

Extension Design for the Use of a Mobile Application for Oil Palm Harvest Recording in Laut Tador District, Batu Bara Regency

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Abstract

Harvest recording supports transparent oil palm production reporting for Roundtable on Sustainable Palm Oil (RSPO) certification. However, smallholders in Laut Tador District, Batu Bara Regency, continue to rely on simple manual systems that may expose harvest data to loss. This study developed an agricultural extension design for a mobile harvest-recording application and assessed its acceptance, behavioural outcomes, and continued application use. A quantitative descriptive approach was employed, with data collected through interviews and questionnaires and analysed using extension planning procedures and Likert-scale scoring. Regional potential identification informed a design specifying objectives, target participants, content, methods, media, session volume, location, timing, and costs. The objectives followed SMART and ABCD principles, with a target achievement level of 60%. Overall acceptance of the extension design reached 86.1%. Evaluation results were 80.9% for knowledge, 78.86% for attitudes, 67% for skills, and 30.4% for continued application use. These findings indicate strong acceptance of the extension design alongside limited sustained use of the application. The study provides an extension design tailored to local conditions and highlights continued assistance as a priority for translating acceptance into routine digital harvest recording and strengthening the transparency of production reporting.

Keywords: Agricultural Extension Design; Mobile Harvest Recording; Oil Palm; Smallholder Acceptance; RSPO Certification

INTRODUCTION

Oil palm is a strategic commodity in Indonesia, contributing to national economic growth through vegetable oil production, export revenues, and smallholder plantation development. Given the scale of the industry, sustainable plantation management requires not only efficient cultivation practices but also reliable documentation of production activities. Harvest records provide essential information for monitoring output, verifying transactions, and supporting accountable plantation management (Daulay & Santoso, 2024). For smallholders, systematic harvest documentation also facilitates the assessment of farm income and expenditure, resource allocation, and business decisions (Sari et al., 2025). Therefore, accurate recordkeeping constitutes an important component of sustainable smallholder plantation management.

The importance of harvest documentation is further reinforced by sustainability certification requirements. The Roundtable on Sustainable Palm Oil (RSPO) promotes responsible palm oil production through standards addressing economic, social, and environmental considerations. Under the applicable smallholder standards, effective land management and the documentation of fresh fruit bunches (FFB) production and sales are essential components of certification compliance (RSPO, 2025). Supply chain traceability is equally important because it enables harvested products to be tracked through documented production and distribution processes (Rahutomo et al., 2023). Accordingly, harvest records serve not merely as administrative documents but also as evidence supporting accountability, traceability, and sustainable plantation governance.

Despite these requirements, conventional recordkeeping remains a challenge for smallholder farmers. Recording harvest transactions on paper, retaining sales receipts, and manually consolidating information can create difficulties in data storage, retrieval, and verification. Such practices also increase the risk of missing documents and inconsistencies during data entry. These limitations are particularly consequential when harvest information must be retrieved for certification audits or production monitoring. Although structured records can improve farm management, their usefulness depends on the availability of a practical and consistent recording mechanism. This situation highlights the need for a more accessible approach to harvest documentation that accommodates the operational circumstances of smallholder farmers.

This issue is evident among RSPO-certified smallholders in Laut Tador District, Batu Bara Regency, North Sumatra, Indonesia. A regional potential assessment conducted in December 2025 indicated that farmers still documented their harvests by collecting sales receipts for fresh fruit bunches and submitting them to their group leader for consolidation. This procedure creates potential risks of missing receipts and data-entry errors during the preparation of consolidated records. Interviews further indicated that farmers needed a simpler recording method, while an audit conducted in November 2025 highlighted the expectation that digital devices should be used to facilitate access to harvest information. These findings reveal a practical discrepancy between the need for systematic, traceable documentation and the predominantly manual recording practices currently employed.

