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Optimising the Hygiene Quality of Salted Fish to Improve the Economy of Coastal Communities

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ABSTRACT

Optimising the hygienic quality of salted fish is critical for coastal communities seeking to grow their economies and overcome the problems of Gaya Baru Village's Fishermen's Home Industry (IRT). Partners face difficulties drying fish when it rains, storing salted fish is still very simple, and partners lack good marketing techniques. The goal of this Community Service (PkM) is to: 1) increase technological knowledge; 2) increase the entrepreneurial spirit and motivation of partner entrepreneurs; and 3) improve HR capabilities in business management, production, and finance. The PkM has resulted in the development of two salted fish businesses in Gaya Baru village, allowing those who work to become self-sufficient.

A. INTRODUCTION

Lapandewa sub-district covers 44.54 km2 and includes seven communities. Burangasi Rumbia and Burangasi villages are the biggest, covering 8.28 km2 or almost 19% of the total area of the Lapandewa sub-district. Meanwhile, Gaya Baru community is the nearest beach community to South Buton Regency's capital, located 60 kilometers away. Gaya Baru community is a seaside community under the administration of Lapandewa Sub-district in South Buton District, with the bulk of the people relying on marine goods, either directly or indirectly. The residents of this hamlet are active in salted fish processing, notably with "Kelomppk Kambala Jaya" as a service partner. Fishermen in this category frequently lack expertise and technology, particularly in post-harvest processing, such as salted fish preservation to increase the shelf life of their catch. Mr La Ode Nasrun indicated that the average monthly compensation for group members is between Rp. 500,000 and Rp 1,500,000. Their fleet of boats is relatively small, thus transporting large quantities of fish is challenging. Furthermore, during times of hunger along the shore, they are unable to fish further afield.

In Gaya Baru Village, Lapandewa Sub-district, the majority (95%) of the people is a fisherman, and the fishing industry provides the majority of the local revenue. The Service Team performed a field research and discovered that fishing business patterns are separated into two categories: fish entrepreneurs who manage the complete production process, from capturing to processing and trading. This business model encompasses medium and large-

scale enterprises. The second sort of entrepreneur does not capture fish, but rather purchases raw fish from fishermen or collectors/dealers, which they then process into dried or salted fish and sell to conventional marketplaces or major traders. The typical capacity of home-based salted/dried fish enterprises is 30-70 kg per day.(Sadat & Nastia, 2023)

Temperature and climatic conditions can have a considerable impact on the fishing operation. In general, the number of fish captured for drying decreases throughout the summer (dry season) from April to the end of October, as well as during the rainy season with high winds. Fishing, on the other hand, often increases between November and the end of March each year. As a result, this condition has an influence on the fishing sector's development potential at the small, medium, and large levels. However, competition in the fishing business is becoming more complicated. To thrive in the competition, it is necessary to boost competitiveness by enhancing quality, productivity, and business efficiency, while also prioritizing elements of food safety and environmental sustainability.(Hasana, 2019)

The partners encountered the following problems: (1) Because salted fish is dried outside and on the side of the road, it is frequently polluted with fine dust due to meteorological conditions. (2) The absence of strictness in the salted fish storage system prior to drying results in damage and quick mould growth in salted fish. (3) The product packaging method involves folding the ends of the plastic and clipping them with less visually attractive staples; also, it enables air to enter, causing the product to oxidise quickly.(Rolf Geffken et al., 2017)

Based on surveys and visual observations, it is clear that the fishermen group in Gaya Baru Village, Lapandewa Sub-district, performs commercial operations for the majority of their processed goods, particularly salted fish of relatively high quality; nevertheless, product packaging is still missing. The captured fish are not all sold in the market; instead, they are dried and salted. Aside from marketing, the primary obstacle for small-scale fish salting firms is fish drying. (Nurul Auliah, 2022). The majority of the fish were taken in big quantities, and some had been processed and graded. To ensure ideal drying quality, several factors must be carefully controlled during the drying process, including airflow rate, drying air temperature, and air relative humidity. A high airflow rate helps accelerate the drying process. The airflow rate recommended for the drying process is 1.5-2.0 m/s. In addition to lowering fishermen's level of life, poor welfare has led to a pessimistic opinion of the fishing profession's future among members of the Gaya Baru Village Fishermen Group, Lapandewa Sub-district, South Buton District.(Suprapty et al., 2023)

