Nitrogen content and C-Organic in the field for tropical fruit plantation in Jinengdalem Village, Bali, Indonesia

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Abstract. This explorative research aims to find out reserves of total nitrogen and soil organic carbon on land for tropical fruit plantations in Jinengdalem Village, Buleleng District, Bali. Climate change will affect the availability of nutrients for these plantations. This research was conducted from December 2019 to June 2020. Soil sampling was carried out based on SNI 7724: 2011. The total nitrogen content of the soil in the sample was determined by the Kjeldahl method and the organic carbon stock in the sample was determined by the Walkley and Black method. The results showed that the total soil nitrogen and soil organic carbon obtained from samples 1 to 5 were respectively 0.007%, 0.00152%, 0.00151%, 0.006%, 0.006%, and 0.003% and for soil organic carbon were 0, 3733%; 0.4200%; 0.5133%; 0.5600% and 0.5133%. The content of soil nitrogen and organic carbon in this soil is very low because the level is less than 1%.

1. Introduction
Indonesia has an abundant sunshine and rainfall that is almost evenly distributed throughout the year in some areas. The development of cultivation of various types of native tropical plants is possible from the diversity of existing soil types, as well as production commodities from subtropical areas that have adapted to tropical climatic conditions [1]. Horticultural products are generally important commodities. Horticultural commodities include seasonal and perennial crops. Until now, the Ministry of Agriculture has recorded 323 types of horticultural plants consisting of 60 types of fruits, 80 types of vegetables, 66 types of biopharmaca (medicinal plants) and 117 types of ornamental plants (floriculture). However, only about 90 types of horticultural commodities have been recorded in agricultural statistics. The Ministry of Agriculture has determined several main and superior horticultural commodities, namely chilies, shallots, potatoes, oranges, mangoes, mangosteen, zalacca, bananas, durian, ginger, orchids and chrysanthemums [2]. In Buleleng District, a tropical fruit planting trial was established which is a project from the Ganesha Education University, located at the Jinengdalem Undiksha Campus. In his remarks, the Regent of Buleleng stated that the existence of this experimental land is a matter of pride for Buleleng because it can increase the potential of local fruit in Buleleng and is expected to become one of the supporting systems in the Buleleng Regency development program which is prioritized in the agricultural sector and can be a barometer for Agrotourism [3]. Paramartha, 2016 states that the fruits that have the potential to be developed in Buleleng are durian, guava, sapodilla, and papaya [4]. The culture of the Buleleng community likes to work with gardening, farming and farming related to religion and socio-culture [5].

However, climate change triggers environmental changes that cause changes in crop response, causing several impacts, one of which is crop failure. Harvest failure due to drought or flooding, the
emergence of plant diseases due to climate change will have an impact on food security which coherently affects almost the entire process of its availability, because the condition of the earth's atmosphere that has been needed has deviated from normal conditions. This process causes the nutrient elements that are released into the soil to be easily lost so that the soil becomes deficient in nutrient elements such as organic carbon [6]. Soil organic carbon is an important part of soil that affects soil fertility, soil structure and soil capacity to retain water [7]. Soil organic carbon is the result of the decomposition of soil material by soil biota, the result of this decomposition is a source of energy and nutrients. In the decomposition process of carbon and several other nutrients, carbon will be released as carbon dioxide or methane gas (anaerobic conditions) as a result of the 3 microbial respiration process and excess nutrients will be released or mineralized into inorganic forms that can be used by microbes or plants [8]. Soil organic matter on average contains 58-60% carbon, so if the soil contains 1% organic carbon from the results of soil tests, means about 1.7% of the weight of the soil material is soil organic matter. Soil organic matter is a mixture of simple and complex carbon compounds that can be divided into several groups that have different functions in the soil ecosystem [9]. The land that will be used as plantation land in Jineng Dalem village is not the original land of the area but is a mound of former buildings. The existing soil conditions are suspected of having low soil organic matter content, so the need for soil management and identification of soil organic matter content, especially C-organic in the soil.

