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Extension Program Design for the Utilization of Oil Palm Stick Waste into Woven Plates by Women Farmer Groups in Kualuh Hulu District, North Labuhanbatu Regency

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Abstract

The utilization of oil palm frond waste in Kualuh Hulu District, North Labuhanbatu Regency, remains limited, constraining its potential to generate added value and livelihood opportunities for Women Farmer Groups (KWTs). This study aimed to develop and evaluate an agricultural extension program for converting oil palm frond waste into woven plates. Conducted from March to May 2026, the study employed a descriptive quantitative approach encompassing the identification of regional potential, formulation of objectives based on SMART and ABCD principles, determination of target groups, development of the extension program, and evaluation of program acceptance. The participants comprised 48 members of four KWTs: Nusa Indah, Teguh, Sentosa, and Mawar. Data were collected through observations, interviews, documentation, and questionnaires and analyzed descriptively. The findings revealed substantial oil palm plantation potential in Kualuh Hulu, although the resulting waste remained underutilized. The proposed extension program attained an acceptance rate of 86.85%, while participants' intention to utilize oil palm frond waste reached

83.93%, indicating that the design was highly appropriate for its intended beneficiaries. The study demonstrates that a systematically designed extension program can support the productive use of locally available agricultural waste. The resulting design provides a practical reference for extension workers and KWTs seeking to strengthen skills, enhance waste utilization, and develop livelihood opportunities based on local resources.

Keywords: Agricultural Extension; Oil Palm Frond Waste; Rural Livelihoods; Women Farmer Groups; Woven Plates

INTRODUCTION

Oil palm (*Elaeis guineensis* Jacq.) is one of Indonesia's strategic agribusiness commodities, contributing substantially to economic activity, household income, and the sustainability of plantation-based livelihoods. The expansion of oil palm plantations has also been accompanied by an increasing amount of biomass residues generated through harvesting and crop maintenance activities. In this context, plantation waste management is not merely an environmental concern but also represents an opportunity to increase the economic value of locally available resources. Oil palm cultivation has an important position in rural economies because plantation activities constitute a major source of income for many farming communities (Elpia & Asriati, 2024). Nevertheless, the growing scale of plantation activities has not been fully matched by the optimization of their by-products.

One potentially valuable residue is oil palm frond midrib, commonly processed as oil palm sticks. Harvesting and pruning activities continuously generate these materials, which may become plantation waste when they are not properly utilized. A single oil palm tree can produce approximately 22–26 sticks annually, and under certain conditions the number may reach 40–50 sticks (Kurniawan et al., 2024). This condition indicates that the availability of raw materials for stick-based products is relatively abundant and renewable throughout the plantation production cycle. Oil palm sticks also possess physical characteristics that make them suitable for various functional handicrafts with economic value (Mailindra et al., 2022). Therefore, their utilization should not be limited to basic processing as raw material but should be directed toward value-added products.

This issue is evident in Kualuh Hulu District, North Labuhanbatu Regency, an area characterized by substantial smallholder oil palm activities. Findings from the Regional Potential Identification (IPW) process and interviews with agricultural extension officers,

farmers, and members of Women Farmers' Groups (KWT) indicate that oil palm stick waste remains underutilized. Most local residents sell dried sticks to collectors, generating relatively limited returns compared with the potential value that could be obtained through further processing into handicraft products. This condition reflects a gap between the availability of local resources and the community's capacity to transform those resources into higher-value products. Previous research has demonstrated that oil palm residues can be converted into handicraft materials that provide economic benefits while contributing to plantation waste reduction (Halisah et al., 2026).

One promising form of utilization is the transformation of oil palm sticks into woven plates. Such products are relatively simple to produce, have practical functions, and can be developed as marketable handicrafts. Rahayu et al. (2023) demonstrated that oil palm sticks can be processed into woven plates with economic value. Further processing can generate greater returns than selling sticks as raw materials because it creates additional product value. Dahlia et al. (2022) also reported that processing oil palm sticks into woven products can increase their selling value and create opportunities for community-based economic activities. Accordingly, the central issue is not simply the abundance of waste materials but the community's knowledge, skills, and willingness to transform them into productive resources.

Within a community empowerment framework, Women Farmers' Groups occupy a strategic position as potential beneficiaries of initiatives aimed at developing local resources. KWT provides an organizational platform through which women in agricultural communities can develop productive skills and improve the economic value of locally available resources (Hasan et al., 2021). Women's involvement in agricultural processing activities can further contribute to local economic development through product diversification and value addition (Afifah & Ilyas, 2020). These characteristics make KWT an appropriate target for an agricultural extension program focusing on the conversion of oil palm sticks into woven plates.

