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A Plan for an Extension Program on the Utilization of Oil Palm Frond Waste as a Material for Craft Plates in Talawi Subdistrict, Batu Bara Regency

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Abstract

Oil palm frond midrib waste is an abundant agricultural by-product with considerable potential for value-added utilization; however, its use remains limited because rural communities often lack the knowledge and practical skills required to transform it into marketable products. This study aimed to identify the agricultural extension potential of Talawi District, Batu Bara Regency, formulate extension objectives based on the SMART and ABCD principles, characterize the intended participants, evaluate the effectiveness of the extension design, and assess women farmers' willingness to utilize oil palm frond midrib waste for woven plate production. A descriptive quantitative approach was employed, involving field observations and questionnaires administered to 30 members of women's farmer groups. The data were analysed descriptively using a Likert scale. The findings indicate that Talawi District has substantial oil palm cultivation potential, although the utilization of frond midrib waste remains suboptimal. The participants were predominantly of productive age, had completed senior secondary education, and owned at least one hectare of

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agricultural land. Following the extension activities, participants' willingness to utilize oil palm frond midrib waste increased from 0% to 79.29%. The proposed extension design achieved an effectiveness score of 78.41%, indicating that it was effective in enhancing participants' willingness to convert agricultural waste into handicraft products. The study concludes that a systematically designed agricultural extension programme can strengthen the capacity and willingness of women's farmer groups to utilize oil palm frond midribs as raw material for woven plates. These findings demonstrate the practical contribution of locally oriented extension programmes to women's empowerment, agricultural waste valorization, rural entrepreneurship, and sustainable agricultural development.

Keywords: Agricultural Extension; Oil Palm Frond Midrib; Rural Entrepreneurship; Waste Valorization; Women's Farmer Groups

INTRODUCTION

The oil palm plantation sector has become one of the most important pillars of Indonesia's agricultural economy due to its significant contribution to national income, employment generation, export earnings, and rural development. Alongside the continuous expansion of oil palm cultivation, substantial quantities of agricultural biomass are produced every year as by-products of harvesting and pruning activities. Although these by-products possess considerable economic potential, they are generally regarded as agricultural waste and remain underutilized in most plantation areas (Badan Pusat Satatistik, 2025). Consequently, transforming plantation waste into value-added products has become an important strategy for promoting sustainable agriculture while improving rural livelihoods.

North Sumatra Province is recognized as one of Indonesia's major oil palm production centers, with extensive areas managed by smallholder farmers (Badan Pusat Satatistik, 2025). Batu Bara Regency represents one of the regions with significant oil palm production, particularly Talawi District, where oil palm plantations dominate the local agricultural landscape. The large plantation area inevitably generates abundant oil palm fronds and midribs throughout the year as a result of routine harvesting and pruning operations (BPS Kabupaten Batu Bara, 2025). This condition indicates the availability of a sustainable raw material that could be developed into economically valuable products through appropriate community-based innovations.

Among various plantation by-products, oil palm midrib waste remains one of the least utilized materials despite its promising physical characteristics. In many plantation communities, the midribs are either left unused in the field or sold to local collectors as raw materials at relatively low prices, providing only minimal economic benefits to farmers (Ngapiyatun et al., 2024). However, previous studies have demonstrated that oil palm midribs possess desirable characteristics, including durability, flexibility, and lightweight properties, making them suitable for producing various handicraft products with substantially higher market values (Rahayu et al., 2023).

One promising alternative is the production of woven plates made from oil palm midribs. Besides serving practical household purposes, woven palm plates have attracted increasing market demand because they are environmentally friendly, biodegradable, and possess aesthetic value. Their commercial value is considerably higher than that of untreated raw materials, thereby offering opportunities to improve household income through small-scale rural enterprises (Azmi et al., 2022). Economic analyses have also indicated that processing one kilogram of oil palm midribs into woven handicrafts generates significantly greater profits than selling the raw materials directly to middlemen (Dahlia et al., 2022).

Despite this substantial economic opportunity, preliminary field observations and regional potential assessments conducted in Talawi District revealed that community participation in utilizing oil palm midrib waste remains relatively low. Most farmers continue to sell dried midribs without any further processing, even though value-added products could generate considerably higher financial returns. This phenomenon reflects a significant disparity between the availability of local natural resources and the community's capacity to transform these resources into profitable products. Such conditions are primarily associated with limited knowledge, insufficient technical skills, and inadequate willingness to adopt innovative agricultural practices rather than the scarcity of raw materials themselves.

