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**SOIL ASSESSMENT QUALITY OF ARABICA COFFEE IN AIE DINGIN, LEMBAH GUMANTI FOR SUSTAINABLE AGRICULTURE**

**Endar Hidayat<sup>1\*</sup>, Irwan Darfis<sup>2</sup>, Yuzirwan Rasyid<sup>2</sup>, Gusmini<sup>2</sup> and Hiroyuki Harada<sup>1</sup>**

<sup>1</sup>Department of Environmental Science, Prefectural University of Hiroshima, Shobara, Japan

<sup>2</sup>Department of Soil Science, University of Andalas, Padang, Indonesia

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**ABSTRACT**

Arabica coffee is one of the main crop in Aie Dingin, Lembah Gumanti. However, production of arabica coffee in Aie Dingin is still low. Thus, this is important for analysis and assessment soil quality which have related to production of arabica coffee. The present study was conducted in Aie Dingin, Lembah Gumanti. The composite sample were collected from 0-20 cm, 20-40 cm, and 40-60 cm of soil depth in 12 location. The analysis of soil included: soil pH, cation exchange capacity (CEC), organic matter (OM), and base saturation (BS). The results showed that the most area in acidity, cation exchange capacity (CEC), organic matter (OM), and base saturation (BS) are dominant very low. For improving soil quality, we suggestion adding lime and fertilizer also growing protecting crops for prevent high rainwater directly to land field so that leaching was not occurred.

**Keywords:** Coffee, soil quality, Aie dingin, coffee production, soil nutrient.

**1. INTRODUCTION**

Coffee is one of the most important agricultural commodities in Indonesia. The contribution of this crop have influence in economic sectors. The mainly exported coffee to Japan, India, USA, Singapore, and China [1]. Generally, production of coffee in West Sumatera Province (2413 tons) with total area (8337 ha) in 2019 [2,3].

Arabica coffee is one the most populer coffee in the world which cause the tasted is suitable for many people and high price. Aie dingin is located in highland of West Sumatera Province which have elevation more than 1000 m asl, it might be suitable for growing arabica coffee. However, production of arabica coffee in Aie Dingin is still low with 450 kg/ha/year [4]. According to [5] that production of arabica coffee per year can be reach 1.8 tons/ha. Thus, this is important for finding the problem for increasing of productivity.

Soil nutrient is the main important factors influence to the productivity of arabica coffee [6]. Acidity, cation exchange capacity, organic matter is the problem in soil fertility. On the other hand, abiotic factors also influence to the soil quality such as rainwater. So, this study was carried out to assessment soil quality in area of arabica coffee plantation. This is important information to coffee farmers for increasing production of arabica coffee in Aie Dingin, Lembah Gumanti.

## 2. MATERIALS AND METHOD

### 2.1 Location and soil sample

The Aie Dingin has an area of 373.800 ha. It is located between 0°32'14" to 01°46'45" (latitudes) and 100°25'00" to 101°41'41" (longitudes) which elevation from 1200 to 2300 m asl with temperature between 18°C and 20°C and annual rainfall 2333.70 mm/year [4]. The soil samples is taken by composite were collected from 0-20 cm, 20-40 cm, and 40-60 cm of soil depth in 12 location.

### 2.2 Chemical analysis

The pH was measured a ratio 1:5 by following [7]. Organic matter was measured by Walkley and Black method [8]. Cation exchange capacity (CEC) were extracted 1M NH<sub>4</sub>OAc pH 7 using atomic absorption spectrofotometer [9]. Base saturation was calculated in Eq (1):

$$\text{Base saturation (\%)} = \frac{\text{Exchangable Cations (Ca,Mg,K,Na)}}{\text{Cation exchange capacity (CEC)}} \times 100 \quad (1)$$