The present study therefore argues that the identified condition requires an extension design that goes beyond conventional information delivery and is systematically developed according to the needs and characteristics of the target group. Agricultural extension constitutes a learning process intended to strengthen community capacity and encourage the utilization of locally available potential (Sofia et al., 2022). Extension materials should

likewise reflect the needs, interests, and circumstances of the intended beneficiaries to facilitate practical application (Prayoga, 2023). Consequently, an effective extension design needs to integrate learning materials, methods, media, frequency, location, timing, and cost so that the intervention can facilitate not only knowledge transfer but also the adoption of an appropriate innovation.

Previous studies have established the potential of oil palm sticks as materials for community-based handicrafts. Elpia & Asriati (2024) found that oil palm sticks could be transformed into various household products and provide economic benefits for artisans. Afif et al. (2023) reported that socialization activities combined with practical demonstrations improved community understanding of oil palm stick utilization and its potential as a marketable craft. Similarly, Mailindra et al. (2022) demonstrated that training in oil palm stick processing into plates improved participants' knowledge and practical skills while creating opportunities for new income-generating activities.

However, existing studies have predominantly emphasized training activities, waste utilization, skill improvement, or economic outcomes following community training. Rahayu et al. (2023), for example, focused primarily on the utilization process and direct community assistance in producing woven products. Veronika et al. (2025) highlighted improvements in participants' skills through socialization, training, mentoring, and learning by doing. Based on these studies, the research gap lies in the limited attention given to extension designs developed systematically from local potential identification while simultaneously assessing beneficiaries' acceptance of the extension components and their intention to adopt oil palm stick utilization. Thus, a more integrated approach is required to connect local resource potential, extension planning, and behavioral readiness.

To address this gap, the study adopts the Theory of Planned Behavior (TPB) as the theoretical foundation for examining the formation of behavioral intention. Ajzen (1991) conceptualized behavioral intention through three major determinants: attitude toward the behavior, subjective norm, and perceived behavioral control. This framework is relevant because the successful utilization of plantation waste depends not only on the availability of raw materials or technical skills but also on whether community members perceive the innovation positively, receive social support, and believe that they are capable of implementing it. The novelty of this study lies in integrating a locally grounded agricultural extension design with an analysis of KWT members' behavioral intention to utilize oil palm

sticks as woven plates. This integration provides a more comprehensive perspective by linking extension planning with the target group's readiness to adopt the proposed innovation.

Accordingly, this study focuses on designing an agricultural extension program for the utilization of oil palm stick waste into woven plates among Women Farmers' Groups in Kualuh Hulu District, North Labuhanbatu Regency. Specifically, the study aims to identify local potential as the basis for extension planning, formulate appropriate extension objectives and target characteristics, and assess the suitability of key extension components, including materials, methods, media, frequency, location, timing, and cost. The study also examines the behavioral intention of KWT members to utilize oil palm sticks as woven plates. The findings are expected to produce a contextual and applicable extension design that responds to community needs while supporting the transformation of plantation waste into a productive local economic resource.

METHODS

This study employed a descriptive quantitative approach to assess the acceptance of a planned agricultural extension program on utilizing oil palm stick waste as woven plates and to examine the intention of Women Farmers' Groups (KWT) members to adopt the proposed utilization practice. A quantitative approach was selected because the study collected structured numerical data through research instruments and analyzed the data statistically using SPSS (Sugiyono, 2021). The study was conducted from March to May 2026 in Kualuh Hulu District, North Labuhanbatu Regency, Indonesia. The research site was selected purposively because the area has substantial potential for oil palm cultivation and had not previously received extension activities specifically addressing the conversion of oil palm stick waste into woven plates.

The research design consisted of several sequential stages, including regional potential identification, formulation of extension objectives and target groups, development of extension materials, determination of extension methods and media, specification of activity volume, location, schedule, and costs, followed by implementation and evaluation. Regional potential was identified using a Participatory Rural Appraisal (PRA) approach, which emphasizes community participation in identifying and understanding local conditions

and resources (Mardiana et al., 2020). The extension objectives were formulated using the SMART and ABCD principles to ensure that the objectives were specific, measurable, achievable, realistic, time-bound, and appropriately directed toward the intended audience and behavioral outcomes (Sabir et al., 2020). The acceptance of the extension design was assessed through seven indicators: extension materials, methods, media, volume, location, time, and cost. Meanwhile, intention was assessed through behavioral intention, attitude toward behavior, subjective norm, and perceived behavioral control, based on the Theory of Planned Behavior (Ajzen, 1991). The extension material focused on the procedures for producing woven plates from oil palm sticks, while demonstrations, discussions, and lectures were employed as the primary instructional methods. Folder materials and videos were used as supporting media.

