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Strengthening women's economic independence through innovation in Snakehead Fish floss products

Al Hikmah[1]*, Rizka Amalia[2], Zahiri Marliansyah[3], Najwa Aliya Safitri[4], Sulistiani Sepvira[1], Pamuji[1]

[1]Faculty of Islamic Economics and Business, Universitas Islam Negeri Raden Fatah, Palembang, Indonesia.
[2]Faculty of Tarbiyah and Teacher Training, Universitas Islam Negeri Raden Fatah, Palembang, Indonesia.
[3]Faculty of Psychology, Universitas Islam Negeri Raden Fatah, Palembang, Indonesia.
[4]Faculty of Ushuluddin and Islamic Thought, Universitas Islam Negeri Raden Fatah, Palembang, Indonesia.
**e-mail: hikmahalhi7@gmail.com*

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ABSTRACT

This study aims to develop the skills and capacity of rural women in processing snakehead fish into high-value dried fish flakes using a Participatory Action Research (PAR) approach involving 24 female participants. Based on the research findings, the diversification of snakehead fish (*Channa striata*) into dried fish flakes has proven to shift sales patterns from high-risk fresh products to value-added processed products with a longer shelf life. This downstream processing enhances economic stability, reduces the risk of spoilage, and expands distribution reach. The application of hygiene and halal principles further strengthens product quality and market legitimacy. Practical training improved technical skills and production autonomy, while also strengthening the economic role of rural women, and mentoring ensured product quality consistency. Although not yet measured quantitatively, the findings indicate increased value added and reduced dependence on price fluctuations. Thus, this program builds a strong foundation for the sustainable development of household microenterprises.

Keywords: Product diversification; value-added processing; women's economic empowerment; Participatory Action Research; rural microenterprise development; halal-compliant production; fishery downstreaming.

1. INTRODUCTION

The empowerment of rural women is a key strategy in community-based economic development (Mohankumar & Stephen, 2025; Thomas, 2024), particularly in regions where the potential of local resources remains underutilized (Amritha et al., 2024). However, previous research has tended to address women's empowerment, value-added processing, and microenterprises separately, as done by Hidayah et al. (2025); Maisaroh et al. (2025); Zakiyah Maulida et al. (2025), and thus have not demonstrated the interrelationship among these three within the framework of an integrated value chain.

Conceptually, women's empowerment involves enhancing their capacity and role in productive economic activities (Breitkreuz & Baird, 2025), while the processing of local commodities into value-added products serves to strengthen economic positions within the value chain (Adejo et al., 2020; Anning-Dorson, 2023; O'Brien et al., 2022). Integrating both in the context of rural microenterprises has the potential to simultaneously enhance capacity, productivity, and economic sustainability.

This study employs a Participatory Action Research (PAR) approach to address the limitations of previous studies, which were generally descriptive in nature and failed to sufficiently involve the community as key actors. This approach enables the direct involvement of women in the process of increasing economic value, thereby contributing to capacity building and the sustainable development of microenterprises.

Empirically, the study was conducted in Danau Rata Village, Muara Enim Regency, and revealed that the utilization of freshwater fish is still dominated by sales in fresh form, which carries low economic value. The gabus fish holds potential to be developed into value-added products, such as fish flakes, which can enhance shelf life, price stability, and market value, and are suitable for household-scale enterprises.

Rural women play a strategic role in household economies (Abdulkareem et al., 2026a, 2026b). Their involvement in product processing not only increases income but also strengthens their independence and entrepreneurial capacity. Therefore, training and mentoring are relevant interventions, while ensuring adherence to hygiene standards and halal principles to support product quality and competitiveness.

The research questions for this study include how to optimize the utilization of snakehead fish through the diversification of value-added products, how to improve the skills and capacity of rural women in product processing, and how mentoring contributes to increasing the economic value added of households. This study aims to develop the skills and capacity of rural women in processing snakehead fish into marketable dried fish flakes through a Participatory Action Research (PAR) approach. Academically, this study contributes to integrating women's empowerment, value-added processing, and microenterprise development within a single participatory intervention framework oriented toward the sustainable enhancement of household economic value.

