The Influence of Land Use Change Toward Hydrological Aspect at Upper Site

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Firman Hidayat*

Abstract--- *The Impact of land-use change not only give some benefit to community but also can cause problem, namely: erosion, sedimentation, flooding and other. Erosion will cause silting of reservoirs, reducting irrigation channel capacity, and disrupt electrical power generation systems. High erosion, flooding in the rainy season not only have a negative impact on the biophysical aspects of natural resources and the environment but also the social aspects of the economic impact on the community. Several cases of changes in land use in some watersheds in Indonesia is presented with a discussion of the causal relationship of hydrological aspects, especially regarding the carrying capacity of the watershed and the frequency of flooding. Hydrology and run off characteristics of a number of primary rivers in Indonesia (Java) presented by using of land that increase timely. Related with that case the research will be taken. The objective is, to analisys influence of land use change to hidrological aspects. at Mahat Hulu watershed, located in the Lima Puluh kota district that 15 years old (1995-2010) deforestation has taken significantly. In 1995 Watershed has Forest area approximarely 50.9% and in 2010 decrease into 28% or from 14523 ha (1995) decrease to 7981 ha (2010) but mix garden increased from 17.1% (1995) to 43.8% (2010) or 4889 ha (1995) to 12508 ha (2010), Consequently, such as runoff increased, flooding, and drought during the dry season, high erosion and sedimentation as well as a decline in productivity and income of farmers. In this case, special aspect that research, were the influence of land use changes on the hydrological aspects such as coefficient of annual and seasonal runoff, and fluctuations. The method used quantitative and multiple regression test. Result of analysis are deforestation will increases coefficient run off, and fluctuations discharged. Coefficient runoff from 20% in the 1999-2002 to 24% in 2007-2010 and fluctuation of discharged (KRS) also increased from 2.4-5.5 (1999-2002) to 5.9-10.7 (2007-2010) indicating DAS is critics. Results of multiple regression test showed a close correlation between the variables (0.9) the formula is C (%) = 975 - 11.2 htn - 15.3 kbn cpr - 10.9 smk blkr + 0.43 tgln dan R-Sq = 42.4%, for the stepwise regression test showed that forest area influence to run off. It can be showed from the equation is CRO = 31.5 - 0.370 htn, , R-Sq = 5.3% Its mean, run off will increased cause by forest area decreased.*

Keywords--- *Hydrology, Erosion, Sedimentation, Runoff.*

I. INTRODUCTION

The research was conducted in the watershed upstream Mahat (28535.49 ha) which has been degraded due to conversion of forest lands into new agricultural areas and illegal logging. Erosion level on site and off site sedimentation level is due to the opening of the land surface. This was reported by Berd I. (2003) due to a reduction of 50.89% forest in 1995 to 40.24% in 2003 the erosion has reached 172.92 tonnes / ha / yr which affect the volume of the reservoir once the turbine installed capacity

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Excessive volume of runoff that could potentially cause flooding downstream. This is in accordance with the opinion Irianto (2003) which states that the annual rainfall accumulated in a short period (December-February) cause the land is not able to accommodate all of the volume of rainwater. Consequently most of the rain water runoff, it is exacerbated by the increasing conversion of forests to other uses such as agricultural, residential, and industrial fields. That will cause considerable potential flooding in downstream areas. Further it is said that the amount of surface runoff will also cause excessive erosion, so it will directly reduce soil fertility. Decline in soil fertility will cause the less vegetation is able to grow properly, so the diminishing forest cover. This will cause a reduction in charging (recharging) upstream water reserves which cause a drought during the dry season.

Meanwhile, according to Arsyad (2010) surface flow (run-off) is water that flows over the ground surface. This runoff can cause soil erosion, being able to carry part of the land in dispersed by raindrops. In this sense the flow of run off is above ground level before they reach the water in the canal or river. Factors influencing of run off properties are as follows; rainfall; (amount, rate, and distribution), temperature, soil: type, substratum, topography, broad basins, vegetation for cover crop (type, number, and density), and land cultivation system. Controling of runoff will have impact directly to erosion, which in turn will affect the availability of water in the dry season and the rainy season flood prevention.

