Model Of Land And Forest Rehabilitation Efforts In Amandit Sub Sub Watersheed

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Research Paper

Model Of Land And Forest Rehabilitation Efforts In Amandit Sub Sub Watersheed

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Abstract: The increasing rate of deforestation leads to increased critical land in forestry, which leads to national critical lands. One of the areas that are critical of the critical land is the Sub-Sub Amandit of Hulu Sungai Selatan Regency. Efforts to rehabilitate forests and critical land can be made with approaches to empirical equation modeling, spatial land modeling and land cover simulation. Formulation of forest and land rehabilitation (RHL) model in a watershed should consider the problem of land criticality (TKL) and socioeconomic aspects. Formulation of the model refers to data obtained through the process of observation and interview. The result of the research before the simulation was done TKL there were 5 classes, that is: Not Critical (TK) 20,51 Ha, Critical Potential (PK) 18.786,44 Ha, Rather Critical (AK) 20.947,31 Ha, Critical (K) 10.062,31 Ha and Very Critical (SK) 105.60 Ha. The value of TP 0.88, (TP <1), means that the carrying capacity of the land can still accommodate more farmers. DASE value 41.64, means support for RHL activities very strong. Extensive model of RHL efforts in Amandite Upper Sub Watershed 15.193.52 Ha and the middle Section 15,922.37 Ha. In addition, there was also a decrease in the TKL as a result of simulation of land cover on RHL model above, where there were 5 TKL classes changed into 3 TKL classes, that is TK 20,51 Ha, PK 30,624,51 Ha and AK 19.27781 Ha.

Keywords: Deforestation, National Critical Land, Land And Forest Rehabilitation Efforts Model, Sub-Sub Amandit of Hulu Sungai Selatan Regency

INTRODUCTION

The department of forestry Republic of Indonesia (2011) stated that the rates of deveopment of deforestry in 1982-1990 was 0,9 million Ha, in 1990-1997 was 1,8 million Ha, in 1997-2000 was 2,83 million Ha and in 2000-2006 was 1,08 million Ha. The data of National Critical Territory is as folllows: Very Critical 5.4449.299,21 ha and Critical 24.467.311,8 ha. The problem mentioned above needs recovery and efforts to improve the function and productivity of forests and land through a well programmed Model of Rehabilitation of Forests and Land.

The regions of amandit river flow teritorry are one of the regions of the negara river flow teritorry which is one of barito river flow Teritorry in South Kalimantan Province with the total area of 117,920.00 Ha. According to BPDAS Barito (2009), in the District of HSS the area on Not Critical Area is 13,724.0 ha, Potentially Critical is 54,819.6 has, Rather Critical is 84,904.2 ha, Critical Area is 13,106.2 ha and Very Critical Area is 2,818.0 ha. The level of the land criticallity is only administratively stated whereas it should be better stated ecologically. The topographical slope of the land which may cause erotion varies, from flat until very steep mountainous slope. The use of land area in the Upper and Middle Regions of Amandit River Flow Teritorry. Among others, is for dry land agriculture, non-irrigated agriculture, plantation and other uses (BPS, Kabupaten HSS, 2014). Based on Ruslan M., et al. (2016), the upstream portion of the Amandit catchment, the area of EP (Moderate, Severe and Very Severe) was 163,14.95 Ha larger than the area of EP (Very Light and Light) 5,352.42 Ha. So were in the midstream portion of the Amandit catchment, the area of EP (Moderate, Severe and Very Severe) was 20,334.55 Ha larger than that of EP (Very Light and Light) 7,920.89 Ha. By contrast, in the downstream portion of the Amandit catchment, the area of EP (Moderate, Severe and Very Severe) was 1,661.41 Ha smaller than that of EP (Very Light and Light) 63,858.11 Ha. The total areas in the directives of land and forest rehabilitation in the Amandit catchment at the Upstream, Midstream, and Downstream portions were 16,314.55 Ha, 20,334.53 Ha and 1,661.41 Ha.

