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Analysis of Soil Quality Index on Agricultural Land Potato (*Solanum tuberosum* L.) in Tosari Pasuruan

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Abstract

Most Indonesians work in the agricultural sector, making Indonesia included in the category of an agricultural country. Agriculture has an important role in the welfare of the Indonesian population because natural conditions suitable for farming increase the quality and quantity of agricultural products. This research aims to determine the soil quality index of andisol on potato (*Solanum tuberosum* L.) agricultural land in Tosari sub-district, Pasuruan district, East Java. The research was carried out in Tosari sub-district, Pasuruan district at an altitude of 1700 meters above sea level. In September 2023 – January 2024. This research uses a random purposive sampling method for taking soil samples. Next, it was analyzed in the laboratory for texture, volume weight, porosity, C-organic, pH, P-available, K-exchangeable and root depth was measured. The soil quality index is calculated using the criteria of Mausbach and Seybold (1998), which can be adjusted to field conditions using the Minimum Data Set (MDS). Based on the research results, it was found that the Soil Quality Index (SQI) of potato fields in Tosari sub-district has two criteria, namely medium and good criteria. Ledoksari Village, Kandangan Village, and Podokoyo Village are classified as Good (G) while Ngawidono Village and Mororejo Village are classified as Medium (M).

Keywords: soil quality index, potato, andisol soil, random purposive sampling

1. Introduction

Most Indonesians work in the agricultural sector, making Indonesia included in the category of an agricultural country. Agriculture has an important role in the welfare of the Indonesian population because natural conditions suitable for farming increase the quality and quantity of agricultural products [1]. Apart from that, natural conditions also increase the quantity of agricultural production.

The Indonesian population is very familiar with the methods and practices of cultivating plants, one of which is food crops. All types of plants that contain carbohydrates and proteins that can be eaten by Indonesian people are called food plants. One example of a food crop that we often see is potatoes Potato (*Solanum tuberosum* L.) is a horticultural crop whose tubers are consumed. In society, potato tubers are called tuber vegetables. Because they contain lots of carbohydrates, potatoes are known as a food that can replace other foods [2].

One of the sectors that has the most influence on the economy in Pasuruan village, East Java is the agricultural sector. To be more precise, Tosari District is one of the areas in Pasuruan Regency which is a potential area for food crops, especially potatoes. . The increase in potato productivity in Pasuruan Regency in 2018 has exceeded the target set by the Pasuruan Regency Agricultural Service. According to the data received, the productivity of potatoes which are rich in carbohydrates reached 378.77 kw.ha^{-1}. Compared to the previous year's realization which reached 286.65 kw.ha^{-1} in 2017, there was a significant increase of 32.14% [3]. Genetic factors and environmental factors influence plant productivity. Environmental factors consist of climate and soil at the planting location. Genetic

factors come from plant seeds. Good soil conditions will produce healthy and high quality plants [4]. It is very important to know the right quality of soil for planting media because soil properties, including chemical, physical and biological properties, indicate that soil quality can increase or decrease. This difference can be caused by the type of soil and land processing techniques used in each village [5]. The physical, chemical and biological properties of soil are greatly influenced by the quality of soil that is well managed [6].

Wrong use of land by farmers can cause the physical and chemical properties of the soil to change, causing land damage and not being able to maintain its productivity in the future. This is in accordance with the opinion of [7] that soil properties such as water content, soil pH, dissolved nutrient levels, and field respiration are very easily influenced by irrigation, weathering, cultivation, liming, and fertilization. According to the explanation above, the aim of the research is to identify requirements related to increasing potato productivity as well as soil quality index. The aim of this research is to produce recommendations on how to improve the soil.

2. Material and Methods

This research was carried out in September – December 2023 through 2 stages, namely observations in the field and further analysis in the laboratory. This observation was carried out on potato (*Solanum tuberosum* L.) agricultural land in Tosari District, Pasuruan Regency, with an altitude of ± 1400 meters above sea level. Laboratory analysis activities were carried out at the Soil Laboratory - East Java Agricultural Instrument Standards Implementation Center. Using tools such as a soil drill, spatula, hoe, tape measure, pH meter, 0.3 mm thick plastic, writing instruments, rubber nipples, 0.5 mm passing sieve, Global Positioning System (GPS) and documentation tools. The materials used are tap water and soil samples that will be tested in the laboratory.