The existence of abundant resources accompanied by low utilization demonstrates that technological availability alone is insufficient to encourage innovation adoption within rural communities. Sustainable agricultural development requires educational interventions capable of changing knowledge, attitudes, and behavioral intentions among farmers. Agricultural extension has therefore become an essential component of rural development because it functions as a non-formal educational process that facilitates farmers' access to information, technology, institutional support, financial resources, and production

innovations aimed at improving productivity and welfare. Consequently, agricultural extension should not merely disseminate information but should also facilitate behavioral transformation that enables farming communities to utilize local resources more effectively.

Agricultural extension is widely recognized as a participatory learning process that empowers farmers to solve agricultural problems independently while enhancing their adaptive capacity toward technological innovation. The effectiveness of extension activities depends largely on how well extension programs are designed according to local needs, community characteristics, available resources, and socio-economic conditions (Anwarudin et al., 2021). Extension programs that neglect these contextual factors frequently fail to encourage innovation adoption because the learning materials, communication methods, and educational media do not adequately address farmers' actual circumstances.

Developing an effective extension program therefore requires a comprehensive assessment of local potential before designing intervention strategies. Regional potential identification provides essential information regarding existing resources, community needs, institutional conditions, and priority problems through participatory approaches involving local stakeholders (Sabir et al., 2020). Such assessments ensure that extension activities are formulated based on empirical field conditions rather than generalized assumptions, thereby increasing the likelihood of successful implementation and technology adoption.

In addition to understanding regional potential, agricultural extension objectives should be formulated systematically using the SMART principles Specific, Measurable, Actionary, Realistic, and Time Frame to ensure that educational outcomes are clearly defined, measurable, achievable, and time-bound. Furthermore, the ABCD framework, Audience, Behaviour, Condition, and Degree provides a practical approach for developing measurable behavioral objectives that explicitly define the intended audience, expected behavioral changes, implementation conditions, and performance standards.

This study specifically focuses on Women's Farmer Groups (*Kelompok Wanita Tani* or KWT) because women play strategic roles in household economic activities, agricultural product processing, and rural entrepreneurship. Women's Farmer Groups function not only as community organizations but also as platforms for strengthening women's capacities, promoting income diversification, and enhancing rural household welfare through productive economic activities (Sarti et al., 2024). Accordingly, empowering women through

agricultural extension concerning oil palm midrib utilization is expected to create alternative livelihood opportunities while encouraging sustainable resource management.

Previous studies have consistently demonstrated the positive contribution of agricultural extension toward improving community participation in utilizing plantation waste. Ardiani et al. (2023) reported that extension activities concerning oil palm plantation waste significantly increased community motivation to manage agricultural residues productively. Similarly, Mardatillah et al. (2022) found that practical training on oil palm midrib handicrafts successfully improved participants' attitudes toward utilizing plantation waste as creative products.

Comparable findings were reported by Adnan et al. (2025), who concluded that product diversification training based on oil palm midribs enhanced Women's Farmer Group members' understanding of raw material selection and processing techniques. Meanwhile, Gusmadevi & Hendrita (2024) demonstrated that demonstration methods combined with appropriate learning media significantly improved extension effectiveness compared with conventional instructional approaches. Likewise, Lestari et al. (2025) showed that combining audiovisual media with practical demonstrations substantially increased farmers' motivation to adopt agricultural innovations.

Although previous studies have confirmed the effectiveness of agricultural extension and community training in promoting plantation waste utilization, most investigations have concentrated primarily on evaluating participants' knowledge improvement, attitude changes, motivation, or post-training outcomes. Limited attention has been devoted to systematically designing an agricultural extension program beginning with regional potential identification, objective formulation based on SMART and ABCD principles, target audience analysis, and comprehensive validation of extension components, including learning materials, instructional methods, educational media, implementation schedules, locations, activity intensity, and financial planning. Furthermore, no previous study has specifically developed an agricultural extension design focusing on transforming oil palm midrib waste into woven plate handicrafts within Talawi District, Batu Bara Regency. This limitation constitutes the primary research gap addressed by the present study.

