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Zero Waste Circular Economy: Transforming Chocolate Production into Chocolate Jam in Bali

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ABSTRACT

The progress of the chocolate industry in Bali, as represented by Pod Chocolate Bali, offers tremendous potential for local economic contribution. However, the chocolate production process produces cocoa pulp as waste which can affect the environment and economic balance. This research discusses the implementation of the zero waste concept by integrating a circular economy through the use of cocoa pulp as a basic ingredient for producing chocolate jam. The background to this research illustrates the important role of chocolate in culture and the economy, but also highlights the challenges of waste generated during production. This research focuses on qualitative research methods with a case study approach that combines observation, interviews and document analysis. The research results show that implementing the zero waste concept by processing cocoa bean dregs into chocolate jam not only solves the waste problem, but also empowers local communities through training and skills development. Additionally, this initiative promotes a circular green economy by harnessing the full potential of cocoa beans. The spread of zero waste solutions in the Pod chocolate industry has had a positive impact in the form of improving the economy of chocolate SME in Bali. This strategy allows reducing food waste, increasing the added value of cocoa beans, and creating high-quality chocolate jam products that can meet local and international market demand. In this context, a zero waste solution not only makes the chocolate production process more sustainable, but also supports the development of cocoa cultivation which empowers local communities.

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INTRODUCTION

The food industry, especially chocolate production, has experienced rapid growth in various parts of the world. Chocolate, with its sweet taste and distinctive characteristics, has become a highly sought after food, bringing various health benefits, and having an undeniable appeal for many individuals. However, beyond its enjoyment, the chocolate industry also has a significant impact on the environment and society, especially in terms of the formation of production waste which can be detrimental. For example, in the process of processing chocolate beans, large amounts of dregs are produced as residue from

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chocolate extraction (Indah, 2021). Data shows that from 3-kilograms of processed cocoa beans, only around 900 grams of final product is produced (even less than 30%), leaving around 2.1 kilograms of dregs as waste. This reflects the great potential to increase the efficiency of resource use and minimize negative impacts through the application of circular economy principles and the zero waste concept.

One location that reflects the reality of the complexity of the chocolate industry and the potential for significant improvement is Dauh Puri Klod, Badung Regency, Denpasar on the island of Bali. This area is one of the centers for cocoa cultivation which plays an important role in the chocolate industry in Bali. However, the local community in Dauh Puri Klod has not fully received the economic benefits they should from the chocolate industry. One of the main reasons is the practice of the bonded debt system which is widely applied in purchasing cocoa beans early (before they are ripe) (Retnoningsih, 2016). This system results in the sale of cocoa beans at cheap prices, harming farmers and local communities because they do not get a decent income; where the price of dry ripe cacao beans is 45 thousand Rupiah per kilo, while the bonded bond system buys raw cacao beans initially at a price of 15 to 25 thousand Rupiah per kilo. In this context, it is necessary to find innovative and sustainable solutions to help improve the welfare of local communities, especially farmers and housewives in this area.

One promising solution is the application of the zero waste concept in the chocolate industry in Dauh Puri Klod. This concept not only provides a solution to the problem of waste produced during the cocoa bean processing process, but can also increase the income of local communities. By using cocoa pulp as a basic ingredient for producing chocolate jam, additional income can be created for farmers and housewives, especially those who have a key role in managing and utilizing this waste into economically valuable products (Dewi, 2023). Thus, this zero waste solution not only contributes to the development of a more sustainable circular economy, but also forms an environmentally conscious mindset, rejects the detrimental debt bondage system, and encourages optimal use of resources.

Within this framework, this research aims to explore in depth the concept of zero waste in the chocolate industry, with a focus on processing cocoa bean dregs into chocolate jam in Dauh Puri Klod. We will also analyze the impact of implementing this zero waste solution on improving the welfare of local communities, especially farmers and housewives (Oddoye, 2013). In carrying out this research, a qualitative approach with a focus on circular economic development and local community participation will be the basis for the methodology used to support the development of economic potential and sustainability in the chocolate industry, producing solutions that are effective and appropriate to the needs of the local context (Heptariza, Darmawan and Ramayu, 2023).

