Jurnal Pertanian Tropik ISSN NO: 2356- 4725/p- ISSN : 2655-7576
Vol.8.No.1. 2021 (6) 44- 51 DOI: 10.32734/jpt.v8i1.6252

# Recommendations for Increasing Sour Dry Sub-Optimal Land Potential for Several Food Crops

**Silvia Nora[1*], Arie Hapsani Hasan Basri[1], Tience Elizabeth[1], Windy Manullang[1], Taufiq Hidayatullah[1], Aisar Novita[2]**
[1]Politeknik Pembangunan Pertanian Medan, Indonesia
[2]University of Muhammadiyah Sumatera Utara
* Corresponding author : silvianora6644@gmail.com

***ABSTRACT***

*Sub-optimal land is land that has low productivity due to parent material, physical, chemical, biological properties of the soil, rainfall and extreme temperatures. To meet the availability of national food sources, it is necessary to utilize sub-optimal land that is widespread in mainland Indonesia. The purpose of the study was to determine recommendations for increasing sub-optimal land potential based on land suitability classes for several food crops, namely lowland rice, upland rice, cassava, sweet potato, corn, soybean and peanut. The research was conducted in Stabat District, Langkat Regency from June to November 2020 and the Asian Agri Laboratory of North Sumatera Province. The research method used is the survey method, while to determine the suitability of the land, namely the matching method. Land potential in Stabat District can be increased by managing it in the form of recommendations for adding N fertilizer was 7,000 kg N/ha or the equivalent of 1,555 kg urea/ ha, the addition of P fertilizer was 158.8 Kg P2O5 or equivalent to 441 Kg SP36/ha, K fertilizer was 26.32 Kg K2O/ha or the equivalent of 43.86 Kg KCl. The adding organic matter or compost is 43.8 kg C-organic/ha or equivalent to 63.9 kg compost/ha.*

***Key words**: Land potential, Food crops, Sub-optimal land, food crop*

**ABSTRAK**

Lahan Sub Optimal merupakan lahan yang mempunyai produktivitas rendah disebabkan oleh faktor internal seperti bahan induk, sifat fisik, kimia dan biologi tanah dan faktor eksternal seperti curah hujan dan suhu ekstrim. Untuk memenuhi ketersediaan sumber pangan nasional maka perlu memanfaatkan lahan sub optimal yang tersebar luas di daratan Indonesia. Tujuan penelitian adalah menentukan rekomendasi peningkatan potensi lahan sub optimal berdasarkan kelas kesesuaian lahan beberapa tanaman pangan yaitu padi sawah, padi gogo, ubi kayu, ubi jalar, jagung, kedelai dan kacang tanah. Penelitian dilakukan di Kecamatan Stabat Kabupaten Langkat pada bulan Juni sampai November 2020 yang dilanjutkan di Laboratorium Asian Agri Provinsi Sumatera Utara. Metoda penelitian yang dilakukan adalah metoda survey sedangkan untuk menentukan kesesuaian lahannya yaitu dengan metode matching. Potensi lahan di Kecamatan Stabat dapat ditingkatkan dengan melakukan pengelolaan berupa rekomendasi penambahan pupuk N yaitu 7.000 kg N/ha atau setara 1.555 kg urea/ha, penambahan pupuk P yaitu 158,8 Kg $P_2O_5$ atau setara 441 Kg $SP_{36}$/ha, pupuk K yaitu 26,32 Kg $K_2O$/ ha atau setara 43,86 Kg KCl. Rekomendasi penambahan bahan organik atau kompos adalah 43,8 kg C-organik/ha atau setara dengan 63,9 kg kompos/ha.

***Kata kunci** : Potensi lahan, Tanaman pangan, Lahan sub optimal*

ISSN NO: 2356- 4725/p- ISSN : 2655-7576
Vol.8.No.1. 2021 (6) 44- 51 DOI: 10.32734/jpt.v8i1.6252

## INTRODUCTION

Sub-optimal land is land that naturally has low productivity due to internal factors such as parent material, soil physical, chemical and biological properties and external factors such as rainfall and extreme temperatures (Las et al. 2012). Most of the mainland land in Indonesia is sub-optimal land consisting of acid dry land (the widest), followed by peat land, dry climate dry land, tidal swamp land and swampland. (Mulyani et al. 2013).

