

EMPOWERMENT OF SEAWEED FARMERS GROUPS THROUGH THE APPLICATION OF POST-HARVEST PROCESSING SCIENCE AND TECHNOLOGY BASED ON SEAWEED PROCESSING DIVERSIFICATION IN ILODULUNGA VILLAGE, ANGGREK DISTRICT, NORTH GORONTALO REGENCY

Sjahril Botutihe¹, Evi Sunarti Antu², Ika Okhtora Angelia³, Asri Silvana Naiu⁴, Irawati Abdul⁵, Selvi⁶
{sjahrilbotutihe@gmail.com¹, eviantu10@gmail.com², ikaokhtora85@gmail.com³,
asri.silvana@ung.ac.id⁴, irawati.abdul@ung.ac.id⁵, selvi@ung.ac.id⁶}

Universitas Ichsan Gorontalo, Jalan Achmad Nadjamudin Gorontalo, Indonesia, 96138^{1,2,3}
Gorontalo State University, Jalan Sudirman No. 6 Gorontalo, Indonesia, 96128^{4,5,6}

Abstract. North Gorontalo Regency, which is one of the regencies in Gorontalo Province, has great potential to develop seaweed cultivation. One of the seaweed producing areas in North Gorontalo Regency is Iلودulunga Village, located in Anggrek District. Iلودulunga Village is one of the villages in North Gorontalo Regency, most of whose people work as seaweed farmers and seaweed processors. This activity aims to empowerment of seaweed farming communities through the application of science and technology in the form of post-harvest processing to support food security based on diversification of seaweed processing and science and technology for seaweed farmers. Seaweed farming business groups have obtained post-harvest technology such as shredders, washing machines and dryers using UV light, which are expected to be able to improve the quality of seaweed production so that it can be sold at high prices and be able to compete with seaweed products in other areas. By empowering communities through science and technology with post-harvest processing of seaweed to increase the added value of products and food security.

Keywords: Empowerment, seaweed commodities, science and technology, North Gorontalo

INTRODUCTION

Indonesia as an archipelagic country with a long coastline of 6,400,000 km² of ocean area and 110,000 km of coastline, and supported by a tropical climate, is an area suitable for the growth of seaweed species. As part of the world's Coral Triangle, Indonesia has at least 550 types of seaweed variants with high economic value. Referring to data released by the Food and Agriculture Organization of the United Nations (FAO) in 2019, Indonesia is the world's number one producer of Eucheuma Cottoni seaweed and controls more than 80 percent of the world's supply (Pembawa et al., 2024). However, what is more important for Indonesia is an archipelagic country with untapped planting potential reaching almost 50%, the total seaweed potential that is still available is 769.5 thousand Ha. Currently, the land that is utilized is only 384.7 thousand Ha. Based on this data, there is still unutilized land, which is around 384.7 thousand Ha. So that the potential is owned by Gorontalo Province where the land area is 1,221,544 Ha and sea waters are 20.00 miles wide, Gorontalo Province has a competitive advantage with a coastline of 560 km and is located in the

Tomini Bay and Sulawesi Sea areas, making it a fairly large regional asset because it is relatively close to the world fisheries market.

Gorontalo Province has the potential for developing marine cultivation of 5,000 ha and which can be utilized for seaweed cultivation of $\pm 2,850$ Ha spread across North Gorontalo, Boalemo and Pohuwat Regencies. North Gorontalo Regency which is one of the Regencies in Gorontalo Province which has great potential to develop seaweed cultivation. This is in accordance with the BI study together with the Institute for Economic, Management and Public Policy Studies (LP2EMKP) of Gorontalo Province has conducted research on the identification of potential and profiles of superior commodity clusters in Gorontalo Province, which determined that the seaweed cluster is in North Gorontalo Regency. Seaweed has become one of the sources of income for the people of North Gorontalo today. Seaweed is a potential commodity in contributing to the income of the people in North Gorontalo Regency, one of the seaweed producing areas in North Gorontalo Regency is Ilodulunga Village which is located in Anggrek District. Ilodulunga Village is one of the villages in North Gorontalo Regency, most of whose people work as seaweed cultivators and some farmers.

