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SOIL QUALITY INDEX RELATIONSHIP WITH RICE PRODUCTION IN SUKOHARJO REGENCY, CENTRAL JAVA, INDONESIA

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ABSTRACT

Climate change has an effect on the degradation of soil, water, growth and crop production. Soil degradation caused by various factors decrease in physical, chemical, and biological soil processes. The decrease in physical properties of the soil due to erosion, compaction, and fractures. The decrease in soil chemical properties is due to nutrient leaching, acidification, and salinization. The decrease of biological properties of the soil is due to the reduction of soil organic matter and diversity of soil biota. Climate change affect the diversity of organisms in the soil. Soil organisms requiring certain temperature conditions for its activities and the state of extreme dry, extreme wet, and increased soil temperature will affect the diversity of soil organisms. The use of fertilizers and organic materials can increase and balance the availability of nutrients needed by plants. The fertilizer can influence the soil fertility represented by a soil quality index. Soil quality is a measure to describe the condition of the soil based on three indicators of the physical, chemical and biological properties. The purpose of this research was to determine the relationship between soil quality with rice productivity in Sukoharjo, Central Java that will affect the climate change. The research was conducted in March-November 2015. The method in this research was a descriptive explorative by field surveying. The sampling method is purposive random sampling. Soil quality indices in eleven sites, Sukoharjo has medium and good (5.47 to 6.91) category. Soil quality indicators are the most influential on permeability, N-total, K-available, and soil organic matter. The regression Soil Quality Index with rice productivity is 17.7%. The relationship between Soil Quality Index against the highest rice yield soil Permeability hasa coefficient determination 43%. Eleven sites has medium-good soil quality and rice productivity with medium categories.

Keyword: Climate change, soil quality, rice productivity

1 INTRODUCTION

Climate change has an effect to food security, soil and crop productivity, health plants, plant pests and diseases, water availability, and environmental ecosystem. From the agricultural sector, activity expansion (extension) land agriculture especially when using forest land, land use peat for agriculture, paddy, fertilizer, and the practice of burning a contributor to

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greenhouse gasses (GHG) emissions. The increased of temperatures and soil moisture can accelerate decomposition of crop residues because microbial activity also increased. Too high or too low soil moisture will interfere root growth and nutrient availability. Various treatments conservation tillage can reduce soil drying speed and increasing infiltration thus reducing the risk of flooding. Erosion may lead to loss of nutrients required by plants to grow and develop optimally. Sudirman et al. (1986) stated that the loss of topsoil can cause decrease levels of organic matter, increasing soil compaction, decrease soil stability, increased the saturation of aluminum and a decrease in soil CEC. Increasingly frequent occurrences of erosion can reduce levels of organic material and nutrients in the soil. This can degrade the quality of the soil then reduce the productivity of the land.

Soil degradation is a critical and growing global problem. As the world population increases, pressure on soil also increases and the natural capital of soil faces continuing decline. International policy makers have recognized this and a range of initiatives to address it have emerged over recent years. The functioning soil is necessary for ecosystem service delivery, climate change abatement, food and fiber production and fresh water storage. Yet key policy instruments and initiatives for sustainable development have under-recognized the role of soil in addressing major challenges including food and water security, biodiversity loss, climate change, and energy sustainability. Soil security refers to the maintenance and improvement of the world’s soil resources so that they can continue to provide food, fiber, and fresh water, make major contributions to energy and climate sustainability, and help maintain biodiversity and the overall protection of ecosystem goods and services (Koch et al. 2012).

Rice is a major food crop for Indonesian citizens who have a fundamental role to meet their food needs. The main challenge to increase food production is the increasing demand for rice in accordance with the increase population (Sembiring 2015). Sukoharjo in Central Java, according to the Central Bureau Of Statistics(Central Bureau Of Statistics 2014) paddy crop production is fluctuating, in 2012 to 2013 occurred a decrease from 346.039 kg to 327.182 kg. Based on the productivity of paddy in Sukoharjo increased at 6.6 ton/ha in 2012 to 6.8 ton/ha in 2013, where as in 2014 the productivity of rice decreased to 6.34 tons/ha (Central Bureau of Statistics 2015).