2. METHOD

This activity uses a Participatory Action Research (PAR) approach with a participatory assistance model. The study involved 24 rural women participants, selected using purposive sampling based on the following criteria: (1) women of productive age, (2) actively involved in household economic activities, (3) having interest in food processing, and (4) willing to participate throughout the program. This approach was chosen because it emphasizes the active involvement of the target group—namely rural women—in all stages of the activity, from identifying potential, skills training, production practices, to evaluating results (Mallory, 2024; Springett et al., 2023; Walker & Suter, 2025). This method is applicable and oriented towards capacity building and economic added value through direct intervention in the field (Cornish et al., 2023; Eelderink et al., 2025).

The project was implemented in two initial phases designed to ensure both contextual relevance and effective community engagement. The first phase focused on identifying and mapping local potential through direct observation of village conditions. This included assessing the availability and sustainability

of snakehead fish (*Channa striata*) as a primary raw material, as well as evaluating the readiness, capacity, and prior experience of local women's groups as key participants in the program. In addition to field observations, focus group discussions (FGDs) were conducted to gain deeper insights into community needs and challenges. These discussions revealed several constraints, including limited technical skills in processing fish into value-added products, restricted access to broader markets, and a lack of knowledge regarding product standardization. However, the FGDs also highlighted significant opportunities, particularly the strong availability of local resources and the enthusiasm of participants to develop small-scale, income-generating activities based on these resources.

The second phase involved outreach and detailed program planning. This stage emphasized clear communication of the program's objectives to participants, ensuring that all stakeholders shared a common understanding of expected outcomes. Participants were introduced to the concept of value addition, focusing on how raw snakehead fish could be processed into higher-value products with better market potential. Training materials also covered hygienic production practices, including proper handling, processing, and storage techniques to ensure product safety and quality. Furthermore, halal principles were introduced as an essential component of production standards, considering their importance in local consumer markets. A structured training plan was then developed, outlining step-by-step activities, timelines, and expected competencies. Roles and responsibilities were assigned to participants to promote active involvement, accountability, and collaboration throughout the program implementation process (See Figure 1).

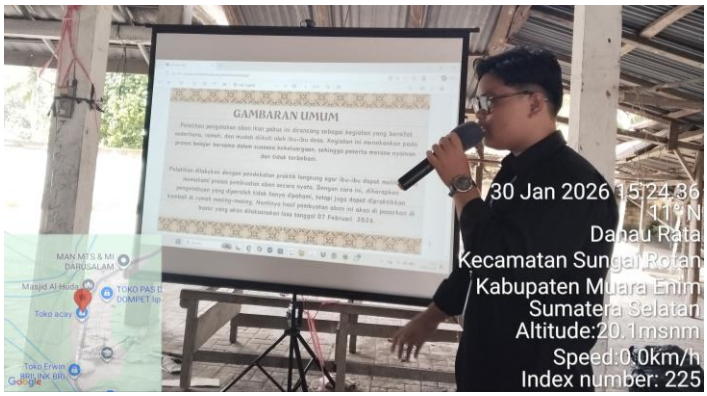

Figure 1. Socialization and Planning Stages of the Product Diversification Program

The third stage consisted of training and technical demonstrations focused on processing snakehead fish into shredded fish products, with an emphasis on building practical, hands-on skills among participants. This stage covered the entire production process, starting from the careful selection and preparation of raw ingredients, including cleaning, filleting, and removing bones from the snakehead fish to ensure product quality and safety. Participants were then introduced to seasoning formulation, where local spices and flavoring techniques were applied to enhance the taste and appeal of the shredded fish product. The processing stage also included cooking methods such as boiling, shredding, and frying, with particular attention given to achieving the desired texture, color, and shelf stability.

In addition, the training addressed proper drying techniques, which are critical for extending the product's shelf life and preventing microbial contamination. Participants were taught how to control moisture content and maintain consistency during the drying process, whether through traditional sun-drying or the use of simple mechanical dryers, depending on available resources. Basic packaging techniques were also introduced, including the use of food-grade materials, proper sealing methods, and simple labeling practices to improve product presentation and market readiness.

The methods used in this stage combined live demonstrations with guided, hands-on practice to ensure that participants not only understood the theoretical aspects but also developed the confidence and competence to perform each step independently. Trainers demonstrated each stage of the process step-

by-step, after which participants practiced in small groups under supervision. This approach allowed for immediate feedback, correction of mistakes, and reinforcement of proper techniques.

