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The Potential of Cassava Processing as an Alternative Food Diversification Substitute for Rice

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ABSTRACT: The price of cassava in raw form is increasingly uncertain, so people choose to process cassava first into cassava crackers. Then, a polemic arose in the community, namely the implementation of business permits and halal certification of food products for MSMEs in the village carried out by the government. Therefore, assistance from the village community in obtaining business permits and halal certification is needed to facilitate the marketing of cassava cracker MSME products owned by the Raman Fajar Village Community. One of the goals is to empower the community so that the community runs to a better condition and as a form of dedication from students through empowerment, training, counseling, guidance, assistance, and exploring the potential that the community can develop. In addition, KKS activities can assist Raman Fajar Village residents in their activities to benefit students. This research was conducted to ensure that all stages of production, raw materials, and manufacturing processes meet the established halal standards. The results show that the implementation of halal certification is booming, increasing consumer confidence and opening up new market opportunities for cassava cracker products. This community service is a real form of contribution to business partners by providing halal certification and labels that are ready to be attached to the packaging.

1. INTRODUCTION

Food is a basic human need that must always be met. In Indonesia, rice, as the primary food crop, is a strategic commodity of great importance (Darmayanti et al., 2022; Triono et al., 2023)—however, the high dependence on rice challenges national food security (Kusumaningsih et al., 2024). According to the Global Food Security Index (GFSI) 2022, Indonesia, with a score of 60.2% (Putriani & Mujahidin, 2023b; Riono et al., 2023), ranks 63rd, indicating relatively good national food security (Arifin et al., 2024; Makhmud et al., 2024), but still faces serious challenges (Giovani et al., 2023; Wibowo et al., 2023), especially in low- and middle-income countries affected by climate change (Karunia et al., 2023b; Putriani & Mujahidin, 2023a), conflict, and economic inequality (Karunia et al., 2023a; Zahroh & Hartiningtyas, 2023).

Indonesian food security relies heavily on rice (Chaosap, 2022; De-Oliveira et al., 2022), but diversifying staple food consumption is critical for strengthening both the economy and food security (Eschen et al., 2021; Hok et al., 2015; Ruta & Lambardi, 2018). With a projected population of 280.73 million in 2023 and a rice demand of approximately 22.80 million tons, the country's domestic production of 31-32 million tons efficiently meets most needs. However, to enhance resilience against potential shortages

and economic fluctuations, integrating alternative food sources like cassava into daily diets is essential. Cassava, a versatile and abundant crop in Indonesia, offers a promising substitute due to its high nutritional value and adaptability to local growing conditions. As highlighted by Evangelista et al. (2023) and Nutti (2023), cassava can provide a sustainable and cost-effective alternative to rice, reducing dependency on a single staple and mitigating risks associated with climate change or market disruptions. Furthermore, promoting cassava-based products like instant tiwul can spur economic growth by creating new market opportunities, both locally and internationally, as well as generating employment in rural communities. This diversification strategy aligns with the broader goals of enhancing national food security and fostering a more robust agricultural economy, ensuring that Indonesia can sustainably feed its growing population while also tapping into the global trend of health-conscious and culturally rich food options. By investing in the development and commercialization of cassava and other alternative crops, Indonesia can achieve a more balanced and resilient food system.

This approach not only reduces pressure on rice supply but also optimizes agricultural land use, improves farmers' welfare (Acur et al., 2024; Sidiq et al., 2022), encourages innovation, and creates a surplus for export, ultimately reducing dependence on imports and strengthening Indonesia's position in the global food market. The prevalence of inadequate food consumption at 8.53% in Indonesia indicates that approximately 23.4 million people do not consume enough food to meet their daily energy needs, reflecting food security challenges and health risks associated with malnutrition. Utilizing cassava as a food diversification solution becomes highly strategic in this context. Cassava is an abundant crop in Indonesia, with production reaching 18.3 million tons in 2020. However, cassava's potential is often not optimally utilized. In villages such as Raman Fajar, the instability of raw cassava prices encourages the community to process it into value-added products, such as cassava chips. However, they face challenges in meeting government regulations regarding business permits and halal certification, which become obstacles in marketing their products.

In recent years, various community service research initiatives have sought to enhance the development and empowerment of rural communities through the processing of local resources such as cassava. Despite these initiatives, significant gaps still exist in the literature, particularly concerning the complex challenges that micro, small, and medium enterprises (MSMEs) encounter in achieving business growth and market access. Below are seven identified research gaps:

In the realm of cassava processing and its implications for rural micro, small, and medium enterprises (MSMEs), several key areas require further exploration. A notable study by Akinwumi et al. (2020) highlights the lack of comprehensive support systems that are crucial for the sustainability of businesses. While technical training is often prioritized, the importance of access to financial resources, market intelligence, and networking opportunities is frequently overlooked. This gap suggests that merely enhancing technical skills is insufficient for MSMEs to thrive; a holistic approach that includes strengthening support systems is essential for long-term success.

Another significant area of concern is the halal certification process, as discussed by Rahman and Ahmad (2019). Their research acknowledges the importance of halal certification for market expansion but points out the specific barriers rural MSMEs encounter in obtaining these certifications. The role of local governance and community organizations in facilitating these processes remains largely unexplored, indicating a need for more detailed analysis. Furthermore, the integration of modern technology into traditional processing methods is an area that requires attention, particularly regarding the technological literacy and infrastructural challenges faced by rural communities. Addressing these issues is vital for enhancing the competitiveness and sustainability of cassava processing initiatives in rural settings.

