Fisheries waste handling to enhanced fishers society economic growth: blue growth initiative perspective

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Abstract. Residual waste processing is an alternative to enhance coastal communities capabilities. This is one of the blue growth initiative programs. Fisheries waste forms are heads, bones, scales, fish entrails, or shells. The purposes of this observation are to provide an alternative way to handling waste produced by scallops to reduce waste, calculate waste treatment product, processing waste shell value and estimate waste processing revenue. The research method uses quantitative descriptive method with a case approach to the management of scallops waste shells in Batang District in Central Java Province. Production of scallop shells in Batang District which can be processed into Ca flour is estimated as much as 9.17 tons per year. Gross income approximately IDR 45,788,080.00 per year. It is an alternative product as a community side job around the shellfish waste landfill area and resolves the problem of shell waste in Batang District.

1. Introduction

In Asia, fish are supplies community food sources of protein about 20%. Along with population and economic growth, by 2030 fishery food consumption in Asia is estimated to increase about 30% [1]. Food and Agricultural Organization (FAO) declared Blue Growth Initiative (BGI) to help developing countries and implemented new agenda as a global connection between the fishing capture and aquaculture, life and food systems, and economic growth derived from the service of aquatic ecosystems.

This program was also leading to the application Code of Conduct for Responsible Fisheries (CCRF) and ecosystem approach to fish capture and aquaculture. This is a reflection of several Sustainable Development Goals purposes, with main target damage prone coastal area and coastal society that depends on natural resources around this area. The ecosystem is already at a stress level due to pollution, habitat destruction, overfishing, and resources exploitation activities that are harmful to aquatic ecosystems [2].

Blue Growth Initiative (BGI) was declared in 2013 by Food and Agriculture Organization of the United Nations (FAO). BGI purposes are strengthening coastal communities and improving the productive potential of fisheries and aquaculture in relation to maintaining food security, reducing poverty and regulating the sustainability of aquatic life [3]. One of the goals of the BGI is the
formation of “Blue Communities” in the target country and increase 30% of the community welfare and enhance their ability to manage natural resources ownership. BGI cooperates with 10 developing countries, namely Cabo Verde, Madagascar, Seychelles, Senegal, Kenya, Mauritania, Morocco, Algeria, Bangladesh, and Indonesia [2].

Resources management not only covers fishing capture and aquaculture activities but also manages fisheries waste products (waste management). The remaining fisheries waste products are classified as animal by-products [4]. Fisheries residual waste management offers an alternative way to resolve the pollution and increase the traditional coastal communities income. Fisheries waste can be in the form of heads, bones, scales, fish entrails, or shells.

According to FAO [2], Indonesia is the second largest fishing producer after China, with production 6,016,525 metric tons in 2014. One of explored fisheries commodities is mollusks, such as sea shells which have potential as an export commodity [5]. In Indonesia, fishing captured activities is a crucial livelihood for residents who lives surround coastal or freshwater area such as rivers, lakes, reservoirs, and swamps. Fishing results leave residual waste and pollute the landfills around the fishing base. It can cause skin and respiratory disease to spread. This problem must be handled sustainably in order to reduce the threat of spreading disease. Shells are used to create accessories and decorations [6]. Shellfish contain high calcium (Ca) content and useful for animal feed, especially poultry farming such as chicken, duck, quail, and etc [7].

The livestock industry in Indonesia is still dominated by poultry farming. Production of animal farm feeding allocated about 83% for poultry, 11% for aquaculture, and 6% share allocation is for pig and cattle farms [8]. Animal feed material in Indonesia, such as fish or shellfish powder are imported from foreign country about 75% for a long time ago [9]. This phenomena leads to the high cost and price of animal farm feeding. Through the fisheries waste handling, hopefully, it can decrease the total amount of imported fish and shellfish powder raw material and provide shellfish waste added value. One of the areas in Central Java Province that has potencies to develop shellfish powder production is Batang District. Shellfish captured by fishers in Batang District is Asian Moon Scallop (Amusium pleuronectes).