This study aims to determine the soil organic C content of land for tropical fruit plantations using the Walkley and Black method. This research was conducted in Jinengdalem Village, Bali, Indonesia, more precisely on the Undiksha Jinengdalem campus, behind the Faculty of Medicine. The results of this study are expected to be able to assist in the process of planting tropical fruit in Jinengdalem Village, Buleleng District, Buleleng Regency. 1.2 Formulation of Problem Based on the background explanation above, the following problems can be formulated as follows what is the soil organic C content in land for Tropical fruit plantations with varying depths in Jinengdalem Village, Buleleng District, Buleleng Regency?

2. Research methods
This research was carried out from December 2019 to June 2020 which was conducted in Jinengdalem Village. Samples were taken on land for tropical fruit plantations in Jinengdalem Village, Buleleng District, and Regency, Bali, Indonesia to be precise behind the Jinengdalem Undiksha Medical Faculty. Sampling using purposive sampling technique. Soil sampling is carried out based on SNI 7724: 2011 in the following manner. Land for plantations was chosen by purposive sampling and one block was made to determine the sampling point which can be seen in Figure 3.2. In the block, it is determined 1 plot with a plot area of 10 × 10 m, soil samples are taken from the plot that has been measured by determining the sampling point (subplot). Then the soil samples were taken from 5 points, namely in the four 19 cardinal directions and in the middle of the plot for the square subplot. Sampling was done by using the composite method, with variations in depth of 10 cm, 20 cm, 30 cm, 40 cm and 50 cm. While taking soil samples using the composite method, at a depth of 10 cm for 5 plots it will be mixed into 1 sample and also for further depth variations. The pH determination is measured by a pH meter. The bulk density determination was carried out by inserting the soil sample into the oven with a temperature of 105 ° C for 3 hours. The soil samples that have been dry and prepared were put in a beaker. The soil sample weight (g) and the sample volume (cm3) in the beaker were recorded. BD is determined by dividing the sample weight of soil (g) and by the sample volume (cm3). The determination of BD is carried out using the following equation 1 (Litbang, 2006). BD = dry weight of sample (gram), and sample volume (cm3). The determination of the Percentage of Soil Organic Carbon was undertaken following the Walkley and Black method as referred by [10].

The percentage of soil organic carbon can be determined by equation as follows.

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\% C = \frac{(V_{\text{blank}} - V_{\text{sample}})}{0.3} \times N \times \text{Wt}
\]  

(1)
3. Results and discussion

3.1. Results

The results obtained from this study are in the form of quantitative data on acidity (pH), bulk density, organic carbon and total nitrogen. The following are the test results of soil content for tropical fruit plantations which can be observed in Table 1.

Table 1. Sample test results of pH Bulk density (g / cm3) c-organic, n-total.

| No. | Depth (Cm) | Water Content (%) | pH  | Bulk Density (g/cm³) | C-Organic (%) | N-Total (%) |
|-----|------------|-------------------|-----|----------------------|---------------|-------------|
| 1   | 10         | 23.99             | 6.69| 2.00871              | 0.3733        | 0.00700     |
| 2   | 20         | 23.68             | 6.78| 1.00127              | 0.4200        | 0.00152     |
| 3   | 30         | 23.36             | 6.67| 0.66758              | 0.5133        | 0.00151     |
| 4   | 40         | 24.57             | 6.90| 0.50134              | 0.5600        | 0.00600     |
| 5   | 50         | 24.42             | 6.85| 0.40015              | 0.5133        | 0.00300     |

