

# Soil Fertility Index of Organic, Semi-Organic, and Conventional Rice Fields on 3 Different Soil Types

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## ABSTRACT

The nature and characteristics of soil formed in rice fields affect the fertility status of soil on rice fields. In Indonesia, there are three management systems, namely organic, semi-organic and conventional. The research aims to determine the fertility index of rice fields with different management systems on several soil types (Vertisol, Ultisol, Inceptisol). The soil parameters analyzed to determine soil fertility index were pH H<sub>2</sub>O, total nitrogen, available-P, available-K, exchangeable-Ca, exchangeable-Mg, Soil Organic Carbon (SOC), exchangeable-Al, Cation Exchange Capacity (CEC), Base Saturation (BS). The soil fertility index is determined based on an indicator of selected chemical properties called the Minimum Soil Fertility Index (MSFI), Pearson's Correlation Analysis, and Principal Component Analysis (PCA). The result showed that the fertility index value of rice fields from 3 types of soil ranged from 0.46 to 0.57. Rice fields on Vertisol have the highest soil fertility index value ranging from 0.52 - 0.57. Rice field with conventional management on Inceptisol has the lowest soil fertility index value of 0.46. Rice field with organic management on Vertisol is the most ideal rice field management system with a soil fertility index value of 0.57.

## Introduction

Rice fields in Indonesia are managed organically, semi-organically, conventionally. The continuous use of inorganic fertilizers can cause a decrease in the content of organic matter and nutrient density in the soil that affects the production of rice crops (1). The nature and characteristics of soil formed in rice fields affect the fertility status of soil on rice fields. Decreased soil fertility can be a significant factor that affects decreased soil productivity. The importance of soil fertility factors in productivity, the soil fertility in an area needs to be evaluated to assess whether the soil still contains optimum nutrients for plants (2). Soil fertility is set using the soil fertility index, based on the assessment, which can provide information on soil nutrient distribution and identify the main limiting factors to agricultural production (3). The research focus on this study is to know the value of soil fertility index and management recommendations based on determining different soil types.

## Location and Method

The research location is on the soil types Ultisol, Inceptisol, and Vertisol with organically, semi-organically, and conventional management. The sample point is the location that has just been harvested.

Soil sampling is done by composite technique at a depth of 0-30 cm. Each soil type (Ultisol, Vertisol, Inceptisol) is represented by three management systems (organic, conventional, and semi-organic) with three replays. The samples to be taken in total there are 27 samples.



Soil fertility index is analyzed with the first step, which is to choose soil fertility indicator or Minimum Soil Fertility Index (MSFI) through Pearson's Correlation Analysis then continued with Principal Component Analysis (PCA) (4).



MSFI is classified into fertility index classes based on (5). Soil Fertility Index calculation is calculated by summing the division result of the sum of weights by the number of MSFI indicators, such as the formula used by (4).

$$SFI = (\text{Sci}/N) \times 10$$

Note: Sci is MSFI weight amount; N is the number of MSFI used.

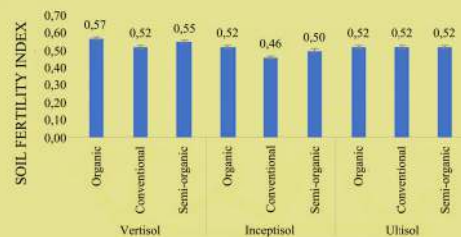


figure 1. Soil Fertility Index Result



Statement by (6) that the use of organic fertilizer or the addition of organic matter continuously can increase soil fertility value, and this is following the result of the calculation of SFI that has been done where all organically managed soils have a better SFI value than conventionally managed.

## Conclusion

- 1) Rice field with organic management have a higher soil fertility index value than other management with an SFI value of 0.57 on Vertisol, 0.52 on Ultisol, and 0.52 on Inceptisol.
- 2) Rice fields on Inceptisol with conventionally managed system have the lowest Soil Fertility Index value of 0.46.
- 3) The addition of organic matter can improve the value of Soil Fertility Index (SFI) of rice field.

## Result and Analysis

Table 1. Pearson's Correlation Analysis

	pH	SOC	T-N	A-P	A-K	Exch-Ca	Exch-Mg	Exch-Al	CEC
SOC	0,73*								
T-N	0,089	0,635*							
A-P	0,844*	0,917*	0,465						
A-K	0,728*	0,771*	0,366	0,765*					
Exch-Ca	0,692*	0,487	0,049	0,637*	0,667*				
Exch-Mg	0,785*	0,291	-0,407	0,539	0,419	0,722*			
Exch-Al	-0,475	-0,11	0,015	-0,316	-0,185	-0,435	-0,483		
CEC	0,856*	0,783*	0,332	0,866*	0,847*	0,867*	0,641*	-0,353	
BS	0,74*	0,295	-0,389	0,512	0,45	0,787*	0,941*	-0,503	0,614*

Note: (SOC) Soil Organic Carbon, (T-N) Total Nitrogen, (A-P) Available-P, (A-K) Available-K, (Exch-Ca) exchangeable-Ca, (Exch-Mg) exchangeable-Mg, (Exch-Al) exchangeable-Al, (CEC) Cation Exchange Capacity, (BS) Base Saturation, (\*) significant correlation at level 0.05

Table 2. Principal Component Analysis

Eigenvalue	6,0713	2,2372
Proportion	0,607	0,224
Cumulative	0,607	0,831
Variable	PC1	PC2
pH	0,38	-0,047
Soil Organic Carbon	0,315	0,377
Total Nitrogen	0,083	0,61
Available-P	0,365	0,213
Available-K	0,335	0,206
Exch-Ca	0,348	-0,128
Exch-Mg	0,312	-0,395
Exch-Al	-0,195	0,238
CEC	0,387	0,101
BS	0,312	-0,395

Five indicators are selected as MSFI, Soil Organic Carbon (SOC), Total Nitrogen, Available-K, Exch-Ca, Cation Exchange Capacity (CEC)..  
 Rice fields with organically managed system have a higher SFI value than semi-organic and conventional managed.  
 Rice fields on Vertisol with organic management have the highest SFI value of 0.57, which is classified as moderate.  
 The highest SFI value is the Vertisol soils with organic management using 2 ton/ha of manure, Local Microorganism Solutions (LMS) 5 L/ha, Liquid Organic Fertilizer (LOF) 15 L/ha.

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