METHODS

This research uses qualitative research methods with an in-depth case study approach. This approach provides freedom to explore and understand the complexity of the food waste problem which exceeds 70% in chocolate processing (Azis, 2021), while also

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enabling the identification of innovative zero waste solutions by utilizing chocolate processing food waste and creating alternative products that can be sold. For this reason, the researcher determined 5 steps in discussing this research, which consisted of:

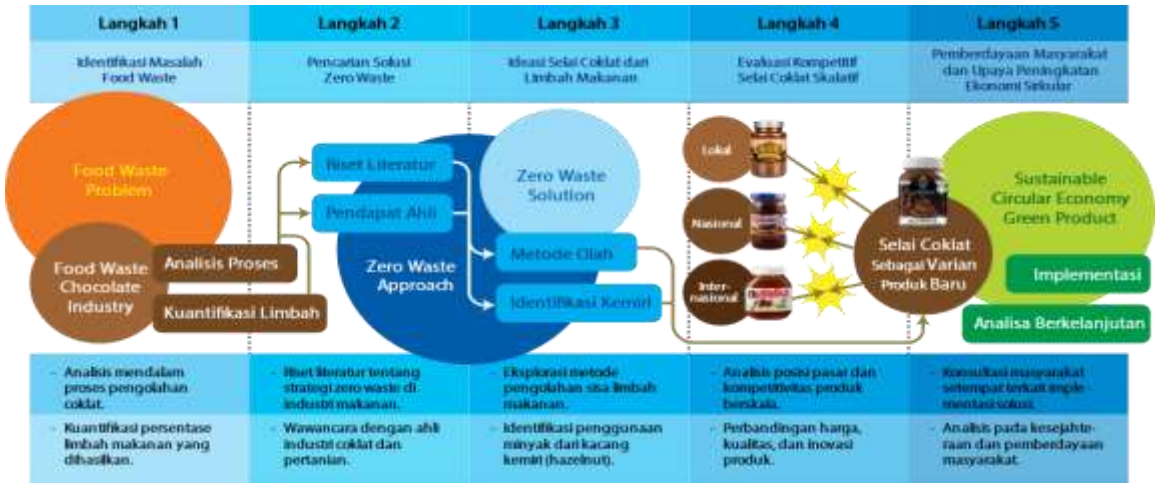

Figure 1. Research Method. Source: Author's Work.

1. Identify Food Waste Problems, by conducting an in-depth analysis of the chocolate processing process to identify the points where food waste occurs and determine the percentage of food waste produced; and collecting data and information from chocolate producers in Dauh Puri Klod, Badung Regency, Denpasar, regarding the volume and type of food waste produced during the chocolate production process.
2. Search for Zero Waste Solutions, by conducting literature research and related studies that focus on zero waste strategies in the food industry, especially chocolate processing; as well as conducting interviews with chocolate industry experts and agricultural experts to understand zero waste solutions that have been implemented and are successful in various contexts.
3. Development of Chocolate Jam Using Food Waste, by exploring various methods and recipes for processing leftover chocolate processing food waste into chocolate jam that has adequate quality and appeal; and identified oil from candlenuts as an additional ingredient that can enrich the taste and texture of the chocolate jam produced.
4. Scalative Competitive Evaluation of Chocolate Jam, by conducting market analysis to assess the position and competitiveness of chocolate jam produced by local, national and international brands; and compare the price, quality, innovation and attractiveness of the product (regarding the scope of packaging design) with other chocolate spreads on the market.
5. Community Empowerment and Circular Economy Improvement, by holding meetings with local communities, especially farmers and housewives, to understand their perspectives regarding the implementation of this zero waste solution and the expected economic benefits; as well as analyzing the long-term economic impact of

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implementing zero waste solutions on increasing welfare and empowering local communities in the context of a sustainable circular economy.

6. Thus, this research seeks to provide a comprehensive and in-depth view regarding zero waste solutions that can bring inspiration and positive change to the chocolate industry (or similar) and of course to the community around Pod Chocolate Bali which is located in Badung District, Denpasar - Bali, Indonesia itself, as an SME with export-ready orientation values.

