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RICE MILL WASTE MANAGEMENT STRATEGY IN REALIZING A CIRCULAR ECONOMY BASED ON GREEN ECONOMY

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Abstract :

This study aims to analyze the strategy of rice mill waste management in order to realize a circular economy based on the green economy in Petiyin Tunggal Village. Rice milling waste such as husks, bran, and straw that have not been optimally utilized so far have great potential to be processed into value-added products. The circular economy and green economy approach is the foundation for creating a waste management system that is not only environmentally friendly, but also has a positive impact economically and socially. This research uses a qualitative method with a case study approach, through field observation, in-depth interviews, and documentation. The results show that around 65% of the rice milling waste in the village has been successfully managed productively, with the husk being used as an alternative fuel for drying grain and bran processed into local animal feed. Indicators of successful implementation of the strategy include an increase in household income by 20% from waste treatment results, as well as the formation of two community business groups that are active in circular economy activities. Suggested strategies include strengthening local institutions, waste treatment training, and collaboration with the private sector and the government. Thus, rice mill waste management can not only reduce environmental impact, but also encourage green economic growth at the village level.

Keywords: *Green Economy, Circular Economy, Waste Management.*

Abstrak :

Penelitian ini bertujuan untuk menganalisis strategi pengelolaan limbah penggilingan padi dalam rangka mewujudkan ekonomi sirkular berbasis green economy di Desa Petiyin Tunggal. Limbah penggilingan padi seperti sekam, dedak, dan jerami yang selama ini belum dimanfaatkan secara optimal memiliki potensi besar untuk diolah menjadi produk bernilai tambah. Pendekatan ekonomi sirkular dan green economy menjadi landasan dalam menciptakan sistem pengelolaan limbah yang tidak hanya ramah lingkungan, tetapi juga berdampak positif secara ekonomi dan sosial. Penelitian ini menggunakan metode kualitatif dengan pendekatan studi kasus, melalui observasi lapangan, wawancara mendalam, dan dokumentasi. Hasil penelitian menunjukkan bahwa sekitar 65% limbah penggilingan padi di desa tersebut telah berhasil dikelola secara produktif, dengan sekam dimanfaatkan sebagai bahan bakar alternatif untuk pengeringan gabah dan dedak diolah menjadi pakan

ternak lokal. Indikator keberhasilan implementasi strategi mencakup peningkatan pendapatan rumah tangga sebesar 20% dari hasil pengolahan limbah, serta terbentuknya dua kelompok usaha masyarakat yang aktif dalam kegiatan ekonomi sirkular. Strategi yang disarankan meliputi penguatan kelembagaan lokal, pelatihan pengolahan limbah, serta kolaborasi dengan pihak swasta dan pemerintah. Dengan demikian, pengelolaan limbah penggilingan padi tidak hanya dapat mengurangi dampak lingkungan, tetapi juga mendorong pertumbuhan ekonomi hijau di tingkat desa.
Kata kunci: *Green Economy, Ekonomi Sirkular, Pengelolaan Limbah.*

INTRODUCTION

Rice milling is one of the important sectors in the agricultural industry that plays a role in providing rice as a basic need for the community. However, these activities also produce large amounts of waste, such as husks, bran, and bran, which are often not optimally managed. If not handled properly, the waste can pollute the environment and cause ecological problems. Therefore, an effective waste management strategy is needed to support the concept of the circular economy and green economy (Sherly Puspa Dewi 2023).

Green economy is an economic development concept that is oriented towards environmental sustainability, resource efficiency, and social welfare. In the context of rice milling, the implementation of the green economy emphasizes the optimal use of waste to reduce negative impacts on the environment while creating added value. One of the approaches in the green economy is the circular economy, which is a system that focuses on reusing, recycling, and utilizing resources efficiently so that the waste produced can be minimized (Mohamad Jamaludin Malik, 2024).

The circular economy is an approach that focuses on the efficiency of resource use by recycling, extending the lifespan, and reusing products or materials that were previously considered waste. In the rice milling sector, this concept can be applied by converting waste such as husks into alternative fuels, bran as raw materials for the feed industry, and bran for nutritious food products. By implementing a circular economy, not only environmental problems can be reduced, but also new business opportunities that are more sustainable and highly competitive are created (Astuti, et al, 2020).