Land in the research location includes acid dry land which has acid soil reaction pH <5, this acid dry land is found in soil orders that have undergone advanced soil development or young or newly developed soil or soil from old sediment and volcanic parent material, and / others with low base saturation <50% (dystrik) and hick soil moisture regime or rainfall> 2,000 mm per year. Rainfall correlates with soil acidity, the higher the rainfall the higher the level of soil weathering. Soil that is formed in wet tropical climates (humid), the process of climate destruction (weathering) and nutrient leaching (alkalis) is very intensive, as a result the soil becomes acidic with low saturation and high aluminum saturation (Subagyo et al. 2000). Characteristics and potential of dry sub-optimal land with a wet climate, generally including the Podsolic Red and Yellow soil (Dudal and Soepraptohardjo 1957) or including Ultisols, Oxsisols and Inceptisols (Soil Survey Staff 1999).

Sub-optimal land use for extensification (agricultural expansion) must be utilized in accordance with the suitability of the land. To determine the level of land suitability, it is necessary to conduct land evaluation, where evaluation of land resources is essentially a process of estimating the potential of land resources for various uses. The basic framework of this land evaluation is to compare the requirements needed for a particular land use with the nature of the resources that exist on the land according to Sitorus (1985), to carry out comprehensive planning, one of the most needed products is the availability of information on environmental physical factors covering activities. land survey followed by evaluating the land of an area.

This study aims to determine sub-optimal land potential based on land suitability classes for several food crops, namely lowland rice, upland rice, cassava, sweet potato, corn, soybeans and peanuts, both actual land suitability and potential land suitability as well as management of land limiting factors for increase the potential of the land

## MATERIALS AND METHOD

This research was conducted from June to November 2020. The research was conducted in sub-optimal land in Stabat District, Langkat Regency, North Sumatra Province which is located at 3o45'04.799 "LS and 98o25'52.296" East Longitude with a height of 10 m asl. The research was thencontinued with soil analysis in the Laboratory. R & D Center of PT Nusa Pusaka Kencana Asian Agri, North Sumatra Province. The tools used are GPS, ground drill, hoe, plastic, rubber and stationery.

This research was conducted using a survey method and land suitability evaluation using a matching system, and comparing the characteristics of the land with the plant growth requirements formulated in the technical guidelines for land evaluation for agricultural commodities. In general, observations

Jurnal Pertanian Tropik ISSN NO: 2356- 4725/p- ISSN : 2655-7576
Vol.8.No.1. 2021 (6) 44- 51 DOI: 10.32734/jpt.v8i1.6252

were made, including the shape of the area, slope, parent material, soil type and drainage. Observations in the field were carried out including physical environmental observations, namely the characteristics of the land that affected its use, including: slope degree, vegetation, altitude, erosion, flooding, land forms, surface rocks and rock outcrops as well as existing parameters in the land suitability class criteria for plants. In determining floods, namely by looking for information on whether or not floods often occur in the area under study. To find out this is to interview / the community's way. To determine the level of erosion hazard is based on the percentage of erosion class differences and to determine the rock and rock outcrops on the surface is based on the distribution classification criteria.

After field observations continued with soil sampling. In taking soil samples, namely by drilling at the depth of 0-30 cm, then the soil sample is air-dried, and refined for analysis in the laboratory.

Analysis of soil samples in the laboratory includes determination of soil texture, K-dd analysis, determination of soil CEC, determination of soil pH, determination of P- available and determination of N-total. The data obtained is then analyzed for land suitability by matching, and comparing the characteristics of the land with the plant growth requirements formulated in the technical guidelines for land evaluation for Agricultural Commodities. In the matching process, Leibig's minimum law is used to determine the limiting factors that will affect the land suitability class and sub-class. Plant growth requirements become criteria in evaluating land suitability

## RESULT AND DISCUSSION

### Land Characteristics

Determining the value of soil characteristics for soil samples is carried out at a depth of 0-30 cm with the assumption that at this depth there is a lot of nutrient content and is widely used by plant roots so that it is more optimal to obtain nutrients. The land characteristic values are presented in Table 1.

