International Journal of Sciences: Basic and Applied Research (IJSBAR)

ISSN 2307-4531
(Print & Online)

http://gssrr.org/index.php?journal=JournalOfBasicAndApplied

Land Suitability Evaluation For Paddy, Corn and Soybean in Binangalom Watershed Toba Samosir District North Sumatera

Tioner Purba[a*], Erwin Masrul Harahap[b], Chairani Hanum[c], Rahmawaty[d]

[a]*Doctoral Student (S3),Agricultural Science. Departemen Ilmu Pertanian, Pasca Sarjana, "Universitas Sumatera Utara" Padang Bulan, Medan 20155, Indonesia*

[b,c,d]*Department of Faculty of Agricultural "Universitas Sumatera Utara" Padang Bulan, Medan 20155, Indonesia*

[a]*Email: purbationer@yahoo.co.id*

Abstract

Food production Increase continues to be encouraged in order to achieve food sovereignty. Various Programs are taken place to support food production. In the scope of the Ministry of Agriculture special efforts activities for paddy, corn, soybean and Agricultural Technology Park are currently being promoted to improve the welfare of farmers. Production increase can be done in two ways; agricultural extension and intensification. Land suitability to improve productivity is needed to achieve that goal. This study aims to: (1) map regional agro-ecological zones of Binangalom watershed. (2) identify potential land resources for the extension of paddy, corn and soybean; (3) map the land suitability to expand the land for paddy, corn and soybean. This research used methods of desk study, observation and survey. To obtain a land units (LU) map is done with overlay topographic maps, soil type maps and elevation maps. The results showed that from the overlay map in Binangalom watershed 16 LU are obtained. Administratively Binangalom watershed is in TOBA SAMOSIR district North Sumatera Province, with an area of 3717.53 ha. Binangalom watershed consists of 3 Agro ecology zone. In Zone I the slope is > 40%. In zone III the slope is 8 -15%. In Zone IV the slope is 0-8%. The land suitability for paddy, corn and soybean is dominated by S2 conformity class.

Keywords: Binangalom watershed; Land Evaluation; Paddy; Corn; Soybean.

---

* Corresponding author.

1. Introduction

1.1. Background

The number of population increases each year. The growing population needs food production increase. Food production Increase continues to be encouraged in order to achieve food sovereignty. Various Programs are taken place to support food production. In the scope of the Ministry of Agriculture special efforts program for paddy, corn, soybean and Agricultural Technology Park are currently being promoted to improve the welfare of farmers. Through special efforts activities for paddy, corn, soybean, the government determined to succeed the food sovereignty in this 3 years. In the special efforts program for paddy, corn, soybean, all the strategies and efforts are made to increase extension and productivity in the areas of food production centers. Operasioanal achievement targets in the field is organized well to make the program successful. That is by providing fund, labouring, fixing damaged irrigation, providing fertilizer, the availability of qualified seed (species, variety, quantity, place, time, quality, price), aid tractors and other agricultural tools which support harvesting and post-harvest including the certainty of marketing.

North Sumatra Province is one of the sites for the implementation of special efforts program for paddy, corn, soybean other provinces are South Sulawesi, Jambi, West Kalimantan, South Kalimantan, Central Kalimantan, Central Java and East Java [14]. One of the area which can be used as the development of paddy, corn and soybeans is in Binangalom Watershed Toba Samosir district of North Sumatra. That's why information about the area that is suitable for the development of the three commodities is required.

One of the efforts to increase agricultural productivity is to grow the types of commodities according to land suitability. Unsuitable Land uses can reduce productivity and crops quality. Production Increase can be held with the implementation of extension and intensification of agriculture. Land suitability to improve productivity is needed to achieve that goal.

1.2. Research Objective

This study aims to: (1) Map regional agro-ecological zones of Binangalom watershed. (2) identify potential land resources for the extensification of paddy, corn and soybean; (3) map the land suitability to exspand the land for paddy, corn and soybean.

2. Material And Method

The research was conducted from February to November 2016. The location of research conducted was in Binangalom watershed, Toba Samosir District of North Sumatera. The equipment used was computer, GPS (Global Positioning System), digital cameras, shovel, soil drill, hoes, knives, tape measure, sample bags, and stationery. The materials used in this study were a Binangalom watershed map, soil types maps, topographical maps, land use maps, rainfall data, farmers' socioeconomic data, materials for the survey and the analysis of physical and chemical properties of soil in the laboratory.

