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Soil Fertility Management Training for Urban Women Farmers Using PUTK and PUPO: A Participatory Rural Appraisal Approach in KWT Roay Lestari, Indonesia

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ABSTRACT

Cultivating crops without soil fertility management can reduce yields and degrade the quality of fertile soil. This applies to rhizome plants. This community service program aimed to improve soil fertility management skills among members of KWT Roay Lestari through the use of simple soil and fertilizer testing tools, namely PUTK, PUPO, and pH meter. The program applied a Participatory Rural Appraisal (PRA) approach, involving farmers actively in training and field practice. Evaluation was conducted using pre- and post-training questionnaires. Results showed an increase in participants' knowledge by more than 80% and a more than 50% Initial-final knowledge increase. Soil analysis indicated moderately fertile soil with slightly acidic pH, moderate phosphorus, low potassium, and low organic matter. Recommended improvements included the application of 20–25 tons/ha of manure, phosphate-solubilizing bacteria (20 ml/L), and 3 tons/ha of lime. The program effectively enhanced farmers' capacity to independently manage soil fertility in urban farming systems.

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INTRODUCTION

The cultivation of rhizome plants such as ginger, turmeric, Javanese ginger, cardamom, galangal, and lesser galangal is currently in demand due to the growing trend of consuming herbal plants. This increase was evident both during and after the COVID-19 pandemic. Improved Clean and Healthy Lifestyles (ICHL) have, among other factors, driven increased consumption of herbal products, including rhizome-derived herbal medicines (Sutana et al., 2020). Rhizome cultivation is also carried out by the Roay Lestari Women's Farmers Group/Kelompok Wanita Tani (KWT), a KWT located in an urban area. KWT Roay Lestari has minimal knowledge and skills regarding soil fertility management for rhizome plant cultivation in particular. Rhizome cultivation is intended, among other things, to serve as the primary ingredient in the production of herbal medicine, thereby increasing the added value of rhizome products, including dried, powdered, and liquid herbal medicines. In cultivating rhizomes, KWT Roay Lestari has not yet implemented soil fertility management, a crucial practice to reduce the risk of nutrient depletion, which could impact agricultural yields (Ifadah et al., 2021). Furthermore, KWT Roay Lestari also produces organic fertilizer from plant residues and goat manure. This organic fertilizer also needs to be evaluated for nutrient content to ensure appropriate fertilization meets the needs of the rhizome plants.

Soil fertility management is part of improving soil fertility. This can be achieved through balanced fertilization, the addition of organic matter (organic fertilizer), efficient irrigation management, soil cultivation, and soil pH management (Batu et al., 2019). One of the steps necessary before implementing balanced fertilization is a soil fertility assessment. A soil fertility assessment is necessary before crop cultivation to determine the fertilizer and lime requirements of the land to be used for soil fertility management (Rachmadiyanto et al., 2020). Furthermore, soil fertility evaluation is useful for reducing the risk of reduced crop yields. There are several methods for evaluating soil fertility, including quantitative and qualitative testing. Quantitative soil testing is conducted in a laboratory using sophisticated testing equipment. Qualitative testing, on the other hand, is conducted simply using reagents without sophisticated testing equipment. Another difference is that qualitative testing is more practical for small-scale farming because it is less expensive and easier for farmers to use (Fitria et al., 2023).

This community service activity, implemented by Roay Lestari KWT, used simple rapid testing technologies for practical soil and fertilizer testing, including the Dry Soil Test Kit/Perangkat Uji Tanah Kering (PUTK) and the Organic Fertilizer Test Kit/Perangkat Uji Pupuk Organik (PUPO). These devices provide a direct, qualitative, rapid testing method in the field (Arifin, 2021). This device can analyze pH and nutrients, including N, P, K, and organic C. The use of this rapid testing technology is also complemented by fertilizer recommendations to ensure accurate dosage and targeting. In addition to using PUTK and PUPO, we also conducted training on field pH meters, which can serve as a reference for quantitatively determining lime requirements. The results of this community service activity provide site-specific fertilization and liming recommendations for rhizome cultivation in urban farming systems.

