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# Evaluation of land suitability for the development of Hiyung cayenne pepper in Hiyung Village, Tapin Tengah District, South Kalimantan

Ratna Taher*, Muhammad Syarbini, and Kamiliah Wilda

Faculty of Agriculture, Lambung Mangkurat University
Jln. A. Yani Km 35.5, Banjarbaru, Kalimantan Selatan 70714, Indonesia
*Corresponding author: ratnapedologi@gmail.com

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## Abstract

Hiyung Village is one of the centers of agricultural production, especially cayenne pepper. The advantage of Hiyung cayenne pepper is its spiciness which has capcaisin compound of 94.5 thousand ppm. It is 17 times spicier than cayenne pepper in general. The success of agricultural cultivation is greatly influenced by the land suitability. Furthermore, soil and environmental conditions affect plant growth and development. This study aims to analyze the soil properties and land characteristics to evaluate their suitability for the development of Hiyung cayenne pepper. This study is a descriptive research, carried out using a land suitability evaluation survey method to obtain data on land characteristics and current land management. Soil samples were taken from five locations, each about 1 km apart. Three sample points were taken at a depth of 0 cm to 20 cm in each location. Observation were made on effective depth, slope, surface rocks, rock outcrops, flood hazard, coarse material in soil cross section, erosion hazard, temperature, mean annual precipitation, length of the dry season, and current land management. The results showed that the actual land suitability is included in the S3 (marginally suitable) with limiting factors of temperature, water availability (rainfall), and nutrient retention (pH and base saturation). Potential land suitability is still included in S3 class (marginally suitable) because the only limiting factors that may be improved are soil pH and base saturation.

## INTRODUCTION

Cayenne pepper (*Capsicum frutescens* L.) is one of the important vegetable commodities widely cultivated in Indonesia. Cayenne pepper is consumed in either fresh or processed forms used as additives and flavorings to improve the taste of food. In addition, cayenne pepper is also used for raw materials in food and pharmaceutical product industries. The prospect of cayenne pepper is quite promising to fulfill domestic consumers and export demands (Sofiarani and Ambarwati, 2020).

Hiyung Village is one of the centers of agricultural production, especially cayenne pepper. Hiyung Village is administratively located in Tapin Tengah District, Tapin Regency, South Kalimantan Province. In an area of 113 ha with a population of 423 families, about 85 % of the population depends on cayenne pepper farming (Dinas Pertanian Kabupaten Tapin, 2017). The cayenne pepper from Hiyung Village is known as hiyung cayenne pepper.

The advantage of Hiyung cayenne pepper is its spiciness. According to tests and publications conducted by the South Kalimantan Agricultural Research and Development Agency, Hiyung cayenne pepper has capcaisin compound up to 94.5 thousand ppm, which is17 times spicier than cayenne pepper in general. Information about Hiyung cayenne pepper, which is 17 times spicier than ordinary cayenne pepper, has now been worldwide. Due to increasing public

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demand and high prices, this chili is widely cultivated. The cultivation of Hiyung cayenne pepper cultivation is expected to increase farmers' income.

The success of agricultural cultivation is greatly influenced by the suitability of the cultivated commodity with the land. Soil and environmental conditions affect plant growth and development. Land suitability evaluation is a process to match the characteristics of land resources for certain uses. This activity applies a scientifically standardized technique, and the results can be used as a guide by land users and planners to identify alternative land uses (Ritung et al., 2007).

Land suitability considers environmental resources (physical suitability) and socio-economic factors (economic suitability) so that land can be used sustainably (Msanya et al., 2001). Land evaluation is carried out by collecting data on the characteristics/ quality of land to obtain information about the feasibility of a land so that appropriate management methods can be determined (Pakpahan, 2018). The characteristics of the land in Hiyung Village is not well known, while Hiyung's cayenne pepper cultivation still follows farmers' tradition.

Therefore, it is necessary to evaluate the land suitability for the development of Hiyung cayenne pepper plants. This study aimed to analyze the soil properties and land characteristics to determine appropriate management as a basis for cultivating this cayenne pepper in other villages or sub-districts in South Kalimantan.

## MATERIALS AND METHODS

The materials used in this research include chemicals for the analysis of soil properties in the laboratory. Meanwhile, the tools used include soil drill, hoe, dagger crowbar machete, measuring instrument and other field tools.