Furthermore, discussions were integrated into the training sessions to address common challenges, such as maintaining consistent product quality, managing production costs, and adapting techniques to local conditions. Participants were encouraged to ask questions, share their experiences, and collaboratively solve problems. By the end of this stage, participants were expected to have a comprehensive understanding of the production process and the ability to produce shredded snakehead fish products that meet basic standards of quality, hygiene, and marketability, thereby strengthening their potential for small-scale entrepreneurship (See Figure 2).

Figure 2. Technical Training and Demonstration of Shredded Snakehead Fish Production

The fourth stage involves production practice and business assistance, where participants begin to produce shredded snakehead fish independently under the supervision of the assistance team. This stage serves as a transition from guided training to semi-independent production, allowing participants to apply the knowledge and technical skills they have acquired in real production settings. Participants are encouraged to manage the entire process from raw material preparation to final packaging while maintaining consistency in quality and efficiency.

During this phase, the assistance team provides continuous mentoring and supervision to ensure that production activities meet basic standards. One of the key focuses is simple quality control, including monitoring the freshness of raw materials, consistency in texture and taste, and ensuring that the final product meets acceptable sensory and safety standards. The implementation of hygienic processing practices is also emphasized, such as maintaining clean workspaces, using proper utensils, and following safe food-handling procedures to minimize contamination risks.

In addition, participants receive guidance on the accuracy of ingredient composition, which is crucial for achieving consistent flavor and product quality across different production batches. Standardized measurements and simple recording practices are introduced to help participants replicate successful formulations. The assistance team also supports the refinement of production techniques, offering practical suggestions to improve efficiency, reduce waste, and optimize available resources.

Beyond technical aspects, this stage also begins to introduce basic entrepreneurial concepts. Participants are guided on simple cost calculations, pricing strategies, and identifying potential local markets for their products. Packaging and product presentation are further refined to enhance attractiveness and competitiveness. Through this combination of hands-on production and targeted assistance, participants gradually build confidence and capability, ensuring that the shredded snakehead fish products they produce are not only of good quality but also viable for commercialization and sustainable income generation (See Figure 3).

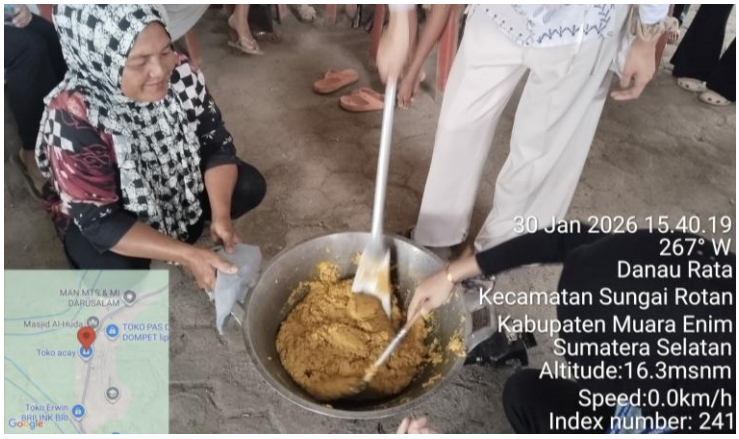

Figure 3. Supervised Production Practice and Business Assistance

The fifth stage consists of evaluation and reflection on the overall results of the program, carried out through a combination of direct observation, product assessment, and structured feedback discussions with participants. At this stage, the assistance team closely observed the production process to assess how well participants applied the techniques and standards introduced in previous stages. Particular attention was given to participants' independence, workflow organization, and adherence to hygienic and halal production practices.

Product quality was evaluated using several key attributes, including texture, taste, aroma, and packaging neatness. These indicators were used to determine whether the shredded snakehead fish products met acceptable standards for market readiness. The evaluation process also included identifying inconsistencies between production batches and understanding the underlying causes, such as variations in ingredient composition or processing techniques. This allowed the team to provide targeted recommendations for improvement.

Structured feedback discussions were conducted to create an open forum where participants could share their experiences, challenges, and suggestions. These discussions provided valuable qualitative insights into the learning process, including participants' confidence levels, perceived benefits, and remaining difficulties. Importantly, this evaluation phase was also attended and reviewed by the District Head, DDP, who offered institutional feedback and encouragement to support the sustainability and potential scaling of the initiative. The presence of local leadership reinforced the program's legitimacy and strengthened community motivation.