Converting area from forest into agricultural land recognized cause many problems such as decreased soil fertility, erosion, extinction of flora and fauna, floods, droughts and even global environmental change. This problem will increase during forest are converted to other business future. (Banuwa, 2008) reported a relation between erosion and deforestation, namely the erosion of a small catchment areas in French Guyana French, increased dramatically after deforestation (deforestation). Observations were conducted on small-scale plots also showed that the logging of natural vegetation has led to an increase in run-off coefficient of 25-100 times, while the erosion increased as well to more than 10 times (Roose, 1986). Opened area causes fluctuations in temperature and soil moisture regime becomes larger. This leads to accelerated decline in soil organic matter (Lal, 1994). Run off is part of precipitation that flows on the surface and subsurface level and next reach to lower area such as: lake or sea (Schwab et al., 1981).For that reason this research was conducted. The objective is analisys of land use chance to hydrological aspects at DAS Mahat Hulu watershed at Lima Pulub Kota District.

II. METHODS

The tools and materials used in this study consisted of Geographical Position System (GPS), cameras, computer hardware PC / Laptop Toshiba Window Xp, software, microsoft word 2007, microsoft excel, program ArcView version 3.2, and ARC GIS.and Minitab 14. Materials used such as: Data discharge, RBI maps, climate maps, maps land use, soil maps, geology maps, Landsat ETM7 1995, 2000, 2005 and 2010, Secondary data, including data physic required in this study includes the data types of land use, topographic data, soil data, discharged data, and climate data. climate data (rainfall) obtained from a Sicincin BMKG station daily data from the year 1995 to 2010. While the discharge data obtained from hydropower Koto Panjang and BWS II Inderagiri Hulu, a monthly discharge data in 1999 - 2010 and the daily discharge in 2004 - 2010 (Table 1)

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Table 1: Types, Sources and Uses of Data

No.	Data Type	Sources of Data	Usefulness of Data
A.	Secondary Data		
1.	Map-Map	BP DAS Indragiri Rokan (1995, 2000, 2005, and 2010), Riau Provincial Forestry Office, Bakosurtanal, Land Research Centre, Directorate of Land Use,	To arrange land units, which would then be used in the estimation of runoff and erosion
	ETM7 Landsat imagery (30 m resolution)		
	Land use maps (scale		
	Topographic maps		
	Map of soil types		
	Forest boundary map		
	Geological map		
	(Bf Scale: 1: 50,000)		
2.	Mahat watershed upstream discharge data	Hydroelectric Koto Panjang	To see the change in flow rate upstream sub-watershed Mahat due to changes in land use
		SWS II Inderagiri	
3.	Climate data (rainfall)	BMKG Sicincin	

Data Collection Techniques

At this stage, identification, inventory, and procurement of materials and the necessary data, such as contour maps, map earth way, the image of Landsat 7 ETM man pereka year 1995, 2000, 2005, and 2010, soil map scale 1:50. 000, Map slopes digital elevation maps obtained through the model (DEM) scale 1: 50. 000 is processed through contour map scale of 1: 50.000 with using the program ArcView 3.2.

Land Use: Land use data obtained from image analysis of Landsat *ETM* 7, k emudian conducted *ground check* / observation at sample sites in the field to see the development of existing land-use change. Data land use is analyzed land use data are available the last 15 years (1995, 2000, 2005 and 2010)

Rainfall: Rainfall data is daily data, the data is collected from the Meteorology, Climatology and Geophysics Agency (BMKG) Sicincin, starting in 1995 through 2010

Mahat Discharge Upstream: Water discharged collected is monthly data for 12 years (1999 -2010), and daily data from 2004 to 2010, this data is used to see the continuing effect of land use change on hydrological factors.