Observation and soil sampling were carried out in Hiyung Village, Central Tapin District, Tapin Regency, Kalimantan Selatan Province. The research was carried out from August to December 2020. This research is a descriptive research, carried out using a land suitability evaluation survey method to obtain data on land characteristics and quality and current land management. Soil samples were taken at five locations, each about 1 km apart. Three sample points were taken at a depth of 0 cm to 20 cm in each location.

Observations were made on effective depth, slope, surface rocks, rock outcrops, flood hazard, coarse material in soil cross section, erosion hazard, temperature, mean annual precipitation, length of the dry season, and current land management. Soil samples were dried, shifted, and analyzed. Soil analysis includes texture, permeability, cation exchange capacity (CEC), base saturation (BS), pH $H_2O$, organic C, total N, $P_2O_5$, $K_2O$, salinity and electrical conductivity (EC).

The data obtained from field observations and the results of laboratory analysis were then used to compile land suitability classes. Land suitability class was arranged based on technical guidelines for land evaluation for agricultural commodities (Djaenudin et al., 2011).

## RESULTS AND DISCUSSION

The results of field observations and the results of soil sample analysis are presented in Table 1. Based on the data in Table 1, each land characteristic can be described as follows:

### Root media (soil drainage, texture, and effective depth)

Soil drainage in the research location is classified as good and slightly blocked. This is due to the fact that

**Table 1.** The land characteristics of the research location in Hiyung Village

| Location | Annual average temperature (°C) | Availability of Water (w) | | Root media (r) | | | Nutrient retention (f) | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Dry month (month) | Annual rainfall (mm) | Soil drainage | Soil texture | Effective depth (cm) | Ca (me.100 $g^{-1}$) | Mg (me.100 $g^{-1}$) | Na (me.100 $g^{-1}$) | CEC (me.100 $g^{-1}$) | BS (%) | pH $H_2O$ | Organic C (%) | Total N (%) | $P_2O_5$ (ppm) | $K_2O$ (ppm) | Salinity (mS.$cm^{-1}$) | Slope (%) | Surface rocks (%) | Rock outcrops (%) | EC (e) | flood hazards (b) |
| Hiyung 1 | 26.10 | 3 | 1,450 | Good, slightly blocked | Clay | > 60 | 6.43 | 0.21 | 0.17 | 46.00 | 15.79 | 4.66 | 7.44 | 0.50 | 6.69 | 0.46 | 0.34 | 0-30 | 0 | 0 | 0 | F0 |
| Hiyung 2 | 26.10 | 3 | 1,450 | Good, slightly blocked | Clay | > 60 | 22.55 | 0.21 | 0.22 | 42.17 | 55.59 | 4.02 | 6.92 | 0.43 | 34.54 | 0.45 | 0.29 | 0-30 | 0 | 0 | 0 | F0 |
| Hiyung 3 | 26.10 | 3 | 1,450 | Good, slightly blocked | Clay | > 60 | 17.46 | 0.21 | 0.05 | 41.31 | 43.92 | 4.50 | 7.53 | 0.38 | 42.73 | 0.42 | 0.22 | 0-30 | 0 | 0 | 0 | F0 |
| Hiyung 4 | 26.10 | 3 | 1,450 | Good, slightly blocked | Clay | > 60 | 6.55 | 0.21 | 0.05 | 40.59 | 17.39 | 4.98 | 8.15 | 0.33 | 1.41 | 0.24 | 0.13 | 0-30 | 0 | 0 | 0 | F0 |
| Hiyung 5 | 26.10 | 3 | 1,450 | Good, slightly blocked | Clay | > 60 | 10.73 | 0.21 | 0.16 | 31.43 | 36.67 | 4.78 | 2.95 | 0.22 | 77.81 | 0.42 | 0.29 | 0-30 | 0 | 0 | 0 | F0 |

cayenne pepper is planted on a high clay textured soil bed. This condition is very suitable for the development of cayenne pepper plants. The soil at the research location has a uniform texture, which is clay. The fine soil texture is not a limiting factor for cayenne pepper plants. Based on the results of soil drilling, the effective depth of the soil is more than 60 cm, so it is not an inhibiting factor for cayenne pepper cultivation.