3.2. Discussion

Based on the tests conducted, it is found that the water content is in the range 23.36-23.99%. According to the standards set by [11], the air content obtained exceeds the set standards, namely 8% - 20% (w / w). The rainfall in Buleleng District in December was 62.0 mm with an average annual rainfall of 105.3 mm [12]. The amount of air content obtained exceeds the standard because on the day before sampling, it was raining in the village of Jinengdalem. Soil reaction (pH) has an important role in essential and insignificant matters, whether it is not micro or macro friendly. The increased solubility of Fe, Al ions and also the activity of soil microorganisms is greatly helped by the state of soil pH [13]. Plant roots will easily absorb the present nutrients in soil conditions that tend to be neutral. In this study, it was found that the pH value was in the range of 6.67-6.90. In organic soil, the highest pH for nutrients is 5.5 and for mineral soils, 6.5. So, neutrality according to pure chemistry definition is different from soil chemistry. According to soil chemistry, neutrality is related to the best conditions for plants [14]. According to Rochayati [15], the pH obtained from the research results is included in neutral pH, which is about 6.6–7.5. Based on the pH obtained, plants that are very suitable for growing at the obtained pH are papaya, orange, chayote, star fruit, sapodilla, snake fruit, mangosteen, passion fruit, and persimmon. For plants that are quite suitable to grow at the pH obtained, namely mango, guava, rambutan, durian, chempedak, langsat domesticum soursop, jackfruit, breadfruit, sugar apple, and longan/litchi [16].

The pH value of agricultural soils ranges from 4-9; in Indonesia soil generally reacts with a large pH ranging from 4.0-5.5; so for soils with a pH of 6-6.5 is quite neutral, although a bit acidic [13]. The increase or decrease in soil pH is influenced by the addition of organic matter, depending on the degree of maturity of the organic matter added to the soil and also depending on the type of soil. The decrease in pH can be caused by the addition of organic material that has not been ripe or is still in the decomposition process, because during the decomposition process, organic matter will release organic acids which cause the pH to decrease. Meanwhile, if the added organic material has been further decomposed (ripe) it will cause an increase in pH in the soil, because of the release of minerals in the form of alkaline cations that have been mineralized from organic matter [17]. Based on the data obtained, plants that are very suitable (S1) to grow at the obtained pH are passion fruit, sapodilla,
orange, mangosteen, salak, banana, star fruit, papaya and pineapple. Whereas plants that were quite suitable for growth (S2) at the pH obtained were klengkeng, mango, durian, guava, rambutan, soursop, nagka, breadfruit, sugar apple, cempedak and duku.

The bulk density which was obtained from the research results indicated few samples, namely sample 1 with a depth of 10 cm of 2.00871 g/cm$^3$, sample 2 with a depth of 20 cm of 1.00127 g/cm$^3$, sample 3 with a depth of 30 cm of 0.66758 g/cm$^3$, sample 4 with a depth of 40 cm at 0.50134 g/cm$^3$, and sample 5 with a depth of 50 cm at 2.40015 g/cm$^3$. In soil samples with varied depth, a decrease in line with the increasing depth of the taken soil was observed. The amount of bulk density in the soil was caused by the type of soil in the land itself. The high value of soil bulk density can also be used as an indicator of soil fertility. The higher the soil bulk density value, the greater the effect it has on the content in it, especially the soil organic content. According to [18], bulk density is an indicator of soil density. The higher the bulk density value, the denser the soil will be, which means that it is more difficult for water to pass into the soil and hard to penetrate the plant roots. The bulk density in the top layer of mineral soil is lower than that of the soil below. The bulk density values for mineral soils range from 1-0.7 g/cm$^3$, whereas the values for organic soils have a bulk density between 0.1-0.9 g/cm$^3$. The bulk density value can be built by several factors such as soil pores, soil texture, soil structure, organic matter and soil cultivation.