This phase plays a crucial role in ensuring that the activities carried out are not only technically effective but also contextually relevant and sustainable. Through a systematic evaluation process, the program captures both measurable outcomes and experiential insights from participants, providing a comprehensive understanding of its impact on the community.

Evaluation indicators include improvements in technical skills, consistency in applying hygiene and halal standards during production, accuracy in raw material composition, and participants' basic understanding of value-added concepts and potential marketing opportunities. Follow-up reflection sessions are then used to identify remaining barriers, such as limited access to packaging materials or market networks, and to formulate practical strategies for improvement. These strategies aim to strengthen the development of local micro-enterprises, ensuring that participants can continue production independently and sustainably beyond the duration of the program (See Figure 4).

Figure 4. Evaluation and Product Review by the Subdistrict Head (DDP)

Activity data were collected through a combination of systematic field observations, detailed process documentation, and records of participants' practice results throughout each stage of the program. Field observations were used to capture real-time implementation dynamics, including participant engagement, adherence to procedures, and challenges encountered during production activities. Process documentation, such as photos, notes, and step-by-step records, provided supporting evidence of how activities were carried out and how techniques were applied in practice. In addition, participants' practice results such as product outputs and consistency across batches—were recorded to assess skill development and production quality.

The collected data were then analyzed using a descriptive approach to clearly illustrate the program's achievements. This analysis highlighted improvements in participants' technical capacities, their ability to apply hygiene and production standards, and their understanding of value-added processing. Furthermore, the findings demonstrate the program's potential to contribute to household economic enhancement through small-scale, sustainable production activities.

3. RESULTS AND DISCUSSION

3.1. Optimizing the Utilization of Snakehead Fish through Diversification of Value-Added Products

The results of the activity demonstrate that diversifying snakehead fish (*Channa striata*) into shredded fish floss has significantly transformed the pattern of commodity utilization, shifting it from reliance on fresh fish sales toward processed products with longer shelf life and more stable economic value. Prior to the intervention, snakehead fish was primarily sold in fresh form, making it highly dependent on daily market fluctuations, limited bargaining power, and relatively low profit margins. The perishable nature of fresh fish also posed a considerable risk of spoilage, especially when supply exceeded demand or when access to markets was constrained. As a result, producers were often forced to sell quickly at unfavorable prices, limiting their ability to maximize income.

Following the training and assistance program, participants were able to process snakehead fish into shredded fish floss with desirable characteristics, including a dry texture, smooth consistency, and readiness for packaging and storage. This transformation marks a crucial shift in product handling and utilization, as the processed product can be stored for longer periods without significant deterioration in quality. Consequently, participants gain greater flexibility in managing production and sales, as they are no longer pressured to sell immediately. The extended shelf life also enables broader distribution opportunities, allowing products to reach markets beyond the immediate local area.

From an economic perspective, this downstreaming process significantly increases added value by converting raw materials into processed goods with higher market appeal. The product is no longer fully dependent on the volatile dynamics of the fresh fish market, which are often influenced by seasonal supply,

environmental conditions, and local consumption patterns. Diversification into processed products reduces vulnerability to these fluctuations and creates opportunities for more stable and potentially higher income. In addition, it minimizes losses caused by unsold or spoiled fish, thereby improving efficiency in resource utilization.

This transformation also reflects a structural shift in the value chain. Households move from being solely suppliers of raw commodities to becoming small-scale processors capable of capturing greater economic value. This shift strengthens local economic resilience and encourages the development of microenterprise activities. Participants begin to recognize the potential of their products not only for daily consumption but also as marketable goods with competitive value.

In terms of food standards, the production process has been aligned with the application of hygiene and halal principles. Participants are trained to maintain cleanliness in workspaces, use appropriate and sanitary equipment, and apply safe handling practices throughout the production process. These measures are essential to ensure product safety, consistency, and consumer confidence. At the same time, halal principles are integrated as a comprehensive system that governs all stages of production, including raw material selection, processing, and packaging.