**Nutrient retention (cation exchange capacity, base saturation, soil pH, and organic C)**

The CEC is high (31.43) to very high (40.59–46.00), making the soil very suitable for the development of cayenne pepper. The base saturation of the research area varies between very low (15.79–17.39), medium (36.67–43.92), and high (55.59). Medium to high base saturation is included in the S1 class (highly suitable) for cayenne pepper plants, while the very low ones are included in the S3 class (marginally suitable). The pH value of the soil in the study area ranges from very acidic (4.02) to acidic (4.50–4.98), which inhibits the growth of chilies, thereby classified as marginally suitable (S3). Cayenne pepper plants can grow well in soils with slightly acidic to slightly alkaline conditions, which is in the pH range of 6.0–7.6. In general, the soil organic C content in the research location was very high (6.92–8.15), classified as very suitable for cayenne pepper plants. The high content of organic C is thought to be due to the provision of manure and the remaining rice yields in the form of straw or swamp grass used by farmers as mulch in the cayenne pepper planting area.

**Nutrient availability (total N, available $P_2O_5$, and available $K_2O$)**

In general, the total N value of land is moderate (0.22–0.50). The N content of soil comes from weathering of organic matter from both manure and grass mulch, or rice straw and inorganic fertilizers given by farmers. Soil P content in the two research locations was very low (1.41–6.69), while in the other three locations, it was high (34.54) and very high (42.73–77.81). The high difference in soil P content is thought to be due to the fertilization pattern applied by farmers. Meanwhile, the soil K conent ranges from low (0.24) to moderate (0.42–0.46).

**Toxicity (Salinity)**

The soil salinity of the research location is classified as very low (0.13–0.34) so that it is not an inhibiting factor for cayenne pepper plants.

**Terrain/mechanization potential (slopes, surface rocks, and rock outcrops)**

The research location is a rice field where the embankment is deliberately made high enough to plant cayenne pepper, no surface rock or rock outcrops are found so that the roots can grow and propagate properly.

**Level of erosion hazard**

There were no signs of erosion or soil loss during field observation. Flat ground conditions and land cover with rice straw mulch or swamp grass, as well as a fairly dense canopy of cayenne pepper plants, contribute to this.

**Actual and Potential Land Suitability**

Actual land suitability is the current suitability of land (based on available data during the survey and evaluation). Meanwhile, potential land suitability is the suitability of the land after the assumption that it is possible to make improvements to the characteristics/quality of the land as a barrier. The actual and potential land suitability for cayenne pepper development at each location is as presented in Table 2 to Table 7.

Table 2 to Table 7 show that the actual land suitability for cayenne pepper plant at the research location in Hiyung Villages is categorized into S3 (marginally suitable) in which the limiting factors include temperature, water availability (rainfall), and nutrient retention (pH and alkaline saturation). The limiting factor of temperature and rainfall cannot be improved so that the potential land suitability class is still S3 (marginally suitable). Cayenne pepper plants grow well at temperatures of 18 °C to 26 °C with a rainfall of 600 mm to 1,200 mm. The average annual temperature and rainfall in Hiyung village are quite high, namely 26.10 °C and 1,450 mm per year, respectively. High temperatures and rainfall harm cayenne pepper plants. According to Santos et al. (2019), temperature can directly affect the physical and chemical properties of water, which will affect soil moisture content, retention, and hydraulic conductivity. It can also cause increased water loss through evapotranspiration. In addition to direct physical effects on soil hydrological properties, increasing temperature causes changes in soil structure, soil organic matter, microbes, and