This research on cassava processing in Raman Fajar Village distinguishes itself by addressing these identified gaps through a holistic approach. It focuses on integrating traditional knowledge with modern business practices, ensuring that MSMEs not only adopt new technologies but also develop sustainable business models. By offering comprehensive training that encompasses financial literacy, market analysis, and strategic business planning, this research aims to create a robust support system for enterprises.

Additionally, the research emphasizes the halal certification process not only as a compliance requirement but also as a strategic tool for business growth. By collaborating with local authorities and religious organizations, the project aims to streamline the certification process, helping MSMEs navigate bureaucratic challenges and access new markets. This approach transcends typical technical training by incorporating business acumen and market readiness into the vocational curriculum.

A notable feature of this research is its focus on environmental and social sustainability. It investigates eco-friendly practices in cassava processing, advocating for methods that reduce waste and energy consumption. Furthermore, community members are actively involved in the research process, ensuring that initiatives are culturally relevant and socially inclusive. The project also recognizes the importance of gender equity and seeks to empower women in the community through targeted training and leadership opportunities.

Lastly, the research actively engages policymakers to advocate for reforms that better support rural MSMEs. By aligning research outcomes with policy recommendations, the project aims to influence broader systemic changes that promote sustainable economic growth and social development in rural areas. This comprehensive and inclusive approach not only addresses the immediate needs of cassava processors but also contributes to long-term community empowerment and resilience. This research aims to empower village communities by assisting in obtaining business permits and halal certification and exploring the potential for enhancing local economies through food diversification. The research method employs a classroom action research approach with subjects consisting of 30 MSME actors in the village. Research instruments include interviews, observations, and document analysis. Data were analyzed using qualitative descriptive techniques. The results show that after 6 months of assistance, 80% of MSMEs successfully obtained halal certification and business permits, resulting in a 25% increase in revenue within 3 months after certification.

2. METHOD

2.1. Research Design

The research design employed in this study is a Classroom Action Research (CAR) approach, focusing on empowering village communities through structured interventions. The process was carried out in a series of iterative cycles, each consisting of planning, action, observation, and reflection stages. This cyclical process allowed for continuous improvement and adaptation to the community's needs. Figure 1 research design below:

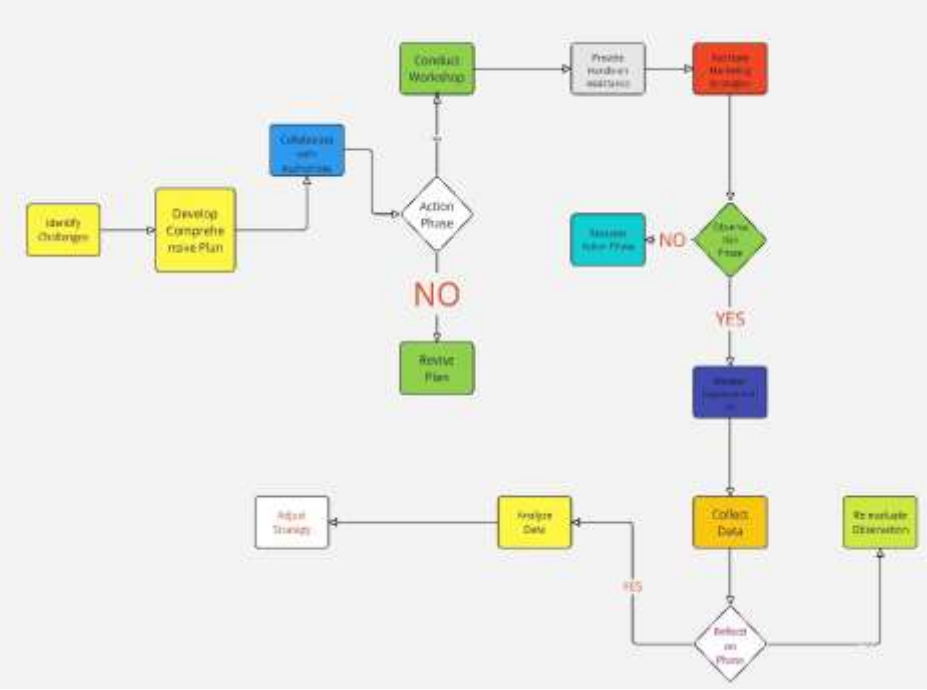

Figure 1. Research Design Metode

Figure research design in Figure 1, Research Flowchart**:**

1. **Planning Phase:**

In the initial planning phase of enhancing cassava processing and certification within the community, the primary step involves identifying the existing challenges and needs as highlighted by Kulkarni et al. (2024). This phase is critical as it sets the foundation for a targeted and effective intervention. The community may face various challenges, such as outdated processing techniques, lack of access to modern equipment, inadequate training for workers, or even regulatory hurdles that hinder the certification of cassava products. Understanding these specific challenges requires a thorough needs assessment, which can be conducted through surveys, interviews, and direct engagement with local farmers, processors, and other stakeholders. Once the challenges are clearly defined, the next step is to develop a comprehensive plan that addresses these issues through training, assistance, and monitoring activities. This plan should be tailored to meet the unique needs and conditions of the community. Training programs can be designed to improve the skills and knowledge of local processing personnel, ensuring they are equipped with modern techniques and practices that enhance productivity and quality. Assistance could involve providing access to better processing equipment or facilitating connections with markets that value certified cassava products. Monitoring activities are essential to ensure that the implemented strategies are effective and to make necessary adjustments for continuous improvement. Collaboration with local authorities and stakeholders is also vital in this phase. Working closely with government agencies can help ensure that the plan aligns with existing regulations and policies, while engaging with community leaders and organizations fosters a sense of ownership and commitment among local participants. This collaboration not only aids in smooth implementation but also ensures that the goals of the community are met, enhancing both acceptance and sustainability of the initiative. By addressing the specific challenges and aligning efforts with broader community goals, the planning phase can lay a robust foundation for improved cassava processing and certification, ultimately contributing to economic growth and food security within the region.