Mobile applications offer a potential means of addressing these limitations. Information technology enables production records to be maintained through digital devices, providing an alternative to conventional paper-based documentation (Wijayanto et al., 2021). One potential development platform is AppSheet, a no-code application development service that supports web and mobile applications connected to data sources such as spreadsheets (Yasmin & Nugraha, 2024). Nevertheless, technological availability does not automatically ensure successful adoption. Farmers must understand the application, recognize its practical value, and develop the skills required to enter and retrieve information accurately. Agricultural extension is therefore necessary to bridge the gap between the availability of digital technology and its effective application in everyday farming activities.

Agricultural extension provides a learning process through which farmers can strengthen their capacity to access information, adopt innovations, and improve their farming practices (Hariadi & Subejo, 2021). Its effectiveness depends on selecting appropriate instructional approaches that reflect farmers' circumstances and learning needs (Syarief, 2020). Extension planning must also consider participants' existing knowledge, practical skills, sociocultural characteristics, and available resources. Appropriate instructional media can clarify information, stimulate participants' attention, and facilitate their understanding of unfamiliar technologies (Gusmadevi & Hendrita, 2024). Moreover, identifying local resources and community conditions provides an essential foundation for designing extension activities that address actual field problems (Ruspianda et al., 2019). These considerations support the development of an extension programme that combines accessible explanations with practical guidance on mobile-based harvest recording.

Previous studies provide relevant foundations for this approach. Muthmainah (2025) developed an agricultural extension programme on producing soft cookies from bengkuang flour, integrating instructional materials, methods, and media with an assessment of programme acceptance. NST (2023) examined an extension programme for controlling *Oryctes rhinoceros* in immature oil palm plantations through pheromone traps, group visits, and practical demonstrations. These studies demonstrate the relevance of extension planning and digital applications to agricultural innovation. However, they do not specifically establish how an extension programme for mobile harvest-recording applications should be designed, accepted, and evaluated among RSPO smallholders in Laut Tador District.

Research on agricultural extension media further emphasizes the importance of selecting communication channels that suit the target audience. Social media platforms, particularly Facebook and WhatsApp, have been identified as useful channels for supporting agricultural extension activities (Suratini et al., 2021). Nevertheless, disseminating information differs from developing operational competence, particularly when participants must perform digital tasks independently. Farmers need to understand not only the benefits of an application but also how to record harvest transactions correctly and retrieve the resulting information. Technical competence and problem-solving ability are therefore relevant considerations in technology-oriented agricultural learning (Mahrunnisya, 2023). Extension activities should consequently integrate information delivery with demonstrations and guided practice rather than rely exclusively on explanatory communication.

The research gap lies in the limited contextual integration of RSPO documentation requirements, mobile-based harvest recording, and post-extension adoption assessment within a single extension programme. Previous studies have addressed agricultural extension design and digital harvest-recording systems separately, whereas the circumstances in Laut Tador require an approach that directly connects certification-related documentation needs with farmers' ability to use digital tools. The present study addresses this gap by positioning agricultural extension as a mechanism for facilitating the transition from manually collected sales receipts to more accessible and traceable digital harvest records.

The novelty of this study lies in designing an agricultural extension programme specifically tailored to the harvest-recording needs of RSPO smallholders in Laut Tador District. Rather than focusing solely on introducing an application, the programme incorporates target-audience acceptance and subsequent application adoption as central

evaluation considerations. Its design draws on the SMART principles and the ABCD framework for formulating measurable extension objectives, as established in Indonesian agricultural extension planning regulations. The programme also considers the selection of relevant materials, instructional methods, and media according to farmers' characteristics and operational requirements. Evaluation is essential for determining whether programme objectives have been achieved and identifying areas requiring improvement (Amalyadi et al., 2022). Changes in farmers' knowledge, attitudes, and skills also provide relevant indicators for assessing extension outcomes (Haq et al., 2021).