**Table 2.** Evaluation of the suitability of cayenne pepper plantations in Hiyung Village (Location 1)

| Land characteristic | Value | Actual land suitability class | | Improvement effort | Potential land suitability class | |
|---|---|---|---|---|---|---|
| **Temperature (t)** | | | **S2** | | | **S2** |
| Average of temperature (°C) | 26.10 | S2 | | - | S2 | |
| **Availability of water (w)** | | | **S3** | | | **S3** |
| Dry month | 3 months | - | | | | |
| Rainfall (mm) | 1,450 | S3 | | - | S3 | |
| **Root media (r)** | | | **S1** | | | **S1** |
| Soil drainage | Good, slightly blocked | S1 | | | S1 | |
| Soil texture | Clay (fine) | S1 | | | S1 | |
| Effective depth | > 60 | S1 | | | S1 | |
| **Nutrient retention (f)** | | | **S3** | | | **S2** |
| CEC | 46.00 | S1 | | | S1 | |
| pH | 4.66 | S3 | | + | S2 | |
| Base saturation | 15.79 | S3 | | + | S2 | |
| Organic C | 7.44 | S1 | | | S1 | |
| **Nutrient availability (n)** | | | | | | |
| Total N | 0.50 | - | | | | |
| Available $P_2O_5$ | 6.69 | - | | | | |
| Available $K_2O$ | 0.46 | - | | | | |
| **Salinity (c)** | | | **S1** | | | **S1** |
| Salinity | 0.34 | S1 | | | S1 | |
| **Toxicity (x)** | | | | | | |
| Al saturation | - | - | | | | |
| Depth of Pyrite | - | - | | | | |
| **Ease of tillage (p)** | | | | | | |
| Texture | Clay | - | | | | |
| Structure | - | - | | | | |
| Consistency | - | - | | | | |
| **Potential for mechanization (m)** | | | **S1** | | | **S1** |
| The slope of the land (%) | 0-8 | S1 | | | S1 | |
| Surface rocks (%) | 0 | S1 | | | S1 | |
| Rock outcrop (%) | 0 | S1 | | | S1 | |
| **Erosion hazard (e)** | | | **S1** | | | **S1** |
| Erosion hazard level | 0 | S1 | | | S1 | |
| **Flood hazard (b)** | | | **S1** | | | **S1** |
| Flood | F0 | S1 | | | S1 | |
| | **Actual (A):** | | **S3** | **+** | **Potential (P) : S3** | |

Remarks: (-) Improvements cannot be made, (+) Improvements can be made and will result in advancement of one grade higher

**Table 3.** Evaluation of the suitability of cayenne pepper plantations in Hiyung Village (Location 2)

| Land characteristic | Value | Actual land suitability class | | Improvement effort | Potential land suitability class | |
|---|---|---|---|---|---|---|
| **Temperature (t)** | | | **S2** | | | **S2** |
| Average of temperature (°C) | 26.10 | S2 | | - | S2 | |
| **Availability of water (w)** | | | **S3** | | | **S3** |
| Dry month | 3 months | - | | | | |
| Rainfall (mm) | 1,450 | S3 | | - | S3 | |
| **Root media (r)** | | | **S1** | | | **S1** |
| Soil drainage | Good, slightly blocked | S1 | | | S1 | |
| Soil texture | Clay (fine) | S1 | | | S1 | |
| Effective depth | > 60 | S1 | | | S1 | |
| **Nutrient retention (f)** | | | **S3** | | | **S2** |
| CEC | 42.17 | S1 | | | S1 | |
| pH | 4.02 | S3 | | + | S2 | |
| Base saturation | 55.59 | S1 | | | S1 | |
| Organic C | 6.92 | S1 | | | S1 | |
| **Nutrient availability (n)** | | | | | | |
| Total N | 0.43 | - | | | | |
| Available P2O5 | 34.54 | - | | | | |
| Available K2O | 0.45 | - | | | | |
| **Salinity (c)** | | | **S1** | | | **S1** |
| Salinity | 0.29 | S1 | | | S1 | |
| **Toxicity (x)** | | | | | | |
| Al saturation | - | - | | | | |
| Depth of Pyrite | - | - | | | | |
| **Ease of tillage (p)** | | | | | | |
| Texture | Clay | - | | | | |
| Structure | - | - | | | | |
| Consistency | - | - | | | | |
| **Potential for mechanization (m)** | | | **S1** | | | **S1** |
| The slope of the land (%) | 0-8 | S1 | | | S1 | |
| Surface rocks (%) | 0 | S1 | | | S1 | |
| Rock outcrop (%) | 0 | S1 | | | S1 | |
| **Erosion hazard (e)** | | | **S1** | | | **S1** |
| Erosion hazard level | 0 | S1 | | | S1 | |
| **Flood hazard (b)** | | | **S1** | | | **S1** |
| Flood | F0 | S1 | | | S1 | |
| | **Actual (A):** | | **S3** | **+** | **Potential (P) : S3** | |

Remarks: (-) Improvements cannot be made, (+) Improvements can be made and will result in advancement of one grade higher