The present study addresses the identified research gap by proposing a comprehensive agricultural extension design tailored to the characteristics and needs of Women's Farmer Groups in Talawi District, Batu Bara Regency. Rather than focusing solely

on the implementation or evaluation of extension activities, this research emphasizes the systematic planning stage as a fundamental prerequisite for successful extension programs. The extension design developed in this study integrates regional potential assessment, objective formulation, participant analysis, selection of extension components, and program validation into a single planning framework. Such an approach is expected to improve the relevance and effectiveness of agricultural extension while increasing the likelihood of innovation adoption among rural communities.

The novelty of this study lies in several aspects. First, it develops an agricultural extension design specifically intended to promote the utilization of oil palm midrib waste as raw material for woven plate handicrafts in Talawi District, an area where no similar extension program has previously been implemented. Unlike previous studies that primarily evaluated the outcomes of extension activities, this research emphasizes the preparation of an evidence-based extension program prior to implementation. Second, the study combines regional potential identification with the formulation of extension objectives based on the SMART and ABCD principles, thereby ensuring that the proposed program is both context-specific and measurable. Third, the research incorporates an analysis of target audience characteristics together with the validation of extension components including learning materials, instructional methods, educational media, implementation schedules, activity frequency, location, and financial planning to produce a comprehensive extension model suitable for local conditions. Finally, this study evaluates participants' willingness to adopt the proposed innovation as an indicator of extension readiness, providing practical information for future implementation.

The theoretical foundation of this study is primarily derived from agricultural extension theory, which conceptualizes extension as a participatory educational process intended to facilitate behavioral change among farmers through knowledge transfer, skill development, and community empowerment (Anwarudin et al., 2021). Within this perspective, agricultural extension functions not only as a communication mechanism but also as an educational intervention designed to strengthen farmers' capacities in utilizing available resources and solving agricultural problems independently. Therefore, extension planning should be developed systematically to ensure that educational objectives correspond with community needs and local development priorities.

The concept of regional potential identification also serves as a fundamental theoretical basis for this study because extension planning should originate from an accurate understanding of local conditions. Regional potential assessment enables extension planners to recognize available natural resources, socio-economic characteristics, institutional capacities, and priority issues through participatory approaches involving local stakeholders (Sabir et al., 2020). Consequently, extension recommendations become more applicable because they are formulated according to empirical conditions rather than generalized assumptions. In the context of this research, regional potential identification revealed the abundant availability of oil palm midrib waste alongside the limited utilization of this resource by local communities, thereby justifying the need for an extension intervention.

The formulation of extension objectives in this study is guided by the SMART framework, which requires objectives to be specific, measurable, action-oriented, realistic, and time-bound. These principles ensure that extension activities possess clearly defined performance indicators and measurable behavioral outcomes. In addition, the ABCD framework strengthens objective formulation by specifying the intended audience, expected behavioral changes, implementation conditions, and achievement criteria. The integration of SMART and ABCD principles therefore provides a systematic basis for designing educational interventions capable of producing observable behavioral improvements.

Behavioral change is further explained through the Theory of Planned Behavior, which argues that an individual's intention to perform a particular behavior is influenced by attitudes, subjective norms, and perceived behavioral control (Ajzen, 1991). Within agricultural extension, farmers' willingness to adopt an innovation depends on their perceptions regarding its benefits, social acceptance, and feasibility of implementation. Consequently, willingness represents an essential indicator of extension effectiveness because it reflects participants' readiness to transform acquired knowledge into actual practice.

The behavioral perspective adopted in this study is complemented by the innovation adoption process proposed by Rogers, which describes adoption as a sequence of awareness, interest, evaluation, trial, and adoption (Rogers, 2003). Individuals typically evaluate the potential benefits and compatibility of an innovation before deciding whether to implement it. Therefore, extension programs should be designed not only to disseminate technical information but also to strengthen positive attitudes and increase participants' confidence in applying newly introduced technologies.