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METHOD

Location and Time of Community Service

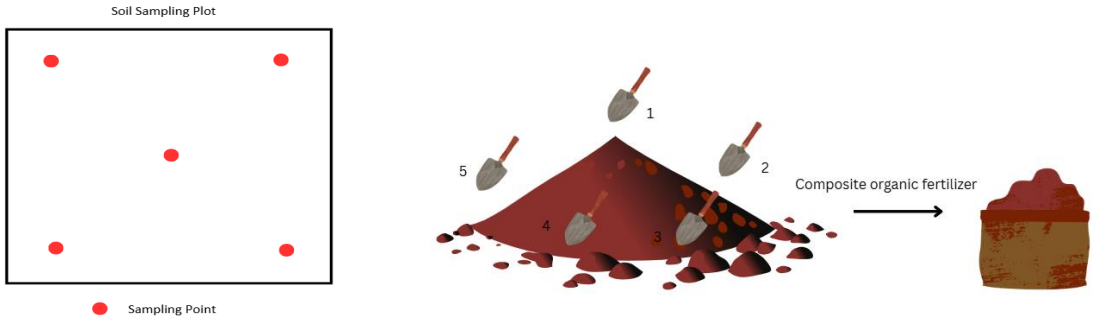
This community service activity was carried out at KWT Roay Lestari, located in the urban area of Kahuripan Village, Tawang District, Tasikmalaya City, West Java, from November to December 2025. The formation of KWT Roay Lestari was motivated by a situation in 2019, when COVID-19 was spreading; at that time, all community activities were restricted. The effects of COVID certainly affected various aspects, including the economic and social sectors. KWT Roay Lestari has the potential for land >200 m2, including yards, belonging to KWT Roay Lestari members. KWT Roay Lestari cultivates many vegetables. The average temperature of urban areas in the Kahuripan area, Tawang District, is between 21 and 29 °C. With rainfall between 1500 and 2500 mm/year.

Soil Fertility Management Extension Method

This community service activity is based on Participatory Rural Appraisal (PRA), which emphasizes community involvement as partners and subjects in all community empowerment activities. This allows partners to freely express ideas and suggestions for community service programs. This method facilitates the exchange of ideas among partners and experts who serve as facilitators of community service activities. Therefore, the planned program reflects the partners' actual conditions that need improvement. This activity involves evaluating partners by completing a questionnaire provided by the community service team. Knowledge evaluation is conducted by administering a questionnaire before and after the extension program is given to members of Roay Lestari KWT. These results will be analyzed by comparing partners' knowledge before and after the extension program, serving as an indicator of the community service program's success.

Soil Fertility Management Analysis Method

This activity began with an introduction to the importance of soil fertility management and an introduction to the PUTK, PUPO, and pH meter tools. This was followed by practical soil and organic fertilizer sampling using the diagonal composite method (soil), as shown in Figure 1 below. Soil samples were collected at 0-20 cm depth. The soil and organic fertilizer samples collected at each of the five locations were then mixed (composite). Subsequently, soil and organic fertilizer samples were collected for analysis using the quarter method (Figure 2).



a) b)

FIGURE 1. a) Soil sampling and b) Organic fertilizer sampling

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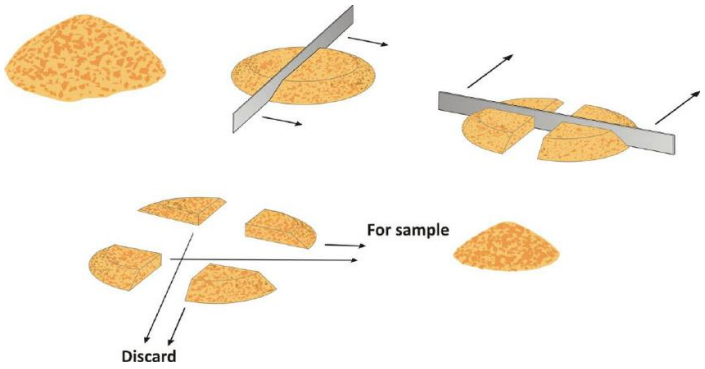

FIGURE 2. Quartering soil/organic fertilizer sampling method
Source: (Alakangas, 2015)

The soil samples selected using the quartering method were then air-dried and ground using a mortar and pestle. After the soil samples were finely ground, they were sieved to remove any dirt or loose soil. The soil samples were then analyzed using PUTK (Plant-Based Fertilizer) for pH (H2O), Potential K, Potential P, and Organic C. The use of PUTK is described in the manual included with the PUTK kit. The organic fertilizer samples were analyzed using PUPO (Total N, pH H2O, K, P, and Organic C). The use of PUPO is described in the manual included with the PUPO kit. Color matching was then performed between the PUTK and PUPO analysis results, yielding low, medium, and high nutrient content classifications.

