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## Study of soil management in rice fields in Bantimurung District Maros Regency

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**Abstract.** Rice productivity in Bantimurung District is unstable every year. Farmers tend not to attend to environmental and soil protection but are racing to increase yields rapidly using excessive chemical fertilizers and pesticides, tilling the soil too frequently, and burning post-harvest straw. This study aims to study rice fields' management in Bantimurung District, Maros Regency, based on the soil's physical and chemical characteristics, which are expected to be a source of information in managing rice fields in Bantimurung District, Maros Regency. Data were collected using a field survey method in irrigated and rainfed rice fields and farmer interviews. Laboratory analysis included soil texture, bulk density, N-total, C-organic, pH, and organic functional group analysis. The result showed that both irrigated and rainfed rice fields have the low category of N-total (0.1-0.23%), low to a moderate category of c-organic (1.87-3.16%), and slightly acid to neutral pH (5.98-6.67). Based on farmers' information, we know that the rice fields in Bantimurung District are still suitable for rice production but must have a proper good management principle. The best management includes not using an-organic fertilizer excessively, adding organic matter, crop rotation, and attending to water needs.

### 1. Introduction

The production of rice fields commodity from 2017 to 2018 in Maros Regency has increased by 13.71%. In the 2016 to 2017 period, there was a significant decrease in rice field production. The rice fields' productivity in the Maros Regency has decreased from 2016 to 2018 are 50.95, 48.97, and 42.62 tons/ha [1]. The decreasing soil quality caused a decrease in production. Soil quality has decreased due to several factors: decreasing organic matter level [2] and water availability in the Maros Regency to support land productivity [3]. The ability of the soil to support plant productivity has also decreased [4]. The intensity of using paddy fields and farmers' behavior who only use organic fertilizers without controlling the return of crop residues to the soil will also reduce soil quality [5,6]. This behavior can lead to unstable rice productivity and requires rice field management. Soil management is an effort to maintain soil quality while still having a high production value at least not experiencing a decrease in productivity [6,7].

Based on the description, it is necessary to conduct a study of rice field management by farmers, both irrigated rice fields and rainfed rice fields, with assessing rice field conditions based on the physical and chemical characteristics. Rice field soils were used to determine the impact of used and managed rice fields in Bantimurung District, Maros Regency.



## 2. Methods

This research includes observations, sampling, and interviews with farmers in irrigated and rainfed rice fields in Bantimurung District, Maros Regency. Soil organic functional group analysis was carried out at the Laboratory of Basic Chemistry, Department of Chemistry, Faculty of Mathematics and Natural Sciences, Hasanuddin University. Analysis of the soil's physical and chemical properties was carried out in the Soil Repair Room with Laboratory of Chemical and Soil Fertility, Department of Soil Science, Faculty of Agriculture, Hasanuddin University. This research was conducted from September 2020 to November 2020.

The tools used in this research are GPS (Global Position System), a set of survey tools, cameras, computers, ArcGIS 10.3, stationery, and a set of soil analysis tools. The materials used are undisturbed soil samples by ring sampler, disturbed soil samples, research questionnaires, and chemical materials for analysis of organic functional groups, soil physical and chemical properties, and land use maps rice fields in Bantimurung District of scale 1:100.000 (figure 1).

