

Study Of Land Potential For The Development Of Palm Plants (Arenga Piñata Merr.) Based On The Land Potential Index In Tuhaha Country, East Saparua District, Central Maluku Regency

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Abstract: This research was conducted with the aim of assessing and identifying land potential, outlining information, and providing guidance on potential land use based on the Land Potential Index (LIP) for sugar palm development in Tuhaha Village, covering an area of 1,779.74 ha. The method used was a survey with a land unit-based analysis approach. The Land Potential Index was determined using a multilevel quantitative method, namely by overlaying all parameters: physiography/topography, slope, soil type, rock type, soil depth, soil texture, hydrology, and disaster vulnerability, which were used as limiting factors. Astronomically, the research location is located between 3°32' – °34' South Latitude and 128°40' – 128°41' East Longitude. The results of the score calculation for determining the IPL for each land unit found that the highest score was 29.0 and the lowest score was 20.4, with an interval class of 3. The IPL classes obtained were low potential (interval 20.4 – 23.4), medium potential (interval 23.5 – 26.5) and high potential (interval 26.6 – 29.6). The land area of the low potential class was 1667.90 ha (9.44%), medium potential was 358.44 ha (20.14%) and high potential was 1194.80 ha (67.13%). Land with high potential showed a better level of suitability. This condition has a positive influence on the vegetative growth and productivity of sugar palm plants. The results of this analysis confirm that most of the research areas have good prospects for developing sugar palm as a leading commodity.

Keywords: sugar palm, index, potential, land

INTRODUCTION

Natural resources are abundant in Indonesia, which contributes to the country's reputation as an agricultural powerhouse. *And then there's Merr.* Or better known as palm, it is a product that is underutilized with a huge potential that has not been utilized.

The palm plant is a multipurpose tropical palm that is widespread in Indonesia and Southeast Asia. Research by Hidayat et al. (2020) in *the Journal of Tropical Plantations* stated that almost all parts of palm plants have high economic value, ranging from sap as raw materials for palm sugar and bioethanol, fruit for kolang-kaling, to palm fiber as a construction material and creative industry. A recent study by Lestari et al. (2022) also confirms that agroforestry-based palm oil development is able to significantly increase farmers' household income compared to traditional monoculture systems. This strengthens the position of palm as a strategic commodity in the development of rural economies based on local resources.

In addition to the economic aspect, palm plants have an important ecological function. Research by Prasetyo et al. (2021) shows that a deep and spreading palm root system is able to improve soil aggregate stability and reduce the erosion rate on sloped land >15%. Similar results were reported by Kurniawan and Putri (2024) who stated that annual palm vegetation, including *Arenga pinnata*, contributes significantly to increasing water infiltration and maintaining micro-hydrological balance in tropical hilly ecosystems.

The term land refers to a specific geographic area on the earth's surface that includes all elements of the biosphere, both static and dynamic, both above and below ground. This includes things like the air that is breathed, the water that is drunk, the plants and animals that are encountered, and the consequences of human actions in the past and present (Juhadi, 2007; Brinkman and Smyth, 1973; Vink, 1975; and FAO, 1976). The term land is used to describe the ability and suitability of an area to utilize its existing characteristics efficiently and environmentally friendly (Jaenudin et al., 2011).

The potential for the development of palm plants is greatly influenced by the biophysical conditions of the land, such as climate, topography, type of land, and water availability. To identify the land potential of an area for palm oil growth, an approach based on the Land Potential Index (IPL) is needed. Andini (2017) proposed the Land Potential Index as a tool to assess property potential. In addition, the Land Potential Index is a quantitative method in evaluating land potential that takes into account a number of environmental variables that affect land productivity (Arsyad, 2010). The value of the land potential index is calculated by summing the scores given to each aspect in this evaluation. Sustainable land management, taking into account current and future land capabilities, will greatly benefit from this. A number of factors, including hydrology, slope, soil type, lithology, and vulnerability to disasters, are used to calculate the Land Potential Index. By knowing the Land Potential Index, one can see how different land classifications are distributed in terms of potential (Suharsono et al., 1994).

