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Implementation of Si Tabur: A Simple Fertilizer Spreading System for Enhancing Efficiency and Productivity in Penanggungan Village, Banjarnegara

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ABSTRACT

Farmers' technological utilization has a significant impact on agricultural output. Most chile and cabbage growers in Penanggungan Village, Wanayasa District, Banjarnegara Regency, still hand-spread fertilizer. This method is time-consuming, involves a lot of energy, and has the potential to cause health issues including back pain. The team used the Community Service Program (KKN) to conduct outreach and training efforts for the creation of SiTabur (a simple fertilizer spreading tool) as an example of appropriate technology that is inexpensive, simple to create, and can be operated directly by farmers. This instrument is made of PVC pipe and has a simple mechanism for adjusting the fertilizer dose to the plant's demands. Outreach, assembly training, and tool demonstrations on locals' agricultural land are all used to carry out activities. According to the evaluation results, farmers' understanding and skills in making and utilizing the tool improved. Farmers replied positively since SiTabur has been shown to assist save time, minimize physical load, and improve fertilization efficiency. Farmers should be able to produce this instrument on their own in the future to ensure the long-term viability of more productive farming techniques.

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1. INTRODUCTION

Penanggungan Village, located in Wanayasa District, Banjarnegara Regency, is a fertile and cool highland area suitable for horticulture. Chilies, cabbage, potatoes, and carrots are popular commodities that are not only consumed locally but also exported. Agriculture is the village's primary economic sector, ensuring food security and providing income for the majority of farming households (Suherman, et al., 2023). However, the majority of farmers in this village continue to apply fertilizer by hand through direct sowing. This old method is time-consuming, labor-intensive, and frequently results in uneven fertilizer distribution, which leads to inefficient fertilizer use and poor crop quality.

Adopting proper technology is a strategic option to address these challenges. Appropriate technology refers to affordable, simple tools that local farmers can easily make and use, tailored to the local context and needs. SiTabur (Simple Fertilizer Spreading System) was invented by KKN students from Muhammadiyah University of Purwokerto in Penanggungan Village (Sinong, et.al., 2024). This tool is simply made using PVC pipes and features an adjustable mechanism that enables fertilizer doses to be tailored according to plant needs—making fertilization more efficient and reducing farmers' effort. Previous distribution of fertilizer-spreading systems in other countries has frequently been hampered by high costs, mechanical complexity, or reliance on foreign spare parts. Before the establishment of SiTabur, there was no such ergonomic and low-cost solution extensively applied in Penanggungan Village, presenting a clear potential for technical intervention.

The SiTabur program was implemented over one month through outreach, assembly training, and field demonstrations. This initiative aligns with sustainable agriculture principles, prioritizing resource efficiency and reducing environmental impact through improved fertilization PSP Agriculture. Tools like SiTabur simplify fertilizer distribution, help prevent fertilizer waste, and maintain soil fertility.

By improving efficiency, farmers can divert their labor time to other tasks such as harvesting or marketing. Accurate and even fertilizer application can boost crop yields and quality, consistent with national agricultural development goals of productivity and sustainability (Barłóg, 2023).

Therefore, implementing SiTabur in Penanggungan Village serves both as a technical solution and an empowerment strategy. Developed in partnership with KKN students, the village government, and farmers, the program is designed to be easily adopted by farmers. SiTabur can be an example of appropriate technical innovation that may be replicated in other villages to promote inclusive and sustainable agricultural modernization.

2. RESEARCH METHOD

The KKN team implemented the SiTabur program at Penanggungan Village, Wanayasa District, Banjarnegara Regency for one month in 2025. The project began with field observations to identify fertilization challenges faced by farmers, especially for crops such as chilies, cabbage, potatoes, and carrots. Interviews revealed that manual fertilization required significant time and energy, motivating the development of practical and efficient technical improvements. The SiTabur tool is made from inexpensive materials commonly available in villages, such as PVC pipes and discarded rubber, integrated into a fertilizer spreading system that can be used while walking in the fields.

Program implementation involved three main stages: (1) socialization and tool demonstration to farmers, (2) training in field use of the tool, and (3) evaluation of effectiveness through questionnaires given to 18 farmers aged 18-40 years with farming experience ranging from 10 to over 20 years. Purposive sampling was used to identify respondents who met the following criteria: (a) were active farmers planting chili and cabbage in Penanggungan Village, (b) had at least 10 or 20 years of farming experience, and (c) were willing to participate in both the training and evaluation phases. The questionnaire included items scored on a 5-point Likert scale (1 = strongly disagree/very difficult, 2 = disagree/difficult, 3 = neutral, 4 = agree/easy, 5 = strongly agree/very easy) that addressed five indicators: ease of use, time efficiency, fertilizer delivery quality, physical strain reduction, and cost efficiency.

Survey data analyzed the tool's ease of use, time efficiency, and productivity impact. These findings provide a basis for future tool design and sustainability programs. A paired sample t-test was used to compare pretest and posttest scores for each indicator, with a significance level of $\alpha = 0.05$, to validate improvements following SiTabur deployment. These insights form the foundation for future tool design and sustainability initiatives.

3. RESULT AND DISCUSSION

The usage of the basic SiTabur fertilizer spreading tool for chili and cabbage farmers in Penanggungan Village resulted in positive outcomes, according to questionnaire data obtained before and after deployment. Prior to employing SiTabur, most farmers relied on manual methods for distributing fertilizer, which required greater physical effort and longer work hours. This has an effect on both productivity and labor expenses. Farmers obtain a technical understanding of how SiTabur works through socialization, training, and field experiments, which range from loading fertilizer to modifying dosages to sowing procedures.