Soil chemical and physical properties are used to determine soil quality. The survey was then followed by interviews with potato land owners regarding land management procedures, including the commodities chosen for planting and maintenance such as fertilization and irrigation. Based on surveys and interviews, soil samples were taken from five villages. Four points were taken from each village as treatment, and each point was used as a replication to reduce the resulting standard error. The research used a survey method for the quality of potato planting land in Tosari District by taking soil samples at each predetermined sample location using a purposive random sampling method with twenty samples of soil samples. Analysis of the chemical properties of the soil was carried out using the analytical method used as in Table 1.

Table 1.
Physical and Chemical Characteristics of Soil

No.	Soil Chemical Characteristics	Unit	Analysis Method
1.	Texture (3 fractions; dust, clay and sand)	%	Pipette
2.	Bulk density	$g.cm^{-3}$	Gravimetrik
3.	Porosity	%	Total Saturation
4.	pH H_2O	-	pH meter (elektrometrik)
5.	C-organic	%	Walkley and Black
6.	Total N	%	Kjeldahl
7.	P-available	ppm	Bray 1 & Olsen
8.	K-exchangeable	$cmol.kg^{-1}$	Extraction HCl 25%
9.	Depth root	cm	Drill mineral soil

Source: Partoyo, 2005

The soil quality index is calculated based on the physical and chemical property data above. [8] criteria are used to calculate this index, which can be adjusted to field conditions using Minimum Data Set (MDS) analysis. Changes made to several things, namely:

1. The percentage of dust + clay is an indicator of stone stability. This percentage really determines the stability of the aggregate, which can affect the filter, support and soil moisture.
2. Organic C is easier to measure, the total C indicator can be used as a substitute.
3. According to the results of measuring parameters in the field, the upper and lower limits of some soil indicators were changed.

The index calculation process is carried out as follows:

a. Multiplying the soil function weight (weight 1) by the weight of the rooting medium (weight 2) and the weight of the rooting depth (weight 3) to produce a weight index. For example, the porosity weight index is obtained by multiplying 0.40 (weight 1) by 0.33 (weight 2) by 0.60 (weight 3), and the result is 0.080.
b. To calculate the score, observation data from the scoring function and soil indicators are compared. Linear equations or interpolation according to a defined range can be used to determine a score based on the score or data collected. Negative scores range from 0 to 1. According to [9], the Linear Scoring Function (FSL) is:

$$(Y) = (x - x_2)/(x_1 - x_2) \quad (1)$$

$$(Y) = 1- (x - x_2)/(x_1 - x_2) \quad (2)$$

Y is a linear score, x is the value of soil properties, x_2 is the upper limit value and x_1 is the lower limit value.

Table 2.
Modification of Indicators, Weights and Assessment Function Limits

Soil function	Weight	Soil indicator	Unit	Weight	Weight	Weight index	Valuation function			
							Lower limit		Upper limit	
	1			2	3	(1x2x3)	x_1	y_1	x_2	y_2
Preserving Biological Activity	0,4	Rooting Media		0,33						
		Depth Root	cm		0,6	0,080	20	0	80	1
		Bulk density	$g.cm^{-3}$		0,4	0,053	0,6	0	1,4	1
		B. Humidity		0,33						
		Porosity	%		0,2	0,027	10	0	55	1
		C-organic	%		0,4	0,053	0,6	0	2	1
		Dust+clay	%		0,4	0,053	0	0	100	1
		C. Nutrient		0,33						
		pH-soil			0,1	0,013	4	0	8,2	1
		P-available	ppm		0,2	0,027	4	0	10	1
		K-exchangeable	$cmol.kg^{-1}$		0,2	0,027	0,05	0	1	1
		C-organic	%		0,3	0,040	0,6	0	2	1
		Total N	%		0,2	0,027	0,15	0	2,5	1
Water regulation and distribution	0,3	Dust+clay	%	0,6		0,18	0	0	100	1
		Porosity	%	0,2		0,06	10	0	55	1
		Bulk density	$g\ cm^{-1}$	0,2		0,06	0,6	0	1,4	1
Filters and buffers	0,3	Dust+clay	%	0,6		0,18	0	0	100	1
		Porosity	%	0,1		0,03	10	0	55	1
		Microbiological processes	%	0,3						
		C-organic	%		0,5	0,045	0,6	0	2	1
		Total N	%		0,5	0,045	0,15	0	2,5	1
		Total				1,00				

Source: Mausbach & Seybold in Partoyo (2005)

c. The Soil Quality Index (SQI) is created by multiplying the score indicator and the weight index. This is done by using the soil quality index equation to assess soil quality [10], namely:

$$SQI = \sum_{t=1}^{n} Wi \; x \; Si \quad (3)$$

Research data was analyzed using analysis of variance (ANOVA) at the 5% level. If there is a significant effect, Duncan's Multiple Range Test (DMRT) is carried out at the 5% level. Data analysis was assisted by IBM SPSS Statistics Version 25 software.