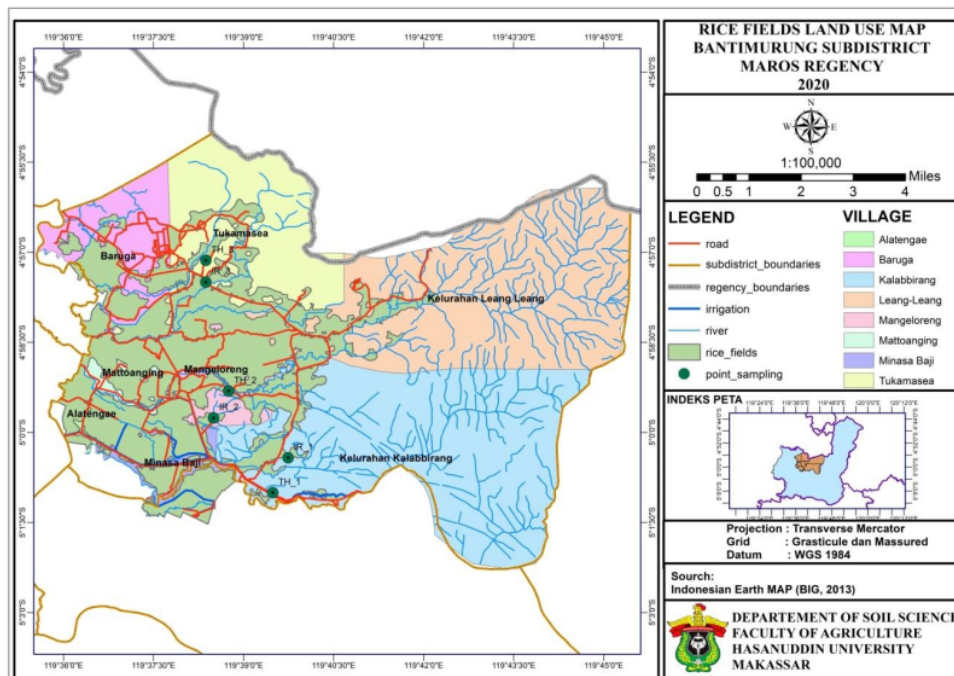


Figure 1. Map of the research location.

This research is exploratory through a field survey. The method used was a field survey method in irrigated and rainfed rice fields in Bantimurung District, Maros Regency. There are six observation points are 3 points for irrigated rice fields and 3 points for rainfed rice fields. Farmer interviews were conducted at the location of soil sampling and around the location. This study also used a survey method by filling out questionnaires through farmer interviews to determine land use in age and land management measures applied by farmers. Besides, observations and profile descriptions were carried out in the location, connected with laboratory analysis results are soil texture, bulk density, total Nitrogen, C-organic, pH, and analysis of organic functional groups with Spectrophotometer Fourier Transform Infra-Red (FTIR).

### 3. Results and discussion

#### 3.1 Texture

The soil texture in each land use is almost the same characteristics. In irrigated rice fields, the soil content is dominated by silt. High silt content is dominant in the top horizon with a range of 50%-84% and in the sub horizon ranging from 50%-76%. So, it is known that irrigated rice fields have silty clay loam texture dominated. In rainfed rice fields, the highest silt content is in the top horizon, ranged from 69%-86%, and in the sub horizon is ranged from 61%-87%. It is known that rainfed <sup>17</sup> is dominated by silt loam texture. The soil texture analysis results in each land unit can be seen in [table 1](#) and [table 2](#) below.

**Table 1.** Soil texture in irrigated and rainfed rice fields.

Land Unit	Depth	Sand (%)	Dust (%)	Clay (%)	Texture
IR 1	Top Horizon	12	57	31	<sup>16</sup> Silty Clay Loam
	Sub Horizon	19	50	31	Silty Clay Loam
IR 2	Top Horizon	6	84	10	Silt
	Sub Horizon	6	76	18	Silty Loam
IR 3	Top Horizon	21	50	29	Silty Clay Loam
	Sub Horizon	16	54	30	Silty Clay Loam
TH 1	Top Horizon	8	69	23	Silty Loam
	Sub Horizon	16	61	23	Silty Loam
TH 2	Top Horizon	4	86	10	Silt
	Sub Horizon	3	87	10	Silt
TH 3	Top Horizon	12	77	11	Silty Loam
	Sub Horizon	13	63	24	Silty Loam

Medium to slightly fine soil texture is quite suitable for rice cultivation because it is easy to cultivate; if it is dispersed, it will close the pores under the processing layer so that the water holding capacity is relatively high and drainage is fast. This is quite supportive for increasing rice yields. The soil with fine texture will accumulate organic matter compared to coarse-textured soil and will have good physical properties and the ability <sup>5</sup> to absorb water [8]. Soil texture suitable for rice fields is a fine texture with low porosity [9]. Texture role in determining the water system in the soil, in the form of infiltration speed, penetration, and the ability to bind groundwater [5]. The most suitable soil texture is the texture containing >50% clay with low permeability [10].