The country of Tuhaha has available land and potential land that has not been properly inventoried. One of the productive plants that has always been cultivated since the ancestors until now on the land is the palm/enu plant (*Arenga pinnata*). In its daily life, people know it as the (local name) of the mayang tree. The main production of palm trees is sap. One of the main sources of livelihood for some people in the Land of Tuhaha is processing palm (tipar mayang) into palm sugar (brown sugar), soup, vinegar and yeast (sageru/sageru/sagoguer). Palm trees are mostly harvested to take sap, but they are also used to make brooms, namely palm brooms and straw brooms, from the stalks and fibers. According to Siregar and Purwanto (2019), a wide palm root system helps to retain soil and water. Referring to Wiryaatmaja (2022), palm sago is a plant that helps maintain ecological balance in rural areas. It should be noted that sago trees have a unique ecological purpose by helping to protect soil and other natural resources. This study aims to study and identify land potential for palm plant development based on the land potential index value (IPL) and describe information and directions for potential land use based on the land potential index value for palm plant development.

RESEARCH MATERIALS AND METHODS

In the Tuhaha Country, East Saparua District, Central Maluku Regency, the author uses the Land Potential Index to determine the suitability of land for planting palm trees (*Arenga pinnata Merr.*). A 1:23,000 scale land unit map was made by stacking topographic maps, slope slopes, master materials, and land use maps (Figure 1). This map serves as an operational tool.

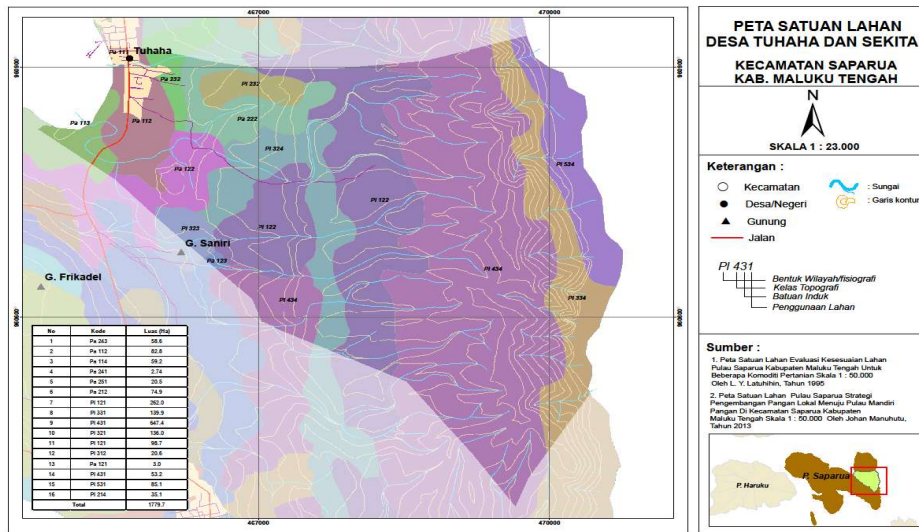


Figure 1. Map of Tuhaha State Land Unit

The method used is the survey method with an analytical approach. Field work was carried out based on the Tuhaha State Land Unit Map.

Intensive observations were carried out on each land unit including physiography/topography, slopes, soil type (external character and internal character), rock type, hydrology and disaster vulnerability and other useful information according to the research title.

Data Processing and Analysis

A tiered quantitative technique is applied in estimating the potential of the land, with all indications and characteristics overlapping.

Physiography, slope slope, soil type, rock type, soil depth, hydrology, and disaster vulnerability are the characteristics used in calculating the land potential index in this study, which refers to Yentri (2016). Weights (scores) are initially applied to each characteristic to determine the Land Potential Index (IPL). The following is the weight given to each parameter.

a. Physiographic/Topographic Factors (F)

Table 1. Physiographic/Topographic Factors

Classes	Physiography	Düsseldorf
F1	Flat – sloping/wavy	5
F2	Bumpy	4
F3	A bit steep	3
F4	Steep	2
F5	Very steep	1

Source : modification from Suahrsono et al., 1994

b. Slope Factor (R)

Table 2. The Importance of the Slope Factor

Classes	Slope Slope	Düsseldorf
R1	0 – 3	5
R2	3 – 8	4
R3	8 – 15	3
R4	15 – 30	2
R5	30 – 45	1

Source: *Suharsono, et al (1994, in Yentri 2016)*

c. Soil Type Factor (S)

Table 3. Property Factor Soil Type

Code	Soil Type	Düsseldorf
S1	Regosol, Lithosol, Organosol	1
S2	Podsolik, Andosol	4
S3	Alluvial Brown, Mediterranean	5
S4	Gley Humus, Renzina, Podsol	3
S5	Lump Sum, Latosol, Grey Alluvial	2

Source: *Suharsono, et al (1994, in Yentri 2016)*

d. Rock Type (B)