Carbon is a food source for soil microorganisms that can determine soil fertility and productivity. The presence of this element in the soil will spur the activities of microorganisms, thereby increasing the soil decomposition process [19]. The carbon content in the soil reflects the content of organic matter in the soil which is an important measure in terms of soil cultivation. The results of the calculation of the organic carbon content of each sample are sample 1 (0.3733%), sample 2 (0.4200%), sample 3 (0.5133%), sample 4 (0.5600%) and sample 5. (0.5133%). The test results of organic carbon content are included in the very low category because the organic carbon content obtained is <1%, while according to [20], good organic carbon content for soil in the medium category is 2-3% [15]. In this study, the C-organic content obtained from samples 1 - 5 was less than 0.8%. The results show that of the 20 types of tropical fruit, 18 of them are included in the S3 class (according to marginal), which is the land has limiting factors that will affect its productivity so that it requires more input and more precise processing. Meanwhile, passion fruit and breadfruit are included in the S2 class (quite suitable) growing on plantation land for tropical fruit.

The nitrogen content of each sample was 0.007% (Sample 1), 0.00152% (Sample 2), 0.00151% (Sample 3), 0.006% (Sample 4), and 0.003% (Sample 5). The test results of total nitrogen are included in the low category because the total nitrogen content is <0.1%, while according to the [20], the total nitrogen content for good soil is in the moderate category with levels of 0.21% - 0.5% [15]. The low level of total nitrogen is due to the absence of soil processing and the land was former building land. The things that can increase the total nitrogen content are by adding organic fertilizers, such as urea and bioarang fertilizers.

4. Conclusion
The results of this study indicate that the deeper the soil is, the higher the organic carbon content; the highest organic carbon content is at a depth of 40 cm at 0.5600%, while the highest N-total content is at a depth of 20 cm which is 0.00152%. Based on the soil criteria, the value of soil organic carbon is very low because the value is <1% and the total N is in the low category because the total nitrogen content is <0.1%. It is necessary to do land management first before using the land for gardening, such as adding organic fertilizers to the soil. It is necessary to take samples with a depth of > 50 cm so that we can know the stratification of the plantation land and be able to manage the land to mitigate climate change.
Refrence

[1] Hadi P U and Susilowati S H 2010 Prospek masalah dan strategi pemenuhan kebutuhan pangan pokok: Seminar Nasional era Baru Pembangunan Pertanian: Strategi Mengatasi Masalah Pangan Bio-Energi dan Perubahan Iklim 25 35–57

[2] Direktorat Jenderal Holtikultura 2015 Rencana strategis direktorat jenderal hortikultura 2015-2019 (Jakarta, Indonesia: Direktorat Jenderal Hortikultura) p 61

[3] BPS Kabupaten Buleleng 2018 Statistik hortikultura Kabupaten Buleleng Buleleng, Bali: BPS Kabupaten Buleleng

[4] Paramarta G Y, Sukaatmadja I P G and Astiti N W S 2017 Penentuan komoditas unggulan pertanian bedasarkan nilai produksi di Kabupaten Buleleng Jurnal Managemen Agribisnis 5(2): 43–48

[5] Anonim 2016 Profil Kabupaten Buleleng (Rencana Program Investa Jangka Menengah (RPIJM) Bidang Cipta Karya Kabupaten Buleleng 2018-2022. [Online] Available: https://sippa.ciptakarya.pu.go.id/sippa_online/ws_file/dokumen/rpi2jm/DOCRIJM_153655_2344bab_2_2017_buleleng.pdf

[6] Dewi E M, Suryaningtyas, D Tj and Suwardi 2011 Aplikasi bahan humat dengan carrier zeolit untuk meningkatkan produksi padi sawah pada Tanah Latosol, Bogor Prosiding Seminar Nasional Zeolit VII Surabaya: Iktatan Zeolit Indonesia Jawa Timur

[7] Favoino E and Hogg D 2008 The potential role of compost in reducing greenhouse gases Waste Management and Research 26(1) 61–9

[8] Bell M and Lawrence D 2009 Soil carbon sequestration-myths and mysteries Tropical Grasslands 43(4) 227–31

