



Geographic Information System of Land Suitability for Commodities Featured in Sawang District North Aceh

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Abstract

Actually, Sawang is the largest sub-district in North Aceh, ±38,465 ha or 11.67% of the total area of North Aceh. Consists of thirty nine villages. 3,449 ha are paddy fields and 35,016 ha are non-paddy fields. The use of non-rice field land is usually used by the surrounding community for gardens, forests, and ponds of 27,997 ha. In order to support government programs in improving people's welfare and creating job opportunities, it can be done by developing the potential of agriculture and plantations. Therefore, integrated and complete information is needed regarding the characteristics of land in North Aceh, especially Sawang Sub - District, which is suitable for planting certain types of plants in support of optimal and sustainable land use policies. The purpose of this study is to analyze the nature of the land that is suitable for use as an agricultural area or plantation of superior commodities. The specific purpose of the research is to provide recommendations to local governments to determine policies for the use of vacant land with appropriate plant types. The research steps include preliminary studies, identification of superior commodities, mapping of vacant land, testing of land suitability parameters, determination of land suitability, policy recommendations. Based on the results of the research that has been carried out, the researchers conclude that cocoa is considered the most appropriate plant among several other options, referring to the results of several parameters and observations that have been made, either through spatial studies based on mapping techniques, using special software, or the study of chemical elements, as a support for plant growth, through the results of laboratory tests that have been carried out by the research team.

Keywords: Land suitability, Featured Commodities, Geographic Information Systems, Mapping.

1. Introduction

North Aceh is an agrarian area where most of the population are farmers. The top five superior products are plantation and agricultural products. The area of North Aceh Regency is 3,296.86 Km² consisting of 27 sub-districts which are lowlands with an average height of ± 125 meters above sea level, located at 04.46.00° North Latitude and 05.00.40° North Latitude, and 96.52.00° and 97.31.00° East Longitude [1].

Sawang sub-district consists of 39 villages and it's the largest sub-district in North Aceh, covering an area of 38,465 ha or 11.67% of North Aceh area. 3,449 ha of rice paddy fields and 35,016 ha of non-rice paddy fields. The use of non-rice fields for gardens, forests, and ponds is 27,997 ha. Lead commodities is palm oil with an area of 1490 ha, 930 ha of areca nut, 750 ha of cocoa, 130 ha of rubber [2] [3].

Agriculture development and plantations is one of the efforts to create jobs and improve the welfare for the local community. However, the condition of a land is only suitable for planting certain crops, or it can be suitable for several types of plants. Errors in determining the types of plants to be planted on a land cause low productivity. This causes losses for farmers or investors because the results obtained are not comparable with the costs that have been spent on cultivation [4] [5].

Many parameters and variables are needed to decide which types of plants are suitable for planting on a particular land. For this reason, an integrated information is needed regarding the characteristics of land in North Aceh, especially Sawang District to support optimal and sustainable land use policies. This is what motivated us to create a suitability superior commodities base on Geographic Information System (GIS), specifically for agriculture and plantations. GIS is a system designed to capture, store, and manipulate, analyze, and manage all types of geographic data or in other words a combination of cartography, statistical analysis, and data-based system technology [6] [7] [8].

2. Literature Review

Prime commodities are mainstay commodities that are in accordance with local physical and environmental conditions and also have competitiveness, both in the regional market itself, in other regions of the national scope, as well as in international markets [9] [10]. Determination of superior commodities in a region is a must with the consideration that commodities that are able to compete sustainably



with the same commodities in other regions are commodities that are managed efficiently from a technological socio-economic perspective and have comparative and competitive advantages [11] [12].

Several methods were used to determine the prime commodities in previous studies, including the location quotient (LQ) [13] [14].

2.1. Land Suitability

Land suitability means suitability of a plot of land for a particular use. It is one interpretation of the results of land surveys and mapping. The resulting map shows the location and distribution of soil units. Physical land suitability is based on all the physical properties of the land that are able to support optimum plant growth [15] [16].

2.2. Geographic Information System (GIS)

GIS is a computer system used to collect, examine, integrate, and analyze information related to the earth's surface, according to Prahasta. Basically, the term geographic information system is a combination of three main elements, namely systems, information, and geography. In other words GIS is a system that emphasizes the elements of geographic information which is part of the spatial [17].