This research used descriptive quantitative survey methods and the researches were divided into several stages.

Stages of the study are presented in the following figure 1.

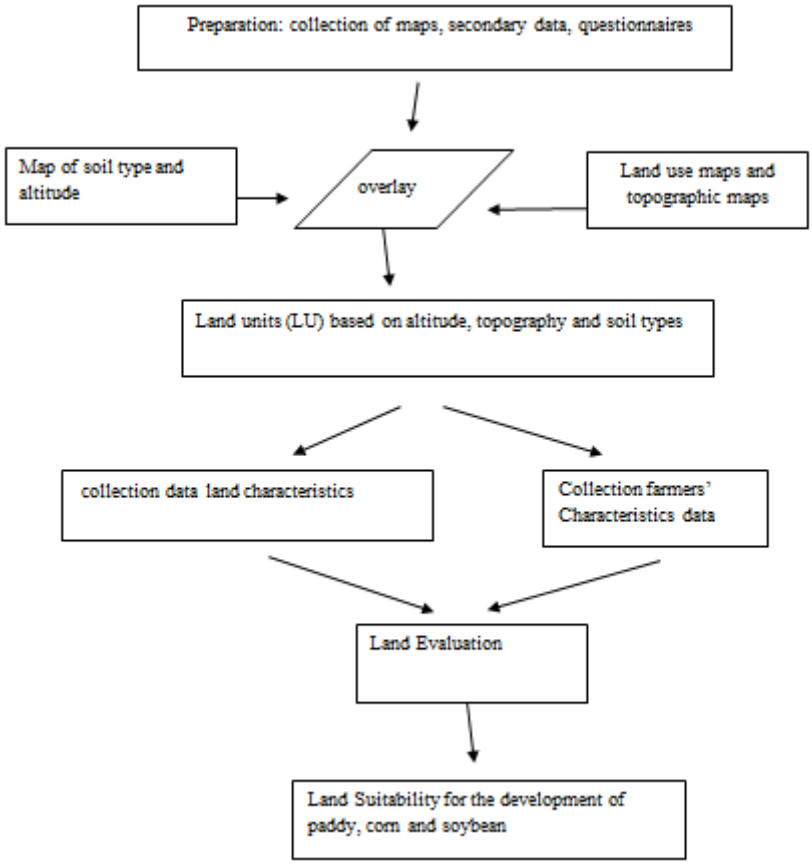

Figure 1: Stages Research

2.1 Collected Data

Collected Data consist of primary and secondary data. Primary data are biophysical, climatic, social and economic characteristics of farmers. The primary data was obtained through observations and direct measurements in the field and farmers interview by questionnaire respondents. Secondary data is the general view of research areas taken from villages and district data, institutions or agencies related reports, maps and relevant agencies.

2.2 Research Conduction

The first phase aims to make land units from the map overlay. Topographic maps, elevation and soil type map are used to divide the research area. Based on the altitude, watershed is divided into three areas, namely the upstream, midstream and downstream. Based on the slope watershed is divided into four zones based on the division of regions for determination of agro ecological zones, In Zone I the slope is > 40%. In zone III the slope is 8 -15%. In Zone IV the slope is 0-8% [4]. Soil sampling area is distinguished by the type of soil.

2.3 Soil Sampling

Composite soil sampling was taken on each unit of land as many as the diversity of soil types in that area. The composite soil samples were taken by drilling the ground as deep as about 0-20 cm from topsoil, then mixed together and took around 1 kg. Soil was taken from the flat surface, not from a former burnt, and not from the holes of plants which still contain organic material [8, 17].

Table 1: Types, Sources and Uses of Data for Land Suitability Evaluation commodity paddy, Corn and Soybean in Binangalom Watersheds.