#### 3.2 Bulk Density

Bulk Density in the two rice fields is almost the same value (figures 2 and 3). However, in the top horizon, the bulk density value was lower than the sub horizon. This occurs in both irrigated rice fields and rainfed rice fields. The bulk density value of the top horizon in irrigated and rainfed rice fields ranged from 1.29g/cm<sup>3</sup> - 1.32 g/cm<sup>3</sup>, while for the sub horizon in irrigated rice fields, the value ranged from 1.30g/cm<sup>3</sup> to 1.39g /cm<sup>3</sup>, and in the rainfed rice fields ranged from 1.36g/cm<sup>3</sup> to 1.39g/cm<sup>3</sup>. The

difference in bulk density value is due to the fact that the top horizon contains more organic matter.

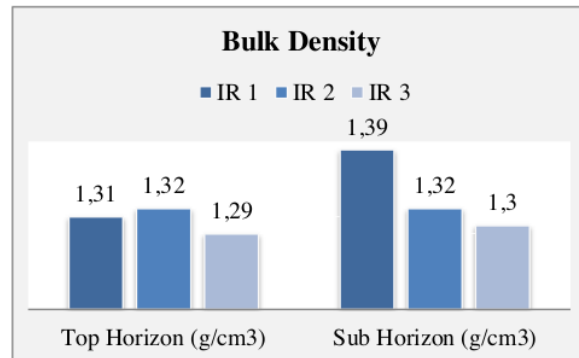


Figure 2. Bulk Density in irrigated (IR) rice fields.

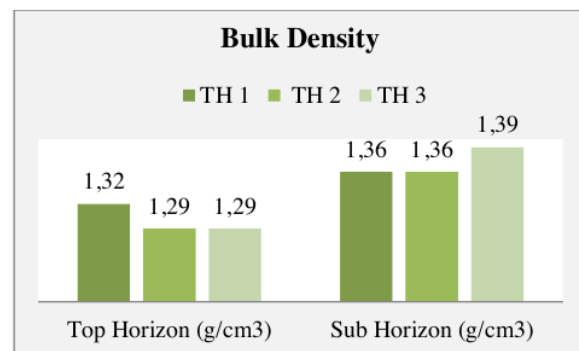


Figure 3. Bulk density in rainfed (TH).

The bulk density affects soil porosity, infiltration, air circulation, and movement of plant roots. The difference in bulk density value is influenced by factors such as fraction content in the soil, organic matter, and even fauna activity in the soil. The soil density is closely related to root penetration and plant production. If soil compaction occurs, water and air are difficult to store, and their availability will be limited in the soil and lead to inhibition of root respiration and low water absorption, besides that they have low nutrients due to low microorganisms activity [11]. The difference in bulk density value is influenced by the ratio between the fraction of sand, silt, and clay on each horizon affects the height and low of bulk density[5] The denser or smoother the soil, the higher the bulk density, which means that the soil is increasingly difficult to carry water or be penetrated by plant roots [5].

### 3.3 Degree of Acidity (pH)

The irrigated rice fields in the top horizon had a degree of acidity ranging from 5.98 to 6.15, while in the sub horizon, it ranged from 6.01 to 6.30, which means the soil pH in rice fields irrigation is acid to slightly acidic [12]. In rainfed rice fields, the top horizon has a degree of acidity ranging from 6.13 to 6.67, while in the sub horizon, it ranges from 6.07 - 6.65, which means that the soil pH in rainfed rice fields is slightly acidic to neutral. The soil pH in Indonesia generally ranges 4.0 - 5.5, soil with a pH of

6.0-6.5 is often said to be relatively neutral even though still acid category [13]. Soil with a pH ranging from 4.5-6.5 is less healthy for soil criteria. Whereas soil with a balanced or neutral pH with a pH value range of 6.6 - 7.5 is soil with fit criteria [14]. The results of measuring the degree of soil acidity can be seen in figure 4 and figure 5 below.

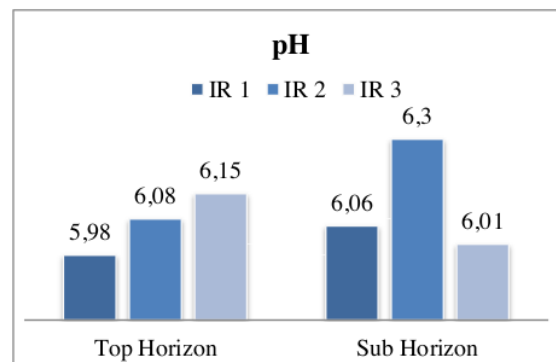


Figure 4. Degree of soil acidity (pH) in irrigated (IR) rice fields.