RESULTS AND DISCUSSION

The application of the zero waste concept in the chocolate processing industry represents a comprehensive journey from problem identification to implementation of sustainable solutions. Initial identification of food waste problems focuses on the cocoa bean processing process, by examining each step carefully to identify potential waste. The next stage is the search for zero waste solutions which involves in-depth literature research and interviews with industry experts (Sukaatmadja, 2021). In this search, effective strategies and practices adapted from various food industries were discovered. The development of chocolate spread from food waste is a promising solution. Creative processing methods enable maximum benefits from chocolate processing residues, producing additional products that have economic value and are able to reduce the amount of waste produced. Competitive evaluation of these products paves the way for understanding market positioning and implementing appropriate marketing strategies to increase competitiveness

Pod Chocolate Bali itself is one of the unique destinations in Badung District, Denpasar - Bali; which amazes both local and foreign tourists with exclusive experiences regarding the world of chocolate, especially with the strong local wisdom of Bali (De Vuyst, 2016). Located in the middle of the natural beauty of the Island of the Gods, this place is not just an ordinary chocolate processing factory. Visitors can experience an extraordinary experience, seeing firsthand the entire chocolate making process from start to finish. The tour begins with an explanation of the cocoa bean, which is the basic ingredient of chocolate, and its long journey from the garden to become ready-to-eat chocolate.

Next, visitors are invited to see how cocoa beans are processed, from fermentation to roasting. The sensation of inhaling the fresh aroma and enjoying the chocolate in the process is an unforgettable moment. In addition, there are also workshops where visitors can try their hand at making their own chocolate, providing an interactive and educational experience. Pod Chocolate Bali also has shops and cafes in several locations, allowing visitors to purchase a variety of exclusive chocolate products and taste delicious chocolate-based dishes (Retnowati, 2021). Pod Chocolate Bali is not only a tourist attraction, but also represents a commitment to supporting local agriculture and living the principles of sustainability, with the concept of a circular economy and zero waste that they apply. Through active involvement with the surrounding community and empowering local farmers, Pod Chocolate Bali dedicates itself to creating a sustainable positive impact on Bali and the surrounding environment.

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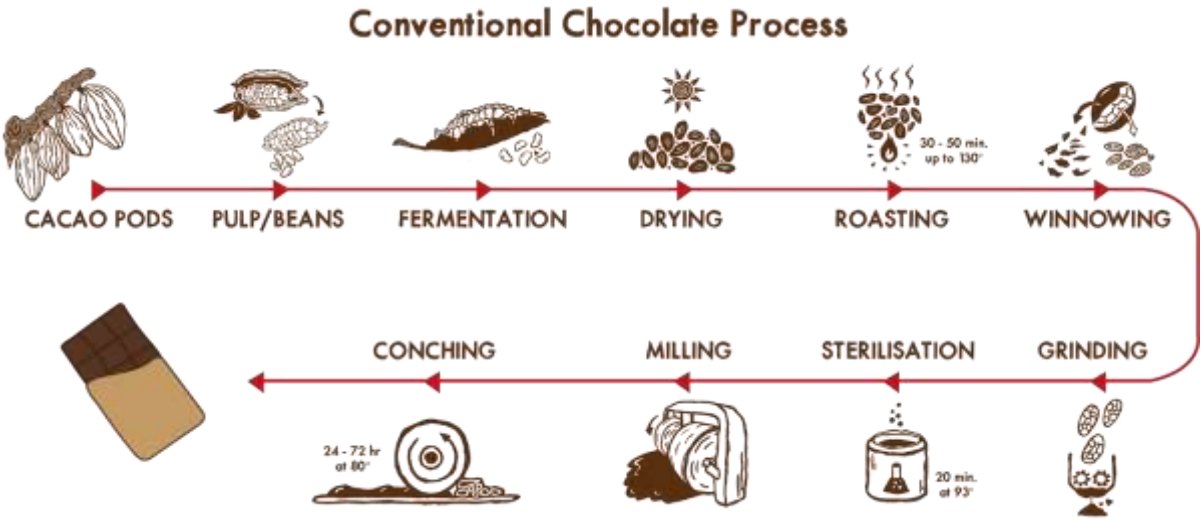

Figure 2. Chocolate Processing Process. Source: lovechock.com.