To preserve fishing goods. The fish drying process works by evaporating water into the air due to the difference in moisture content between the air and the object being dried. Under these conditions, the air contains less water vapour or has a lower relative humidity, allowing water to evaporate from the dry substance. Water evaporates into vapour at the boiling point, but drying generally involves the transfer of water in the form of vapour and air. Drying is generally the last step in the manufacturing process before the material is stored, ensuring that the dried item has an appropriate moisture content and a long shelf life. Especially for fishing settlements on distant islands, the economy and culture have a history of underdevelopment.(Mega Putri Pertiwi, La Onu La Ola, 2018)

This research introduces novelty in its approach to improving the hygienic quality of salted fish in Gaya Baru Village by incorporating an environmentally-friendly fish drying technology using solar energy, which has not been widely applied in this coastal area. Additionally, this research introduces a fish drying system that does not depend on weather conditions, which can accelerate the drying process, maintain product cleanliness, and improve the competitiveness of salted fish products in the local market. Another innovation

is the application of attractive packaging technology to enhance the market value of salted fish, which had previously been overlooked by local entrepreneurs.

With this integrated approach, it is hoped that the welfare of coastal communities, particularly salted fish processing businesses, can be improved, and it will contribute to the development of a more sustainable community-based economy.

B. METHODS

This study employs a descriptive qualitative approach to systematically describe and summarize the various conditions, events, and phenomena of social reality that occur in the community under study. Primary data were collected through direct interviews with respondents using a set of structured questions, while secondary data were obtained from relevant research and literature reviews. A probability sampling technique was used to select a sample of 20 businesses for the first objective of the study. For the second objective, stakeholder analysis was employed to identify key stakeholders, including two government representatives from the Fisheries Agency and three community members, namely fish cracker traders, smoked fish traders, and salted fish traders in Gaya Baru Village, Lapandewa Sub-district.(Sugiyono, 2011)

The data collected through interviews and observations were analyzed to identify the main challenges faced by local fish processors in improving the hygiene and quality of their salted fish products. Additionally, the study examined the socio-economic impact of the new drying and packaging technologies introduced to the community. The results of the data analysis were used to assess the effectiveness of the interventions and to make recommendations for further improvements. This method enabled the research team to obtain a comprehensive understanding of the community's needs and the potential benefits of implementing the proposed solutions.(Steven J.Taylor, Robert Bogdan, 2016)

In addition, a participatory approach was utilized during the community engagement process, ensuring that local stakeholders were actively involved in identifying problems, evaluating solutions, and providing feedback throughout the implementation phase. This collaborative approach not only helped in the successful deployment of technologies but also empowered local communities to take ownership of the improvements, ensuring sustainability and long-term benefits for the region's economy. The study's findings provide valuable insights into the challenges and opportunities for enhancing the salted fish industry in coastal areas through community-based interventions.(Leavy, 2017)

C. RESULTS AND DISCUSSION

South Buton District has launched measures to enhance the cleanliness standards of salted fish quality in Gaya Baru Village, Lapandewa Sub-district, as part of its efforts to boost the economy of coastal villages. One of the methods adopted is to transform fresh fish raw materials into salted fish products in order to reduce the amount of water in the fish body. This procedure tries to produce high-quality salted fish by drying it, preventing germs from multiplying. The curing procedure for high-quality salted fish necessitates the use of precisely chosen curing components and instruments, such as fresh fish and pure salt. In addition, fish can be preserved in a variety of techniques, including as salting, drying, casting, smoking, and fermenting.

According to the findings of a service team that performed an assessment at Gaya Baru Village's beach site in Lapandewa District and South Buton Regency, the technique of preparing salted fish remains basic or traditional. Sea fish, sorted by variety and size, are placed in a container and sprinkled or soaked in a strong salt solution. Large fish are sometimes cut or diced first to allow salt to penetrate the flesh before being sun-dried. The

salted fish production method involves both dry and wet salting in cement tanks, with the fish combined with salt crystals in a 3:1 or 4:1 ratio. Depending on the weather, the mixture is placed into 500 gallons of saturated salt solution for 2-2.5 tons of fish and left for one to three nights. After proper salting, and if the weather permits, the fish is taken from the salt solution and sun-dried.(Fathy, 2019)

The quantity of salt used by fisherman typically ranges from 20 to 40% of the fish weight, but can frequently approach 60 to 100%. Drying time ranges between one and six days. Small fish, such as anchovies, can be dried in 5-7 hours under optimal conditions, medium-sized fish in 2 days, and large fish in up to 4 days. This drying method is done to keep salted fish clean, since in addition to being exposed to viruses and bacteria in the air, fish can also be contaminated by flies, which carry a variety of pathogens. Fish are dried in the sun on a bottomless beach surface using bamboo, zinc, and tarpaulin racks after being removed from the sea.(Reswita, 2004).

