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Identification of the Effectiveness of Land Cover in Some Areas in Borisallo Village for Conservation Measures

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Indonesia possesses abundant land resources suitable for agriculture, characterised by diverse topography variations. The research conducted in Borisallo Village, Parangloe District, Gowa Regency, from October 2023 to April 2024, seeks to ascertain the efficacy of land cover. The analysis was conducted at the Soil Physics and Conservation Laboratory and the Soil Fertility and Chemistry Laboratory of Hasanuddin University. This study gathers both primary and secondary data, which is then transformed into maps representing different land units. Soil samples are collected based on the map and examined in the laboratory to quantify permeability, organic carbon content, specific gravity, and porosity. The findings indicate that certain regions necessitate conservation measures to mitigate the risks of landslides and erosion, particularly in places with inclined terrain, notwithstanding the presence of land cover. Low soil permeability levels suggest the necessity for improved soil management. Implementing conservation measures such as maintaining vegetation cover, employing mechanical stabilisation techniques, and utilising organic materials can enhance soil permeability and mitigate the likelihood of degradation. The implementation of this policy is crucial for ensuring the sustainable utilisation of land and the maintenance of long-term agricultural productivity in Borisallo Village.

Keywords: Slope, Permeability, Conservation, Land Cover, Degradation

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1. Introduction

The increase in population over time provides many changing factors for survival. One thing that is experiencing changes is land cover. Land cover is closely related to the physical and biological surface of the earth which is formed naturally. Land cover is also formed due to human intervention, such as being used to create settlements or agricultural land. Wahyudi et al., (2019) in their research are of the view that the use and utilization of space in an area is actually regulated in the Spatial Planning Plan, but it often happens that the actual implementation conditions experience deviations or even the planning is still not quite right. Apart from that, the spatial planning concept for sustainability must pay attention to several important aspects such as ecology, social, economic and institutional (Widiatmaka et al., 2015).

Land cover provides an overview of appropriate agricultural land planning and evaluates the suitability of land for sustainable crop cultivation activities without damaging the soil with excessive use of chemicals. Mala et al (2016) in their research revealed that differences in land use will determine

the quality of the physical and chemical properties of the soil. Determining the quality of soil fertility is closely related to soil physics, one of which is assessing the amount of soil organic matter content expressed by the C-organic value, while determining the physical quality of soil can be expressed by texture (percentage of sand, dust and clay fractions, unit weight and permeability land.

The organic matter content will affect the size of soil pores which will determine whether the soil has low or high permeability where permeability may also be close to zero if the soil pores are very small (Setyo et al., 2023). Low soil permeability can cause rainwater to become stagnant because the speed at which the soil passes water is slow, this can result in flooding (Adiningsih et al., 2021). Generally, soil permeability is influenced by the physical and chemical conditions of the soil. Texture, organic matter, carbonate content ($CaCO_3$), types of clay minerals and also sesquioxides can influence the permeability value of the soil (Bryk and Kołodziej 2021). Infiltration rates and permeability can also be influenced by the agricultural system implemented by the community. The polycultural farming system is able to increase the infiltration rate and soil permeability so as to reduce surface runoff (Endarwati et al., 2017).

Areas that have less than optimal land cover can result in various negative impacts such as flooding, erosion, landslides and drought which result in other problems on the land, namely that the land is not able to maximize plant productivity because many nutrients are leached, especially land that has a sloping surface (Nuraeni, 2021). Yulina (2015) is of the view that steeper slopes have a higher level of soil erodibility so that Soil is less resistant to erosion and transports material to lower ground. High rainfall at the study site can also cause intense leaching. For this reason, one effort to maximize land cover is soil conservation.

Conservation is an effort to manage and protect resources both with vegetation, mechanics and chemistry. In addition to minimizing the impact of erosion, conservation in agriculture can expand new planting areas that have abundant nutrients, which is expected to increase productivity.

Borisallo is one of the villages in Parangloe District, Gowa Regency, whose area has varying slopes. The slope of the slope greatly influences the level of soil erodibility, the steeper the slope, the higher the soil erodibility, which will affect the low level of organic matter on the upper slope, this is caused by erosion (Kalaati et al., 2019). At each different slope, there are also differences in the amount of organic matter content which can affect the soil permeability value (Suraj et al., 2019).