To implement a zero waste solution in the Bali Chocolate Pod industry, researchers believe it can have a broad positive impact. Apart from an environmental perspective, where reducing food waste leads to a greener and more sustainable planet, there are also significant economic and social implications. Recovering waste to produce chocolate spread, for example, creates new business opportunities and opens up access to wider markets. This can increase income for local farmers and producers, empowering local communities economically. In addition, the zero waste approach builds awareness and a caring attitude towards waste management among industrial players, inspiring more people to apply zero waste principles in everyday life (Aprillia, 2020). In a holistic view, the application of the zero waste concept in chocolate processing reflects a commitment to achieving sustainability, paving the way towards a future where food waste is no longer a burden, but becomes a valuable resource for Indonesian society, especially Bali.

Discussion

The process of identifying food waste problems in chocolate processing begins with a comprehensive analysis of each production stage, starting from selecting cocoa beans to packaging (Vogel, 2020). Cocoa beans, as the main raw material, are the initial focus. Bean quality, potential defects, and excess production that does not meet quality standards are the main aspects evaluated. In the fermentation and drying process, the disadvantages of beans that do not meet the requirements become obvious. The roasting and grinding stages can also produce food waste in the form of powder or paste that does not meet standards. Through a quantitative approach, the percentage of food waste is identified and measured. The results of this analysis illustrate how the efficiency of the production process can be increased to minimize food waste.

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Figure 3. Comparison of Chocolate Processing Waste. Source: lukerchocolate.com.

Identification of food waste problems in a scientific context is the process of analyzing and documenting the causes, patterns and impacts of food waste in the food system. Scientifically, food waste can be identified as the result of excessive food production and distribution, inappropriate management in the supply chain, and consumer habits (Susilo, 2023). At the production level, food waste may come from production leftovers, food that does not meet market standards, or even errors in production planning. At the distribution stage, inefficient stock management and logistics can result in expired or damaged food (Azis, 2021). Furthermore, consumers also contribute significantly to food waste through behaviors such as excessive purchasing, improper storage, and throwing away food that is still suitable for consumption by chocolate fans.

In scientific studies, it is important to measure and analyze the amount of food waste, identify the types of food that is wasted, assess the lost economic value, and consider environmental impacts such as greenhouse gas emissions associated with food decomposition (Zhafran, 2022). These scientific steps help develop more effective food waste management strategies, design policies to reduce food waste, and educate the public about the importance of reducing food waste in a sustainable manner.

Search for Zero Waste Solutions

Efforts to find zero waste solutions rely on thorough literature research on zero waste strategies that have proven successful in the food industry. Various effective techniques and practices that can be adopted in reducing food waste are discovered. In addition, interviews with chocolate and agricultural industry experts provide in-depth insight into the challenges and opportunities faced (Ardiani, 2023). These experts share best practices and field knowledge on food waste management. The results of this combination of literature research and interviews form a comprehensive framework for developing a zero waste strategy that can be implemented successfully in the chocolate industry. Factors such as operational efficiency, role of technology, and supply chain management play a key role in generating effective solutions.

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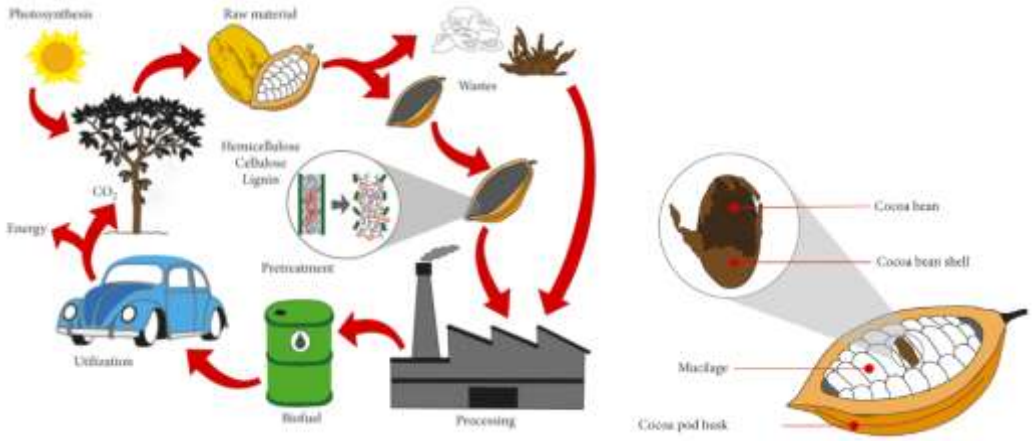

Figure 4. Chocolate Processing Process and Waste. Source: hindawi.com/journals/jchem/2021/3388067.

