

## CHARACTERISTICS AND LAND QUALITY INDEX IN DRY LAND IN MUARA BATU DISTRICT, NORTH ACEH DISTRICT

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### ABSTRACT

Soils in dry land generally have low soil quality. This is related with lack of controlling factors of soil fertility such as the low content of organic matter and nutrients. Land on dry land generally has low soil quality, this is related to the lack of controlling factors for soil fertility such as low organic matter content and nutrients. Research Objectives To provide a general description of the biophysical conditions of dry land in the West Reuleut Village of North Aceh District Muara Batu District and its potential suitability associated with crop development and patterns. This research was carried out on Dryland West Reuleut Village, Muara Batu District, North Aceh Regency. Flat photography is located at an altitude of + 7 meters above sea level. The study began in August 2017 and ended in April 2018. The study began with pre-research with soil sampling. The method used in this study is a semi-detailed survey level free grid survey method. Research Results Based on dry land biophysical conditions, especially the conditions of the agro-climate zone, then several districts in North Aceh as a limiting factor are nutrient retention of pH and soil organic matter, nutrient availability of N, P, K so that to rehabilitate and optimize marginal (critical) land in North Aceh district can be done by planting food crops using intercropping systems

**Keywords:** Dry land, soil quality index, North Aceh district

### INTRODUCTION

Dryland is agricultural land that has the potential to be developed because of its large area. The main problem of farming on dry land is the limited supply of water because it only relies on the arrival of rainwater. In general, dry land is defined as a stretch of land that has never been inundated or inundated at most times of the year (Adimihardja et al., 2000). Farming is carried out on dry land which has a certain cropping pattern in one year. Determining the right cropping pattern can determine the increase in crop production which in turn will increase farmers' income. The soil in dryland generally has low soil quality. This is related to the lack of controlling factors for soil fertility such as low levels of organic matter and nutrients. Rukmana (2001) defines dry land as a plot of land that can be used for agricultural business using or utilizing water in a limited way and usually depends on rainwater. Efforts to improve soil quality can be done by introducing these materials into the soil (Susilowati et al. , 2017). Dryland is also a plot of land that can be used for agricultural businesses using limited water and usually depends on rainwater. Dryland has characteristics which also become limiting factors in the form

of sandy texture, loose structure, low storage capacity, and nutrient content, so that its properties are needed to improve (Yuwono, 2009).

One of the factors that determine the productivity of dry land is the condition of the soil water content which is very dependent on rainfall as the main water source. Most of the plant's water needs are taken from the soil. The water that plants absorb is water that is in the pores of the soil in the root layer. Therefore the ability of the soil to hold water is a major factor that determines plant growth and production. Therefore, to meet national food needs.

The Ministry of Agriculture has launched an optimal soup land utilization program, including dry land, for the development of food crop cultivation. The level of soil quality on dry land in the North Lombok Regency, NTB Province is limited by the physical, chemical, and biological characteristics of the soil which are not favorable for plant growth (Kusumo et al, 2011). The decrease in the ability of the soil to carry out its functions indicates that soil quality has been disturbed, which has increased in critical land, decreased soil productivity, and environmental pollution. One of the causes of decreasing soil quality is a land-use change or land conversion (Arifin, 2011). Strategies that need to be applied to improve soil properties (chemical and biological properties) include providing topsoil and providing organic materials as well as planting easy-to-grow or local plants (Rahmawaty 2002). Research Results Arifin et al., (2006) To improve soil quality in dryland, it is necessary to input 5 tons/ha of organic fertilizer (manure), plus 50% of recommended fertilizer. Positioning dry land as an agricultural food resource is faced

