Competitiveness and SMEs production sustainability through the cleaner production (case study: SMEs of fish processing unit in Pinrang Regency, Indonesia)

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Abstract. The challenge for the success of SMEs in Indonesia is increasing competition that demands adaptation to environmental changes. In 2018 SMEs fish processing for boneless frozen milkfish in Pinrang Regency has a production capacity of 150 tons, potentially producing solid, liquid or gas waste. The purpose of this research is to analyze the potential of SME's fish processing waste and its utilization in supporting the sustainability of production. The study was conducted in Pinrang Regency from December 2018 to April 2019 with a qualitative descriptive approach. Data collection through field observation, interviews, and documentation. The results showed that the potential of waste produced by 20-30 percent was used as food, feed and fertilizer products. The diversification of the main products into "fish meatballs" and "fish crackers" increases competitiveness and reduction of solid waste. Solid waste is also used to produce by-products in the form of "shredded milkfish" and "fishbone sticks". SMEs fish processing has dynamically applied the concept of clean production in handling and utilizing waste. Waste management has reduced the impact on the SME's fish processing environment. The implementation of clean production has increased production capacity, product diversification, guaranteed product quality, and the welfare of owners and workers. The strategy for handling and managing waste has optimized added value and supports the improvement of competitiveness and sustainability of production.

1. Introduction
Indonesia has an enormous potential of marine wealth with abundant varieties of marine fish. Therefore the government is targeting the growth of processed fishery products to 6.8 million tons by 2019 [1-3]. The fishing industry is experiencing rapid development and more and more waste. Producers get increased pressure from stakeholders to reduce the environmental impact of their activities [4]. Law No. 45 of 2009 concerning Fisheries Article 20 paragraph 3 and 4 mandates that all people handling and processing fish must fulfill and apply the eligibility requirements for fish
processing, fisheries product quality, safety assurance systems, and must obtain a Certificate of Processing Feasibility [5].

The new concept in a manufacturing business is clean production (CP) and environmentally friendly technologies that are important both for environmental quality and for sustainable production [6]. CP is an integrated preventive action that can be applied in the production process, to improve efficiency and reduce adverse effects on humans and the environment [6-8]. At present, the focus of activities is specifically to develop and implement CP to deal with environmental pollution problems [9]. The increasing environmental costs, operations, markets, regulations, voluntary initiatives, and international standards are important steps for the implementation of CP. However, some manufacturing companies are still reluctant to take more aggressive and proactive actions toward CP. There is a lack of evidence that the impact of CP exceeds the costs involved in implementing this strategy [10]. Clean production through the application of technology solid and liquid livestock waste processing is an adaptation strategy for farmer groups in the Pinrang district for the sustainability of its business [11].

The Ministry of Industry develops programs that encourage SME fish processing units to implement clean production. The management attitude of SMEs responsible for the environment and selected technologies is very important to support the program. CP will increase the efficiency of the use of raw materials, energy, prevent the use of hazardous and toxic materials, and reduce the amount and toxicity of all emissions and wastes before leaving the processing process [12]. At present most SMEs have made significant efforts in implementing CP. The results of implementing CP can serve as a basis for improving performance or efficiency [13].

SME fish processing units will produce main products or waste materials, both in the form of solid, liquid or gas. Waste material in the form of liquid and wastewater from the washing process. Solid waste in the form of fish heads, fins, scales, and stomach contents. Fisheries waste still contains nutrients that are not different from the main ingredients. Waste will cause negative externalities if not handled properly. CP is a strategy to minimize the occurrence of waste and reduce the occurrence of environmental pollution. Conceptually the attempt is 1E5R: Elimination; Reduction; Re-use; Recycle; and Recovery. The main objective of doing clean production is efficiency in the process of beginning to end production so that environmental sustainability is achieved [14].