The search for zero waste solutions is carried out through a scientific approach which includes in-depth analysis of the latest strategies and technology in waste management, searching for best practices in the food industry, as well as studying government policies that support zero waste practices. This method also includes interviews with industry experts, stakeholders and environmental experts to gain a holistic perspective regarding the implementation of zero waste solutions in various contexts (Purnamawati, 2014). This scientific research involves collecting and analyzing quantitative data about the amount and type of food waste generated at each stage of the food supply chain, as well as analyzing the factors that cause food waste such as inappropriate production policies, inefficient distribution practices, and consumer behavior. (Darmawan, 2023). In addition, this research also considers the environmental and economic impacts of food waste, including greenhouse gas emissions, land degradation, and economic losses due to food waste.

In identifying zero waste solutions, this scientific study recommends an integrated approach that includes public education about waste management, technological innovation for recycling and optimizing food use, as well as the formulation of policies that encourage sustainable production and consumption (Useng, 2016). This study views the zero waste solution as a comprehensive effort that requires collaboration between government, industry and society to achieve optimal waste management goals.

Development of Chocolate Jam from Food Waste

The process of developing chocolate jam from food waste begins with the exploration of efficient and creative processing methods. Leftover chocolate and ingredients not used in the chocolate powder production process, such as seed shells, can be used to create delicious chocolate spread. Identification of the use of oil from candlenuts as an additional ingredient is a point of emphasis (McCarthy, 2008). Combining this oil with chocolate food waste can produce jam with a unique taste and economic value. The development process also considers aspects of food safety and quality standards to ensure the final product is

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safe for consumption and meets consumer tastes. For this reason, researchers conducted a study related to the process of making chocolate jam from chocolate processing waste by following a series of careful and efficient steps. Chocolate bean processing waste which is still rich in nutrients is extracted to separate the dregs and obtain cocoa powder which is the main ingredient for jam (Mayfield, 2015). The resulting dregs are then mixed with additional ingredients such as flour, granulated sugar, sweetened condensed chocolate, powdered milk and water. This mixture is heated and continuously stirred until it reaches the desired consistency, with the addition of margarine or butter as the final step. This process maximizes the utilization of cocoa bean processing waste, producing quality chocolate jam with aroma, taste and texture that meet standards.

Figure 5. Comparison of Chocolate Processing Waste. Source: Researcher Documentation.

These scientific steps apply the principles of waste management and production efficiency, turning waste dregs into high-value products. In addition, using the right additional ingredients helps create delicious and nutritious chocolate spread (Hosseini, 2021). By adopting this process, the chocolate processing industry can minimize waste and achieve economic sustainability through optimizing the use of production residues. The resulting chocolate spread can be applied to a variety of bakery products, cakes or desserts, supporting efforts to minimize waste and encourage the full use of the cocoa bean's potential. Knowing the process of making chocolate jam from chocolate processing waste has significant implications related to the concept of a circular economy and zero waste. This process shows that the waste generated during the processing of cocoa beans can be converted into high-value products such as chocolate jam, avoiding waste and achieving a sustainable circular economy (Postawa, 2012). Chocolate jam produced from chocolate processing dregs proves that materials which are generally considered waste can be reused with the right methods. In this context, waste is transformed into new economic assets, supporting the main idea of the circular economy, namely the reuse and recycling of resources to prevent waste and increase the efficiency of resource use. Apart from that, understanding how to make chocolate jam from waste from the chocolate making process provides insight into zero waste efforts. This process is a clear example of a zero waste strategy, where processing residues that were previously considered waste are fully processed into products that have real economic value and benefits. Thus, the resulting

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chocolate spread not only reflects increased efficiency and better waste management, but also promotes a more integrated cycle in food production, leading to the widespread implementation of zero waste principles (Grillo, 2019). This conclusion confirms that understanding and implementing circular economy processes like this is an important step in achieving the goal of zero waste in various industrial sectors.