Empowerment of seaweed farmer groups through the application of post-harvest processing science and technology in supporting food security based on diversified seaweed processing is aimed at the community in Ilodulunga Village, North Gorontalo Regency, most of whom work as seaweed farmers. There are 2 (two) business groups engaged in the seaweed processing business (Fitra Bersama) and seaweed farming business (Lestari 1). Before the empowerment activity was held, the seaweed in the area was purchased at a low price by middlemen because the quality was less than satisfactory, so that unsold seaweed was wasted and left to rot in the area. This study aims to increase understanding among farmers about effective seaweed cultivation and seaweed processing through diversified processing through the application of appropriate technology in post-harvest seaweed processing. To overcome this problem, the solution offered is that this community service activity will focus on training in processing seaweed into value-added products such as chips, jelly candy, carrageenan, seaweed noodles, ice cream and other products.

RESEARCH METHOD

The training includes the selection of raw materials, processing, packaging, and product marketing. The implementation method of this community service program includes socialization, training, mentoring and direct demonstration to the two target partner business groups, Fitrah Bersama and Lestari 1. The expected output target is to increase the knowledge and skills of the Fitra Bersama seaweed processing business group in processing seaweed and diversifying processed seaweed products. Meanwhile, the Lestari 1 seaweed farming business group is able to increase the economic value of seaweed products through the use of post-harvest technology to produce quality seaweed, which can support food security and the economy of the community in Ilodulunga Village, Anggrek District, North Gorontalo Regency. Participants in this community service activity are the Lestari 1 seaweed farming business group and the Fitrah Bersama seaweed processing business group. The method used to improve the skills of the people of Ilodulunga Village, Anggrek District in utilizing post-harvest tools and processed seaweed products is a structured and sustainable method. The following are the steps of the method used, as follows:

- a. Counseling and Socialization. Before the technical training, counseling and socialization activities were carried out to provide an understanding to the community regarding the importance of post-harvest processing and diversification of seaweed products. This counseling includes the economic potential of processed seaweed products and the long-term benefits of using post-harvest tools.
- b. Fabrication of Post-Harvest Tools and Seaweed Product Processing. The process begins with designing seaweed post-harvest tools. The design of this tool is adjusted to the type and volume of seaweed to be processed and the processes required, namely washing, drying, automatic stirring, flouring, sieving and pressing. Equipment specifications include materials used, size, capacity, and energy efficiency.

- c. Post-Harvest Equipment Usage Training. In this training, the community is given technical guidance on how to use and maintain post-harvest equipment, namely seaweed dryers and washers. The training includes live demonstrations and practice by participants to ensure they master the correct and efficient usage techniques.
- d. Seaweed Derivative Product Processing Training. The community is trained to make processed products made from seaweed, including ice cream, dry noodles, wet noodles, crackers, carrageenan, and jelly candy. This training is carried out through a demonstration method, then continued with independent practice by participants. This activity aims to enable the community to create products that are ready to be sold and have added value.
- e. Periodic Mentoring and Evaluation. After the training, periodic mentoring sessions are held to monitor the progress of participants and ensure that post-harvest equipment is used optimally. Evaluations are also carried out to identify obstacles or additional needs faced by the community in operating the equipment or producing processed seaweed.
- f. Introduction to Marketing Strategy. As part of business development, the community is introduced to marketing techniques for processed seaweed products, such as attractive packaging, pricing, and promotional strategies. The goal is to help communities increase the appeal and sales of products in local and wider markets.
- g. Strengthening Business Group Institutions. To improve the sustainability of the program, institutional strengthening or the formation of community business groups is carried out. This group is tasked with managing the use of post-harvest tools, facilitating joint production, and regulating the sale and distribution of processed seaweed products.

