

## AGRICULTURAL CROPS SUITABILITY FOR ACEH BARAT DISTRICT

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### Abstract

Tree farming was dominant in the west coast prior to tsunami, and that they promised not only sustainable livelihood, but also superior environmental protection. During the tsunami, considerable portion of this 'green infrastructure' was devastated and thus land suitability evaluation efforts is required for supporting the redesign and reconstruction. The objective of this research was to evaluate the land suitability of Aceh Barat District for tree crops and food crops. The field survey was conducted in April to May 2008 for assessment of land characteristics and its environment including secondary data collection. Land suitability evaluation was conducted by matching between land characteristics in every soil mapping unit with crop requirements. Sustainable agriculture production could be achieved by including economic and environmental stability consideration. Based on land suitability evaluation, the potentially suitable tree crops and have prospective economic value in the low land area with moderate well and well drained ecosystem are : areca nut, rambutan, manggo, rubber, oil palm, durian, coconut. In the valley floor, swalle, and river backswamps the suitability crops is for low land rice. In the peatland of less than 3 meters deep the potentially moderate suitable tree crops are oil palm and rubber, while peat land deeper than 3 meters is recommended for conservation due to it's fragile ecosystem. In the hilly to mountaineous region with slope >40% (area dominantly cover by bushes and forests) is recommended for forest conservation and ecosystem stability.

**Key words:** Tree crops, food crops, land suitability evaluation, sustainable, environmental protection, Aceh Barat district

### Introduction

The Tsunami disaster in west coast of Aceh Barat have caused widepsread destruction not only to the infrastructures but also to the farmlands. Around 24.7% of agricultural land along the coast of Aceh Barat district was affected by tsunami, including the perennial tree and annual crop lands. The disaster has caused at least 6,7% (763 households) lost their farms and 64% irrigation network damages (Dinas Pertanian Tanaman Pangan-NAD, 2005). Remote sensing analyses by comparing data before and after tsunami following by limited ground truth, indicated that were about 1,950 ha paddy field, and 658 ha settlements was affected by various degrees damages including 24 ha as a sunk areas (ISRI, 2005). The affected land underwent either one or combination of two to three changes (Agus *et al.*, 2008): deposition of mud, silt, sand or coarser materials, increase in soil and water salinity; and desurfacing and compaction of topsoil. The sea mud contains various salts and organic matter and its accumulation on soil surface changes soil physical and chemical properties. Tsunami disaster changed in soil profiles and nutrient balance in the upper soil layer.

The efforts to rehabilitate of tsunami disaster affected agricultural land that are based on amount of rainfall, soil salinity, and infrastructure damaged. Aceh Barat District falls into region with high amount of rainfall (>2800-3700 mm/year), coarse soil texture with relatively shallow ground water (<1m). This condition has stimulated to speed up the

leaching of salts so that the soil salinity has decreased drastically in one year after tsunami. Salinity analysis in West Aceh District conducted in June 2006 (1.5 years after tsunami) indicated that the salt content in soil, soil water and surface water, in general, had decreased to  $<2 \text{ dS m}^{-1}$ , (Subiksa *et al.* 2006), to the level most crops tolerate.

Reconstruction of tree crops and food crops farming require careful planning based on natural resources potential and crop requirements. The utilization of the land for agriculture is important as a basic area for agricultural development in the future. However, land suitability evaluation with considering on economic value of agricultural crops commodities and environmental protection will provide information and guidance for proper land uses. This paper aimed at providing spatial information of agricultural crops land suitability for Aceh Barat district as an input and guidance for proper landuse planning.

### Material and methods

A Physiographic Mapping Unit (PMU) was established by means satellite remote sensing data analysis to present areas with similar potential for agricultural development. Field observations were conducted from February to March 2008, through all mayor landscapes, either by cross sectional transect stretching from the shore to the inland or by random observations, depending on the landscapes variation/homogeneity (Soil Survey Staff, 2003 and Buurman *et al.*, 1990). Dominant soil represented the PMU's were observed from pits, minipits or soil auger, and selected representative samples for soil laboratory analysis. Soil Classification at sub-group level was based on the Keys to Soil Taxonomy (Soil Survey Staff, 2003). Dailly rainfall data were collected from the local station of Meteorology and Biophysics Agency (BMG), as well as from the local Board of Statistics of Aceh Barat district.