## 3. RESULTS AND DISCUSSION

(Table 1) shows that the pH value which range between 4.70 and 7.5 with the criteria from slightly acid, acid and neutral. The change pH level in soil depth due to washing process and the accumulation of soil materials by rainwater [10]. The highest volume of rainwater received in soil would be might to become acid might cause increasing hydrogen ions (H<sup>+</sup>). Low pH values requiring liming in soil [11]. Soil organic matter is a source of organic compounds that it can be absorbed by plants. Organic matter in the soil is one of the factors that plays a role in the success of agricultural sectors. This is might cause organic matter can improve soil fertility such as physically, chemically, and biology. (Table 2) shows that the most dominant criteria of organic matter are between very low and low, this might be due to high rainfall. Rainfall is the problem in tropical climates and highland. The high rainfall might be influence degradation of organic matter into humus is quickly and then shaping to become soil nutrient. However, the high rainfall also influence soil nutrient is easy to leach into water surface and make poor organic matter that utilize on coffee plant.

Cation exchange capacity (CEC) is the ability or capacity of soil colloids to absorb cations because they are held negatively charged on clay and humus. As shown in (Table 3), the criteria of CEC value in the range very low to low. Soil with low CEC, indicate they receive large of volume of rainwater to leach some of ionic elements in the horizon. As mentioned by Dai et al. that CEC have significant effect with organic matter (OM) due to influence of soil chemical and physical properties [12]. Base saturation is the result of a comparison between base cations and CEC values. Base saturation are generally a nutrient required by plants and have influence to climate, organic matter and soil pH. As shown in (Table 4), the value of base saturation in the range from 9.59% to 34.01% with criteria between low to very low. This value might be due to rainwater received is higher. The higher amount of base saturation indicates the more acidity and short time to become neutral conditions [13].

**Table 1. Soil pH in Aie Dingin, Lembah Gumanti**

Location	Depth(cm)	Soil pH	Criteria <sup>14</sup>
Aie Dingin/100 <sup>0</sup> 47'2"E/-1 <sup>0</sup> -7'-27"	0-20	5.58	Slightly Acid
	20-40	5.23	Acid
	40-60	4.99	Acid
Aie Dingin/100 <sup>0</sup> 46'45"E/-1 <sup>0</sup> -7'-16"S	0-20	5.00	Acid
	20-40	4.70	Acid
	40-60	4.70	Acid
Aie Dingin/100 <sup>0</sup> 47'4"E/-1 <sup>0</sup> -7'-29"S	0-20	4.95	Acid
	20-40	4.95	Acid
	40-60	5.10	Acid
Aie Dingin/100 <sup>0</sup> 47'18"E/-1 <sup>0</sup> -7'-17"S	0-20	5.01	Acid
	20-40	5.01	Acid
	40-60	5.33	Acid
Aie Dingin/100 <sup>0</sup> 47'23"E/-1 <sup>0</sup> -9'-1"S	0-20	7.5	Neutral
	20-40	7.35	Neutral
	40-60	6.95	Neutral
Aie Dingin/100 <sup>0</sup> 47'24"E/-1 <sup>0</sup> -9'-4"S	0-20	5.36	Acid
	20-40	5.34	Acid
	40-60	5.59	Acid
Aie Dingin/100 <sup>0</sup> 46'26"E/-1 <sup>0</sup> -7'-27"S	0-20	7.30	Neutral
	20-40	7.23	Neutral
	40-60	7.21	Neutral
Aie Dingin/100 <sup>0</sup> 46'28"E/-1 <sup>0</sup> -7'-27"S	0-20	6.01	Slightly Acid
	20-40	6.45	Slightly Acid
	40-60	6.46	Slightly Acid
Aie Dingin/100 <sup>0</sup> 49'21"E/-1 <sup>0</sup> -11'-10"S	0-20	5.94	Slightly Acid
	20-40	6.16	Slightly Acid
	40-60	6.23	Slightly Acid
Aie Dingin/100 <sup>0</sup> 49'20"E/-1 <sup>0</sup> -11'-6"S	0-20	6.39	Slightly Acid
	20-40	6.35	Slightly Acid
	40-60	6.12	Slightly Acid
Aie Dingin/100 <sup>0</sup> 50'39"E/-1 <sup>0</sup> -11'0"S	0-20	6.68	Neutral
	20-40	6.60	Neutral
	40-60	6.76	Neutral
Aie Dingin/100 <sup>0</sup> 50'40"E/-1 <sup>0</sup> -11'-1"S	0-20	6.79	Neutral
	20-40	6.23	Slightly Acid
	40-60	6.89	Neutral

