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Turning Fishery Waste into Economic Opportunities: Women's Participation and Circular Practices in Sidamukti Village, Indonesia

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Abstract: The Fishery-waste utilization presents an opportunity to connect environmental resource management with inclusive economic development in rural communities. However, the potential of fish-processing residues to create economic opportunities for women while supporting circular practices remains insufficiently explored at the community level. This study examines how fishery-waste utilization creates economic opportunities for women while supporting circular practices in Sidamukti Village, Cilacap, Indonesia. The study employs a qualitative case study based on program documentation of the Sidamukti Smart Eco-Fisheries Village, a community development initiative implemented through the corporate social responsibility program of PT Pertamina Patra Niaga Fuel Terminal Lomanis. The findings show that eel-processing residues, particularly heads, bones, and fins that were previously discarded, were transformed into value-added food products through the participation of a women-led fish-processing group. This process created economic opportunities through skills development, product diversification, market access, and additional household income. The findings also indicate complementary circular practices through the conversion of organic waste into maggot biomass, which is subsequently utilized as an alternative feed input for fisheries and livestock. These activities were supported by organizational formalization, financial management, product legalization, marketing development, and institutional partnerships. The study demonstrates that fishery-waste utilization can function as a connecting pathway between resource recovery and women's economic opportunities when embedded within community organizations and supported by market and institutional arrangements. The findings provide an empirical perspective on how community-level circular practices can contribute to local economic value creation without treating circularity solely as a technological or environmental intervention.

Keywords: Fishery waste; Women's participation; Circular practices; Rural fisheries.

1. Introduction

Fishery resources constitute an important source of livelihood and economic activity for rural communities, particularly in areas where fisheries are closely connected to local economic systems. However, the availability of fishery resources does not automatically translate into inclusive economic opportunities when communities remain concentrated on primary production and have limited capacity to create additional value from available resources (Gordon, 2019). Sustainable fisheries development therefore involves not only increasing production but also improving the ability of local communities to diversify economic activities, add value to fishery products, and utilize resources more efficiently (Aguado et al., 2016). Value addition and resource recovery are increasingly recognized as important components of sustainable livelihood development because they can extend the economic value generated from primary resources while reducing resource losses and environmental pressures.

One of the challenges associated with fisheries development is the generation of residual materials from fish processing (Coppola et al., 2021). Fish heads, bones, fins, skin, and other processing residues are frequently treated as waste even though some of these materials retain nutritional and economic value. Fish-processing waste should therefore not be viewed solely as an environmental burden, but also as a potentially recoverable resource that can be transformed into new products and sources of economic value (Stevens et al., 2018). The challenge, particularly in rural communities, lies in the capacity to transform these residual materials into productive resources. Such transformation requires more than technological solutions; it may depend on local knowledge, skills, organizational capacity, access to markets, and the participation of community members in value-added activities (Li et al., 2019).

This issue also has an important gender dimension. Women have long participated in fisheries-related activities, particularly fish processing, marketing, household-based production, and other activities that support family livelihoods (S. Harper et al., 2023). Nevertheless, women's participation in fisheries does not necessarily imply equal access to productive resources, skills, markets, and income-generating opportunities. Women's economic participation becomes more meaningful when women have opportunities to develop productive

capabilities, participate in value creation, access markets, and generate or contribute to household income (Kabeer, 2016). In this respect, the utilization of fishery-processing residues may provide an opportunity to expand women's involvement beyond traditional supporting roles toward more productive and value-adding economic activities.

At the same time, the utilization of residual materials has increasingly been associated with circular economy thinking. Circular economy approaches seek to reduce resource loss and retain the value of materials through reuse, recovery, recycling, and the development of new productive uses for materials that would otherwise become waste (Zink & Geyer, 2017). In fisheries, circular practices can include the conversion of processing residues into food products, feed, fertilizers, or other value-added products. However, circularity in rural fisheries should not be understood solely as a technological process of material recovery; it also involves the social actors, capabilities, organizational arrangements, and economic opportunities that enable previously discarded resources to re-enter productive activities (Ayeh et al., 2025).