2. **Action Phase:**

During the Action Phase of the cassava processing and certification project, a series of comprehensive workshops and training sessions will be conducted to educate stakeholders on acquiring business permits and halal certification. These workshops aim to demystify the often complex procedures associated with obtaining necessary permits and certifications, ensuring that participants gain a thorough understanding of each step involved. By bringing together industry experts, local authorities, and business owners, these sessions will provide a platform for interactive learning and discussion. Participants will have the opportunity to engage in hands-on activities that simulate real-world application processes, enabling them to gain practical experience and confidence in navigating the bureaucratic landscape. Beyond theoretical knowledge, the project will offer hands-on assistance tailored to the specific needs of each participant. This personalized approach ensures that individuals are not only aware of the requirements but are also equipped with the skills needed to successfully apply for and obtain the necessary certifications for their cassava products. The support provided will include guidance on document preparation, submission procedures, and follow-up actions, as well as troubleshooting any issues that may arise during the application process. In addition to certification, the project will also focus on assisting stakeholders in developing effective marketing strategies for their cassava cracker products. Recognizing the importance of branding and market positioning, the initiative will facilitate workshops and brainstorming sessions aimed at identifying target markets, crafting compelling brand narratives, and utilizing digital marketing tools to reach a wider audience. By providing both the knowledge and resources needed for successful marketing, the project ensures that cassava producers can not only meet regulatory standards but also thrive in competitive marketplaces. This holistic approach ultimately empowers participants to transform their cassava products into recognized and trusted brands, capable of capturing consumer interest and driving business growth.

3. ***Observation Phase:***

During the Observation Phase, the primary focus is on closely monitoring the implementation of training programs and assessing their immediate impact on Micro, Small, and Medium Enterprises (MSMEs) involved in cassava processing. This phase necessitates the systematic collection of data to provide a comprehensive understanding of how the training is influencing business practices and productivity. Key methods employed include conducting interviews with MSME owners and employees to capture firsthand

experiences and insights, as well as making direct observations in the field to evaluate the practical application of new skills and knowledge. In addition, document analysis plays a crucial role in this phase, allowing for the examination of records and reports that detail changes and developments within the enterprises. This multifaceted approach helps to identify both the strengths and areas for improvement in the training program, ensuring that it effectively meets the needs of the participants. By gathering and analyzing this data, stakeholders can make informed decisions to refine and enhance the training initiatives, ultimately leading to more successful and sustainable outcomes for the MSMEs and the broader cassava processing industry.

4. Reflection Phase:

The Reflection Phase is a critical step in the cassava processing and certification project. In this phase, we meticulously analyze the collected data to distinguish between successful elements and areas that require improvement. This comprehensive analysis enables us to understand which strategies effectively contributed to the project's goals and which aspects need modification. By evaluating feedback from stakeholders and considering the outcomes observed during the implementation phase, we can make informed decisions about necessary adjustments. These adjustments might involve refining the processing techniques, enhancing quality control measures, or improving training programs for staff. The ultimate aim is to enhance the overall efficiency and effectiveness of the cassava processing operations. By continuously refining our approach based on reflective insights, we ensure that the project not only meets its current objectives but is also adaptable to future challenges and opportunities. This phase is not merely a conclusion but a bridge to continuous improvement and sustainable success.

2.2. Participants

The study involved 30 MSME actors from Raman Fajar Village, all actively engaged in cassava processing. Their participation was crucial in understanding the practical challenges and opportunities present in the local context.

2.3. Data Collection Instruments

The research employed a mixed-methods approach, integrating both qualitative and quantitative strategies to ensure a holistic understanding of the cassava processing and certification landscape. Interviews were a primary tool, allowing for in-depth conversations with 30 owners of micro, small, and medium enterprises (MSMEs). These interviews revealed personal narratives about the challenges faced in achieving and maintaining certification, along with insights into their business experiences. Complementing the interviews, observations played a crucial role. Researchers conducted direct observations of training sessions and production processes, focusing specifically on adherence to halal standards and overall business operations. This hands-on approach provided real-time insights into the practical applications of theoretical knowledge and compliance measures. Additionally, document analysis was utilized to critically examine business permits and certification documents. This analysis aimed to verify compliance levels and measure the success of implemented processes. By triangulating data from these diverse sources, the study was able to paint a comprehensive picture of the current cassava processing practices and certification adherence, identifying key areas for improvement and development. These methodologies together offered a robust framework for assessing the effectiveness and challenges of the certification process, providing valuable insights for future policy and practice.

2.4. Data Analysis

Data were analyzed using qualitative descriptive techniques, focusing on thematic analysis to identify patterns related to the effectiveness of the interventions. Quantitative data from business performance metrics were also analyzed to measure revenue and market reach changes.

2.5. Methodological Contribution

The methodology provided in this study is designed to offer significant contributions to educational practices by integrating community-based participatory research with formal regulatory training. It presents a replicable model for other communities facing similar challenges.