The study population consisted of 93 KWT members from four groups: Nusa Indah in Sono Martani Village, Teguh in Kuala Beringin Village, Sentosa in Londut Village, and Mawar in Pulo Dogom Village. The sample was selected using probability sampling through simple random sampling. Based on the Taro Yamane formula with a 10% margin of error, a total of 48 respondents were selected. The respondents were members of KWT groups located in areas with substantial oil palm resources and had not previously utilized oil palm stick waste to produce woven plates.

Data were collected through interviews, questionnaires, observation, and documentation (Romdona et al., 2025). The questionnaire employed a five-point Likert scale ranging from strongly accepting to strongly not accepting. Prior to the main data collection, instrument validity was examined using data from 15 respondents, with an r-table value of 0.441. The validity test yielded 31 valid items out of 49 items measuring the extension design and 14 valid items out of 20 items measuring intention. Reliability was assessed using Cronbach's Alpha. All extension-design variables produced coefficients above 0.600, while the intention instrument yielded an alpha coefficient of 0.834, indicating acceptable reliability (Amalia et al., 2022).

The data were analyzed descriptively and quantitatively. Questionnaire responses were tabulated, scored according to the Likert scale, and converted into percentages to determine the level of acceptance of the extension design and the intention of KWT members. The resulting percentages were interpreted using a five-category continuum: strongly not accepting, not accepting, moderately accepting, accepting, and strongly

accepting (Simamora, 2022). Evaluation was conducted after the extension activities to assess the suitability of the materials, methods, media, volume, location, time, and cost, while also determining the participants' intention to utilize oil palm stick waste as a material for woven plates.

RESULTS

The findings indicate that Kualuh Hulu District, North Labuhanbatu Regency, possesses local resources that can support the development of oil palm stick waste utilization as a basis for handicraft production. The regional potential and problem identification revealed intensive oil palm plantation activities and a continuous availability of oil palm sticks as plantation waste. Nevertheless, the availability of this material has not been accompanied by optimal utilization among Women Farmer Groups (KWT). The sticks were generally sold as raw materials or left unprocessed, while knowledge and skills related to converting them into value-added products remained limited. These conditions served as the empirical basis for designing an agricultural extension program focused on transforming oil palm sticks into woven plates.

The extension program targeted 48 members of the Nusa Indah, Teguh, Sentosa, and Mawar Women Farmer Groups. The design incorporated several components, namely objectives, target participants, materials, methods, media, implementation volume, location, timing, and cost. The extension objective was formulated from an initial condition of 0% and a target of 50%, equivalent to 24 KWT members being willing to utilize oil palm sticks to produce woven plates. The program was designed to be delivered in two meetings separated by a two-week interval. The extension materials addressed the utilization of oil palm sticks for woven-plate production, while lectures, discussions, and practical demonstrations were selected as the main instructional methods. Folders and videos were used as supporting media to facilitate information delivery and visualize the production process.

Table 1. Acceptance of the Extension Program Design Components

Component	Percentage	Category
Materials	84.92%	Very accepted
Methods	85.21%	Very accepted
Media	86.58%	Very accepted

Component	Percentage	Category
Volume	87.71%	Very accepted
Location	88.33%	Very accepted
Timing	86.25%	Very accepted
Cost	85.42%	Very accepted
Total	86.34%	Very accepted

Source: Compiled by the researcher (2026)

Table 1. Acceptance of the Extension Program Design Components shows that all components of the extension program design received high acceptance scores, ranging from 84.92% to 88.33%. The location component recorded the highest percentage, whereas the material component recorded the lowest, although both remained in the "very accepted" category. The overall average acceptance reached 86.34%, indicating that the proposed design was positively received by the target participants.

The material component achieved an acceptance rate of 84.92%, indicating that participants perceived the information as relevant to their needs and applicable to the proposed innovation. The strongest response was associated with the economic practicality of producing woven plates, particularly the perception that the process did not require substantial expenditure. The methods component achieved 85.21%, reflecting positive responses to the integrated use of lectures, discussions, and practical demonstrations. The media component reached 86.58%, demonstrating that folders and videos were considered useful learning supports for understanding the innovation.

