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Evaluation of Land Suitability for Sustainable Maize Crops in Popayato District, Pohuwato Regency

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ABSTRACT

Utilisation of land resources requires information on the potential and limitations of land use so that commodities to be cultivated can achieve optimal results. This study aims to determine the suitability of land for corn (Zea mays L.) in Popayato District, Pohuwato Regency. This research uses a qualitative method that combines a statistical analysis approach with spatial analysis techniques. Results pH, texture, effective depth, organic C-C, clay CEC, temperature, rainfall, drainage, slope, altitude, and erosion. The maize crop requires an optimum temperature between 26°C and 807-1200 mm of rainfall annually, which is a uniform distribution of rainfall. The soil has a texture of loam, dusty loam, or sandy loam which is ideal for maize growth and development. Maize requires sufficient aeration so that the plant roots can absorb nutrients well. The soil drainage is good and the growth rate is quite fast.

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Keywords: Suitability, land, actual, potential, maize, Popayato.

INTRODUCTION

Given its potential and much larger land area compared to paddy fields or peatlands, the development of dryland agriculture in Indonesia holds great promise for achieving resilient agriculture in the future. Region A in the monsoon rainfall pattern that has a significant difference between dry season and udimodial rainfall is known as wet climate dryland (Aldrian, 2007). This region is quite widespread, covering 74.58 million hectares, of which 48 million hectares are potentially suitable for food agriculture development.

The main constraint in agriculture is the low level of productivity, characterised by acidic soil reaction, nutrient poverty, low organic matter, iron, manganese, and aluminium content. Low agricultural productivity is mainly caused by low organic matter, low nutrients, acidic soil reaction, high iron, manganese, and aluminium content that exceeds plant tolerance limits, and erosion (Hidayat and Santoso, 2000). The overuse of natural resources to fulfil human needs is currently the most significant environmental problem. The widespread utilisation of natural resources beyond their allocation, such as the conversion of agricultural land to non-agricultural land and the clearing of agricultural land into steep slope areas and protected forests, is a result of population growth and socio-economic pressures.

The world's population of more than 7.5 billion people depends on soil for their survival. It is the foundation for many

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ecosystem functions that sustain human well-being both directly and indirectly (Bach et al., 2020), as a medium for growing plants (Embong et al., 2021), storing plant nutrients (Erizilina et al., 2019), denaturing pollutants and filtering water, sequestering carbon and moderating climate (Lal, 2016), and providing habitat for biodiversity (Idjudin, 2011; Lal, 2016). Soil has an important role in producing goods that can support survival, such as rice and corn, in order to fulfil human needs.

Maize productivity is closely correlated with land quality and characteristics (Subardja and Sudarsono, 2005). After rice, maize (Zea mays L.) is the second most important food crop in Indonesia. Pohuwato District is one of the regions in Indonesia where maize is one of the leading commodities. Of the 643,512.00 tonnes of maize produced annually in Gorontalo Province, Pohuwato Regency is the maize food centre with the highest production (309,088.00 tao/year) (BPS Gorontalo Province, 2022). Even on land with steep slopes, farmers have a tendency to overuse land resources when growing maize. This land has many limitations.

METHODS

This research was conducted in Popayato Sub-district, Pohuwato District, Gorontalo Province. This study used a qualitative methodology that combined a statistical analysis approach with spatial analysis techniques. The area of maize cultivation on maize farms and slope are the observed land characteristics. The location map of the maize farming area in this study is as shown in the following figure.