According to data from the Ministry of Agriculture, Indonesia produces around 13 million tons of rice husks per year, of which about 60% has not been optimally utilized. In addition, research shows that rice husks have a calorific value of 3,000–3,500 kcal/kg, so it has the potential to be an environmentally friendly biomass fuel. The implementation of this strategy not only contributes to reducing environmental impact, but also opens up new economic opportunities for local communities (Purba Sanjaya et al, 2014).

This research is unique and important because it focuses on the local context in Petiyin Tunggal Village, which has not received much attention in the study of circular economy-based agricultural waste management. In contrast to previous research that tends to emphasize technology or large-scale industrial aspects, this study focuses on community-based approaches and local

potential to form a waste management system that is inclusive, sustainable, and in accordance with village characteristics. Thus, the results of this research are expected to be a model for village-based green economy development that is applicable and has a direct impact on community welfare.

Petiyin Tunggal Village was chosen as a case study in this study because it is one of the areas that has considerable rice milling activities, but still faces challenges in its waste management. Through this research, it is hoped that effective strategies can be found to optimize the use of rice milling waste, thereby supporting sustainable economic development that is in line with the principles of the green economy. Although the concept of a circular economy offers many benefits in the management of rice milling waste, its implementation still faces various limitations. One of the main obstacles is the lack of adequate infrastructure and technology to effectively recycle waste. In addition, the low public awareness and knowledge about the economic potential of rice milling waste is also a challenge in encouraging the use of waste as a sustainable economic resource. Therefore, synergy is needed between the government, the private sector, and the community in developing policies and technologies that support more efficient waste management and high economic value.

THEORETICAL BASIS

The green economy and the circular economy are two approaches in economic development that focus on environmental sustainability and social welfare. These two concepts complement each other in an effort to achieve sustainable development that not only prioritizes economic growth, but also environmental sustainability and social justice. In the context of rice milling in villages such as Petiyin Tunggal, these two approaches provide a very relevant framework to address the problem of agricultural waste that has not been handled optimally. The green economy encourages the sustainable and inclusive use of local resources, while the circular economy provides a practical direction for recycling and processing waste into value-added products such as biomass fuel, animal feed, or compost. By integrating these two approaches, villages can not only reduce pressure on the environment, but also create new economic opportunities based on the independence and innovation of local communities.

Green Economy

Green economy according to the United Nations Environment Programme (UNEP) (1992) is an economic concept that aims to improve the welfare and social equality of the community while significantly reducing the risk of environmental damage. This concept focuses on a low-carbon economy, resource efficiency, and social justice. Another opinion from Robert P. Borrong (2009) Green economy is a coordinated movement that includes economic growth, environmental sustainability, poverty reduction, and social involvement through the sustainable development and utilization of global resources. From this opinion, it can be concluded that the green economy is an economic system that is not only oriented towards financial profits, but also

responsible for the environment and social welfare (Khoirunisa Wahida & Hoirul Uyun, 2023).

Other experts also gave their views on the green economy. For example, in the book Blueprint for a Green Economy by Pearce, Markandya, and Barbier, a green economy is defined as a system of economic activities related to the production, distribution, and consumption of goods and services that lead to improved people's well-being in the long term, without exposing future generations to significant environmental risks and reducing the shortage of environmental resources (Anwar, 2022). This approach emphasizes the importance of a balance between economic growth and environmental sustainability, so that development is not only oriented towards short-term gains, but also considers its impact on future generations. Thus, the green economy is not just a concept, but a must in realizing sustainable and inclusive development.

The implementation of the green economy in various sectors is an important step to reduce pressure on natural resources while encouraging sustainable economic growth. One of the sectors that has great potential to apply green economy principles is the agricultural sector, especially in the management of agricultural waste products. Agricultural waste, which has been seen as an environmental problem, actually holds high economic value if managed correctly. For example, rice husks, straw, and bran from rice milling can be used for various purposes, ranging from biomass fuel, organic compost making, to environmentally friendly creative industry raw materials (Mahrus, et al, 2022).