**Table 1.** The Land Characteristic Values Langkat District

| | Date Value | Criteria |
|---|---|---|
| Annual average temperature ($^oC$)* | 27,68 | |
| **Land Characteristics** | 82,7 | |
| Dry Month (< 75 mm)* | 2,5 | |
| Climate type (Oldeman)* | D3 | |
| Rainfall / year (mm)* | 1659 | |
| Drainage*** | Obstructed | |
| Textur*** | Dusty clay | Smooth |
| Effective depth (cm)*** | >80 | Deep |
| CEC (me/100 g soil)** | 13,42 | Low |
| Base Saturation (%)** | 11,48 | Very Low |
| Soil pH ** | 5,8 | Sour |
| C Organic** | 0,81 | Very Low |
| N Total (%)** | 0,15 | Low |
| $P_2O_5$ (ppm)** | 6,78 | Low |

Jurnal Pertanian Tropik ISSN NO: 2356- 4725/p- ISSN : 2655-7576
Vol.8.No.1. 2021 (6) 44- 51 DOI: 10.32734/jpt.v8i1.6252

Tabel 1. Continue

| | | |
|---|---|---|
| $K_2O$ (me/100 g)** | 0,36 | Middle |
| Slope (%)*** | 0-2 | Flat-wavy |
| Rocks on the surface (%)*** | < 15 | Slight |
| Rock outcrop (%)*** | 0 | Nothing |
| Erosion level*** | < 0,15 | Very low |
| Flood*** | F1 | Slight |

Sumber : * Deli Serdang Climatology Station (2020)
** Soil chemical properties assessment criteria (Balittanah, 2009)
*** Djaenuddin *et al* (2011)

**1.1.**
**Land Suitability Class Evaluation for Food Plant**

Food plant evaluated for land potential are gogo rice, rice, cassava, sweet potatoes, corn, soybeans and peanuts. where some of these plants include plants that support national food security.

**The Recommendations For Land Improvement For Gogo Rice Crops**

CEC limiting factors can be done to increase efforts with a low level of management, namely by adding organic material or adding fertilizers containing sulfur. The limiting factor of base saturation can be made to improve efforts with a high level of management, namely by adding organic matter or adding fertilizers containing sulfur.

The limiting factor for C-organic can be improved with a moderate level of management, namely the addition of organic matter. The need for C-organic for upland rice plants for the criteria is very suitable, it takes 3%, while the

The limiting factor for N-total soil can be improved with a moderate level of management, namely by fertilizing according to the needs of the plant. The N-total requirement for upland rice for very suitable criteria is needed 0.5% while the total N availability in the soil at the time of the research is 0.15% so

availability of C-organic in the soil at the time of the research is 0.81% so that an additional 2.19% is needed. Where 2.19% x 2000 tons is 43.8 tons. The soil weight contains 10% organic C content so that 43.8 x 10% is 4.38 tons C / ha which is equivalent to 7.7 tons of organic matter / ha.

The total N requirement in upland rice for very suitable criteria is needed 0.5% while the total N availability in the soil at the time of the research is 0.15% so that an addition of 0.35% is required. 0.35 / 100 x 2000,000 is 7000 kg. N / ha. Because the soil weight is 10%, then 100/45 x 7000 x 10% is 1,555 kg Urea / ha. So that the total demand for upland rice fertilizer in the area on average requires an additional 7000 kg N / ha or 1,555 kg Urea / ha.