The challenge is to preserve the sanitation and quality of salted fish controlled by coastal communities, which necessitates the use of technology to aid in salted fish processing. An ecologically friendly salted fish processing system using solar cells is presented as a solution for coastal residents in Gaya Baru Village, Lapandewa District. This device uses solar energy to create heat at various temperatures for the salted fish manufacturing process. (Utami et al, 2014) The temperature may rise to 106°C and be sustained for 12 hours, with a low of roughly 50°C. To obtain the best drying quality, various elements, such as airflow velocity, drying air temperature, and air relative humidity, must be addressed and changed during the drying process. A higher airflow velocity helps shorten the drying process time. The suggested airflow velocity for optimal drying outcomes is 1.5 to 2.0 m/s.(Ayu, 2018)

1.1. Characteristics of respondents

According to the findings of this survey, respondents had an average age of 30 to 50 years, which is considered a fruitful age for salted fish processors looking to grow their business. The average formal education level of responders is 9.6 years, which is comparable to the secondary school level. This amount of formal education influences the power of adoption and innovation in corporate management. Respondents had an average of 5.6 years' experience cooking salty seafood. This expertise assists processors in making judgments and learning from prior experiences, so they understand how to increase the efficiency of their businesses. The average number of dependents in respondents' homes was four. 3. The necessity to sustain the family motivates processors to seek ways to boost the fishing business's profits.

Of the three main problems faced by partners in improving the quality of salted fish hygiene and the economy of coastal communities in Gaya Baru Village, Lapandewa District, namely dependence on weather conditions that hinder the optimisation of salted fish production, marketing techniques that are still traditional, and financial management that has not been well documented, the results of the actions taken through this service can now be seen as follows:

1. The community has been trained in sanitary salted fish drying practices, which will help to prevent rotting in salted fish.
2. A salted fish drier technology that is weather-independent and shortens drying time has been introduced.
3. The use of appealing packaging techniques and marketing strategies has resulted in improved product sales.

The team conducted internal coordination and consolidation to equalize viewpoints across the service team, plan activities, and share tasks. This task was performed well. This

activity's outcomes and outputs included agreements, activity notes/minutes, and attendance. The team divided tasks into activities such as (a) identifying community problems that need appropriate technology assistance, (b) analysing problem solutions and looking for appropriate technology alternatives, (c) designing agreed-upon appropriate technologies, (d) designing engines and boats, (e) community mentoring, and (f) publication.

The team also collaborated with partners to ensure perceptual equity. The activities included (a) determining the type of business and potential partners, as well as the surrounding area; (b) mapping problems and alternative solutions that could be offered through observations and interviews; and (c) analyzing alternative solutions to partners' problems using appropriate technology. This action produced data demonstrating that the group's equipment is basic and manual, making full use of current cooking utensils and unaffected by suitable and acceptable technology. This leads to slow manufacturing, poor cleanliness, and worse quality.(Devi Yuni Susanti1*), Prihati Sih Nugraheni2 & 1, n.d.)

The results of this study were derived from both primary and secondary data collected through interviews, field observations, and literature reviews. The data were analyzed to identify the main challenges faced by fish processors in Gaya Baru Village, as well as the effectiveness of the new technologies introduced. A total of 20 businesses were sampled for the primary data, and five key stakeholders were involved in the stakeholder analysis. These stakeholders, including government representatives and local traders, provided valuable insights into the existing problems and the potential for improvements in the salted fish processing industry.

1.2. Identification of Challenges in Salted Fish Production

From the interviews and observations, it was found that the primary challenges faced by the fish processors in Gaya Baru Village were related to the environmental conditions that hindered the drying process, the lack of effective packaging methods, and inadequate marketing techniques. The drying process was significantly affected by unpredictable weather conditions, particularly during the rainy season, which made it difficult for the processors to maintain consistent product quality. Furthermore, the traditional packaging methods used by local producers were inefficient, leading to faster spoilage of the products. The lack of modern packaging and storage systems resulted in low product shelf life and, consequently, limited market reach.

1.3. Impact of Technology Interventions

The introduction of the solar-powered fish dryer (Solcus Hexa) and improved packaging techniques had a notable impact on both the production process and the quality of the final product. Through the new drying system, fish processors were able to reduce drying time and ensure better sanitation during the drying process. The solar dryer, which operates independently of weather conditions, significantly improved the hygiene of the salted fish by preventing contamination from dust and other pollutants. Interviews with the fish processors indicated that the drying process now takes a fraction of the time compared to traditional methods, leading to increased productivity.