Table 4. Lithological Factors

Code	Rock Types	Düsseldorf
B1	Massive igneous rocks	5
B2	Pyroclastic Materials	8
B3	Coarse-grained Clastic sediments	5
B4	Fine-grained Clastic sediments	2
B5	Gamping and Metamorphic Sediments	3
B6	Batu Gamping	5
B7	Alluvium/Coluvium	10

Source: *Suharsono, et al (1994, in Yentri 2016)*

e. Soil Depth (K)

Table 5. Value of Soil Depth Factor

Code	Depth	Düsseldorf
K1	Very deep	5
K2	In	4
K3	Medium	3
K4	Shallow	2
K5	Very shallow	1

Source : *Suharsono, et al (1994, in Yentri 2016)*

f. Soil Texture Class (T)

Table 6. Soil Texture Value

Code	Texture	Düsseldorf
T1	Rough	1
T2	A bit rough	4
T3	Medium	5
Q4	Rather subtle	3
Q5	Smooth	2

Source : *Suharsono, et al (1994, in Yentri 2016)*

g. Hydrological/Groundwater Factors (H)

Table 7. Hydrological Factors

Code	Hydrology	Düsseldorf
H1	High productivity, wide spread	5
H2	Medium productivity, wide spread	4
H3	Local medium-high productivity	3
H4	Local small-medium productivity (local)	2
H5	Scarce groundwater	0

Source: *Suharsono, et al (1994, in Yentri 2016)*

h. Disaster Vulnerability Factors (B)

Table 8. The Dignity of Disaster Vulnerability Factors

Code	Flood	Düsseldorf
B1	Often Flooded	0,6
B2	Sometimes Flooded	0,7
B3	Rarely Flooded	0,8
B4	Without	1,0

Source: *Riyadi (1994) in Yentri 2016)*

A tiered quantitative procedure is applied in estimating the Land Potential Index. All limiting criteria, including physiography, slope, soil type, rock type, soil depth, soil texture, hydrology/groundwater, and vulnerability to disasters, are stacked. First, the author determines the relative importance of each element by looking at how much it affects the potential of the land. The following formula is applied in calculating the weight of disaster vulnerability: summing up the weights of the following parameters: physiography, slope slope, soil type, rock type, soil depth, soil texture, and hydrological/groundwater value.

$$IPL = (F + R + S + B + K + T + H) * Kb$$

Remarks

IPL	: Land potential index	K	: Soil depth
F	: Physiography/topography	T	: Soil texture
R	: Slope	H	: Hydrology
S	: Soil type	Kb	: Disaster vulnerability
B	: Types of rocks		

After calculating the total score for each unit of land, the interval class obtained from the highest score is made, subtract the lowest score by dividing the number of classes desired. In this study, 3 classes of land potential will be used, namely high, medium and low with the following calculation formula:

$$K_i = \frac{St - Sr}{3}$$

Remarks				
To	:	Interval class	Mr.	: Lowest score
St. John's	:	Highest score	3	: Number of classes

RESULTS AND DISCUSSION

Administrative, Geographical and Astronomical Location

Tuhaha is a study location with an area of 1,779.74 hectares. Located in East Saparua District, Central Maluku Regency, the small town of Tuhaha is administratively part of the northern coast of Saparua Island. Based on the map, the boundaries of Tuhaha village are as follows:

- The North side borders Desa Mahu
- The eastern side is bordered by the lordships of Itawaka and Ihamahu
- The South is bordered by the State of Sirisori Amalatu and
- The west is bordered by the sea (Tuhaha Bay).

Astronomically, the state of Tuhaha is located between 3°32' – °34' S and 128°40' – 128°41' E.

Physiography and Topography

Physiographically, the country of Tuhaha is located in a coastal zone with a few mangrove forests by the sea and hills at the back which is a tropical archipelago character with the form of a landscape in the form of a combination of coastal lowlands, hills to higher areas.

Height of Place

The country of Tuhaha is located at an altitude between 0 – 300 m above sea level (masl). No mountains were found with an altitude of > 500 meters above sea level.

Geology and Parent Materials

Saparua including the islands of Lease, Seram, Ambon and Buru are in the outer circle of the Banda Arc whose formation is closely related to the Banda Dalam Arc. Van Bemmelen, 1949 and Hemilton, 1979 suggested that its composition is dominated by young volcanic andesites that form hilly and highland areas. Furthermore, it was stated that there was also sediment deposition (coral reef, napal, sandstone and conglomerate). These materials are lifted upwards slowly so that they form hills and sedimentary plains.

