.109	0.237	0.521	0.248	0.125	0.627
Academics (17.7%) ^{**)}	0.087	0.252	0.661	0.125	0.024	0.319	0.235	0.297	0.814	0.082	0.104
Average (dec)	0.302	0.257	0.440	0.160	0.155	0.143	0.244	0.298	0.637	0.123	0.2406
Average (%)	30.24%	25.74%	44.02%	16.02%	15.50%	14.30%	24.36%	29.82%	63.66%	12.28%	24.06%

^{*)} The value is based on the choice of local priorities for each factor

^{**)} Processed from the totally 40 respondents with percentage each actor category

The results of the analysis in table 1 show that the most dominant actor in determining the strategy for increasing farmer capabilities in the supply chain is the: head of the Maritime Affairs and Fisheries Service (39.8%), Extension Officer (26.6%), Academician (17.7%), Port Head



(9.3 %) and Entrepreneurs (6.5%). Results of the respondent's analysis (Table 1) show that capabilities of seaweed farmers is strongly influenced by the supply chain (70.56%). The average education level of farmers is still low, so that farmers generally do not have sufficient knowledge and technology in post-harvest activities (63.66%) which causes the low quality of dry-seaweed production and acceptance in the supply chain. It is similar, low capabilities due to farmer do not understand processing management exactly (24.06%) in the supply chain activities, so they do not see the level of dry-seaweed competition with competitors, while storage (12.28%) has little influence, where farmers are be able to maintain storage conditions before being sold, in addition to that generally dried natural seaweed has been offered to buyers, to avoid an increase in the water content of the material.

The second factor influences the capabilities is the human capital of the farmer (21.98%). The most important issue that determines the capability of farmers in the supply chain flow is skills (40.02%). This is caused by the lower bargaining of farmers in the supply chain channel than smallholders and wholesalers due to the lower ability of farmers to provide acceptable quality products at reasonable prices. Farmers' skills are also influenced by farmers' cognitive abilities as a knowledge factor (30.24%). The skill and knowledge factors have a high impact on the capabilities of farmers, but on the contrary, the influence of the competency factor (25.74%) has a lower impact on the capabilities of farmers in the supply chain channel. Competence is closely related to entrepreneurial ability where entrepreneurial competence can contribute to improving the financial performance of farmers and this is a strategy for increasing farmer capabilities in the supply chain (Nieuwoudt *et al.*, 2017).

The third factor affects the capabilities of farmers in the supply chain is farmer's performance (7.46%). Capabilities are more influenced by the ability of farmers in process innovation (29.8%), namely the level of creativity of farmers in developing different processes and becoming a competitive advantage then the capabilities farmer increase in the supply chain. The capabilities of farmers are also influenced by the ability to compile and make planning innovations (24.4%), namely the ability to plan processes and products that are specific and effective in achieving product acceptance levels in the supply chain. Furthermore, the process capability and farmers' innovative planning have an impact on effectiveness and efficiency in productivity (16%) and profitability (15.5%) and encourage to create innovation management (14.3%) that increasing the farmers' capabilities in the supply chain.



Referring to the results of the problem identification (Figure 2) that occurred in Laikang, Takalar, the analysis of the strategy for increasing the farmer's capabilities, a matrix of actors, factors and alternative strategic decisions is compiled within the Analysis Hierarchical Process (AHP) framework which can be used as a reference in the best decision making process.

Process Hierarchy Analysis (AHP) is an analytical framework for making decisions effectively for complex problems, by simplifying and speeding up decision making (Nurani, 2003). This decision analysis is the result of an analysis of choosing the most appropriate strategy for seaweed farmers, by compiling a hierarchical structure by combining priority variables in each hierarchy by giving numerical considerations to subjective considerations about the relative importance of variables and synthesizing various considerations to determine which variables have priority highest (Figure 3).

Decision against strategy for increasing farmer capabilities in the supply chain determined by actor, consist of: head of the maritime affairs and fisheries service (39.8%), extension officer (26.6%), academican (17.7%), port head (9.3%) and entrepreneurs (6.5%) (Table 2). Base on respondents' perceptions to the alternative to solve the farmer's problem show that decision alternative is: 1) Improving Farmer's Competence and Management (16.58%), 2) Changing the Farmer's Work-Ethic (10.52%), 3) Implementation of Policies and Programs (26.58%), and 4) Improvement Training Program (46.32%).

Table 2. Data on Respondents' perceptions to the alternative to solve the farmer's problem

Responden	Alternatif ^{*)}			
	Improving Farmer's Competence and Management	Changing the Farmer's Work-Ethic	Implementation of Policies and Programs	Improvement Training Program
Maritime Affairs and Fisheries Service (39.8%) ^{**)}	0.169	0.035	0.285	0.511
PT. GLC (6.5%) ^{**)}	0.272	0.088	0.387	0.253
Head of Port (9.3%) ^{**)}	0.087	0.153	0.232	0.528
Extension Officers (26.7%) ^{**)}	0.226	0.114	0.108	0.552
Academics (17.7%) ^{**)}	0.075	0.136	0.317	0.472
Average (dec)	0.166	0.105	0.266	0.463
Average (%)	16.58%	10.52%	26.58%	46.32%

^{*)} The value is based on the choice of local priorities for each factor

^{**)} Processed from the totally 40 respondents with percentage each actor category

The hierarchy is composed of six levels. The first level is the objective, namely the improvement strategy for seaweed farmer. The second level is actors consisting of: 1) the Head of



the Maritime Affairs and Fisheries Service of Takalar, 2) the Head of Fishery Ports, academics, 3) seaweed processing entrepreneurs, and 4) extension workers. The third level is a factor consisting of: 1) human capital, 2) performance, and 3) supply chain. The fourth level is the sub factor. The sub-factors of the human capital factor consist of: 1) knowledge, 2) competence, and 3) skills. The sub factors of the performance factor consist of: 1) productivity, 2) profitability, 3) management innovation, 4) planning innovation, and 5) process innovation. The sub-factors of supply chain factors consist of post-harvest, storage and processing. Then the sixth level is an alternative which consists of: 1) Improving Farmer's Competence and Management, 2) Changing the Farmer's Work-Ethic, 3) Implementation of Policies and Programs, and 4) Improvement Training Program. AHP is carried out using the Expert Choice 11 program, and the results obtained are summarized in local priorities and global priorities.