This Community Service activity is carried out based on the results of team research, both the implementation team and the mentoring team. There are several researches related to the implementation of activities, including: Design and testing of dodol mixers (Admin et al., 2019). Women's Empowerment through joint efforts to produce briquettes and compost from household waste in the PKK program in Sipayo Village, Pohuwato Regency, Marine-based community empowerment with carrageenan processing in Tihengo Village, Ponelo Kepulauan District, North Gorontalo Regency (Angelia et al., 2019). The effect of the soaking time of *Kappaphycus alvarezii* seaweed on the organoleptic value of mangrove pedada fruit jam (*Sonneratia caseolaris*) (Datunsolang et al., 2020). The effect of adding seaweed on the hedonic value of sweet bread products made from sweet potato flour (Lagarusu, Yusuf, and Naiu 2022). The effect of seaweed fortification on the organoleptic value of sweet potato crackers (Kasim, Silvana, and Marsuci 2023). Analysis of the difference in the quality of *Kappaphycus alvarezii* seaweed jelly candy packaged in Edible Film based on CMC complex gelatin and Nanokitin Complex (Naiu et al., 2021). Training in making fishery-based products in Huangobotu village Design and construction of a chili grinder using an electric motor (Gaga, Botutihe, and Haluti 2019). Utilization of Greenhouse Effect (ERK) dryers as an alternative to drying processed fish (Djamalu et al., 2021).

Design and construction of a compost shredder with a 45 degree blade angle (Sunge, Djafar, and Antu 2019), Utilization of palm vinegar in the extraction of gelatin from tuna fish bones and fishery waste, can be used in processed seaweed waste. The impact of Empowerment of seaweed farming communities through the application of post-harvest processing science and technology to support food security based on diversified seaweed processing in Ilodulunga Village, Anggrek District, North Gorontalo Regency has target partners including the Fitrah Bersama business group engaged in seaweed processing and the Lestari 1 business group as a seaweed cultivator. With the aim of empowering communities through science and technology in post-harvest processing of seaweed to increase the added value of products and food security. Based on these objectives, the technical implementation carried out is as follows:

Fitrah Bersama Target Partners

1. Socialization

- a. Conveying and explaining the objectives of this community service program to all Fitrah Bersama business groups
- b. Conducting data collection and identifying the needs and characteristics of Fitrah Bersama partners

- c. Compiling easy-to-understand and interesting socialization materials about partner problems and potentials, especially related to technology and quality management
 - d. Carrying out socialization with Fitra Bersama partners and the Ilodulunga village government
- 2. Training
 - a. Conducting technical training, namely providing training on more efficient and modern processing technology, such as the use of tools/machines that will be used during processing
 - b. Quality management training, namely providing training on quality management systems to improve product quality and customer satisfaction
 - c. Product development training, namely conducting training for the development of new, innovative products that are in accordance with market trends
- 3. Technology Application
 - a. Selecting technology that is in accordance with the company's needs and capacity, and is easy for employees to adopt
 - b. Conducting production trials to ensure optimal technology use performance
 - c. Preparing new SOPs to accommodate the use of new technology.
- 4. Assistance
 - a. Providing periodic assistance to overcome technical obstacles that may arise during the process of implementing new technology
 - b. Providing assistance in terms of production management, marketing and finance
 - c. Conducting periodic evaluations to measure the success of the program and making adjustments if necessary.
- 5. Evaluation and Sustainability
 - a. Establishing clear indicators of success such as increasing productivity, increasing product quality, and increasing sales, so that the sustainable actions that will be developed in Fitra Bersama partners will be known
 - b. Measuring the performance of Fitra Bersama partners after the program implementation by creating a questionnaire on their behavior before and after the program implementation.
 - c. Conducting a final evaluation to assess the overall impact of the program and will provide recommendations regarding the sustainability of their business

Lestari Target Partners 1

- 1. Socialization
 - a. Delivering and explaining the objectives of the community service program to all sustainable seaweed farming business groups 1
 - b. Conducting a survey to determine the specific training needs required, such as modern cultivation techniques, water quality management and marketing
 - c. Establishing a working group consisting of representatives from Lestari 1 and the community service team to ensure the smooth implementation of the program.
- 2. Training
 - a. Providing training on more efficient and sustainable cultivation techniques, such as the use of environmentally friendly mooring ropes, better seed sowing techniques and pest and disease management.
 - b. Providing training on the importance of maintaining water quality, monitoring water quality parameters, and how to overcome pollution problems
 - c. Training on how to manage a business, both marketing management,
- 3. financial management. Technology Implementation
 - a. Selecting technology that is in accordance with sustainable conditions and needs 1, namely the use of post-harvest technology such as washing machines, drying machines and shredding/cutting machines
 - b. Installing new equipment and conducting equipment trials to ensure that the tools/machines are used properly
 - c. Compiling new SOPs to accommodate the use of new technology.