In addition to theoretical considerations, effective agricultural extension requires the careful selection of instructional components. Previous studies have emphasized that demonstration methods supported by appropriate educational media encourage greater participant engagement and improve knowledge transfer (Amalyadi et al., 2022). Likewise, operational planning involving activity frequency, scheduling, implementation venues, and financial resources significantly influences extension effectiveness because these elements determine participants' accessibility and learning experiences (Irdiana et al., 2024). Accordingly, this study incorporates all extension components into a unified planning framework to maximize program effectiveness.

From a practical perspective, Women's Farmer Groups constitute an appropriate target for this intervention because they play important roles in household economic diversification and agricultural product processing. Strengthening women's capacities through agricultural extension may generate additional income opportunities while encouraging sustainable utilization of locally available resources. Transforming oil palm midrib waste into woven handicrafts not only contributes to environmental management by reducing agricultural residues but also promotes rural entrepreneurship through the creation of value-added products.

Based on the foregoing discussion, this study focuses on developing an agricultural extension design for the utilization of oil palm midrib waste as raw material for woven plate handicrafts among Women's Farmer Groups in Talawi District, Batu Bara Regency. Specifically, the research aims to identify regional agricultural extension potential, formulate extension objectives according to SMART and ABCD principles, analyze target audience characteristics, evaluate the effectiveness of the proposed extension design, and assess participants' willingness to utilize oil palm midrib waste as woven handicraft material. By integrating local resource potential, behavioral theory, and systematic extension planning, this study is expected to provide both theoretical and practical contributions to agricultural extension science. Furthermore, the proposed extension design may serve as a reference for extension practitioners and local governments in developing community-based empowerment programs that promote sustainable agricultural waste utilization, increase rural household income, and strengthen environmentally responsible rural development.

METHODS

This study employed a quantitative approach using a descriptive quantitative research design. A descriptive quantitative approach was selected to systematically examine the acceptance level of the Women's Farmer Group (Kelompok Wanita Tani/KWT) toward the proposed agricultural extension program and to assess members' willingness to utilize oil palm frond midribs as raw materials for handicraft plate production. This approach enables researchers to describe research phenomena objectively through numerical measurements without investigating causal relationships among variables (Alfatih, 2021). Quantitative data were collected through structured questionnaires and were supported by field observations and documentary evidence to obtain comprehensive information regarding the research setting.

The research was conducted in Talawi District, Batu Bara Regency, North Sumatra Province, from March to May 2026. The study site was selected purposively because the area has considerable potential for oil palm cultivation but has not yet optimized the utilization of oil palm frond midribs as value-added handicraft products. This condition reflects a gap between the availability of local agricultural resources and their practical utilization, making the area appropriate for developing an agricultural extension design focusing on waste utilization.

The research design began with an identification of regional potential using the Rapid Rural Appraisal (RRA) approach. This stage involved field observations, community discussions, and direct interviews to identify local resources, community characteristics, and existing problems related to the utilization of oil palm frond midribs. The findings from this preliminary assessment served as the basis for developing the agricultural extension design, including the determination of extension targets, objectives, learning materials, extension methods, instructional media, implementation volume, location, schedule, and operational costs (Lestari et al., 2025).

The extension objectives were formulated based on the SMART principle, which consists of Specific, Measurable, Actionary, Realistic, and Time Frame components. The SMART framework was adopted to ensure that the proposed objectives were clearly defined, measurable, feasible, realistic, and achievable within a specified period (Sabir et al., 2020). In addition, the formulation of extension objectives also followed the ABCD framework, which comprises Audience, Behaviour, Condition, and Degree. This framework was applied to

ensure that the extension objectives reflected the characteristics of the target participants, the expected behavioral changes, the expected conditions, and the desired level of achievement.

The first research variable was the effectiveness of the agricultural extension design. This variable was measured using seven indicators, namely extension materials, extension methods, instructional media, implementation volume, extension location, implementation time, and operational costs. These indicators were developed based on the essential components of agricultural extension program planning (Amalyadi et al., 2022). The selection of these indicators also considered the characteristics of effective agricultural extension activities to ensure that every component corresponded to the needs of the target group.

The second variable was the willingness of Women's Farmer Group members to utilize oil palm frond midribs for handicraft plate production. This variable was measured using the Theory of Planned Behavior (TPB) developed by Ajzen (1991). According to this theory, an individual's willingness to perform a particular behavior is influenced by behavioral intention, attitude toward behavior, subjective norm, and perceived behavioral control. These four dimensions were used to evaluate participants' readiness to adopt the proposed innovation in utilizing oil palm waste as an economically valuable handicraft product.