**Table 2. Soil organic matter in Aie Dingin, Lembah Gumanti**

<b>Location</b>	<b>Depth(cm)</b>	<b>Organic matter (%)</b>	<b>Criteria<sup>14</sup></b>
Aie Dingin/100 <sup>0</sup> 47'2"E/-1 <sup>0</sup> -7'-27"	0-20	0.33	Very Low
	20-40	0.28	Very Low
	40-60	0.14	Very Low
Aie Dingin/100 <sup>0</sup> 46'45"E/-1 <sup>0</sup> -7'-16"S	0-20	0.16	Very Low
	20-40	0.24	Very Low
	40-60	0.10	Very Low
Aie Dingin/100 <sup>0</sup> 47'4"E/-1 <sup>0</sup> -7'-29"S	0-20	0.77	Very Low
	20-40	0.34	Very Low
	40-60	0.45	Very Low
Aie Dingin/100 <sup>0</sup> 47'18"E/-1 <sup>0</sup> -7'-17"S	0-20	1.18	Low
	20-40	0.61	Very Low
	40-60	0.17	Very Low
Aie Dingin/100 <sup>0</sup> 47'23"E/-1 <sup>0</sup> -9'-1"S	0-20	0.80	Very Low
	20-40	0.82	Very Low
	40-60	0.61	Very Low
Aie Dingin/100 <sup>0</sup> 47'24"E/-1 <sup>0</sup> -9'-4"S	0-20	1.03	Low
	20-40	0.90	Very Low
	40-60	0.73	Very Low
Aie Dingin/100 <sup>0</sup> 46'26"E/-1 <sup>0</sup> -7'-27"S	0-20	0.51	Very Low
	20-40	0.38	Very Low
	40-60	0.21	Very Low
Aie Dingin/100 <sup>0</sup> 46'28"E/-1 <sup>0</sup> -7'-27"S	0-20	0.24	Very Low
	20-40	0.07	Very Low

	40-60	0.04	Very Low
Aie Dingin/100°49'21"E/-1°-11'-10"S	0-20	0.33	Very Low
	20-40	0.28	Very Low
	40-60	0.14	Very Low
Aie Dingin/100°49'20"E/-1°-11'-6"S	0-20	0.16	Very Low
	20-40	0.24	Very Low
	40-60	0.10	Very Low
Aie Dingin/100°50'39"E/-1°-11'0"S	0-20	0.29	Very Low
	20-40	0.13	Very Low
	40-60	0.19	Very Low
Aie Dingin/100°50'40"E/-1°-11'-1"S	0-20	1.07	Low
	20-40	0.84	Very Low
	40-60	0.74	Very Low

**Table 3. Soil cation exchange capacity (CEC) in Aie Dingin, Lembah Gumanti**

Location	Depth (cm)	CEC (me/100g)	Criteria <sup>14</sup>
Aie Dingin/100°47'2"E/-1°-7'-27"	0-20	7.57	Low
	20-40	5.43	Low
	40-60	4.14	Very Low
Aie Dingin/100°46'45"E/-1°-7'-16"S	0-20	6.96	Low
	20-40	9.56	Low
	40-60	11.25	Low
Aie Dingin/100°47'4"E/-1°-7'-29"S	0-20	9.56	Low
	20-40	9.38	Low
	40-60	9.27	Low

