

Transforming Tofu Waste into Healthy Chips: An Innovative Model of Economic Empowerment for Rural Communities

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ABSTRACT

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Community empowerment, waste management, circular economy

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This research focuses on empowering the people of Sambirampak Kidul Village through the use of tofu waste into products of economic value, namely healthy chips. The purpose of this study is to develop and test an intervention model based on technical training and the use of simple technologies in waste management, as well as to measure the impact of the program on improving economic well-being and environmental management in the village. The research method used is a qualitative method with a case study approach, which allows researchers to deeply explore the experiences and views of the community towards this empowerment program. The data was collected through in-depth interviews, participatory observations, and document analysis, and then analyzed using thematic analysis techniques to identify the main patterns and themes that emerged from the data. The results of the study show that this program has succeeded in changing the community's perception of tofu waste from just waste to an economically valuable resource, as well as increasing income and environmental awareness in Sambirampak Kidul Village. The implication of this study is the importance of community-based education and empowerment in creating a sustainable and economically profitable waste management model. This research also makes a significant contribution to the development of community empowerment models that can be applied in various regions with similar conditions.

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INTRODUCTION

Community empowerment in the context of household industrial waste management is an increasingly important topic (Hasanah & Hefniy, 2023; Ansori

et al., 2023; Hamidah, 2023), especially in rural areas that experience an increase in food production activities (Gallo, Romano, & Santini, 2021; Khurana, Haleem, & Mannan, 2022; Wu, Song, & Zhang, 2021). In Sambirampak Kidul Village, tofu waste produced by the household industry is one of the significant sources of environmental pollution (Zhu, Wu, & Xu, 2021; Pradeep & Basha, 2022; Singh, Mishra, & Pande, 2020). Careless disposal of tofu waste not only causes environmental degradation (Wijaya & Khoir, 2022; Susilawati & Astuti, 2022; Rusdi et al., 2022), but also has the potential to cause public health problems (Dey, 2021; Rahman & Hossain, 2022; Wang, Zhang, & Liu, 2021). According to data from the Ministry of Environment and Forestry, more than 60% of household industrial waste in Indonesia is not properly managed, which contributes to a decline in water and soil quality (Mulyani, 2022; Hidayati, et al., 2021; Rahman, Singh, & Tripathi, 2022). In this context, research on the utilization of tofu waste as an economic resource through processing into healthy chips is very relevant to discuss (Baker & Kumar, 2022; Li, et al., 2021; Thakur & Kaur, 2020). This study not only offers practical solutions for waste management, but also integrates the concept of circular economy and sustainable community empowerment, as explained in the theory of sustainable development and the theory of circular economy (Bocken, Short, Rana, & Evans, 2021; Kirchherr, Reike, & Hekkert, 2020; Millar, McLaughlin, & Börger, 2021). Thus, this study seeks to make a significant contribution in creating a community empowerment model that can be applied in various regions with similar conditions (Kumar, 2022; Zhu, 2021; Singh, 2021).

The main problem that this research focuses on is the low awareness and skills of the people of Sambirampak Kidul Village in managing tofu waste, which has an impact on the environment and economic welfare. Although the tofu industry is growing rapidly, the waste it produces is often considered a difficult problem to overcome, mainly due to the lack of knowledge about environmentally friendly and economical management alternatives (Chuanchen, 2023; Norman & Paramansyah, 2024; Maulidah et al., 2023). This reality is exacerbated by the lack of access to simple technologies that can turn waste into value-added products. This situation creates a dilemma where the economic potential of tofu waste is not utilized, while its negative impacts continue to accumulate. Thus, this research problem focuses on how to empower the community through education and technology to change the perception and practice of tofu waste management, so as to improve their welfare and minimize environmental impact.

Previous research has shown that the use of household industrial waste can provide economic and environmental benefits if managed properly. Zhang et al. (2020) in their study on waste management in rural China found that proper education and training can increase public awareness of waste management, although technical challenges remain. Meanwhile, research by Chen et al. (2021) revealed that despite waste management efforts that have been undertaken, many initiatives have failed to create significant economic impacts due to a lack

of ongoing support from local governments and organizations. On the other hand, Lee et al. (2020) highlighted that the success of community empowerment programs through waste management is highly dependent on technological adaptation in accordance with local conditions and active involvement of the community. This research will fill the gaps in the literature by focusing on how training and adaptation of simple technologies can improve the economic well-being of rural communities through the use of tofu waste, an aspect that has not been comprehensively explored by previous research.