The results of the field study found that the parent material that formed the soil at the study site consisted of alluvium, andesite interclestic with coral and andesite.

Climate

The average annual rainfall on Saparua Island is 3,287 mm, providing a moderately humid or very wet environment (*perhumid*). Referring to Laimeheriwa (2014), the local rainfall pattern on Saparua Island is characterized by wetter springs (April-September) and drier autumns (October-March). On an annual basis, the most rainy months are June and July (average 581-671 mm/month), while the driest months are November (average 65 mm/month).

The eleven-month growing season on Saparua Island begins in December and continues until October, according to Oldeman's (1975) climate categorization system. The island is located in the C1 Agroclimatic Zone. In addition, tropical rainforest vegetation as well as very high rainfall indicate a Type A climate in this area, referring to the Schmidt-Ferguson (1951) climate classification.

The sea temperature on Saparua Island averages 26.6 degrees Celsius throughout the year, with the lowest temperature being 25.2-25.3 degrees Celsius in July and August and the highest temperature of 27.6-27.8 degrees Celsius in November and December. The maximum annual average air temperature is 30.4°C, with a range of 27.9°C in July and 32.1°C in December. The lowest air temperature each year is 23.8 degrees Celsius, with monthly averages ranging from 23.1 degrees Celsius in August to 24.1 degrees Celsius in December, January and April.

December, January, and February have the lowest average monthly relative humidity of 81%, while June has the highest humidity of 89%. In July, when rainfall is highest, the proportion of sunny hours is 29%, and in November, when rainfall is lowest, the proportion of sunny hours is 79%.

Soil

The determination of soil classification units is based on the National Soil Classification Technical Guidelines (Subardja et al., 2014) and its approach with the Soil Taxonomy Classification System (Soil Survey Staff, 2014).

The results of field observations found soil types Aluvial (Fluvents), Regosol (Psamments), Gleisol (Aquepts) and Kambisol Tropepts).

Hydrology and Inundation

The hydrological system is influenced by the interaction between groundwater and seawater. Surface water in this region is generally in the form of small river flows, springs, and swampy areas that collect rainwater before flowing into coastal areas. The three major rivers that flow through the land of Tuhaha are the Ulamete river, the Ollono river and the Illa river. The headwaters of the Ulamete river are in the lordship of Mahu Village but its flow passes through the state of Tuhaha and empties into the sea. This river flows in the rainy season and in the dry season the river is dry. The Ollono and Illa rivers have dendritic and aqueous drainage patterns throughout the year but in the dry season their water discharge decreases. Soil drainage was observed in the condition of inundation at the ground level as well as the symptoms of the influence of water below the ground surface through the observation of soil color. Overall, the drainage classes in the land of Tuhaha range from poor – very good.

Land Use and Vegetation

Field observations found that the current form of land use in Tuhaha Country is presented in Table 2.

Table 10. Current Land Use Types and Vegetation at the Research Site

Land Use	Vegetation/Land Cover
Mixed garden	Durian, coconut, gandaria, langsung, mangosteen, pineapple, kuini, bicang, mango, avocado, rambutan, guava, orange, cempedak, kedondong, duku, salak, tuber, corn, banana, sago, palm, areca nut, mayang, breadfruit, walnut, gondal, gupasa, salawaku, gayam
Bushes	Kinar, waru, acacia, hanetol, hanekil, hatutul, hanua, coconut wood, betel wood, thornwood, matarano, gumira, kata-kuti, guajawa, sung-supload, alang-alang, wire nails, biroro
Secondary forests	Gondal, gupasa, agarwood, forest bintgrape, lenggua, sureng, pulaka, banyan, pule, tawang, ketapang, forest nutmeg, forest langsung, king wood, enal, shell wood, titi, galala, walnut, mango barabu, ray fruit, samama, marong

Discussion

Land Unit

The part of land that is delineated and mapped is called a land unit. Land units are categorized based on certain characteristics. Land shape, topography, parent materials, and land use are the physical variables of the land that are the basis of the land units in the area studied.

The result of the overlap of the four land characters resulted in 14 land units shown in Table 15 as follows.