The intersection between these issues reveals an important academic problem. Research on fishery-waste utilization has generally emphasized technological processing (Aguado et al., 2016), product development(Rudovica et al., 2021), environmental benefits (Palmer & Brigham, 2016), and resource efficiency (Mojibul et al., 2022). Meanwhile, research on women in fisheries has commonly examined women's livelihood roles(Sarah Harper et al., 2017), participation, household income, and gender-related constraints (Koralagama et al., 2017). Although both strands of research recognize the economic potential of fisheries and the importance of resource utilization, they have less frequently been examined together at the community level. Similarly, research on circular economy in fisheries tends to emphasize resource efficiency and waste recovery, while the role of women as actors who participate in transforming residual resources into economic value remains comparatively less explored.

The research gap addressed in this study lies in the limited understanding of how fishery-waste utilization can simultaneously create economic opportunities for women and support circular practices within a rural fisheries community. Existing research tends to discuss fishery-waste valorization, women's economic participation, and circular practices as relatively separate areas. As a result, there remains limited empirical understanding of the process through which fishery-processing residues are transformed by community actors into value-added economic activities while contributing to more circular patterns of resource use.

This gap is particularly important in rural communities where economic vulnerability and resource-utilization challenges occur simultaneously. Examining the relationship between resource recovery and women's economic opportunities can provide a more integrated understanding of circular practices, not simply as mechanisms for reducing waste but also as potential pathways for inclusive local economic development.

The empirical context of this study is Sidamukti Village, Cilacap, Indonesia, where fisheries activities have developed alongside a community empowerment initiative implemented through the corporate social responsibility (CSR)/community development program of PT Pertamina Patra Niaga Fuel Terminal Lomanis (FT Lomanis). The broader program is known as the Sidamukti Smart Eco-Fisheries Village and forms part of FT Lomanis's social community development initiative.

The village provides a relevant setting for examining the research gap because it combines local fisheries potential with socioeconomic vulnerability. Program documentation identifies unemployment, agricultural laborers, low-income residents, elderly people, and small-scale fish farmers among vulnerable groups in the community. At the same time, fisheries activities in the village include eel (*Anguilla* spp.) aquaculture and fish processing, creating opportunities for local value creation.

Within this context, fish-processing activities generate residual materials such as eel heads, bones, and fins. Before the intervention, these materials were disposed of at the village temporary waste disposal site rather than being further utilized. The program also facilitated the development of a community fish-processing group, Poklahsar Sida Rasa Tiga, which was formally established with 15 members. The documentation identifies women among the group members and records socioeconomic vulnerabilities including unemployment, low income, and household-based livelihoods.

The case also provides evidence of broader circular practices within the community development program. In addition to fishery-waste utilization, organic waste is managed through maggot cultivation, in which organic materials are converted into maggot biomass and subsequently used as an alternative feed input. The program documentation explicitly identifies this activity as a circular-economy-based waste-management practice and records approximately 2,700 kg of organic waste being managed annually through maggot cultivation. The coexistence of fishery-waste utilization, women's participation, and other resource-recovery practices within the same rural community provides an appropriate empirical setting for examining how environmental resource utilization can intersect with inclusive economic opportunities.

The novelty of this study lies in connecting fishery-waste utilization, women's economic opportunities, and circular practices within a single community-level analysis. Rather than examining fishery waste solely as

an environmental problem or women's participation solely as a livelihood outcome, this study examines fishery-waste utilization as a connecting process through which previously underutilized materials can be transformed into economic opportunities for women while supporting more circular patterns of resource use.

The study therefore shifts the focus from the technical conversion of fishery waste toward the social and economic process of resource valorization, particularly the role of women in transforming residual fishery materials into value-added activities. By bringing together resource recovery, women's economic opportunities, and community-level circular practices, this study contributes an empirical perspective on how circular practices can become embedded in local livelihood development rather than being treated solely as an environmental or technological intervention.

Accordingly, this study focuses on examining how fishery-waste utilization creates economic opportunities for women while supporting circular practices in Sidamukti Village, Indonesia.