The formulation of the RHL Effort Model in certain River Flow Teritorry needs to pay attention to the local biophysical and cultural social economic aspects. The biophysical aspect is based on erotion, sedimentation, flood in rainy season, dryness in dry season and the level of the land criticallity. The locally social economic aspects are the pressure of the local people and the aspect of the social economic support. (Departemen Kehutanan R.I., 1998).

Method Of Collecting Data

1. The Level of Land Criticallity
   a. Data of Land Closing dan Persentage of and Closing

The Data Percentage of Land Closing editorial **(tajuk)** is obtained by transforming Citra Landsat 8 DCM channel 4 and 5 to Citra *Normalized Difference Vegetation Index* using the following formula (Jensen, 2000):

$$\mathbf{NDVI} = \frac{\mathbf{Spectral\ Score\ Channel\ 5} - \mathbf{Spectral\ Score\ Channel\ 4}}{\mathbf{Spectral\ Score\ Channel\ 5} + \mathbf{Spectral\ Score\ Channel\ 4}}$$

Where : NDVI is *Normalized Difference Vegetation Index*.

b. Level of Erotion Danger

There is a big assumption that erotion is one of the basis to determine Level of Erotion Danger (TBE) counted using the following USLE formula (Wischmeier and Smith, 1978) :

A = R.K.L.S.C.P.0,61

where : A = Erotion (ton/hectares/year), R = Rain Erocivity hujan (mj.cm/hectares/hour-year), K = Land Erodibility (ton hectares.hour/hectares/mj.cm), L = length of the slope (m), S = DeclivityLand (%), C = Plant management and P = Land conservation factor 0,61 = Correction faktor (Ruslan, 1992).

TBE calculation using the matrix of Erotion Danger Class and Land Solum (Dep Kehutanan RI, 1998). The TBE Data, the percentage of Density **editorial (tajuk),** the Area Function are layered arranged with the data of Regions of Amandit River Flow Territory.

c. The Moral Value of Critical Area (TKL)

In the analysis of TKL, the function of forest area is grouped to kinds: the Area of Protected Forest and the Area of Cultivated Agriculture. According to Peraturan Dirjen BPDAS-PS No.P.4/V-SET/2013, the parameters of modelling the critical area needed are: Area Closing, the aslant of slope, TBE, land pruductivity and management. The data of land closing is only used in the Area of Protected Forest, whereas the land productivity is for the Area of Cultivated Agriculture.

Each of the land function is determined by the supporting factor which is devided to some classes. In the Production Forest Area/Cultivated Agricultural Area, the analysis of the level of land creativity is done through the overlay of Productivity Map, the Slope Class Map, the Erotion Map and the management Map. In the Area of Protected Forest it is done through the overlay of the Closing Land Map, the Slope Class Map, Erotion Map and Management Map.

2.Social Economic Data

a.Population Pressure (TP)

The formuation used to count the Population Pressure (TP) in a River Flow Territory is (Soemarwoto, 1984):

$$TP = Zx\frac{fP_0(1+r)^t}{L}$$

where :TP = Index of Population Pressure, Z = The minimum area farmers can have proper life, f = The proportion of farmers in population, P_o = the number o inhabitant when t = 0, R= The Rate of average Population Growth per year, T = Range of time in 5 years (5), L = The tota area of the agricultural land.

The result of the TP is interprated as folows: if TP is ≤ 1, the land can still accomodate more farmer inhabitants and the opposite if TP is >1, the population pressura is more than the and capacity.

b. The Moral Value of the Support of Social Economic Aspect

According to the Department of Forestry R.I. (1998) the Support of Social Economic Aspect is based on : a) 6 parameters of the inhabitants' dependence to land with 50% weight (the area of land ownership, the status of land ownership, the difersification of livelihood, distribution/allocation of work-time , specific habit tradition) , b) The level of farmers' adoption to new conservation technology of 30% weight are 2 parameters (vegetatif technique and mechanical/civil technique and c) The condition and institutinal activities, 20% weight with 2 parameters (form and function and activities). It is stated too that the DASE grade obtained is related to the criteriaSelanjutnya disebutkan pula, nilai DASE yang didapatdihubungkan dengan kriteria, the DASE/SSEA grade iof 40-50 means Very Strong support , DASE of 20-30 Middle Strong, DASE 10 – 20 Less Strong Support and DASE < 10 Very Weak Support.