Competitive Evaluation of Chocolate Spread

Competitive evaluation of chocolate spreads brings attention to market analysis and competition between brands. Market positioning analysis involves an in-depth assessment of the position of chocolate spread in local and international markets. This includes assessing price, quality, product innovation and brand attractiveness. Comparison with competitors such as Nutella and Morin provides an in-depth understanding of relative strengths and weaknesses, helping in determining effective marketing and product development strategies (Sahin, 2022). This competitive evaluation is important to achieve product differentiation and optimize market penetration. For this reason, researchers carried out an analysis process of 3 relatively competitive products, both on a local, national and international scale; as follows:

Figure 6. Competitive Comparison of Chocolate Jam Brands. Source: Researcher Documentation

Table 1. Comparison of Competitive Details of Chocolate Jam Brands. Source: Researcher's Work

Nama Merek	Skala	Kualitas	Inovasi	Harga	Desain Kemasan
Junglespread	Lokal untuk Ekspor	Brand didukung dengan produk coklat batang, yang telah cukup dikenal konsumen sebagai salah satu produk khas Bali yang berkualitas ekspor.	Memiliki rasa lain termasuk coklat, hazelnut, sea salt, mocha, mix, dan buah-buahan.	**Rp. 180.000,- / 425gr**	Memiliki filosofi "coklat asli dari Bali" Sudah memiliki nilai hirarki visual yang harmonis Memiliki konsistensi pada varian (rasa) lain
Kompetitor	**Skala**	**Kualitas**	**Inovasi**	**Harga**	**Desain Kemasan**
Nutella	Internasional	Brand telah mendunia, dan rasa yang telah diterima.	Merambah ke ranah makanan ringan (*snack*).	**Rp. 45.000,- / 200gr**	Memiliki filosofi "perut yang bahagia" Memiliki nilai hirarki visual yang harmonis Tidak memiliki varian selai lain
Morin	Nasional	Brand telah diterima skala nasional, namun rasa relatif biasa.	Memiliki rasa lain termasuk kacang, mix, dan buah-buahan.	**Rp. 60.000,- / 330gr**	Kurang memiliki nilai hirarki visual (chaos) Memiliki konsistensi pada varian (rasa) lain
Delicho	Lokal	Brand masih dirintis, dan rasa belum terlalu berkesan (diingat) konsumen.	Memiliki varian coklat dan varian bertekstur krispi.	**Rp. 25.000,- / 350gr**	Kurang memiliki nilai hirarki visual (chaos) Tidak memiliki konsistensi pada varian (rasa) lain

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Analysis of Junglespread Chocolate Spread Products in terms of price, it can be concluded that Junglespread's price is relatively high compared to local competitors, but comparable to Morin, Nutella has a high price because of its international orientation, and Delicho offers the lowest price with a class that adjusts to the purchasing power of local consumers. Meanwhile, for the analysis of Junglespread Chocolate Jam Products in terms of quality, it can be concluded that Junglespread has a strong quality reputation related to Balinese chocolate. This clearly cannot beat Nutella which has a global reputation, but it is very likely to compete with Morin which has a national reputation but has a positioning which is standard for national consumers, while Delicho is still in the introduction stage. For the analysis of Junglespread Chocolate Jam Products in terms of innovation, it can be concluded that the quality of Junglespread's innovation is superior by offering a wider variety of flavors related to chocolate, this differentiates it from Nutella which is more focused, and although Morin also has variations, for chocolate variants it remains Junglespread, as the producer. chocolate, best understands both the composition and favorite variants of chocolate consumers, while Delicho has a special variant focus on crispy textures. And for the analysis of the Junglespread Chocolate Jam Product in terms of the attractiveness of the packaging design, it can be concluded that the attractiveness of the Junglespread packaging design offers a packaging design with a distinctive philosophy and also has consistency, this differentiates it from Morin and Delicho which are less organized in terms of packaging design aesthetics, However, the Nutella packaging design also has a name and focuses on the emotional message "happy stomach", so this emphasizes brand awareness as well as being a reminder at the interest stage so that it is integrated into the communication strategy, especially the call to action for consumer loyalty.