In Pinrang Regency, South Sulawesi, there are 21 SMEs of fish processing unit that have been formed, 8 of which are still actively operating. The production volume of UKM UPI reaches 150 tons per year with the potential for waste as much as (20 to 30) % of the total raw material for processed fresh fish. “UKM 88 Marijo” with a production capacity of 46.3 tons per year is one of the SMEs of fish processing unit that has dynamics in handling and utilizing the waste it produces. The resulting waste will provide added value for SMEs after being handled creatively and innovatively. The adoption of clean production as an environmental prevention strategy is not only successful in reducing adverse effects on humans and the environment but also can increase the efficiency and sustainability of production [15,16]. The purpose of this research is to analyze the potential of waste and identify some of the best practices of clean products that are applied and their impact on the sustainability of the production of SMEs in fish processing units.

2. Methods

The study was conducted in December 2018 until April 2019. The object of the research was the SME Processing Unit of frozen boneless milkfish in Pinrang Regency, South Sulawesi, Indonesia. The location of the study was conducted purposively. This study uses qualitative methods, which are descriptive by using case study techniques. The qualitative approach emphasizes investigative efforts to examine naturally (natural) phenomena that are occurring in their overall complexity [17]. The technique of collecting data is through in-depth observation of research problems, semi-structured interviews, and documentation. The data analysis technique uses the Miles and Huberman models which consist of data reduction, data presentation, and conclusion drawing. The researcher used the triangulation technique to test the validity and credibility of the data obtained. Data reduction to select
data that has been collected from the field according to the needs or predetermined categories. The next step is to present data. In qualitative research, the presentation of data can be done in the form of descriptions and brief descriptions to be able to draw a conclusion [18].

3. Results and discussion

SME processing unit of frozen boneless milkfish in Pinrang District at the beginning of its operation did not necessarily apply the practice of CP. Generally SMEs process in open spaces under the house. This invites wild animals such as flies, dogs, and chickens to arrive. The processing of boneless frozen milkfish that has been carried out has not yet applied the principle of sanitation and hygiene. Disposal of liquid waste into open sewers that flow into rice fields also causes pollution which invites protests from neighbors as well as conflicts over rice field owners. Potential conflicts occur as happened in the gold mining area [19]. In the beginning, SMEs have not yet handled solid waste that is produced optimally so that it is wasted. Slowly, SMEs owners realize that fish processing, which is one of the forms of business activity, cannot be separated from environmental influences, both directly and indirectly.

SME owners actively coordinate with government agencies and related stakeholders to support the progress of their business. Slowly, UKM 88 Marijo implemented the CP practice, supported by guidance and direction from various relevant agencies. Marijo UKM 88 applies the CP approach pattern according to UNEP (1999) in carrying out prevention and reduction of waste, namely with the 1E4R strategy (Elimination, Reduce (reducing waste at its source), Reuse (waste reuse), and Recycle (waste recycling), and Recovery (separation of an ingredient or energy from a waste) To make the application of clean production more effective, the National Clean Production Policy is set forth in 5R (Re-think, Re-use, Reduce, Recover and Recycle).

3.1. Clean production in the processing

The concept of CP which was earlier implemented by SMEs was to carry out Elimination, which is an effort to prevent the emergence of the waste directly from its source, starting from raw materials, production processes to products ready to be marketed. Clean production aims to prevent and minimize the formation of waste or environmental pollutants in all stages of production [19]. Sustainability considerations are related to areas such as energy and water consumption, waste control or the development of by-products [20]. To optimize efforts to prevent the emergence of waste, the SME of fish processing units applies the principle of Re-think (the concept of thinking at the beginning of operational activities), through improvements to conventional processing towards the implementation of GMP. The scope of GMP is divided into 8 aspects, namely the procurement of raw material inputs, design and production room facilities, employee health and hygiene, production process control, maintenance of processing facilities and sanitation, storage and transportation, product packaging and labeling, and administrative records and product withdrawal [21].