3. The Model of Forest and Land Rehabilitation Efforts

The Model of RHL Effort in the Protected Area and Cultivated Area are determined based on the Criticallity Level of Land; are Very Critical, Critical and Rather Critical as the targets of the model of Forest and Land Rehabilitation Effrorts, whereas the Non-Critical and Potentially Critical happen the opposite and only being taken care of, the model of RHL Effort is elaboratedly described using the following variables: The Criticallity of Land (VC, C and RC), parts of the Regions of River Flow Territory, the Forest Area, The Closing Area and Consideration of social economy aspects. The RHL Technology using Vegetatif Approach and the Civil Technics of Building Land and Water Conservation To get the Respond of the RHL Effort Model to the Land Critical Level a Model of Land Closing Simulation and Content Analysis will be implemented.

RESULTS AND DISCUSSION

A. Level of Land Criticallity (TKL)

In the Analysis of Criticallity Level to determine Effort Model of RHL, TKL in the downstream of the Regions of Amandit River Territory is not included because the topography is relatively flat to sightly slope and the use of the land is dominantly for farming, bushes and swamps.

From the data of some parameters collected in the field, analzyed using Spatial Critical Land Model (Kementerian Kehutanan RI, 2013) in the Cultivation Area and Protected Area, result was found that the Level of Land Criticallity in the Upper and Middle Regions of Amandit River Flow Territory are very much vary and there are 5 classes of them: Very Critical, Critical, Rather Critial, Potentially Critical and Not Critical. Besides that there are Levels of Criticality which is over limit of Criticallity.

The number of Territory within the Level of Criticallity in the Cultivated Area in the Upper and Middle Regions of Amandit River Flow Teritorry consist of Potentially Critical 13,809.15 Ha (44.38%) and Rather Critical 12,505.51 Ha (40.19%). The number of Critical Area in the Protected Area in the Upper and Middle Retgions of Amandit River Flow Teritorry consist of: Not Critical 20.51 Ha (0.07%); Potentially Critical 4,977.29 Ha (16.00%); Rather Critical 8,441.80 Ha (27.13%); Critical 10,062.97 Ha (32.34%) and Vry Critical 105.60 Ha (0.34%).

From the data of Level of Criticallity in this Cultivated and Protected Areas in the Regions of Amandit River Flow Teritorry, in fact the area of the Cultivated Area in the Upper and Middle Parts as the target of RHL (Rather Critical) is 12.505,53 Ha (40.19 %), This situation shows the less optimal function of the cultivated area and the level of the land criticality should be Critical or Potentially Critical because this area is the *buffer one* and protection area for the downstream part of the River Flow Territory. It is assumed that it is caused by the closing area, erotion danger level and the declivity of the slope. The data of observation in the Upper and Middle Area of the Cultivated Area of the Regions of Amandit River Flow Territory the dominant closing land is SB = Very Heavy and LT 17,061.37 Ha (64.84%), TBE which is considered to be Heavy and Very Heavy 13,929.07 Ha (52.00%) and the Steep and Rather Steep topography is 7,003.93 Ha (26.62%). The Very Heavy and LT land closing is less productive land closing because some of the land is bare (gundul) and full of underbush and tall coarse grass. An area like that is an area which is changed in use, so the land is not productive. Solaimani *et al*. (2009) and Badaruddin (2014) state that if the persons who change the use of land are not capable of doing, it will make the land become easily critical. Then Zhang and Wang (2007) also state that the use and the closing of land, if done unsutably to the use in the protected and agricultural cultivated areas will result in negetive impact, high level of land criticality which can decrease its role; the high level of criticallity can decrase its protection role and the increase of community prosperity.