Table 15. Land Units at the Research Location

No.	Units Land	Shape of Region/Topography	Slope	Master Materia	Peng. Land	Wide	
						Ha	%
1.	Pa 111	Flat	0 – 3	1	1	58,6	3,29
2.	Bar 112	Flat	0 – 3	1	2	82,8	4,65
3.	Pa 113	Flat	0 – 3	1	3	2,74	0,15
4.	Bar 122	Flat	0 – 3	2	2	59,20	3,33
5.	Pa 123	Flat	0 – 3	2	3	3,00	0,17
6.	Bar 222	Undulating	3 – 8	2	2	74,90	4,21
7.	Pa 232	Undulating	3 – 8	3	2	20,50	1,15
8.	Pl 122	Flat	0 – 3	2	2	360,70	20,27
9.	Pl 232	Undulating	3 – 8	1	2	35,10	1,97
10.	Pl 323	Bumpy	8 – 15	1	3	20,60	1,16
11.	Pl 324	Bumpy	8 – 15	2	4	136,00	7,64
12.	Pl 334	Bumpy	8 – 15	3	4	139,90	7,86
13.	Pl 434	A bit steep	15 – 30	3	4	700,60	39,37
14.	Pl 534	Steep	30 – 45	3	4	85,10	4,78
Total						1779,74	100,00

Land Potential Index

The part of land that is delineated and mapped is called a land unit. Land units are categorized based on certain characteristics. Land shape, topography, parent material, and land use are the physical variables of the land that are the basis of the land units in the area studied (Yentri, 2016).

Physiographic/Topographic Parameters

Physiography is the study of the shape of the earth's surface and the processes that form it and its relationship with environmental conditions (Verstappen (1983). In the study of land potential, physiography is used to determine the basic characteristics of the area that affect the ability and suitability of land for various forms of utilization, such as agriculture, settlements, forestry, and infrastructure development. Areas with flat to sloping physiography usually have a higher land potential value than hilly or mountainous areas because they are easier to manage, have better accessibility, and have a lower risk of disasters.

According to Van Zuidam (1985), the physiographic approach can be used to identify terrain units based on the similarities of topographic, lithology, and geomorphological processes. This approach is widely used in land capability evaluation because it is able to describe the physical condition of the area as a whole. Physiography is also closely related to the process of soil formation and regional water systems. Lowland areas generally have more stable and easily developed conditions than hilly or mountainous areas which have a higher risk of erosion and landslides. In addition, physiographic conditions affect river flow patterns, water infiltration, and vegetation distribution.

Slope Parameter (R)

Slopes show the level of slope of the land surface which greatly affects the stability of the land, the level of erosion, the ability to infiltrate water, and the ease of land management. The steeper the slope, the higher the potential for erosion and landslides so that the potential value of the land tends to be low. On the other hand, flat to sloping land is easier to use for agriculture, settlements, and infrastructure development.

According to Sitanala Arsyad in *Soil and Water Conservation* (2010), slope slope is the main factor that affects the size of surface flow and soil erosion. Steep slopes increase the speed of surface runoff, increasing the ability of water to transport soil particles. Meanwhile, Van Zuidam (1985) stated that slope classification can be used to assess land affordability and land use suitability based on topographical conditions.

Soil Type Parameters (S)

Soil type describes the physical and chemical characteristics of the soil that affect fertility, water-holding ability, aeration, and root development of plants. Fertile soil that has a good structure will provide a higher value of land potential than soil that is poor in nutrients or easily eroded.

According to Sarwono Hardjowigeno (2015), soil properties such as texture, structure, organic matter content, and cation exchange capacity greatly determine land productivity. Soils that have a high nutrient content and crumb structure are generally better for plant growth. In addition, Raymond W. Miller and Roy L. Donahue in *Soils in Our Environment* explain that soil type affects the soil's ability to store water and provide nutrients for plants. Some soil types such as alluvial and latosol generally have high productivity, while lithosol or regosol tend to have limitations for intensive cultivation.

Rock/Lithology Parameters (R)

Rock or lithological parameters indicate the type of land-forming rock that affects soil formation, permeability, slope stability, and mineral content. Certain types of rocks such as alluvium and volcanic materials usually produce more fertile soil than hard rocks or metamorphic rocks.

According to Verstappen (1983), lithology is an important factor in landscape formation because it affects the rate of weathering, erosion, and soil development. Volcanic rocks are generally more easily weathered and produce fertile soil than hard or metamorphic sedimentary rocks. In addition, Bemmelen in *The Geology of Indonesia* explained that the characteristics of rocks greatly determine slope stability and the potential for soil movement.

Lithology also affects the vulnerability of disasters such as landslides and erosion. Rocks that are easily weathered tend to produce thick but less stable soil on steep slopes.