With this approach, the green economy plays a role in changing society's paradigm from a linear consumption and production pattern (take, use, throw away) to a circular economy pattern, where products and materials are maintained in the economic cycle for as long as possible. This not only extends the life of the use of resources, but also reduces waste and pollution. Green economy-based rice milling waste management supports the creation of new business ecosystems in rural areas that are more independent, innovative, and highly competitive, while strengthening local economic resilience and improving environmental quality (Illankoon, et al, 2023).

Green economy in rice milling waste is one example of the implementation of the green economy concept. Rice milling waste, which is usually considered waste, can be converted into an alternative energy source that is environmentally friendly through the recycling process. By harnessing this waste, we not only reduce our negative impact on the environment, but also create new economic opportunities in the field of renewable energy. In addition, the green economy can also create new jobs and improve the welfare of the community as a whole (Rahmadi A, et al, 2021).

Through the use of rice milling waste as an alternative energy source, we can also reduce our dependence on fossil fuels that are running low. Thus, the green economy in rice milling waste not only provides environmental benefits, but also contributes to global efforts to reduce greenhouse gas

emissions and address climate change (Mustamu, 2022). By continuing to develop this green economy concept, we can create a more sustainable environment and provide long-term benefits for future generations.

Circular Economy

Circular economy is an economic concept that aims to reduce the waste of natural resources and minimize waste by designing products to be recycled, reused, or restored after use. The main principle of the circular economy is to change consumption patterns from a linear (take-make-discard) model to a more sustainable model, where the products and materials remain in the economic cycle for as long as possible.

The circular economy became popular around the 1990s to address the challenges of economic development and reduce the excessive use of natural resources. The main point for circular economy is to take advantage of the use of manufactured goods and to balance economic growth with the development of the environment and natural resources. The goal is to create a more sustainable economic system by reducing dependence on limited natural resources and minimizing negative impacts on the environment (Stephan, 2022).

One of the main principles of the circular economy is the concept of "reduce, reuse, recycle", which prioritizes waste reduction and reuse of existing products. By extending the useful life of goods and repairing damaged products, the circular economy can help reduce the amount of waste produced by the community. In addition, by paying attention to the product life cycle from the beginning of production to the end of recycling, companies can design products that are more environmentally friendly and easier to recycle. Thus, the circular economy can be an effective solution in maintaining environmental and economic sustainability in the future (Permata, et al, 2024).

The implementation of the circular economy is not only focused on large industrial sectors, but is also highly relevant at the community and small business level. For example, in the agriculture and food processing sectors, organic waste can be reprocessed into compost or bioenergy, which is then used to support subsequent production activities. This model creates a more self-reliant and resilient local economic ecosystem, where waste is no longer considered a burden, but rather as a new resource of economic value. Thus, the circular economy is able to encourage innovation and new business opportunities, while strengthening community-based economic resilience (Stoyanova-Koval, et al, 2023).

In addition, the concept of the circular economy also changes the role of consumers in the economic system. Consumers no longer only act as end-users who dispose of goods after use, but rather play an active role in extending the life cycle of products through activities such as repairing, renting, or recycling goods. Education and changes in people's mindset are the keys to the successful implementation of the circular economy. Through collective awareness, both from individuals, communities, and the industrial sector, transformation towards a more sustainable economy can be achieved. Therefore, collaboration

between governments, business people, and communities is very important in accelerating the adoption of circular economy models in various sectors of life (Sijtsema, et al, 2020).

Through this approach, the community and companies can contribute positively to maintaining environmental sustainability. By promoting circular economic practices, we can reduce pressure on natural resources and minimize negative impacts on the environment. By doing so, we can create a cleaner, healthier, and more sustainable environment for future generations.