In the Upper and Middle of the Protected Areas, the targets of RHL (Rather Critical, Critical and Very Critical) is 18,610.39 Ha (78.25%), This situation shows the less optimal function of the protected area and the Criticall Level should be TK, Not Critical or PK, Potentially Critical because this area has function to protect and keep the land fertility and also regulate good flow of water. It is assumed that this High Level of Land Criticallity besides the TBE and the Slope is the influence of the land closing. For example in the Upper and Middle Regions of Amandit River Flow Terrirory for SAGK and HL the condition of the closing land is dominated by underbrush and Opened Area is 16,686.45 Ha (70.68%). Actually the two areas must be dominated by forests. In fact the forest closing area is only 4,997.79 Ha (21.17%). If seen from th cosing areas in the Area of SAGK and HL is dominantly Underbrush; it means that the use of the areas have been changed and the management does not give less attention to the principles of land and water conservation, so the land becomes critical. Ruslan *et al*. (2016), state that the closing area in the Protected Area which is dominated by Underbrush shows that the area experienced big deforestation and degradation will result in high level of erotion danger and the land will become critical.

Result of the Grade/Moral Value of the Population Pressure in the Upper and Middle Regions of Amandit River Flow Territory is 0.88. The value of TP 0.88< 1, which means that land in that area is still be able to accomodate more farmers (Dephut Republic of Indonesia, 2009 dan Soemarwoto, 1977). The Moral Value of the Support of the Social Economic Aspect in the Upper and Middle Regions of Amandit River Flow Territory is 41.64, it includes in the range of 40-50 which means that the support of social economic aspect is in the level of Very Strong. With the very strong support of this social economic aspect, the activities of Forest and Land Rehabilitation in a River Flow Territory will have a big chance to be operated. (Dephut Republic of Indonesia, 2009).

B. The Model of Forest and Land Rehabilitation Effort

Some factors considered in formulated the Model of RHL Efforts are: :1)Very Critical (SK), Critical (K) and Rather Critical (AK) as the result of the analysis of the Level of Land Criticallity determination, 2) The Function of Forest Area is Protected Area (HL and SAGK), whereas the Cultivated Area are (HP and APL). In the Proctected Forest Area the main activities are Reboitation, Forest Succession, Plant Forest and Agroforestri and Garden (if the Closing Land are Dry Land Agriculture and Rubber Estate, Oil Palm Estate, Mixed Garden). In the Cultivated Area is mainly Dry Land Agriculture and Production Forest. 3) The Closing Land, adjusted to the existing condition, there is some that is change with the more productive and has protection function and keep using prime seeds if the

land closing is Garden/PLK and 4). The data of social economic aspect (Population Pressure 0,88< 1 and the Moral Value of DASE is 41,64).

From the data as the analysis result of Level of Criticallity and Social Economic Aspects (TP dan DASE) above, continued with the Simulation of Land Closing (area and kind of land closing), until the recapulation of the lRHL Efforts Model in the Cultivated and Protected Areas in the Upper and Middle of Amandit Sub River Flow Territory, the elaborated result of which is presented in Table 1.