Data Types	Sources	Uses of Data
Secondary Data		
The geographical position, soil characteristics, climate, topography, rainfall data	Base map, topographic map, map of soil types, BP DAS Asahan Barumun, BMKG data	Describing the characteristics of the area and determining land units
The type and extent of land use	BP DAS Asahan Barumun,	Describing the characteristics of land use
Primary Data		
Land Biophysical (soil physical and chemical properties)	soil survey and laboratory analysis	Land suitability evaluation
Terms growing plants	Survei dan metode matching	Land suitability evaluation

2.4 Land Suitability Evaluation.

Land suitability Identification to determine agro-ecological zones used land evaluation according to Land Suitability Criteria for Agricultural Commodities [7]. Each unit of land maps resulting from the surveying and/or mapping of land resources, land characteristics can be detailed and elaborated, that includes the physical state of the environment and the land. Those data are used for the purposes of land interpretation and evaluation for a particular commodity. Land characteristic data is also used to determine land use suitability classes.

3. Results and discussion

3.1 Layout And Size

Geographically Binangalom watershed lies between 99 ° 0'30,409 "E and 99 ° 6'42,699" E 2 ° East longitude and 35'53,1 "N to 2 ° 24'24,244" N Latitude North with an area of 3717 , 53 ha. Administratively Binangalom watershed is located in the Lumban Julu, Toba Samosir District [3], as in Table 2.

3.2 Climate / Rainfall

Based on Oldeman climate classification [13], climatic conditions in the Binangalom watershed Toba Samosir is in zone B with a wet month between 7 to 11 months and dry months between 1 to 5 months. Rainfall in

Binangalom watershed range between 1827.00 mm to 3166,41mm. Based on the number of wet and dry months the types of rain in the Binangalom watershed is rather wet [15]. Some important elements of the climate, such as: temperature, humidity, and precipitation are presented in Table 3.

Table 2: Area Binangalom watershed

districts	Subdistrict	Rural	Area (ha)
Toba Samosir	Lumban Julu	Lintong julu	1500.00
		Pasar lumban julu	250.00
		Sibaruang	429.70
		Hutanamora	580.00
		Hatinggian	820.00
		Sionggang utara	137.826
		Sub DAS Binangalom	3717.53

Table 3: Some Elements of Climate average 20 Years (Years 1995-2014).

Year	Rainfall (mm)	Rainy days (days)	Number of Months Wet / humid	Dry	Temperature Max	Min	Average	humidity
2005	1954,98	163	2	10	26,00	14,55	22,71	75,10
2006	1907,80	195	2	10	24,26	22,98	23,55	78,44
2007	2341,60	198	1	11	26,19	22,66	23,75	79,67
2008	2568,70	206	3	9	30,13	17,35	26,29	72,75
2009	1981,85	161	2	10	31,97	28,30	29,95	62,80
2010	1827,00	163	3	9	31,71	28,17	29,79	63,15
2011	3166,41	178	2	10	30,77	27,63	29,2	59,2
2012	2796,90	172	3	9	30,33	28,32	29,4	59,3
2013	2348,00	183	4	8	30,74	28,55	29,5	59,4
2014	2423,77	165	5	7	33,64	28,29	30,5	66,2

3.3 Aspects of Land Use

Land use in the Binangalom watershed is dominated by farmland with an area of 1806.066 hectares or about 48.58% of the area of Binangalom watershed.. While the smallest of land use is settlement about 3.538 or about 0.095% (Table 4) and maps of land use (Figure 2).

Table 4: Percentage of Land Use Types in subzone Binangalom

No	Type of use	Land area (Ha)	Percentage (%)
1.	Forest	560.485	15.077
2	thicket	1068.035	28.730
3	Paddy field	279.406	7.516
4	Farmlands	1806.066	48.582
5	Settlement	3.538	0.095
	Amount	3717,53	100,00