The study objectives are providing an alternative way of scallop waste management, calculating waste handling production (Ca flour), to find the waste treatment product value, and predict total income per year from the Ca flour production.

The paper summarize literature review about sustainable development, blue economy, and animals by-products in chapter two. Then the methods are explained in the next chapter. The fourth chapter is the result and discussion that provide information about fishing gear which scallop captures in Batang Regency called Arad and also scallop production for the last eight years. The scallop waste treatment product and its value in Batang are calculated and discuss further in the fourth chapter.

2. Literature review

2.1. Sustainable development

Pathways to achieve rapid economic growth for countries in the world are aware of the effects of increasingly alarming exploitation of natural resources. Although economists in the past have included elements of the natural environment in their economic analysis, the attention of new environmentalists gave international attention around 1960s [10].

In 1984, an independent group was formed in the United Nations consisted of 22 people from developed and developing countries [11]. This team is called the World on Commission on Environment and Development [10]. The task of the Team is to identify a long-term environmental strategy for the international community. They submitted a report in 1987 during the World Conference on Environment and Development entitled “Our Common Future” which came to be known as the “Brundland report” in the name of the chairman, Norwegian Prime Minister Gro Harlem Brundtland. The report uses the term “sustainable development,” which is defined as development that
meets current needs by thinking that the capabilities of future generations may not be able to meet their own needs [11].

Sustainable development has a broad meaning, appearing multiple dimensions of sustainability. The first is towards reduction and liberation from poverty. Second, sustainability requires the need for conservation and strengthening of resources that can ensure poverty reduction to permanent. Third, it requires expansion of the concept of development which covers not only the fields of economic growth, but also social and cultural development. The fourth and most important is the integration of economic and ecological sides in decision making at all levels [12].

2.2. Blue economy
The definition of "Blue Economy" is very diverse, according to UNEP (2013) in Pauly (2018), the blue economy should be able to improve human capacity and social equality, in line with reducing environmental risks and ecological scarcity significantly. Pauli (2010) and UNEP (2013) in Pauly [13] highlight the conditions that it will be able to make economic resilience and more based on the local ability to shocks, such as economic and environmental shocks.

The concept of a blue economy is to respond to the present need for a holistic (holistic) management of marine and social natural resources [14]. The blue economy has a fundamentally sustainable aspect of its activity component, in principle, it must continue forever [13]. The roots of the blue economy is conceptually can be seen to the rear of the conceptualization of sustainable development. Which is a challenge for the use of natural resources at the same time also saves the economic and social objectives, which became the focus of the international community since the 1960s [13].

2.3. Animal by-products
Animal by-products are all animal body parts, parts of the animal's body, or products from animals that are not intended to be eaten by humans [15]. In England, Ireland, and Scotland, the residual waste from animal production is strictly regulated to protect human and animal health and the environment. This arrangement includes collecting, storing, delivering, handling, processing, use, and disposal. Even the marketing and export of these processed waste products and their derivative products are very tightly regulated.

The rest of the animal product yield is divided into three categories, category 1 is material that has very high risk, category two is a material high risk, and third is the group that has low risk. This third category includes waste from fisheries and other marine animals and various types of shells [4]. As an animal by-product, shellfish must also be handled and treated with the same standards as other animal by-products. So that the treatment or disposal of waste must go through facilities that have a license to carry products in this category.