Table 1. Result of the Land Closing Simuation to determine Model of Land And Forest Rehabilitation Efforts In Amandit Sub Sub Watersheed

Forest Areas	LC	Pattern of Direction Of Forest and Land Rehabilitation (RHL)	Area (Ha)	%
HL,SAGK, APL, HP	PLK	Agroforestri	3.714,10	11,94
HL, HP, APL	HT	Maintained and recommended the plantation of plants of MPTS kinds	617,86	1,99
HL, HP, APL	KS	Maintained and Keep up the Maintenance	83,56	0,27
HL APL, HP	PKM	Maintained and Development of garden plantation	111,05	0,36
APL	SB/LT	Forestration or HTI (Industrial Plant Forest)	2.347,40	7,54
HL HP	SB/LT	Reboisation	13.274,33	42,66
HP, APL	PTB	Reclamation and Revegetation	121,47	0,39
SAGK	SB	Natural Wuccession	212,1	0,68
HL,SAGK, APL, HP	KC	Keep maintained by Renovation and Added with the MPTS Kinds	1.609,95	5,17
HL,SAGK, APL, HP	KK	Keep maintained, and rehabilitated with the prime seeds	8.997,03	28,91
HL HP, APL	BJ	Road Pillar and drainage making	27,03	0,09
The Number of all the the direction of Forest and Land Rehabilitation			31.115,88	100,00

Ino : PL = Land Cosing; HL = Protected Forest,SAGK = Gunung Kentawan Natural Sanctuary, HP = Production Forest, APL= Other Land Use; KK = Ruber Estate, KS = Pam Oil Estate, KC = Mixed Garden, PMK = Settlement, PLK = Dry Land Agriculture, SB/LT = Underbrush/Open Land, SB = Underbrush, BJ = Main Road, HT = Plant Forest and PTB = Mining.

From the data as the analysis result in Table 1.a spatial of RHL Effort Model spatial leaflet of the Upper and Middle of Amandit River Flow Territory can be made, and the result is presented in Figure 1.

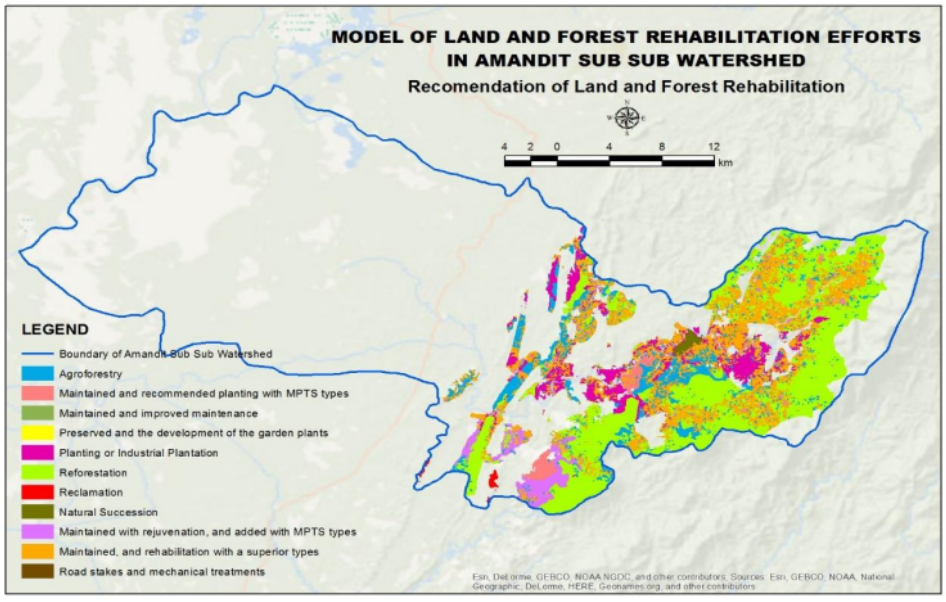

Figure 1. The Map Model of Land And Forest Rehabilitation Efforts In Amandit Sub Sub Watersheed.

The comparison of the number of level of land criticallity (TKL) before the simulation of land closing in the Protected and Critical Area of the Upper and Middle Regions of Amandit River Flow Territory, the detail of can be seen in Table 2.