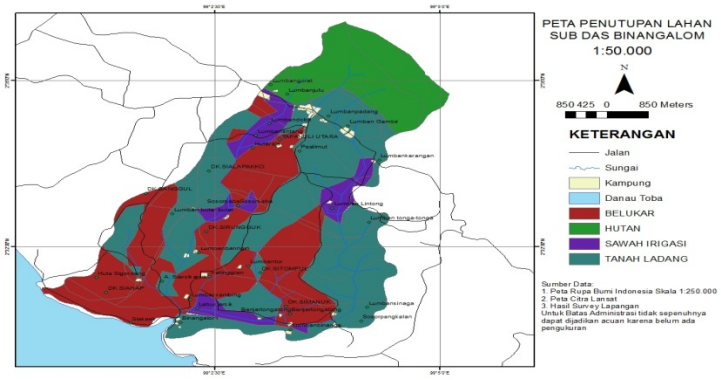

Figure 3

The application of the farm systems system package should be based on a more comprehensive agro ecological zone (ZAE) assessment so as to facilitate plant planning and management [1]. The use of Geographic Information Systems (GIS) has been used for the determination of agro ecological zones of a number of major crops in nine major regions of Asia, Africa and America in relation to dry weight of harvest [16]. GIS applications in the commodity zoning have also been carried out by Bhermana and his colleagues (2004) [6], namely to arrange and analyze the territorial area of Kandul District of North Barito, Central Kalimantan. The area of rice farming commodities based on GIS-based ZAE has been studied by Nurwadjedi and his colleagues (2009) [12]

3.4 Evaluation of Land Suitability

Land suitability evaluation begins with a map of homogeneous land units (LU), biophysical characterization of soil to determine the quality and nature of the soil in each LU, evaluate the suitability of land (to match the quality and nature of the land to the growing requirements of plants). Map of the land can be used as baseline data that can be interpreted in accordance with the needs and goals of its development. In agriculture, soil maps are used as basis for the assessment of land suitability for different types of commodities that will be developed

and the level or management system should be implemented. Numbering land units is sorted by type of land and then based on the degree of slope and altitude. Map of LU is very important as a separation unit of land/land for the purposes of analysis / interpretation of the potential or suitability for a type of land use. LU is also used as the basis for selecting the sample, the determining the number of samples, checking the field, soil sampling, interviewing farmers and guiding respondents. In this study, soil map overlaid with topography map, and elevation map to get homogeneous LU. From the overlay result 16 LU are obtained. The result is presented in the form of a map as shown in Figure 2 and detailed descriptions are presented in Table 5.

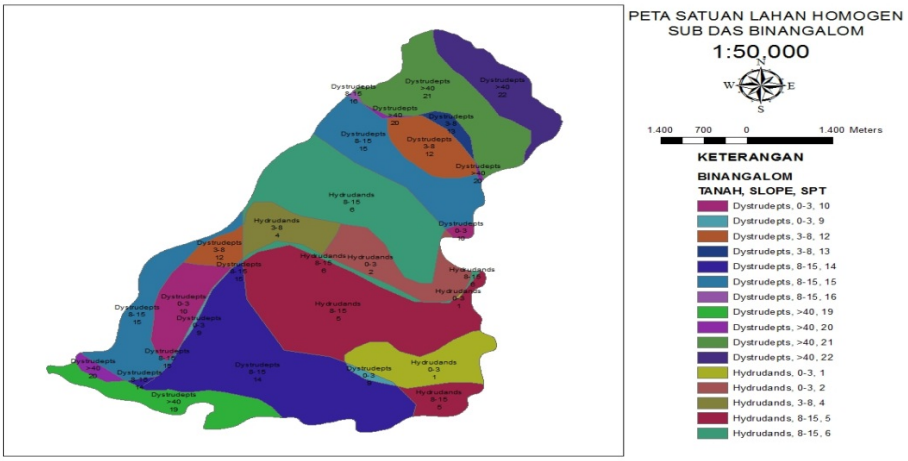

Figure 2: Map of Land Units By overlaying maps Soil type, Topography and Altitude

Table 6: Land Unit by overlaying maps of soil types, topography and altitude

No	Soil Types	Topografi	Elevation	Land area (ha)
1	Hydrudands	0-3	900-1100	179.36
2	Hydrudands	0-3	1100-1300	162.23
3	Hydrudands	3.-8	1100-1300	115.96
4	Hydrudands	8.-15	900-1100	644.24
5	Hydrudands	8.-15	1100-1300	476.23
6	Dystrudepts	0-3	900-1100	16.06
7	Dystrudepts	0-3	1100-1300	149.96
8	Dystrudepts	3.-8	1100-1300	178.15
9	Dystrudepts	3.-8	1500-1700	26.7
10	Dystrudepts	8.-15	900-1100	616.97
11	Dystrudepts	8.-15	1100-1300	455.46
12	Dystrudepts	8.-15	1500-1700	2.73
13	Dystrudepts	>40	900-1100	155.71
14	Dystrudepts	>40	1100-1300	26.59
15	Dystrudepts	>40	1500-1700	318.09
16	Dystrudepts	>40	1700-1900	193.09