The study population consisted of 30 members of the Kenanga Women's Farmer Group located in Talawi District. This group was selected because it is officially registered, actively participates in agricultural extension activities, and possesses both the potential and challenges associated with the utilization of oil palm frond waste. Since the total population was relatively small, the study employed a saturated sampling (census) technique, in which all members of the population were included as research respondents (Sugiyono, 2022). This sampling technique ensured that all characteristics of the target population were comprehensively represented.

Data were collected through field observation, structured questionnaires, and documentation. Field observation was conducted during the preliminary stage to identify regional conditions, community characteristics, farming activities, and the availability of oil palm frond waste (Alfatih, 2021). Structured questionnaires served as the primary instrument for measuring respondents' acceptance of the agricultural extension design and their willingness to utilize oil palm frond midribs as handicraft materials. Documentary data were obtained from the Central Statistics Agency (BPS), the Agricultural Extension Center of

Talawi District, the Kenanga Women's Farmer Group, and other relevant institutional documents.

The questionnaire was constructed using a five-point Likert scale. The effectiveness of the agricultural extension design was assessed using response categories ranging from very ineffective to very effective (Arikunto et al., 2021). Participants' willingness was measured using response categories ranging from very unwilling to very willing (Sun et al., 2022). Each response was assigned a score from one to five to facilitate quantitative analysis of respondents' perceptions.

Before the main survey was conducted, the research instrument underwent a pilot test involving 10 respondents who were not included in the research population. The pilot respondents were selected because they possessed characteristics similar to those of the target participants, thereby providing an appropriate basis for evaluating the quality of the research instrument (O. L. Sari et al., 2021). The pilot testing process was intended to ensure that each questionnaire item accurately measured the intended research variables.

Instrument validity was examined using the Pearson Product-Moment correlation with the assistance of Statistical Product and Service Solutions (SPSS) version 26. Questionnaire items were considered valid when the calculated correlation coefficient exceeded the critical value of the correlation table at a significance level of 5%. Items that failed to satisfy the validity criterion were excluded from the final questionnaire to improve measurement accuracy.

Instrument reliability was assessed using Cronbach's Alpha. A research instrument was considered reliable when the Cronbach's Alpha coefficient was 0.60 or higher. The reliability analysis demonstrated that all research variables exceeded the minimum acceptable threshold, indicating satisfactory internal consistency for subsequent data collection.

The research procedure consisted of several sequential stages, including regional potential identification, preparation of the agricultural extension design, development of research instruments, instrument validation and reliability testing, implementation of the agricultural extension activities, and administration of the final questionnaire. The agricultural extension program was implemented in two meetings. The first meeting emphasized knowledge transfer through discussions and practical demonstrations concerning the utilization of oil palm frond midribs for handicraft plate production. The second meeting was conducted two days later to evaluate participants' practical work, provide

additional demonstrations, reinforce learning outcomes, and collect questionnaire responses from all participants.

Data were analyzed using descriptive statistical analysis. Respondents' scores were converted into percentage values using the acceptance and willingness measurement formulas. The percentage scores were subsequently interpreted using a continuum scale to classify the effectiveness of the proposed agricultural extension design into five categories ranging from very ineffective to very effective. Participants' willingness was also interpreted using a continuum scale consisting of five categories ranging from very unwilling to very willing. Finally, the research findings were presented in the form of descriptive statistics, percentage distributions, and narrative explanations to provide a comprehensive overview of the effectiveness of the agricultural extension design and the willingness of Women's Farmer Group members to utilize oil palm frond midribs as raw materials for handicraft plate production.

RESULTS

This study aimed to develop and evaluate an agricultural extension program to increase the willingness of members of the Kenanga Women Farmer Group (KWT Kenanga) to utilize oil palm fronds as raw materials for handicraft plate production. The study began with an assessment of regional potential, followed by the preparation of an extension design consisting of extension materials, methods, media, implementation schedule, location, volume, and operational costs. After the extension activities were conducted, participants' acceptance of the extension design and their willingness to adopt the innovation were evaluated.



