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## Identification of Landslide Potential using Electrical Resistivity Tomography Method Wenner-Schlumberger Configuration in Sampiro, Bolaang Mongondow Utara, North Sulawesi

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**Abstract.** Trans-Sulawesi road was being cut off in the Sampiro village, Bolaang Mongondow Utara district, North Sulawesi caused by the soil movement. This problem gives a loss to the villagers and hampers the economy. This research was using geoelectrical resistivity method and supporting data in the form of well data and standard penetration test value. Geoelectrical resistivity measurements in Sampiro were carried out in 3 measurement trajectories, with various resistivity values. The resistivity value at 4-10  $\Omega\text{m}$  is a layer of high porosity alluvium with 10 meters of thickness and there is a potential for landslides. Resistivity value at 10.3-40  $\Omega\text{m}$  is a layer of sandstone clay and sandstone which having rainwater intrusion. Massive sandstone and claystone layers with resistivity values at 40-70  $\Omega\text{m}$ .

### 1. Introduction

Sampiro is on the north coast of the northern arm of the island of Sulawesi. Based on the regional geological map of the Kotamabagu sheets, Sampiro is included in the Tapadaka formation. The Tapadaka formation is dominated by early miocene-late myocene sandstones and shales [1].

Geotechnical tests are time consuming and expensive. On the other hand, geoelectrical methods are faster and cooperatively cheap [2]. The basic concept of Geoelectrical Method is Ohm's Law which was first coined by George Simon Ohm. He stated that the potential difference arising at the ends of a medium is directly proportional to the electric current flowing on the medium. In addition, he also stated that the electrical resistance is directly proportional to the length of the medium and inversely proportional to its cross-sectional area.

ERT is a geophysical prospecting method. Direct current is injected into the ground through a pair of electrodes and the potential difference is measured between two different electrodes. As the electrical conductivity is closely related to water content and salinity in rocks and soils, it is possible to characterize landslides with great contrast between the dry bedrock and the wet overlying layers. The surface water infiltrates and migrates in the subsurface along fracture zones, fissures, or faults; thus, the spatial distribution of the fracture networks in the slope and hard rock as well as the seepage field characteristics can be deciphered from monitoring the resistivity variations. To figure out the temporal landslide features, it is essential to implement a long-term monitoring system and then assess the landslide potential [3].

Landslide are complex geological phenomena with a high socioeconomical impact also in terms of loss of live and damage. In order to achieve objective of this study, that is to verify the distribution of geoelectrical resistivity of soil in areas associated with mass movement in Sampiro.

The geoelectrical resistivity tomography method is an active geophysical method that can provide 2D or 3D image of the distribution of the electrical resistivity in the subsurface. Currently, the use of geophysical method to contemporary landslide concentrates on the determination of colluvial zone, slip surface, staging of landslides and soil-water condition in the vicinity of the slope [3].



The in-field procedure includes the use of a multi-electrode cable, laid on the ground, to which a number of electrodes are connected at a fixed distance according to specific electrode configuration. The electrodes are used both of the voltage (V) and the injection of the current (I) in the subsoil. Apparent resistivity value can be calculated by knowing the I and V value and the geometrical coefficient depending on the electrode configuration used. The value are positioned at pseudo-depths according to a geometrical reconstruction [4], which the result representing an approximate picture of the true subsurface resistivity distribution [5].

## 2. Data and Method

This research acquisition was conducted in Sampiro, Bolaang Mongondow Utara, North Sulawesi on March 2nd 2019 using geoelectrical resistivity method wenner-schlumberger configuration. The goals was to verify the distribution of electrical resistivity of soil in areas associated with mass movement. Measurements were made using Geomative GD 10 Supreme. The survey was conducted along 60 electrodes using wenner-schlumberger array, the distance of each electrode were 5 meters. The coordinates of the electrode were conducted using GPS (figure.1).

The data sets were processed and inverted using RES2DINV based on a smoothness-constrained least-square method which allow to obtain 2D section through finite differences or finite elements computations, taking into account the topographic correction.



Figure 1. Location of the ERT profile and borehole position, Sampiro.

## 3. Result and Discussion

In the obtained electrifusion cross-section a compliance between borehole profiles with characteristic resistivity diversion in the region of alluvium (4-10  $\Omega$ m), sandstone (40-60 $\Omega$ m), granite boulder (>60  $\Omega$ m) and sandy-claystone (10-40  $\Omega$ m).

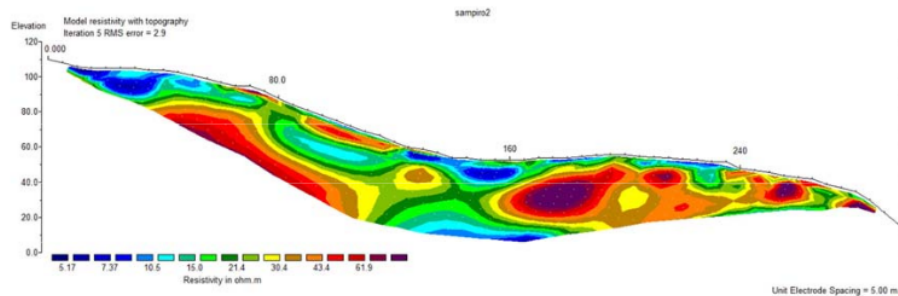


Figure.2 Electrical resistivity cross-section profile 2.

#### 4. Conclusions

By using electrical resistivity tomography (ERT) method it was possible to acquire the distribution of electrical resistivity in the soil in a 2D scheme in sampiro slope. The result of geophysical study have enabled significant expansion of geo-engineering analysis of slope stability with additional information about arrangement of lithological layers and the degree of homogeneity of each layer.

It is important, the result of ERT in sampiro is an indication of the potential slip surface of landslide.

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