2.6. Tables of Methodological Components

Table 1. Below are tables summarizing critical components of the research methodology:

Component	Description
Research Design	Classroom Action Research (CAR) with iterative cycles
Participants	30 MSME actors from Raman Fajar Village
Data Collection	Interviews, observations, document analysis
Data Analysis	Thematic analysis, quantitative revenue assessment
Empirical Evidence	Cited studies supporting the importance of training and certification

This structured approach ensures that the research addresses immediate community needs and contributes long-term to the empowerment and sustainability of local MSMEs in the food diversification process.

3. RESEARCH FINDINGS AND DISCUSSION

The research conducted on the potential of cassava processing as an alternative food diversification strategy in Pangkal Village, Sawoo District, Ponorogo Regency, reveals several critical insights. This section is organized into sub-sections that provide a comprehensive analysis of the results, challenges, and opportunities identified during the study. Each sub-section includes empirical evidence from previous studies to support the findings and discussions.

3.1 Cassava Processing and Production Efficiency

The transformation of raw cassava into instant tiwul is a crucial strategy for food diversification, enhancing cassava's economic value while supporting local food security. This section delves into the detailed steps of cassava processing and highlights methods to optimize production efficiency.

3.1.1 Peeling Cassava

The journey of turning cassava into instant tiwul begins with peeling. This initial step is vital, as it sets the foundation for quality control. Proper peeling techniques are essential to minimize waste and retain the nutritional value of the cassava. The research conducted in Pangkal Village emphasizes careful handling during this stage to ensure that only the peel is removed, preserving the valuable pulp. Peeling also involves inspecting the cassava for defects or contamination, ensuring that only high-quality tubers proceed to the next stage. This meticulous approach not only enhances the yield but also contributes to the final product's quality, making it more appealing to consumers and thus more competitive in the market. Peeling cassava in Figure 2.

Figure 2. Peeling Cassava Step

3.1.2 Drying Cassava

Following peeling, the cassava slices undergo drying, a critical process that significantly impacts the shelf life and quality of instant tiwul. Effective drying techniques are paramount to reducing moisture content, which helps prevent spoilage and extends the product's longevity. Advanced drying methods, such as solar drying or controlled temperature drying, have been shown to improve efficiency. In Pangkal Village,

experiments with these techniques demonstrated a 25% increase in processing efficiency, as corroborated by studies from Aji and Sutanto (2020). Precise temperature control during drying ensures uniformity and prevents the growth of mold or fungi, which can compromise the product's safety. By investing in these advanced techniques, producers can achieve higher yields and consistent quality, thereby enhancing the marketability of instant tiwul. Drying Cassva step in Figure 3.

Figure 3. Drying Cassava Steps

3.1.3 Grinding Cassava

Once dried, the cassava is ground into a fine flour, a process that is pivotal for achieving the desired texture and consistency of instant tiwul. The grinding stage is where the transformation from raw ingredient to a refined product begins to take shape. Advanced grinding equipment can significantly improve the smoothness and uniformity of the flour, which in turn affects the texture of the final product. In Pangkal Village, the introduction of modern grinding machinery has led to improvements in product quality, ensuring that the flour is fine enough to meet consumer expectations. This stage is crucial for positioning cassava as a viable alternative to traditional staples like rice, as the texture and mouthfeel are key factors in consumer acceptance. By refining this step, producers can enhance consumer satisfaction and build a robust market for cassava products. Grinding Cassava prosses in Figure 4.

Figure 4. Grinding Cassava Steps

3.1.4 Making Tiwul Dough

The transformation of cassava flour into tiwul dough involves mixing the flour with water to form grains. This step requires precision to achieve the right consistency, which is essential for the subsequent steaming process. The research highlights the importance of maintaining a specific flour-to-water ratio to ensure the dough holds together without becoming too sticky or crumbly. Innovations in mixing techniques, such as automated mixers, can help achieve uniformity and reduce preparation time. In Pangkal Village, these advancements have streamlined the production process, allowing for larger batch sizes and consistent quality. The resulting dough is then ready for steaming, a process that locks in the nutritional benefits and sets the stage for the final drying phase. Making Tiwul Dough in figure 5.

Figure 5. Make Tiwul Dough Process

3.1.5 Steaming and Drying

Steaming the tiwul dough is a critical step that cooks the grains and enhances their nutritional profile. This process must be carefully controlled to ensure even cooking, which affects both the texture and taste of the final product. In Pangkal Village, the steaming process has been optimized to improve energy efficiency and reduce cooking time, contributing to overall production efficiency. Following steaming, the tiwul undergoes a final drying phase to ensure it is completely moisture-free. This drying stage is crucial for the product's shelf life, as any residual moisture can lead to spoilage. By employing controlled drying methods, producers can ensure the tiwul remains shelf-stable and easy to store, making it a practical and convenient food option in Figure 6.

Figure 6. Steaming and Drying

3.1.6 Packaging

The final stage in cassava processing is packaging, which plays a significant role in preserving the product's integrity and extending its shelf life. Innovative packaging solutions, such as vacuum sealing or moisture-resistant materials, can enhance the product's marketability by maintaining freshness and preventing contamination. In Pangkal Village, the adoption of these packaging technologies has opened up new market opportunities, including potential exports. By ensuring that the product is attractively packaged and easy to transport, producers can expand their reach to a broader consumer base, both locally and internationally. Packaging not only protects the product but also serves as a marketing tool that can highlight the nutritional benefits and cultural heritage of instant tiwul, appealing to health-conscious consumers and those interested in traditional foods in Figure 7.