Figure 1. Oil Palm Frond Waste

Figure 1. Oil Palm Frond Waste shows that oil palm fronds are one of the most abundant agricultural residues generated from oil palm plantations. Although commonly regarded as waste, these materials possess physical characteristics suitable for handicraft production, including woven plates. Their continuous availability provides an opportunity to increase the economic value of agricultural waste while supporting environmentally sustainable rural development. This local potential formed the basis for developing the extension program implemented in this study.

The regional assessment demonstrated that Talawi District possesses favorable conditions for implementing an extension program on oil palm waste utilization. Oil palm is the dominant plantation commodity, supported by extensive plantation areas that continuously produce large quantities of oil palm fronds. In addition, farmer institutions in the district are well established, consisting of farmer groups, farmer group associations, and women's farmer groups. KWT Kenanga, comprising 30 members, was selected as the extension target because its members were actively involved in community empowerment activities and showed interest in developing household-based income-generating enterprises. Most participants were within the productive age group, had completed senior high school, possessed several years of farming experience, and managed their own agricultural land, indicating adequate capacity to receive and implement the proposed innovation.

The extension program was designed using a participatory approach to encourage active learning among participants. The learning objectives focused on increasing participants' willingness to utilize oil palm fronds for handicraft plate production. Demonstration and group discussion were selected as the primary extension methods because they enabled participants to directly observe each production stage while simultaneously exchanging experiences and solving practical problems. Instructional videos and actual handicraft products were employed as learning media to facilitate understanding of weaving techniques and product quality standards. The extension activities were conducted in two meetings at the residence of the head of KWT Kenanga, which was considered accessible and convenient for all participants.

Table 1. Summary of Extension Design Evaluation

Extension Component	Percentage (%)	Category
Materials	80.17	Effective
Methods	79.25	Effective
Media	79.50	Effective

Extension Component	Percentage (%)	Category
Volume	79.50	Effective
Location	81.50	Effective
Timing	72.17	Effective
Cost	74.83	Effective
Overall Acceptance	78.41	Effective

Source: Compiled by the researcher (2026)

Table 1. Summary of Extension Design Evaluation shows that the overall acceptance of the extension design reached 78.41%, indicating that the program was classified as effective. Among the evaluated components, the location received the highest acceptance score (81.50%), reflecting participants' positive perception of the accessibility, safety, and comfort of the learning environment. Extension materials also obtained a high level of acceptance (80.17%) because they were considered relevant to participants' economic needs and presented systematically from raw material preparation to product completion. The methods, media, and extension volume also achieved effective categories, suggesting that the combination of demonstrations, discussions, instructional videos, and real products successfully facilitated participants' understanding of the innovation. Although timing and cost obtained relatively lower scores than other components, both remained within the effective category, indicating that the extension schedule and financial requirements were generally acceptable for participants.

Following the evaluation of the extension design, participants' willingness to adopt the innovation was assessed using the Theory of Planned Behavior (TPB), which measures behavioral intention through four dimensions: behavioral intention, attitude toward behavior, subjective norm, and perceived behavioral control. The findings demonstrated that the extension activities positively influenced participants' willingness to utilize oil palm fronds for handicraft production.

Participants expressed strong intentions to practice handicraft production independently after completing the extension activities and were willing to gradually develop the innovation into an additional household enterprise. Positive attitudes toward the innovation were reflected in participants' beliefs that utilizing oil palm fronds could reduce agricultural waste while generating additional income. Social support from family members, fellow KWT members, community leaders, and agricultural extension officers also strengthened participants' motivation to adopt the innovation. Furthermore, most participants perceived themselves as capable of producing handicraft plates and believed that

potential obstacles could be overcome through continuous learning and cooperation within the group.

Overall, the average willingness score reached 79.29%, indicating that participants were categorized as willing to adopt the innovation. Among the TPB dimensions, attitude toward behavior achieved the highest score, suggesting that participants primarily recognized the environmental and economic benefits of converting oil palm fronds into value-added handicraft products. Behavioral intention received the lowest score among the TPB dimensions, although it still remained within the willing category, indicating that some participants still required further encouragement before fully implementing the innovation as a business activity.