The practical design also specified two extension meetings separated by two weeks, implemented at the KWT leader's residence beginning at 14.00. The estimated production cost was Rp2,380 per woven plate. The relatively low production cost was associated with the local availability of oil palm sticks, which reduced the need to purchase the main raw material.

Figure 1. Documentation of Regional Potential Identification and Extension Activities

Figure 1. Documentation of Regional Potential Identification and Extension Activities shows that the extension program was developed from actual field conditions and involved the target community in identifying local resources, discussing existing problems, and introducing the practical conversion of oil palm sticks into woven plates. The documentation visually illustrates the connection between local potential identification, extension activities, and practical application.

After the extension activities were implemented, the evaluation of participants' intention produced a total score of 2,820 out of a maximum score of 3,360, corresponding to 83.93% and categorized as "accepting." A total of 40 participants demonstrated willingness to utilize oil palm sticks for woven-plate production, exceeding the predetermined target of 24 participants or 50%.

The intention assessment further revealed variation across its dimensions. Behavioral intention reached 80.83%, attitude toward behavior 84.38%, and subjective norm 85.63%. These findings indicate that participants' willingness was shaped by both individual evaluations of the innovation and perceived social support from their surrounding environment.

Taken together, the results demonstrate that the extension design was well received and that its implementation was associated with a high level of willingness to utilize oil palm stick waste. The empirical findings indicate that an extension design grounded in local potential, target-group characteristics, and practical learning can provide an appropriate framework for introducing agricultural waste utilization as a productive activity among Women Farmer Groups.

DISCUSSION

The findings indicate that the central issue surrounding oil palm stick waste utilization in Kualuh Hulu is not the absence of raw materials but the limited capacity and willingness of Women Farmer Groups (KWT) to convert locally available waste into value-added products. The regional assessment revealed that oil palm sticks are readily available as a by-product of plantation activities, yet their availability has not been matched by systematic utilization. This condition reflects a gap between the abundance of local resources and the community's capacity to transform them into productive economic activities. Accordingly, the role of agricultural extension in this study extends beyond information delivery to connecting local resource potential with the learning needs and practical capabilities of the target group.

The relatively high acceptance of the extension materials provides an important explanation for the success of the proposed design. The material component obtained an acceptance score of 84.92%, indicating that participants regarded the innovation as relevant to their circumstances. Mardikanto (2018) argues that extension materials should be grounded in the actual needs of the target community so that information becomes meaningful and applicable. The present findings support this perspective because the extension materials were directly derived from a locally available waste resource, introduced relatively simple processing techniques, and emphasized a product with functional and economic potential. The findings therefore suggest that contextual relevance is a major factor underpinning the acceptance of agricultural innovations.

The results concerning extension methods further demonstrate the importance of combining instructional approaches when the innovation requires practical skills. The 85.21% acceptance score for the methods suggests that the integrated use of lectures, discussions, and practical demonstrations was highly appropriate. Lectures established the basic conceptual understanding, discussions facilitated clarification and experience sharing, while demonstrations provided a concrete representation of the weaving process. This pattern is consistent with Mardikanto (2018), who emphasizes the need to align extension methods with program objectives, target characteristics, and the nature of the material. It also supports Ramadhana & Subekti (2021), whose findings, as cited in the thesis, indicate that demonstration-based extension can strengthen farmers' knowledge and skills more effectively than purely theoretical delivery.

The acceptance rate of 86.58% for the extension media highlights the complementary function of printed and audiovisual communication. The folder provided concise information that participants could review independently after the extension activity, while the video enabled participants to visualize the production process. This finding is consistent with Kiswari & Pratiwi (2021), who emphasized the usefulness of folders for self-directed review, and with Fayzah et al. (2025), who demonstrated the contribution of video to clearer comprehension through visual presentation. In this context, the value of the media lies not merely in their format but in their ability to reduce the gap between conceptual explanation and the practical procedures that participants are expected to master.

The high acceptance of location, implementation volume, timing, and cost further demonstrates that the effectiveness of the extension design depended on more than instructional content. Location received the highest acceptance score at 88.33%, followed by volume at 87.71%. These results suggest that using facilities already available within the group context can increase the practicality and acceptability of the program. The low estimated production cost of Rp2,380 per woven plate also strengthened the perception that the innovation could be applied without substantial initial investment. Together, these characteristics reinforce the feasibility dimension of the innovation and make its adoption more realistic at the community level.