Accordingly, this study aims to develop an effective extension programme for using a mobile application to record oil palm harvests in Laut Tador District, assess farmers' acceptance of the proposed programme, and evaluate application adoption following the extension activities. The programme establishes a target of increasing application adoption from an initial level of 0% to 60%, equivalent to 37 farmers. By connecting digital technology with practical learning and certification-related documentation requirements, this study is expected to provide a context-specific reference for agricultural extension and support more systematic, accessible, and traceable harvest-recording practices among smallholder oil palm farmers.

METHODS

This study employed a quantitative descriptive approach to examine farmers' acceptance of an agricultural extension program and assess changes in their knowledge, attitudes, skills, and application of SIPP Sawit Mobile for recording oil palm harvests. The research was conducted from March to April 2026 over a two-month period in Laut Tador District, Batu Bara Regency, North Sumatra, Indonesia. The research site was purposively selected because of its substantial oil palm cultivation potential and the presence of farmers participating in the Roundtable on Sustainable Palm Oil (RSPO) certification scheme, which requires harvest documentation. The study addressed the existing practice of recording harvest information manually using relatively simple methods.

The research design encompassed the planning, implementation, and evaluation of an agricultural extension program introducing the mobile application. Program planning involved establishing objectives based on the SMART and ABCD principles and determining

the target participants, content, methods, media, frequency, location, schedule, and costs. Program acceptance was assessed through seven indicators: extension content, methods, media, frequency, location, timing, and costs. These indicators reflected the suitability of the proposed program to farmers' needs. The evaluation of extension outcomes focused on four behavioural dimensions: knowledge, attitudes, skills, and application. Knowledge was assessed through farmers' understanding of the application's basic concepts, features, and operating procedures. Attitudes were examined in terms of perceived usability, benefits, recording accuracy, relevance to farmers' needs, and willingness to use the application continuously. Skills were evaluated through practical demonstrations, while application was assessed by monitoring subsequent harvest records submitted to the application portal. Regional potential identification employed the Rapid Rural Appraisal (RRA) approach through interviews and secondary data collection (Widiakongko, 2023).

The study population comprised 377 oil palm farmers belonging to ten farmer groups affiliated with the Tani Mandiri Farmers' Association who had participated in RSPO certification. Participants were selected using probability sampling through simple random sampling. The sample size was calculated using the Taro Yamane formula with a 10% precision level, yielding 79 respondents. Proportional random sampling was subsequently applied to allocate respondents across farmer groups according to their respective population sizes.

Primary data were collected through observation, interviews, questionnaires, documentation, and checklists, while secondary data were obtained from relevant literature and institutional records. The program acceptance questionnaire employed a Likert scale, the knowledge instrument consisted of multiple-choice questions, and the attitude instrument used four response categories. Skills and subsequent application were assessed using checklists. Questionnaire validity was examined using Pearson's Product–Moment correlation with 15 respondents, while reliability was assessed using Cronbach's alpha in SPSS version 25. Data were analysed descriptively through tabulation, score calculation, and percentage analysis. Program acceptance was interpreted using percentage categories ranging from 20% to 100%. Changes in knowledge were examined by comparing pre-test and post-test results, whereas attitudes, skills, and application were evaluated using the corresponding score percentages or proportions of farmers meeting the specified criteria.

RESULTS

Acceptance of the Extension Design

The extension design for using SIPP Sawit Mobile to record oil palm harvests was developed in response to farmers' needs, target-group characteristics, and local farming conditions in Laut Tador District, Batu Bara Regency. The design comprised seven components: extension materials, methods, media, volume, location, timing, and cost. The activities employed group discussion and practical demonstration, supported by a printed guidebook, the SIPP Sawit Mobile application, and a tutorial video. One session was conducted for each of the ten farmer groups, resulting in ten sessions using the same materials and methods.