In addition to evaluating participants' acceptance and willingness, the study also assessed the preliminary economic feasibility of handicraft plate production. The estimated production cost was relatively low because most raw materials originated from locally available agricultural waste. Revenue projections indicated that handicraft production could generate positive income, supported by favorable R/C and B/C ratios as well as break-even values below the planned production capacity. These findings suggest that handicraft production using oil palm fronds has promising economic prospects as a household-based enterprise while simultaneously contributing to agricultural waste management.

Overall, the findings indicate that the agricultural extension program was successfully designed according to local conditions and participants' needs. The effective acceptance of the extension components, combined with the high level of participants' willingness to adopt the innovation, demonstrates that the program has considerable potential to encourage sustainable utilization of oil palm fronds through community-based handicraft production. Furthermore, the positive economic feasibility supports the opportunity to develop handicraft production as an alternative income-generating activity while promoting environmentally sustainable management of oil palm plantation waste.

DISCUSSION

The findings of this study indicate that Talawi District has substantial potential for developing innovation in utilizing oil palm frond waste as raw material for plate handicrafts. This potential is supported by the extensive oil palm plantation area, which reaches 1,528.07 ha and generates a considerable amount of frond waste that has not yet been optimally

utilized as a value-added product. These conditions suggest that the main challenge is not the availability of raw materials, but rather the limited willingness of community members to transform waste into economically valuable products. Therefore, the extension program was designed as an intervention to enhance the willingness of members of the Women Farmers Group (KWT) through an approach tailored to the characteristics and needs of the target community. Bahua (2022) stated that the success of agricultural extension programs is highly influenced by the accuracy of identifying local potential and understanding the needs of target groups so that the delivered materials become relevant to community conditions. Ramadhiana et al. (2022) explained that extension programs developed based on local conditions are more likely to increase innovation acceptance because they are aligned with the actual needs of the community.

The evaluation of the extension design revealed that all extension components, including materials, methods, media, volume, location, time, and cost, were categorized as effective, with an overall acceptance level of 78.41%. Although all components achieved an effective category, differences were observed in the level of acceptance among each component. The location component obtained the highest score at 81.50%, while the time component received the lowest score at 72.17%. The high acceptance of the location aspect indicates that selecting an accessible, safe, and mutually agreed-upon venue contributes to creating a conducive learning environment. In contrast, the relatively lower score for the time aspect indicates that several KWT members needed to adjust the extension schedule with household responsibilities and agricultural activities. These findings demonstrate that the effectiveness of an extension program is determined not only by the quality of the content but also by technical aspects of implementation. Nurfa et al. (2024) stated that interaction intensity, learning environment conditions, and time management are important factors influencing the success of extension activities. Irdiana et al. (2024) explained that extension programs become more effective when all planning components are developed based on the social, economic, and activity characteristics of the target participants.

Regarding the extension materials, methods, and media, the results demonstrate that participants responded positively to the applied learning approaches. The materials related to the utilization of oil palm frond waste were considered relevant to the economic needs of KWT members and were systematically arranged to facilitate understanding. Demonstration methods and discussions were also perceived as effective because they provided opportunities for participants to directly observe the process and discuss practical challenges

encountered during implementation. Furthermore, the use of videos and real objects complemented each other in clarifying the production process and the final handicraft outcomes. These findings support the concept of adult learning, which emphasizes that participants acquire knowledge more effectively when learning experiences are connected with direct practice and real-life situations. Irdiana et al. (2023) stated that extension materials that correspond to the needs of target groups can increase the possibility of innovation adoption.

Dewi et al. (2024) explained that demonstration methods are more effective than conventional material delivery because they allow participants to learn through observation and direct practice. Hamidah & Muthi (2025) emphasized that demonstration-based learning can increase participant involvement in practice-oriented learning processes. Rahmadilla & Kholidya (2025) stated that the use of real objects improves participants' understanding of technical skills because the objects can be directly observed and examined. Pusvyta, Sari (2019) explained that video-based media can assist in presenting work procedures that are difficult to understand through verbal explanations alone.