Table 2. TKL Result before and after the Simulation of Land Closing in Model of Land And Forest Rehabilitation Efforts In Amandit Sub Sub Watersheed

Simulation Land Closing	Level of and Criticallity				
	Not (Ha)	Potentially (Ha)	Rather (Ha)	C (Ha)	Very (Ha)
Before	20.51	18,786.44	8,441.80	10,062.97	105.60
After	20.51	30,124.51	19,277.81	0.00	0.00

From the data in Table 2 we can see that after the simulation of land closing in deciding the RHL Effort Model the land criticality after the simulation, the area of the Land Criticality goes down from the Critical Land of 10,062.97 Ha and Very Critical 105.60 Ha to 0.00 Ha each and so does rather critical from 20,947.31 Ha goes down to 19,2777.81 Ha critical, very critical and rather critical land have changed to potentialy critical, where the potentially critical has changed from 18,786.44 Ha before becomes more to 30,624.51 Ha, because the land closing simulation can not be done 100% due to the land closer which have been dominated by the community (Rubber and palm oil estates, dry land agricuture, settlement and road), the result of the reduction of the land criticallity that happened is not optimal until the land criticallity is not critical.

From the eleven models of the RHL effort models above, 4 models can be determined to have the biggest area than the others: the HL and HP Areas as SB/LT land closing is converted to become forest using the pattern of Reboisation of 13,274.33 Ha; the HL, HP APL areas and the SAGK land closing the KK is maintained as ruber estate and rehabilitated with the prime seed kind of rubber of 8,997.03 Ha, Agroforestry is deveoped for the PLK land closing of 3,714.10 Ha and in the APL Area the SB/LT land closing is converted and becomes forest of plantation with the forestation or Forest of Industrial Plant (HTI) of 2,347.40 Ha.

In the HL and HP Areas the land closing SB/LT are converted to become forests using Reboisation pattern. It is hoped that it can reduce the level of land criticallity. This is because of the role of forest vegetation canopy which can protect the land from the strike of kinetic energy of rain drops and can reduce the flow of the surface water because there is a mountain rapid of forest vegetation and the phisycal characteristic of the land which becomes better. This is in line with opinions of Kadir *et al*.(2013) and Ruslan *et al*. (2016) that the use of land with forest vegetation will bring more important role or impact to erotion and sediment than ot her factors such as: season, land characteristics and topography.

The spread of RHL Efforts Model (Table 1 and Picture 2) above can also be devided to 2 groups : 1) The group of Land Closing . with certain treatment and 2) The group of Land Closing which is converted to become plantation forest and Agroforestry. The Group of Land Closing which will be maintained with certain treatment are: Rubber Estates (Kebun Karet = KK), Palm Oil Estates (Kebun Sawit = KS), Mixed Gardens (Kebun Campuran = KC), Settlement (Pemukiman = PMK), Main Road (Badan Jalan = BJ) and Forests (Hutan = HT). The Group of Land Closing which which is converted to become plantation forests and Agroforestry are : Underbrush/Open Area (Semak Belukar/Lahan Terbuka = SB/ LT), Dry Land Agriculture (Pertanian Lahan Kering = PLK) and Mining (Pertambangan = PTB).

The RHL Efforts Model in the Upper and Middle Regions of Amandit River Flow Territory which is presented above. In line with Ruslan opinion (Ruslan *et al*., 2013) and Badaruddin (Badaruddin 2014) that the main activities of RHL efforts are Reboisation, reforestation, Industrial Plant Forest (Hutan Tanaman Iindustri = HTI), Maintenance and The Implementation of Land Conservation