RESEARCH METHODS

Research Methods and Types

This study uses a qualitative approach with a case study method, which aims to gain an in-depth understanding of the rice mill waste management strategy in Petiyin Tunggal Village. Data collection techniques are carried out through field observations, documentation, and in-depth interviews. Interviews were conducted directly with the owner of a rice mill in the village to find out information related to the production process, the type of waste produced, and the waste management efforts or initiatives that have been implemented. This interview was conducted at the factory location so that researchers could see firsthand the field conditions and rice processing activities, so that the data obtained was more contextual and accurate. In addition, interviews were also conducted with community leaders and other related parties as data triangulation to strengthen the validity of the research findings.

The results of this study are expected to provide valuable insights for readers and other researchers in understanding the social dynamics that occur. In addition, the research methods used are also expected to contribute to the development of qualitative and quantitative research methods in the future. Thus, this research is expected to make a significant contribution in the field of social sciences and can serve as a reference for future studies (Haki, et al, 2024).

Location and Research Object

The location of the research is in Petiyin Tunggal Village, Dukun District, Gresik Regency. The subjects of this study are the owners and workers at the Adem Ayem rice mill and the object of the research is the Adem Ayem rice mill located in Petiyin Tunggal Village, Dukun District, Gresik Regency, East Java Province. The time for this research will be carried out from mid-March to the end of July 2025.

Data Types and Sources

Data Primer

Primary data is information collected by researchers directly from primary sources or locations of research subjects. Examples of primary data include information collected from interviews, observations, and documentation (Rizky Fadilla & Ayu Wulandari, 2023). Primary data is very important in research because it provides an accurate and direct picture of the research subject.

By collecting primary data, researchers can get more in-depth and

detailed information about the topic being researched. In addition, primary data also allows researchers to test hypotheses and make more valid conclusions based on facts obtained directly. Thus, the collection of primary data is a crucial step in the research process that must be carried out carefully and carefully (Pakpahan et al., 2021). In this review, an important source of information comes from interviews with owners and workers at the Adem Ayem rice mill.

Data Seconds

Secondary data is data collected and processed by other parties, not by the researcher himself. This data is often used to support or supplement the primary data that has been collected. For example, secondary data can be government statistics, industry reports, or the results of research that has been done before. By using secondary data, researchers can obtain additional relevant information and support the findings of the ongoing research (Rizky Fadilla & Ayu Wulandari, 2023).

Secondary data can be a very valuable source of information in conducting research or analysis. Resources such as archives, books, and journals can provide context and a deeper understanding of the topic being researched. In addition, secondary data can also be used to validate or corroborate findings obtained from primary data. By using secondary data wisely, researchers can produce more comprehensive and accurate analyses (Kurniati, 2023).

FINDINGS AND DISCUSSION

Waste Management at UD Adem Ayem

UD Adem Ayem, a rice milling business located in Petiyin Tunggal Village, has implemented a number of simple but functional steps in managing milled waste such as husks, bran, and bran. According to the owner's statement, the resulting husk waste is reused as fuel for the oven and re-milled for certain purposes. Meanwhile, bran is used by farmers as animal feed, showing that there is local synergy in the use of organic waste. The business owner stated, *"We use the husk again for oven fuel, so it is not wasted. If it is bran, usually farmers here take it to make a mixture of cow or chicken feed."*

Qualitatively, this practice reflects the existence of ecological awareness that grows organically in rural communities, although it has not been formalized in a structured waste management policy or system. The use of waste into fuel and animal feed not only reduces operational costs, but also strengthens socio-economic relations between business actors and the surrounding community. This suggests the basic principles of the circular economy have begun to be implemented, albeit on a microscale and without a high-tech approach. However, this effort is still pragmatic and has not been fully supported by quantitative data on energy efficiency, potential emission reductions, or overall increase in economic added value (Latif, et al, 2023). Therefore, further deepening is needed through environmental and social impact assessments, so that this practice can be replicated or developed as a

model of sustainable waste management.

Figure 1. Rice grinding machine

Waste management at UD Adem Ayem is considered by the owner to be maximum in accordance with the available capacity and resources. However, this statement does not rule out the possibility that there is room for the development of a more efficient and environmentally friendly waste management system, especially in view of technological advances and sustainable practices that are increasingly developing. The main challenge in managing rice mill waste in Petiyin Tunggal Village is not only limited to processing techniques, but also to the limitations of tools and infrastructure owned by business actors.