2. Method

1) Research Area

This research will be carried out in Borisallo Village, Parangloe District, Gowa Regency, South Sulawesi Province from October 2023 until April 2024. Analysis of the physical properties of the soil will be carried out in the Soil Physics and Conservation Laboratory, and analysis of the chemical properties of the soil will be carried out in the Chemistry and Fertility Laboratory Soil, Department of Soil Science, Faculty of Agriculture, Hasanuddin University.

2) Tools and Materials

The tools that will be used in researching the characteristics of soil permeability on different land covers and slopes in Borisallo village are Global Positioning System (GPS), camera, hoe, crowbar, machete, measuring bar, field knife, sample ring, soil drill, stationery., lup, software and ArcGIS 10.8 as well as laboratory equipment. Materials to be used namely Digital Elevation Model SRTM data with a resolution of 30 m, Soil Type Map, Land Cover Map, plastic sugar, labels, disturbed soil samples, as well as chemicals for analyzing soil samples in the laboratory.

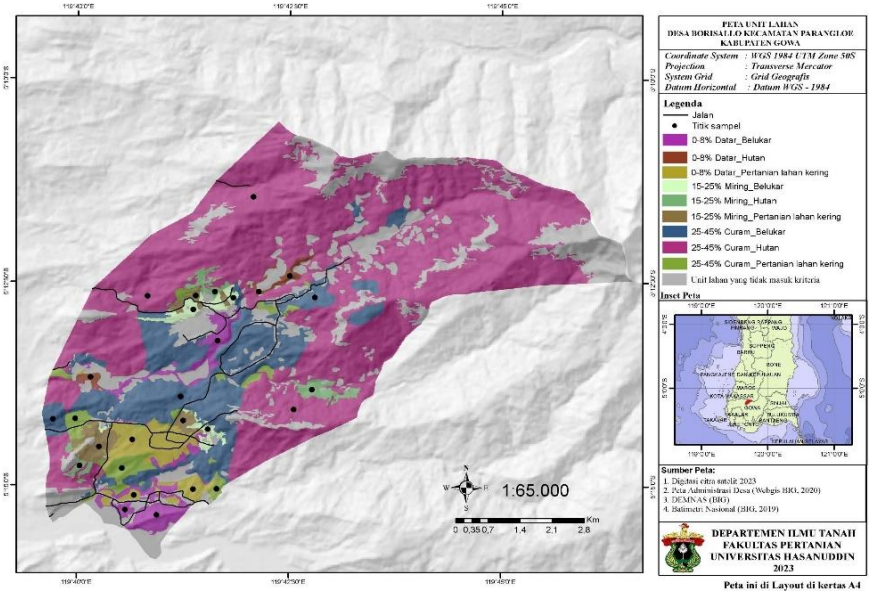


Figure 1. Map Which is the Object of Research

3) Research Methods

This research method uses quantitative data. In the preparatory stage, literature study and data collection were carried out, then primary data and secondary data were collected. After that, the data is processed into a land unit map. Then soil samples are taken according to the points determined based on the land unit map. After taking soil samples, laboratory analysis is then carried out to analyze soil texture, soil permeability, C-organics, bulk density, soil structure, porosity, pore size distribution, grain size distribution, and roots (Suhardjo, 2019).

A literature study was carried out to collect supporting literature related to the methods that will be used and the data collection required for this research.

The data collection stage is carried out by collecting primary and secondary data that supports the research. Primary data collection Primary data collection such as taking coordinate points on secondary dry land forest land use, mixed dry land agriculture, and shrubs, soil texture data, soil permeability, C-organics, bulk density, soil structure, porosity, pore size distribution, grain size distribution, and rooting.

Secondary data that can support such as slope data, soil type data, and land cover data and primary data are collected such as soil texture data, soil permeability, organic C, and roots.

The work map that will be used is a base map . The work map was used as a reference in the field which was created using ArcGIS 10.8. This map is produced by overlaying slope maps, soil type maps and land cover maps. On the work map there are 9 land units that will be used to determine the coordinates for taking sample points. For a more complete image of the land unit map of Borisallo Village, see the attachment section.