The need for P2O5 for upland rice plants according to the criteria required 16 ppm while the availability of P2O5 in the soil at the time of the study was 8.06 ppm so that an additional 7.94 ppm x 2,000,000 is needed, namely 15,880,000 ppm or 15.88. kg P. Equivalent to 101.03 kg SP36/ha.

that an addition of 0.35% is required. 0.35 / 100 x 2000,000 is 7000 kg. N / ha. Because the soil weight is 10%, then 100/45 x 7000 x 10% is 1,555 kg Urea / ha. So the total fertilizer needed for upland rice in that area requires an additional average of 7000 kg N / ha or 1,555 kg Urea / ha.

Jurnal Pertanian Tropik ISSN NO: 2356- 4725/p- ISSN : 2655-7576
Vol.8.No.1. 2021 (6) 44- 51 DOI: 10.32734/jpt.v8i1.6252

The need for P2O5 upland rice plants according to the moderate criteria is required 16 ppm while the availability of P2O5 found in the soil at the time of the study is 8.06 ppm so that an additional 7.94 ppm x 2,000,000 is required, namely 15,880,000 ppm which is equivalent to 158.8 kg P2O5 / ha or the equivalent of 441 kg SP36 / ha.

The K2O requirement of upland rice plants according to the moderate criteria is required 0.5 me / 100 gr, while the availability of K2O found in the soil at the time of the research is 0.36 me / 100 gr so that an addition of 0.14 me / 100 gr or 0.14 x 94 is needed 13.16 ppm x 2,000,000 which is 26.32 kg K20 or 100/60 x 26.32 which is 43.86 Kg KCl.

According to Abdurrahman (2002), rice plants that produce 6 t / ha absorb N, P and K nutrients, respectively 90 kg N / ha, 16 Kg P / ha and 90 kg K / ha, even though the ability of paddy soil to provide N nutrients , P and K respectively only 40-45 kg N / ha, 12-19 kg P / ha and 60-100 K kg / ha, resulting in a shortage of 50-55 kg N / ha, 0-4 kg P / ha and 0-30 kg K / ha. The need for organic C is needed 3%, the data at the research location is 0.81%, so the addition of organic fertilizer from rice straw compost as much as 2 tonnes / ha / planting season can contribute K nutrients equivalent to 50 kg KCl / ha / season (Dobbermann and Fairhurst , 2000 cit Zaini, 2012). In addition, the return of rice straw is best to reduce phosphate loss

Soil with slightly obstructed drainage is very suitable for lowland crops. The importance of drainage in paddy fields is related to oxygen supply (aeration). Surface water that contains a lot of oxygen can enter the soil through vertical percolation. The presence of an oxygen supply can prevent the reduction potential from being too low, which can lead to plant poisoning with iron and manganese, certain organic acids or, occasionally, sulfides. Greenland (1985) argues that soils that have a very hampered drainage class are also not suitable for being used as paddy fields because even though lowland rice grows well in a flooded state, drainage at a certain level is still very much needed. Low soil pH can be overcome by flooding. The inundation process can raise the pH to near neutral or even neutral (value 7) so that the growth of rice plants allows significant yields.

**The Recommendations For Land Improvement For Cassava** (*Manihot utilisima*)

The limiting factor for N-total soil can be improved with a moderate level of management, namely by fertilizing according to the needs of the plant. The N-total requirement of cassava plants for very suitable criteria is needed 0.5% while the total N availability in the soil at the time of the research is 0.15% so that an addition of 0.35% is required. So the total fertilizer needed for cassava in that area requires an additional average of 7000 kg N / ha or the equivalent of 1,555 kg Urea / ha.

The need for P2O5 for cassava plants according to the moderate criteria is needed at 16 ppm while the availability of P2O5 found in the soil at the time of the study is 8.06 ppm so that an addition of 7.94 ppm x 2,000,000 is 15,880,000 ppm or equivalent to 158.8 kg of P2O5. / ha or equivalent to 441 kg SP36 / ha

Cassava plants are sensitive to excessive N fertilization, which will result in more leaf formation than root growth. Excessive use of N in addition to reducing tuber yield can also reduce

