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Digital Innovation and Effective Management to Expand the Market for Taro Chips with Zero Waste Concept in Wanagiri Village, Buleleng, Indonesia

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ABSTRACT

This community engagement project aimed to empower local microenterprises in Wanagiri Village, Buleleng, by introducing digital innovation and effective business management to enhance the production and market expansion of taro chips. Two main community partners, the PKK women's group and the Wanagiri Youth Taro Processing Group (KPT), previously relied on conventional methods with limited market reach and minimal waste utilisation. The intervention implemented a five-phase strategy: (1) socialisation and stakeholder mapping, (2) training and technology introduction, (3) hands-on practice, (4) mentoring, and (5) evaluation and sustainability planning. Key outputs included standardised hygienic production processes (GMP/SSOP), financial bookkeeping systems, digital marketing capability through social media and marketplaces, new branding and packaging, and a prototype for processing taro waste into animal feed. The program significantly improved partners' production volume, quality, digital literacy, and business sustainability. This initiative demonstrates how community-based digital innovation and management capacity building can transform local agribusinesses, increase household income, and contribute to sustainable rural development.

Contribution to Sustainable Development Goals (SDGs):

SDG 8: Decent Work and Economic Growth

SDG 12: Responsible Consumption and Production

SDG 9: Industry, Innovation, and Infrastructure

1. INTRODUCTION

1.1. Research Background

Taro-based product processing presents increasing prospects and development opportunities in the current agri-food landscape.



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To date, most taro processing practices remain rooted in conventional approaches [1]. One prominent derivative product is taro chips [2], a snack food processed by communities in Wanagiri Village, Sukasada Subdistrict, Buleleng Regency, Bali Province. Chips, or kripik, are typically thin slices of tubers, fruits, or vegetables fried in vegetable oil [3]. To achieve a

savoury and crispy texture, these chips are often coated with a flour batter mixed with selected spices [4].

From a nutritional perspective, taro, as a base ingredient, offers a high caloric value and is rich in essential nutrients, including vitamins and minerals. This makes taro chips not only an enjoyable snack but also one that contributes to dietary benefits. Generally, chips are processed through frying, although some variants involve sun-drying or dehydration methods [5]. Taro chips can exhibit various dominant flavors such as salty, spicy, sweet, sour, umami, or a combination thereof. They are produced in diverse flavours and variations [6].

The taro chip production process varies significantly across villages, contributing to the unique local identity of each production centre. However, this variability leads to differences in product quality and food safety. Factors such as the type and quality of raw materials and supporting ingredients, uncontrolled processing environments, and inconsistent end points in production contribute to this inconsistency [7].

Traditional production methods are often characterised by low sanitation and hygiene standards, the use of substandard or less fresh raw materials, uncertain food safety, outdated and rudimentary technologies, and informal family-run business structures with limited managerial capabilities. Despite these limitations, taro chips represent a creative culinary innovation that leverages local resources into appealing and marketable food products with strong potential in the snack industry.

Nevertheless, the non-standardised and inconsistent quality of taro chips poses challenges for product shelf life, food safety, and scalability. Therefore, conventional processing requires targeted improvements through the application of fundamental food safety and quality assurance standards [8]. Incorporating Good Manufacturing Practices (GMP) and Sanitation Standard Operating Procedures (SSOP) is necessary to produce high-quality, safe-to-consume taro chips [4][11][12].

Quality management and safety assurance in both raw materials and end products must be addressed to develop entrepreneurial capacity and improve product marketing [9][10]. Addressing these challenges aligns with broader regional development strategies. In Buleleng Regency, a national priority project has allocated approximately 5.5 billion Indonesian Rupiah to develop 20,274 hectares of agricultural zones through a sustainable agricultural commodity production program initiated by the Ministry of Agriculture. The regency holds significant potential in the agriculture, livestock, fisheries, trade, and tourism sectors.

Digital innovation is not solely about technology—it is about creating sustainable added value for all stakeholders. Through community service initiatives funded by Universitas Warmadewa, it is expected that the PKK Wanagiri women's group and the Wanagiri Youth Taro Processing Group can strengthen their business capacities in production, marketing, and management, thereby enabling taro chips from Wanagiri Village to compete in broader markets.

1.2. Literature Review

Taro chips, as one of the most popular local snacks, offer not only a broad market potential but also rich nutritional value. However, to fully harness this potential, improvements in production facilities supported by digital innovation are necessary. Technological advancements increasingly influence the way consumers interact with food products today. With the

widespread use of the internet and smart devices, consumption patterns have shifted. Consumers now tend to choose products that are not only delicious but also healthy and provide added value.