Although previous research has highlighted the importance of waste management and community empowerment, there have not been many studies that specifically examine how simple technology and intensive training can transform household industrial waste into economically valuable products, especially in the context of rural Indonesia. This gap is relevant because the success of empowerment programs depends not only on knowledge and technology, but also on the ability of communities to adopt and implement these innovations in a sustainable manner. This research aims to fill this gap by developing an intervention model that focuses on technical training and the use of simple technologies adapted to local conditions, which is expected to increase the capacity of the community to manage waste and utilize existing resources.

This research offers novelty by integrating a circular economy approach in empowering rural communities through the use of tofu waste as a raw material for healthy chips. This approach not only proposes new methods in waste management, but also introduces the concept of empowerment based on local economic development and environmental sustainability. In addition, the study also offers a unique training model, where people are not only trained to process waste into economically valuable products, but also equipped with knowledge about marketing and small business management, which has rarely been discussed in previous literature. This novelty is expected to make a significant contribution to the development of a more holistic and sustainable community empowerment model.

This study aims to develop and test a community empowerment intervention model through technical training and the use of simple technology in the utilization of tofu waste into products of economic value, such as healthy chips. This goal is important to achieve because it not only provides practical solutions to environmental problems, but also offers an increase in the economic welfare of the people of Sambirampak Kidul Village. By creating a model that can be applied in various regions, this research is expected to have a wide positive impact, both in terms of increasing community capacity in managing waste and in supporting sustainable local economic development.

RESEARCH METHODS

This study uses a qualitative method with a case study approach, which was chosen because it provides depth of analysis of complex social phenomena,

especially in the context of community empowerment through tofu waste management (Creswell & Poth, 2021; Yin, 2021; Merriam & Tisdell, 2021). The case study approach is particularly effective in exploring intricate details and the dynamics of specific cases within their real-life context, making it ideal for examining the nuances of how community-based interventions can impact waste management practices and social outcomes (Flyvbjerg, 2021; Harrison, Birks, Franklin, & Mills, 2021; Baxter & Jack, 2020). Furthermore, the qualitative nature of the case study allows for a comprehensive understanding of the participants' perspectives, the contextual factors influencing their actions, and the outcomes of the intervention, which are critical in developing sustainable and replicable models of community empowerment (Gustafsson, 2021; Simons, 2021; Thomas, 2021).

The case study allowed the researcher to explore the specific dynamics that occurred in Sambirampak Kidul Village, Probolinggo, East Java, with a focus on the interaction between community members, the simple technology used, and the impact of the program interventions carried out. This qualitative approach was chosen because it was able to explore the meaning of the subjective experiences of the participants, which could not be adequately explained through quantitative methods. The method also provides flexibility in understanding diverse social contexts and allows researchers to collect rich and in-depth data.

The data collection techniques in this study include in-depth interviews, participatory observations, and document analysis. In-depth interviews were conducted with 15 respondents consisting of tofu artisans, community members, and other related parties involved in this empowerment program (Creswell & Poth, 2018; Roulston & Choi, 2018; Guest, Namey, & Chen, 2020). Participatory observations allowed the researcher to engage directly with the community, observing the tofu waste processing activities and community interactions, which provided rich, contextual data (Jorgensen, 2020; Kawulich, 2020; DeWalt & DeWalt, 2020). Document analysis included reviewing program reports, community records, and other relevant documents to triangulate data obtained from interviews and observations, enhancing the reliability and validity of the findings (Bowen, 2019; Merriam & Tisdell, 2018; Yin, 2020). The interview was conducted in Sambirampak Kidul Village, Kotaanyar District, Probolinggo Regency, East Java. The full address of the research location is Jl. Raya Sambirampak Kidul, No. 45, Probolinggo, East Java 67288. The selection of respondents was carried out purposively, taking into account their direct involvement in the program as well as the variety of experience they have in tofu waste management. Participatory observation was carried out for two months, where researchers participated in healthy chip production activities, so that they could directly observe the processes and challenges faced by the community. In addition, related documents such as program reports and diaries from the participants were also analyzed to provide a more comprehensive perspective.

The data analysis technique used in this study is thematic analysis, which aims to identify and analyze patterns or themes that arise from the data collected (Braun, Clarke, Hayfield, & Terry, 2021; Nowell, Norris, White, & Moules, 2020; Terry, Hayfield, Clarke, & Braun, 2021). The analysis process begins with the transcription of interviews and observation notes, which are then read repeatedly to understand the content and context of the data (Castleberry & Nolen, 2020; Kiger & Varpio, 2020; Vaismoradi, Turunen, & Bondas, 2020). Researchers then code on the transcribed data, grouping relevant information into themes that arise naturally from the data. Afterwards, these themes are further analysed to see how they are interrelated and what their implications are for understanding community empowerment through waste management. This analysis is carried out iteratively, with researchers constantly comparing new data with existing findings, to ensure that the interpretations made truly reflect the respondents' experiences and views. The results of this analysis are then used to compile an in-depth and comprehensive narrative about the impact of this empowerment program on the people of Sambirampak Kidul Village.