Soil Depth Parameters (K)

The root zone of the plant is determined by the depth of the soil, which is sometimes called the soil profile. The depth of the soil is directly proportional to its capacity to hold water and nutrients, which in turn facilitates the development of crops and agricultural ventures.

According to Sarwono Hardjowigeno (2015), the effective depth of the soil determines the root space of the plant and the capacity of the soil to provide water and nutrients. Deep soil has a better ability to support plant growth than shallow soil. Meanwhile, Sys et al. (1991) stated that soil depth is one of the main parameters in evaluating the suitability of agricultural land.

Shallow soils have limitations on root development and water capacity so that the potential of the land is lower than deep or very deep soil.

Soil Texture Parameters (T)

The relative amount of sand, mud, and clay make up the texture of the soil. Soil aeration, permeability, and cultivability are all affected by its texture. Soil retention capacity is one of these characteristics.

According to Foth (1990), soil texture is the most fundamental physical property of soil because it affects almost all processes in the soil, including the movement of water and air. Medium-textured soils generally have a balance between water holding and drainage ability making them suitable for agriculture. In addition, Brady and Weil in *The Nature and Properties of Soils* explain that coarse-textured soils tend to lose water quickly, while fine textures have poor aeration.

Medium-textured soils are generally best for agriculture because they have a balance between water storage and drainage capabilities. A texture that is too rough causes water to disappear quickly, while a texture that is too smooth can inhibit aeration and infiltration.

Hydrology/Groundwater Parameters (H)

Hydrological parameters are related to the water management conditions of an area, such as groundwater availability, drainage, infiltration, and potential inundation. Good hydrological conditions will support land productivity and reduce the risk of drought and flooding.

According to Asdak (2010), the hydrological condition of an area is greatly influenced by the ability of infiltration, surface runoff, and natural drainage systems. Good water management will increase the availability of groundwater and reduce the risk of land degradation. In addition, Chow (1988) stated that hydrological characteristics strongly determine the sustainability of land use and water resource management.

Areas with sufficient water availability and good drainage have a higher land potential value than areas that are often flooded or lack water.

Disaster Vulnerability Parameters (B)

Disaster vulnerability is a limiting factor in determining IPL because it is related to the level of risk of land damage due to disasters such as erosion, landslides, floods, and earthquakes. The higher the level of disaster vulnerability, the lower the value of land potential.

According to Wisner (2004) in *At Risk: Natural Hazards, People's Vulnerability and Disasters*, disaster vulnerability is a condition that can increase the level of damage caused by natural hazards to humans and the environment. In IPL analysis, this factor is usually used as a multiplier to reduce the final value of land potential in areas that have a high risk of environmental disturbances.

Determination of Land Potential Index Weights

Determination of weights in the analysis of the Land Potential Index (IPL) is an important stage to determine the level of influence of each parameter on the potential of a land. Weights are given based on the size of the contribution of environmental physical parameters to the ability of land to support space utilization activities, such as agriculture, settlements, plantations, and regional development.

According to Sys et al. (1991), weighting in land evaluation is carried out to describe the level of relative importance of each environmental factor to land suitability. Parameters that have a dominant influence on land ability will be given greater weight than parameters that have a smaller influence.

The Land Potential Index is calculated by applying a tiered quantitative approach. This approach involves the imposition of all limiting criteria, which include physiography/topography, slope, soil type, rock type, soil depth, soil texture, hydrology, and sensitivity to disasters. First, the author determines the relative importance level of each element by looking at how much impact it has on its potential land. The vulnerability of an area to disasters is calculated by adding the topographic/physiographic weight, slope, soil type, rock type, soil depth, soil texture, and hydrological characteristics. Class I indicates a high level of potential, Class II indicates a moderate level, and Class III indicates a low level. Each plot of land is given weight in the Land Potential Index (LPI) based on a *scoring system*.

1) Land Unit 111

For the Pa 111 land unit, the value of the land potential index (IPL) is not calculated because it is a settlement that cannot be disturbed or changed for other forms of use.