This is where digital innovation plays a key role, offering producers of taro chips an opportunity to adapt their production processes to become more efficient and appealing to contemporary consumers. The modernisation of production facilities, integrated with digital technologies, can significantly improve product quality. For example, the use of automated machinery for peeling and slicing taro can reduce production time and increase the consistency of chip size. Additionally, temperature and humidity monitoring technologies during frying can optimise the texture and flavor of taro chips, leading to greater consumer satisfaction.

Therefore, digital innovation extends beyond tools and machines; it also encompasses data management and analysis, enabling producers to understand market trends and consumer preferences better. The implementation of information technology in production management is a crucial element of digital transformation. Cloud-based management systems allow taro chip producers to monitor the entire production process in real-time. The data collected from such systems can be analysed to improve production efficiency, identify potential issues, and plan more effective marketing strategies.

For instance, sales data analytics can help producers determine the optimal timing for production and marketing, thus reducing the risk of overstock-related losses. Furthermore, digital innovation opens up opportunities for broader marketing reach. By leveraging social media and e-commerce platforms, taro chip producers can access wider consumer markets—locally, nationally, and even internationally. Strategic use of digital marketing can enhance brand awareness and customer loyalty, creating a competitive advantage in an increasingly saturated marketplace.

Nevertheless, challenges remain in adopting digital innovation within the taro chip industry. Not all producers have the financial or human resources to invest in new technologies. Hence, support from the government and related institutions is essential, particularly in the form of technical training and funding schemes. Such support can empower small and medium-sized producers to access necessary technology and improve their production capacity.

Digital innovation in improving taro chip production infrastructure is a strategic step toward enhancing product quality and competitiveness. By adopting modern technology, producers can increase both efficiency and consistency while expanding their market reach. Through collaboration between producers, government entities, and educational institutions, the taro chip industry is expected to grow rapidly and contribute significantly to the local economy.

1.3. Research Objective

This study aims to implement digital innovation and effective management strategies to: (1) improve the quality and productivity of taro chip production; (2) expand market access through digital platforms; (3) enhance financial literacy and record-keeping; and (4) apply zero-waste principles by utilizing processing residues as animal feed.

2. MATERIALS AND METHODS

The intervention used a participatory approach involving local stakeholders, including PKK Wanagiri, KPT Wanagiri, and the Village Government. The five-stage implementation method consisted of: (1) Socialization and Partner Identification: Mapping needs and readiness of target groups; (2) Training: GMP/SSOP-based production, digital marketing, branding, and financial literacy; (3) Technology Transfer: Provision of simple tools (slicer, spinner, sealer), packaging materials, and waste processing units; (4) Assisted Practice: On-site guidance in production, bookkeeping, and e-commerce usage; (5) Monitoring and Evaluation: Pre/post assessments, feedback sessions, and sustainability planning..

3. RESULT AND DISCUSSION

Based on the results of the pre-training assessment illustrated in the chart (Figure 1), it is evident that most participants already possessed a fundamental understanding of production-related aspects of microenterprise operations. Specifically, 100% of respondents reported being aware of how to improve their production output, and 90% acknowledged the importance of maintaining consistent product quality. Additionally, 80% indicated that they had already applied efficient and environmentally friendly production techniques in their practices.

While these figures reflect a solid foundational knowledge in production processes, the pre-test results also revealed critical gaps that require attention during the training sessions. One significant weakness lies in the area of financial management. Only 20% of participants reported maintaining regular financial records, and merely 40% demonstrated an understanding of how to calculate business profit and loss. These findings point to a substantial lack of competence in essential business finance practices, which are crucial for long-term business sustainability and decision-making.

In terms of digital marketing, the participants' knowledge and skills were generally limited. Only 30% reported using social media to market their products, and an even smaller proportion—just 10%—indicated that they were capable of creating engaging digital promotional content. This suggests a significant skills gap in leveraging digital platforms, which are increasingly vital for accessing broader markets and building brand awareness in the digital economy.

Nonetheless, there are encouraging indicators that suggest room for improvement. Notably, 70% of respondents reported having previously attended a workshop or outreach session on digital marketing. This demonstrates a basic level of exposure that can be built upon through more focused, hands-on training interventions.

Overall, the pre-training assessment highlights a clear need for capacity building, particularly in the domains of financial management and digital marketing. These two areas are essential pillars for the growth and sustainability of small enterprises. Therefore, the training program must prioritise strengthening these competencies, ensuring that participants are not only capable of producing quality products but are also equipped to manage their businesses effectively and compete in increasingly digitised markets..

