Agrotech Journal
Url: http://usnsj.com/index.php/ATJ
Email: editor.atj@usnsj.com

Soil Characteristics on Sustainable Food Agriculture Land (LP2B) in Sawerigadi Sub-District, Muna Barat Regency

AUTHORS INFO

Wa Embe
Faculty of Agriculture, Muhammadiyah Kendari University
waembe@umkendari.ac.id

Asriani
Faculty of Agriculture, Muhammadiyah Kendari University
asriani@umkendari.ac.id

ARTICLE INFO

e-ISSN: 2548-5148
p-ISSN: 2548-5121
Vol. 6 No. 1, June 2021
URL: http://dx.doi.org/10.31327/atj.v6i1.1565

Abstract

The research was conducted in Sawerigadi Subdistrict on Sustainable Food Agricultural Land (LP2B) consisting of five profiles. The research objectives were to determine soil characteristics in physics, chemistry, biology, and to determine the level of soil fertility on it. The research method that is; 1) Land Survey, 2) Research implementation includes the both preparation stage and data collection stage (field implementation), 3) Soil analysis includes analysis of physics, chemistry and biology. Observation and carried out soil sampling were by making soil profiles at each point. The results of the physical observation properties from the five profiles were almost the same, which had a reddish yellow to brownish yellow color with the texture of loam, clay, clay loam to silty clay. Soil structure is angular blocky and rounded blocky and has a slightly sticky to very sticky consistency. The results of laboratory analysis of the five research profiles have slightly acidic to neutral pH, very low to low C-Organic and N-Total, very low to moderate CEC, very low to very high alkali saturation, P-available is low to very high, K-available is low to moderate, and very low to high base cations (Mg, Ca, Na, K). The value from the results of laboratory analysis of the five profiles at each layer tended to decrease with soil depth. The biological characteristics of the five research profiles are related to macro and micro activity of soil fauna, a little to a lot, the existence of macro and micro activity of soil fauna depending on vegetation conditions on the soil surface. The soil fertility level of the five research profile is in the low to medium category

Keywords: agriculture, soil, land, food, sustainable

A. Introduction

The characteristics and types of soil differ from one place to another, and these differences can affect the ability of the soil to support the growth and production of cultivated / cultivated crops. Food needs are increasing while agricultural land is decreasing. An important issue in current developments is sustainable agriculture, which is a process that maximizes agricultural resources to meet the needs and welfare of today's society without sacrificing future needs and welfare, so that agricultural resources become a priority for agricultural land, especially land, food agriculture in a sustainable manner.

The direction of planning for food agriculture areas in the Spatial Plan for Muna Barat Regency which is broader than that of the Central Government shows that the potential for developing sustainable food agriculture is still open. This development must be supported by academic studies so that the development of land area is directly proportional to the production of food. The study of soil characteristics in physical, chemical and biological soil can help in soil treatment during cultivation now and in the future.

The use of Sustainable Food Agriculture Land (LP2B) in Muna Barat, especially in Sawerigadi Sub-District, is still not optimal, this can be seen from the local food needs mostly sourced from other regions. In general, local farmers cultivate the land traditionally and without the addition of organic matter. The lack of food production is also caused by, among others, the low level of public knowledge about soil characteristics, so that the treatment of soil as a planting medium is not appropriate.

Research on soil characteristics, especially in Sawerigadi Subdistrict, has obviously no previous research as supporting data on soil fertility. In connection with this, the author will conduct research on Soil Characteristics on Sustainable Food Agricultural Land (LP2B), as a basis for consideration of the treatment of agricultural land which is expected by knowing the characteristics of the soil, the treatment of soil as a planting medium is carried out appropriately and proportionally, as well as agricultural production food increases.

B. Literature Review

1. Soil Defenition

Soil is a natural body which is formed and developed from natural materials on the surface of the earth. This natural body differentiates to form mineral and organic horizons with varying depths and different in nature from the parent material that lies beneath it in terms of morphology, physical, chemical and biological properties (Notohadiprawiro, T., san S.H. Suparnowo. 1994).