The main problem is low soil quality with a variety of soil fertility problems that differ from one region to another. Doran and Parkin (1994) stated that soil quality is the ability of a soil to function within various ecosystem boundaries in supporting biological productivity, maintaining environmental quality, and improving the health of living things. The results of research conducted by Lukman Hakim. L and Santoso. D, (1980) stated that the role of organic fertilizers in the soil is the key to the success of dryland farming, but only returning the plant residue is not sufficient to maintain soil organic C content in the initial conditions of 2–2.5%. Dryland in Aceh Utara Regency is generally marginal (critical) characterized by shallow soil solum, soil physical and chemical properties that do not support plant growth and production, climate type which is classified into type c according to Schmidt-Ferguson, hot and dry air and humidity is less than 90% and the dominant vegetation consists of shrubs and grasses with narrow and needle-leaved leaves. Based on the above description, it is necessary to research on Changes in Characteristics and Soil Quality Index in Dry Land of Gampong West Reuleut District Muara Batu, North Aceh Regency. to optimize marginal dryland productivity. The purpose of this research is to provide a general description of the biophysical conditions of dry land in Gampong Reuleut Barat, Muara Batu District, Aceh Utara District, and its potential/suitability linked to plant development and patterns.

## METHODS

### Place and time of research

This research was conducted in the dry land of Gampong Reuleut Barat, Muara Batu District, North Aceh Regency. The flat topography is located at an altitude of + 7 meters above sea level. The research began in August 2017 and ends in April 2018

### Materials and Tools

The materials used in this study were soil samples taken from the research location in several drylands of Gampong Reuleut Barat, Muara Batu District, North Aceh Regency as well as chemical materials used for analysis in the laboratory. The tools used in this study were a 1: 50,000 scale soil type map, 1: 50,000 Beringin District Administration Map. Global Positioning System (GPS) to find out the coordinates and altitude of the place, a clinometer to measure the slope of the slope, drill soil to take soil samples, label paper to label soil samples, plastic bags as soil sample containers, rubber bands to tie soil samples in bags plastics, cameras as a tool for documentation of activities, markers, stationery, and tools used for analysis in the laboratory.

### Research methodology

The research began with pre-research with soil sampling. The method used in this research is the free grid survey method at the level of a semi-detailed survey (observation density of 1 sample per 100 meters). The implementation of soil sampling is 5 sample points with a distance of 100 meters in the field using a scattered random method with a predetermined area guided by the base map in the manner shown in Figure 1.

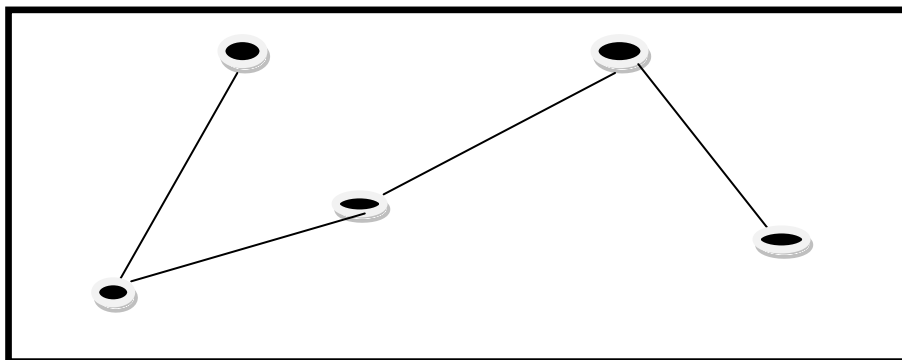


Figure 1. Taking soil sample points in the field

### Research Implementation

#### Preparation phase

The initial survey with the assessment of the location of the method used in this study is a free survey to see and analyze a suitable research area to be carried out by analyzing the physical, chemical, and biological characteristics of dry land.