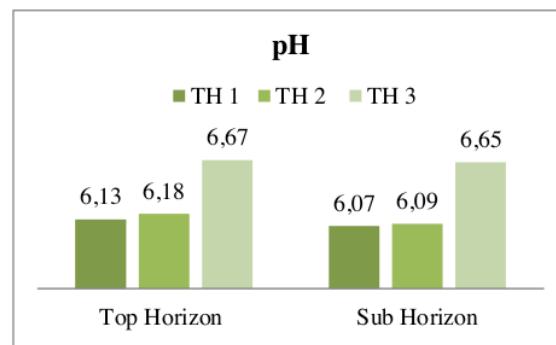


Figure 5. Degree of soil acidity (pH) in rainfed (TH).

Acidic soil pH can be caused by the continuous use of an-organic fertilizers, especially nitrogen fertilizers. The habit of farmers in one of the cycle crops is to add nitrogen fertilizers such as ZA and Urea to increase their production. Therefore, in the research location, soil pH is generally acidic to neutral. Fertilizers containing nitrogen in ammonia or other forms can turn into nitrates, resulting in a decrease in soil pH. Nitrification resulting in the production of hydrogen ions and can increase soil acidity [15]. The soil reaction (pH) determines whether or not nutrients can be easily absorbed by plants, nutrients that are easily absorbed by plant roots, namely at a pH around neutral because at that pH, the nutrients dissolve easily in the soil.

### 3.4 C-Organic

Based on the analysis of C-Organic content in each land unit, it was found that the C-Organic content in the irrigated rice fields in the top horizon was classified as moderate, ranging from 2.67%-2.83%. While on rainfed, C-organic content in the top horizon classified moderate to high as 2.61% -3.16%.

This is because the straw is transported after harvest and the use of chemical fertilizers such as Urea, ZA, and SP-36 in high doses by farmers in Bantimurung Regency. As for rainfed, farmers often rotate crops such as rice-watermelon, sweet potato, and several other vegetable commodities. Crop rotation can increase the accumulation of organic matter. Based on the criteria for assessing soil chemical properties, in general, the C-Organic content is included in the high category (3%-5%) [16]. Rotating rice plants with other seasonal crops can improve the soil and increase the soil organic matter content [17]. The analysis of soil C-organic content can be seen in figure 6 and figure 7 below.

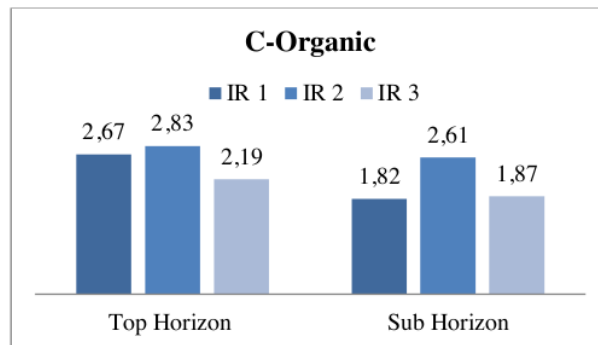


Figure 6. Soil C-Organic content in irrigated rice (IR) fields.

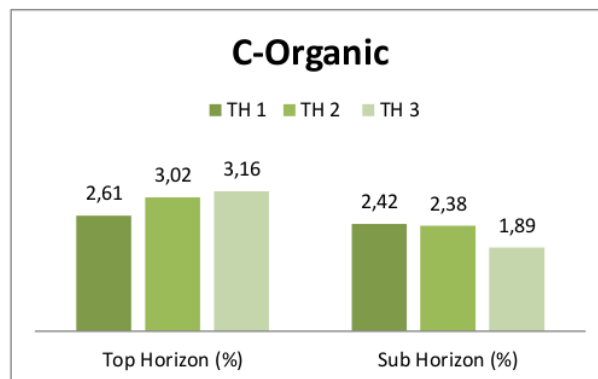
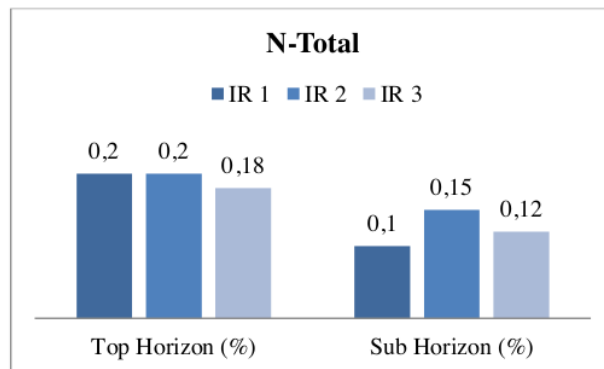