2. *Physical Characteristics of Soil*

a. Soil Texture

Texture is the ratio of the relative size of soil particles in the form of sand, dust, and clay fractions. Where for the sand fraction (2 mm-50μ), dust (50 - 2μ) and clay (<2μ) in the soil. Soil texture is commonly known as a texture triangle consisting of 12 soil texture classes, namely: sand, loamy sand, sandy loam, loam, dusty loam, dust, clayey clay, sandy clay, dusty clay, sandy clay, dusty clay, clay (Hardjowigeno , 1993).

b. Soil Structure

Soil structure is a small lump of soil grains, occurs because grains of sand, dust and clay are bonded to one another by a soil adhesive such as organic matter, iron oxides and others. These little lumps come in different shapes, sizes, and stability.

c. Soil Consistency

Soil consistency refers to the cohesion between soil particles and the adhesion between soil particles and other objects, the resistance of the soil to deformation. If the soil structure is related to the composition and shape of the lump (ped), then consistency deals with the strength and nature of the forces acting between the particles. Consistency is determined by three levels of soil moisture, namely wet, moist, and dry (Siradz, 2003).

d. Soil Color

Soil color reflects the integration and transformation and chemical, physical, and biological translocation that occurs in the soil. In general, the color of the surface horizon reflects a strong picture of biological processes, especially those related to the origin of organic matter. Organic material gives a dark brown to black color. Usually the higher the organic matter, the darker the soil color. The bright light color corresponds to the eluvization horizon where sesquoxide, carbonate and clay minerals have leached out (Tan, 1991).

3. *Soil Chemical Characteristics*

a. Soil Reaction (Soil pH)

The soil reaction shows the acidity or alkalinity of the soil which is expressed by the pH value. The pH value shows the number of hydrogen ion (H +) concentrations in the soil. The higher the H + ion content, the more acidic the soil will be (Susanto, and Sirappa, 2005).

b. Cation Exchange Capacity (CEC)

CEC is defined as the total amount of exchangeable cation adsorption. CEC is expressed in chemical units, namely milliequivalents per 100 g (me / 100 g). One equivalent is an amount chemically equivalent to 1 g of Hydrogen. The number of atoms in each equivalent is 6.02 x 1023 = (avogadro's number). Thus 1 me is equivalent to 1 mg of hydrogen and consists of 6.02 x 1020 hydrogen atoms. Soil CEC varies depending on (1) the grade and type of clay; (2) levels of organic matter and organic compounds composing organic matter (Hardjowigeno, 2003).

c. *Base Saturation (KB)*

Base saturation shows the ratio between the number of base cations with the number of all cations (alkaline and acidic cations present in the soil seepage complex). The maximum number of cations that can be absorbed by the soil indicates the magnitude of the CEC value of the soil. Basic cations are generally nutrients needed by plants (Ca ++, Mg ++, K +, and Na +). While the acid cations (H + and Al +++). Besides alkalis, it is easy to wash, so that the soil with high KB indicates that the land has not been washed much and is fertile soil. KB is closely related to soil pH, where soils with low pH generally have low KB, and vice versa.

Base Saturation = (Number of Base Cations)/CEC x 100%

4. *Soil Biological Characteristics*

Relation to macro and micro activity of soil fauna. In this case, soil fauna, both macro and micro, plays a very important role in improving soil structure, improving soil aeration and as a source of soil organic matter. Large animals (macro fauna) which are land dwellers in the form of large ground-breaking animals, earthworms, arthropods and mollusks (Hardjowigeno, 1993).