3.1.1. Aspects of procurement of inputs. SME of fish processing units uses raw material of milkfish with prime quality and applies cold chains from the receipt of raw materials until the product arrives in the hands of consumers. SME of fish processing units will return raw materials supplied by suppliers if they do not meet the agreed criteria. SME of fish processing units is very consistent in implementing GHP (good handling practices) which is a practice, provision, and steps to ensure the safety and suitability of food in each food chain, where it starts from the quality of raw material inputs. To guarantee the quality of raw materials, the SMEs UPI sets specifications for fresh milkfish that can be well defined and can be understood by suppliers, the purchasing, receiving, processing and storing of raw materials. Quality standards for fresh milkfish that will be used as raw material based on sensory attributes are by looking at the characteristics of the eyes, gills, mucus, meat and stomach, odor, and consistency. SME of fish processing units owners uses agreed standard and grade (quality class) to facilitate purchasing, handling, and processing [22].
SMEs use water raw materials that initially come from open wells. The use of well water in the production process does not guarantee the safety of its products. The SMEs then switched to using water from a hygienic source, namely the PDAM, but it was insufficient, until finally using groundwater (wellbore). The groundwater source used is equipped with a water purification treatment installation, to meet drinking water standards. SMEs even processes cooking water to be used at the stage of the final washing process of the product. SMEs use enough ice to guarantee the application of cold chains from receipt of raw materials to products arriving at the hands of consumers. Initially, SMEs bought bulk ice, then made their ice using PDAM water sources. The quality of ice used increases and saves the cost of purchasing bulk ice in the amount of approximately Rp.600,000 per month. SME of fish processing units uses equipment that is more energy-efficient. Some government aid equipment that uses high electrical energy such as; vacuum sealer was replaced with a hand sealer, large capacity and energy-intensive meatball making machine replaced with a manual process.

Both owners/managers and labours also constantly improve their knowledge and skills by actively participating in various training. SME of fish processing unit owners is committed to implementing CP practices. The integration of employees in the clean production process encourages them to increase their knowledge and skills in ensuring the innovation process is fully achieved. SME of fish processing units achieves sustainable production through the application of better management [23,24]. High levels of competence in identifying challenges have a significant influence on the implementation of CP [8,25]. Psychologically, the SME of fish processing units owners always direct and encourage anyone, both families, employees, researchers, and visitors involved in the production process and support the practice of implementing CP. The functions of culture, behaviour and mindset of employers and employees in SME of fish processing units affect the performance of awareness promoting the CP [26].

3.1.2. Design and production room facilities. SMEs of fish processing unit develops production facilities according to production requirements so that they meet sanitation and hygiene standards. SME of fish processing units has establishes designed the production room at 3 times, starting from using open spaces, moving to semi-permanent buildings, until now it has used permanent buildings. Figure 1 shows the SME of fish processing unit layout.

![Figure 1. Lay Out of “UKM 88 Marijo”](image-url)
3.2. Solid waste management

The main types of waste found in the fisheries processing industry are blood, skin, fish head, scales, or leftover meat attached to the bone [27]. Solid waste caused by processing boneless milkfish is provided; middle fish, fine thorns, fish fins, fish scales, and fish entrails. According [28] the total yield of edible meat (77.2%) is the largest portion. The stomach contents accounted for 9.9%, bones with sticky meat were 11.3% of the total fish weight, and also parts containing 1.6%. Percentage of waste distribution produced in Figure 2. SMEs further process the remaining production process materials to reduce environmental pollution problems. Steps to utilize solid waste by reusing it through physical, chemical or biological processing. The SME processes waste in the form of (1) boneless milkfish that fails in the process of becoming a fish meatball product; (2) milkfish bones become fishbone stick products; (3) fish spines and fins become shredded milkfish. SMEs sell stomach contents, namely milkfish intestines for Rp. 50,000 per package. SME owners and employees use gills and other fish digestive organs as feed; catfish, geese, and ducks. Milkfish waste has the best alternative use, only fish scales are thrown into landfills. SME owners create the same work with employees to be responsible for implementing clean production.

![Figure 2. Percentage of Boneless Milkfish Distribution [27].](image)

3.3. Liquid waste management

Food industry liquid waste is one source of pollutants for the environment. These pollutants are generally in the form of suspended or dissolved organic matter in the form of carbohydrates, fats, proteins, and vitamins. Industrial wastewater is water originating from a series of production processes that contain components and if disposed of into an environment without proper management it can disrupt the recipient's water body [28]. Most of the food industry liquid waste can be handled with biological systems. SME fish processing units first conduct filtration of liquid waste produced before disposal. Filtering liquid waste will remove most of the suspended solids, dissolved material and for filtering nutrients (nutrients) in the form of nitrogen and phosphorus. Filtering will reduce or reduce waste deposits at the source. SMEs will dispose of liquid waste that has been free of solids by first flowing it to the catfish pond, then to the sewer to the rice fields. This liquid waste has the potential to become a natural organic fertilizer that fertilizes rice in the field.