From an innovation-diffusion perspective, the high level of acceptance can be understood through the compatibility of the innovation with the characteristics of its intended recipients and their social environment. Rogers (2003) explains that innovation adoption is shaped by compatibility, communication channels, time, and the social system. In this study, the innovation was not introduced as an external technology detached from participants' daily circumstances; rather, it involved the transformation of a resource already available in their surroundings. The selection of lectures, discussions, demonstrations, folders, and videos was similarly adapted to the participants' characteristics. The thesis further indicates that extension designs developed around target-group characteristics are more likely to be accepted and may be applicable to groups with comparable social and economic conditions.

The post-extension intention score of 83.93%, representing 40 willing participants, demonstrates that the extension objective was exceeded. Substantively, this result is important because the initial target was only 24 participants or 50%. However, the finding

should be interpreted as evidence of readiness and intention rather than as definitive evidence of sustained adoption. This interpretation is supported by the 80.83% behavioral intention score, which was lower than the 84.38% attitude toward behavior and 85.63% subjective norm scores. Participants therefore appeared to have developed positive perceptions and strong social support, while some uncertainty remained regarding their individual readiness to consistently perform the new behavior.

The findings are also relevant to the Theory of Planned Behavior employed in the study. Intention functions as an important mechanism connecting attitudes and social influences with behavioral tendencies. The relatively high subjective norm score indicates that the group environment may provide meaningful social reinforcement for adoption decisions. In contrast, the comparatively lower behavioral intention score suggests that individual confidence and practical readiness still require reinforcement. The thesis attributes this condition to such considerations as limited weaving experience, the time required for production, and uncertainty regarding product marketing. Therefore, the initial extension intervention should be viewed as a stage of intention formation rather than the endpoint of the adoption process.

The principal contribution of this study lies in its integrated extension design, which connects regional potential assessment, target-group characteristics, instructional components, acceptance evaluation, and behavioral intention. Rather than focusing solely on changes in knowledge, the study demonstrates the value of evaluating the overall suitability of the extension system. Theoretically, the findings strengthen the applicability of innovation-diffusion perspectives in explaining why compatibility between an innovation and its recipients matters for acceptance. Practically, the resulting design can serve as a reference for extension workers and KWTs operating in areas where agricultural waste is abundant but remains economically underutilized.

Nevertheless, several limitations should be acknowledged. The study involved 48 members from four Women Farmer Groups in a single geographical setting, which limits the extent to which the findings can be generalized to communities with different social, cultural, and organizational conditions. In addition, the evaluation focused primarily on program acceptance and intention, leaving longer-term outcomes such as sustained adoption, production capacity, market performance, and income effects outside the analytical scope. Future studies should therefore investigate whether the intention generated through

extension can be translated into consistent production behavior and measurable economic benefits.

CONCLUSION

This study demonstrates that Kualuh Hulu District, North Labuhanbatu Regency, possesses substantial local resource potential for developing oil palm stick waste into woven plates, although this potential has not been accompanied by sufficient willingness among the target groups to utilize the waste productively. The extension program was therefore designed to address this condition by establishing an increase in the willingness of Women Farmers' Group (KWT) members from an initial level of 0% to 50% as the primary extension objective. The implementation of the program involving 48 members of the Nusa Indah, Teguh, Sentosa, and Mawar KWTs exceeded the targeted outcome, as 40 members (83.93%) expressed an intention to utilize oil palm stick waste for woven-plate production. Furthermore, the overall evaluation of the extension design achieved an acceptance rate of 86.85%, categorized as highly accepted, indicating that the proposed extension components were considered appropriate to the needs and characteristics of the target participants.

These findings confirm that extension planning grounded in local potential and target-group needs can provide a relevant approach for promoting the acceptance of innovations in agricultural waste utilization. Practically, the study contributes an extension design that can serve as a reference for KWTs and agricultural extension workers in developing oil palm stick waste into value-added products. The study also highlights the role of agricultural extension beyond knowledge transfer by facilitating willingness and readiness to adopt locally relevant innovations. Sustained implementation should be supported through continuous extension and mentoring, production-skill development, and stronger business-oriented management. Future research should examine the sustainability of innovation adoption, product quality and competitiveness, and the extent to which oil palm stick waste utilization contributes to increased income and the welfare of KWT members.

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