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Agricultural Extension on The Use of pH meters and Indicator Paper to Enhance Lime Application Efficiency in Rice Fields: A Case Study in Lubuk Seberuk Village, South Sumatra

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Abstract
Agricultural extension plays a pivotal role in advancing the agricultural sector by enhancing farmers' knowledge, skills, and attitudes toward effective farm management. This study was conducted in Lubuk Seberuk Village, Lempuing Jaya Subdistrict, Ogan Komering Ilir Regency, South Sumatra. The main issue identified in the area was the improper application of agricultural lime in rice fields, primarily due to the absence of soil pH measurements prior to liming. Such practices often lead to inefficient lime use, which can negatively affect soil fertility and reduce rice productivity. This study highlights the role of agricultural extension in promoting the use of simple soil pH assessment tools namely, pH meters and pH indicator paper, to optimize lime application within the framework of precision agriculture for food security enhancement. The extension activities involved four active Brigade Pangan in Lubuk Seberuk Village. Through participatory learning and demonstration, farmers were introduced to practical methods of soil pH testing and lime requirement estimation. The results showed a substantial improvement in farmers' competencies, with knowledge levels increasing by 66% and practical skills as reflected in farmers' attitudes improving by 49%. These findings indicate that targeted extension activities effectively enhanced farmers' capacity for efficient rice field management, thereby contributing to sustainable rice production and supporting national food self-sufficiency initiatives.

INTRODUCTION

Indonesia continues to face major challenges in the agricultural sector due to rapid population growth and the conversion of agricultural land to non-agricultural uses, which threaten the sustainability of food production. Rice remains the main staple food for most Indonesians, making its production a strategic component of national food security (Mulyani et al., 2021). Strengthening agricultural productivity therefore requires improved farmer capacity and more efficient use of available agricultural land. One government initiative to address this challenge is the Brigade Pangan Program, which involves youth groups in

managing and optimizing agricultural land while supporting farmer regeneration (Susilowati, 2022; Nugroho et al., 2023).

In South Sumatra, particularly in Ogan Komering Ilir Regency, more than 230 Brigade Pangan groups have been established and are actively managing thousands of hectares of land. Lubuk Seberuk Village is one of the areas participating in this program. However, rice cultivation in this region faces several constraints, particularly highly acidic soil conditions that limit nutrient availability and reduce plant growth. Soil acidity is widely recognized as a major factor affecting crop productivity in tropical agricultural systems because it can lead to nutrient imbalances and the toxicity of certain elements, such as aluminum (Fageria & Baligar, 2020; Kochian et al., 2021).

To overcome this constraint, farmer education programs have introduced simple soil diagnostic tools such as digital pH meters and pH indicator paper. Accurate soil pH measurement allows farmers to determine appropriate liming requirements, which can improve soil fertility and increase crop productivity. The use of simple technology through extension activities also supports data-based land management and the adoption of precision agriculture practices. Technology-based extension approaches have been shown to significantly improve farmers' knowledge and encourage the adoption of sustainable agricultural practices (Jamil et al., 2023; Nguyen et al., 2024).

RESEARCH METHODOLOGY

This extension activity was conducted on April 24, 2024, in Lubuk Seberuk Village, Lempuing Jaya District, Ogan Komering Ilir Regency, South Sumatra Province. The activity involved students from the Polbangtan Malang, agricultural extension workers from the Lempuing Jaya Agricultural Extension Center (BPP), and members of four Brigade Pangan: Taruna Muda, Muda Berjaya, Subur Tani, and Sinar Tani. The extension program began with an Identification of Regional Potential (IPW) to determine the main agricultural problems and development opportunities in the study area. This identification process was conducted through field surveys, interviews with Brigade Pangan members, and a review of existing agricultural extension programs. The results of the IPW analysis were used to design an extension program tailored to farmers' needs, particularly in addressing soil acidity problems in rice fields. The extension activity focused on introducing and demonstrating the use of soil pH measurement tools, namely digital pH meters and pH indicator paper, to improve the efficiency and accuracy of liming practices.