3. Results and Discussion

3.1 The Influence of Planting Patterns on Soil Physical Properties

The physical properties of the soil will determine the soil's ability to obtain optimal results. The results of analysis of variance showed that the dust and clay content and soil specific gravity of the five types of soil were significantly different. The results showed that potato cultivation in five villages had a significant effect on dust and clay content, as well as bulk weight; However, it has no effect on root depth, specific gravity, or soil porosity (Table 3). The coordinate points for each soil sampling location from the five villages are as follows (1) Ledoksari village (7˚53'29,292"S - 112 ˚ 54'8,454"E); (2) Ngawidono village (7˚53'43,626"S - 112 ˚ 54' 4,458"E); (3) Mororejo village (7˚54'59,958"S - 112 ˚ 53' 13,326"E); (4) Kandangan village (7˚54'54,321"S - 112 ˚ 53' 58,542"E); and (5) Podokoyo village (7˚54'34,656"S - 112 ˚ 54' 12,144"E).

Table 3.
Average Soil Physical Properties in Potato Fields

Fields	Rate (%)			DC	DR	BD	PD	n
	Sand	Dust	Clay		(cm)	(g/cm3)	(g/cm3)	(%)
L	33,25 ab	21,75 a	32,25 ab	54,00 ab	45,36 a	0,77 a	2,18 a	63,69 a
N	53,75 a	24,25 a	24,25 ab	48,50 b	45,93 a	0,68 ab	2,11 a	67,86 a
M	44,00 ab	43,00 a	26,25 ab	69,25 ab	43,36 a	0,70 ab	1,51 a	51,46 a
K	12,25 b	51,50 a	35,75 a	87,25 a	42,33 a	0,67 ab	2,04 a	64,28 a
P	39,75 ab	63,00 a	19,25 b	82,25 ab	45,8 a	0,66 b	1,58 a	57,09 a

Note: The means in a column followed by the same letter indicate that they are not significantly different according to the 5% DMRT test; L =Ledoksari; N =Ngawidono; M =Mororejo; K=Kandangan; P=Podokoyo; DC= dust+clay; DR= depth root; BD= bulk density; PD= particle density; n=porosity

Soil texture in five villages, namely Ledoksari, Ngawidono, Mororejo, Kandangan and Podokoyo villages. The sand fraction in Ledoksari Village is 33.25%, dust 21.75%, and clay 32.25% belonging to the loamy clay texture, in Ngawidono Village sand 53.75%, dust 24.25%, and clay 24.25% classified as a sandy clay loam soil texture, in Mororejo Village 44.00% sand, 43.00% dust, and 26.25% clay can be said to have a dusty clay texture, in Kandangan Village 12.25% sand, 51.50% dust, and 35.75% clay is a sandy clay texture, and finally in Podokoyo Village 39.75% sand, 63.00% dust, and 19.25% clay are classified as a clayey clay texture. Those that are dominant in dust will have lots of medium pores (rather poreus) [11].

The root depth is around 50 – 70 cm because it is andisol soil. Several studies have stated that andisol has a root depth of around 100 cm [12][13]. From the five villages, all root depth values are almost the same, starting from Ngawidono Village with the highest value of 45.93 cm, Podokoyo 45.80 cm, Ledoksari 45.36 cm, Mororejo 43.36 cm, and the lowest root depth value 42.33 cm which is in Kandangan Village. The effective depth value of the slope tends to decrease along with the slope of the slope. According to [14] land with a low slope experiences a slower erosion process than land with a medium slope, and soil particles are deposited from the upper slope, causing the depth of soil

solubility to increase. According to [15] the effective rooting depth usually follows the depth of soil solubility because roots form in the A and B horizons. Roots also do not form in environments with mechanical obstacles such as bulk soil or rocks. Bulk density is the ratio of soil mass to the volume of soil pores.