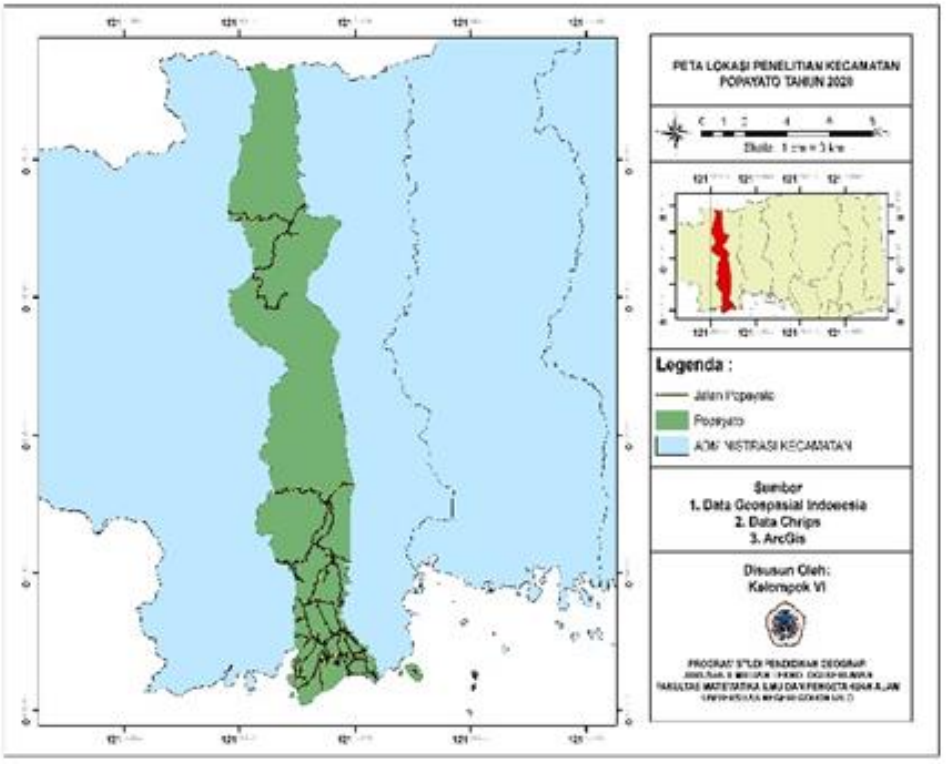


Figure 1. Location Map

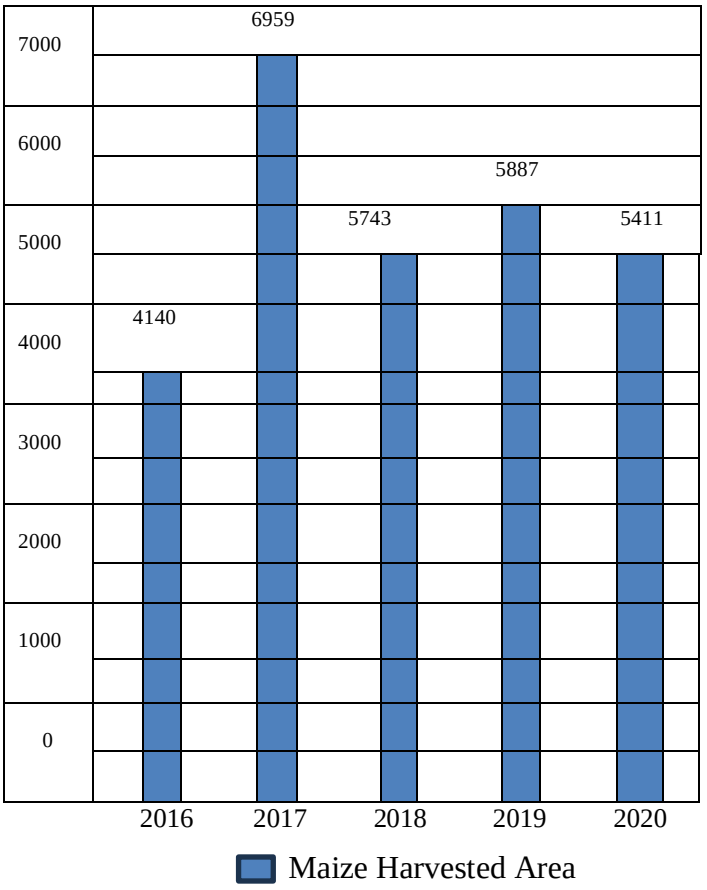
The data analysis method of this research combines statistical and spatial analyses. Spatial analysis techniques utilised Geographic Information System (GIS) concepts. utilised ArcGIS software for spatial analysis and map generation. Digital maps were overlaid with the spatial analyses used. Descriptive statistics were used in the statistical analysis of this study. Maize plantation land area and slope became the standard variables in this study. spatial analysis technically.

RESULTS AND DISCUSSION

Pohuwato Regency consists of 13 districts, including Popayato District. This 90.92 km2 sub-district is bordered by East Popayato Sub-district to the north, West Popayato Sub-district to the west, East Popayato Sub-district to the east, and Tomini Bay to the south. Because of its proximity to the sea, most of Popayato District is coastal. Torosiaje Village, one of the village areas in Popayato District, is located above sea level.

Tegal, or Taman, is also located in Popayato District. Tegal, also known as garden, is an agricultural area that is not used for rice fields (dry land) and is separated from the house yard. It is planted with seasonal or annual crops. If this land is fertile, it may be worked again in a few years.

Harvested area and productivity (yield per hectare) of food crops are the main data collected. Multiplying harvested area by productivity yields food crop production. In Indonesia, harvested area data is collected monthly through the subdistrict wide approach. The method used to collect productivity data is direct measurement on 2½ mx 2½ m maize plots. Productivity data is collected every six months during the farmers' harvest season. The quality of the dry shelled maize production data presented is high. The following presents the Maize Harvested Area (Hectares) in Popayato sub-district, from 2016-2020.



Source: Pohuwato District Agriculture Office

Figure 2. Maize Harvested Area in Popayato Sub-district, from 2016-2020

Figure 2. above illustrates how unevenly farmers produce maize each year; Popayato sub-district has 5,411 hectares of maize land. Additional details on production. Slopes between 0 and 25% are usually good for agriculture. See the following table for more information.