2. Discussion

2.1 From an Informal Activity to an Organized Women's Fish-Processing Group

The development of fishery-waste utilization in Sidamukti cannot be separated from the development of the community organization involved in fish processing. The program documentation shows that, before the intervention, there was no formally established group of women involved in fish processing with legal recognition from the village government. This condition changed following the establishment of Poklahsar Sida Rasa Tiga through the Decree of the Head of Sidamukti Village Number 141/08/19.03-01/II/2025 concerning the establishment of the Fish Processing and Marketing Group "Sida Rasa Tiga". The group subsequently had 15 active members.

The formation of the group represented an institutional development from relatively informal economic activities toward an organized community-based fish-processing activity. The program documentation records that, prior to institutional strengthening, group activities were more limited and the organizational structure did not yet have clearly differentiated functions. Following the development of the program, activities were organized into several functions, including fish cultivation, independent feed production, waste management and maggot cultivation, and fishery-product processing through Poklahsar as a supporting business unit.

The establishment of the group is important for understanding women's economic opportunities because it created an organizational space through which women could participate in fish-processing activities. The document identifies all members of Poklahsar Sida Rasa Tiga as women from Sidamukti Village with different occupational backgrounds. The group processes local fishery products, including eel, catfish, tilapia, and gourami, into products such as eel sambal, fish floss, fish nuggets, and fish crackers. The document explicitly positions the group as part of the effort to increase the value of fishery products and strengthen women's roles in productive economic activities.

Thus, women's economic opportunities in this case did not begin directly with the sale of fishery-waste products. They were preceded by the creation of an organized group, formal recognition, and the development of productive roles within the local fisheries value chain. This institutional foundation provided the setting in which women could subsequently participate in value-added processing and resource utilization.

2.2 Transforming Fishery Waste into Value-Added Products

The central finding concerning fishery-waste utilization is the transformation of materials previously treated as waste into products with economic value. The processing of eel into unagi generates residual materials consisting of eel heads, bones, and fins. Before the intervention, these materials were not utilized and were disposed of at the temporary waste disposal site in Sidamukti Village. The program documentation identifies this condition as a failure to optimize an existing local resource because the residual materials still had potential for further utilization.

In 2025, FT Lomanis provided training for women involved in the fish-processing group to utilize these residual materials. The training introduced techniques for processing eel-processing residues into food products. The documented products include eel-fin crackers, chips made from eel fins and bones, and sambal made from eel heads.

The change can therefore be represented as a simple transformation:

Eel processing → residual materials → processing skills → value-added food products

Before the intervention, the residual materials ended at the disposal stage. Following the intervention, they were redirected into a productive activity. This represents an important change in the use of local resources because the economic process was extended beyond the primary production and processing of eel to include the utilization of materials that had previously been discarded.

The document further reports that the utilization of these residues was not limited to a training activity.

The women continued to develop the products and expand their marketing networks. The activity was reported as continuing at the time of documentation, with the group developing its skills and expanding marketing networks.

The finding indicates that fishery-waste utilization in Sidamukti operates through a process of resource valorization. Materials that previously had no recognized productive function within the community were incorporated into a new value-creating activity. The significance of the process therefore lies not simply in reducing the volume of waste, but in changing the status of the material from discarded residue into an input for community-based production.

2.3 From Waste Utilization to Women's Economic Opportunities

The utilization of fishery waste created a direct economic opportunity for the women involved in the processing group. The program documentation explicitly states that the training enabled the women to sell products made from eel-processing residues and that the activity increased their economic income. The products included eel-fin crackers, chips made from fins and bones, and sambal made from eel heads. The document further states that the activity created a new source of income for their families.

This finding is important because the economic opportunity did not originate from an entirely new resource. Instead, it emerged from an existing material that had previously been treated as waste. The economic process can therefore be understood as:

Existing fishery activity → residual material → women's processing activity → value-added product → marketable product → additional income opportunity.