The evaluation results indicate that the extension activities successfully increased KWT members' willingness to utilize oil palm frond waste as a material for plate handicrafts, with an overall willingness score of 79.29%. Based on the Theory of Planned Behavior (TPB) approach, this willingness was shaped by several components, including attitude toward behavior (80.33%), subjective norms (79.83%), perceived behavioral control (79.33%), and behavioral intention (78.00%). Attitude toward behavior obtained the highest score, indicating that KWT members perceived the utilization of oil palm frond waste as providing not only economic benefits but also environmental advantages through waste reduction. Subjective norms also demonstrated the important role of support from families, extension agents, and farmer groups in strengthening participants' confidence toward the introduced innovation. Meanwhile, perceived behavioral control indicated that most KWT members felt capable of implementing the innovation, although they still considered several challenges, including raw material availability and business sustainability.

Ajzen (1991) explained that an individual's intention to perform a behavior is influenced by attitude, subjective norms, and perceived behavioral control. Astuti et al. (2023) demonstrated that these three factors significantly contribute to shaping individuals' intentions in adopting innovations and engaging in entrepreneurial activities. Aisyah &

Cahyasita (2023) explained that stronger beliefs regarding the benefits and capability to perform an action increase the possibility that the action will eventually be realized as actual behavior.

Overall, this study demonstrates that an extension program developed based on local potential, target characteristics, and participatory learning approaches can improve acceptance of the extension design while strengthening KWT members' willingness to adopt innovation in utilizing oil palm frond waste. These findings imply that extension activities function not only as a medium for knowledge transfer but also as an empowerment mechanism that enhances motivation, skills, and readiness to develop local resource-based economic activities. Therefore, the extension design developed in this study can serve as a model for implementing similar programs in other regions with comparable resource characteristics and target groups. Nevertheless, this study is limited to measuring participants' willingness after the extension intervention and does not yet evaluate the long-term sustainability of innovation adoption. Future research should examine actual implementation, business performance, and factors influencing the sustainability of oil palm frond waste utilization as a productive economic activity to provide a more comprehensive evaluation of the extension program's impact.

CONCLUSION

This study aimed to design and evaluate an agricultural extension program to enhance the willingness of members of the Kenanga Women Farmer Group (KWT Kenanga) to utilize oil palm fronds as raw materials for handicraft plate production. The findings indicate that Talawi District possesses considerable potential for developing this innovation due to the abundant availability of oil palm fronds generated from local plantations. However, prior to the intervention, these agricultural residues were largely underutilized because community willingness to transform them into value-added products remained limited. Based on the regional assessment and target group characteristics, an extension program was developed by integrating appropriate extension materials, methods, media, implementation volume, location, scheduling, and operational costs tailored to participants' needs.

The evaluation demonstrated that the proposed extension design achieved an overall acceptance level of 78.41%, which falls within the effective category, indicating that the program components were well aligned with participants' characteristics and learning

requirements. Following the extension activities, participants' willingness to utilize oil palm fronds for handicraft plate production reached 79.29%, exceeding the predetermined target of increasing willingness from zero participants to at least 60% of the target group. These findings confirm that the study successfully achieved its objectives by developing an effective extension program capable of strengthening participants' willingness to adopt an agricultural waste utilization innovation.

This research contributes both practically and theoretically. From a practical perspective, it offers an extension design model that can be implemented in community empowerment programs based on locally available agricultural resources, particularly in oil palm-producing regions. From a theoretical perspective, the findings reinforce the applicability of the Theory of Planned Behavior (TPB) in explaining how positive attitudes, subjective norms, and perceived behavioral control collectively influence individuals' willingness to adopt agricultural innovations. Furthermore, the study demonstrates that extension programs designed according to local needs and supported by participatory learning approaches can effectively improve community readiness to adopt innovations that simultaneously generate economic value and promote sustainable agricultural waste management.

The findings also provide important implications for agricultural extension practice and rural development. A systematic and locally adapted extension design can serve as an effective strategy for agricultural extension officers, local governments, and farmer organizations seeking to develop value-added enterprises based on agricultural waste. Accordingly, members of KWT Kenanga are encouraged to continuously apply the acquired skills and further develop handicraft plate production as an alternative household income source. Agricultural extension officers may also use the proposed extension model as a reference for implementing similar programs in regions with comparable characteristics. Future research is recommended to investigate the long-term adoption of the innovation, evaluate post-extension behavioral changes, and explore broader aspects such as product commercialization, business sustainability, and community economic empowerment to maximize the long-term impact of the innovation.

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