Lime requirements were determined using pH meter measurements. This method uses the pH values shown in Figure 1a. Next, record the soil pH values from each of the five sample points. The average pH values from the five sample points are calculated. The lime requirement was calculated using the following formula:

$$\Delta pH = 6.5 - pH\ Field \quad (1)$$

The next step is to match the calculation results with the lime requirements table in Figure 3:

TABLE 1. Table of lime requirements

Δ pH	Lime Requirements Kapur (tons/ha)	Δ pH	Lime Requirements (tons/ha)
2.0	6.8	1.0	3.7
1.9	6.5	0.9	3.4
1.8	6.2	0.8	3.0
1.7	5.9	0.7	2.7
1.6	5.6	0.6	2.4
1.5	5.3	0.5	2.1
1.4	4.9	0.4	1.8
1.3	4.6	0.3	1.5
1.2	4.3	0.2	1.1
1.1	4.2	0.1	0.8

RESULTS AND DISCUSSION

The soil fertility management outreach program was attended by 30 members of the Roay Lestari KWT (Farmers' Group) as community service partners. The soil fertility management briefing began with an introduction to the use of PUTK, PUPO, and pH meters, followed by a practical application of soil nutrient and fertilizer evaluation. The partners were given a questionnaire to assess their initial and final

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knowledge after the outreach program was completed.

FIGURE 3. Soil fertility management explanation

a) b)

FIGURE 4. a) Filling out the questionnaire b) Practice of using PUTK and PUPO

The evaluation results show that the outcomes achieved include increased knowledge and skills. Providing knowledge and practice on the use of pH meters, PUTK, and PUPO showed that >80% of partner members experienced increased knowledge and skills, as detailed below:

TABLE 2. Information on increasing the knowledge of community service partners

Partners	Number of Respondents	Average pretest score	Average posttest score	Initial-final knowledge increase (%)	Partner members whose knowledge increased (%)
KWT Roay Lestari	30	38	88	56	>80

Increasing partner knowledge is supported by the PRA extension method, which, according to Sulaeman et al. (2023), is considered a positive approach that can help partners follow up on community service activities. This is in line with the results of community service carried out in urban areas by Kurniawan et al. (2025), which show that the PRA method can increase the knowledge and skills of community service partner members by more than 50%.

The results of soil and fertilizer analysis in KWT Roay Lestari were analyzed using a PUTK, a PUPO, and a pH meter. This analysis was conducted before cultivating rhizome plants such as ginger, turmeric, cardamom, temulawak, and galangal. The analysis using a pH meter and PUTK showed that the soil pH

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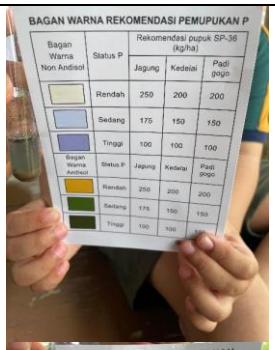
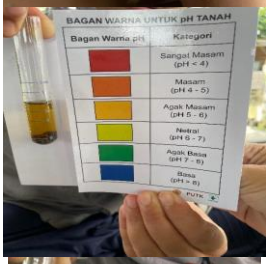
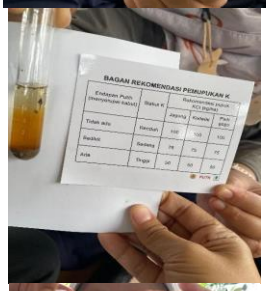
in the cultivated land was slightly acidic (Table 2). Meanwhile, phosphorus (P) levels were moderate, potassium (K) levels were low, and organic matter was low (Table 2). The low-moderate potassium and organic matter levels are typical of intensively cultivated urban soils, which often experience nutrient removal without adequate organic input. Similar conditions were reported by previous studies on urban farming systems. Therefore, the community service team provided recommendations for fertilization and liming as a follow-up to improvements with an organic approach. The recommendations for improvement were the use of fermented manure, liquid organic fertilizer, solid goat manure compost (10-15 tons/ha), and 20 ml/L of phosphate-solubilizing bacteria (Bacillus sp., Pseudomonas sp.). Menurut Kania & Maghfoer (2018), in a study, the use of goat manure (20-25 tons/ha) as an organic fertilizer, combined with phosphate-dissolving bacteria (20 ml/L), effectively increased shallot bulb weight by up to 12 tons/ha. Meanwhile, the recommended liming rate is 3 tons/ha (applied before planting). Liming is intended to reduce acidity levels in cultivated land (Nopriani et al., 2023).