Sjahril Botutihe¹, Evi Sunarti Antu², Ika Okhtora Angelia³, Asri Silvana Naiu⁴, Irawati Abdul⁵, Selvi⁶

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4. Assistance

- a. Providing periodic assistance to overcome technical obstacles that may arise during the process of implementing new technology
- b. Providing assistance in production management, marketing management and financial management
- c. Conducting periodic evaluations to measure the success of the program and making resolutions if necessary.

5. Evaluation and Sustainability of the program

- a. Establishing clear indicators of success for increasing seaweed cultivation productivity, seaweed product quality and increasing the income of seaweed farmers
- b. Collecting data periodically to measure cultivation performance after program implementation
- c. Conducting evaluations to assess the overall impact of the program and preparing recommendations for the sustainability of the program on seaweed farmers

RESULT AND ANALYSIS

In the implementation of this community service activities in accordance with the activity implementation method obtained during the activity process with target partners, namely the first Fitrah Bersama seaweed processing business group and Lestari 1 as a seaweed farmer in Ilodulunga Village, Anggrek District, North Gorontalo Regency and are as follows:

1.1 Socialization Activities

In the first stage of activity, socialization activities were carried out to the two target partners on October 6, 2024 at the Ilodulunga Village Hall. This activity aims to convey and explain the objectives of the Kosabangsa community service program to all target partners, namely Fitrah Bersama and Lestari 1. This socialization aims to instill a deep understanding among the community, in this case the target partners of the Fitra Bersama and Lestari 1 business groups, about the importance of processing seaweed into products with added value. In addition, this socialization also aims to open the community's insight into the broad market potential for processed seaweed products. This activity was attended by two target partners, This socialization activity was attended by participants from both target groups plus the community and the Ilodulunga village government, and all participants were very enthusiastic about this program. The delivery of socialization materials was carried out by the mentoring team and the implementing team from Kosabangsa, the materials presented were how to utilize the potential of seaweed and its processed products, simple and practical seaweed processing processes and innovative seaweed processed products and related to market potential strategies and marketing of processed seaweed products. And the material was delivered in a simple, interesting and relevant way to the activities that will be empowered to the two target groups.



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Fig. 1. Socialization Activities

1.2 Training Activities

This training activity was carried out with the aim of equipping the Fitrah Bersama seaweed processing business group and Lestari 1 as a seaweed cultivator with the knowledge and skills needed to process seaweed into products with added value. In addition, this training also aims to strengthen the capacity of business groups in processing seaweed processing businesses sustainably. The product manufacturing training was held on October 19, 2024 at the Ilodulunga Village Office Hall. This product manufacturing training was created to provide understanding and improve skills in processing seaweed into value-added products, as well as encourage innovation in the development of new products in the form of diversified processed products for members of the two target partner businesses, namely Fitra Bersama and Lestari 1 as seaweed farmers. The materials provided include providing an understanding of the types of seaweed, nutritional content and safe and hygienic processing methods. In the training, a live demonstration was carried out on making various processed products such as seaweed chips with flavors such as balado, barbequiu, cheese and grilled corn. Seaweed noodles with flavors balado, barbequiu, cheese and grilled corn, seaweed coconut roots, seaweed panada. And for the Lestari 1 group, an understanding and knowledge was given related to the selection of good seaweed seeds and how to overcome pests for seaweed plants and how to maintain the quality of seaweed after harvest so that it produces quality and high-value seaweed. The second training is to strengthen the capacity of business groups. This training was carried out with the aim of training the two business groups in strengthening their business capacity starting from administrative processing, financial management and marketing. This training directly presents resource persons, the Head of the Fisheries and Marine Service and the Head of the Industry, Trade, Cooperatives and MSMEs Service of North Gorontalo Regency. This capacity building training was conducted on October 31, 2024. At the end of the training, product demonstrations were carried out, including the manufacture of processed seaweed products and a final evaluation was carried out by providing pre-test and post-test questionnaires after the training to measure the increase in knowledge of participants in this case the target partners of Fitra Bersama and Lestari 1. The results of increasing the knowledge of Fitra Bersama's target partners before and after the seaweed product making training and capacity building are as follows:

Table 1. Capacity Building Training and Processing Assistance

Component	Before Activity (n=20)			After Activity (n=20)		
	Very Knowledgeable	Know	Not Know	Very Knowledgeable	Know	Not Know
Product Development	2 (10%)	2 (10%)	16 (80%)	17 (85%)	2 (10%)	1 (5%)
Capacity Building	1 (5%)	1 (5%)	18 (90%)	17 (85%)	2 (10%)	1 (5%)
Technology Usage Assistance	2 (10%)	2 (10%)	16 (80%)	17 (85%)	2 (10%)	1 (5%)

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Based on the table above, it is known that participants in this case the Lestari 1 business group have knowledge related to product processing before the training, they know very well 10%, know 10% and don't know 80% and after the training, they know very well 85%, know 10% and don't know 10%. While for capacity building before the training, participants know very well 5%, know 5% and don't know 80%, but after the training, they know very well 85%, know 10% and don't know 5%.. The results of Fitra Bersama's target partner's knowledge before and after the seaweed product making training, Capacity Building Training and processing assistance are as follows:

Table 2. Capacity Building Training and Processing Assistance

Component	Before Activity (n=20)			After Activity (n=20)		
	Very Knowledgeable	Know	Not Know	Very Knowledgeable	Know	Not Know
Product Manufacturing	2 (10%)	2 (10%)	16 (80%)	17 (85%)	2 (10%)	1 (5%)
Capacity building	1 (5%)	1 (5%)	18 (90%)	17 (85%)	2 (10%)	1 (5%)

Based on the table above, it is known that participants in this case the Lestari 1 business group have knowledge related to product processing before the training, they know very well 10%, know 10% and don't know 80% and after the training, they know very well 85%, know 10% and don't know 10%. While for capacity building before the training, participants know very well 5%, know 5% and don't know 80%, but after the training, they know very well 85%, know 10% and don't know 5%.

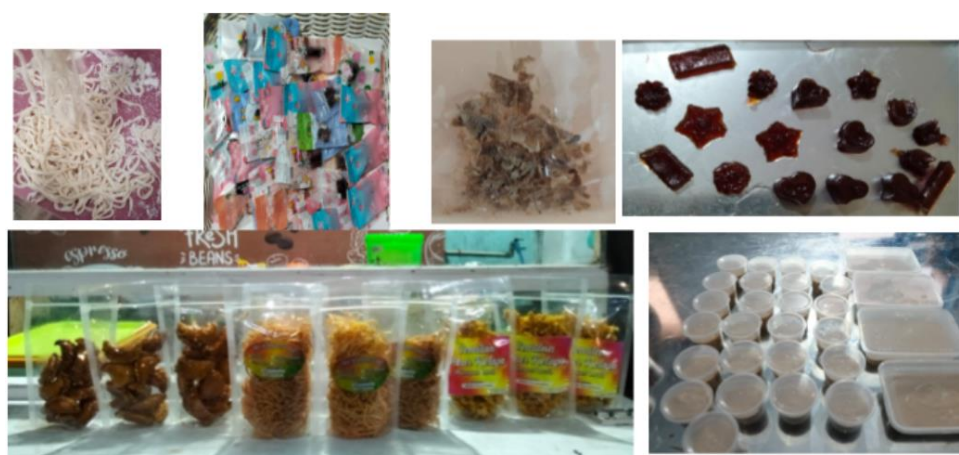


Fig 2. Product Manufacturing/Processing Training

CONCLUSION

Based on the description of the results of the implementation of the community service program, it can be concluded as follows:

- 1) Seaweed farmer empowerment activities in Ilodulunga Village, Anggrek District, North Gorontalo Regency have great potential to improve community welfare and food security. Supporting factors such as the potential for abundant natural resources, especially seaweed, high community interest, government support from both the Ilodulunga village government and the local government, namely the Fisheries and Marine Service and the Industry, Trade, Cooperatives and UMKM Service of North Gorontalo Regency and the involvement of universities in this case Ichsan University Gorontalo as the implementing team and

- accompanying team of Gorontalo State University, as well as the availability of potential markets have made a significant contribution to the success of this community service program.
- 2) The community service program activities have been able to produce a seaweed farmer empowerment program, namely the Fitrah Bersama business group as a seaweed processor and the Lestari 1 business group as a seaweed cultivator in terms of increasing seaweed production with better quality, increasing the variety of processed seaweed products that have higher economic added value, business groups have increased knowledge and better skills in seaweed cultivation and processing.

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