Table 1. Acceptance of the Extension Design

Design Component	Percentage (%)	Category
Extension materials	86.2%	Very effective
Extension methods	85.2%	Very effective
Extension media	86.1%	Very effective
Extension volume	85.9%	Very effective
Extension location	88.6%	Very effective
Extension timing	85.0%	Very effective
Extension cost	86.4%	Very effective
Overall	86.1%	Very effective

Source: Compiled by the researcher (2026)

Table 1. Acceptance of the Extension Design shows that the extension design achieved an overall acceptance score of 86.1%, classified as very effective in the thesis. Location received the highest score (88.6%), while timing received the lowest (85.0%). Despite these differences, all seven components were classified as very effective, suggesting that the proposed design was generally considered appropriate for the participating farmers.

Acceptance of Extension Media

Three types of media were used: a printed guidebook, the SIPP Sawit Mobile application for hands-on practice, and a tutorial video. These resources were intended to complement one another by presenting the information in written, practical, and audiovisual formats.

Table 2. Acceptance of Extension Media

Extension medium	Obtained score	Maximum score	Percentage (%)	Category
Guidebook	1,033	1,185	87.1%	Very effective
SIPP Sawit Mobile application	1,712	1,975	86.6%	Very effective
Tutorial video	1,337	1,580	84.6%	Very effective
All extension media	4,082	4,740	86.1%	Very effective

Source: Compiled by the researcher (2026)

Table 2. Acceptance of Extension Media shows that the three media received an overall acceptance score of 86.1%. The guidebook obtained the highest reported score (87.1%), followed by the SIPP Sawit Mobile application (86.6%) and the tutorial video (84.6%). These findings indicate positive acceptance of the combined printed, digital, and audiovisual resources.

Evaluation of Knowledge, Attitudes, Skills, and Application

The extension activity was evaluated in terms of knowledge, attitudes, practical skills, and continued application use. Knowledge was measured through pre- and post-tests, attitudes through a Likert scale, skills through observed performance, and application use through the addition of harvest records to the connected data repository.

Table 3. Results of the extension evaluation

Evaluation dimension	Main findings	Achievement of the target
Knowledge	Mean score increased from 8.45 to 15.29; the reported relative increase was 80.9%	Increased
Attitudes	51 farmers (64.56%) were willing to apply the application; 23 (29.11%) were very willing; 5 (6.33%) were unwilling	74 of 79 farmers (93.67%) expressed willingness
Skills	53 farmers (67.0%) were skilled; 9 (11.5%) were moderately skilled; 17 (21.5%) were unskilled	Achieved: 53 farmers exceeded the target of 47
Application	24 farmers (30.4%) applied the application; 55 (69.6%) did not	Not achieved: 24 farmers compared with the target of 47

Source: Compiled by the researcher (2026)

Table 3. Results of the extension evaluation shows that the extension activity was associated with an increase in knowledge, generally positive attitudes, and a skills outcome that exceeded the target. However, continued application use remained limited. Only 24 farmers (30.4%) were recorded as using the application after the extension activity, below the target of 47 farmers.

The mean knowledge score increased from 8.45 before the activity to 15.29 afterward. In the practical assessment, 53 farmers met both accuracy and speed criteria. By

contrast, application records indicated that most farmers had not continued using SIPP Sawit Mobile. Interviews identified internet connectivity, limited familiarity, perceived difficulty, and the application's limited feature set as barriers to sustained use.

DISCUSSION

The extension design for using SIPP Sawit Mobile to record oil palm harvests achieved an overall acceptance score of 86.1%, classified as very effective according to the criteria applied in the study. This high level of acceptance suggests that the seven design components—materials, methods, media, volume, location, timing, and cost—were generally considered appropriate for the needs and circumstances of farmers in Laut Tador District. The finding reinforces the view that agricultural extension effectiveness depends not only on the quality of the information delivered but also on the alignment of the entire programme with the characteristics of its target audience. Bahua (2022) explains that effective extension helps farmers obtain relevant information, skills, and innovations to support their farming activities. In this study, this alignment was reflected in the introduction of an application specifically designed for harvest recording, the combination of discussion and practical demonstration, and the provision of learning materials that participants could use during and after the sessions.