The incorporation of halal standards enhances product legitimacy, particularly in communities where Muslim consumers dominate the market. Compliance with these principles builds trust and increases the acceptability of the product, thereby improving its competitiveness. Moreover, the integration of hygiene and halal practices contributes to a perception of higher product quality, which can positively influence consumer preferences and purchasing decisions.

The diversification of snakehead fish into shredded fish floss represents a comprehensive approach that combines technical innovation, economic value enhancement, and adherence to quality and ethical standards. By extending shelf life, stabilizing prices, and strengthening production practices, this initiative provides a sustainable pathway for improving household income and supporting the development of local, community-based economic activities.

3.2. Improving the Skills and Capacity of Rural Women

Demonstration-based training combined with guided practice resulted in a significant improvement in participants' technical skills across all stages of production. Participants became more capable in preparing raw materials, including properly cleaning, filleting, and handling snakehead fish to maintain quality and safety standards. They also developed better skills in processing and mixing spices with accurate proportions, which contributed to more consistent taste and product quality. Furthermore, participants gained practical understanding of effective drying techniques, an essential step in producing shredded fish floss with the desired dry texture and longer shelf life. Simple packaging methods suitable for market distribution were also introduced, enabling participants to improve product appearance and readiness for sale. As a result, participants not only understood the production stages conceptually but were also able to carry out the process independently with minimal supervision.

In addition to technical improvements, there was a noticeable increase in participants' understanding of hygiene standards and halal principles in food processing. Participants applied basic hygiene practices such as separating raw and cooked materials to prevent contamination, maintaining cleanliness of tools and workspaces, and ensuring that packaging processes were conducted under dry and sanitary conditions. Halal principles were understood not merely as labeling requirements but as a comprehensive assurance system that includes the selection of permissible raw materials, cleanliness of equipment, and integrity throughout the entire production process.

From a development perspective, strengthening women's capacity through this program contributes to expanding access to household-based economic opportunities. This approach aligns with the local social context, where women often play an important role in supporting family income. The program not only improves technical competence but also enhances women's confidence and economic participation. As a result, women are better positioned to contribute to household welfare while also playing a more active role in the broader community's economic activities and development processes.

3.3. Contribution of Assistance to Increasing Household Economic Added Value

Assistance in production practices ensures that the intervention does not stop at the transfer of knowledge but extends to strengthening product quality, consistency, and practical application in real production settings. In this stage, participants produce shredded snakehead fish independently while still receiving supervision and guidance from the assistance team. The focus is placed on maintaining consistent taste, achieving the appropriate level of dryness, and ensuring neat and attractive packaging. These elements are essential not only for product acceptability but also for building competitiveness in local markets. The process also functions as an initial quality control mechanism, where participants learn to evaluate their own products and identify areas for improvement. At the same time, it serves as a reflective learning stage, allowing participants to reinforce their understanding through repeated practice and direct feedback.

Although no quantitative measurement of income growth has been conducted, there are clear qualitative indications of increased added value resulting from this intervention. The transformation of raw snakehead fish into processed shredded fish products enables participants to access higher-margin opportunities compared to selling fresh fish. In addition, the emergence of small-scale, community-based marketing initiatives demonstrates early signs of economic activation at the local level. Participants begin to recognize potential market channels within their immediate environment, such as neighborhood sales or local events, which reduces reliance on traditional fresh fish markets. This shift also decreases vulnerability to price fluctuations that typically affect perishable commodities.

From a sustainability perspective, this approach contributes to more efficient resource utilization by extending product shelf life and minimizing the risk of spoilage. By processing fish into a durable form, participants can better manage production timing and reduce losses associated with unsold fresh products. Furthermore, the intervention opens opportunities for the gradual development of community-based microenterprises, as participants acquire not only technical skills but also an understanding of production standards and basic business practices.

Therefore, the primary contribution of this assistance lies in establishing a strong foundation for household-scale enterprises. It emphasizes skill development, consistent production practices, and product quality as key drivers of long-term sustainability, rather than focusing solely on short-term income increases. This foundation is crucial for enabling participants to continue and expand their economic activities independently over time.

4. CONCLUSION

Based on the research findings, the diversification of snakehead fish (*Channa striata*) into dried fish flakes has proven effective in shifting traditional sales patterns from high-risk fresh products to value-added processed products with a longer shelf life. This transition reduces dependence on daily market fluctuations and minimizes the risk of spoilage, which is commonly associated with perishable commodities. As a result, participants gain greater flexibility in managing production and sales, while also expanding their potential distribution reach beyond local markets.