2) Land Unit 112

Table 16. Results of Land Unit Score Calculation Pa 112

IPL Parameters	Description	Weight
Physiography	Flat	5
Slope (%)	2	5
Soil type	Gleisol	3
Types of rocks	Aluvium	10
Soil depth (cm)	100	4
Soil texture	Dusty clay	2
Hydrology/groundwater	High productivity, wide spread	5
Disaster vulnerability	Often flooded	0,6
Score		20,4

3) Land Unit 113

Table 17. Results of Land Unit Score Calculation Pa 113

IPL Parameters	Description	Weight
Physiography	Flat	5
Slope (%)	2	5
Soil type	Regosol	1
Types of rocks	Aluvium	10
Soil depth (cm)	75	3
Soil texture	Clayey sand	1
Hydrology/groundwater	High productivity, wide spread	5
Disaster vulnerability	Rarely flooded	0,8
Score		24,0

4) Land Unit 122

Table 18. Results of Land Unit Score Calculation Pa 122

IPL Parameters	Description	Weight
Physiography	Undulating	5
Slope (%)	5	5
Soil type	Ambisol	4
Types of rocks	Volcanic andesite	5
Soil depth (cm)	100	4
Soil texture	Dusty clay	3
Hydrology/groundwater	Medium productivity, wide spread	4
Disaster vulnerability	Rarely flooded	0,8
Score		24,0

5) Land Unit 123

Table 19. Results of Land Unit Score Calculation Pa 123

IPL Parameters	Description	Weight
Physiography	Undulating	5
Slope (%)	7	4
Soil type	Ambisol	4
Types of rocks	Andesite volcano	5
Soil depth (cm)	100	4
Soil texture	Clay clay	3
Hydrology/groundwater	Local medium-high productivity	3
Disaster vulnerability	Without	1,0
Score		28,0

6) Land Unit 222

Table 20. Results of Land Unit Score Calculation Pa 222

IPL Parameters	Description	Weight
Physiography	Undulating	5
Slope (%)	8	4
Soil type	Ambisol	4
Types of rocks	Andesite interclad with limestone	2
Soil depth (cm)	> 100	4
Soil texture	Clay	5
Hydrology/groundwater	High productivity, wide spread	5
Disaster vulnerability	Without	1,0
Score		29,0

7) Land Unit Pa 232

Table 21. Results of Land Unit Score Calculation Pa 232

IPL Parameters	Description	Weight
Physiography	Flat	5
Slope (%)	3	5
Soil type	Ambisol	4
Types of rocks	Andesite volcano	5
Soil depth (cm)	100	4
Soil texture	Dusty clay	3
Hydrology/groundwater	Local medium-high productivity	3
Disaster vulnerability	Without	1,0
Score		29,0

8) Land Unit Pl 122

Table 22. Results of Land Unit Score Calculation Pl 122

IPL Parameters	Description	Weight
Physiography	Undulating	5
Slope (%)	7	4
Soil type	Ambisol	4
Types of rocks	Andesite interclad with limestone	3
Soil depth (cm)	100	4
Soil texture	Clay clay	3
Hydrology/groundwater	High productivity, wide spread	5
Disaster vulnerability	Without	1,0
Score		28,0

9) Land Unit Pl 232

Table 23. Results of Land Unit Score Calculation Pl 232

IPL Parameters	Description	Weight
Physiography	Undulating	5
Slope (%)	7	4
Soil type	Ambisol	4
Types of rocks	Andesite volcano	5
Soil depth (cm)	100	4
Soil texture	Dusty clay	3
Hydrology/groundwater	Medium productivity, wide spread	4
Disaster vulnerability	Without	1,0
Score		29,0

10) Land Unit PI 323

Table 24. Results of Land Unit Score Calculation PI 323

IPL Parameters	Description	Weight
Physiography	Bumpy	4
Slope (%)	12	4
Soil type	Ambisol	4
Types of rocks	Andesite interclad with limestone	3
Soil depth (cm)	100	4
Soil texture	Sandy clay	3
Hydrology/groundwater	Local small-medium productivity (local)	2
Disaster vulnerability	Without	1,0
Score		24,0

11) Land Unit PI 324

Table 25. Results of Land Unit Score Calculation PI 324

IPL Parameters	Description	Weight
Physiography	Bumpy	4
Slope (%)	15	4
Soil type	Ambisol	4
Types of rocks	Andesite volcano	5
Soil depth (cm)	100	4
Soil texture	Dusty clay	3
Hydrology/groundwater	Medium productivity, wide spread	4
Disaster vulnerability	Without	1,0
Score		28,0

12) Land Unit PI 334

Table 26. Results of Land Unit Score Calculation PI 334

IPL Parameters	Description	Weight
Physiography	Bumpy	4
Slope (%)	15	4
Soil type	Ambisol	4
Types of rocks	Andesite volcano	5
Soil depth (cm)	100	4
Soil texture	Dusty clay	3
Hydrology/groundwater	Local small-medium productivity (local)	2
Disaster vulnerability	Without	1,0
Score		26,0