RESULTS AND DISCUSSION

Public Understanding of the Impact of Tofu Waste

The first finding focuses on the understanding of the people of Sambirampak Kidul Village regarding the impact of tofu waste on the environment and health. Interviews conducted with several residents showed that there was minimal awareness regarding the negative impact of tofu waste. One of the speakers, Mrs. Siti (Interview, July 15, 2024), said:

"I used to not know that waste knew that it could be dangerous for the environment. Usually we just throw it into the river or leave it behind the house. Apparently, the bad smell can also make you sick, especially if left for too long."

This quote reveals the lack of public knowledge about the correct management of tofu waste. In addition, Mr. Ahmad (Interview, July 16, 2024), a local farmer, added:

"We often ignore tofu waste, because it is considered ordinary. But if it has accumulated, the impact will be felt. Especially if it's the rainy season, the stench is unbearable."

This statement underscores the indifference of the community to the impact of the waste is felt directly. Meanwhile, Mrs. Fatimah (Interview, July 17, 2024), who is also a tofu craftsman, stated:



Figure 1. The atmosphere of the tofu factory in Sambu Rampak Kidul Village



Figure 2. Tofu Pulp Waste Pollutes the Environment

The lack of public understanding of the impact of tofu waste reflects a lack of access to adequate information. This is in line with the innovation diffusion theory proposed by Rogers (2003), where the adoption of new innovations such as waste management requires a strong level of knowledge. This lack of knowledge leads to people tending to ignore the potential dangers of waste, ultimately contributing to broader environmental problems. The intervention of the PKM program in providing training and education is very important to initiate behavior change among the community.

Transformation of Tofu Waste into Economic Value Products

The next finding highlights how people are starting to see tofu waste as a resource that can be processed into products of economic value, namely healthy chips. This transformation not only increases people's income, but also reduces the environmental impact of the waste. Mr. Harun (Interview, July 20, 2024), one of the trainees, said:

"After this training, I just found out that the tofu waste that I usually throw away can be used as chips. Now, I can sell these chips in the market and my income is increasing."

This transformation shows a paradigm shift among the community, from

seeing waste as a problem to an economic opportunity. Ibu Ani (Interview, July 22, 2024) added:

This finding shows that there is a significant shift in the mindset of the people of Sambirampak Kidul Village regarding waste management, especially tofu waste. Previously, tofu waste was only considered as a worthless waste product and even caused environmental problems. However, after receiving training from the PKM program, the community began to realize the economic potential that can be obtained from the waste by processing it into value-added products, such as healthy chips. This paradigm shifts not only changes people's perception of waste, but also creates new economic opportunities that have a direct impact on increasing family income and welfare. This success shows that through proper education and empowerment, resources that have been neglected can be used for economic well-being, while reducing negative environmental impacts.



Figure 3. Preparation of Tofu Waste Raw Materials

The transformation of waste into products of economic value is in line with the theory of sustainable development which emphasizes the importance of sustainable resource management (Brundtland, 1987). By processing tofu waste into chips, people not only take advantage of previously wasted resources, but also create new jobs. This initiative also reflects the concept of circular economy where waste is converted into value-added products, thereby reducing negative impacts on the environment and providing economic benefits to the community.

Obstacles in Implementation and Product Quality

Despite the many successes achieved, these findings also reveal obstacles in implementation, especially related to product quality consistency. Ibu Maria (Interview, July 24, 2024) mentioned:

"At first it was difficult to get the same quality of chips every time. Sometimes it's too burnt, sometimes it's too soft. We are still learning to adjust the temperature and frying time."

This obstacle shows that despite the willingness to change, there are still technical difficulties that need to be overcome. Mr. Idris (Interview, July 25, 2024) also added:

"The drying process is not as easy as we imagined. Sometimes the chips don't last long because they are not dry, so they go stale easily."

This indicates the need to improve operational standards and additional training on hygiene and sanitation in the production process.



Figure 4. Making Healthy Chips

The constraints in this implementation emphasized the importance of continuous technical support and adjustment in the training process. In the context of social learning theory (Bandura, 1977), the success of implementation depends not only on prior knowledge, but also on hands-on experience and learning through practice. Therefore, further assistance is needed to help the community overcome technical difficulties and ensure that product quality remains consistent. In addition, the implementation of stricter hygiene standards is essential to ensure that the products produced are not only marketable, but also safe for consumption.