Critically, the current system has several advantages, such as the ecological awareness of business actors, locally integrated waste utilization practices, and a mutually beneficial socio-economic relationship between mills and farmers. However, on the other hand, there are weaknesses such as limited capital, lack of access to appropriate technology, and the lack of a documentation or monitoring system for the impact of waste management. In addition, opportunities arise as bioenergy technology develops and the demand for environmentally friendly products can be used as a reason to encourage innovation at the micro and small business level. However, threats such as reliance on traditional practices, lack of regulatory support, and low technological literacy are obstacles to creating a truly sustainable system (Kumar, 2022).

Structural obstacles can also be seen from the unintegrated role of local governments in providing supporting facilities or incentives for small business actors. In addition, the lack of coordination between stakeholders such as the Environment Agency, agriculture, and research institutions is an obstacle in building an innovation ecosystem based on the green economy in rural areas. The lack of regulations that encourage sustainable waste management also causes entrepreneurs to tend to rely on individual initiatives rather than coordinated systems (Makki, et al, 2020).

Sustainable management of rice milling waste is very important in the context of the circular economy and green economy. The concept of the circular economy emphasizes the importance of reuse, recycling, and reusing resources so as to reduce pressure on the environment. In this case, agricultural waste

such as husks and bran can be an alternative raw material for products of economic value, while reducing the number of waste that pollutes the environment (Nadira Amalia et al., 2024).

In various regions, innovations in rice mill waste management have succeeded in producing products such as briquettes from husks, organic compost from straw, to bioenergy that can be used to support local energy needs. This shows that with the right approach, waste is not a burden, but a potential resource that can support sustainable development. The application of appropriate technology and community involvement are key to transforming waste into economic assets (Belading, et al, 2024).

Therefore, it is important for business actors such as UD Adem Ayem to get assistance and access to environmentally friendly technological innovations. Synergy between the government, the private sector, and local communities is needed so that waste management is not only oriented towards disposal, but also on empowerment. With this step, Petiyin Tunggal Village can become a model village that is able to integrate green economic principles in its agricultural activities in real terms.

Waste Potential and Green Economy Opportunities

UD entrepreneur Adem Ayem hopes that in the future processing and packaging tools can be equipped even better. With more modern equipment, waste treatment can be done in a more energy-efficient way, does not pollute the environment, and even has the potential to generate additional economic value. In general, waste from rice milling has great potential to be used economically. Rice husks, for example, can be processed into husk charcoal, briquettes, or raw materials for making silica.

In addition, charcoal that has been burned is often called charcoal husks are an excellent planting medium because they have pores that help aerate and maintain soil moisture. This husk charcoal is also environmentally friendly and is often used in the cultivation of horticultural crops and organic farming. Bran and bran, apart from animal feed, can also be used as raw materials for organic fertilizers if further processed. With proper treatment, these wastes can not only reduce pollution, but also become a high-selling commodity.

Figure 2. Husk burning machine and husk charcoal products

The application of circular economy principles in the rice milling business can have a significant positive impact, both on environmental sustainability and on increasing the income of business actors. This principle encourages the use of waste as a new resource, not just a waste product.

Experience from various regions shows that the development of agricultural waste-based industries can create new jobs in the rural sector. For example, small and medium-sized businesses that produce briquettes from husks have managed to reduce their dependence on fossil fuels while opening up new market opportunities. In this context, collaboration between farmers, entrepreneurs, and creative industry players is needed to create a sustainable value chain (Fransiska Widyawati 2019).

In addition to economic value, proper waste management also provides great ecological benefits. Reducing greenhouse gas emissions, preventing soil and water pollution, and increasing land fertility are some of the positive impacts of using agricultural waste wisely. This is in line with the Sustainable Development Goals (SDGs), especially on points related to responsible consumption and production as well as action on climate change (Rahmadi A, et al, 2021).