ISSN NO: 2356- 4725/p- ISSN : 2655-7576
Vol.8.No.1. 2021 (6) 44- 51
DOI: 10.32734/jpt.v8i1.6252

starch content (Radjit et al, 2014). Cassava plants have wide adaptations and are very efficient in absorbing nutrients in the soil so that they can live and produce in less than optimal lands (Howeler, 2002). However, in the cultivation of cassava, the addition of fertilizer is needed to replace the nutrients transported from the soil at harvest time. According to Radjit et al (2014), to produce 15 tons of cassava, the nutrients transported during harvest are 35 kg N, 5.8 kg P, 46 kg K, 7 kg Ca and 4.5 kg Mg / ha / season where 25 % N, 30% P2O5 and 26% K2O are in the tubers. This shows that if the land is planted with cassava continuously without adequate fertilization, it can reduce soil nutrients. To achieve good growth and yields, cassava plants need soil with a K nutrient content of 0.15 - 0.25 meg / 100 g.

The nutrients needed for Ca and Mg are 1.0-5.0 meg / 100 g and 0.4-1.0 meg / 100 g, respectively. The nutrient Ca plays an important role in the provision and regulation of water in plants, Mg nutrient is a basic component of chlorophyll for photosynthesis (Radjit et al, 2014).

**The Recommendations For Land Improvement For Sweet Potato** (*Ipomea batatas*)

The need for fertilizer for sweet potatoes in that area requires an additional average of 7000 kg N / ha or the equivalent of 1,555 kg Urea / ha. The P2O5 requirement of sweet potato plants according to the moderate criteria is required 16 ppm while the availability of P2O5 found in the soil at the time of the study is 8.06 ppm so it is necessary to add 7.94 ppm x 2,000,000, namely 15,880,000 ppm which is equivalent to 158.8 kg P2O5 / ha or the equivalent of 441 kg SP36 / ha.

The total fertilizer needed for sweet potatoes in that area requires an average addition of 25% to meet microbial needs and loss of phosphate so it is necessary to add a fertilizer of 198.5 kg P2O5 / ha or 551.25 kg SP36 / ha.

**The Recommendations For Land Improvement For Corn** (*Zea Mays*)

The limiting factors of land suitability for maize plants that can be improved are soil CEC, alkaline saturation, organic C, total N, P2O5 and soil K2O, while limiting factors that cannot be improved are temperature, rainfall and drainage.

According to Subandi et al (1988), the ideal distribution of rain for the growth of maize is approximately 200 mm / month. To increase the availability of N, P and K nutrients in the soil, fertilizer is required. To produce seeds of 7.5 tonnes / ha, it takes about 135 k N / ha. On soils with low P and K content, fertilizer of 100 kg P2O5 / ha and 170 kg K2O / ha is required.

If studied further, the limiting factor of temperature, it can be said that it is not a serious problem. Based on the opinion of the Department of Agriculture (1997), in general in Indonesia, especially in areas of production centers, temperature is not a problem, because the optimum temperature for the growth of maize plants is between 23-27 oC. However, the inhibiting factors for maize growth are rainfall and humidity, both in terms of advantages and disadvantages. Even distribution of rainfall during growth is essential for maize, which requires sufficient water for growth. Especially just before flowering and filling the seeds.

**The Recommendations For Land Improvement For Soybean** (*Glycine max*)

Temperature and rainfall cannot be improved. Rainfall affects the growth of soybean yields, either directly or indirectly. If the rainfall exceeds, there will be puddle on the surface of the soybean plant. Indirectly, high rainfall can reduce production because the quality of the harvest decreases. Moisture regulation is very important, especially when the seeds turn into sprouts, before the soybeans flower until the pods are formed and filled.

Temperature is an important factor for the growth and development of soybean plants. If there is sufficient water, soybeans can still grow well at very high temperatures. The weight of soybean vegetables increased with increasing temperature from 23.8$^0$C to 32.2 $^o$C. temperature also affects nutrient uptake, potassium levels in soybeans increase with increasing temperature to 32 $^o$C. Soybean plants that grow in cold places (14-24 $^o$C) absorb more nitrogen and have higher grain protein content than soybeans that grow on higher soil temperatures.