Productivity of paddy in Sukoharjo Regency decreased one factor that may be due to declining soil fertility. One way to face that problem is improving soil fertility in Sukoharjo district. Soil fertility can be seen from SQI (Soil Quality Index) (Haefele et al. 2014).

Soil quality is an indicator that is based on the soil physical properties, soil chemical properties and biological properties of the soil (Karlen et al. 1996). Sukoharjo regency not yet knows about paddy soil quality in supporting increased productivity of rice. Therefore research is needed on the relationship between soil quality and productivity of paddy. The purpose of this study is to determine the quality of the soil in Sukoharjo with the productivity of paddy in Sukoharjo district. Research relations soil quality rice productivity also useful to know the causes of declining productivity of paddy in Sukoharjo, Central Java. Rice productivity will increase the availability and food security so that the realization of prosperity for farmers in Sukoharjo district.

2 MATERIALS AND METHODS

This study uses a descriptive exploratory study with a survey approach. The study was conducted in March-November 2015 in eleven sites of Sukoharjo regency by taking soil samples studied in Laboratory of soil physics, Laboratory of Soil Chemistry and Laboratory Soil Biology. Sampling was done by overlaying map precipitation (abuzadan.staff.uns.ac.id), land use, slope, elevation and soil types.

Analysis performed includes soil permeability, soil texture, pH, CEC, P-available, K-available, N-total, SOM, soil respiration and the number of colonies. Rice productivity data is secondary data obtained from Central Bureau Of Statistics.

Determination of soil quality using PCA on Minitab software, by choosing eigenvalue >1 as MDS (minimum data sets) (Andrews et al. 2002). Relationship quality of the soil and rice productivity can be determined by regression analysis. Regression analysis is an analysis that allows us to predict the values of a dependent variable of the values of one or more independent variables.Assessment of soil quality was based on soil quality was based on soil quality index described as follows:

$$SQI = \sum_{i=1}^{n\ Soil} Wi \times Si \quad (1)$$

Where SQI is soil quality index, Wi is the assigned weight of each indicator, Si is the indicator scores and n is the number of variables in the refined minimum data set (MDS).

3 RESULT AND DISCUSSIONS

3.1 Area condition

According to Central Bureau of Statistics data in 2014 Sukoharjo land use consists of a wetland at 44.60% (20.814 ha) and land instead of paddy amounted 55.40% (25.852 ha). Wetland in Sukoharjo district that has technical irrigation area of 14.751 ha (70.87%), semi-technical irrigated 2.161 ha (10.38%), simple irrigation 1.895 ha (9.10%) and rainfed area of 2.007 ha (9, 64%). Instead of paddy land in the land for housing, offices, schools, etc.

According to the table one research location has a height of 101.67 to 354 m above sea level it means that eleven samples are located in the lowlands. Lowland itself has a range of between 0-600 m above sea level, while in the middle latitudes ranging between 600 - 1,500 m above sea level, and from 1,500 to 2,500 m above sea level plateau. The rice plant itself is a plant that fits on the uplands and medium. According to the Research and Technology (2012) that rice plants can be grown in lowland area, with a pH of 4-7, at pH 8 which can also be due to the process of flooding inducing reduction on pH to neutral. The rice plant is a plant that requires direct full sun shines, without shade.

Table 1. Description of the siterural research in Sukoharjo, Central Java

No	Site	Residance	Slope	Elevation	Coordinate
1	Blimbing	Gatak	0-8	137.67	07º 35' 39.258" and 110º 44' 09.277"
2	Bakipandeyan	Baki	0-8	101.67	07º 36' 19.251" and 110º 47' 24.360"
3	Parangjoro	Grogol	0-8	115.3	07º 37' 36.190" and 110º 49' 01.290"
4	Kelurahan Dukuh	Sukoharjo	0-8	128.3	07º 40' 22.721" and 110º 47' 42.323"
5	Pundungrejo	Tawangsari	0-8	152.67	07º 45' 38.296" and 110º 48' 01.384"
6	Daleman	Nguter	0-8	129.3	07º 43' 53.275" and 110º 52' 00.000"
7	Desa Dukuh	Mojolaban	0-8	113.3	07º 36' 05.486" and 110º 52' 21.568"
8	Genengsari	Polokarto	8-15	162	07º 37' 36.779" and 110º 56' 51.090"
9	Cabeyan	Bendosari	0-8	206.3	07º 42' 40.379" and 110º 56' 08.436"
10	Plesan	Nguter	0-8	203	07º 43' 31.237" and 110º 53' 09.825"
11	Sanggang	Bulu	0-8	354	07º 47' 24.678" and 110º 48' 33.849"

