EVALUATION OF RICE FIELD SOIL FERTILITY IN VARIOUS CROP ROTATIONS IN SUMBERHARJO VILLAGE, KAPANEWON PRAMBANAN, SLEMAN REGENCY

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Judul Penelitian	: Evaluasi Kesuburan Tanah Sawah Pada Berbagai Rotasi Tanaman di Kalurahan Sumberharjo, Kapanewon Prambanan, Kabupaten Sleman.
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EVALUASI KESUBURAN TANAH SAWAH PADA BERBAGAI ROTASI TANAMAN DI KALURAHAN SUMBERHARJO KAPANEWON PRAMBANAN KABUPATEN SLEMAN

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ABSTRACT

Paddy soil fertility is greatly influenced by the management system, including crop rotation patterns. This study aims to evaluate the status of paddy soil fertility based on soil chemical characteristics and the influence of various crop rotations in Sumberharjo Village. Sampling was carried out purposively with 11 sample points on five types of crop rotations: rice-rice-rice, rice-rice-corn, rice-rice-chili, rice- rice-soybean, and rice-rice-peanut. The parameters analyzed included pH H_2O, C- organic, N-total, P_2O_5, K_2O, CEC, and Base Saturation. The results showed that the soil fertility status was dominated by low to very low classes. The main limiting factors were CEC, K_2O, and C-organic. Legume crop rotation showed potential in increasing soil fertility through the contribution of organic matter and nitrogen fixation.

Keywords: Soil Fertility Evaluation, Soil Fertility, Crop Rotation, Paddy Field Soil.

INTRODUCTION

The intensive use of rice monoculture systems contributes to the decline in soil fertility in Sumberharjo Village (Purba et al., 2018). Rice fields are land managed for cultivating rice fields, by flooding during or part of the rice growing season (Pardosi et al., 2013). Crop rotation, especially with secondary crops and horticulture, is expected to improve soil chemical characteristics. Legumes such as soybeans and peanuts can increase organic C levels and nitrogen fixation through symbiosis with Rhizobium bacteria by converting them into forms that can be used by plants, namely ammonium, nitrite and nitrate (Hapsari and Djoko, 2014). Corn plant litter (roots) plays an important role as a source of organic biomass because it contains 6.0% hemicellulose, 12.8% lignin, and 20.4% silica which are humified into humus (Mulyono, 2010). Decomposing roots and plant debris can provide a substrate for soil microbes.

Soil fertility is the potential of the soil to provide sufficient nutrients in a form that is available and balanced to ensure optimum plant growth and production (Yamani, 2010). Soil fertility evaluation is the process of assessing nutrient problems in the soil that are needed by plants in order to determine the level of soil fertility and provide recommendations for proper fertilization or soil management. One method that is often used in assessing soil fertility is through an approach with soil analysis. There are five soil fertility parameters used in this study to assess soil fertility status, namely KPK; KB; C-organic; total soil P and K content according to the technical instructions for soil fertility evaluation (PPT, 1995).

METHODS

The method used in this study is the field survey method. The survey method is a method of collecting data to obtain information by conducting direct reviews and observations at the research location. Determination of the location was carried out by purposive sampling, namely on the use of rice fields based on the application of crop rotation in Sumberharjo Village, namely: Rice-Rice-Rice Crop Rotation, Rice-Rice-Soybean Crop Rotation, Rice-Rice-Corn Crop Rotation, Rice-Rice-Chili Crop Rotation, and Rice-Rice-Peanut Crop Rotation.

Soil sampling was carried out randomly based on different crop rotation map delineations, so that 11 sample points were obtained. Each crop rotation had 2-3 sample points. The Rice-Rice-Chili crop rotation took 3 sample points and the other crop rotations took 2 sample points. Soil sampling at 1 sampling point was taken at 3 adjacent points. Then the soil samples were composited and taken as much as 1 kg to be put into ziplock plastic, and labeled on each sample. The soil samples that had been taken were then air-dried to reduce the soil water content and after air-dried, the soil was ground and then filtered through 0.5 mm to be taken to the laboratory so that the content of N-Total, P_2O_5, K2O, C-Organic, KPK, KB, and pH could be analyzed.

RESULT AND DISCUSSION

1. Soil pH (H_2O)

Table 5.1 H_2O pH Levels of Paddy Fields in Various Types of Crop Rotation in Sumberharjo Village

No	Type Rotation	Soil pH (pH)	PPT Value (1995)
1.	Rice-Rice-Rice	5.53	Acidic
2.	Rice-Rice-Corn	5,68	Slightly Acidic
3.	Rice-Rice-Chili	5.77	Slightly Acidic
4.	Rice-Rice-Soybean	6.02	Slightly Acidic
5.	Rice-Rice-Peanuts	5.56	Slightly Acidic

Soil Reaction (pH) at the research location (Table 5.1), obtained an average value of rice-rice-rice rotation of 5.53 (Acidic), rice-rice-corn rotation of 5.68 (Slightly Acidic), rice-rice-chili rotation of 5.77 (Slightly Acidic), rice-rice-soybean rotation of 6.02 (Slightly Acidic), and rice-rice-peanut rotation of 5.56 (Slightly Acidic). Soil Reaction (pH) is classified as slightly acidic in 4 (four) crop rotations and pH is classified as acidic in 1 (one) rice-rice-rice rotation. This is because the acidic and slightly acidic soil reactions indicate that the soil in the research area still has quite high hydrogen ion (H^+) activity, which can have an impact on the availability of certain nutrients.