Table 1. Slope of agricultural land

Number	Slope (%)	Relief form slope class
1	0-8%	Flat
2	8-15%	Ramps
3	15-25%	Steep
4	25-45%	Slightly steep
5	>45%	Very steep

Therefore, because the slope is steeper, the work is noticeably more difficult if the slope is less than 25%. The carrying capacity of the activities that will take place decreases as the steepness of the slope increases.

Evaluation of Land Suitability for Maize Crops

Maize can be grown at altitudes between 800 and 1800 metres above sea level in both lowland and upland areas. The following land properties affect the "highly suitable", "moderately suitable" and "marginally suitable" classes: pH, texture, effective depth, organic C-C, clay CEC, temperature, rainfall, drainage, slope, altitude and eryvosion.

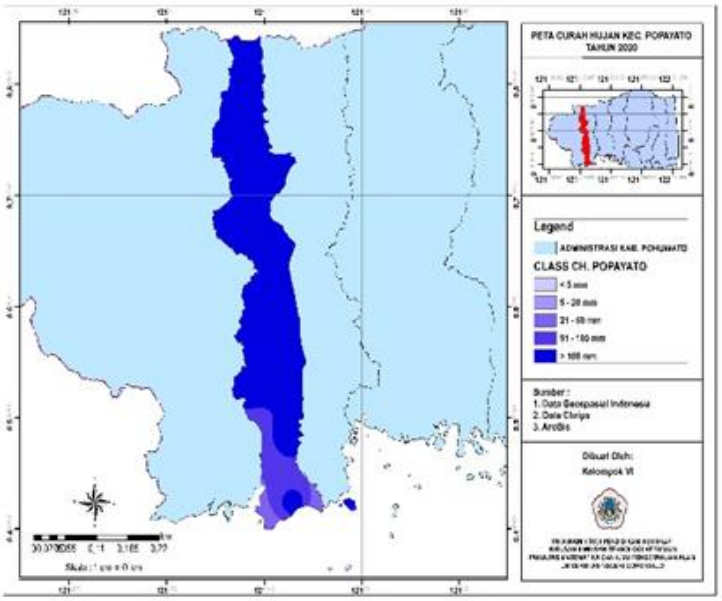


Figure 2. Rainfall Map

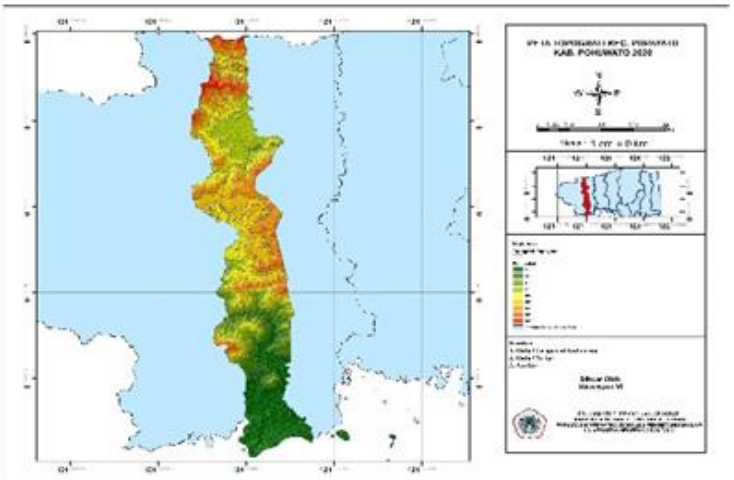


Figure 3. Contour Map

Maize requires an optimum temperature of between 26°C and 807-1200 mm of rainfall annually, which is a uniform distribution of rainfall. The soil has a texture of loam, dusty loam, or sandy loam which is ideal for maize growth and development. Maize requires sufficient aeration so that the plant roots can absorb nutrients well. Soil drainage is good and the growth rate is quite fast.

A pH of 5.5 to 6.5 is required in the soil for maize plants to grow optimally. Lime can be applied to acid soils, which are defined as soils with a pH of less than 5.5. Since organic matter is an adhesive that stabilises soil aggregates and has a good consistency value because it maintains the soil structure so that soil pores cannot close during rainfall, the more organic matter there is in the aggregate, the more stable it is. Between 0 and 800 metres above sea level and between 800 and 1200 metres above sea level, maize plants can grow successfully. Maize should not be grown in areas higher than 1200 metres above sea level.

CONCLUSION

Based on the description that has been presented, the conclusion of this research is that there is a significant effect of rainfall, slope on the growth rate of corn plants on the location of corn farmland. The slope of the slope has a big effect because the slope is steeper, the work will be more difficult if the slope is less than 25%. The carrying capacity of the activities that will take place decreases as the steepness of the slope increases.

Author's declaration

Authors' contributions and responsibilities

The authors made substantial contributions to the conception and design of the study. The authors took responsibility for data analysis, interpretation and discussion of results. The authors read and approved the final manuscript.

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Availability of data and materials

All data are available from the authors.

Competing interests

The authors declare no competing interest.

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