5. Sustainable Food Agriculture

Sustainable Food Agricultural Land is a field of agricultural land designated to be protected and developed consistently in order to produce staple food for self-sufficiency and national food sovereignty security. The protection of sustainable food agricultural land is carried out based on sustainable food agriculture land planning which includes: (1) Sustainable Food Agriculture Areas, (2) Sustainable Food Agriculture Land, and (3) Sustainable Food Agriculture Reserves (Susanto, and Sirappa, 2005).

C. Methodology

This research was conducted in Sawerigadi District, West Muna Regency in August 2020. Soil analysis was carried out at the Bogor Soil Research Institute. The research method that is; 1) Soil Survey, 2) Research implementation includes the preparation stage and data collection stage (field implementation stage), 3) Soil analysis includes analysis of physics, chemistry and biology. Observation and soil sampling were carried out by making a soil profile on the Sustainable Food Agriculture Land (LP2B) which became the sample area.

1. Research Design
   The research method that is; 1) Soil Survey, 2) Research implementation includes the preparation stage and data collection stage (field implementation stage), 3) Soil analysis includes analysis of physics, chemistry and biology.
2. Sample
   This research consists of five profiles. Each profiles taken three of soil sample based on layer of profile. So that the number of soil samples taken is 15
3. Technique of Data Collection
   Observation and soil sampling were carried out by making a soil profile on the Sustainable Food Agriculture Land (LP2B) which became the sample area.
4. Instruments

a. Soil profile observations involving external and internal data using a manual for observing soil profiles in the field.
b. Soil samples analysis was carried out at the Bogor Soil Research Institute laboratory.

5. Technique of Data Analysis
   c. Physical Soil Analysis. (Texture by filtering and pipetting methods (ISRIC, 1993), Soil Color (refers to the Munsell Soil Color Chart book, Structure and consistency (Soil Conservation Service, 1972)
   d. Chemical Soil Analysis
      Soil samples analysis was carried out at the Bogor Soil Research Institute laboratory.

e. Biological Soil Analysis
Biological observations can be made in the field directly on the existing soil profile, by observing macro and micro biological activity in the soil.

D. Result

1. Result

a. Physical Characteristics of Soil from Five Profiles in Sawerigadi Sub-District
The results of observations of the morphological properties of the physical properties at the research location which consist of five (5) soil profiles can be seen in Table 1:

Table 1. Soil Physics Morphology of the Five profiles in Sawerigadi Sub-District

Profiles/ Points	Layers	Code	Horizon	Depth (cm)	Color	Color Notation	Texture	Structure	Consistency
I	I	P1L1	O	0-15	10YR 3/3	Brownish Yellow	Loam	Angular Blocky	Slightly Sticky
	II	P1L2	B	15-40	10YR 5/6	Reddish Yellow	Clay Loam	Rounded Blocky	Slightly Sticky
	III	P1L3	C	40-80	10YR 7/8	Yellow Gray	Clay	Rounded Blocky	Sticky
II	I	P2L1	O	0-15	10YR 4/6	Brownish Yellow	Loam	Angular Blocky	Slightly Sticky
	II	P2L2	A	15-53	10YR 5/8	Reddish Yellow	Silty Clay	Angular Blocky	Sticky
	III	P2L3	C	53-74	7,5YR 5/8	Brownish Yellow	Clay	Angular Blocky	Sticky
III	I	P3L1	O	0-23	7,5 YR 4/6	Brownish Black	Silty Clay	Rounded Blocky	Sticky
	II	P3L2	B	23-52	7.5YR 4/6	Brownish Black	Clay	Angular Blocky	Verry Sticky
	III	P3L3	C	52-88	7,5YR 5/8	Brownish Yellow	Clay	Angular Blocky	Verry Sticky
IV	I	P4L1	O	0-15	10YR 4/6	Brownish Yellow	Clay Loam	Rounded Blocky	Sticky
	II	P4L2	A	15-53	10YR 5/8	Reddish Yellow	Clay	Angular Blocky	Sticky
	III	P4L3	C	53-74	10YR 5/8	Reddish Yellow	Clay	Angular Blocky	Sticky
V	I	P5L1	O	0-19	10YR 4/2	Brownish Yellow an	Loam	Rounded Blocky	Sticky
	II	P5L2	B	19-25	10YR 4/2	Brownish Yellow	Loam	Rounded Blocky	Sticky
	III	P5L3	C	25-50	10YR 6/1	Yellow Gray	Silty Clay	Angular Blocky	Verry Sticky