From the test results, the highest density was in Ledoksari Village with a value of 0.77 g.cm-3 and the lowest value was in Podokoyo Village with a value of 0.66 g.cm-3. A low unit weight value indicates that the soil has incompressible (loose) soil. Soil that has a low volume weight produces high soil micro pore space [16] Soil specific gravity indicates the total density of solid particles. From the results obtained, the highest value for specific gravity was in Ledoksari Village with a value of 2.18 g.cm-3 and the lowest value was in Mororejo Village with a value of 1.51 g.cm-3. The highest Porosity value is in Ngawidono Village with a value of 67.86% and the lowest value is in Mororejo Village with a value of 51.46%. The porosity value can be obtained from calculating the bulk density and particle density values, so the denser the soil, the higher the bulk density, which means it is more difficult for air to pass through or for plant roots to penetrate. Particle density is important in determining sedimentation rates and particle movement by air and wind. Soil porosity is also important because it is a reflection of soil aeration and drainage as well as the quality of the structure in the soil.

3.1 The Influence of Planting Patterns on Soil Chemical Properties

The total chemical reaction between soil particles and added materials, such as fertilizer or other soil amendments, is known as soil chemistry. In general, reactions that occur in the soil are influenced by certain activities and environmental factors [17]. The results of variance analysis showed that there was a significant influence on pH and K-exchangeable in potato fields. Meanwhile, Total N, P-available, and C-organic showed no significant influence (Table 4).

Table 4. Average Soil Chemical Properties in Potato Fields

Fields	pH-soil	Criteria	Total N (%)	Criteria	P-available (ppm)	Criteria	K-exchangeable (ppm)	Criteria	C-organic (%)	Criteria
L	6,85 a	Netral	0,25 a	Medium	12,02 a	Medium	1,26 a	Very high	1,92 a	Low
N	6,73 ab	Netral	0,21 a	Medium	12,36 a	Medium	1,08 a	Very high	1,55 a	Low
M	6,63 abc	Netral	0,19 a	Low	11,34 a	Medium	0,33 b	Low	1,44 a	Low
K	6,43 c	Slighty acid	0,25 a	Medium	11,49 a	Medium	0,68 ab	High	1,94 a	Low
P	6,50 bc	Slighty acid	0,26 a	Medium	11,77 a	Medium	1,19 a	Very high	1,84 a	Low

Note: The means in a column followed by the same letter indicate that they are not significantly different according to the 5% DMRT test; L =Ledoksari; N =Ngawidono; M =Mororejo; K=Kandangan; P=Podokoyo

Based on Table 4, the chemical properties of the soil with the highest pH are in Ledoksari Village with a value of 6.85, which is said to be neutral pH, while the lowest pH is in Kanangan Village with a value of 6.43, which is said to be non-acid pH. The acid pH is thought to be due to the influence of the parent material, climate and level of soil development. [18] stated that the acidity reaction of Andisol is related to the complex nature of allophanic clay minerals which have pH-dependent charges.

The highest total N was in Podokoyo Village with a value of 2.26% and the lowest total N value with a value of 0.19% was in Mororejo Village. The high total N value is due to the use of manure, urea and also NPK fertilizer. [19] stated that giving organic fertilizer and NPK independently has a real impact on the total amount of nitrogen in the soil, but giving BPF independently does not

have a real impact on the amount of nitrogen in the soil. P-available from the five villages, the highest value with a value of 12.36 ppm is in Ngawidono Village, a value of 12.02 ppm is in Ledoksari Village, a value of 11.77 ppm is in Podokoyo Village, a value of 11.49 ppm is in Kandangan Village , and the lowest value was in Mororejo Village with a value of 11.34 pm. Maximum P availability in the soil is in the pH range 6-7 [20].

K-exchange has the highest value in Ledoksari village with a value of 1.26 ppm and the lowest value in Mororejo village with a value of 0.33 ppm. This difference in value is due to differences in fertilizer provision in each village. In Ledoksari village, NPK 16:16:16 fertilizer, Meroke KKB and urea are used.

C-organic with the highest value was in Kandangan village with a value of 1.94% and the lowest value was in Mororejo village with a value of 1.44%. There is no significant difference in the P-available and C-organic elements in the villages of Ledoksari, Ngawidono, Mororejo, Kandangan and Podokoyo because the fertilizer treatment tends to be the same in these villages. The high C-organic content is caused by the nature of Andisol itself which contains a lot of amorphous clay minerals. According to [21] the presence of amorphous clay minerals that form complex compounds with organic materials stabilizes organic materials against the decomposition process, which allows them to maintain high organic material content over long periods of time. This is known as a bed of organic matter.

