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Enhancing the Efficiency of Traditional Nugal Rice Farming through Simple Digital Technologies: A Participatory Action Research with the Dayak Community in West Kalimantan

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ABSTRACT

The *nugal* tradition is a traditional rice planting practice that the Dayak community in West Kalimantan has long preserved. Although it embodies strong cultural values, farming activities are still conducted without the support of digital technology, resulting in limited access to weather information, inefficient planting schedule management, and inadequate agricultural record-keeping. This community service program aimed to introduce simple and culturally appropriate digital technologies to improve the efficiency of local rice farming in Entabuk Village while maintaining the cultural integrity of the nugal tradition. The program employed a Participatory Action Research (PAR) approach, involving community socialization, training on online agricultural information access, and the introduction of land mapping using Google Maps. The results indicate an improvement in farmers' digital literacy, increased accuracy in determining planting schedules, and enhanced capability in utilizing basic digital applications to support farming activities. These findings demonstrate that simple digital interventions can effectively enhance the efficiency of traditional agricultural practices and encourage positive behavioral changes toward sustainable technology adoption.

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INTRODUCTION

The *nugal* tradition represents a form of local wisdom of the Dayak community that has been practiced for generations in rice and other crop cultivation. This agricultural practice embodies not only farming activities but also strong cultural and spiritual values deeply embedded in the social life of the Dayak people (Dewi, 2019; Suri, 2022). Traditionally, *nugal* is performed by planting rice seeds using a sharpened wooden stick (halu) to create holes in the soil before inserting the seeds. The activity is carried out collectively through cooperation and is conducted once a year, reinforcing social cohesion and strengthening the cultural identity of the Dayak community.

Despite its cultural significance, the *nugal* practice is still largely conducted without technological support, giving rise to several challenges. These include inaccuracies in determining planting schedules due to climate variability, limited access to up-to-date agricultural information, the absence of systematic agricultural record-keeping, and inefficient coordination among farmers that continues to rely primarily on face-to-face communication. These constraints reduce farming efficiency and increase vulnerability to environmental and climatic uncertainties.

Recent advancements in digital technology present new opportunities to address these challenges without undermining the core values of traditional practices. Simple and accessible digital tools, such as weather forecasting applications, digital record-keeping systems, and communication platforms like WhatsApp, offer practical and low-cost solutions that can enhance agricultural efficiency while remaining compatible with local customs and traditions.

Within this context, digital literacy plays a crucial role in improving agricultural productivity and empowering rural communities to adapt to technological change (Irawati, 2020; Wahyudi, 2021). However, existing studies and community programs have paid limited attention to the integration of digital technology into culturally rooted agricultural practices such as *nugal*, particularly through participatory approaches that actively involve local communities. This gap highlights the need for community-based interventions that combine technological innovation with cultural preservation.

Therefore, this community service program aims to: (1) enhance digital literacy among the Dayak farming community, (2) introduce simple and low-cost digital technologies to support traditional *nugal* rice farming, and (3) improve agricultural efficiency without altering the cultural essence of the *nugal* tradition through a Participatory Action Research (PAR) approach.

METHOD

Research Approach

The community service program employed a Participatory Action Research (PAR) approach, which actively involved community members in all stages of the program. The PAR approach was selected to ensure that the introduced digital technologies were aligned with the local needs, cultural values, and farming practices of the Dayak community. Farmers, traditional leaders, and the research team collaboratively participated in problem identification, program planning, implementation, and evaluation.

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Participants and Location

The program was conducted in Entabuk Village, Belitang Hilir District, West Kalimantan. Participants consisted of local rice farmers who practice the nugal tradition, traditional leaders, and members of the community service team. Traditional leaders were involved to ensure cultural appropriateness, while farmers actively participated as primary beneficiaries and co-researchers throughout the program.

Program Stages

The implementation of the program was carried out in four main stages.

The first stage was observation and problem identification, which involved field surveys, interviews with farmers, and dialogues with traditional leaders. This stage aimed to map community needs related to agricultural information and technology usage. The main problems identified included low utilization of digital technology, limited access to weather information, the absence of systematic agricultural record-keeping, and reliance on face-to-face coordination.

The second stage was reflection and planning, during which the research team and community members collaboratively determined appropriate forms of intervention. The planned activities included training on weather forecasting applications, simple digital record-keeping, the use of WhatsApp for coordination, access to online agricultural information, and land mapping using Google Maps.

The third stage was program implementation, which consisted of a series of training sessions and practical activities. These activities included training on weather applications such as BMKG and AccuWeather, training on simple digital record-keeping using mobile phones (Excel, Google Forms, and basic note applications), an introduction to Google Maps for estimating land area and location, training on the use of the internet to search for agricultural information, and the formation of a WhatsApp group to support coordination during nugal activities.

Evaluation Techniques

The evaluation stage employed participatory evaluation methods to assess program effectiveness. Evaluation techniques included simple pre-tests and post-tests to measure changes in participants' digital knowledge, direct observation of digital application usage during farming activities, and feedback discussions with participants to capture their experiences, challenges, and perceptions of the introduced technologies.

RESULTS AND DISCUSSION

The results of the program implementation indicate a significant improvement in digital literacy and changes in working patterns within the Entabuk Village farming community in supporting the nugal tradition. This section integrates empirical findings from pre-test and post-test results with an analytical discussion of how digital technology adoption influenced farming efficiency and community behavior.