3.2 Indicators of soil quality

Soil quality indicators analyzed the physical, chemical and biological properties of the soil in the eleven research sites. Based on table 2 permeability in eleven sites included in the category of extremely slow to moderate. Blimbing, Daleman Genengsari sites are very slow permeability because of the value <0.125. Permeability is very slow due to having the soil pores are small so that the water flows very slowly. Land which has large pores then its permeability quickly, it is because the water flows quickly (Dariah et al. 2006).

Based on Table 2 that the pH ranges from 5.4 to 7.2, in this case, it can be said that the eleven sites have a sour pH-neutral. pH ranges from 4.5 to 5.8 on mineral soils have much Al that can be exchanged then can interfere plant growth and low saturation. Land belonging to the acidic pH of Daleman and Plesan Site. pH 5.5-6.5 is slightly acidic soil of Blimbing, Bakipandeyan, Kel. Dukuh, Dukuh, Genengsari, Cabeyan, and Sanggang site including soil samples with a slightly sour category. Parangjoro siteand Pundungrejo site havea pH rangefrom 6.6 to 7.5 with neutral category according to Hardjowigeno (2003) including land with the base saturation of 100% and no Al can be exchanged. Sites that have the highest CEC is Pundungrejo, which can exchange cations 56.80 (cmol (+). Kg^{-1}). Soil samples which had the lowest CEC are the site Genengsari 20.00 (cmol (+). Kg^{-1}), so in this case more difficult for binding ions or colloids in the soil (Sulaiman et al. 2005).

Table 2. Results of Soil Analysis Properties in Sukoharjo

Site	Permeability (cm/hour)	pH	CEC (cmol(+). kg^{-1})	N-total (%)	P-available (ppm P)	K-available (cmol(+). kg^{-1})	SOM (%)	Respiration ($mgCO_2$ $m^{-2}hour^{-1}$)
Blimbing	0.027^{VS}	5.6^{Sa}	37.60^{H}	0.94^{VH}	16.51^{VH}	1.7^{VH}	0.14^{VL}	0.44^{H}
Bakipandeyan	2.492^{M}	6.3^{Sa}	43.20^{VH}	0.49^{M}	21.94^{VH}	1.7^{VH}	0.27^{VL}	0.68^{H}
Parangjoro	3.293^{M}	7.1^{N}	53.60^{VH}	0.92^{VH}	7.03^{L}	0.8^{H}	0.32^{VL}	0.61^{H}

Kel. Dukuh	4.177^{M}	5.8^{Sa}	35.20^{H}	1.13^{VH}	7.37^{L}	2.8^{VH}	0.29^{VL}	0.72^{H}
Pundungrejo	1.354^{SS}	7.2^{N}	56.80^{VH}	1.35^{VH}	7.89^{M}	2.9^{VH}	0.19^{VL}	0.23^{H}
Daleman	0.013^{VS}	5.4^{A}	49.20^{VH}	0.81^{VH}	7.55^{M}	1.4^{VH}	0.29^{VL}	0.72^{H}
Dukuh	0.712^{SS}	5.7^{Sa}	38.40^{H}	0.83^{VH}	8.32^{M}	0.9^{H}	0.21^{VL}	0.20^{H}
Genengsari	0.004^{VS}	5.8^{Sa}	20.00^{S}	0.80^{VH}	13.97^{H}	2.1^{VH}	0.18^{VL}	0.75^{H}
Cabeyan	2.689^{M}	5.7^{Sa}	49.60^{VH}	0.80^{VH}	14.75^{H}	1.4^{VH}	0.18^{VL}	0.12^{M}
Plesan	2.712^{M}	5.4^{A}	44.80^{VH}	1.26^{VH}	7.33^{L}	1.0^{H}	0.21^{VL}	0.50^{H}
Sanggang	2.836^{M}	5.9^{Sa}	30.40^{H}	0.74^{H}	28.41^{VH}	3.8^{VH}	0.13^{VL}	0.29^{H}