#### Field Activity Phase

The work begins with a preliminary survey, namely by conducting a field research orientation such as taking coordinates. After the preliminary survey, it is followed by the implementation of the main survey with the main objective of taking composite soil samples. Soil samples were taken in a zig-zag manner at a depth of 0 - 20 cm and then they were compiled from several locations so that some soil samples were obtained. Then put the soil sample into the plastic with a soil weight of approximately 2 kg and given a code on the label for each soil sample. From each soil sampling, the results of the reading of the coordinates on the GPS are recorded as well as the effective depth measurement of the soil where at the time of drilling the drill bit cannot penetrate the soil layer.

Soil samples from each sampling of air-dried soil for examination in the laboratory which include the chemical properties of the soil contained in the soil characteristics table. Soil Analysis Parameters

**Table 1. Chemical and biological analysis parameter**

| No | Parameter           | Unit      | Method                               | Information          |
|----|---------------------|-----------|--------------------------------------|----------------------|
| 1  | N-total             | (%)       | Kjeldhal                             | Chemical Propertis   |
| 2  | P-Avl.              | (ppm)     | Bray II                              | Chemical Propertis   |
| 3  | K-dd                | (me/100g) | Extract 0,1N NH <sub>4</sub> Oac ph7 | Chemical Propertis   |
| 4  | pH.H <sub>2</sub> O | -         | pH Meter aquadest                    | Chemical Propertis   |
| 5  | C-Organik           | (%)       | Walkey and Black                     | Biological Propertis |
| 6  | Organic Ingredients | (%)       | Walkey and Black                     | Biological Propertis |

## DISCUSSION

### Result

The results of the analysis of soil chemical properties and root depth at various observation points in the soil layer are presented in Table 2. Concerning the N, P, and K nutrient status, N and P nutrient status, where N nutrients remain in low status and P remains in low nutrient status. The status of K nutrients at the observation point is in a moderate status. This increase occurs, not only because of the process of churning out organic fertilizers that produce K but mostly due to the role of organic fertilizers as a source of soil organic matter in improving cation exchange capacity (KPK). Organic matter can increase KPK (Hanafiah 2005). Cation exchange capacity is important for soil fertility related to its role as controlling the loss of cation nutrients such as K<sup>+</sup>, NH<sub>4</sub><sup>+</sup> and Ca through the process of leaching.

Table 2. Results of chemical analysis of marginal soils in Gampong Reuleut Barat Village, Muara District, Aceh Utara District, Aceh Province.

| Observation Point/<br>Soil Layer | N-total (%) | P-Avl. (ppm) | K-dd (me/100 g) | pH.H <sub>2</sub> O | C-Organik (%) | Organic Ingredients (%) |
|----------------------------------|-------------|--------------|-----------------|---------------------|---------------|-------------------------|
| I-1                              | 0,17 (R)    | 6,52 (R)     | 0,47 (S)        | 5.2 (M)             | 0.56 (SR)     | 0.96                    |
| I-2                              | 0,15 (R)    | 5,73 (R)     | 0,45 (S)        | 5.1 (M)             | 1,04 (R)      | 1,80                    |
| I-3                              | 0,08 (SR)   | 5,30 (R)     | 0,40 (S)        | 4.9 (M)             | 1.69 (R)      | 2.91                    |
| Average                          | 0,13 (R)    | 5.76 (R)     | 0.44 (S)        | 5.06 (M)            | 1.09 (R)      | 1.89                    |
| II-1                             | 0,19 (R)    | 7,00 (R)     | 0,50 (S)        | 5.4 (M)             | 0.43 (SR)     | 0.74                    |
| II-2                             | 0,17 (R)    | 6,74 (R)     | 0,47 (S)        | 5.3 (M)             | 0.54 (SR)     | 0.93                    |
| II-3                             | 0,09 (SR)   | 6,35 (R)     | 0,45 (S)        | 4.7 (M)             | 1.69 (R)      | 2.92                    |
| Average                          | 0,15 (R)    | 6.69 (R)     | 0.47 (S)        | 5.13 (M)            | 0.88 (SR)     | 1.53                    |
| III-1                            | 0,18 (R)    | 6,94 (R)     | 0,43 (S)        | 4.8 (M)             | 0.76 (SR)     | 1.31                    |
| III-2                            | 0,15 (R)    | 6,75 (R)     | 0,47 (S)        | 5.4 (M)             | 0.72 (SR)     | 1.24                    |
| III-3                            | 0,08 (SR)   | 6,20 (R)     | 0,40 (S)        | 5.3 (M)             | 0.66 (SR)     | 1.14                    |
| Average                          | 0,14 (R)    | 6.63 (R)     | 0.43 (S)        | 5.16 (M)            | 0.71 (SR)     | 1.23                    |