The development of economic opportunities was also supported by improvements in the group's access to product marketing. Before the intervention, the products produced by Poklahsar Sida Rasa Tiga lacked PIRT and halal certification, and the documentation reports that some products were rejected by shops and souvenir centers because of the absence of these requirements. FT Lomanis subsequently facilitated marketing training, product legalization, and improvements in product design and packaging. These interventions were intended to enable the products to meet quality and food-safety requirements and to expand their market reach from the local to the regional level.

The economic opportunity was therefore supported by more than the ability to produce goods. It also involved the development of capabilities required to make products commercially accessible. The marketing training covered product characteristics and value propositions, distribution strategies, social-media utilization, and customer relationship management. The document states that these capabilities were intended to support market access and contribute to the stability of group income.

The group also received training in simple financial management. Members were trained to record income and expenditure associated with the sale of processed fish products, including raw-material purchases, packaging, electricity, and other operational expenses. The training introduced simple cash-book practices that could be used to record daily, weekly, and monthly transactions. The Poklahsar also had a group cash balance of Rp925,000, which the document states was used to support production and marketing activities.

Marketing capacity was further strengthened through digital media. The program developed an Instagram-based social-media network for Poklahsar Sida Rasa Tiga, and women in the group received training to create marketing content. The documentation explains that the platform could be used to present products, communicate the group's activities, interact with consumers, receive feedback, and potentially expand market reach.

These findings show that the economic opportunity generated through fishery-waste utilization involved several interconnected elements: access to productive activity, processing skills, product development, market access, and income generation. The process was therefore broader than simply converting waste into products. It involved creating conditions under which women could participate in the economic value chain associated with those products.

2.4 Linking Circular Practices, Economic Opportunities, and Institutional Support

The utilization of fishery-processing residues in Sidamukti represents more than an effort to reduce the amount of waste disposed of by the community. The activity connects resource recovery with economic activities undertaken by the women's processing group. Residual materials from eel processing, particularly heads, bones, and fins, which were previously discarded, were redirected into productive activities through processing and product development. These materials were transformed into products such as eel-head sambal, eel-fin crackers, and chips made from eel fins and bones. The process indicates a shift from a linear pattern of production and disposal toward a practice in which materials that would otherwise become waste are reintroduced into productive activities.

The circular dimension becomes more evident when fishery-waste utilization is considered alongside the broader waste-management practices developed within the program. In addition to processing eel residues into value-added food products, the community developed organic-waste management through maggot cultivation. Organic waste is used as a substrate for maggot cultivation, while the resulting maggot biomass is subsequently utilized as an alternative feed input for fisheries and livestock. The program documentation explicitly describes this process as an integrated circular economic system connecting waste management with productive activities. The documented scale of this practice reached approximately 2,700 kg of organic waste managed per year.

These two practices demonstrate different pathways of resource recovery within the local fisheries system. The first pathway involves fish-processing residues being transformed into marketable food products, while the second involves organic waste being converted into maggot biomass and subsequently used as a productive input. Although the program documentation explicitly identifies the organic-waste-to-maggot activity as a circular-economy practice, the utilization of eel-processing residues is primarily described as an effort to utilize waste and create products with economic value. Therefore, the case is better understood as involving a set of circular practices rather than as evidence that the entire village economy has transitioned to a circular-economy model.

The economic dimension of these practices is closely connected to the participation of women in the fish-processing group. The documentation reports that the utilization of eel-processing residues created opportunities for women to produce and sell value-added products and contributed to additional household income. The economic opportunity was supported by efforts to improve product quality, obtain product certification, strengthen packaging and product presentation, and expand market access. Prior to these interventions, the group's products faced limitations in market access because they did not yet have PIRT and halal certification, with some products being rejected by shops and souvenir centers. The subsequent facilitation of product legalization, packaging, and marketing was intended to enable the products to enter wider markets.

The development of market capabilities further strengthened the connection between waste utilization and women's economic opportunities. Marketing training covered product characteristics and value propositions, distribution strategies, social-media utilization, and customer relationship management. These capabilities were intended to support market access and the continuity of group income. Women in the group were also introduced to the use of Instagram for product promotion and were trained to develop marketing content. The platform was intended to support product presentation, communication with consumers, feedback collection, and wider market reach. Thus, the economic opportunity generated through waste utilization was not limited to the ability to process residual materials. It also involved developing the capabilities required to connect the resulting products with consumers and markets.