Additionally, the introduction of more attractive and durable packaging methods allowed for better preservation of the salted fish, reducing oxidation and spoilage. These improvements in both production and packaging were directly linked to the increased marketability of the products, as local traders reported higher demand for the freshly packaged salted fish.(Hendrawan & Kurnia, 2018)

1.4. Socio-Economic Impact

The socio-economic impact of these technological improvements was assessed through follow-up interviews with the community members. The majority of the respondents reported

increased income due to improved product quality and the ability to sell their products at higher prices in local markets. The introduction of solar dryers also helped reduce the physical strain on the processors, as they no longer needed to rely on manual drying methods under harsh environmental conditions. Additionally, the training provided to the community on hygienic fish processing practices contributed to greater awareness of food safety and quality standards.

The implementation of the drying and packaging technologies also empowered the local community to take ownership of the improvements, which contributed to a sense of pride and confidence in their business capabilities. As a result, several fish processors expressed interest in expanding their operations and investing in additional technologies to further improve their production capacity.

The solutions provided by this Community Service Programme are as follows:

a. Use of Solcus Hexa

Aluminum was chosen as the external material since it is lightweight and corrosion-resistant. In addition, sengon wood serves as an intermediary material. The sengon wood acts as an insulator, retaining the heat within Solcus Hexa. (Utami, E. S., Priyantika, D., 2014). In the inside of Solcus Hexa, a mirror with a certain angle was chosen to be hung. The purpose of this mirror is to reflect and direct sunlight so that it falls on the surface of the base, which is constructed of food grade aluminum. Aluminium was chosen due of its corrosion resistance and relatively good heat conductivity. In addition, the Solcus Hexa's cover is made of transparent glass, which allows sunshine to penetrate.

Solcus Hexa operates on the principle of a solar collector, with sunlight reflected and focussed on an aluminium surface as a basis. The drying process in the Solcus Hexa mode of operation consists of three steps that occur concurrently, particularly during the drying stage. First, direct solar drying happens. Second, the solar collector's mirror reflects and focuses sunlight. Third, heating happens via the aluminum surface, which is heated by both direct and reflected sunlight. (purnomo, 2018)

When compared to normal drying techniques, this equipment design provides several advantages, including:

Higines is more hygienic for drying food items since it has a top that keeps them from being exposed directly to outside air. Solcus Hexa is user-friendly and simple to operate. The Solcus Hexa design has the following advantages: it is ergonomic, practical, and easy to use in everyday life, with simple maintenance. The use of this instrument boosts the productivity of salted fish drying since the process is accelerated. The team will undertake a field research in Gaya Baru Village, Lapandewa Sub-district, focusing on community income. This information is necessary to identify the materials that will be utilized to manufacture Solcus Hexa. Partners will manufacture Solcus Hexa using predefined components, but if this is not possible, they will explore for other materials. The goal is for the community to be able to run Solcus Hexa independently following this investment, particularly financially. The team will create Solcus Hexa based on the characteristics and requirements of the coastal community in Gaya Baru Village, Lapandewa Sub-district. During the socialization stage, the community will be introduced to the technology that will be installed, specifically Solcus Hexa. The community will learn about the advantages, manufacturing materials, and how to manufacture and maintain Solcus Hexa. Implementation includes testing to solve the community's salted seafood drying difficulties. Data gathered at this level will be used for future development. The monitoring and evaluation step will be carried out to ensure that Solcus Hexa is used as intended. The obtained data will be examined to determine the tool's efficacy and efficiency.(Kurniawan et al., 2023).

b. Salted Fish Processing Techniques

Every day, commercial processes such as salted fish processing take place at the industrial facility. The primary raw material in the salted fish processing sector is fresh fish acquired from fishermen and delivered straight to the production facility. The fish species used are gulama fish, quill fish, temple fish, canned fish, belukang fish, and duri fish. The use of fresh fish as raw material is critical since it affects the quality of the final salted fish product.(Ariyani, 2022) The salted fish manufacturing process involves the following steps:

1) Freshly acquired fish is split and cleansed of its entrails. However, many varieties of fish, such as little chicken feather fish, do not require splitting. To get a decent and appealing salted fish form, the splitting procedure demands talent.
2) Once split, the fish is cleaned with clean water to eliminate any lingering entrails or contaminants.
3) The next step is salting. The fish is salted and immersed in a soaking tub for about three days. The amount of salt used is one-third of the fish's weight. When soaking the fish, arrange them carefully so that the split fish does not shut again.
4) After about three days of soaking, the fish is washed with clean water to remove any salt residue. Cleaning techniques include brushing and rinsing with water. This procedure is done three times in a succession in the hopes of fully cleaning the fish.
5) The thoroughly cleansed fish is carefully put out and sun-dried for 1-2 days. The ratio of fresh to salted fish is 1:3. When the salted fish has dried, it may be packed and sold.(Utami.E.S., Priyantika.D., 2014)

Cleaning, salting, and drying are the three phases in the preparation of salted fish.

a) Cleaning Stage: Wash in a tub with water until clean. The fish is placed in a designated area, which is a huge bucket, after the raw materials have been cleaned.