b. Soil Chemical Characteristics
The results of the chemical properties analysis on the five soil profiles in Sawerigadi Sub-District, Muna Barat Regency, are presented in Table 2.

Table 2: Results of Analysis of Soil Chemical Properties of Five Profiles in Sawerigadi District, West Muna Regency.

Profiles/ Points	Layers	pH		C-Org	KB (%)	KTK	P-Available (ppm)	K-Available (ppm)	K (%)	Ca (%)	Mg (%)	Na (%)	N-Total
		H_2O	KCl										
I	I	6,1	4,7	1,00	85	17,97	71	27	0,05	12,81	2,33	0,14	0,10
	II	6,3	4,8	0,54	88	16,83	49	29	0,05	13,13	1,45	0,10	0,05
	III	6,5	4,9	0,21	91	16,03	3	23	0,04	12,94	1,47	0,08	0,03
II	I	5,1	3,7	0,49	54	4,39	8,2	11	0,01	2,28	0,22	0,91	0,06
	II	5,4	3,9	0,30	74	4,20	6,6	12	0,01	2,85	0,20	0,05	0,04
	III	5,7	4,1	0,20	77	5,41	3	18	0,02	3,74	0,40	0,03	0,03
III	I	5,2	3,9	0,66	27	5,24	10,2	11	0,18	0,70	0,50	0,03	0,07
	II	4,9	3,7	0,36	19	3,80	1,4	33	0,04	0,48	0,19	0,02	0,05
	III	4,9	3,7	0,28	14	4,93	7,9	20	0,02	0,45	0,15	0,05	0,04
IV	I	5,5	4,4	0,88	73	5,05	28,7	31	0,05	2,77	0,85	0,04	0,10
	II	5,8	4,5	0,35	77	5,77	2	24	0,04	3,44	0,80	0,14	0,05
	III	6,3	5,0	0,29	84	5,98	14	19	0,03	4,13	0,85	0,02	0,04
V	I	7,2	6,2	1,08	>100	7,61	62	14	0,01	7,64	1,02	0,08	0,12
	II	7,7	6,8	1,21	>100	8,16	20	15	0,01	10,83	1,16	0,02	0,12
	III	7,2	6,3	0,38	>100	8,51	8	18	0,01	7,98	1,20	0,05	0,05

E. Discussion

1. Physical Characteristics

a. Soil Color

The results of field observations on the five soil profiles, the colors obtained were generally light to dark dominant, namely brownish yellow to brownish black, this shows that most of the research points of low soil organic matter. The four profiles, each profile in each layer, the lighter the soil color is. This shows that the deeper the soil layer, the less organic matter available in the soil.

b. Texture

The soil texture in the five profiles has a texture in layers ranging from loam, clay, dusty loam to clay dusty. This profile shows the dominant has a slightly smooth texture. In general, clay-textured soils, because the texture is slightly smooth to smooth, each weight unit has a large surface area so that the ability to hold water and provide high nutrients. Soil texture in the five profiles shows that the lower the layer, the smoother the texture. Shows that the ability to bind water and nutrients in the soil is still high.

c. Structure

Profiles I, II, III, IV, and V at the study location have a rounded blocky and angular blocky structure in each layer. The rounded blocky structure is caused by previous tillage and the dominance of the sand fraction, while the angular blocky structure due to the increasingly compressed soil aggregate.

d. Consistency

The results of the observations on the five profiles can be seen at, dominated by slightly sticky, sticky, and very sticky at each layer. This is due to the low organic matter content and soil cultivation factors which are continuously without adding soil organic matter.