Figure 7. Soil C-Organic content in rainfed (TH).

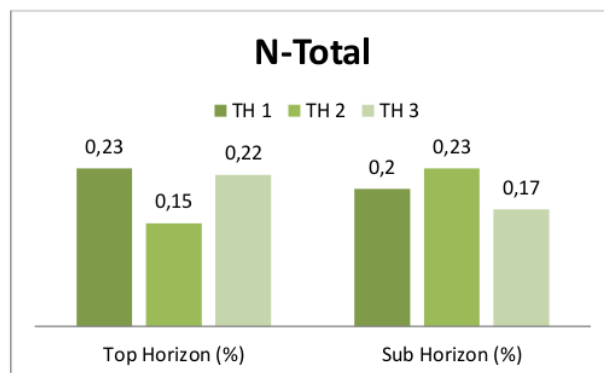
The C-Organic content decreases with increasing soil depth due to farmers' habits who do not return the soil's remaining harvest. Organic material only comes from the remaining roots of rice plants accumulating in the upper horizon and is only partially washed into the sub horizon [6,18]. The lower the soil depth, the smaller the C-Organic percentage; this is influenced by the inundation process and the many clay fraction of the rice fields, which causes the weathering process in the sub horizon to run slower than the top horizon, and the decomposition process that occurs only in the upper layer [6]. The presence of organic matter in the sub horizon is caused by soil processing, transportation by soil organisms, and organic matter leaching [18].

### 3.5 Nitrogen-Total

Nitrogen-Total (N-total) is almost the same value between irrigated rice fields and rainfed. The N-Total are classified as low to moderate category [12]. The N-total value between the top horizon and sub horizon has a difference, where the deeper the soil depth, the N-total value tends to decrease. This is in line with the c-organic content. Nitrogen is needed in addition to plant growth and the formation of new cells [18]. The results of the N-total analysis can be seen in figure 8 and figure 9 below.



**Figure 8.** N-Total of soil in irrigated (IR) rice fields.



**Figure 9.** N-Total of soil content in rainfed (TH).

Nitrogen levels decrease in greater soil depth due to losses due to the leaching process. Nitrogen is a nutrient that is mobile in the soil so that it is possible to lose due to leaching [18]. Loss of nitrogen from soil consists of loss in gas form ( $N_2$ ,  $N_2O$ ,  $NO$ , dan  $NH_3$ ), losses due to leaching, and loss of nutrients with a harvest. The loss of nitrogen in the form of  $NO_3$  is easily washed out by rainwater (leaching) and is not retained by the soil colloids [19].

### 3.6 Organic Functional Groups (FTIR)

Based on the analysis of organic functional groups in rice fields, irrigated rice fields are dominated by the single bond of C-C/C-N/C-O in the range of frequency 351.04 - 1099.43 ( $cm^{-1}$ ). The high

intensity was found in single bonds, double bonds, and triple bonds. Rainfed dominated with a single bond, namely C-C/N/C-O, in the range of frequency 347.19 - 1103.28 (cm-1) with high intensity in the single bond 632.65 - 779.24 (cm-1). The results of organic functional group analysis can be seen in figure 10 and figure 11 below.