**The Recommendations For Land Improvement For Peanuts** (*Arachis hypogea*)

The results of semi-detailed level land suitability evaluation for peanut plants on actual land suitability include marginal fit with limiting factors for annual rainfall, soil texture and nutrient retention (sub class S2 Wrfn). Improvement efforts cannot be carried out on the limiting factor of soil texture, so that the potential land suitability is classified as quite suitable (S2). For N, P and K nutrients, it can be improved by fertilizing with the amount of fertilizer in accordance with the calculated recommendations for cassava, sweet potato, corn and soybeans.

## CONCLUSION

The land potential in Stabat District can be increased by managing in the form of improving drainage channels, adding compost such as manure and mycorrhizal and increasing soil fertility by adding N, P and K fertilizers as recommended. Recommendation for N fertilizer is 7.000 kg N / ha or equivalent to 1.555 kg urea / ha. P Fertilizer is 158.8 Kg P2O5 or quivalent to 441 Kg SP36 / ha. K fertilizer is 26.32 Kg K2) / ha or the equivalent of 43.86 Kg KCl. Recommendation for organic material or compost is 43.8 kg C-organic / ha or equivalent to 63.9 kg of compost / ha**.**

## ACKNOWLEDGEMENT

The author would like to thank the strategic research funding assistance from the Agricultural Education Center of the Ministry of Agriculture and all the teams that have collaborated in the implementation of this research.

## REFERENCES

Balai Penelitian Tanah (2009) Petunjuk Teknis Edisi 2. *Analisis Kimia Tanah, Tanaman, Air dan Pupuk*. Balai Penelitian Tanah Bogor. Jawa Barat. 246 hal.

Djaenudin, D., Marwan, H., Subagjo, H., dan A. Hidayat (2011) *Petunjuk Teknis Evaluasi Lahan Untuk Komoditas Pertanian*. Balai Besar Litbang

*Jurnal Pertanian Tropik* ISSN NO: 2356- 4725/p- ISSN : 2655-7576
Vol.8.No.1. 2021 (6) 44- 51 DOI: 10.32734/jpt.v8i1.6252

Sumberdaya Lahan Pertanian, Badan Litbang Pertanian, Bogor. 36p.

Las, I., M. Sarwani dan A. Mulyani (2012) *Laporan Akhir Kunjungan Kerja Tematik dan Penyusunan Model Percepatan Pembangunan Pertanian Berbasis Inovasi Wilayah Pengembangan Khusus Lahan Sub Optimal*. Balai Besar Litbang Sumberdaya Lahan Pertanian, Bogor

Mulyani, Anny dan Sarwani, Muhrizal (2013) *The Characteristic and Potential of Sub Optimal Land for Agricultural Development in Indonesia*. Jurnal Sumberdaya lahan. Vol 7 no 1. 11 hal

Peraturan Menteri Pertanian No.79/Permentan/OT. 140/8/2013. *Pedoman Kesesuaian Lahan Pada Komoditas Tanaman Pangan*. Jakarta. 21 Hal

Subagyo, H., N. Suharta, AB. Siswanto (2013) *Tanah-tanah Pertanian di Indonesia*. Halaman 21-66 pada Buku Sumberdaya Lahan Indonesia dan Pengelolaannya. Pusat Penelitian Tanah dan Agroklimat, Bogor.

Wahyunto, Hikmatullah, E. Suryani, C. Tafakresnanto, S. Ritung, A. Mulyani, Sukarman, K. Nugroho, Y. Sulaeman, Y. Apriyana, Suciantini, A. Pramudia, Suparto, R.E. Subandiono, T. Sutriadi, D. Nursyamsi (2016) *Petunjuk Teknik Pedoaman Penilaian Kesesuaian Lahan untuk Komoditas Pertanian Strategis Tingkat Semi Detail Skala 1 : 50.000*. Balai Besar Penelitian dan Pengembangan Sumberdaya Lahan Pertanain, Badan Penelitian dan Pengebangan Pertanian Bogor. 37 Hal