Land Area Binangalom Watershed	3717.53

3.5. Agroecology Zone (ZAE)

Agro ecology zone (ZAE) is a grouping of a region based on the physical state of similar environment in which the diversity of plants and animals is expected to be the same [11]. The main component of agro ecology is the climate, physiographic and soil. Climate is the most dominant variable in determining the growth of plants. The main components of the climate in the determination ZAE is air temperature associated with altitude, humidity and rainfall. Agricultural business is also determined by the shape of the region and soil type. Shape region is easier to convey with the magnitude of the slope. Soil properties determining farmland is acidity and texture of soil and drainage [8,14]. The better the state of the land the more alternative crops can be selected. In the selection of suitable plant to cultivate on an area of land, required input data on a slope, drainage, texture, acidity, and is equipped with a data regime of humidity or rainfall and the regime of temperature or altitude [9]**,** because ZAE is one way to organize land use through clustering region on the basis of similarities in the nature and condition of the region. One purpose of grouping ZAE is to set the area or crop mapping and to improve commodity in accordance with the capacity of the environment. The increase of crops in accordance with ZAE will obtain optimal and sustainable farming.

The results of analysis of soil properties and biophysical Binangalom watershed are presented in Table 6. CEC characteristics of the soil has a low level of acidity in the range of very sour, sour and slightly sour, C-organic is categorized as low to very high, soil texture is argillaceous sand and sandy clay, and drainage conditions is good.

Binangalom Watershed has ZAE characteristics as follows:

1. Zone I is a land that has a slope> 40% or a region which is very steep where the slope is not permitted for cultivation of agricultural crops. Zone I area is ideal for forestry as productive forests or protected forests. There are several subzones in Zone I, namely: 1) Subzone Y, areas with high rainfall or Moist regime humidity, with annual rainfall between 1700-2500 mm, 2) Subzone B with area altitude between 500-1000 m above the sea level (asl) or Cool temperature regime, 3) Subzone 1, a region that has a good drainage conditions.

2. Zone II. It is a zone with the type of land used for plantation/cultivation of annual crops/fruits. Tutorial utilization is for plantation crops or perennial plants with conservation farming system. Planting without tillage, minimum tillage and the use of cover crops under annual plants does help to prevent erosion that can lead to degradation of land quality and environmental damage [2]. Types of commodities suitable for plantations or perennial crops in this zone are cocoa, coffee, rubber and cotton. This zone can also be directed to the utilization of limited production forest, with the principles environmentally friendly management. The silvicultural system (selective logging, planting) can be applied in forest management in a consistent and sustainable, remembering the soil conditions that is still relatively vulnerable to erosion. With those principle, forest and land sustainability can be maintained and the production of wood as a source of income for the regional economy can be sustainable too.

3. Zone III is a land with a slope of 8-15% or land physiographic choppy and somewhat steep slope. The farming system in zone III is a combination of agroforestry with annual crops and productive food crops, fodder crops and monoculture food crops by applying conservation technology. Subzone contained in Zone III is 1) Subzone Y, areas with high rainfall or Moist regime humidity, with annual rainfall between 1700-2500 mm, 2) Subzone B with area altitude between 500-1000 m above the sea level or Cool temperature regime, 3) Subzone 1, a region that has a good drainage conditions.

4. Zone IV is a land with a slope <8% where the land can be used for planting all kinds of commodities, intensively either for seasonal or annual crops by using monoculture or intercropping. Land in this zone is flat land up to rather flat. Subzone contained in Zone IV are: Subzone Y, areas with high rainfall or Moist regime humidity, with annual rainfall between 1700-2500 mm, 2) Subzone B with area altitude between 500-1000 m above the sea level (asl) or Cool temperature regime, 3) Subzona 1, a region that has a good drainage. conditions. Suggested Commodities developed is based on land suitability evaluation in each zone as presented in Table 8-11 below.

3.6 Land Suitability for Paddy

Evaluation of suitability for paddy was not done at all LU. Land evaluation was performed on LU 1- 12, while at LU 13-16 were not evaluated because the use of land in LU is for forest. Land suitability characteristics for each commodity refer to land characteristics according to Djaenudin and his colleagues (2011) [7,5].