3. Method
The study method is quantitative descriptive with a case approach to the management of scallop shell waste in Batang Regency. The data used is secondary data, namely the yearly number of arad fishing gear, yearly production of the catch, and the production value of scallop shells (Amusium pleuronectes) in Batang from 2010 to 2017. Secondary data gathered from Batang District Fisheries and Marine Department. The data were analyzed with descriptive statistics quantitative approach to calculate the scallop shell waste. Then become an estimation basis of production waste treatment, value from results of processing waste into scallop shell flour (Ca flour) and predict per year revenue generated from the handling process.
4. Result and discussion

4.1. Fishing gear and scallop production in Batang district

Fishing captured is the main livelihood of people who live on the coast, as well as in Batang District, Central Java. Batang District itself has five Fish Auction Points (TPI). Of the five TPI, only 1 TPI is located at the Port of Coastal Fisheries, namely PPP Klidang Lor. While the other four are only Fish Landing Bases (PPI), namely West Roban PPI, East Roban, Siklayu, and Celong with a small fish landing capacity. The use of the fishing gear is not too varied, recorded in the data of the Department of Fisheries and Maritime Affairs of Batang, namely gillnet, bubu, arad, trammel net, and cantrang fishing gear. Scallop shells (Anusium pleuronectes) are caught using arad fishing gear which is a catch that alternates seasons with catching shrimp [16] and [17]. The number of arad fishing gear in Batang District fluctuated from 2010 to 2017 in the range of 400 fishing fleet units.

![Source: Batang District Fisheries and Marine Department, 2018](image1.png)

**Figure 1.** Arad fishing gear in batang district from 2010-2017

![Source: Batang District Fisheries and Marine Department, 2018](image2.png)

**Figure 2.** Scallop production in batang district from 2010-2017
Based on the number of arad fishing gear in Batang District, arad fishing gear per unit can produce 69.05 kg of scallops on average. With a production value of IDR 252,789,000.00 per year. Even though the production value is only 0.2% from total fishery production value in Batang District, the remaining waste produced leaves problems that need to be addressed.

Catching scallops leaves excessive shellfish waste because the sellers who buy will peel the meat from the shell and throw away the shells. There are 3 types of shelled scallop shell products, namely the whole shell (taken all the inside of the shell), the adductor muscle is taken or called Rhoe Off, and the third part is taken from the muscle and the gonad, which is called Rhoe On. Products like this have a share of exports to Asian and European countries. Meanwhile, local markets are usually sold whole without peeled. The price per kg of shell scallops is between IDR 35,000.00 - IDR 45,000.00 for the Rhoe Off and IDR 30,000.00 - IDR 35,000.00 for the Rhoe On. Meanwhile, the whole peeled ones were only IDR 20,000.00– IDR 25,000.00. For 1 kg of shelled scallops with a size of over 5 cm, the weight becomes 550–600 grams after being whole shelled (60% of the initial weight). And after taking the adductor muscle, it weighs 300 - 350 grams (about 35% of the initial weight). Meanwhile, 1 kg of scallops with a shell size of 4–4.5 cm after being whole shelled weighs 350-400 grams. The scallops sold at PPI Roban Barat, East Roban, and Celong are generally peeled for sale to collectors in Pemalang Regency [17]. The residu from this peel creates a landfill problem that has turned into a pile of garbage over the years. The following is a picture of the scallop shell products traded at TPI Batang District.

![Whole Meat](image1)
![Rhoe On](image2)
![Rhoe Off](image3)

Figure 3. Scallop products (*Amusium pleuronectes*)

![Figure 4. Scallop shell (*Amusium pleuronectes*) waste in PPP Roban, Batang District](image4)
4.2. Scallop waste handling

Based on research conducted by Agustini, et al. [18], shellfish waste is processed into flour which can be of more use value to be mixed in foods such as cookies (pastries) or nuggets. However, for shellfish flour that is processed to be mixed into food, it is the waste of new shells. Meanwhile, the shells that have been buried for years are more appropriate to be processed into animal feed. Clamshells have micro calcium carbonate (CaCO$_3$) compound of about 98.7%, a very high calcium carbonate compound compared to eggshells, limestone, ceramics, and other materials. The high level of calcium carbonate in the shells can be seen from the level of hardness. The harder the shell, the higher the calcium carbonate content [19]. Based on this research, the calcium (Ca) content in shellfish is very high so it is good for the growth of laying poultry such as chickens, ducks, quail and other livestock such as cows and so on [19] and [7].