2. C-Organic

Tabel 5.2 Kadar C-Organik Lahan Sawah Pada Berbagai Jenis Rotasi Tanaman di Kalurahan Sumberharjo

No	Type Rotation	C-Organic (%)	PPT Value (1995)
1.	Rice-Rice-Rice	1,063	Low
2.	Rice-Rice-Corn	0,891	Very Low
3.	Rice-Rice-Chili	0,877	Very Low
4.	Rice-Rice-Soybean	1,693	Low
5.	Rice-Rice-Peanuts	0,583	Very Low

Based on the results of the C-Organic analysis at the research location (Table 5.2), the average value of rice-rice-rice rotation was 1.063% (Low), rice-rice-corn 0.891% (Very Low), rice-rice-chili rotation 0.877% (Very Low), rice-rice-soybean rotation 1.693% (Low), and rice-rice-peanut rotation 0.583% (Very Low). The low C-Organic content indicates that biological soil fertility in the research area is still not optimal. The highest value was obtained in the rice-rice-soybean rotation, which is a legume plant. This can be explained by the role of legume plants in contributing easily decomposed root biomass and litter, as well as their ability to form symbiosis with Rhizobium bacteria, which in addition to contributing to nitrogen fixation, also enrich soil organic matter.

3. Total N

Table 5.3 Total N Content of Paddy Fields in Various Types of Crop Rotation in Sumberharjo Village

No	Type Rotation	Total N (%)	PPT Value (1995)
1.	Rice-Rice-Rice	0,296	Medium
2.	Rice-Rice-Corn	0,096	Very Low
3.	Rice-Rice-Chili	0,159	Low
4.	Rice-Rice-Soybean	0,147	Low
5.	Rice-Rice-Peanuts	0,28	Currently

Based on the results of the N-Total analysis at the research location (Table 5.3), the average value of rice-rice-rice rotation was 0.296% (Medium), rice-rice-corn 0.096% (Very Low), rice-rice-chili rotation 0.159% (Low), rice-rice-soybean rotation 0.147% (Low), rice-rice-peanut rotation 0.28% (Medium). The low levels of N-total in several rotations, such as in the rice-rice-corn and rice-rice-chili rotations, can be caused by low organic matter content, minimal nitrogen fertilizer input, and high nitrogen leaching rates in coarse-textured Regosol soils.

4. Phosphorus Pentoxide (P_2O_5) Content

Table 5.4 P_2O_5 Levels of Paddy Fields in Various Types of Crop Rotation in Sumberharjo Village

No	Type Rotation	P_2O_5 (mg/100g)	PPT Value (1995)
1.	Rice-Rice-Rice	3,229	Very Low
2.	Rice-Rice-Corn	2,911	Very Low
3.	Rice-Rice-Chili	1,414	Very Low
4.	Rice-Rice-Soybean	3,646	Very Low
5.	Rice-Rice-Peanuts	3,573	Very Low

Based on the results of the P_2O_5 analysis at the research location (Table 5.4), the average value of rice-rice-rice rotation was 3.229 mg/100g, rice-rice-corn 2.911 mg/100g, rice-rice-chili rotation 1.414 mg/100g, rice-rice-soybean rotation 3.646 mg/100g, rice-rice-peanut rotation 3.573 mg/100g with very low values for all. This is due to the condition of the Regosol soil in the research area which naturally has limitations in providing phosphorus available to plants. The average value of rice-rice-chili is only 1.414 mg/100g, indicating that this rotation is the worst in maintaining or increasing the availability of P_2O_5. This is due to the high level of phosphorus absorption by chili plants and the lack of appropriate addition of organic matter or P fertilizer.

5. Potassium Oxide (K_2O) Content

Table 5.5 K_2O Levels in Paddy Fields in Various Types of Crop Rotation in Sumberharjo Village

No	Type Rotation	K_2O (mg/100g)	PPT Value (1995)
1.	Rice-Rice-Rice	3,658	Very Low
2.	Rice-Rice-Corn	10,268	Low
3.	Rice-Rice-Chili	6,403	Very Low
4.	Rice-Rice-Soybean	14,351	Low
5.	Rice-Rice-Peanuts	2,298	Very Low

Based on the results of K2O analysis at the research location (Table 5.5), the average value of rice-rice-rice rotation was 3.658 mg/100g (Very Low), rice-rice-corn 10.268 mg/100g (Low), rice-rice-chili rotation 6.403 mg/100g (Very Low), rice-rice-soybean rotation 14.351 mg/100g (Low), rice-rice-peanut rotation 2.298 mg/100g (Very Low). This is because at the time of sampling, the plants had passed the growth phase. Potassium is absorbed by plants in the vegetative phase as much as 85% and 15% in the generative phase (Setianingsih, 2017).