Description: VS = Very Slow, M = Medium, SS = Slightly Slow, Sa= Slightly acid, N = Neutral, A = Acid, H = High, VH = Very High, VL = Very Low, L=Low

Nitrogen itself is used as a component of plant proteins and chlorophyll; nitrogen deficiency when the plants will be pale due to inhibition of the formation of chlorophyll per-plant will be slow and stunted (Zahrah 2011). The value of N total of eleven samples is 0.49 to 1.35%. The highest value of total N in the site Pundungrejo, while the lowest N content is the site of Baki Pandeyan, where a low N content can also be caused due to water-logging process (Haefele et al. 2014).

P nutrient is a macro nutrient that plants need for increased production (Swanopoel et al. 2014). P-value provided the highest in the site Sanggang, while the lowest is Parangjorosite. Phosphorus plays an important role in the plant that is in the process of photosynthesis, respiration, transfer and energy storage, cell division and enlargement (Zhang et al. 2012). According to the table of K-available the lowest in Parangjoro, while the highest in Sanggang. According to the research that K is available in the soil is high because of the range of 0.6 to 1 cmol (+). Kg^{-1} and extremely high ranges> 1 cmol (+). Kg^{-1}.

The highest organic material are found at Parangjoro site, while the lowest is at Blimbing Site. Organic materials of eleven site is included in the category of very low at <2%. According to Karlen et al. (2003), soil organic matter is one indicator of soil quality. Soil organic matter can be lost as a result of diffusion and the mineralization process preventing the formation of new colonies or microorganisms (Ekschmitt et al. 2005).

The respiration rate is set on the ground level of CO_2 evolution. CO_2evolution generated by the decomposition of organic matter. Thus, the respiration rate is an indicator of the level of decomposition of organic matter that occurs at certain intervals. Respiration is the highest in the site Genengsari of 0.75 $mgCO_2m^{-2}h^{-1}$, while the lowest is the site Cabeyan with a value of 0.12 $mgCO_2m^{-2}h^{-1}$. The biological activity of soil respiration can be seen, one way to look at the evolution of soil respiration CO_2 (Elmholt 2008). Soil enzymes and biological indicators, for example, the evolution of CO_2 can be used as an evaluation of soil quality (Bananomi et al.2011).

3.3 Soil quality

Soil quality is measured by three indicators, namely physical, chemical and biological properties. The method used in determining the quality of the soil is the method of PCA (Principal Component Analysis).

3.3.1 PCA Method

Based on the analysis output indicates that eigenvalue> 1, that for the first main component (PC1), second (PC2), third (PC3), fourth (PC4). When accumulated four main components states 85.5% of the total variability. PCA obtained Minimum Data Set amounted to 4 variables influencing the soil quality is BO, permeability, total-N and K-are available.Each and every PC show the highest value and nearly equal, then show the correlation of these variables, if the p-value <0.05 then selected as minimum data sets and belong the value of the variable proportion. Table correlations are presented in Table 4.

Table 3. PCA Data Analysis

Eigenvalue	2.6361	1.7582	1.4239	1.0223
Proportion	0.330	0.220	0.178	0.128
Cumulative	0.330	0.549	0.727	0.855
Variable	PC1	PC2	PC3	PC4
Permeability	0.167	0.204	0.590	-0.027
pH	0.267	0.381	0.347	-0.141
CEC	0.456	0.281	-0.070	-0.421
N-total	0.302	0.392	-0.215	0.620
P-available	-0.516	0.066	0.315	-0.318
K-available	-0.320	0.351	0.399	0.415
OM	0.468	-0.358	0.333	-0.063
Respiration	0.120	-0.570	0.334	0.374