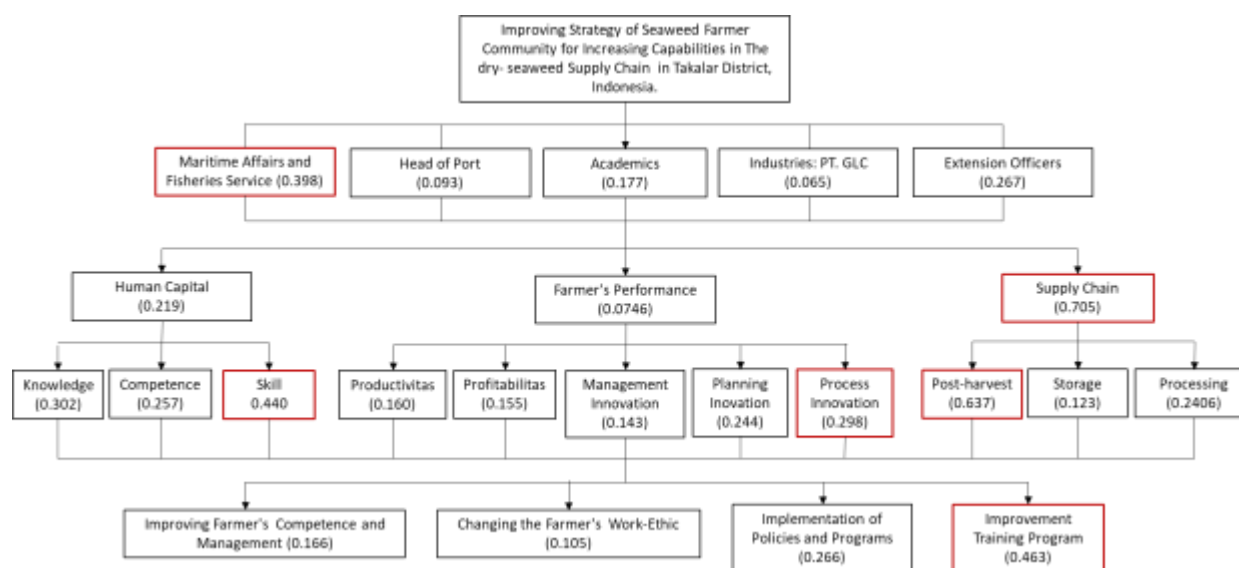


Figure 3. Structure of farmer's performance improvement strategy in the supply chain of dry-seaweed products

Based on the results of the AHP analysis in Figure 3, it shows the level of decision-making objectives, namely: "Improving Strategy of Seaweed Farmer Community for Increasing Capabilities in The dry-seaweed Supply Chain in Takalar District, Indonesia". At the factor level, the most influencing factor is the supply chain (0.705) with the most influencing sub factor, post-

harvest (0.637). Furthermore, the second order factor is human capital (0.219) with the dominant sub-factor being skills (0.44). Then the third order factor is farmer's performance (0.0746) with the dominant sub-factor process innovation (0.298). Furthermore, based on global priorities, namely priorities that pay attention to all criteria, the best strategy that should be implemented so that farmers' capabilities can be further increased is the addition of training for seaweed farmers in Laikang, Takalar, namely the Improvement Training Program (0.463). Furthermore, the second priority is Implementation of Policies and Programs (0.266) and the third priority is Improving Farmer's Competence and Management (0.166), and the fourth priority is Changing the Farmer's Work-Ethic (0.105). These results can be used as a reference for government policies in public decision making.

CONCLUSION

Observation and interviews with respondents from stakeholder and formulated in the fish-bone and Analytical Hierarchical Process (AHP) approach result that capabilities of seaweed farmers is strongly influenced by the supply chain (70.56%), with sub factor dominant is post-harvest activities (63.66%) processing management (24.06%) and storage (12.28%). The second factor influences the capabilities is the human capital of the farmer (21.98%), with sub factor dominant is skills (40.02%), knowledge (30.24%) and competency (25.74%). The third factor affects the capabilities of farmers in the supply chain is farmer's performance (7.46%), with sub factor is process innovation (29.8%), planning innovations (24.4%), productivity (16%), profitability (15.5%) and innovation management (14.3%).

The results of the respondents' decisions on alternative solutions to farmers' capabilities in the supply chain are: Improvement Training Program (46.3%), Implementation of Policies and Programs (26.6%), Improving Farmer's Competence and Management (16.6%), and Changing the Farmer's Work-Ethic (10.5%).

FUTURE DIRECTIONS

Continuity and quality issues are the main problem in the seaweed supply chain for both domestic and export needs.. The success of the supply chain for seaweed commodities is very dependent on supply from farmers as primary producers and the sustainability of grass production at the upstream level related to the interests of stakeholders in the supply chain so that it requires special attention. Therefore, this research is expected to contribute to the basic



study of farmer human capital and farmer's performance that are specific to different areas, so that it is an important topic for mapping specific farmer problems as well. This research domain will have a managerial impact on the government in carrying out public policies, especially related to the interests of strengthening farmers in the upstream sector in a sustainable manner.

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