Land suitability evaluation for agricultural crops commodities were conducted by matching (comparing) between land characteristics in every PMU with its crop requirements, using *Automated Land Evaluation System (ALES)* software package (Rositer and van Wambeke, 1995 and 1997). The crop requirements were based on "Guidelines for Land Evaluation" (Djaenuddin *et al.*, 2003). Land quality in this evaluation included air temperature regimes, water availability, rooting condition, nutrient retention, nutrient availability, salinity and toxic elements.

In this present study, three suitability classes were selected: S1 (highly suitable), S2 (moderately suitable) and class S3 (marginally suitable) and a class N for not suitable. In the screening for the perennial tree crops and food crops, S3 or marginally suitable class was included, even tree crops put in the higher priority of the current project on perennial tree crops suitability evaluation.

### Result and discussion

Land suitability for Agricultural crops commoditiesThe result of crops suitability evaluation, almost fall into class marginally suitable (S3) and in the hilly to mountaineous region with slope  $>40\%$  falls into Not suitable (N) for all agricultural crops.

In the sand beach (recent) is not suitable (N) for all kind of crops. The main limiting factors are rooting condition /loose sand accumulation of tsunami material. Complex of recent beach ridge and swale (in the marine region) these are marginally suitable (S3) for : cocoa, coconut, coffee, water melon and nilam. The major limiting factors are low nutrient availability and rooting condition (sandy texture of sub-soil), and brackish water. Complex of beach ridges and swalle- resent with poor drainage, are not suitable for tree crops, however moderately suitable for wetland rice. The limiting factors are water

inundation, low nutrient content and sandy texture of sub-soil. Complex of sub recent beach ridge and swale (in marine region) both unit are marginally suitable to moderately suitable for cacao, coconut, coffee, rubber, oil palm, areca nut, duku, rambutan, durian, manggo, manggoesten, citrus banana and water melon. The main limiting factors are low nutrient content and sandy texture of sub-soil. Sub recent of beach ridges and swalles covered by shallow peat, both unit are marginally suitable for rubber oil palm and paddy. The limiting factor are: water inundation, low nutrient and sandy material of sub-soil. Shallow peat: peat depth <1,0 m) this unit is marginally suitable for rubber, oil palm, coconut, mustard, egg plant, long bean, and water melon. The limiting factors are water inundation and low nutrient content. Moderately deep peat (peat depth 1-<3 meter) both unit are marginally suitable for rubber, oil palm and coconut. The limiting factors are water inundation and low nutrient content. Deep to very deep peat (peat depth >3 meter). This unit is not suitable for agricultural due to fragile ecosystem, should be remain for forested conservation areas.

Dry land region surrounding the river (levee), is moderately to marginally suitable for coconut, cacao, coffee, duku, durian, manggoesten and rambutan. The limiting factors are low nutrient and water inundation. Complex of river backswamp, narrow river valley, aluvio-marine deposits (dominated by aquepts and aquents soil) are moderately suitable (S2) for paddy. The major limiting factor are low nutrient availability. Alluvial plain and undulating tectonic plain, both unit are moderately/ marginally suitable for rubber, oil palm and paddy. The major limiting factor is low nutrient availability and drainage assessibility.

Rolling tectonic plain and graben, both unit are suitable for rubber, oil palm, cacao, clove and banana. The limiting factors are low nutrient and erosion hazards/ slope steepness. Hilly tectonic terrains are suitable for rubber, rambutan, manggo, cacao, clove, duku, durian, citrus, manggoesten, pineapple and banana. The limiting factors are low nutrient and erosion hazards/ slope steepness. Strongly dissected hilly tectonic terrain, with slope 30-50%, are suitable for agroforestry. The limiting factors are low nutrient and erosion hazards/ slope steepness. Mountaineous tectonic terrain with slope >40%, are not suitable for agricultural crops due to fragile ecosystem, should be remain for forested conservation areas to maintain ecosystem stability.