Source: Analysis of Data

Table 4. Corelation of Caracteristic Physic, Chemical and Biology

	Permeability	pH	CEC	N-total	P- available	K- available	OM
pH	0.257 0.446						
CEC	0.195 0.566	0.476 0.139					
N-total	0.133 0.696	0.229 0.498	0.323 0.332				
P-available	0.052 0.880	-0.119 0.727	-0.436 0.180	-0.636 0.035			
K-available	0.185 0.585	0.165 0.629	-0.353 0.287	0.094 0.783	0.514 0.106		
OM	0.348 0.294	0.230 0.496	0.395 0.530	-0.035 0.919	-0.527 0.096	-0.407 0.214	
Respiration	-0.010 0.977	-0.080 0.816	-0.280 0.405	-0.155 0.648	-0.155 0.648	-0.084 0.805	0.614 0.044

Information: -Pearson's corelation
- P value

3.3.2 Soil Quality Index

The value of each variable. namely Results of Soil Quality Index (SQI) = 0.33 S (organic matter) + 0.22 S (N-total) + 0.178 S (permeability) + 0.128 S (K -available). The total number of factors that affect the 0.856. Formula Final SQI = 0.386 S (organic material) +

0.257 S (N-total) + 0.208 S (permeability) + 0.149 S (K-available) (Chantu et al.. 2007 that have been modified).

Soil quality index value can be seen in Table 5. Based on Table 5 value normalization on Soil Quality Index is obtained by the comparison between the value SQI of the each site with the highest SQI value (5.000), in order to get the numbers 0-1. Furthermore, to facilitate the reading of soil quality class, SQI normalized value multiplied by 10 (Mukhopadhyay et al., 2014). SQI eleven sites in Sukoharjo research areas ranges from 0.547 to 0.691. Soil quality class ground in eleven sites of the study are moderate, and good. The soil quality is good according to Chantu et al. (2007) range (6.0 to 7.9), and the class is a quality soil with a range from 3.5 to 5.9.

The highest Soil Quality Index is Pundungrejo wich is entisols, has the characteristics according to Hardjowigeno (2003) is developing new land and a fertile soil. Entisols soil is soil suitable for agricultural land one of them is for rice crops. SQI Lowest value the Site Baki Pandeyan with a value of 0.547 (medium).

3.4 Relationship between soil quality and rice productivity

Soil quality is a tool to measure the status of the land related to soil fertility (Herrick 2000). In agricultural production, high or good soil quality may be associated with high production. In addition to the production of soil quality rice production is also associated with environmental degradation (Griffiths et al. 2010).

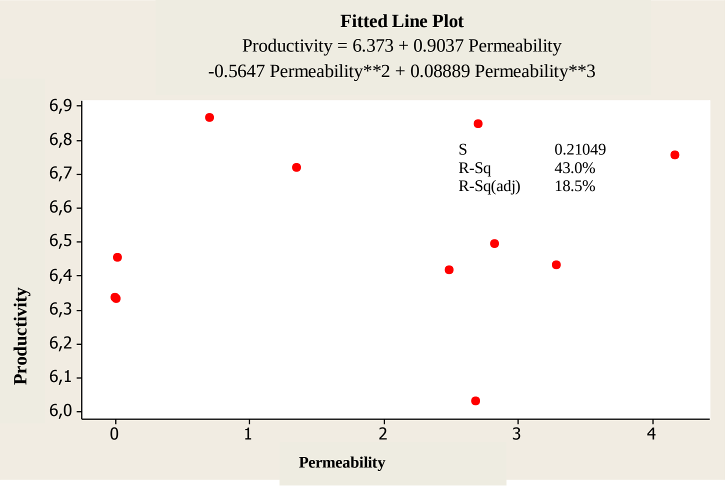


Figure 1. Graph of permeability relationship with Rice Productivity in Sukoharjo, Central Java

Permeability is used as one indicator of the level of soil drainage. Soil with permeability levels rather slowly suitable to be used as wetland (Dariah and Agus 2005). Based on the differences in soil permeability according Prihar et al. (1985) there are three types of fields, namely (1) brown paddy soilis paddy soil derived from good permeability soil, (2) a rice field in gray are paddy soil derived from soil permeability is slow, (3) a rice field of paddy Glei is ground the fields are derived from very slow permeability.