3.2 Calculation of SQI Preserving Biological Activity

Soil biological properties refer to the activities of living organisms in the soil and on its surface. In the soil, various kinds of living creatures grow, including animals, plants and large (macro) and small (micro) living creatures.

Table 5.
Calculation results of Soil Quality Index to Preserve Biological Activity in Potatoes Based on Soil Function

Assessment Indicators	Soil Quality Index (SQI)				
	Ledoksari	Ngawidono	Mororejo	Kandangan	Podokoyo
A. Rooting Media					
Root depth	0,048	0,053	0,048	0,055	0,055
Bulk density	0,012	0,005	0,006	0,005	0,004
B. Humidity					
Porosity	0,031	0,034	0,024	0,032	0,027
C - Organic	0,049	0,035	0,031	0,050	0,046
Dust+clay	0,028	0,0281	0,036	0,046	0,043
C. Nutrient					
pH	0,009	0,008	0,008	0,007	0,007
P- available	0,035	0,036	0,032	0,032	0,034
K- exchangeable	0,033	0,028	0,007	0,017	0,031
C- organic	0,049	0,035	0,031	0,050	0,046
Total N	0,002	0,001	0,001	0,001	0,002
Total	0,299	0,266	0,227	0,298	0,298

Source: Analysis of weight and score calculation results

Soil has several indicators of biological activity, such as rooting medium, moisture, and nutrients. Table 5 shows that the highest SQI based on maintaining soil biological activity is in Ledoksari Village with a value of 0.299, Kandangan and Podokoyo Villages have the same value of 0.298, Ngawidono with a value of 0.266, and the lowest SQI is in Mororejo Village with a value of 0.227. Based on Partoyo's soil quality index classification, the soil quality index of the five villages is classified as low.

3.2 Calculation of SQI Water Regulation and Distribution

Soil can be used for air regulation and distribution due to factors such as the percentage of dust and clay, porosity, and soil volume weight. Instead, soil must be supported by factors such as porosity, organic matter, percentage of silt and clay, and organic C in order to function as a buffer. Data generated from calculating the soil quality index is obtained by multiplying the soil weight index value by the indicator value score obtained from the regression coefficient.

Table 6.
Calculation Results of Soil Quality Index Based on Soil Function as Regulation and Distribution of Water in Potatoes

Assessment Indicators	Soil Quality Index (SQI)				
	Ledoksari	Ngawidono	Mororejo	Kandangan	Podokoyo
Dust+clay	0,097	0,095	0,124	0,157	0,148
Porosity	0,031	0,033	0,024	0,031	0,027
Bulk density	0,011	0,010	0,008	0,010	0,011
Total	0,140	0,140	0,157	0,199	0,187

Source: Analysis of the results of weight and score calculations

With the percentage of dust and clay, total porosity, and bulk density, soil functions as a place for regulating and channeling air. Table 6 shows the results of SQI calculations based on soil function for air regulation and distribution. The results of the analysis of general indicators for evaluating air regulation and distribution in various land uses do not show significant differences. Table 6 shows that the highest SQI is in Kandangan Village with a value of 0.199 and the highest SQI value is in Ledoksari and Ngawidono Villages with a value of 0.140. [22], the dust + clay fraction is a soil texture that is related to soil composition as a proportion of particles in the soil mass. Soil porosity is a term that refers to the space that exists in parts of soil particles, which consist of different ratios of air and air [23]. Penetration speed is greatly influenced by the structure, texture and weight of the content. Coarse soils have a higher infiltration rate than clay soils, making the infiltration capacity of sandy soils much higher [24]. The physical properties of the soil determine how much air can flow into the soil pores.

3.3 Calculation of SQI Filters and Buffers

The function of soil as a filter and buffer is a combination of several soil physical and chemical indicators. Soil physics include dust+clay and porosity while soil chemistry includes C-organic and total nitrogen soil.

Table 7.
Calculation Results of Soil Quality Index Based on Soil's Function as a Filter and Buffer for Potatoes

Assessment Indicators	Soil Quality Index (SQI)				
	Ledoksari	Ngawidono	Mororejo	Kandangan	Podokoyo
Dust + clay	0,097	0,095	0,124	0,157	0,148
Porosity	0,031	0,034	0,024	0,032	0,027
Microbiological Processes					
C-organic	0,042	0,030	0,026	0,043	0,039
Total N	0,002	0,002	0,001	0,002	0,003
Total	0,173	0,161	0,176	0,233	0,217

Source: Analysis of the results of weight and score calculations

The SQI calculation is based on the soil's function as a filter and buffer, which is supported by the percentage of dust and clay, total porosity, organic C, total N, and soil respiration. It can be seen in Table 7. It shows that the highest value is in Kandangan Village with a value of 0.233 and the lowest SQI value with a value of 0.161 is in Ngawidono Village.