**Table 4.** Evaluation of the suitability of cayenne pepper plantations in Hiyung Village (Location 3)

| Land characteristic | Value | Actual land suitability class | | Improvement effort | Potential land suitability class | |
|---|---|---|---|---|---|---|
| **Temperature (t)** | | | **S2** | | | **S2** |
| Average of temperature (°C) | 26.10 | S2 | | - | S2 | |
| **Availability of water (w)** | | | **S3** | | | **S3** |
| Dry month | 3 months | - | | | | |
| Rainfall (mm) | 1,450 | S3 | | - | S3 | |
| **Root media (r)** | | | **S1** | | | **S1** |
| Soil drainage | Good, slightly blocked | S1 | | | S1 | |
| Soil texture | Clay (fine) | S1 | | | S1 | |
| Effective depth | > 60 | S1 | | | S1 | |
| **Nutrient retention (f)** | | | **S3** | | | **S2** |
| CEC | 41.31 | S1 | | | S1 | |
| pH | 4.50 | S3 | | + | S2 | |
| Base saturation | 43.92 | S1 | | | S1 | |
| Organic C | 7.53 | S1 | | | S1 | |
| **Nutrient availability (n)** | | | | | | |
| Total N | 0.38 | - | | | | |
| Available P2O5 | 42.73 | - | | | | |
| Available K2O | 0.42 | - | | | | |
| **Salinity (c)** | | | **S1** | | | **S1** |
| Salinity | 0.22 | S1 | | | S1 | |
| **Toxicity (x)** | | | | | | |
| Al saturation | - | - | | | | |
| Depth of Pyrite | - | - | | | | |
| **Ease of tillage (p)** | | | | | | |
| Texture | Clay | - | | | | |
| Structure | - | - | | | | |
| Consistency | - | - | | | | |
| **Potential for mechanization (m)** | | | **S1** | | | **S1** |
| The slope of the land (%) | 0-8 | S1 | | | S1 | |
| Surface rocks (%) | 0 | S1 | | | S1 | |
| Rock outcrop (%) | 0 | S1 | | | S1 | |
| **Erosion hazard (e)** | | | **S1** | | | **S1** |
| Erosion hazard level | 0 | S1 | | | S1 | |
| **Flood hazard (b)** | | | **S1** | | | **S1** |
| Flood | F0 | S1 | | | S1 | |
| | **Actual (A):** | | **S3** | **+** | **Potential (P) : S3** | |

Remarks: (-) Improvements cannot be made, (+) Improvements can be made and will result in advancement of one grade higher

**Table 5.** Evaluation of the suitability of cayenne pepper plantations in Hiyung Village (Location 4)

| Land characteristic | Value | Actual land suitability class | | Improvement effort | Potential land suitability class | |
|---|---|---|---|---|---|---|
| **Temperature (t)** | | | **S2** | | | **S2** |
| Average of temperature (°C) | 26.10 | S2 | | - | S2 | |
| **Availability of water (w)** | | | **S3** | | | **S3** |
| Dry month | 3 months | - | | | | |
| Rainfall (mm) | 1,450 | S3 | | - | S3 | |
| **Root media (r)** | | | **S1** | | | **S1** |
| Soil drainage | Good, slightly blocked | S1 | | | S1 | |
| Soil texture | Clay (fine) | S1 | | | S1 | |
| Effective depth | > 60 | S1 | | | S1 | |
| **Nutrient retention (f)** | | | **S3** | | | **S2** |
| CEC | 40.59 | S1 | | | S1 | |
| pH | 4.98 | S3 | | + | S2 | |
| Base saturation | 17.39 | S3 | | + | S2 | |
| Organic C | 8.15 | S1 | | | S1 | |
| **Nutrient availability (n)** | | | | | | |
| Total N | 0.33 | - | | | | |
| Available P2O5 | 1.41 | - | | | | |
| Available K2O | 0.24 | - | | | | |
| **Salinity (c)** | | | **S1** | | | **S1** |
| Salinity | 0.13 | S1 | | | S1 | |
| **Toxicity (x)** | | | | | | |
| Al saturation | - | - | | | | |
| Depth of Pyrite | - | - | | | | |
| **Ease of tillage (p)** | | | | | | |
| Texture | Clay | - | | | | |
| Structure | - | - | | | | |
| Consistency | - | - | | | | |
| **Potential for mechanization (m)** | | | **S1** | | | **S1** |
| The slope of the land (%) | 0-8 | S1 | | | S1 | |
| Surface rocks (%) | 0 | S1 | | | S1 | |
| Rock outcrop (%) | 0 | S1 | | | S1 | |
| **Erosion hazard (e)** | | | **S1** | | | **S1** |
| Erosion hazard level | 0 | S1 | | | S1 | |
| **Flood hazard (b)** | | | **S1** | | | **S1** |
| Flood | F0 | S1 | | | S1 | |
| | **Actual (A):** | | **S3** | **+** | **Potential (P) : S3** | |