2. Chemical Analysis

a. Soil Reaction (Soil pH)

The results of the soil chemical analysis of the five soil profiles having soil pH ranging from the low (slightly acidic) to moderate (neutral) category indicate that the research location is a soil that is developing and has a little further weathering, this is also indicated by the presence of a B horizon, namely there is an increasing illusion (accumulation) of clay content from the top layer to the bottom layer. The low soil pH is due to the fact that there is still a little leaching of base cations and other soil materials at each layer. The neutral pH of the soil in one of the profiles (profile V) is due to the use of land at this location in the form of rice fields so that the application of chemical fertilizers is the cause of increasing soil pH.

b. C-Organic, N-total

Based on the results of laboratory analysis of C-Organic, the five soil profiles ranged from very low to low. Decreasing levels of C-organic in the soil along with decreasing soil depth (the deeper the soil, the smaller the value of C-organic content in the soil), the presence of C-organic content in each first layer is caused by decomposition of plant debris and animal waste which then mixed with soil minerals. The low levels of C-organic in the soil at the study location were due to the presence of vegetation on the surface which was dominated by grass vegetation, so that the decomposition of plant litter was slightly decomposed as a source of organic matter in the soil.

Amount of N-Total in the soil in the five profiles (I, II, III, IV, and V) in Sawerigadi Sub-District ranged from very low to low in each layer, this was due to the lack of plants containing source of N in the soil, where the research location is dominated by low-level plants (shrubs to mixed gardens) so that the process for the entry of N in the soil mostly comes from the residue / waste of the surrounding vegetation.

c. Cation Exchange Capacity (CEC) and Base Saturation (KB)

The results of the CEC Laboratory analysis on the profiles of the five profiles ranged from very low to moderate categories. The low CEC is caused by flat topographical conditions with land use types from the four profiles in the form of mixed gardens and rice fields so that the process of leaching or hoarding organic matter and soil cations will occur. An increase or decrease in CEC in each soil layer is in line with the increase or decrease in C-organic content in the soil.

The results laboratory analysis of the basal saturation (KB) of the research locations in the five profiles were in the low to very high category. The low base saturation was due to the fact that the study site had undergone further weathering which reacted with acid and a little leaching of alkaline cations. The high level of alkaline saturation at the research location was due to the fact that the research location had undergone further weathering and leaching of alkaline cations. This can also be seen in the table of the results of soil chemical analysis, namely the Ca cation is higher than the Mg, Na and K cations. These base cations are generally nutrients that are much needed by plants.

d. P-availability and K- availability

Based on the results of laboratory analysis, the P- availability research location in the soil varies, namely the very low to very high category. The low P- availability is caused by the use of land in the form of mixed gardens and shrubs so that the weathering process of vegetation that falls on the soil surface will be decomposed into the soil which will later become a source of phosphorus in the soil. High P-Availability is due to flat land conditions so the possibility of leaching of soil elements / soil material is small, as well as the dominant clay content factor when viewed from the soil texture.

The results of laboratory analysis of K- availability at the research location of the five profiles (I, II, III, IV, and V) are in the low to moderate category, namely 11-33 ppm, this indicates that the availability of K in the soil is sufficiently available. The availability of K in the soil is related to the pH and saturation of the soil base, low pH and base saturation causes the availability of K in the soil is low. The availability of K in the soil is due to the addition of potassium fertilizer, but at the research location there was no application of potassium fertilizer so it was in the low dominant category.

e. Base Cations (Mg, Ca, Na, and K)

The results of laboratory analysis of Mg cations for the five profiles were in the very low to moderate category. The low levels of Mg are caused at this location apart from being on a flat topography, as well as the use of abandoned shrublands and mixed gardens (without land cultivation) and no application of fertilizers causing the value of Mg cations to be very low, this is also in line with the pH value soil. On the other hand, the level of Mg in the medium category is caused by the condition of the land which is still made into mixed gardens and rice fields so that the presence of Mg cations is still sufficient in the soil, apart from that the factor of fertilizer use on the land causes the value of the Mg cation to be moderate.