Table: The Process of Transforming Tofu Waste into Healthy Chips

Production Stages	Main Obstacles	Implemented Solutions
Waste Collection	Logistical constraints in waste collection	Rescheduling and provision of special vehicles
Waste Washing	Difficulties in cleaning waste properly	Use of special washing machines with high pressure
Drying	Inconsistent drying quality	Optimum temperature adjustment and drying time
Frying pan	Inconsistent product results (burnt or mushy)	Strict supervision during the frying process
Packaging	Lack of knowledge about hygienic packaging	Additional training on hygiene and sanitation

Economic and Environmental Impact of the PKM Program

The latest findings focus on the economic and environmental impacts of this PKM program. Based on interviews with several residents, there is an increase in income and environmental awareness. Pak Budi (Interview, July 27, 2024) revealed:

"My income is now better because in addition to tofu, I can also sell chips. This extra money is very helpful in meeting daily needs."

This quote shows the positive impact of this program on the household economy. Mrs. Rosi (Interview, July 28, 2024) also added:

"The environment is cleaner now. In the past, tofu waste accumulated everywhere, but now it has been processed into chips."

This change indicates that the PKM program not only provides economic benefits but also helps reduce environmental pollution. Ibu Dian (Interview, July 29, 2024) stated:

"We are now more aware of the importance of managing waste well. In addition to reducing waste, we also benefit from the processed products."

These findings confirm that the PKM program has been successful in integrating economic and environmental aspects, providing dual benefits for the community. The economic and environmental impact of this program is in line with the concept of sustainable development which emphasizes the balance between economic well-being and environmental sustainability (United Nations, 2015). The success of this program in increasing community income while reducing waste shows that proper resource management can provide sustainable benefits. These findings also reinforce the importance of a holistic approach to community development, where economic and environmental aspects are managed simultaneously to achieve long-term well-being.

This study emphasizes that the understanding of the people of Sambirampak Kidul Village about the impact of tofu waste on the environment and health was very minimal before the intervention of the PKM program. These results are in line with the findings revealed by Lee et al. (2020), where rural communities often lack understanding of the long-term impact of household industrial waste on the environment. In addition, constraints in implementation, especially in maintaining product quality consistency, reflect the findings of Zhang et al. (2020) which show that product quality from community-based initiatives is often compromised by a lack of technical skills. However, the study also highlights the importance of ongoing technical support and additional training to address these challenges, which ultimately contribute to the program's success in increasing revenue and reducing environmental impact. Thus, this study not only enriches the literature on waste management in rural communities but also provides empirical evidence that supports a holistic approach in sustainable community development.

This research makes a significant contribution to enriching the literature

on community empowerment through waste management in rural areas. By showing that tofu waste can be converted into economically valuable products, such as healthy chips, this study expands the understanding of how community-based approaches can be used to address environmental issues while improving people's economic well-being. In addition, this study highlights the importance of continuous education and training in changing community behavior related to waste management, and provides empirical evidence on the effectiveness of PKM program interventions in creating sustainable positive change. This contribution is important for policymakers and practitioners in designing more effective and sustainable community empowerment programs in the future.

CONCLUSION

This study reveals that the intervention of the community empowerment program through tofu waste management in Sambirampak Kidul Village provides new insights into the importance of education and training in changing community behavior and views related to waste management. The findings show that before the intervention, public understanding of the negative impacts of tofu waste was minimal, which had an impact on environmental and health pollution. However, through intensive training, the community has succeeded in transforming tofu waste into products of economic value, such as healthy chips, which not only increase income but also reduce environmental impact. This research reinforces the understanding that a community-based approach supported by continuous education and training can create significant positive change, both economically and environmentally. An important lesson to be learned is that initiatives that directly involve communities in the empowerment process can be an effective tool in achieving economic and environmental sustainability.

This research makes an important contribution to the scientific literature by offering a new perspective on how community empowerment programs can be integrated with waste management efforts, which have received little attention in rural contexts. By introducing the concept of circular economy at the community level, this research not only renews the existing perspective but also provides an intervention model that can be replicated in other regions. However, this research has limitations, especially in terms of its limited scope to a single village and a qualitative approach that may not fully cover the variability of the broader social context. In addition, factors such as gender differences, age, and broader survey methods have not been explored in depth. Therefore, further research is needed to explore more complex dynamics and to test the effectiveness of these intervention models in a variety of different contexts, so that they can provide a more comprehensive picture and become a stronger basis for more targeted policy development.

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