Remarks: (-) Improvements cannot be made, (+) Improvements can be made and will result in advancement of one grade higher

**Table 6.** Evaluation of the suitability of cayenne pepper plantations in Hiyung Village (Location 5)

| Land characteristic | Value | Actual land suitability class | | Improvement effort | Potential land suitability class | |
|---|---|---|---|---|---|---|
| **Temperature (t)** | | | **S2** | | | **S2** |
| Average of temperature (°C) | 26.10 | S2 | | - | S2 | |
| **Availability of water (w)** | | | **S3** | | | **S3** |
| Dry month | 3 months | - | | | | |
| Rainfall (mm) | 1,450 | S3 | | - | S3 | |
| **Root media (r)** | | | **S1** | | | **S1** |
| Soil drainage | Good, slightly blocked | S1 | | | S1 | |
| Soil texture | Clay (fine) | S1 | | | S1 | |
| Effective depth | > 60 | S1 | | | S1 | |
| **Nutrient retention (f)** | | | **S3** | | | **S2** |
| CEC | 31.43 | S1 | | | S1 | |
| pH | 4.78 | S3 | | + | S2 | |
| Base saturation | 36.67 | S1 | | | S1 | |
| Organic C | 2.95 | S1 | | | S1 | |
| **Nutrient availability (n)** | | | | | | |
| Total N | 0.22 | - | | | | |
| Available P2O5 | 77.81 | - | | | | |
| Available K2O | 0.42 | - | | | | |
| **Salinity (c)** | | | **S1** | | | **S1** |
| Salinity | 0.29 | S1 | | | S1 | |
| **Toxicity (x)** | | | | | | |
| Al saturation | - | - | | | | |
| Depth of Pyrite | - | - | | | | |
| **Ease of tillage (p)** | | | | | | |
| Texture | Clay | - | | | | |
| Structure | - | - | | | | |
| Consistency | - | - | | | | |
| **Potential for mechanization (m)** | | | **S1** | | | **S1** |
| The slope of the land (%) | 0-8 | S1 | | | S1 | |
| Surface rocks (%) | 0 | S1 | | | S1 | |
| Rock outcrop (%) | 0 | S1 | | | S1 | |
| **Erosion hazard (e)** | | | **S1** | | | **S1** |
| Erosion hazard level | 0 | S1 | | | S1 | |
| **Flood hazard (b)** | | | **S1** | | | **S1** |
| Flood | F0 | S1 | | | S1 | |
| | **Actual (A):** | | **S3** | **+** | **Potential (P) : S3** | |

Remarks: (-) Improvements cannot be made, (+) Improvements can be made and will result in advancement of one grade higher

**Table 7.** Actual and potential land suitability for the development of cayenne pepper plants in Hiyung Village

| Location (Point) | Actual land suitability | Limiting factor | Potential land suitability | Limiting factor |
|---|---|---|---|---|
| Hiyung 1 | S3 | t,w,f | S3 | t,w,f |
| Hiyung 2 | S3 | t,w,f | S3 | t,w,f |
| Hiyung 3 | S3 | t,w,f | S3 | t,w,f |
| Hiyung 4 | S3 | t,w,f | S3 | t,w,f |
| Hiyung 5 | S3 | t,w,f | S3 | t,w,f |

Remarks: t= temperature, w= availability of water and rainfall, f= nutrient retention, pH, and base saturation

plant dynamics. Soil heating can negatively affect soil aggregate stability and increase carbon loss. Soil heating can lead to faster macro-aggregate turnover, possibly due to faster decomposition of organic matter.