On the other hand, according to Chang, it means a computer system consisting of hardware, software, data, human, organizational components used to capture, store, search, analyze, and display geospatial data. Meanwhile, geospatial data describes the location and attributes of spatial features [6] [18].

There are some of GIS applications that have been carried out, especially in the agricultural sector, include land suitability, solar agriculture suitability detect critical land [19] [20].

3. Methods

Sources of data that used by the researcher, consist of primary and secondary data. Primary data to obtain the physical and chemical characteristics of the land. This data was obtained through field survey activities, soil parameter testing, and interviews with agricultural and soil experts. Secondary data was obtained from several literatures that support the research, such as the BPS website, the local government, and work reports, and previous research. Secondary data in the form of rainfall data, soil maps, land use maps, slope maps, geological maps, land contour maps, climate maps (rainfall) and administrative maps, as well as cost data for financial analysis.

4. Results and Discussion

The study was conducted in several areas of vacant land in Sawang sub-district, North Aceh. The following is a general description of the research area.

4.1. Geographical Location

The administrative map of Sawang District can be seen in the image below:

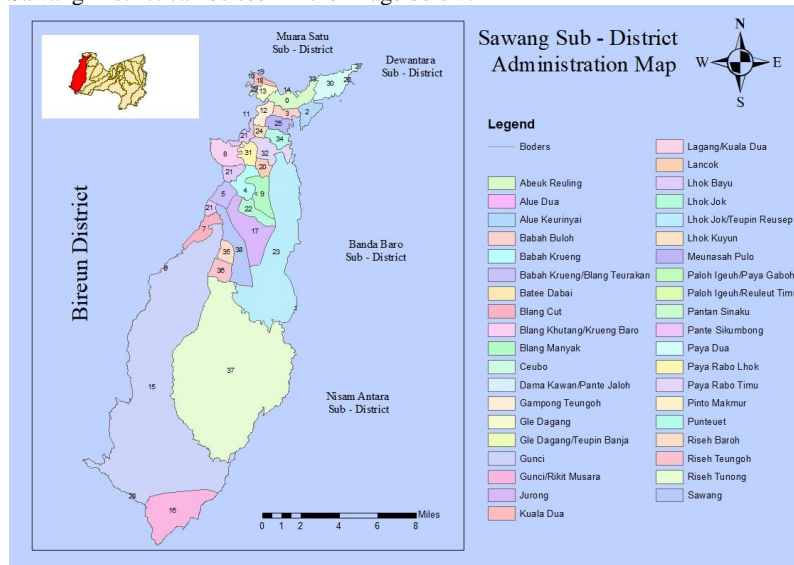


Fig 1. Map of Sawang Sub - District (BPS, 2021)

As shown in the picture above, administratively, Sawang is part of the North Aceh District, consisting of thirty-nine villages. Administratively, it borders several districts and sub-districts, including the following:

- In the north bordered by : Sub – District of Muara Batu, Sub - District of Nisam, and District of Bireuen.
- In the south bordered by : Sub – District of Nisam, District of Bireun, and District of Bener Meuriah.
- In the west bordered by : District of Bener Meuriah and District of Bireun.
- In the east bordered by : Sub – District of Nisam, Sub – District of Dewantara, and Sub – District of Muara Batu.

4.2. Land Use

Most of the land in Sawang District is used for rice cultivation, the rest is vacant land and plantations. Given the existence of a large river, namely Krueng Sawang that flows through this area, so that the water supply can be met throughout the year. As evidenced by the rice production of 6,057 tons/year (BPS, 2021), this sub-district is one of the largest rice contributor areas for North Aceh Regency. Geographically, the land use map can be seen in the image below:

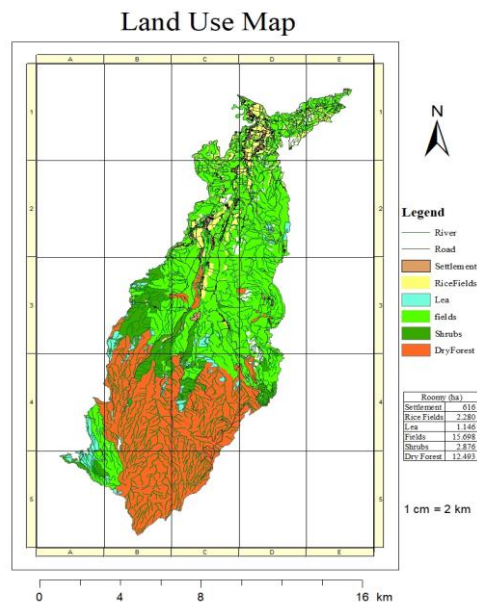


Fig 2. Map of land use in Sawang Sub – District

4.3. Land Slope

According to Van Zuidam in Bernama, (Bernama, 2006). Classification of a land based on the height of an area can determine the suitability of plants to be cultivated. The slope classification can be seen in the following table :

Table 1. Clasification of Land Height

No	Range (MOSL)	Nort Aceh (Ha)	Sawang (%)	Sawang (Ha.)
1	0 – 25	146.096	11,66	17034,8
2	25 – 100	63.781	11,66	7436,86
3	100 – 500	88.526	11,66	10322,1
4	500 – 1000	20.932	11,66	2440,67
5	>1000	10.351	11,66	1206,93
Total		329.686		38441,39

based on the area use map in Figure 2, unproductive land is at an altitude of 100 to 1000 meter above sea level (masl), or is in the rather steep and steep category, and a small part is very steep.

4.4. Temperature and Weather Climate Conditions

Climatological data for the North Aceh Regency area shows that the average monthly air temperature ranges from 25.5°C to 27.5°C, with a range from 18.0°C to 37.0°C, with pressures between 108-102 millibars (BAKOSURTANAL, 2016). The annual rainfall in Aceh Utara Regency ranges from 1,039 mm – 1,907 mm, with an average annual rainfall of 1,592 mm. The highest rainfall generally occurs in October and November, which is 20-21 days, while the lowest rainfall occurs in February and March, which is 2-7 days.

4.5. Identify Featured Commodities

In the plantation sector, coconut, areca nut, and cocoa are some of the leading commodities in this sector. Of all the cocoa plantation sectors, it is the commodity that has the highest economic value, but from the vastness of this sub-district, cocoa production has not been maximized, due to the high level of unproductive land, (BPS, 2021).

Land characteristics, based on the results of laboratory tests conducted at the Faculty of Agriculture, University of North Sumatra, from several soil samples taken at several locations. Soil texture tends to lead to sandy loam, indicating that the soil conditions tend to be a bit dry, besides that there are also several other mineral content that supports the growth and development of certain plants, namely, cocoa.

5. Conclusion

Based on the final results of geographical observations and chemical characteristics of the land, the authors conclude that the vacant land with an area of about ± 12,493 ha, is very suitable for planting cocoa trees as a plant with high economic value, and able to improve the standard of living of the people in the District. Sawang. The following are some conclusions and suggestions that can be found as the final result of the research are as follows:

1. The shape of the land is dominated by its narrowness, which is limited to 88% of the total area, so that there is still a lot of vacant land that cannot be maximized according to his opinion, because the community chooses to live in pepped plains, both highlands and steep.

2. The height of the vacant land is in the range of 500 – 1000 mdpl, where cocoa trees are very suitable to be planted at a maximum height of 800 mdpl.
3. The air temperature in Sawang is in the range of 25.5 C to 27.5° C, and cocoa grows at a minimum temperature of between 300 – 320 C and a minimum of 180 C – 210 C.
4. Rainfall that supports the growth and development of cocoa plants ranges from 1100 – 3000 mm per year. North Aceh has an average rainfall of 1,592 mm/year, and Sawang is the administrative area of North Aceh Regency.
5. There is no soil that is one of the important factors in the growth of cocoa plants, based on the results of laboratory tests, is not conducive enough to grow this plant.

There are several conclusions that can be drawn from the results of this study, therefore the authors suggest that the local government should be more proactive in providing space for investors to invest their capital. Especially in terms of administration and regulation in forest management.

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