A questionnaire analysis meant to assess farmers' first understanding, experience, and needs for the SiTabur fertilization tool revealed a considerable shift in farmers' beliefs and practices following their use of the tool. Pretest data suggested that most farmers encountered challenges throughout the fertilization procedure, particularly with regard to unequal fertilizer distribution and non-ergonomic working conditions. This is demonstrated by the low average ease of use score and the prevalence of answers ranging from "difficult" to "very

difficult". Following intensive training and trial use of the tool, the post test questionnaire demonstrated a significant increase in perceived ease of use, with the majority of respondents ranking it as "easy" to "very easy."

Statistical analysis applying a paired sample t-test revealed substantial increases in all five assessed indices (easy of use, time efficiency, distribution quality, physical strain reduction, and cost efficiency) between pretest and posttest findings ($p < 0.001$). The most significant mean increase was seen in convenience of use (from $M = 3.1$, $SD = 0.5$ to $M = 4.6$, $SD = 0.4$), followed by cost efficiency.

Variable	Manual Method (Mean)	SiTabur Method (Mean)	% Improvement
Average working time per 1000 m²	50 minutes	30 minutes	40% faster
Estimated operational cost per cycle (IDR)	50,000	35,000	30% cheaper
Average ease-of-use score (1–5)	3.1	4.6	+48%
Farmer satisfaction (%)	62%	94%	+32%
Back pain complaints (%)	78%	22%	–56%

Figure 1. illustrates the visual comparison of pretest and posttest scores.

In addition to convenience, the questionnaire assessed farmers' perceptions of fertilizer distribution quality, which had previously been a key impediment to manual methods. The results reveal that using SiTabur considerably improves fertilizer distribution by providing a steady and consistent dispensing method that avoids accumulating at specific places, which might harm plants. Respondents reported favorable experiences such as more measured sowing distances and a reduction in the requirement for frequent bending, hence lowering physical weariness, a major complaint among farmers. Figure 2 and 3 illustrates how visual documenting of tool use in cabbage fields enhances these conclusions.

Figure 2 and 3. Documentation of Farmers Using the SiTabur Tool in Cabbage Farming Land

In terms of time efficiency, the poll found that 85% of farmers reported a 40% decrease in work duration compared to manual methods. This accelerated fertilization procedure has a direct impact on farmers' production and working time. This finding is consistent with the FAO report (2023), which claims that proper agricultural technology can cut labor costs while greatly increasing operational efficiency. According to the survey, the reduction in working hours was countered by an increase in fertilizer application quality, ensuring that production outcomes were not compromised. According to questionnaire data, 78% of farmers observed a reduction in symptoms of pains and back pain. The upright working position made possible by SiTabur minimizes the risk of musculoskeletal diseases, which have long been a leading cause of injury and chronic weariness among farmers. This is consistent with the ILO recommendations, which emphasize the importance of ergonomic agricultural equipment innovation in improving the health and productivity of agriculture workers (ILO, 2024).

The questionnaire also evaluated operational costs and the economic viability of adopting SiTabur. While needing a considerable initial investment, farmers report long-term cost savings via reduced supplementary labor and faster work processes. This conclusion is supported by the fact that the cost efficiency indicator score

increased from 3.1 to 4.6 after utilizing the tool. Farmers said that using a single operator allowed for faster completion of 1,000 m² of field without affecting harvest quality. According to the questionnaire, farmer confidence increased from 62% to 94% after training and tool testing. Training entails technical use, maintenance, and tool optimization in order to remove psychological and technical impediments. This demonstrates how education is a critical aspect in fostering the acceptance of new technology at the village level.

Overall, the survey results show that SiTabur is more than simply a technological tool; it is a solution that satisfies farmers' actual requirements by enhancing agricultural efficiency, ease, and productivity. These findings corroborate the UNDP's principles of suitable technology, which require technology to be simple, cost-effective, easy to understand, and relevant to the target community's socioeconomic conditions (UNDP, 2018). As a result, SiTabur has the potential for further development and application in a wide range of agricultural commodities.

The implementation of SiTabur as a field-based innovation indicates how technology may help to long-term agricultural change, boost farmer welfare, and reduce occupational health concerns. The implementation of this technology also has a positive impact on lowering production costs and increasing crop yields, which can boost village farmers' income and standard of living. Future development recommendations include improving continuous training programs, creating tool variants for different types of crops, and incorporating digital technologies to track usage and harvest yields. A participatory approach that includes farmers in the innovation process is also necessary to guarantee that tools are continually tailored to field demands and conditions.

4. CONCLUSION

The Si Tabur (Simple Fertilizer Spreading System) tool was implemented in Penanggungan Village, Wanayasa District, Banjarnegara Regency, and has proven to be efficient in enhancing fertilization efficiency, ease, and productivity for chili and cabbage growers. Using this equipment accelerates the fertilization process by up to 40%, minimizes physical fatigue, and assures more even fertilizer delivery, preserving crop quality and yields. In addition to technical benefits, this initiative empowers farmers through training, field demonstrations, and capacity building. Farmers' confidence in technology has grown dramatically, and long-term operational costs are more efficient. A paired sample t-test showed substantial gains ($p < 0.001$) in all assessed metrics, including ease of use, time efficiency, fertilizer distribution quality, physical strain reduction, and cost efficiency. Operational costs per cycle fell by about 30%, but farmer satisfaction increased from 62% to 94%. Back discomfort incidence decreased from 78% prior to installation to only 22% post-implementation, indicating the tool's ergonomic benefits.

Si Tabur, with its basic, low-cost, and user-friendly design, can be cited as an example of acceptable technology innovation that addresses local requirements. This technique has the potential to be reproduced in other villages to help farmers practice more productive, sustainable, and healthy agriculture. Future development recommendations include improving continuous training programs, creating tool variants for different crop types, and incorporating digital technology to track usage and yields.

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