The extension materials were delivered through a combination of lectures, group discussions, and hands-on demonstrations. Educational media such as leaflets and demonstration tools (digital pH meters and pH indicator paper) were used to enhance farmers' understanding of soil pH measurement and its importance in determining appropriate lime application. These participatory learning methods were intended to facilitate knowledge transfer and encourage farmers to apply the technology in their farming practices. A total of 39 participants from the four Brigade Pangan attended the extension activity. The effectiveness of the extension program was evaluated by measuring changes in participants' knowledge and attitudes regarding the importance of measuring soil pH before liming. The evaluation employed a one-group pre-test and post-test design, using structured questionnaires administered before and after the extension activity. The questionnaire consisted of 10 questions assessing knowledge and 10 questions assessing attitudes toward the use of pH measurement tools. Knowledge levels were measured using the Guttman scale, which

provides dichotomous response options (Yes/No). Each correct response was assigned a score of 1, while incorrect responses were assigned a score of 0. Conversely, for negatively worded statements, the scoring was reversed. Meanwhile, participants' attitudes toward the use of pH meters and pH indicator paper were measured using a Likert scale, where responses represented levels of agreement with specific statements related to soil pH measurement and liming efficiency. Each response option was assigned a numerical score reflecting the level of agreement, allowing the assessment of participants' attitudes toward the adoption of the technology.

RESULTS AND DISCUSSION

The extension activities conducted in Lubuk Seberuk Village, Lempuing Jaya District, Ogan Komering Ilir Regency significantly improved farmers' understanding of the importance of measuring soil pH before applying lime. The introduction of simple soil testing tools, such as digital pH meters and pH indicator paper, enabled farmers to determine soil acidity more accurately and make better decisions regarding liming practices. Soil pH is a key factor affecting nutrient availability and crop productivity, particularly in tropical soils where acidity problems are common (Fageria & Baligar, 2020; Kochian et al., 2021). Prior to the extension program, most farmers applied lime without measuring soil pH, which often resulted in inefficient use of lime and increased production costs. After participating in the extension activities, farmers reported that soil pH measurement helped them determine the appropriate lime dosage according to actual soil conditions. This finding is consistent with previous studies showing that soil testing technologies can improve nutrient management decisions and increase fertilizer efficiency (Havlin et al., 2022; Agegnehu et al., 2021).

The effectiveness of the extension program is reflected in the results of the pre-test and post-test evaluations. In terms of knowledge, the total pre-test score was 116, with 30% categorized as low, while the post-test score increased to 375 with 96% categorized as very high, indicating a 66% increase in farmers' knowledge. Statistical analysis using the paired t-test showed a significance value of 0.0001 ($p < 0.05$), confirming a significant difference between knowledge levels before and after the extension activity. This increase can be partly explained by the demographic characteristics of the respondents, most of whom were in the productive age range (19–43 years) and had relatively adequate educational backgrounds. Farmers in productive age groups generally have stronger motivation to learn and are more receptive to technological innovations (Nugroho et al., 2023). Education also plays an important role in shaping farmers' ability to understand and apply new information in agricultural practices.

A similar trend was observed in the attitude aspect. The pre-test attitude score reached 923 (47% categorized as sufficient), while the post-test score increased to 1,869 (96% categorized as very high), indicating a 49% improvement in positive attitudes toward the use of soil pH measurement tools. The paired t-test analysis also showed a significant difference with a significance value of 0.0001 ($p < 0.05$). The improvement in attitudes was influenced by the farming experience of the respondents, where many participants had more than ten years of farming experience. Farming experience often shapes farmers' perspectives and openness toward innovations that can improve productivity and efficiency. Participatory extension approaches combining lectures, discussions, and practical demonstrations have been proven effective in improving farmers' knowledge, attitudes, and adoption of agricultural innovations (Jamil et al., 2023). However, challenges remain, particularly the limited access to digital pH

meters due to cost constraints. Therefore, continuous extension support and improved access to affordable soil-testing tools are necessary to ensure the sustainability of soil pH-based liming practices and to support sustainable rice production systems.

CONCLUSIONS AND SUGGESTIONS

The extension activity conducted in Lubuk Seberuk Village, Lempuing Jaya District, Ogan Komering Ilir Regency effectively improved farmers' knowledge and attitudes regarding the importance of measuring soil pH before liming in rice cultivation. The introduction of simple soil testing tools, such as digital pH meters and pH indicator paper, enabled farmers to better understand soil acidity conditions and determine appropriate lime application based on actual soil requirements. The results showed a significant increase in farmers' knowledge (66%) and positive attitudes (49%) toward the adoption of soil pH measurement practices, which was statistically supported by paired t-test analysis ($p < 0.05$). These findings demonstrate that participatory extension approaches combined with practical demonstrations are effective in strengthening farmers' capacity to adopt simple agricultural technologies for improved soil management. Therefore, continuous extension support and improved access to affordable soil testing tools are recommended to ensure the sustainability of soil pH-based liming practices and to support sustainable rice production in swamp-land ecosystems.

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