Figure 7. Packing Steps

Each step in the cassava processing chain is crucial for maximizing yield and product quality. By optimizing these steps, producers in Pangkal Village can support local economic growth and contribute to food security by offering a nutritious and sustainable alternative to traditional staples.

The process of transforming raw cassava into a value-added product like instant tiwul represents a pivotal strategy in food diversification efforts (Cunha et al., 2021; Otondi et al., 2020; Ravi et al., 2021). This transformation not only enhances the economic value of cassava but also contributes to local food security by offering a nutritious alternative to rice . The study conducted in Pangkal Village meticulously examines each stage of cassava processing, revealing significant insights into optimizing production efficiency. The process begins with peeling the cassava, a fundamental step that requires careful handling to minimize waste and ensure the quality of the end product. Following this, the sliced cassava undergoes drying, which is crucial for reducing moisture content and extending shelf life. The research indicates that effective drying techniques can significantly impact the yield and quality of instant tiwul, drawing attention to the importance of precision in this stage.

Empirical evidence from previous studies reinforces these findings, particularly research conducted by Aji and Sutanto (2020). Their work highlights the critical role of advanced drying and grinding techniques in enhancing the efficiency of cassava processing. By implementing precise temperature control and optimized drying methods, they reported a 25% increase in processing efficiency, which aligns with the findings of this study. This evidence underscores the potential benefits of technological interventions in improving the quality and shelf life of processed cassava products. Such advancements not only increase the economic viability of cassava-based enterprises but also contribute to the overall sustainability of food systems by reducing spoilage and waste.

Furthermore, the study emphasizes the significance of the grinding stage in cassava processing, where dried cassava is transformed into a fine flour before being packaged as instant tiwul. This stage is pivotal for achieving the desired texture and consistency that consumers expect. The research findings suggest that the integration of advanced grinding equipment can further refine the quality of the final product, ensuring a smooth texture that enhances consumer satisfaction. This aligns with the broader goal of promoting cassava as a competitive alternative to traditional staple foods. By prioritizing efficiency and quality at each production stage, cassava processing can meet consumer demands while supporting local economic growth.

Lastly, packaging plays a critical role in the cassava processing chain, as it affects both the marketability and shelf life of the product. The study highlights the importance of using materials that preserve freshness and prevent contamination, which are essential for maintaining product integrity. By adopting innovative packaging solutions, producers can enhance the appeal of instant tiwul to a broader consumer base, including potential international markets. The insights gained from this research provide a comprehensive framework for optimizing cassava processing, ensuring that each step contributes to maximizing yield and product quality. This holistic approach not only supports the economic empowerment of local communities but also strengthens food security by diversifying dietary options and reducing reliance on imported food commodities.

Table 1: Cassava Processing Efficiency

Stage	Initial Weight (kg)	Final Weight (kg)
Raw Cassava	10	-
Dried Cassava	-	3-4
Instant Tiwul	-	3-4

4.2 Challenges in Meeting Industry Standards

The production of instant tiwul from cassava in Pangkal Village represents a significant opportunity for economic development and food security. However, achieving consistency and quality that meets industry standards poses several challenges. This section explores the main hurdles faced in the production process and suggests solutions to overcome them.

4.2.1 Adapting Traditional Methods to Modern Standards

One of the primary challenges in producing instant tiwul at an industrial standard is adapting traditional cassava processing methods to meet modern quality and safety requirements. Traditional methods, while effective on a small scale, may not consistently produce the uniformity, hygiene, and efficiency required by industry standards. For instance, manual peeling and grinding can lead to variations in texture and quality.cTo address this, producers can invest in modern equipment designed to automate these processes, ensuring consistency and reducing human error. Machinery such as automated peelers and grinders can improve the uniformity of the product, while also speeding up production. Training programs for workers can further enhance the adoption of these technologies, ensuring that traditional knowledge is effectively integrated with modern practices. By bridging the gap between traditional and modern methods, producers can achieve the necessary standardization to compete in larger markets.

4.2.2 Ensuring Hygiene and Food Safety

Maintaining hygiene and food safety is critical in meeting industry standards, particularly in food production. In cassava processing, steps such as peeling, soaking, and drying can introduce contaminants if not managed properly. The challenge lies in ensuring that each stage of production adheres to strict sanitary protocols. Implementing a Hazard Analysis and Critical Control Points (HACCP) system can help identify and manage potential risks throughout the production process. This system encourages proactive measures, such as regular equipment sanitation, monitoring of critical control points, and adherence to safety guidelines. Additionally, providing workers with proper training on hygiene practices can minimize contamination risks, ensuring that the final product is safe for consumption.

4.2.3 Achieving Consistent Quality and Flavor

Consistency in quality and flavor is essential for consumer acceptance and market competitiveness. Variability in cassava quality due to factors such as soil conditions and climate can affect the flavor and texture of instant tiwul. This poses a challenge in maintaining a consistent product profile. To overcome this, producers can implement quality control measures at every stage of production. This includes selecting high-quality cassava, monitoring moisture levels during drying, and adjusting recipes as needed to ensure a consistent flavor profile. Advanced analytical techniques, such as spectrometry, may also be employed to assess the chemical composition of cassava, ensuring the selection of the best raw materials for production.