Land suitability assessment of semi-detailed level for paddy in Binangalom watershed is presented in the following table 8:

Table 8: Rating suitability of land for paddy in the Binangalom watershed

L	Land Characteristic														
U	CEC		BS		pH-H2O		C-org		Soil depth (cm)		Slope		Temperature		Suitability
1	7,89	S2	54,25	S1	5,95	S1	1	S2	>100	S1	0-3	S1	24	S1	S2 (f)
2	7,9	S2	49,06	S1	5,79	S1	1,45	S2	>100	S1	0-3	S1	23	S2	S2(f,t)
3	8,58	S2	63,66	S1	6,08	S1	3,35	S1	>100	S1	3-8	S1	23	S2	S2 (f,t)
4	9,34	S2	88,01	S1	6,3	S1	2,03	S1	>100	S1	8-15	S2	24	S1	S2(f)
5	20,43	S1	7	S3	5,5	S1	6,04	S1	>100	S1	8-15	S2	23	S2	S3(f)
6	11,1	S2	58	S1	5,9	S1	1,21	S2	>100	S1	0-3	S1	24	S1	S2(f)
7	7,74	S2	43,45	S1	5,45	S2	1,44	S2	20-50	S2	0-3	S1	23	S2	S2(f,t)
8	14,13	S2	26,33	S2	5,21	S2	7,37	S1	20-50	S2	3-8	S1	23	S2	S2(f,t,s)
9	8,88	S2	42	S1	5,9	S1	2,2	S1	20-50	S2	3-8	S1	20	S3	S3 (t)
10	14,21	S2	44,41	S1	5,66	S1	3,38	S1	>100	S1	8-15	S2	24	S1	S2(f,t)
11	8,28	S2	5,57	S3	5,57	S1	1,36	S2	>100	S1	8-15	S2	23	S2	S3 (f)
12	13,82	S2	6,6	S3	5,02	S2	7,32	S1	>100	S1	8-15	S2	20	S3	S3(t)

CEC: Cation exchangeable capacity, BS: base saturation (f) soil fertility, (t) temperature

3.7 Land Suitability for Corn

Land suitability assessment of semi-detailed level for corn in Binangalom watershed is presented in the following table 9.

Table 9: Rating suitability of land for corn in the Binangalom watershed

L	Land Characteristic													
U	CEC		BS		pH-H2O		C-org		Soil depth cm)		Slope		Temperature		Sutability
1	7,89	S2	54,25	S1	5,95	S1	1	S1	>100	S1	0-3	S1	24	S1	S2(f,)
2	7,9	S2	49,06	S2	5,79	S1	1,45	S1	>100	S1	0-3	S1	23	S1	S2(f,)
3	8,58	S2	63,66	S1	6,08	S1	3,35	S1	>100	S1	3-8	S1	23	S1	S2(f,)
4	9,34	S2	88,01	S1	6,3	S1	2,03	S1	>100	S1	8-15	S2	24	S1	S2(f,t)
5	20,43	S1	7	S3	5,5	S2	6,04	S1	>100	S1	8-15	S2	23	S1	S3(f)
6	11,1	S2	58	S1	5,9	S1	1,21	S1	>100	S1	0-3	S1	24	S1	S2(f)
7	7,74	S2	43,45	S2	5,45	S2	1,44	S1	20-50	S1	0-3	S1	23	S1	S2(f)
8	14,13	S2	26,33	S3	5,21	S2	7,37	S1	20-50	S2	3-8	S1	23	S1	S3(f)
9	8,88	S2	42	S2	5,9	S1	2,2	S1	20-50	S2	3-8	S1	20	S1	S2(f,s)
10	14,21	S2	44,41	S2	5,66	S2	3,38	S1	>100	S2	8-15	S2	24	S1	S2(f,s,t)
11	8,28	S2	5,57	S3	5,57	S2	1,36	S1	>100	S1	8-15	S2	23	S1	S3(f)
12	13,82	S2	6,6	S3	5,02	S2	7,32	S1	>100	S1	8-15	S2	20	S1	S3(f)

CEC :Cation exchangeable capacity, BS: base saturation (f) soil fertility, (t) temperature, (s) soil depth

3.8 Land Sutability for Soyben

Land suitability assessment of semi-detailed level for soybean in Binangalom watershed is presented in the following table10.

Factors limiting the suitability of land for paddy, corn and soybeans in binangalom watershed that can be improved is the C-Organic, and pH.