From an economic perspective, this downstream processing contributes to improved stability at the household level. By transforming raw fish into processed products with higher market value, participants are able to capture greater economic benefits and reduce reliance on unstable fresh fish prices. The application of hygiene and halal principles further enhances product quality, safety, and consumer trust, particularly in markets with strong preferences for halal-certified goods. These standards not only ensure compliance but also increase the competitiveness and legitimacy of the product.

Practical, demonstration-based training plays a key role in improving participants' technical skills, enabling them to carry out production processes independently and consistently. At the same time, the program strengthens the economic role of rural women by equipping them with income-generating skills that can be applied at the household level. Ongoing mentoring ensures that product quality, consistency, and basic production standards are maintained over time.

Although quantitative measurements of income growth have not yet been conducted, qualitative findings indicate increased value-added and reduced dependence on price volatility.

To enhance the sustainability and long-term impact of this program, several strategic recommendations can be proposed. Future initiatives should incorporate quantitative monitoring of income changes to provide clearer evidence of economic outcomes and program effectiveness. In addition, strengthening support in packaging, branding, and digital marketing is essential to improve product attractiveness and expand access to wider markets beyond the local area. Facilitating access to microfinance schemes, savings groups, or cooperative models can further support participants in increasing production capacity and scaling their businesses.

Continuous training and mentoring should be maintained to ensure consistent product quality, adherence to hygiene and halal standards, and ongoing skill development. Institutional support from local governments and community organizations is also crucial to create an enabling environment for business growth. By integrating these elements, the program can achieve greater sustainability, strengthen household resilience, and support the long-term development of community-based microenterprises.

Ethical Approval

This community-based empowerment program does not require formal ethics committee approval because it does not involve medical intervention, clinical trials, or the collection of sensitive personal data. Activities include training, mentoring, and observation within the framework of community service using a Participatory Action Research (PAR) approach.

All procedures are conducted in accordance with general research ethics standards, including respect for participant autonomy, voluntary participation, confidentiality, and responsible use of data for academic purposes.

Informed Consent Statement

All participants were informed about the objectives, procedures, and expected outcomes of this program before they became involved. Participation was entirely voluntary, and participants had the right to withdraw at any stage without any consequences.

Written consent was obtained prior to data collection through observation and documentation. All information collected during the activities was processed confidentially and used solely for academic and reporting purposes. No personal data was disclosed in this publication.

Authors' Contributions

AH and RA: conceptualization, methodology, supervision; ZM: writing – original draft; NAS, SS, and P: investigation, data curation, and analysis; all authors: review and editing.

Disclosure Statement

The author(s) declare that there is no financial, personal, or professional conflict of interest that could have influenced the implementation of the program or the reporting of its results. No external funding or commercial interests were involved in this study.

Data Availability Statement

The data supporting the findings of this study consist of field observations, documentation records, and descriptive evaluation notes generated during the community empowerment program. Due to privacy and ethical considerations involving community participants, the data are not publicly available.

However, relevant data may be made available from the corresponding author upon reasonable request and for academic purposes only, subject to confidentiality considerations.

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Notes on Contributors

Al Hikmah
Al Hikmah is affiliated with Faculty of Islamic Economics and Business, Universitas Islam Negeri Raden Fatah, Palembang.

Rizka Amalia
Rizka Amalia is affiliated with Faculty of Tarbiyah and Teacher Training, Universitas Islam Negeri Raden Fatah, Palembang.

Zahiri Marliansyah
Zahiri Marliansyah is affiliated with Faculty of Psychology, Universitas Islam Negeri Raden Fatah, Palembang.

Najwa Aliya Safitri
Najwa Aliya Safitri is affiliated with Faculty of Ushuluddin and Islamic Thought, Universitas Islam Negeri Raden Fatah, Palembang.

Sulistiani Sepvira
Sulistiani Sepvira is affiliated with Faculty of Islamic Economics and Business, Universitas Islam Negeri Raden Fatah, Palembang.

Pamuji
Pamuji is affiliated with Faculty of Islamic Economics and Business, Universitas Islam Negeri Raden Fatah, Palembang.

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