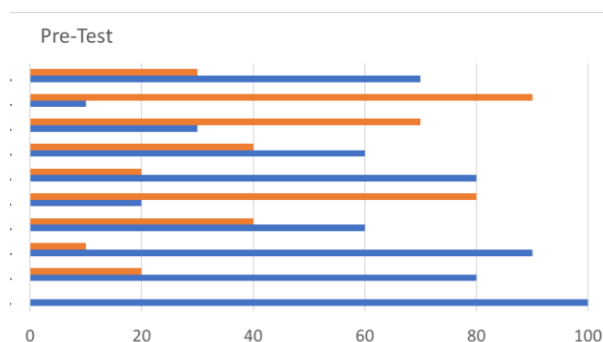


Figure 1. Pre-test result: (blue is yes; orange is no)

The post-training assessment results, as illustrated in the chart above, indicate a significant improvement in participants' understanding and skill levels. Every statement in the questionnaire received a 100% "YES" response, signifying that all participants fully grasped and were able to apply the training content. Participants not only demonstrated an understanding of strategies for enhancing production and efficiency in business operations but also exhibited competence in maintaining product quality, formulating production plans, and implementing structured financial record-keeping systems (Figure 2).

This marks a substantial improvement compared to the pre-training results, particularly in the areas of financial management and business digitalisation, which had previously shown notable deficiencies. The post-test results confirm that these critical gaps were effectively addressed through the training program.

Moreover, participants also showed remarkable progress in digital marketing competencies. All respondents reported being able to create basic promotional content, understood the benefits of digital marketing, and expressed motivation to further develop their digital marketing strategies. These outcomes reflect the training's success in supporting the digital transformation of micro and small enterprises (MSEs).

Such comprehensive improvements serve as clear indicators of the training's effectiveness in enhancing participants' capacity and readiness to manage their businesses more professionally and sustainably. It suggests that the program not only improved technical capabilities but also fostered a forward-thinking mindset toward innovation and market competitiveness.

Going forward, continuous mentoring and periodic evaluations will be essential to ensure that the knowledge and skills acquired during the training are consistently and optimally applied in daily business practices. Sustained support will help consolidate these gains and enable long-term impact on enterprise development and community resilience.

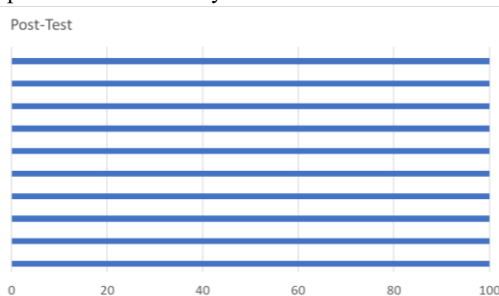


Figure 2. Post-test result



Figure 3. Outreach programs

The overall impact of this program highlights the transformative potential of integrated community training in enhancing both technical and managerial capacities among rural microentrepreneurs. The dual focus on improving production processes and integrating digital tools aligns with best practices in community development and SME empowerment. The significant changes seen between the pre-test and post-test indicate that structured, participatory, and context-relevant training is effective in upgrading business competencies.

The success in digital marketing adoption is particularly noteworthy, considering the low baseline knowledge among participants. This suggests that even limited exposure to digital platforms, when combined with targeted training and practical tools, can lead to substantial behavioural change. Similarly, the shift toward disciplined financial practices, despite initial unfamiliarity, reflects that hands-on, scenario-based training can demystify core management concepts for grassroots entrepreneurs.

Moreover, the project's emphasis on zero-waste processing and environmental sustainability provides a replicable model for other rural food sectors. Integrating waste utilisation with income-generating strategies adds value not only economically but also socially and ecologically. Future efforts should emphasise certification, scale-up support, and broader market integration to maintain long-term impact.

4. CONCLUSION

The first-year implementation of the PM-UPUD program was highly successful, demonstrating a measurable impact across several dimensions. The program fostered active participation from community members and partner groups throughout the training and practical sessions, enabling strong knowledge transfer and skill development. The introduction of simple yet context-appropriate technologies significantly enhanced production efficiency and output. Furthermore, the majority of partners successfully adopted basic financial bookkeeping practices, marking an important shift toward more accountable and structured business management. The program also catalysed

the initiation of digital marketing efforts, including creative product promotion on social media platforms. Notably, there was a marked increase in awareness regarding hygienic production standards and the potential for waste utilisation through zero-waste practices. Collectively, these outcomes reflect the program's ability to initiate transformative change in local microenterprises, establish the foundations for sustainable rural entrepreneurship, and contribute to the long-term economic resilience of Wanagiri Village.

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