Values the regression variables based image 1 is y = 6.373 + permeability 0.9037 - 0.5647 permeability ^{2}+.088889 permeability^3, while the value of R^2 = 43.0%. The regression value means the ability permeability in explaining the productivity of rice is 43%, so there is a 57% paddy productivity is explained by other factors. Value determination included in sufficient category.

Based on the known image 2 cubic regression line between N-total land and rice productivity with R2 is 41.4%. The trend line shows the relationship between the two variables are positively correlated, when the N-total soil increases the productivity of rice also increased. N-ground capabilities in explaining the total variance of rice productivity by 41.4%. Mostly 58.6% of paddy productivity can be explained by other factors.

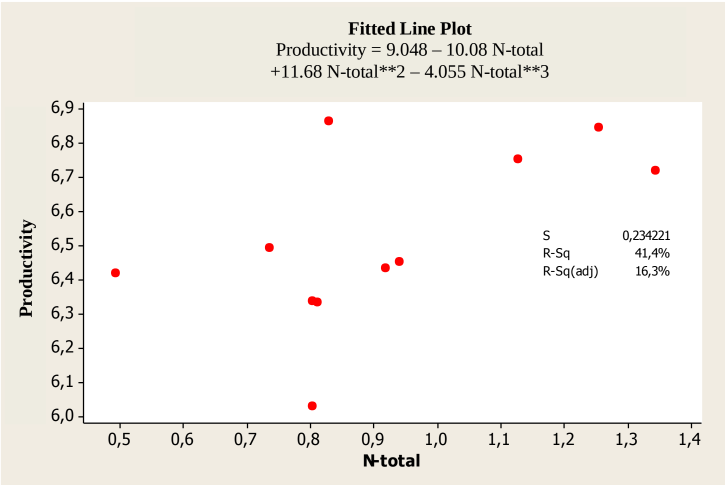


Figure 2. Regression of N-totality and Productivity of Rice in Sukoharjo, Central Java

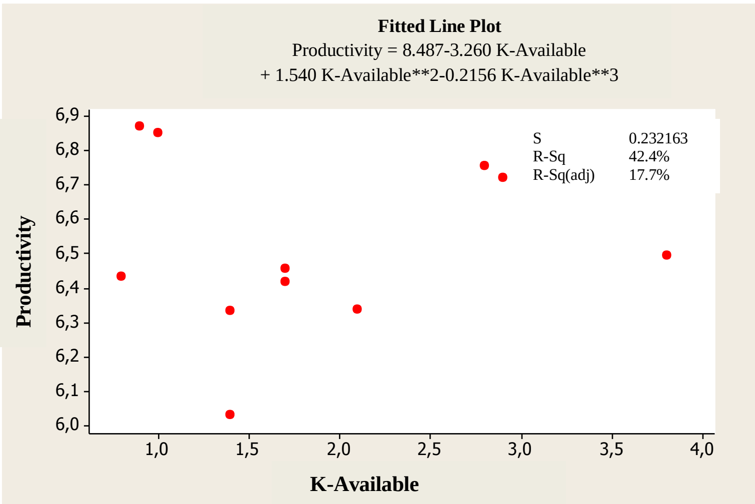


Figure 3. Regression of from K-available with Rice Productivity in Sukoharjo district

Based on Figure 3 the coefficient of determination is 42.4%. In view of the regression, the relationship between the K-available with Productivity of paddy has a positive correlation.

The Relationship between two variables, namely if K-available increased, then the rice production increased. R^2 in the regression analysis this means that K-available capabilities in explaining the production of paddy in Sukoharjo district by 42.4%. Mostly 57.6% of rice production can be explained by other factors.