Improvement in Community Digital Knowledge

Digital technology training resulted in a substantial increase in participants' ability to use weather applications, digital record-keeping tools, and WhatsApp for coordination

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TABLE 1. Improvement in Digital Technology Training Participants' Knowledge

No.	Knowledge Indicator	Pre-test Score	Post-test Score
1	Using weather applications	35%	82%
2	Performing digital record-keeping	22%	75%
3	Searching for agricultural information on the internet	28%	80%
4	Using WhatsApp for coordination	50%	90%

Sumber: Results of the Entabuk Village PKM Evaluation (2025)

As shown in Table 1, participants' knowledge of weather application usage increased from 35% in the pre-test to 82% in the post-test, while the ability to perform digital record-keeping rose from 22% to 75%. Similarly, the ability to search for agricultural information via the internet improved from 28% to 80%, and the use of WhatsApp for coordination increased from 50% to 90%.

These results demonstrate an average increase of approximately 47% in digital knowledge among participants. This improvement indicates that simple and context-appropriate digital training can effectively enhance digital literacy in traditional farming communities. The findings support Pratiwi (2020), who reported that digital literacy training contributes significantly to improving agricultural efficiency and farmers' decision-making capacity.

Furthermore, after the training, approximately 85% of participants were able to independently access weather forecasts using the BMKG mobile application. This capability enabled farmers to anticipate rainfall patterns more accurately and adjust their planting activities accordingly, reducing uncertainty associated with climate variability.

Utilization of Weather Applications for Determining the Nugal Schedule

Before the program, the determination of the nugal planting schedule relied primarily on natural signs and the experience of traditional leaders. While this indigenous knowledge remains culturally significant, it is increasingly challenged by unpredictable climate conditions. Following the intervention, farmers began to combine traditional knowledge with scientific weather forecasts obtained from BMKG and AccuWeather applications.

TABLE 2. Changes in the Determination of the Nugal Schedule

No.	Category	Before the Training	After the Training
1	Source of Information	Natural Signs, Experience	Weather Application and Experience
2	Accuracy of Scheduling	Low	High
3	Coordination	Face-to-face Meeting	WhatsApp Group

As summarized in Table 2, the source of information for scheduling shifted from solely natural indicators to a combination of weather applications and experience. The accuracy of planting schedule determination improved from low to high, and coordination among farmers transitioned from face-to-face meetings to WhatsApp group communication.

This integration of digital weather information with indigenous knowledge reduced the risk of seed damage caused by heavy rainfall and improved the overall efficiency of the nugal process. These findings align with previous studies indicating that the use of digital weather information enhances agricultural decision-making and reduces climate-related risk in rural farming systems (Wahyudi, 2021)

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Utilization of WhatsApp as a Coordination Medium

The establishment of a village WhatsApp group significantly improved communication among farmers.

TABLE 3. Frequency of WhatsApp Utilization by Participants

No.	Activity	Frequency Before PKM	Frequency After PKM
1	Discussion of the *nugal* schedule	5%	80%
2	Sharing agricultural information	3%	70%
3	Activity documentation	0%	65%

As presented in Table 3, the frequency of discussions related to nugal scheduling increased from 5% before the program to 80% after the program. Similarly, the sharing of agricultural information increased from 3% to 70%, while activity documentation, which was previously absent, reached 65% after the intervention.

This shift reflects a transformation in communication culture from traditional, limited interactions to more dynamic and continuous digital communication. Improved coordination facilitated faster decision-making and strengthened collective action among farmers. These findings are consistent with Wahyudi (2021), who highlighted the role of digital communication platforms in enhancing collaboration and information exchange in rural communities.

Introduction of Digital Record-Keeping

Participants were trained to use simple applications such as Google Forms, Notes, and Excel. The following data presents the number of participants who were able to use digital record-keeping.

TABLE 4. Participants' Ability in Digital Record-Keeping

No.	Ability	Number of Participants Capable	Presentase
1	Creating digital records	23 people	76%
2	Inputting agricultural data	20 people	66%
3	Saving and uploading files	18 people	60%

As shown in Table 4, 76% of participants were able to create digital records, 66% were capable of entering agricultural data, and 60% could independently save and upload files.

The adoption of digital record-keeping improved farmers' ability to manage nugal activities systematically and monitor harvest outcomes. This practice represents a critical step toward more organized farm management and supports long-term planning without disrupting traditional farming values. The findings indicate that even basic digital tools can significantly enhance agricultural management practices in traditional farming contexts.

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Activity Documentation

FIGURE 1. Training on Digital Record-Keeping Using Mobile Phones by PKM Participants

FIGURE 2. Training on the Use of Weather Applications in the Field with the Head of the Farmers' Group.

This photo illustrates the community's enthusiasm in participating in simple digital training that is relevant to their agricultural needs.

CONCLUSION

The community service program demonstrates that the integration of simple digital technologies can significantly improve the efficiency of traditional nugal rice farming without undermining its inherent cultural values. The adoption of weather forecasting applications, digital record-keeping, and online communication tools has enhanced farmers' decision-making accuracy, strengthened coordination among community members, and improved the overall management of farming activities. These improvements contributed to more accurate planting schedules, reduced risks of crop failure, and more organized agricultural practices.

The application of the Participatory Action Research (PAR) approach ensured active community involvement throughout all stages of the program, fostering a sense of ownership and acceptance of the introduced technologies. By aligning technological interventions with local wisdom and cultural practices, the program successfully improved digital literacy while preserving the cultural integrity of the nugal tradition.

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Furthermore, the findings indicate that culturally adaptive and low-cost digital interventions have strong potential for scalability and replication in other traditional farming communities facing similar challenges. The integration of simple digital tools with indigenous agricultural practices can serve as a sustainable model for rural agricultural development, particularly in regions where technological adoption must be carefully balanced with cultural preservation.

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