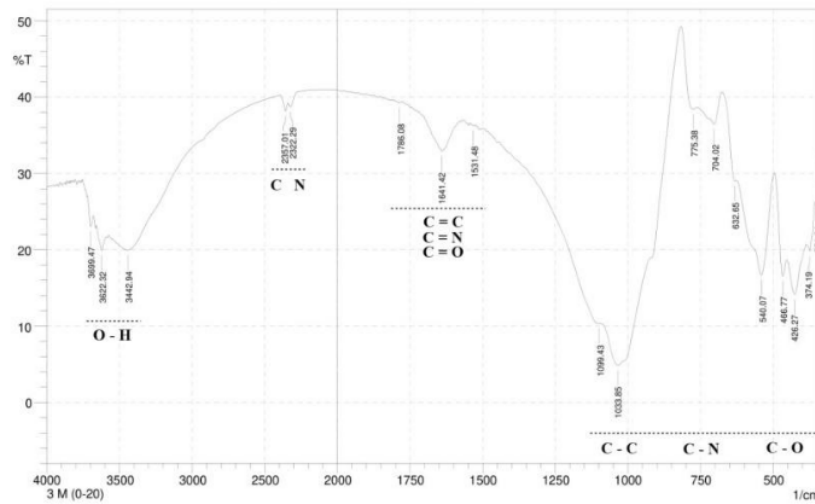


Figure 10. Organic functional groups of soil in irrigated rice fields.

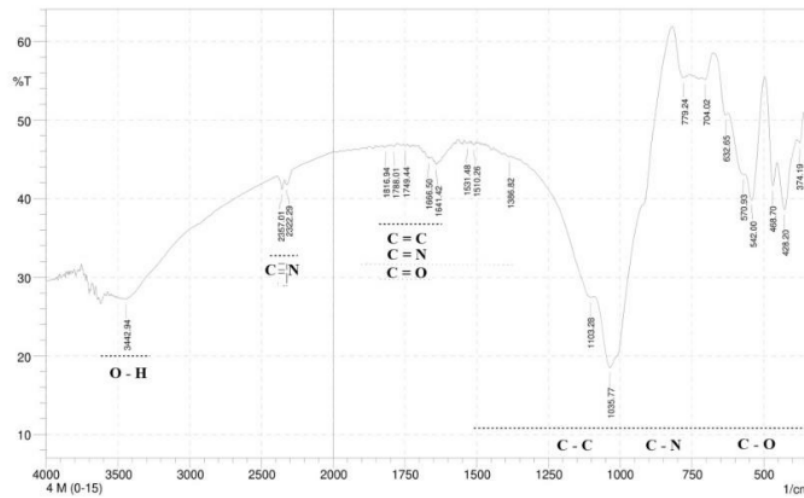


Figure 11. Organic functional groups of soil in rainfed.

Based on the two figures, organic matter in irrigated rice fields and rainfed was not completely decomposed. This is because most of the organic matter found in the soil only comes from plant roots remains and is only processed in tillage. The decomposition rate of organic matter is also influenced by cellulose other than lignin, whose absorption can see at 3300 – 3800 (cm<sup>-1</sup>) peak value [20]. Organic matter in the research location needs to be added to maintain soil carbon stock for soil sustainability [21,22].

#### 4. Conclusions

Soil bulk density in the sub-horizon was increased, while C-Organik and N-total were decreasing. pH increasingly acidic in line with C-H/C-N/C-O functional groups. But the rice fields in Bantimurung District are still suitable for rice production. However, the farmers must pay more attention to proper good management principles, such as not using an organic fertilizer excessively, adding organic matter, crop rotation, and attending to water needs.