Figure 1. Cleaning

b) Salting Stage: The use of salt in salted fish serves as a preservative since it reduces the water content of the fish, hence inhibiting microbial development and enzyme activity. To get a white and delicate texture, salted fish is made with table salt or pure salt (NaCl). When soaked in water, salted fish quickly absorbs water and, when fried, tastes like fresh fish. The ratio of basic materials to salt is 1:2.

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Figure 2. Salting

c) Sun-drying Stage: After the fish has been salted and rinsed thoroughly, it is dried in the sun using a rack. The drying area must be shade-free so that sunlight may reach the fish ideally. The racks are built from sliced bamboo. The practice of shifting the fish under the sun is repeated at least 2-3 times every day. This drying process typically takes 2-3 days.

Figure 3. Drying

The Salted Fish Sales Process is a salted fish company sales method that allows clients to purchase salted fish directly from the manufacturing location (at their house). Salted fish marketing is currently centered on the local market in South Buton Regency, Southeast Sulawesi, with sales taking place in the Gaya Baru Village Market for IDR 50,000 per kilogram. A marketing strategy is a plan or sequence of activities designed to sell a product with the goal of meeting marketing aims and objectives in the business. In the face of dynamic and ever-changing competition, the degree of competitiveness in society has an impact. As a result, "Kelompok Kambala Jaya" employs a variety of marketing methods that are tailored to the specific demands of their salted fish company. To expedite the growth of a better salted fish company, an effective plan must be implemented based on the salted fish agribusiness system's potential, strengths, weaknesses, and threats. (Asriningputri & Handayeni, 2019)

D. CONCLUSION

The implementation of the solar-powered fish dryer and improved packaging techniques has significantly enhanced the hygiene and quality of salted fish production in Gaya Baru Village, Lapandewa Sub-district. These technological interventions have addressed key challenges faced by the local fish processors, such as the dependency on weather conditions and the lack of effective packaging methods. As a result, the drying process has become more efficient, reducing the time required for drying and ensuring a cleaner, more hygienic product. The new packaging methods have also contributed to longer shelf life and improved product presentation, which has increased marketability and demand.

In addition to improving production processes, the interventions have had a positive socio-economic impact on the community. The fish processors have reported increased income due to the higher quality and marketability of their products. The use of the solar dryer has reduced physical labor and improved the working conditions for the processors. Furthermore, the training provided to the community on hygienic practices and business management has empowered them to take greater ownership of their operations, leading to long-term sustainability. Overall, this community-based intervention has successfully enhanced both the economic and social welfare of the Gaya Baru Village community, offering a model for similar coastal areas to improve their livelihoods through appropriate technological solutions.

The findings of this community service activity can be summarized as follows:

1. Skill in the manufacture of salted fish utilizing a hygienic salted fish drier has resulted in a reduction in the time required for fish production during drying.
2. In this service, we use drying machine technology to manufacture sanitary salted fish.
3. Currently, drying salted fish is faster since it does not take as long.

To ensure optimal drying quality, numerous factors must be correctly adjusted throughout the drying process. The parameters include air flow rate, drying air temperature, and relative humidity. High air flow rates can speed up drying time, so keep them between 1.5 and 2.0 m/s.

The test was conducted at high temperatures in an ecologically friendly fish drying chamber with the use of solar panels and direct sunshine. At this level of testing, direct sunlight was used without the inclusion of solar panels. Because there is no wind while utilizing a room or drying instrument, the intensity of sunlight rises, allowing the heat created to aid liberate water molecules attached to fish meat. The water will then flow out through the room's channels. Furthermore, the usage of the room can limit the activity of bacteria that may generate an unpleasant odor in fish, and the constant temperature in the fish aids in the process of continuous water release.

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F. AUTHOR CONTRIBUTIONS

List the contributions of all team members to the community engagement activities and the article writing process. Only authors with contributions should be listed, with their names provided**:** Activity implementation: AS, HL, NS, Article preparation: AS, LS, Impact analysis: NS, YS, Results presentation: AS, Article revision: LS, Other contributions : HL YS.

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