The government and related institutions have a strategic role in driving this transformation. Through the provision of training, the provision of appropriate technology, and incentives for green businesses, waste management can become a new leading sector in rural areas. Moreover, a community-based approach will strengthen the community's sense of ownership of the innovations carried out, so that its sustainability is more guaranteed (Rahmi, 2019).

In the long term, the integration of green economy principles in the rice milling sector will not only reduce the environmental burden, but also strengthen the competitiveness of the village economy. This can be a replication model for other villages that have similar potential. Thus, a simple effort started by a small business unit like UD Adem Ayem has the potential to be part of a major change towards a more sustainable and inclusive future.

Direction of Sustainable Development

To realize sustainable waste management, collaboration between business actors, the government, research institutions, and the surrounding community is needed. Counseling, training, and technology assistance are needed so that small businesses like UD Adem Ayem can upgrade and remain sustainable. With the spirit of independence that it already has, UD Adem Ayem shows great potential to become an example of micro businesses that are environmentally friendly. Support from various parties and increased access to appropriate technology will be key to making the rice milling business not only a livelihood, but also a driver of the green economy in rural areas (Gilani, 2023).

Simple measures such as the use of waste for fuel and animal feed should be appreciated and improved with a more structured and scientific

approach. That way, rice mill waste management can be an integral part of a sustainable village development strategy (Rani, 2022).

In the framework of inclusive village development, strengthening local capacity is the main aspect. Business actors like UD Adem Ayem not only need tools, but also knowledge to make more optimal use of waste. Training on waste treatment techniques, environmentally friendly business management, and access to marketing of waste derivative products must be part of the village development agenda.

Furthermore, the development of circular economy-based areas can be realized through the establishment of interconnected agricultural and rice milling business clusters. In this cluster, the remaining production from one business unit becomes an input for other units, so that no waste is wasted. This concept not only increases efficiency, but also strengthens collaboration between business actors at the local level.

It is also important to have affirmative policies from local governments to support green innovation in the agriculture and milling sectors. Fiscal incentives, ease of licensing, and facilitating access to financial institutions can encourage the growth of more businesses such as UD Adem Ayem which are oriented towards environmental sustainability (Illankoon et al., 2023).

Finally, the direction of sustainable development must rest on the principles of social, economic, and ecological sustainability. This means that business activities must not only be economically profitable, but also able to improve the quality of life of village communities and maintain environmental balance. When this principle is applied consistently, waste management is no longer a challenge, but an opportunity for transformation towards an empowered and sustainable independent village.

CONCLUSION

The management of rice mill waste in Petiyin Tunggal Village shows that agricultural waste does not have to be a source of environmental pollution, but can instead be processed into a resource that has added value. Businesses such as UD Adem Ayem have proven that husk, bran, and bran waste can be reused for various purposes, such as alternative fuel, animal feed, and planting media. This utilization is clear evidence that circular economy practices can be applied even on a small and traditional scale.

The approach used by UD Adem Ayem is in line with the principles of the green economy, namely the efficient and environmentally friendly use of resources. Without having to rely on advanced technology, these businesses have made optimal use of waste and contributed to the reduction of carbon footprint. Although it is still simple, this management system has been able to reduce waste discharged into the environment and at the same time provide additional economic value for businesses and the surrounding community. However, on the other hand, limitations in terms of technology, information, and capital are still the main challenges in more optimal waste management. The processing process is still carried out manually and has not been integrated

with modern processing technology that can improve the efficiency and quality of processed waste products. This shows the need for support from various parties, both from the government, research institutions, and the private sector. Business actors' awareness of the importance of sustainable waste management is also key in carrying out green economy practices. In this case, business actors have shown good initiative in overcoming the negative impact of waste and innovating in creating new products from existing waste. However, to improve the scale and quality of management, it is necessary to increase the capacity of human resources and access to relevant knowledge and technology.

Overall, waste management at UD Adem Ayem reflects the great potential of the implementation of a circular economy in the rural rice milling sector. If maximized, this practice will not only provide economic benefits, but also strengthen the environmental and social resilience of the village community. Therefore, this approach is worthy of being used as a model for other small businesses in encouraging sustainable and environmentally friendly village development.

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