The role of porosity in regulating soil quality as a filter. [25] determined soil porosity parameters for the movement of water and air in the soil. Granular soil structure can provide sufficient porosity for infiltration. As a nutritional buffer, organic C and N work together. To find out how quickly soil microbes destroy organic matter in the soil and convert it into energy to produce the nutrients plants need. This is done by measuring the total concentration of organic C and N. To improve nutrition and increase CEC, the role of organic materials is very important. This increase in CEC in the soil can reduce the loss of nutrients added by fertilization, thereby increasing fertilization efficiency [26].

3.4 Calculation of Weights and Scores Based on Soil Function

The function and weight are soil quality indices obtained using the three formulas in the equation. The indicator scores are combined into a soil quality index, which is calculated by adding up the scores for each variable and then multiplying by the weight index [9]. Table 8. Results of analysis of weights and scores of research indicators based on soil function on Potato Fields.

Table 8.
Results of analysis of weights and scores of research indicators based on soil function on Potato Fields.

Soil function	Soil Quality Index (SQI)				
	Ledoksari	Ngawidono	Mororejo	Kandangan	Podokoyo
Preserving Biological Activity	0,299	0,266	0,227	0,298	0,298
Water Regulation and Distribution	0,140	0,140	0,157	0,199	0,187
Filters and Buffers	0,173	0,161	0,176	0,233	0,217
Total	0,612	0,568	0,561	0,731	0,703

Source: Results of weight and score calculations (processed)

3.5 Soil Quality Index Criteria in Several Potato Farming Lands

Using one of the Minimum Data Bases (MDS), the soil quality index quantifies the physical and chemical properties of the soil. Data were ranked into five criteria: very low, low, moderate, good, and very good. If the total value of the minimum data set is close to one, then the soil quality is considered better.

Table 9.
Soil quality criteria based on soil quality index (SQI) values

No.	Fields	SQI values	Criteria
1.	Ledoksari	0,612	Good (G)
2.	Ngawidono	0,568	Medium (M)
3.	Mororejo	0,561	Medium (M)
4.	Kandangan	0,731	Good (G)
5.	Podokoyo	0,703	Good (G)

Source: Results of weight and score calculations (processed)

To determine the criteria for the Soil Quality Index, the values of soil functions such as preserving biological activity, regulating and channeling air, filtering and buffering are added up. It can be seen from Table 9 that the Good (B) criteria with an SQI value of 0.60 – 0.79 are in Ledoksari Village (0.612), Kandangan Village (0.731), and Podokoyo Village (0.703). Those included in the Medium (S) criteria with a value of 0.40 – 0.59 are in Ngawidono Village (0.568) and Mororejo Village (0.561). Of the five villages that are included in the good criteria, there are three villages, namely Ledoksari Village, Kandangan Village, and Podoyoko Village. This is because the land processing is different in each village, the land processing carried out is the application of kohe, dolomite, and humic acid to during land processing or before planting.

Meanwhile, in Ngawidono Village and Mororejo Village, which are included in the medium criteria, there is no application of organic fertilizer, dolomite and humic acid during land processing. At the beginning of the survey, researchers suspected that the SQI value in potato fields was classified

as low - medium, meaning that if the same type of plant is planted throughout the year without crop rotation, the nutrients absorbed by the plant are reduced. This condition is made worse if there are no adequate conservation measures [27]. After further analysis the initial suspicion was rejected, the soil quality index value on the potato field showed the criteria were medium until good. Various steps can be taken to improve land management, one of which is using soil amendments such as microbial solubilizers of phosphorus (P) and potassium (K), which have an important role in accelerating the solubility process of sources of P and K nutrients that are difficult to dissolve [28].

4. Conclusion

Based on research results, it shows that there are differences in the soil quality index on potato fields in several villages in Tosari sub-district. Potato land in Tosari sub-district has two criteria, namely medium and good criteria. Ledoksari Village, Kandangan Village, and Podokoyo Village are classified as Good (B) while Ngawidono Village and Mororejo Village are classified as Medium (S).

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