The results of Ca cation analysis for profiles I and V are in the medium to high category, namely 7.64-13.13%. This is also because these two locations are on land that is being processed in the form of mixed gardens and rice fields so that the availability of alkaline cations Ca is high enough to be absorbed by plants, besides the high value of Ca content in the soil is due to the use of fertilizers in the land.

Laboratory analysis results of the five soil profiles (I, II, III, IV, and V) for basic cations (K, and Na), where the K and Na cations are in the very low-low category. the value of cation along with soil depth as well as soil pH. The low level of K and Na cations at the research location is because there has been no application / use of fertilizers containing K and Na elements as a source of these base cations.

The results of the basal saturation (KB) laboratory analysis of the research locations in the five profiles were in the low to very high category. The low base saturation was due to the fact that the study site had undergone further weathering which reacted with acid and a little leaching of alkaline cations. The high level of alkaline saturation at the research location was due to the fact that the research location had undergone further weathering and leaching of alkaline cations. This can also be seen in the table of the results of soil chemical analysis, namely the Ca cation is higher than the Mg, Na and K cations. These base cations are generally nutrients that are much needed by plants.

3. Biological Characteristics

The biological characteristics of the five research profiles, the number of macro and micro-soil fauna are in the range / number of a little to a lot, this is due to varying land use conditions, namely mixed gardens, former gardens (shrubs), former rice fields and rice fields so that the vegetation that falls on Soil surface makes less activity for macro and micro-soil fauna.

F. Conclusion

The physical characteristics of the soil formed in the five profiles of the study area (I, II, III, IV, and V), namely the color of the soil ranges from reddish yellow to brownish yellow, the soil structure ranges from angular blocky and rounded blocky, the texture is in the Loam, clay, silty clay to clay loam, while the consistency of the soil ranges from slightly sticky to very sticky. The chemical characteristics of the soil formed in the five soil profiles (I, II, III, IV, and V), namely the soil pH is slightly acidic to neutral, C-organic and N-Total are very low to low, CEC is very low to moderate, KB is very low to very high, low to very high available P-available, low to moderate available K, very low to low base cations (Mg, Ca, Na, K). The biological characteristics of the five research observation profiles for macro and micro activity of soil fauna range from a little to a lot. Based on the physical, chemical and biological characteristics of the soil, the soil fertility level in profiles I and V has a moderate level of fertility, while those in profiles II, III, and IV have low soil fertility.

G. references

Hardjowigeno, S., (1993). Soil Classification and Pedogenesis. Akademika Presindo. Jakarta.

Haedjowigeno, S., (2003). Soil Science. Akademika pressindo. Jakarta.

ISRIC. (1993). Procedures for Soil Analysis. In van Reewijk, L.P. (Ed.) Techical Paper, International Soil Reference and Information Centre. Wageningen, The Netherlands. 4th ed. p. 100.

Notohadiprawiro, T., san S.H. Suparnowo. (1994). Principles of Pedology. Soil Science Department, Faculty of Agriculture. UGM. Yogyakarta.

Siradz, Syamsul A., (2003). Genesis, Morphology and Soil Classification. Department of Soil, Faculty of Agriculture, Gadjah Mada University. Yogyakarta.

Soil Conservation Service. (1972). Section 4: Hydrology in National Engineering Handbook. USA: SCS.

Susanto, N.A., and Sirappa, M.P. (2005). Prospects and Strategies for Corn Development to Support Food Security in Maluku. Journal of Agricultural Research and Development. Maluku.

Tan, K. H., (1991). Basics of Soil Chemistry. Gadjah Mada University Press. Yogyakarta.