6. Cation Exchange Capacity (CEC)

Table 5.6 Cation Exchange Capacity (CEC) Values of Paddy Fields in Various Types of Crop Rotation in Sumberharjo Village

No	Type Rotation	CEC (cmol(+)/kg)	PPT Value (1995)
1.	Rice-Rice-Rice	6,122	Low
2.	Rice-Rice-Corn	7,992	Low
3.	Rice-Rice-Chili	18,319	Medium
4.	Rice-Rice-Soybean	18,021	Medium
5.	Rice-Rice-Peanuts	4,509	Very Low

Based on the results of the Cation Exchange Capacity (CEC) analysis at the research location (Table 5.6), the average value of rice-rice-rice rotation was 6.122 cmol(+)/kg (Low), rice-rice-corn 7.992 cmol(+)/kg (Low), rice-rice-chili rotation 18.319 cmol(+)/kg (Medium), rice-rice-soybean rotation 18.021 cmol(+)/kg (Medium), rice-rice-peanut rotation 4.509 cmol(+)/kg (Very Low). The Cation Exchange Capacity (CEC) in the rice-rice-peanut rotation is classified as very low because the pH is relatively acidic and the clay content at the location is less than 15% which is classified as loamy sand texture (appendix 5). If the soil pH is below neutral, the soil KPK will decrease and conversely, if the pH is above neutral, the soil KPK value will be high (Utomo, 2015).

7. Base Saturation (BSA)

Table 5.7 Base Saturation Value (KB) of Paddy Fields in Various Types of Crop Rotation in Sumberharjo Village

No	Type Rotation	Base Saturation (%)	PPT Value (1995)
1.	Rice-Rice-Rice	29,579	Low
2.	Rice-Rice-Corn	30,171	Low
3.	Rice-Rice-Chili	18,305	Very Low
4.	Rice-Rice-Soybean	22,703	Low
5.	Rice-Rice-Peanuts	32,764	Low

Based on the results of the Base Saturation (KB) analysis at the research location (Table 5.7), the average value of rice-rice-rice rotation was 29.579 (Low), rice-rice-corn 30.171 (Low), rice-rice-chili rotation 18.305 (Very Low), rice-rice-soybean rotation 22.703 (Low), rice-rice-peanut rotation 32.764 (Low). Base Saturation (KB) in the rice-rice-chili rotation is classified as very low due to the slope factor in this rotation, so that nutrients easily escape when it rains. This is in line with the statement of Pinatih et al., (2015) that land slope also has a major influence on the loss of bases in the soil.

8. Soil Fertility Status Evaluation

Results of the evaluation of the status of rice field fertility in Sumberharjo Village (Table 5.8).

Table 5.8 Results of the Evaluation of the Status of Rice Field Fertility in Sumberharjo Village

No	Type Rotation	CEC (cmol (+)/kg)	KB (%)	P_2O_5 (mg/ 100 g)	K_2O (mg/ 100 g)	C-Organic (%)	Fertility Status
1.	Rice-Rice-Rice	L	L	VL	VL	L	Low
2.	Rice-Rice-Corn	L	L	VL	L	VL	Low
3.	Rice-Rice-Chili	M	VL	VL	VL	VL	Low
4.	Rice-Rice-Soybean	M	L	VL	L	L	Low
5.	Rice-Rice-Peanuts	VL	L	VL	VL	VL	Very Low

Description: VL: Very Low, L: Low.

The results of the study of soil fertility status based on the 1995 PPT soil fertility status determination criteria obtained two classes, namely low and very low. The rotation of rice-rice-rice, rice-rice-corn, and rice-rice-soybean showed low fertility status, with general characteristics of KPK and KB being classified as low (R), but the content of P_2O_5 and K_2O available being classified as very low (SR). This shows that although the soil still has the ability to retain and provide cations, the availability of essential macronutrients such as P and K is still very limited. In the rotation of rice-rice-soybean, the C-organic value is classified as low, possibly because the contribution of organic matter from legume plants is not enough to improve soil properties as a whole.

CONCLUSION

1. Soil fertility status in all crop rotations is low to very low, with soil pH ranging from acidic to slightly acidic.

2. The worst soil fertility status is found in the rice-rice-peanut rotation, which is dominated by the very low class, while other rotations are generally included in the low class according to the 1995 PPT criteria.
3. The nutrients that are generally limiting are organic C, P_2O_5, K_2O, and KPK, which are mostly found in the very low category.

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