13) Land Unit PI 434

Table 27. Results of Land Unit Score Calculation PI 434

IPL Parameters	Description	Weight
Physiography	A bit steep	3
Slope (%)	20	3
Soil type	Ambisol	4
Types of rocks	Andesite volcano	5
Soil depth (cm)	> 100	5
Soil texture	Clay clay	3
Hydrology/groundwater	Medium productivity, wide spread	4
Disaster vulnerability	Without	1,0
Score		27,0

14) Land Unit PI 534

Table 28. Results of Land Unit Score Calculation PI 534

IPL Parameters	Description	Weight
Physiography	Steep	2
Slope (%)	40	2
Soil type	Ambisol	4
Types of rocks	Andesite volcano	5
Soil depth (cm)	100	4
Soil texture	Clay clay	3
Hydrology/groundwater	Local small-medium productivity (local)	2
Disaster vulnerability	Without	1,0
Score		22,0

After knowing the highest and lowest scores for each unit of land, the next step is to determine the IPL interval class with the following formula:

$$K_i = \frac{St - Sr}{3}$$

Description: : K_i = interval class

St. John's = highest score

Mr. = lowest score

3 = number of classes desired

Based on the results of the score calculation for the determination of IPL in each land unit, it was found that the highest score was 29.0 in the land units Pa 123, Pa 222, Pa 232, PI 122, PI 232, PI 234 and PI 434 and the lowest score was 20.4 in the land unit Pa 112. Thus the interval class for IPL calculation is:

$$K_i = \frac{29 - 20,4}{3} = 2,9 = 3$$

With the results of the calculation of the interval class of three, the land potential index obtained is three classes as presented in Table 29 below.

Table 29. Land Potential at the Research Site

Classes	Interval	Land Potential Index	Units Land	Wide	
				Ha	%
III	20,4 – 23,4	Low	Pa 112; Pl 534	167,90	9,44
II	23,5 – 26,5	Medium	Bar 113; Bar 122; Pl 323; Pl 334	358,44	20,14
I	26,6 – 29,6	Height	Pa 123; Pa 222 ; Pa 232 ; Pl 122; Pl 232; Pl 234; Pl 434	1.194,80	67,13
Settlement				58,60	3,29

If viewed from the results of the calculation of the land potential index value, it is known that the research area has land potential that is in the low, medium and high categories for the development of palm plants.

Land with low potential covering an area of 167.90 ha (9.44% of the research area) was found in land units Pa 112 and Pl 534. Land with medium potential of 358.44 ha (20.14% of the research area) was found in land units Pa 113, Pa 122, Pl 323 and Pl 334. Land with high potential of 1,194.80 (67.13% of the research area) was found in land units Pa 123, Pa 222, Pa 232, Pl 122, Pl 232, Pl 234 and Pl 434.

Land with low potential generally has several limiting factors that are quite dominant, such as disaster vulnerability because it often experiences inundation and steep slopes. This condition has the potential to cause less optimal plant growth and relatively low productivity.

Although palm plants have the ability to adapt to various environmental conditions, the existence of high limiting factors in low-category areas causes the level of suitability of the land to be limited for intensive development. Therefore, the development of palm plants in this area requires more intensive land management efforts, such as the application of soil and water conservation techniques, improving soil fertility, and managing more appropriate land use so that plant productivity can be increased.

Thus, areas that are included in the category of low land potential are not a top priority in the development of palm plants, but still have the opportunity to be used in a limited manner by paying attention to aspects of sustainable land management and conservation

Land with medium potential shows that the physical condition of the land in the area is basically quite supportive for the cultivation of palm plants, but there are still several limiting factors that can affect the growth rate and productivity of plants. However, land with medium potential still has good opportunities to be developed, especially if supported by proper land management and conservation techniques.

Land with high potential shows a better level of suitability because it has more supportive physical characteristics of the land. These conditions have a positive influence on vegetative growth and productivity of palm plants, so that their development potential is considered higher than other regions.

The results of this analysis confirm that most of the study areas have quite good prospects in the development of palm plants as a regional leading commodity. Therefore, areas with high potential categories are recommended as priority areas for the development of palm cultivation because they are considered more effective and efficient in supporting increased production and sustainability of land use. The areas with the medium category can still be developed through sustainable land management efforts to minimize the existing limiting factors.

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