Extension location received the highest acceptance score, at 88.6%, whereas timing received the lowest, at 85.0%, although both remained within the very effective category. The high score for location indicates that holding sessions at farmers' plantations and the homes of farmer-group leaders, based on mutual agreement, provided convenient access and a learning environment suited to participants' circumstances. This consideration is important because farmers have different work routines and live in dispersed locations, making travel distance and time potential barriers to participation. Ramadhana & Subekti (2021) explain that appropriate location selection can support participation and understanding among extension participants. Meanwhile, the score for timing suggests that scheduling still requires attention to avoid conflicts with plantation activities. Bachtiar et al. (2025) state that agreeing on the time and location of extension activities gives farmers greater flexibility to participate without disrupting their routines. Future activities could therefore benefit from more flexible scheduling and additional assistance for farmers who need repeated practice.

Acceptance of the extension media reached 86.1%, with the guidebook, SIPP Sawit Mobile application, and tutorial video serving complementary functions. The guidebook enabled farmers to revisit application procedures independently, the tutorial video presented the operating process audiovisually, and the application provided opportunities for direct practice. The guidebook's reported acceptance score of 87.1% indicates that printed materials remain relevant to digital technology extension, particularly when users need instructions they can consult after the session. Sobri et al. (2025) report that printed media can support extension effectiveness because it is easy to understand and requires no specialised skills to use. In addition, the 90.6% score for explanatory images in the guidebook highlights the importance of visual elements in clarifying instructions. This finding is consistent with Arisjulyanto et al. (2025), who explain that illustrations in printed materials can help participants understand the information presented.

The SIPP Sawit Mobile application received an acceptance score of 86.6%, while the tutorial video received 84.6%. Within the application assessment, ease of understanding the features scored 88.8%, higher than the 84.5% score for visual attractiveness. This difference suggests that farmers responded positively to the application's functionality and ease of use, although its visual design still has room for improvement. This pattern is understandable because the application's initial version prioritised basic recording functions and simple operation. Suharti et al. (2023) explain that audiovisual media can support extension effectiveness and behavioural change by presenting information through visual and auditory channels. The finding is also consistent with Wibowo et al. (2023), who identified benefits from combining printed and audiovisual materials, and Hamidah (2022), who explained that practical teaching aids allow participants to practise the material directly and can strengthen understanding and recall. Nevertheless, this study did not compare groups using different media. Consequently, the high acceptance scores indicate that participants considered the media appropriate, but they do not establish the separate contribution of each medium to learning outcomes.

In addition to media selection, the combination of discussion and practical demonstration played an important role in communicating the innovation. Discussion enabled farmers to share experiences, ask questions, and connect the material with their existing harvest-recording practices. Practical demonstration complemented this process by allowing participants to follow the application procedures directly. Yohan et al. (2023) emphasise that extension methods should be selected according to the characteristics of the

target audience, the objectives, and the content being delivered. The combination was appropriate for this study because understanding the benefits of digital recordkeeping needed to be accompanied by the practical ability to record harvests. However, the long-term effectiveness of these methods still depends on opportunities for repeated practice and access to assistance when difficulties arise after the extension activity.

The evaluation showed that farmers' mean knowledge score increased from 8.45 before the extension to 15.29 afterward, representing a reported relative increase of 80.9%. Regarding attitudes, 74 farmers, or 93.67%, stated that they were willing or very willing to use SIPP Sawit Mobile. In the skills assessment, 53 farmers, or 67%, met the established accuracy and speed criteria, exceeding the target of 47 farmers. These findings suggest that the extension activity successfully introduced foundational knowledge about the application, encouraged acceptance of the innovation, and helped most participants acquire basic harvest-recording skills. However, the increase between pre- and post-test scores demonstrates a change in measured outcomes before and after the activity; it does not establish a fully causal relationship proving that the extension intervention alone produced all the observed changes. The study also lacked a comparison group against which the outcomes of participants could be assessed.