1. Field surveys and sampling Field surveys are carried out to see field conditions and determine the location of soil sampling locations. Determination of sample points using the purposive random sampling method.
2. Sampling is carried out to obtain soil samples. Soil samples consist of two types of samples, namely intact soil samples and disturbed soil samples. Soil samples were taken from the top soil or top layer of soil consisting of 3 replications.
3. Plot layout and randomization Plot layout and randomization are based on the results of Arcgis 10.8 software, randomization is generated from the overlay process of the land cover map and slope map. This research was structured in a split plot design with slope slope, as follows: L1 = 0-8% L2 = 15-25% L3 = 25-45% Subplots (AP) are 3 types of land cover, as follows: T1 = Thicket T2 = T3 Forest = Dry Land Agriculture Based on this combination there are 9 treatment combinations, each treatment combination is repeated 3 times to obtain 27 treatment units.



Figure 2. Analysis of physical and chemical properties of soil

4) Data Analysis

Data Analysis Laboratory analysis will be carried out after the field survey is completed by analyzing intact soil samples and disturbed soil samples.

Analysis of variance (ANOVA) was carried out based on a split plot design (RPT). There were 9 treatment combinations, each treatment combination was repeated 3 times to obtain 27 treatment units. If there is an effect of treatment on the analysis of variance, a further DUNCAN test is carried out at a confidence level of 95%.

3. Result and Discussion

Table 1 shows that the permeability character has an interaction between land type and slope level. The lowest permeability value is found in shrub land with a slope of 15-25% (1.65 cm/hour). Meanwhile, shrub land with a slope of 25-45% has the highest permeability compared to others, namely 3.86 cm/hour. Fast permeability will reduce the potential risk of erosion and landslides because water is not retained in one place when the intensity of rain is high. On the other hand, if permeability is slow, the rate of water will slow down until the soil becomes saturated because the water becomes trapped. This is also in line with the opinion of Sugiharyanto et al (2009) that the slower the soil permeability, the more water will be retained in the soil, making the soil saturated. Soil that is saturated with water has the potential to grow if the rain becomes heavier and

longer. This saturation causes the soil grains to be compressed, causing the soil mass to move.
Table 2 shows the range of permeability based on class and value. If correlated with table 1, the area that is the object of research is included in the slow to medium permeability class. Thus, it requires conservation measures as a measure to prevent erosion and landslides on several slopes. Soil permeability is closely related to soil pore characteristics which are also influenced by soil aggregates to determine pore stability. This is in accordance with the opinion of Zaffar and SG Lu (2015) that the shape and number of pores are greatly influenced by the clay content in the soil.

Table 1. Average soil permeability values (cm/hour) on several types of land and slope levels

Treatment	L1 (0-8%)		L2 (15-25%)		L3 (25-45%)		Average	DMRT
T1 (Thicket)	1.76	ap	1.65	ap	1.65	bq	1.65	
T2 (Forest)	2.11	ap	2.18	ap	2.18	ap	2.18	2.57
T3 (Dry Land Agriculture)	1.90	ap	2.35	ap	2.35	ap	2.35	
Average	1.92		2.06		2.73			
DMRT					2.96			

Source: Primary Data, 2023

Table. 2 Value of Soil Permeability

Permeability Class (cm/hour)	Mark	Code
Fast	>25.4	1
It's arriving fast	12.7 - 25.4	2
Currently	6.3 - 12.7	3
Medium to slow	2.0 - 6.3	4
Slow	0.5 - 2.0	5
Very slow	<0.5	6

Source: Arsyad (2010)

Bulk density (BD) of soil with different levels of land slope shows quite large differences, especially between slopes of 0-8%, 15-25% and 24-45%, namely ranging above 2 g/ cm3. The steeper the slope, the smaller the bulk density value. The bulk density value shows the density level of a soil particle. The denser the soil, the higher the bulk density value. On the other hand, if the bulk density value is low, it shows that the soil has many pores and is loose.