Drought can have a significant effect and its effects can be permanent if not treated immediately. Araus et al (2002) in Effendi et al (2016) explain that drought is one of the main factors limiting plant growth and development. soil organic C content in one growing season (Table 2). These results indicate that there is an improvement in P availability either directly through the mineralization process and / or indirectly through the dissolution of P-fixed in the presence of organic acids due to the input of organic fertilizers. According to Hilman (2005), on acid dry land, the problem of phosphate (P) availability becomes the main obstacle in increasing yield. Richman et al (1982) explained that there are several mechanisms for increasing the availability of P with the addition of organic matter, namely (1) the mineralization process of organic matter, the release of mineral P ( $\text{PO}_4^{3-}$ ) (2) the dissolving process of P which binds to Al, Fe and Ca by acid. -organic acid from the decomposition of BO; (3) the formation of a complex of phospho-humate and phospho-fulvate which can be exchanged and more available to plants, because the phosphate is weakly absorbed in organic matter.

However, the increase in the C-organic content had not yet increased the C-organic level which was in low status. This shows that the use/input of organic fertilizers / other sources of organic matter in this soil is necessary. According to Handayanto (1999), the agricultural system can be sustainable if the soil organic C content is more than 2%. Partoyo (2005) reported that the addition of clay soil and manure to agricultural land in the sand of BulakTegalrejo beach, Samas, Bantul can improve soil quality as indicated by an increase in soil organic C, total N and K exchanged compared to the original land. Soil with high organic matter content and quality will provide better conditions for plant growth and development. This is related to the role of organic matter in improving soil physical, chemical, and biological properties. The calculation of the Soil Quality Index (IKT) value refers to the IKT calculation using the Minimum Data Sets method according to Mausbah and Seybold 1998; Partoyo (2005), namely by determining the function of the soil by selecting soil indicators that are appropriate to the field level. The soil has good quality if it can support the survival of organisms in and on it, this is inseparable from the function of the soil as a place of biological activity. and divides water and functions as a buffer (buffer capacity),

Soil functions are divided into several parameters which include physical, chemical, and biological properties of soil which strongly support the function of the soil. Soil as a place of biological activity has several indicator functions that support biological activity, namely root media. Meanwhile, the nutritional function is determined by the parameters of soil pH, available P, available K, organic C, and total N. Taking into account the problems faced in sub-optimal dry land as previously mentioned, technically, there are two main approaches in its management for planting, namely selection of adaptive commodities or varieties as well as improving soil fertility by cultivating the soil and applying manure. In the intercropping pattern, the soil quality index is in the middle category. Intercropping is planting more than one type of crop on the same land at the same time. The advantage of the intercropping cropping pattern is that it produces a variety of crops and can add to fertility.

## CONCLUSION

Based on the biophysical conditions of dry land, especially the conditions of the agro-climatic zone, then Some areas of North Aceh district as the limiting factor are nutrient retention of pH and soil organic matter, nutrient availability of N, P, K and very low organic matter content Suggestion To rehabilitate and optimize marginal (critical) dry land in Aceh Utara

district, it can be done by planting food crops using intercropping systems, selecting adaptive types of commodities or varieties and improving soil fertility by cultivating the soil and applying manure. In the intercropping pattern, the soil quality index is in the middle category

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