TABLE 3. Soil analysis results using PUTK

Parameters	Evaluation Criteria	Documentation
Phospor (P) Potential	Moderate	
pH H2O	Slightly Acidic	
Potassium (K) Potentials	Low (No sediment)	
Organic Matter	< 2 cm (Low)	

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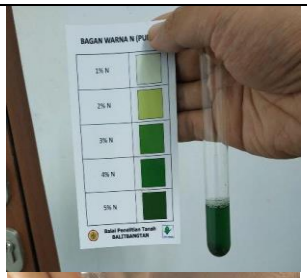
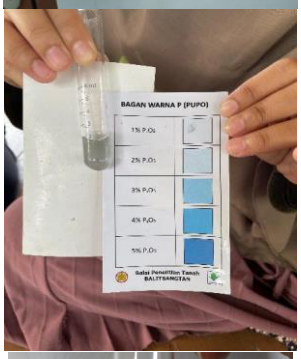
Parameters	Evaluation Criteria	Documentation
Lime requirement (average soil pH)	5.7 (Slightly Acidic)	

Analysis of organic fertilizer from goat manure produced by KWT Roay Lestari was conducted using the PUPO method. The analysis included total N, Phosphorus (P), Potassium (K), organic C, and pH H2O. The analysis results (Table 3) show that total N is around 4%, Phosphorus (P) is around 1%, Potassium (K) is in the low range, organic C is around 10%, and pH H2O is neutral.

TABLE 4. Organic fertilizer analysis results using PUPO

Parameter	Value Status of Organic Fertilizer Nutrient	Documentation	Description
Nitrogen (N)	4%		In accordance with the provisions of Organic Fertilizer Quality According to KEPMENTAN Number 261 of 2019 (Minimum N+P+K value 4)
Phosphor (P)	1%		
Potassium (K)	<1% (No sediment)		

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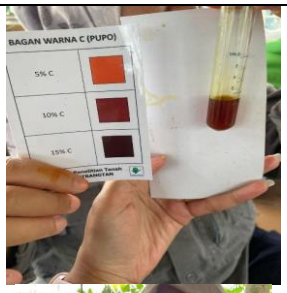
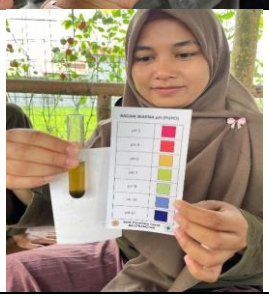
Parameter	Value Status of Organic Fertilizer Nutrient	Documentation	Description
Organic C	10%		The minimum organic C value is 15% based on KEPMENTAN Number 261 Tahun 2019
pH H2O	7		The pH value of H2O meets the quality standards KEPMENTAN Nomor 261 Tahun 2019 4-9

Referring to the 2019 Ministry of Agriculture Decree No. 261 for Organic Fertilizer Quality, a minimum N+P+K value of 4 is sufficient. The organic C value, however, needs to be increased to at least 15%. The pH value, however, meets quality standards.

CONCLUSION

Community service using the PRA method is considered effective in improving the knowledge and skills of community service partners. This knowledge and skills provision increased partner members' knowledge and skills in soil fertility management by more than 80%.

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