#### References

- [1] BPS Maros 2020 *Kabupaten Maros dalam Angka 2020* Maros: BPS Kabupaten Maros
- [2] Rasyid B, Oda M and Omae H 2018 Soil water retention and plant growth response on the soil affected by continuous organic matter and plastic mulch application *IOP Conf. Ser. Earth Environ. Sci.* **157** 1–6
- [3] Lias S, Irmayani and Laban S 2020 The potential of water availability in Maros Watershed using Thornthwaite-Mather water balance method *IOP Conf. Ser. Earth Environ. Sci.* **486** 1–6
- [4] Ompusunggu G, Guchi H and Razali 2015 Pemetaan status c-organik tanah sawah di Desa Sei Baman, Kecamatan Sei Baman Kabupaten Serdang Bedagai *J. Agroekoteknologi* **4** 1830–7
- [5] Wunangkolu R, Rismaneswati and Lopulisa C 2019 Karakteristik dan produktivitas lahan sawah irigasi di Kecamatan Duampanua Kabupaten Pinrang *J. ecosolum* **8** 34–49
- [6] Ahmad A, Farida M and Lopulisa C 2021 Pedogenic processes of carbonate rocks in the tropical region as a key for sustainable soil management *IOP Conf. Ser. Earth Environ. Sci.* **648** 1–7
- [7] Harjadi B 2020 *Tindakan Konservasi Menyelamatkan Produktivitas Lahan dan Ketersediaan Air dalam Tanah* Yogyakarta
- [8] Mahmud, Wardah and Toknok B 2014 Sifat fisik tanah dibawah tegakan mangrove di Desa Tumpapa Kecamatan Balinggi Kabupaten Parigi Moutong *J. War. Rimba* **2** 129–35
- [9] Supriyadi S, Santoso A I and Amzeri A 2009 Evaluasi kesesuaian lahan untuk tanaman pangan di Desa Bilaporah, Bangkalan *J. Agrovigor* **2** 110–7
- [10] Ahmad A, Alamudi Z F and Lopulisa C 2019 Karakteristik tanah sawah dari batuan lava-vulkanik di lereng Gunung Lompobattang, Sulawesi Selatan *Median* **11** 24–33
- [11] Limbong W M M, Sabrina T and LUBIS A 2017 Perbaikan beberapa sifat fisika tanah sawah ditanami semangka melalui pemberian bahan organik *J. Agroekoteknologi Univ. Sumatera Utara* **5** 152–8
- [12] BPT 2005 *Analisis Kimia Tanah, Tanaman, Air dan Pupuk*. Balai Penelitian Tanah Bogor
- [13] Hardjowigeno S 2007 *Ilmu Tanah* Jakarta: Akademia Presindo
- [14] Lantoi R R, Darman S and Patadungan Y S 2016 Identifikasi kualitas tanah sawah pada beberapa lokasi di Lembah Palu dengan metode skoring lowery *J. Agrol.* **23** 243–50
- [15] Firmansyah I and Sumarni N 2013 Pengaruh dosis pupuk n dan varietas terhadap pH tanah, N-total tanah, serapan N, dan hasil umbi bawang merah (*Allium ascalonicum* L.) pada tanah Entisols-Brebes Jawa Tengah (Effect of N fertilizer dosages and varieties on soil pH, soil total-N, N U *J. Hortik.* **23** 358–64
- [16] Saputra W T M, Rauf A and Sabrina T 2019 Effect of conservation methods at oil palm plantation on soil nutrients status of N, P, K, and C-organic *J. Tanah dan Sumberd. Lahan* **06**

- 1027–32
- [17] Kemala N, Supriadi and Sabrina T 2017 Pemetaan c-organik di lahan sawah daerah irigasi pantoan Kecamatan Siantar Kabupaten Simalungan *J. Agroekoteknologi FP USU* **5** 729–39
- [18] Sipahutar A, Marbun P and Fauzi F 2014 Kajian C-organik, N dan P Humitropepts pada ketinggian tempat yang berbeda di Kecamatan Lintong Nihuta *J. Agroekoteknologi Univ. Sumatera Utara* **2** 1332–8
- [19] Suarjana I W, Supadma A N and Arthagama I D M 2015 Kajian status kesuburan tanah sawah untuk menentukan anjuran pemupukan berimbang spesifik lokasi tanaman padi di Kecamatan Manggis *J. Agroekoteknologi Trop.* **4** 314–23
- [20] Annisa, Wahida and Subagio H 2016 Profile analysis of the effects of organic matter on iron concentration and absorption in tidal swamp land *J. Inform. Pertan.* **25** 241–8
- [21] Hairiah K, Noordwijk M Van, Ratna R, Dwi D, Suprayogo D, Kurniawan S, Prayogo C and Gusli S 2020 Agriculture, ecosystems and environment soil carbon stocks in indonesian (agro) forest transitions : compaction conceals lower carbon concentrations in standard accounting *Agric. Ecosyst. Environ.* **294** 106879
- [22] Gusli S, Sumeni S, Sabodin R, Muqfi I H, Nur M, Hairiah K, Daniel U and Noordwijk M Van 2020 soil organic matter, mitigation of and adaptation to climate change in cocoa – based *Land* **9** 2–18

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