| No. | Scallop Information                        | Value   |
|-----|------------------------------------------|---------|
| 1   | Total production in 8 years (ton)         | 256.45  |
| 2   | Shell waste in 8 years (ton)              | 135.92  |
| 3   | Waste as Ca Flour in 8 years (ton)        | 73.26   |
| 4   | Scallop waste per year average (ton)      | 32.06   |
| 5   | Shell waste average/year (ton)            | 16.99   |
| 6   | Waste as Ca Flour/year (ton)              | 9.16    |
| 7   | Total income/year (IDR)                  | 45,788,080 |
| 8   | Average income per month (IDR)            | 3,815,673 |

Source: Data processing, 2020.

The waste of shellfish collected from the stripping is 53% of the total catch weight of scallops [19]. Meanwhile, the yield of shellfish flour (Ca flour) from the original condition was 53.9%. The total production of scallops from 2010 to 2017 in Batang District was 256.45 tons [20], so the collected shellfish waste was around 135.92 tons. If average, the production of scallops is 32.06 tons per year with a waste of 16.99 tons per year. Waste that is not handled every year will accumulate and have a bad impact on the surrounding environment. By processing the waste into Ca flour, this problem will be reduced and it has a sale value. Waste can be processed with a yield percentage of 53.93% or per year can produce as much as 9.16 tons of Ca flour from shells. When added with the waste that has been buried, it means that an additional 73.3 tons of Ca flour can be produced. The price per kg of shellfish waste if purchased is IDR 2,000.00/kg [19]. The resulting Ca flour can be sold for IDR 5,000.00/kg. Then the gross income from the sale of scallops Ca flour per year is IDR 45,788,080.00. Per month income is around IDR 3,815,673.00. This is the value of the shell waste that is produced into Ca flour and has the potential to increase the income of fishers living around the coastal area. The source for the scallop shells does not only come from Batang District. However, it can also be imported from other areas such as Kendal, Pemalang, and Brebes. This is an alternative to maintain the continued production of Ca flour from the scallop shells.

A similar Blue Growth Initiative program has also been undertaken in Uganda by FAO. This organization is working with the local government to develop a program to make MUKENE fish powder (fish meal) from the rest of the fishermen's catch to help overcome the diminishing income of fishermen and at the same time to overcome food malnutrition in children at the same time [21]. In the past, Ugandan fishermen processed their catch and disposed of any unused waste as waste. However, now they can sell it to processors who process the waste into flour products. This flour is rich in calcium and other minerals as well as vitamins which can be sautéed or steamed as a food flavor enhancer [21]. So that here can also be offered the process of making flour for animal feed and flour in addition to food. Flour for animal feed can be produced by utilizing waste that has been hoarded for
years. Meanwhile, flour for additional food can be made from fresh shell waste obtained from fishers captures.

This potential can be developed to provide job diversification for coastal communities around the waste dumping area. With the amount of waste that can be overcome, of course, it will also help maintain environmental quality and improve public health. Of course, cooperation between the capital owner, government, academic, non-governmental organizations, and all relevant stakeholders so that the potential development initiatives can be realized.

5. Conclusion
Shellfish waste in Batang District can be managed and processed to be more useful, namely to become shellfish flour (Ca flour). The production of scallop shells in Batang that can be processed is estimated to be able to produce as much as 9.16 tons per year. With gross revenue of IDR 45,788,080.00 per year. This has great potential to increase the income of the community in the vicinity of the shellfish scallop landfill area while addressing the problem of shellfish waste in Batang District. The source for the shell of a scallop is not only found in Batang District. But it can also be imported from other regions such as Kendal, Pemalang, also Brebes. This is an alternate option to sustain the flour Ca scallop shells production.

Acknowledgments
The authors would like to thank the Department of Fisheries and Marine Affairs Batang District for the cooperation and shared information.

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