Aie Dingin/100 <sup>0</sup> 47'18"E/-1 <sup>0</sup> -7'-17"S	0-20	8.95	Low
	20-40	6.41	Low
	40-60	4.48	Very Low
Aie Dingin/100 <sup>0</sup> 47'23"E/-1 <sup>0</sup> -9'-1"S	0-20	11.27	Low
	20-40	4.30	Very Low
	40-60	10.54	Low
Aie Dingin/100 <sup>0</sup> 47'24"E/-1 <sup>0</sup> -9'-4"S	0-20	11.98	Low
	20-40	13.16	Low
	40-60	10.06	Low
Aie Dingin/100 <sup>0</sup> 46'26"E/-1 <sup>0</sup> -7'-27"S	0-20	9.33	Low
	20-40	6.24	Low
	40-60	3.46	Very Low
Aie Dingin/100 <sup>0</sup> 46'28"E/-1 <sup>0</sup> -7'-27"S	0-20	5.92	Low
	20-40	10.87	Low
	40-60	6.15	Low
Aie Dingin/100 <sup>0</sup> 49'21"E/-1 <sup>0</sup> -11'-10"S	0-20	8.53	Low
	20-40	7.11	Low
	40-60	6.02	Low
Aie Dingin/100 <sup>0</sup> 49'20"E/-1 <sup>0</sup> -11'-6"S	0-20	4.67	Very Low
	20-40	3.40	Very Low
	40-60	3.57	Very Low
Aie Dingin/100 <sup>0</sup> 50'39"E/-1 <sup>0</sup> -11'0"S	0-20	4.41	Very Low
	20-40	2.83	Very Low
	40-60	9.24	Low
Aie Dingin/100 <sup>0</sup> 50'40"E/-1 <sup>0</sup> -11'-	0-20	5.45	Low

1°S	20-40	8.84	Low
	40-60	6.63	Low

**Table 4. Soil base Saturation (BS) in Aie Dingin, Lembah Gumanti**

Location	Depth(cm)	Base Saturation(%)	Criteria <sup>14</sup>
Aie Dingin/100°47'2"E/-1°-7'-27"	0-20	9.59	Very Low
	20-40	15.96	Very Low
	40-60	19.30	Very Low
Aie Dingin/100°46'45"E/-1°-7'-16"S	0-20	20.09	Very Low
	20-40	11.36	Very Low
	40-60	13.06	Very Low
Aie Dingin/100°47'4"E/-1°-7'-29"S	0-20	11.39	Very Low
	20-40	12.29	Very Low
	40-60	10.57	Very Low
Aie Dingin/100°47'18"E/-1°-7'-17"S	0-20	13.79	Very Low
	20-40	18.13	Very Low
	40-60	21.08	Very Low
Aie Dingin/100°47'23"E/-1°-9'-1"S	0-20	12.03	Very Low
	20-40	21.14	Low
	40-60	10.23	Very Low
Aie Dingin/100°47'24"E/-1°-9'-4"S	0-20	14.85	Very Low
	20-40	13.38	Very Low
	40-60	12.56	Very Low
Aie Dingin/100°46'26"E/-1°-7'-27"S	0-20	11.38	Very Low
	20-40	19.39	Very Low
	40-60	34.01	Low

Aie Dingin/100 <sup>0</sup> 46'28"E/-1 <sup>0</sup> -7'-27"S	0-20	17.93	Very Low
	20-40	11.41	Very Low
	40-60	16.15	Very Low
Aie Dingin/100 <sup>0</sup> 49'21"E/-1 <sup>0</sup> -11'-10"S	0-20	11.21	Very Low
	20-40	16.12	Very Low
	40-60	18.42	Very Low
Aie Dingin/100 <sup>0</sup> 49'20"E/-1 <sup>0</sup> -11'-6"S	0-20	15.14	Very Low
	20-40	19.4	Very Low
	40-60	18.300	Very Low
Aie Dingin/100 <sup>0</sup> 50'39"E/-1 <sup>0</sup> -11'0"S	0-20	17.23	Very Low
	20-40	20.41	Low
	40-60	10.12	Very Low
Aie Dingin/100 <sup>0</sup> 50'40"E/-1 <sup>0</sup> -11'-1"S	0-20	20.67	Low
	20-40	11.40	Very Low
	40-60	20.43	Low

#### 4. CONCLUSION

This study concluded that soil pH in the area coffee of Aie Dingin are mostly acidity, it might be required to adding lime for increasing the value. Organic matter (OM), cation exchange capacity (CEC) and base saturation (BS) are mostly very low. This might be due to the high of rainwater volume is received which leaching in horizon. However, for sustainable agriculture we suggestion for growing protecting crops for prevent of rainwater directly to the land field and also requiring fertilizer for increasing nutrient in soil.

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