Technique vegetatively and technical civil in critical and unproductive lands. The activities of RHL Efforts which give priority to the trees planting (**tajuk** layers and mountain rapids on the forest floor) will be more effective in protecting land from the strike of kinetetic energy of raindrops and reduce the surface flow so that the level of erotion becomes smaller. This in line with Asdak and Kadir opinions (Asdak 2010) and (Kadir *et al*. 2013) and that land closing in the form of forest vegetation as the ecosystem component of River Flow Territory can reduce *run off*, erotion and sedimentation because there are: a) Interception of pillar tree and mountain rapids on the forest floor. So it may reduce the kinestetic energy of the rain and the strike to the grain of land is smaller, b) The Forest Vegetation will reduce the speed of the *run off*, and the water damage strength, c) The influence of the roots of the forest vegetation humus and the land biology activities to the stability of the land structure and the land porosity and d) Transpiration of the forest vegetation can reduce the satAuration of land water so that the amount of the infiltrated water inside the land will be more and less *run off*, which then result in smaller erotion. Besides that, in line with Kadir's opinion (Kadir 2014) which states that if the Underbrush is converted to forest using RHL direction by implementing Reoisation and the development of **teras gulu,** it can reduce the critically level of the land from Very Critical to Potentially Critical and the danger level of flood from Dangerous to Less Dangerous.

For the APL Area for Rather Critical Level, the model of RHL Effort of reforestation or Industrial Plantatiatioon Forest or HTI 2.347,40 Ha, it is suggested that besides the use of forestry plantation it is better to use kind of other plantation as alternative, like mixed garden plantation, so that people in the community can develop agricultural and plantation including the combination with one-season plant, with the hope that it can increase people's income in the surrounding areas in the Subs Amandit River Flow Territory. This is in line with the moral value of Population Pressure of 0,88, which means <1, and means that the community agricultural activities can still be developed and the moral value of the Social Economic Aspect of 41,64 (including the range value of 40-50) which means the support of the social economic aspect to HTL activities is **Very Strong.** With the Very Strong of the social economic of Amandit have the chance to gain a very big success.

CONCLUSION

The Level of Criticallity (TKL) in the regions of Amandit River Flow Territory varies and consists of several classes of Not Critical, Potentially Critical, Rather Critical, Critical and Very Critical and there are places with over limit of the already determined criticallity. The Level of Criticality in the Cultivated Area of the Upper and Midde Parts of Amandit Subs River Flow Territory as are the targets of RHL are: Rather Critical 12,505.53 Ha (13.64%). The Level of Criticality in the Protected Area of the Upper and Midde Parts of Amandit Subs River Flow Territory as the targets of RHL are: Very Critical 105.61 Ha (0.44%); Critical 10.062,97 Ha (42.31%); Rather Critical 20,947.34 Ha (49.14%).

The Analysis of Moral Value of Population Pressure (TP) is 0.88 (TP <1), means that the land can still have supportive capacity and can accomodate more farmers. The Moral Value of the support of the social economic aspect (DASE) in the regions of the Upper and Middle Parts of Amandit River Flow Territory is 41.64 (Strong).

Model of RHL Efforts in Area of Cultivation and Protected Area in Amandite Subdivision of Upper and Middle Section of 31.115,88 Ha, consisting of 11 kinds of RHL direction pattern, 1) Dryland Farming developed with Agroforestry; 2) Forest maintained Planting with the types of Multi Purpose Tree Species (MPTS); 3) Palm Garden maintained and upgraded; 4) Settlements maintained and developed with yard crops; 5) Shrubs/Open Fields converted into forests with Greening and Industrial Plantation Forest; 6) Shrubs / Open Fields are converted to forests by Reforestation; 7) In the former mining area is done reclamation and revegetation; 8) Shrubs on Natural Reserves Mount Kentawan is converted to forest with Suksesi Alamai; 9) Mixed gardens are retained with rejuvenation and added type of STT; 10) Rubber gardens are retained and rehabilitated with superior plant species; and 11) Road bodies are maintained and road shoulders are planted with trees Road Turus and Making of salurandrainase for drainage.

The Level of Land Criticallity as the influence of the Level of the land closing simulation in the Model and Land of Forest above which was five levels before becomes three Level of Criticallity: Not Critical 20.51 Ha, Potentially Critical 30,624.51 Ha and Rather Critical 19,277.81 Ha.

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Model Of Land And Forest Rehabilitation Efforts In Amandit Sub Sub Watersheed

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