The conclusion from this analysis in terms of competitive evaluation, the 4 advantages of Junglespread Chocolate Jam include: (1) Guaranteed Quality; where Junglespread is famous for its high quality, related to Balinese chocolate bars. This gives consumers confidence in quality products. (2) Flavor Variant Innovation; where Junglespread has a variety of interesting flavors, including chocolate, hazelnut, sea salt, mocha, mix, and fruit. This innovation appeals to consumers looking for a variety of flavors. (3) Strong Packaging Philosophy; where packaging design with the philosophy of "Real chocolate from Bali" provides a strong identity and differentiates it from competitors. This reflects a commitment to product authenticity and uniqueness (Darmawan, 2023). And (4) Consistency of Flavor Variants; where packaging provides consistency in flavor variants, helping consumers identify the desired variant easily. Meanwhile, the 3 Disadvantages of Junglespread Chocolate Spread include: (1) High Price; where Junglespread prices are quite high, especially on a local scale. This may limit the purchasing power of some local consumers. (2) Level of External Competition; where in competition with international brands such as Nutella, Junglespread's higher prices could be an obstacle in reaching a wider external market. (3) Potential Market Limitations; where the wide variety of flavors can confuse consumers and even limit certain target markets who are looking for clarity in product choices. So you need the right targeting strategy.

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Community Empowerment and Circular Economy Improvement:

Considering social and economic aspects, the focus shifts to empowering local communities and the long-term impact of zero waste solutions. Consultation with local communities, especially farmers and housewives, allows a better understanding of how implementing these solutions can improve the welfare of cocoa farmers (Miswar, 2017). Long-term impact analysis considers the effect of solutions on the circular economy, including sustainability and economic growth potential in the long term. This approach ensures that zero waste solutions not only provide environmental benefits, but also empower communities and bring positive change in a sustainable manner.

Figure 7. Empowerment of Chocolate Farmers and Housewives. Source: Researcher Documentation

Apart from increasing productivity, this empowerment also makes an important contribution in improving the welfare of the surrounding community, including housewives. Housewives play a role in processing chocolate food waste into chocolate jam. Involvement in processing processes such as sorting, packaging and quality inspection of chocolate spread. This involvement gives them the opportunity to participate in producing products of economic value, so that it not only supports the household economy, but also provides a stronger sense of ownership and role in managing chocolate food waste (Patrisius, 2021). This encourages the adoption of more inclusive and sustainable circular economy practices, by involving the entire community in overcoming waste problems and improving shared prosperity. The application of zero waste solutions in the context of processing brown food waste is the adoption of an approach that considers social and economic aspects holistically. Empowering local communities, especially farmers and housewives, is the main focus to understand and implement this solution effectively. Consulting with them allows for an in-depth understanding of how zero waste solutions can improve individual and communal well-being.

It is important to note that zero waste solutions not only have positive implications for the environment, but also have a significant economic impact in the long term. Long-term impact analysis includes an evaluation of the circular economy, which considers sustainability and the potential for economic growth in society. This approach ensures that a zero waste solution is not just waste management, but is also a sustainable economic

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empowerment strategy, bringing about sustainable positive change (Osorio, 2021). Through the involvement of housewives in the waste processing process, circular economy practices become more inclusive and have an impact on improving welfare, providing a sense of ownership, and encouraging active participation in efforts to better manage brown food waste.

CONCLUSION

The local community in Dauh Puri Klod, especially farmers, can use cocoa pulp which was previously considered waste to produce chocolate jam, creating additional income for them. This additional income can help improve the quality of life and economic independence of local communities, especially those who have an important role in managing and utilizing this waste into economically valuable products. Apart from an economic perspective, empowering local communities also builds awareness and a caring attitude towards waste management, encourages optimal use of resources, and rejects the detrimental debt bondage system. This forms a more environmentally conscious mindset and contributes to the development of a more sustainable circular economy. In the context of community empowerment, there needs to be a collaborative approach between government, industry and society. Government support in the form of policies that facilitate the implementation of zero waste solutions and education related to waste management is very important. Industry can also play a role in providing training and guidance to local communities to maximize the use of brown waste. Overall, the implementation of zero waste solutions in the chocolate industry in Dauh Puri Klod not only reflects a commitment to achieving economic and environmental sustainability, but also promotes the welfare of the local community. This brings hope to create a sustainable ecosystem, where waste is transformed into an economic asset, empowering communities, and leading to a future where waste is no longer an issue.

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