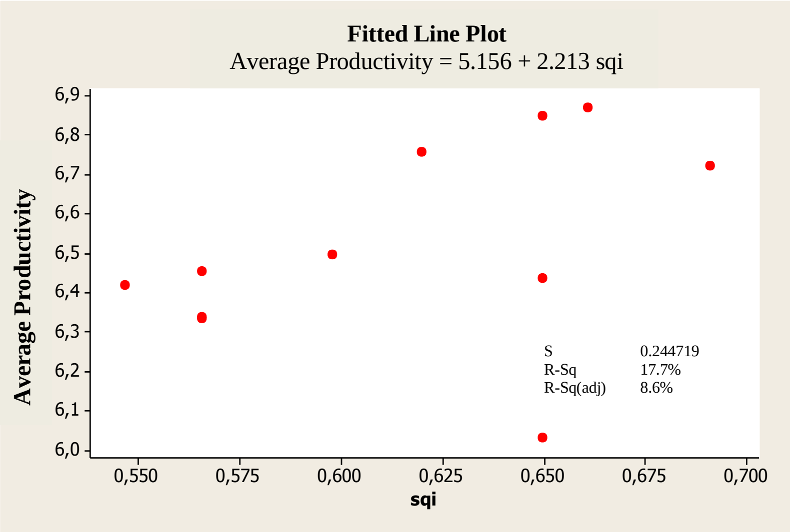


Figure 4. Regression of Soil Quality Index with Rice Productivity in Sukoharjo, Central Java

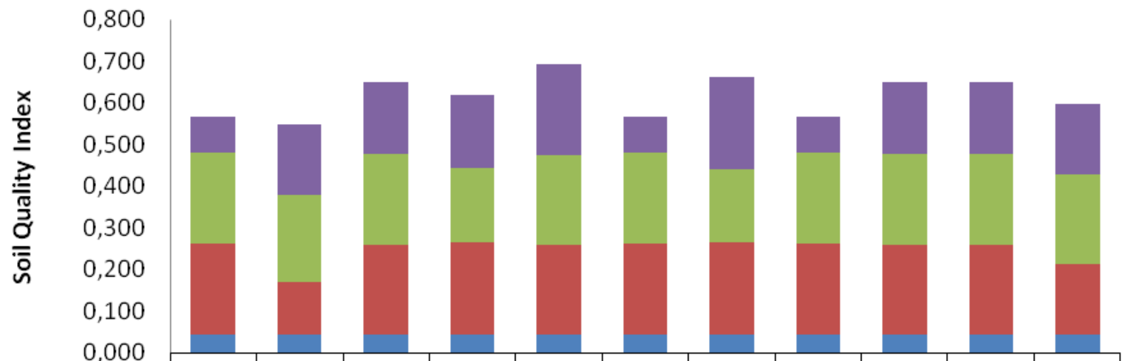
Regression relationship between soil quality index and rice productivity is equal to 17.7%, so 82.3% is influenced by other factors. Based on the pictures it is known that rice productivity varies from 6.03 tons/ha - 6.87 tons/ha, rice productivity at eleven study areas are found in medium category. Rice productivity has the medium category by Dierolf et al. (2001) ranges from 4 tons/ha-7.99 ton/ha.

Table 5 : Soil Quality Class

	Wi	Blimbing	Bakipa ndeyan	Paran gjoro	Kel Dukuh	Pundu ngrejo	Dale man	Dukuh	Geneng sari	Cabe yan	Plesa n	Sang-gang
OM	0.386	1	1	1	1	1	1	1	1	1	1	1
N-total	0.257	5	3	5	5	5	5	5	5	5	5	4
K-available	0.149	5	5	5	4	5	5	4	5	5	5	5
Permeability	0.208	2	4	4	4	5	2	5	2	4	4	4
SQI		2.832	2.734	3.248	3.099	3.456	2.832	3.307	2.832	3.248	3.248	2.991
High SQI		5.000										
SQI Normalisation		0.566	0.547	0.650	0.620	0.691	0.566	0.661	0.566	0.650	0.650	0.598
Class Soil Quality		5.66	5.47	6.50	6.20	6.91	5.66	6.61	5.66	6.50	6.50	5.98
Rate		Medium	Medium	Good	Good	Good	Medium	Good	Medium	Good	Good	Medium

Data of paddy productivity in Sukoharjo is obtained based on the average of productivity in 2012 - 2014 according to data from the District in Figures. The highest Rice productivity is in the District Mojolaban Dukuh site. whereas the lowest at Cabeyan Rural District of

Bendosari. The highest soil quality index is the site of District Pundungrejo. Tawangsari rice productivity is 6.72 tons/ha, Hamlet Site District of Baki Pandeyan have soil quality index of 0.547 (medium) and rice productivity 6.42 ton/ha (medium). One cause low productivity is the process of fertilization in paddy fields. Fertilization related to nutrients availability in the soil (Yuwono 2007).