From Table 8,9,10, it appears that the repairing attempt need to be done on the limiting factors organic C and pH is by the addition of organic matter and liming.

Thus suitability for nutrient retention can be improved. Actual and potential land suitability after repairing at each plant are listed in the following table 11.

Table 10: Rating Suitability of Land for Soybean in the Binangalom Watershed

LU	Land Characteristic														Suitability
	CEC		BS		pH-H2O		C-org		Soil depth(cm)		Slope		Temperature		
1	7,89	S2	54,25	S1	5,95	S1	1	S2	>100	S1	0-3	S1	24	S1	S2(f,)
2	7,9	S2	49,06	S1	5,79	S1	1,45	S1	>100	S1	0-3	S1	23	S1	S2(f,)
3	8,58	S2	63,66	S1	6,08	S1	3,35	S1	>100	S1	3-8	S1	23	S1	S2(f,)
4	9,34	S2	88,01	S1	6,3	S1	2,03	S1	>100	S1	8-15	S2	24	S1	S2(f,t)
5	20,43	S1	7	S3	5,5	S1	6,04	S1	>100	S1	8-15	S2	23	S1	S3(f)
6	11,1	S2	58	S1	5,9	S1	1,21	S1	>100	S1	0-3	S1	24	S1	S2(f)
7	7,74	S2	43,45	S1	5,45	S1	1,44	S1	20-50	S3	0-3	S1	23	S1	S2(f)
8	14,13	S2	26,33	S2	5,21	S1	7,37	S1	20-50	S3	3-8	S1	23	S1	S3(s)
9	8,88	S2	42	S1	5,9	S1	2,2	S1	20-50	S3	3-8	S1	20	S2	S2(s)
10	14,21	S2	44,41	S1	5,66	S1	3,38	S1	>100	S1	8-15	S2	24	S1	S2(f)
11	8,28	S2	5,57	S3	5,57	S1	1,36	S1	>100	S1	8-15	S2	23	S1	S3(f)
12	13,82	S2	6,6	S3	5,02	S1	7,32	S1	>100	S1	8-15	S2	20	S2	S3(f)

CEC:Cation exchangeable capacity, BS:base saturation (f) soil fertility, (t) temperature, (s) soil depth

Table 11: Suitability Assessment of Actual and Potential Land for Paddy, Corn And Soybeans

LU	Suitability of land for paddy		Suitability of land for corn		Suitability of land for soybean	
	Actual	Potensial	Actual	Potensial	Actual	Potensial
1	S2 (f)	S1	S2(f,)	S1	S2(f,)	S1
2	S2(f,t)	S2	S2(f,)	S1	S2(f,)	S1
4	S2 (f,t)	S2	S2(f,)	S1	S2(f,)	S1
5	S2(f)	S1	S2(f,t)	S2	S2(f,t)	S2
6	S3(f)	S2	S3(f)	S2	S3(f)	S2
9	S2(f)	S1	S2(f)	S1	S2(f)	S1
10	S2(f,t)	S2	S2(f)	S1	S2(f)	S1
12	S2(f,t,s)	S2	S3(f)	S2	S3(s)	S3
13	S3 (t)	S3	S2(f,s)	S2	S2(s)	S2
14	S2(f,t)	S2	S2(f,s,t)	S2	S2(f)	S1
15	S3 (f)	S1	S3(f)	S2	S3(f)	S2
16	S3(t)	S3	S3(f)	S2	S3(f)	S2

The results obtained wide with GIS analysis of actual and potential land suitability in Binangalom watershed (Table 12)

Table 12: Area of Suitability of Land for Paddy, Corn and Soybeans

Comodity	actual land suitability	width	potential land Suitability	width
Paddy	S2	2062,93	S1	1295,5
	S3	961,12	S2	1699,5
corn	S2	1911.48	S1	623.57
	S3	1112.57	S2	1940.31
Soybean	S2	1911.48	S1	1240.54
	S3	1112.57	S2	1605.36

In table 12 it can be seen that the actual land suitability classes for paddy, corn and soybean are quite suitable class (S2) and the suitable marginal (S3). The suitable class (S1) and quite suitable (S2) can be upgraded by limiting factor nutrient retention and through the provision of organic materials and liming suitability classes.