Table 3. Average bulk density (g/cm^3) in some slope slopes

Treatment	Average		DMRT
L1 (0-8%)	3.86	c	
L2 (15-25%)	1.25	b	1.17
L3 (25-45%)	1.19	a	

Source: Primary Data, 2023

Agustianto et al., (2021) argue that the lower slopes tend to form new soil due to accumulation from the position of the slope above. This new soil formation tends to have quite a lot of soil cavities. In other research on Bulk Density conducted by Sokolowski et al (2020) it was concluded that untreated soil had a greater Bulk Density value than conventionally cultivated soil in long-term crop rotation on sandy loam soil.
C-organic is an important component in supporting plant productivity on the subject land. C-organic helps bind soil particles thereby increasing soil aggregation and maintaining soil structure stability. The results of the analysis show that dry land agriculture contains slightly more organic C than shrubs and forests. Apart from decomposing plants that can increase the organic content, another factor that can increase the organic content of a land is organic material that is transported and carried to the lowest places from high slopes.

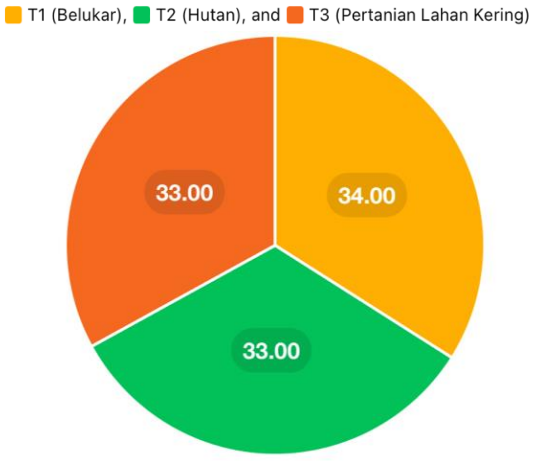


Figure 3. Diagram of the results of organic

C-organic analysis on land that is the object of research. Based on the analysis of the porosity diagram, the porosity values do not have a significant difference between one another. Shrub land has a slightly higher porosity value than dry land and forest farming, namely 34%.
From the porosity figures at the research location, it is still considered safe. The porosity threshold that experiences critical soil damage is if the figure is more than 70% or less than 30%. Soil with a porosity below 30% indicates that the soil has difficulty absorbing water because it is dominated by micro pores. Likewise, if above 70% of the soil it is difficult to bind water because it is dominated by macro pores (Gusmara et al., 2016).

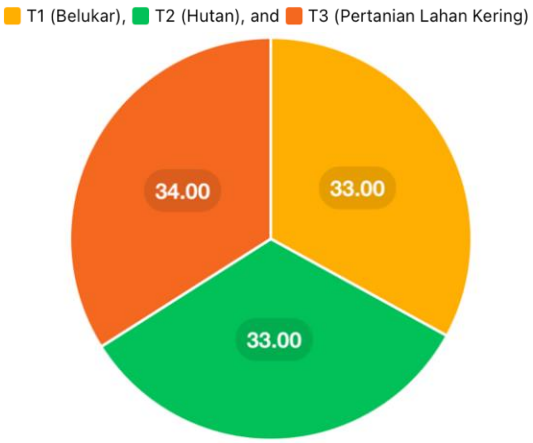


Figure 4. Diagram of porosity analysis results on land that is the object of research

4. Conclusion

From this research it can be concluded that even though there is land cover, several areas in Borisallo village still require conservation measures to prevent landslides and erosion, especially on land that has a slope. This can be seen from the permeability value which is included in the slow category. The bulk density estimations reveal significant differences among different slopes, emphasising the need for tailored conservation efforts. As the incline of the slope becomes steeper, the susceptibility of the soil to erosion rises, resulting in a reduction in the amount of organic matter present and a detrimental effect on the ability of the soil to allow water to pass through.

5. Author Contributions

The first author's contribution is as a compiler and formulation of scientific methodology, while the second author's contribution is to assist the first author in analyzing scientific data, the third author's contribution is to assist with revisions in writing scientific articles, the fourth contribution is to assist with sampling in the field, the fifth contribution is to assist with revision editing scientific articles, the sixth contribution is helping with data collection in the field and soil analysis testing in the laboratory.

6. Completing Interests

The authors have declared that there are no competing interests and that it is a shared research and responsibility.

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