	Blimbing	Baki Pandeyan	Parangjoro	Kel. Dukuh	Pundungrejo	Dalem an	Dukuh	Genengsari	Cabeyan	Plesan	Sanggang
permeability	0,087	0,168	0,173	0,177	0,216	0,087	0,220	0,087	0,173	0,173	0,171
K-available	0,218	0,210	0,217	0,177	0,216	0,218	0,176	0,218	0,217	0,217	0,214
N-total	0,218	0,126	0,217	0,221	0,216	0,218	0,220	0,218	0,217	0,217	0,171
OM	0,044	0,042	0,043	0,044	0,043	0,044	0,044	0,044	0,043	0,043	0,043

Figure 5. Proportion of Soil Quality Indicators to Soil Quality Index

According to Sutanto (2006), the use of chemical fertilizers continue to cause soil biological ecosystem to become unbalanced so that fertilization purposes to replenish nutrients in the soil is not reached. Any plant genetic potential cannot be achieved close to maximum. Impartial fertilization needs to be applied to maintain the condition of the soil to remain fertile (Sembiring 2015) 3 images from determination coefficient value of 42.4%. In view of the regression line relationship between the cubic-K is available with Productivity of paddy has a positive correlation. Relationship to two variables, namely if K-available increased, then the rice production increased. The R2 in the regression analysis this means that K-available capabilities in explaining the production of paddy in Sukoharjo district by 42.4%. Means that 57.6% of rice production is explained by other factors. The coefficient of determination highest permeability than the third determination coefficient value of other variables, so that it can be said soil permeability soil quality indicators that affect the productivity of rice.

Soil quality index can be seen with the proportion of each indicator influential. The proportion of each indicator in determining soil quality index can be seen in Figure 5. Based on the proportion of each site 5 image research, soil quality indicators have different contributions to the index of the quality of the soil, for example on Desa Blimbing organic materials have low contributed 0.044; N-total of 0.218, K-available 0.218, while the permeability of 0.087. The site Dukuh soil permeability indicator had the highest contribution of 0.220, while the organic material 0.044. Contribution to its lowest permeability in the site Blimbing and site Daleman with a value of 0.044, while the lowest soil organic matter is the site Baku Pandeyan with value 0.042. N-total contribution to its lowest in the site of Sanggang.

Proportion soil quality indicators between soil quality index useful to determine indicators to need attention to incress of soil quaity. Based on figure 5 lowest proportion of soil organic matter, so that need increase soil organic matter. In 20 year latest from specially expert have other assessment about cause of decressed of productivity paddy, in about cause low of soil orgnic matter.

Characteristics of the soil affect the amount of productivity that results from the availability of water, the environment and also the special conditions of the rhizosphere, salinity, pH, alkalinity, and toxins in the soil that will adversely affect the growth of plants. According to Supartha (2012) application of fertilizer on agricultural systems also can affect the productivity of rice plants. The treatment combination of solid organic fertilizer and liquid organic fertilizer significantly affected rice yields.

4 CONCLUSIONS AND RECOMMENDATIONS

The conclusion that can be drawn from the research relationship betweenthe Soil Quality and Rice Productivity in Sukoharjo, Central Java, namely:

a. SQI (Soil Quality Index) eleven sites is 0.547-0.691 have the soil quality medium and good, is the quality of the land was in the range of 5.47 to 6.91.
b. Indicators of physical, chemical and biological most influence on soil quality are the permeability, K-Available, N-total and soil organic matter.
c. Soil quality index influential to productivity paddy of 17.7%.
d. The proportion of soil quality indicators to soil quality index the low is soil organic matters and soil permeability.

Based on the research results Soil Quality Relationship with Rice Productivity in Sukoharjo, Central Java, it can be suggested that:

a. Here needs to be more research in other sites, especially in Sukoharjo evenly distributed in terms of the development of rice production.
b. Judging from the organic matter content is very low then required the addition of organic matter, such as composting and increased biomass input.

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