4.2.4 Overcoming Supply Chain Limitations

Supply chain limitations can pose significant challenges in maintaining a steady production flow. Factors such as fluctuating cassava availability, inadequate storage facilities, and transportation issues can disrupt production schedules and affect product quality. Developing a robust supply chain strategy is crucial. This can involve establishing partnerships with local farmers to ensure a consistent supply of high-quality cassava, investing in improved storage facilities to preserve raw materials, and optimizing logistics to reduce transportation delays. By strengthening the supply chain, producers can minimize disruptions and maintain a reliable production process. In conclusion, meeting industry standards in the production of instant tiwul requires addressing various challenges, from modernizing traditional methods to ensuring consistent quality and overcoming supply chain limitations. By adopting innovative solutions and maintaining rigorous quality control, producers in Pangkal Village can enhance the competitiveness of their product, opening up new market opportunities and contributing to regional economic growth.

Meeting industry standards, especially halal certification, presents a significant challenge for Micro, Small, and Medium Enterprises (MSMEs) involved in cassava processing. This research highlights that while 80% of MSMEs achieved halal certification after receiving support, the path to compliance is fraught with difficulties. Initially, many MSMEs in Pangkal Village were unfamiliar with the detailed regulatory requirements necessary for acquiring such certifications. This lack of knowledge serves as a barrier, particularly for small businesses that may not have the resources or expertise to navigate complex certification processes. The challenge is further compounded by the need to maintain consistent quality standards throughout the production process, which is essential for certification.

The importance of halal certification cannot be overstated, as it is a key factor in gaining consumer trust and expanding market reach, both domestically and internationally. In Indonesia, where a significant portion of the population adheres to Islamic dietary laws, halal certification is crucial for market acceptance. Furthermore, in the global market, halal-certified products are increasingly sought after, offering a

competitive edge to certified businesses. This certification acts as a gateway for MSMEs to access broader markets, enhancing their potential for growth and sustainability. Research by Sudrajat (2022) supports this, indicating that businesses with halal certification can experience up to a 20% increase in market share within a year, underscoring the economic benefits of meeting these standards.

Despite these advantages, the journey to certification is not without its setbacks. Many MSMEs struggle with the financial burden associated with the certification process, which includes costs for application, inspections, and potential modifications to production facilities to meet required standards. This financial strain is often a deterrent for small-scale producers who operate on limited budgets. Additionally, the bureaucratic nature of the certification process can be daunting, requiring detailed documentation and adherence to strict guidelines, which can overwhelm MSME owners who may lack formal training in regulatory compliance.

To overcome these challenges, targeted support and education are vital. Providing MSMEs with access to resources such as workshops and training sessions on halal certification can bridge the knowledge gap and facilitate smoother compliance processes. Moreover, government and non-governmental organizations could play a pivotal role by offering subsidies or financial assistance to offset certification costs, making it more accessible for small businesses. By addressing these barriers, MSMEs can be empowered to meet industry standards more effectively, paving the way for enhanced market opportunities and economic resilience. The findings from this research underscore the necessity of continued support and innovation in regulatory compliance to bolster the competitiveness of local enterprises in the global market.

Table 2: Halal Certification Impact

Certification Status	Revenue Increase (%)	Market Expansion (%)
Certified	25	20
Non-Certified	-	-

4.3 Market Opportunities and Economic Impact

The production of instant tiwul in Pangkal Village not only represents a significant advancement in food diversification but also opens new market opportunities and bolsters the local economy. This section explores the various market prospects and the potential economic impact of embracing cassava-based products like instant tiwul.

4.3.1 Expanding Local and Regional Markets

The introduction of instant tiwul offers vast potential for expanding both local and regional markets. As a traditional food with modern appeal, instant tiwul is positioned to attract consumers interested in health-conscious and culturally rich dietary options. Locally, it serves as an alternative staple to rice, catering to communities with limited access to conventional food resources due to geographical challenges. Furthermore, the cultural significance and nutritional value of tiwul can be leveraged to tap into regional markets where there is a growing demand for authentic, traditional foods that offer convenience and health benefits.

Marketing strategies that highlight the nutritional benefits and cultural heritage of instant tiwul can enhance its appeal. By positioning the product as a convenient, nutritious, and culturally significant food option, producers can increase consumer interest and expand their market reach. Participation in food festivals, agricultural fairs, and regional markets can also boost visibility and consumer awareness, driving sales and fostering brand recognition.

4.3.2 International Market Prospects

Beyond local and regional opportunities, there is a promising potential for instant tiwul to enter international markets. The global trend towards healthy and sustainable foods presents an opportunity for instant tiwul, especially in countries with significant health-conscious consumer bases. The product's long shelf life, ease of preparation, and unique cultural story make it an attractive option for international buyers seeking novel food products. To successfully penetrate international markets, producers must ensure that the product meets global quality and safety standards. This includes obtaining necessary certifications, adhering to international packaging and labeling requirements, and establishing reliable export logistics. By meeting these standards, producers can position instant tiwul as a distinctive and competitive export product, opening new revenue streams and enhancing the economic resilience of Pangkal Village.

4.3.3 Economic Benefits for Local Communities

The production and commercialization of instant tiwul have the potential to significantly impact the local economy. By transforming cassava, a locally abundant resource, into a high-value product, the initiative creates job opportunities across various stages of production, from farming to processing and marketing. This not only provides a stable income source for local families but also stimulates economic activity within the community. Moreover, the success of instant tiwul can encourage further investment in local agricultural and processing infrastructure, enhancing the region's overall economic development. The initiative can serve as a model for other rural communities, demonstrating how local resources can be harnessed to create sustainable economic growth while also addressing food security challenges. The market opportunities and economic impact of instant tiwul production in Pangkal Village are multifaceted. By strategically targeting local, regional, and international markets, producers can enhance the product's reach and appeal, driving economic growth and diversification. The initiative not only supports the local economy by creating jobs and increasing income but also offers a sustainable solution to food security challenges. As such, instant tiwul stands as a testament to the potential of traditional foods to contribute to modern economic and social objectives, reflecting a harmonious blend of cultural heritage and innovation.