High rainfall can destroy soil aggregates so that they are easily eroded. Soil erosion is a major threat to food security (Mwango et al., 2016). In addition, high rainfall can cause nutrient leaching (Simanjuntak, 2021). The base saturation of the study area varies between very low, medium, and high, presumably due to leaching, especially in locations with low coverage rates Ca and Na are the exchangeable cations leached the fastest(Pincus et al., 2017).

Climatic conditions, namely temperature and rainfall, greatly affect the decomposition of soil organic matter (Wiesmeier et al., 2019). The combination of high rainfall and temperatures in the tropics causes rapid weathering rates. Higher average rainfall causes a more rapid decrease in CEC, thereby leaching nutrient cations (Pincus et al., 2017). Nutrient loss is an important issue in the protection of soil and water resources. Organic C transport is also important for the global C cycle. The loss of nutrients from agricultural land causes a decrease in soil fertility, which negatively affects plant growth (Korkanç, 2019).

Maintaining the level of soil surface cover, especially organic mulch that has been reduced due to weathering processes, can be done as an anticipatory for high temperatures and rains. The research of Xu et al. (2012) and Mwango et al. (2016) showed that grass cover and plant leaf mulch could affect soil properties, including soil organic matter, organic C, and total N.

The results of interviews with farmers showed that during the rainy season (very high rainfall), the rice fields were quite deep, about 80 cm. Even though it did not inundate the Hiyung cayenne pepper plantations, efforts are still needed to make drainage channels to prevent stagnant water from getting higher and potentially damaging the cayenne pepper plants. Rainwater collection equipment, wells, or water flow from rivers can also be prepared (if possible) so that during the dry season, there is still sufficient water to irrigate the cayenne pepper plants.

The characteristics of land that can be upgraded are pH and base saturation. Moderate management can increase land suitability from S3 (marginally suitable) to S2 (moderately suitable). Management actions that can be taken include applying lime to increase soil pH and providing organic matter in the form of chicken manure or cow dung and straw left-over from rice, vegetables, and fruit crops.

Soil organic matter content needs to be maintained because it has a very important role. Soil organic matter affecting the chemical, physical and biological properties of soil is the main form of C found in soil, which can also be used as an index of soil sustainability (Signor et al., 2018). Increasing soil organic matter content can also partially replace the use of chemical fertilizers and additional irrigation, while restoring the environment. Soil organic C and total N are derivatives of organic matter after decomposition so that total-N is estimated to have a very strong correlation with soil organic C (Mwango et al., 2019).

Increasing the organic matter content of degraded soils can have a positive effect on crop yields. The beneficial effects of crop rotation, cover cropping, and N fertilization cannot be separated from the increase in soil organic C content (Lal, 2020). The amount of organic C in the soil at any given time depends on the long-term balance between C inputs and the rate of loss (Alidoust et al., 2018). Soil moisture determines not only soil organic C input but also microbial activity and soil organic C output. Low and high soil water content reduces microbial activity due to reduced substrate mobility/availability of $O_2$ accumulation of soil organic C (Weismeir et al., 2019). Soil microbes play an important role in the N and C cycle (Nicolás et al., 2019).

Although the evaluation of land suitability is included in the S3 class for cayenne pepper plants. In general, Hiyung cayenne pepper grows well in the research location (Hiyung Village). A brief history conveyed by the head of the new work farmer group (Mr. Junaidi) that Hiyung cayenne pepper was found in Linuh Village, Piani Sub-District by Mr. Subarjo, a young man from Hiyung Village. The cayenne pepper found in Linuh Village was then brought and planted in Hiyung Village since 1980, which was then followed by the local community, and in 2012, it became widely known and was called Hiyung cayenne pepper. Currently, the demand for Hiyung cayenne pepper has come from overseas (currently the barcode-making process is being signed), including Japan and Spain.

The success of Hiyung cayenne pepper cultivation shows that plant has conformity or has adjusted (tolerance) to local conditions The Hiyung cayenne pepper plant may have its suitability pattern so that planting in other areas has not shown similar results. Therefore, further research is necessary to obtain deeper into information.

## CONCLUSIONS

The actual land suitability is included in the S3 class (marginally suitable) with limiting factors of temperature, water availability (rainfall) and nutrient retention (pH and base saturation). Potential land suitability is still included in S3 class (marginally suitable) because the only limiting factors that may be improved are soil pH and base saturation. Management is needed to anticipate high temperatures and rainfall so as not to cause plant damage.

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