The difference between knowledge, attitudes, skills, and actual application constitutes the most important finding of this study. Despite relatively high acceptance and skills outcomes, only 24 farmers, or 30.4%, were recorded as using the application after the extension activity, while 55 farmers, or 69.6%, had not adopted it. The implementation target of 60%, equivalent to approximately 47 farmers, was therefore not achieved. This finding indicates that knowledge of a technology's benefits and the ability to operate an application during a demonstration do not necessarily develop into sustained use. Positive attitudes reflect farmers' willingness to try or accept an innovation, whereas implementation represents actual behaviour after the activity has ended. Extension evaluation should therefore measure not only short-term changes in knowledge, attitudes, and skills but also monitor technology use over a subsequent period.

Interviews identified internet dependence, limited familiarity with the application, perceptions that digital recording was difficult, and the restricted scope of the application's features as barriers to implementation. Internet dependence represents a significant technical obstacle because reliable network access is not available at every plantation location.

Consequently, farmers who understand the application procedures may still struggle to record harvests at sites without adequate connectivity. Future development should consider offline recording with data synchronisation when a connection becomes available, subject to technical feasibility and data-security requirements. In addition, established manual-recording habits and perceived difficulty indicate the need for post-extension assistance, repeated practice, and support when users encounter problems. Expanding the application to include other farming activities could also be considered according to farmers' priorities, while preserving a simple interface so that additional functions do not make the application more difficult to use.

The contribution of this study lies in its extension design, which integrates programme planning, learning media, practical application demonstrations, and implementation evaluation using harvest-recording data. The use of actual application records provides a more concrete picture of the difference between acceptance of an innovation and its implementation after extension. Nevertheless, the findings are based on 79 farmers in the local context of Laut Tador District. Their applicability to other areas should therefore be considered in relation to differences in digital infrastructure, target-group characteristics, and existing recordkeeping practices. Future studies should extend the monitoring period, test offline recording support, and evaluate whether regular assistance improves the consistency of application use. Overall, the extension design was highly accepted and produced positive outcomes in knowledge, attitudes, and skills. However, the low rate of actual implementation demonstrates that introducing a digital innovation through a single extension activity is insufficient to ensure sustained adoption. Long-term use requires technology suited to field conditions and continuing support for users.

CONCLUSION

This study concludes that the agricultural extension program designed to introduce SIPP Sawit Mobile for oil palm harvest recording in Laut Tador District, Batu Bara Regency, was developed by considering farmers' needs and local conditions. The design incorporated objectives, target participants, content, methods, media, session volume, location, schedule, and costs. The SMART and ABCD principles provided a structured basis for defining extension objectives and assessing their achievement. The findings indicate that overall acceptance of the extension design reached 86.1%, placing it in the very effective category.

All seven assessed components—content, methods, media, volume, location, timing, and costs—also received very effective ratings, suggesting that the proposed program was considered appropriate by its intended participants.

The extension evaluation recorded a post-intervention knowledge score of 80.9% and an attitude score of 78.86% toward using the application. In addition, 53 farmers, representing 67% of the participants, demonstrated proficiency in operating SIPP Sawit Mobile. These findings indicate that the extension objectives concerning knowledge, attitudes, and practical skills were achieved in accordance with the established targets. However, sustained application remained limited: only 24 farmers, or 30.4% of the participants, continued using the application after the extension activities. Consequently, the target for continued application was not achieved.

The study offers a practical contribution by providing an extension design that can guide the introduction of digital harvest-recording tools to oil palm farmers. Its findings highlight that favourable acceptance of an extension program and improvements in farmers' capabilities do not necessarily translate into sustained technology use. Farmers should therefore be encouraged to record harvest data regularly to support production reporting transparency and audit requirements. Agricultural extension officers may adapt the proposed design in other areas with comparable needs and conditions. Future research should investigate the factors influencing continued application use and evaluate post-extension support strategies to determine how ongoing assistance can strengthen technology adoption and routine digital recordkeeping.

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