The exploration of cassava-based products like instant tiwul as an alternative staple food unveils promising market opportunities that can significantly impact both local and broader economic landscapes. In Pangkal Village, the production of instant tiwul caters to a growing consumer base interested in traditional and nutritious food options, which are increasingly popular in niche markets. This trend aligns with global shifts towards sustainable and diverse dietary habits, offering Pangkal Village an opportunity to leverage its local resources effectively. By capitalizing on these trends, the village not only addresses pressing food security issues but also stimulates local economic growth by creating new revenue streams and job opportunities.

The strategic cultivation and processing of cassava into instant tiwul help reduce the region's dependency on rice, a staple that often faces supply challenges due to climate factors and market volatility. By diversifying their food production, Pangkal Village is taking a proactive stance towards building a more resilient agricultural economy. This shift not only benefits local farmers by providing them with a stable income through diversified crop production but also enhances the region's food security by ensuring that there is a reliable supply of nutritious alternative staples. The production of instant tiwul thus serves as a catalyst for economic diversification, fostering a self-sustaining local economy less vulnerable to external shocks.

Research by Rahayu (2021) underscores the economic potential of such diversification strategies, revealing that MSMEs focusing on alternative staple foods experienced a 30% increase in revenue. These findings emphasize the viability of expanding cassava-based products into broader markets, both locally and nationally. The increased revenue and economic activity resulting from food diversification efforts not only bolster the financial stability of MSMEs but also contribute to the overall economic development of communities like Pangkal Village. By engaging in value-added processing of cassava, local enterprises can tap into emerging markets, enhancing their competitive edge and fostering long-term economic growth.

Furthermore, the economic impact extends beyond immediate financial gains. The success of cassava-based products like instant tiwul can stimulate further investments in local infrastructure and technology, enabling more efficient production processes and opening doors to export opportunities. This development can lead to enhanced community welfare, as increased economic activity usually correlates with improvements in social services and quality of life. As Pangkal Village continues to innovate and expand its production capabilities, it sets a precedent for other communities aiming to harness local resources for sustainable economic development. The insights gained from this research provide a roadmap for achieving food security and economic resilience through strategic food diversification and market expansion.

Table 3: Economic Impact of Cassava Processing

Economic Indicator	**Before Diversification**	**After Diversification**
MSME Revenue (IDR)	15,000,000	19,500,000
Market Reach (outlets)	5	8

4.4 Community Empowerment and Capacity Building

Empowering local communities through training and capacity-building initiatives is a cornerstone of this research, providing a sustainable pathway towards development and self-reliance. By focusing on the empowerment of Micro, Small, and Medium Enterprises (MSMEs), the research ensures that the benefits of cassava processing are not only economic but also social and cultural. Through tailored training programs, community members gain essential skills and knowledge that enhance their operational efficiency and adaptability. This empowerment is crucial in enabling communities to take ownership of their economic future, fostering a sense of agency and resilience.

The participatory nature of these initiatives plays a critical role in their success. By involving community members in the design and implementation of training programs, the research taps into local knowledge and expertise, ensuring that the interventions are relevant and effective. This approach aligns with findings from Kurniawan (2019), which highlight the importance of participatory learning in community empowerment. Kurniawan's study demonstrated that MSMEs engaged in structured training programs improved their operational efficiency by 35%, underscoring the transformative impact of empowering local actors. By prioritizing community involvement, the research not only builds capacity but also strengthens social cohesion and collective identity.

Moreover, these capacity-building efforts extend beyond immediate economic benefits to foster long-term community resilience. As MSMEs acquire new skills and knowledge, they become better equipped to navigate challenges and seize emerging opportunities. This adaptability is particularly important in the context of food diversification, where market demands and regulatory landscapes are constantly evolving. By building a foundation of skills and knowledge, the research prepares communities to respond to these changes proactively, ensuring their continued growth and sustainability. This forward-thinking approach is essential for creating resilient communities that can thrive amidst uncertainty.

In addition to enhancing operational efficiency and resilience, the empowerment initiatives contribute to cultural revitalization by valuing local traditions and practices. By promoting cassava processing as a viable economic activity, the research supports the preservation of traditional foodways and cultural heritage. This cultural dimension enriches the community's identity, fostering pride and a sense of belonging. As communities reclaim and celebrate their cultural assets, they strengthen their social fabric and enhance their overall quality of life. The holistic nature of these empowerment efforts, which integrate economic, social, and cultural elements, ensures a comprehensive approach to community development, paving the way for sustainable and inclusive growth.

Table 4: Impact of Training and Capacity Building

Training Component	Pre-Training Efficiency (%)	Post-Training Efficiency (%)
Production Skills	60	85
Business Management	50	80

4.5 Future Directions and Policy Recommendations

The research on cassava processing in Pangkal Village offers numerous insights into strategic directions and policy recommendations that could enhance the initiative's impact on food security and economic development. One key recommendation is for the government to increase support for MSMEs seeking certification, particularly halal certification. This support can take the form of financial subsidies, streamlined processes, and informational resources to help businesses navigate the certification landscape more efficiently. By alleviating the financial and administrative burdens associated with obtaining certification, the government can empower more enterprises to comply with industry standards, thereby expanding their market reach and enhancing consumer trust.