The continuity of these activities was also supported by institutional and financial arrangements within the group. Poklahsar Sida Rasa Tiga was formally established through a village government decree and consisted of 15 active members. The group also developed a collective financial mechanism, with a recorded cash balance of Rp925,000 that was used to support production and marketing activities. In addition, the group received training in simple financial management, including recording income and expenditure related to raw materials, packaging, electricity, and other operational costs. These arrangements indicate that the utilization of fishery waste was embedded within an increasingly organized economic activity rather than operating as an isolated environmental initiative.

Institutional support also extended beyond the women's group itself. The program documentation identifies collaboration with the DPUKM of Cilacap Regency for continuing assistance related to institutional strengthening, product quality, and market access. Koperasi Mina Sidat was also identified as a strategic partner providing continuing assistance to the fish-processing group in developing the utilization of eel-processing residues. These forms of support provided an institutional environment through which the economic activities could continue to develop beyond the initial training intervention.

Taken together, the findings show that fishery-waste utilization in Sidamukti is connected to both economic opportunity creation and circular resource use through a combination of resource recovery, women's participation, market development, financial organization, and institutional support. The process begins with materials that were previously discarded, continues through women's participation in processing and product development, and extends toward market access and additional household income. At the same time, the broader organic-waste-to-maggot pathway demonstrates how residual materials can be redirected into productive inputs within the local fisheries system. The role of institutional and market support is important because the transformation of waste into economic value requires more than processing skills; it also depends on organizational capacity, access to markets, financial management, and continuing assistance.

Overall, the Sidamukti case indicates that circular practices can become connected to local economic opportunities when resource recovery is embedded within community organizations and supported by market and institutional arrangements. In this context, women are positioned not merely as recipients of a CSR

intervention but as participants in the transformation of residual fishery materials into value-added products. The process therefore illustrates how environmental resource utilization and local economic activities can intersect within a community-based fisheries development initiative.

3. Conclusion

This study examined how fishery-waste utilization creates economic opportunities for women while supporting circular practices in Sidamukti Village, Indonesia. The findings show that the utilization of fishery-processing residues developed from an activity focused on waste reduction into a community-based value-creation process. Residual materials from eel processing, particularly heads, bones, and fins, which were previously discarded, were redirected into productive activities through women's participation in processing and product development. This process enabled previously underutilized materials to become inputs for value-added products while creating additional economic opportunities for the women involved in the fish-processing group.

The findings further indicate that these economic opportunities were not generated through waste utilization alone, but through a combination of women's participation, skills development, product development, market access, and organizational support. The establishment and formalization of Poklahsar Sida Rasa Tiga provided an institutional space for women to participate in fish-processing activities, while product legalization, marketing development, financial management, and digital promotion supported the connection between production activities and market opportunities. Thus, the economic significance of fishery-waste utilization lies not only in the value of the resulting products but also in the creation of opportunities for women to participate more actively in local value-added economic activities.

The case also demonstrates the presence of complementary circular practices within the Sidamukti fisheries system. Fish-processing residues were transformed into value-added food products, while organic waste was converted through maggot cultivation into an alternative productive input for fisheries and livestock. The latter was explicitly identified in the program documentation as a circular-economy-based waste-management practice. These practices indicate that resource recovery can connect environmental management with local economic activities when residual materials are redirected toward productive uses rather than being treated solely as waste.

Overall, the Sidamukti case demonstrates that fishery-waste utilization can function as a connecting pathway between resource recovery and women's economic opportunities within a rural fisheries community. The process is strengthened when waste utilization is embedded within community organizations and supported by market, financial, and institutional arrangements. The study therefore contributes an empirical perspective showing that circular practices at the community level can extend beyond environmental objectives by creating opportunities for local actors to participate in value creation. However, the findings should be understood within the contextual boundaries of the Sidamukti case and the documented program activities; they do not imply that the entire village economy has adopted a fully circular-economy model.

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