3.4. Diversification of SMEs products

SMEs diversifies its products by recovery, reclaim, and recycle solid waste. SMEs efforts to take materials that still have the economic value from waste, then proceed to the production process with or without physical, chemical and biological treatments. The values of input and output of SMEs by diversifying products can be seen in figure 3. The productivity of SME of fish processing units if only producing boneless frozen milkfish is 106.69%. SME of fish processing units diversifies its products by producing shredded milkfish, milkfish crackers, milkfish meatballs, and milkfish bones stick, so that their productivity increases to 111.66%. The profits obtained also increased by 82.12%, from Rp.55,996,000 to Rp.101,978,000.
Figure 3. Input Costs and Output Values of Diversified Products of SMEs Fish Processing Unit.

The technology used in this clean production concept uses several modifications at each stage of the production process, thus benefitting in terms of reducing the number of raw materials, reducing energy, and reducing the waste produced [30]. Flowchart of UPI SME waste utilization can be seen in figure 4.

3.5. Competitiveness of SME fish processing units
At the end of 2013, the SME fish processing units received a visit from the LS-Pro-HP Team to evaluate the production process of boneless milkfish for their eligibility to obtain SNI Certificates. The conditions for obtaining SNI are also prepared. These requirements include the production process Standard Operating Procedure, processing facilities (factories) according to the Good Manufacturing Practice standard, employees are equipped with knowledge and skills. His efforts were not in vain, “UKM 88 Marijo” succeeded in getting SNI Certificate for boneless milkfish products on June 16, 2014. “UKM 88 Marijo” is the only processing unit for boneless milkfish that has obtained SNI certificates in Indonesia. Since obtaining the SNI Certificate, the volume of production of “UKM 88 Marijo” has increased. In 2012 the production volume of 15,074.5 kg has doubled in 2014, amounting to 31,600.0 kg. Production volume in 2018 increased to 43,550 kg.

The dynamics of the application of clean production by SME of fish processing unit provides significant progress and results. The SME of fish processing unit managed to get an extension of SNI
certification for boneless milkfish products which was valid until 2020. Some innovations such as processing of milkfish envelopes were also successful in obtaining SNI certificates. Processing of solid waste in the form of thorns becomes shredded milkfish thorns which are currently in the process of obtaining SNI certificates. Certain patenting a product or technology, designing a new product, or developing a new distribution channel can only offer the organization a temporary competitive advantage because sooner or later, competitors can imitate or improve innovation, which makes profits disappear. Success in finding something new allows the organization to continue to gain a competitive advantage in the long run.

Clean production provides an optimistic impact on manufacturing competencies, environmental and economic performance that is significant to the sustainability of production. Also, economic performance is identified as an end in production sustainability, which can be significantly improved by competency and environmental performance [26, 31]. The SMEs equips economic development through the addition of development funds and diversified processed products. The waste treatment provides opportunities for workers to obtain additional income. Workers can also take waste to be processed into additional family food and feed for livestock raised.

4. Conclusion
The clean production strategy is a key method for harmonizing economic interests and maintaining the environment. By implementing a clean production strategy in developing its business, the SME can benefit from: (1) Increasing competitiveness and business activities can also be sustainable; (2) By considering environmental aspects in each production process activity on an ongoing basis, the company obtains economic benefits by increasing effectiveness and efficiency in all aspects; and (3) SME can reduce production costs and waste treatment costs and simultaneously reduce the occurrence of environmental damage and pollution. Clean production implemented by SME involves efforts to improve the efficiency of the use of raw materials, supporting materials and energy in all stages of production. By applying the concept of clean production, natural resources can be more protected and utilized sustainably. In short, clean production provides two advantages, first efficiency in the production process; and second is minimizing the formation of waste so that it can protect the preservation of the environment. Continuous creative and innovative efforts are still needed to be able to process and process waste, especially for fish scales that have not been utilized.

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