### **Landuse Recommendation**

To interpret the combination of land suitability class, selecting and screening is necessary based on the priority of regional/ district development planning, existing landuse, including prospective impact on the economic value and environmental protection. In the screening for the perennial tree crops, S3 or marginally suitable class was included, because of the higher priority of the current project on perennial tree crops suitability evaluation. The approach in screening of land suitability for example, the land that is currently being utilized, especially for perennial tree crops/ estate crops and paddy field fields are left as such as long as they fall into suitable class. Those lands may be recommended for intensification for increasing their productivity. Land that currently are not optimally used or not being used such as shrub, conversion forest, or absentee agricultural land were recommended for extensification for other suitable commodities with has high economic value and environmental protection. The overall landuse recommendation for Aceh Barat District is presented in Table 1.

**Table 1:** Landuse Recommendation for Agricultural Crops Commodities

Symbol Region	Limiting Factor	Crops Recommendation	Areas (Hectares)
A	Low nutrient, sandy texture of subsoil (brackish water)	Cacao, Coconut, Coffe, water melon, nilam	2.343
B	Low nutrient, sandy texture of subsoil (fresh water)	Coconut,cacao, coffe rubber, oil palm, durian, manggo, citrus, duku, rambutan, water melon	1.144
C	Water inundation, low nutrient, moderately well drained	Coconut, cacao, coffe, manggo, citrus, duku, durian, rambutan, rambutan	12.108
D	Low nutrient, Sandy texture of sub soil	Coconut, cacao, coffee, duku, manggo, manggoesten, rambutan, banana, water melon, maize, peanut	1.441
E	Water inundation, shallow peat, low nutrient, sandy texture of subsoil	Rubber, oil palm, paddy	5.938
F	Low nutrient, erosion hazard	Rubber, oil palm, cacao, cl ove, banana,	49.232
G	Water inundation, low nutrient, shallow peat (<1m)	Rubber, oilpalm, coconut, mustard, egg plant, long bean, water melon	2.980
H	Water inundation, low nutrient, moderately deep peat (1-<3m)	Rubber, oil palm, coconut	16.474
I	Low nutrient, poor soil drainage	Rubber, oilpalm, paddy	23.964
J	Low nutrient	Paddy	14.401
K	Water inundation, low nutrient, sandy texture of subsoil	Paddy and rainfeed paddy	2.354
L	Low nutrient, Erosion hazards	Clove, duku, durian, citrus, cacao, rubber, rambutan, coffe coconut, manggo, pineapple manngoesten, nilam,	6.246
M	Erosion hazard, low nutrient	Agroforestry	32.707
N	Erosion hazard, low nutrient	Forested conservation area	115.822
O	Loose tsunami sand	Non suitable for Agricultural crops	88
P	Poor drainage, deep peat (>3meters)	Not suitable, conserved for forest	5.554
<b>TOTAL AREA</b>			<b>292.796</b>

**Summary**

Land use recommendation map at the scale of 1:50,000 (map not shown) has been developed and this could play as a main input in the district land use planning. This study recommend that: (i) areas close to the coastal line may be developed for the improvement of existing small-holder coconut plantation as well as for coastal spruce trees; (ii) the ancient sandy beach are recommendable for areca nut, rambutan, manggo and rubber; (iii) the alluvial ecosystem are recommendable for coconut, cacao, areca nut, manggo, and cacao; (iv) the shallow (<3m deep) peat-dome areas are suitable for oil palm and rubber while the deeper peat (>3 meter deep) is recommended for conservation due to the fragile

ecosystem. Land use recommendation is expected not only to improve farmer's livelihood, but also the environmental protection of the west coast of Aceh Barat District.

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