[9] Chan K Y, Cowie A, Kelly G, Singh B P and Slavich P 2008 Scoping Paper: Soil Organic Carbon Sequestration Potential for Agriculture in NSW (NSW DPI Science & Research Technical paper)

[10] Estefan G, Sommer R and Ryan J 2013 Methods of Soil, Plant, and Water Analysis : A manual for the West Asia and North Afric region International Center for Agricultural Research in the Dry Areas (ICARDA) [Online] Available: https://www.aktion-wuestenwald.de/app/download/5794918017/Soil,+Plant+and+Water+Analysis+-+ICARDA+2013.pdf

[11] Kementerian Republik Indonesia 2019 Keputusan Kementerian Pertanian Nomor 261/KPTS/SR.310/M/4/2019 tentang persyaratan teknis minimal pupuk organik, pupuk hayati dan pembenah tanah [Online] Available: https://psp.pertanian.go.id/2019/04/keputusan-menteri-pertanian-nomor-261-kpts-sr-310-m-4-2019-tentang-persyaratan-teknis-minimal-pupuk-organik-pupuk-hayati-dan-pembenah-tanah/

[12] Gelman, F., Binstock, R., & Halicz, L. 2011 Application of the Walkley Black titration for Organic carbon quantification in organic rich sedimentary rocks. Real Estate Management and Valuation, 24(4) 70–8

[13] Keputusan Kementerian Pertanian Nomor 261 tahun 2019 tentang Persyaratan Teknis Minimal Pupuk Organik, Pupuk Hayati dan Pembenah Tanah [Regulation] Available: https://psp.pertanian.go.id/2019/04/keputusan-menteri-pertanian-nomor-261-kpts-sr-310-m-4-2019-tentang-persyaratan-teknis-minimal-pupuk-organik-pupuk-hayati-dan-pembenah-tanah/

[14] Pemerintah Kabupaten Buleleng 2019 Sekapur Sirih Bupati Buleleng dalam Rangka Peresmian Lahan Percobaan Tanam Buah Tropis di Kampus Undiksha [Online] Available: https://bulelengkab.go.id/bankdata/sekapur-sirih-bupati-buleleng-dalam-rangka-peresmian-lahan-percobaan-tanam-buah-tropis-di-kampus-undiksha-68

[15] Fauzi A 2008 Analisa kadar unsur hara karbon organik dan nitrogen di dalam tanah perkebunan kelapa sawit Bengkalis Riau [Thesis] (Medan, Indonesia: Universitas Sumatera Utara)
[14] Notohadiprawiro T 1983 *Persoalan tanah masam dalam pembangunan pertanian di Indonesia* (Yogyakarta, Indonesia: Fakultas Pertanian, Universitas Gadjah Mada)

[15] Rochayati S 2018 *Interpretasi data hasil analisis tanah, tanaman, dan pupuk* Bogor, Indonesia: Balitbangtan

[16] Djaenudin D, Marwan H, Subagjo H and Hidayat A 2011 *Petunjuk teknis evaluasi lahan untuk komoditas pertanian* (Kedua) (Bogor, Indonesia: Badan Litbang Pertanian)

[17] Nazir M, Syakur and Muyassir 2017 Pemetaan kemasaman tanah dan analisis kebutuhan kapur di Kecamatan Keumala Kabupaten Jurnal Ilmiah Mahasiswa Pertanian Unsyiah *2*(1) 21–30

[18] Hardjowigeno S 2003 *Ilmu Tanah* (Jakarta, Indonesia: Penerbit Akademika Pressindo)

[19] Utami S N H and Handayani S 2003 *Sifat kimia entisol pada sistem pertanian organik Ilmu Pertanian* *10*(2) 63–9

[20] Balai Penelitian Tanah 2005 *Petunjuk teknis analisis kimia tanah, tanaman, air dan pupuk* (Bogor, Indonesia: Balai Penelitian Tanah) pp 81–7