4. Conclusion

1. Zone Agroecology in Binangalom watershed classified into four zones, namely Zone I, II, III and IV. Each zone is divided into sub-zones dominated by sub Zone Y (humid), B (cool) and 1 (good drainage).
2. Regional Binangalom watershed is potential for the development of paddy, corn and soybeans that is indicated by appropriate land suitability classes and quite appropriate.
3. Class suitability of land for the development of paddy, corn and soybeans are suitable (S1) and quite suitable (S2) in Binangalom watershed.

Acknowledgements

The author is very grateful for the services provided by Mr. Erwin Masrul Harahap, Mrs.Chairani Hanum, and Mrs.Rahmawaty, for guidance and direction during the completion of this paper, for Rado Ganda Purba and Arif Rizaldi for collecting field data during the study period.

References

[1] Amien .I. Analisis Zona Agroekologi Untuk Pembangunan Pertanian, Pusat Penelitian Tanah dan Agroklimat. Badan Litbang Pertanian. Bogor. 2000

[2] Asdak, C. Hidrologi & Pengefolaan Daerah Aliran Sungai. Yogyakarta: Gadjah Mada University Press.2010

[3] BPDAS Asahan Barumun. Rancangan Pembangunan Model DAS Mikro Sub DAS Gopgopan. Pematangsiantar. Indonesia. 2011

[4] Balai Penelitian Tanah. Petunjuk Teknis Penyusunan Peta Pewilayahan Komoditas Pertanian Berdasarkan Zona Agro Ekologi (ZAE) skala 1:50.000 (Model 1). Balai Penelitian Tanah, Puslitbangtanak Bogor. 2001

[5] Balai Penelitian Tanah. Petunjuk Teknis Evaluasi Lahan Untuk Komoditas Pertanian. Balai Penelitian Tanah, Puslitbangtanak Bogor. 2003

[6] Bhermana, A, R.Massiani dan R. Ramli. Aplikasi Sistem Informasi Geografis untuk penyusunan dan Analisis pewilayahan Komoditas. Prosiding Seminar Nasional Inovasi Teknologi Sumberdaya Tanah dan Iklim. 2004

[7] Djaenudin, D., Marwan, H., Subagjo, H., dan A. Hidayat. Petunjuk Teknis Evaluasi Lahan Untuk Komoditas Pertanian. Balai Besar Litbang Sumberdaya Lahan Pertanian, Badan Litbang Pertanian, Bogor. 36p. 2011

[8] Hardjowigeno, S. Ilmu Tanah. Akademika Pressindo. Jakarta. 2003

[9] F.A.O, 1983. Guidelines Land Evaluation for Rainfed Agriculture. Soil Bulletin No. 52. Soil Resources Management and Consevation Service Land and Water Development Division

[10] FAO. Guidelines for Soil Profile Description. Soil Resources Development and Cons. Service, Land and Water Development Division. FAO/UNESCO, Rome. 1978.

[11] Las, I., A.K. Makarim, A. Hidayat, A. Syarifuddin, dan I. Mawan. Pewilayahan Agroekologi Utama Tanaman Indonesia. Puslitbangtan, Edisi Khusus, Pus/03/90.Bogor. 1990

[12] Nurwadjedi, B. Mulyanto dan Suwardi. The Assessment of the rice field sustainability in java base on regional spatial use planning (RSUP). Jurnal Ilmu Tanah dan Lingkungan. 2009.9:80-87

[13] Oldemandan Frere. Report on the Agroecological Zones Project. Vol. 1, Methodology and Result for Africa. Rome. 1982

[14] Pusat Penelitian Tanah dan Agroklimat & Proyek Pembinaan Kelembagaan Penelitian dan Pengembangan Pertanian, Upaya Khusus Pajale. Bogor. 1999

[15] Schmidt, F.H., and J.H.A. Ferguson. Rainfall Type Based on Wet and Dry Period Ratios for Indonesia with Western New Guinea. Verh. No.42. Jawatan Met. dan Geofisik, Djakarta. 1951

[16] Shivakumar, MKV dan C. Valentin. Agroecological zones and the assessesment of crop production potential. Phil. Trans. R.Soc. Lond. 1997. B, 352:907-916

[17] Soil Survey Staff. Keys to Soil Taxonomy, 8th edition 1998. Nasional Resources Conservation Service, USDA. 1998