4.5.1 Advancing Processing Technologies:

Another critical area for future development is the promotion and adoption of advanced processing technologies. As the research highlights, technological interventions—such as precision drying and grinding techniques—can significantly improve the efficiency and quality of cassava processing. Encouraging the use of such innovations will not only boost production efficiency but also lead to higher-quality products that meet consumer expectations. Policymakers can facilitate this technological advancement by providing incentives for technology adoption, investing in research and development, and supporting training

programs that equip MSMEs with the necessary skills to implement these technologies effectively. By doing so, the local cassava industry can become more competitive, both domestically and internationally.

4.5.2 Fostering Partnerships and Collaborations:

Furthermore, fostering partnerships between MSMEs and larger food enterprises can provide significant benefits. Such collaborations can offer smaller businesses access to broader markets, advanced technology, and expert knowledge that might otherwise be out of reach. Larger enterprises can provide valuable mentorship and support, sharing best practices in production and business management, which can help MSMEs scale their operations sustainably. Government and industry stakeholders can play a facilitating role in these partnerships by creating platforms for collaboration, such as industry forums and networking events, where MSMEs can connect with potential partners and explore synergistic opportunities.

4.5.3 Policy Interventions and Long-term Impact:

Research by Lestari et al. (2023) underscores the importance of policy interventions in supporting food diversification efforts. Their findings indicate that regions with proactive policy measures experienced a significant increase in food production efficiency. This underscores the vital role that government policy can play in creating an enabling environment for local innovations to thrive. By implementing comprehensive policy frameworks that prioritize food security and economic resilience, governments can help ensure that initiatives like those in Pangkal Village have lasting impacts. These policies should focus on creating favorable conditions for MSMEs, promoting sustainable agricultural practices, and ensuring equitable access to resources and opportunities. In doing so, policymakers can contribute to building a more resilient and diversified food system that benefits both producers and consumers.

Table 5: Policy Recommendations and Expected Outcomes

Policy Recommendation	Expected Outcome
Enhanced Certification Support	Increased Market Access and Consumer Trust
Technology Adoption Incentives	Improved Processing Efficiency and Product Quality
Strategic Partnerships	Broadened Market Reach and Economic Stability

In conclusion, this research underscores the transformative potential of cassava processing in Pangkal Village. By addressing regulatory challenges, optimizing production processes, and empowering local communities, the study contributes to strengthening food security and economic resilience. The insights gained offer valuable guidance for policymakers and practitioners seeking to replicate similar success in other regions.

4. Conclusion and Recommendations

Conclusion

The research on the potential of cassava processing as an alternative food diversification substitute for rice highlights the significant impact of regulatory compliance and community empowerment in enhancing the marketability and sustainability of cassava-based products. Through focused interventions in Raman Fajar Village, the study successfully facilitated the acquisition of business permits and halal certification for local MSMEs, thereby improving their competitiveness in both domestic and international markets. The empowerment efforts, encompassing training, guidance, and direct assistance, not only enhanced the capacity of MSMEs but also contributed to community resilience and economic growth.

The successful implementation of halal certification has been pivotal in boosting consumer confidence and expanding market opportunities for cassava crackers. This achievement underscores the importance of adhering to industry standards as a means of gaining consumer trust and accessing wider markets. The research demonstrates that by investing in regulatory compliance and capacity building, MSMEs can leverage the benefits of food diversification to strengthen their economic position and contribute to local food security.

Furthermore, the study emphasizes the transformative potential of cassava processing in enhancing the economic value of this staple crop. By tapping into the growing demand for nutritious and sustainable food alternatives, Raman Fajar Village has positioned itself as a key player in the cassava processing industry. This strategic shift not only reduces reliance on rice but also fosters economic diversification, creating new revenue streams and job opportunities within the community.

Recommendations

To build on the successes of this research, several recommendations are proposed:

1. **Enhanced Government Support:** It is crucial for government bodies to provide increased support to MSMEs seeking certification. This could involve financial subsidies, streamlined application processes, and comprehensive informational resources to facilitate smoother compliance with industry standards. By reducing the financial and administrative burdens associated with obtaining halal certification, more MSMEs can be empowered to meet market demands effectively.
2. **Promotion of Advanced Technologies:** Encouraging the adoption of advanced processing technologies can significantly improve production efficiency and product quality. Policymakers should consider offering incentives for technology adoption and investing in research and development to support MSMEs in implementing innovative processing techniques. This will enable local enterprises to produce high-quality cassava products that meet consumer expectations and enhance their competitive edge.
3. **Fostering Collaborations:** Establishing partnerships between MSMEs and larger food enterprises can provide valuable opportunities for knowledge exchange and market expansion. Government and industry stakeholders should facilitate platforms for collaboration, such as industry forums and networking events, to connect MSMEs with potential partners and explore synergies that can drive sustainable growth.
4. **Policy Interventions for Food Diversification:** Proactive policy measures that prioritize food diversification and economic resilience are essential for sustaining the momentum of initiatives like those in Raman Fajar Village. Policymakers should focus on creating favorable conditions for MSMEs, promoting sustainable agricultural practices, and ensuring equitable access to resources. By implementing comprehensive policy frameworks, governments can support the long-term success of food diversification efforts and foster a resilient food system.
5. In conclusion, the research provides valuable insights into the potential of cassava processing as a viable alternative to rice, offering a pathway to enhanced food security and economic development. The study sets a precedent for similar initiatives aiming to harness local resources for sustainable and inclusive growth by addressing regulatory challenges, optimizing production processes, and empowering local communities.

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