Landsat images were analyzed using ERDAS V, 8.7 For getting land use information contained in the image is done klassifikasi the Landsat image ETM recording 7 years 1990,1995,2000 and 2010. Classification method used is the maximum similarity clasification supervised (maximum likelihood supervised classification), where each spectral class is described by a probability distribution in a multispectral space. Overlay analysis techniques using ArcView 3.2 aims to determine the type of the existing spatial changes between 1995 to 2010

To see the effects of changes in land use or watershed response Mahat Hulu to hydrology aspects that is input into the discharge rain, it will be the analysis of rainfall, flow analysis and land-use change. Discharge data analysis will be done by looking at the trend of the influence of land use change on river discharge is generated. The method used is the mathematical models namely multiple regression analysis (multiple regression) to illustrate the degree of

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correlation between several independent variables and the dependent variable, discharge data is the data that will be used monthly discharge series Mahat Hulu DAS 12 years (1999-2010)

Regression mathematical form as follows:

$$Q_{max} = \beta_o + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5 + \beta_n x_n + \acute{\varepsilon}$$

$$Q_{min} = \beta_o + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5 + \beta_n x_n + \acute{\varepsilon}$$

$$CRO = \beta_o + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5 + \beta_n x_n + \acute{\varepsilon}$$

where x 1; x 2; x 3; x 4; x 5, and x n; was the proportion of each type of land use, β o, β 1, β 2, β 3, β 4, β 5 and β n coefficients regression of each variable x, while έ is the residual or error is assumed to be normally distributed with mean 0 and standard deviation close to certain.

III. RESULTS AND DISCUSSION

Land Use Change at Mahat Hulu Watershed

Analysis of land use changes of the image is done in three (3) periods of time ie 1999-2002, 2003-2006, and 2007-2010 for more details can be seen in the following table (Table 2)

Table 2: Changes in Land Use in the Watershed Upstream Mahat 1995-2010

		Periode 1999-2002	(%)	Periode 2003-2006	(%)	changes Ha	(%)	Periode 2007-2010	(%)	changes Ha	(%
1	Forest	11,200.2	39.3	9,683.8	33.9	(1,516.4)	(5.3)	8,447.6	29.6	(2,752.6)	(9.6)
2	Mix garden	8,443.3	29.6	10,408.0	36.5	1,964.6	6.9	11,976.0	42.0	3,532.7	12.4
3	shrubs	3,164.2	11.1	2,911.8	10.2	(252.4)	(0.9)	2,720.0	9.5	(444.2)	(1.6)
4	Dry lands	2,447.3	8.6	2,251.4	7.9	(195.9)	(0.7)	2,111.3	7.4	(335.9)	(1.2)
5	Wet lands	1,800.2	6.3	1,897.7	6.7	97.4	0.3	1,908.0	6.7	107.8	0.4
6	Settlement	65.1	0.2	68.4	0.2	3.3	0.0	69.7	0.2	4.6	0.0
7	Water	217.7	0.8	283.7	1.0	66.0	0.2	306.5	1.1	88.8	0.3
8	cloud	1,197.4	4.2	1,030.8	3.6	(166.7)	(0.6)	996.3	3.5	(201.2)	(0.7)
	Total	28,535.5	100.0	28,535.5	100.	(0.0)	(0.0)	28,535.5	100.0	(0.0)	(0.0)

Source: Results of Landsat imagery interpretation ETM7 (1995-2010)

Table 2 is seen that watershed land use Hulu Mahat period 1999-2002 consists of 6 (six) in addition to the use of water bodies and cloud are: a) forest, b) mixed garden, c) shrubs, d) dry land, e) wet land, and f) settlement. In this period DAS Mahat Hulu is still dominated by forest vegetation covering an area of 11200.2 ha (39.3%), and mixed garden 8443.3 ha (29.6%), while at the end of the period 2007-2010 forest area only 8447.6 ha (29.6%) decreased 9.6% (2752.6 ha), but 11976 ha of mixed gardens, increased 12.4% (3532.7 ha). For more visibility upstream Mahat watershed land use can be seen from Figure 1 map land use Hulu Mahat DAS 1995.and 2010. Deforestation cause by new agricultural land, especially for gambir.

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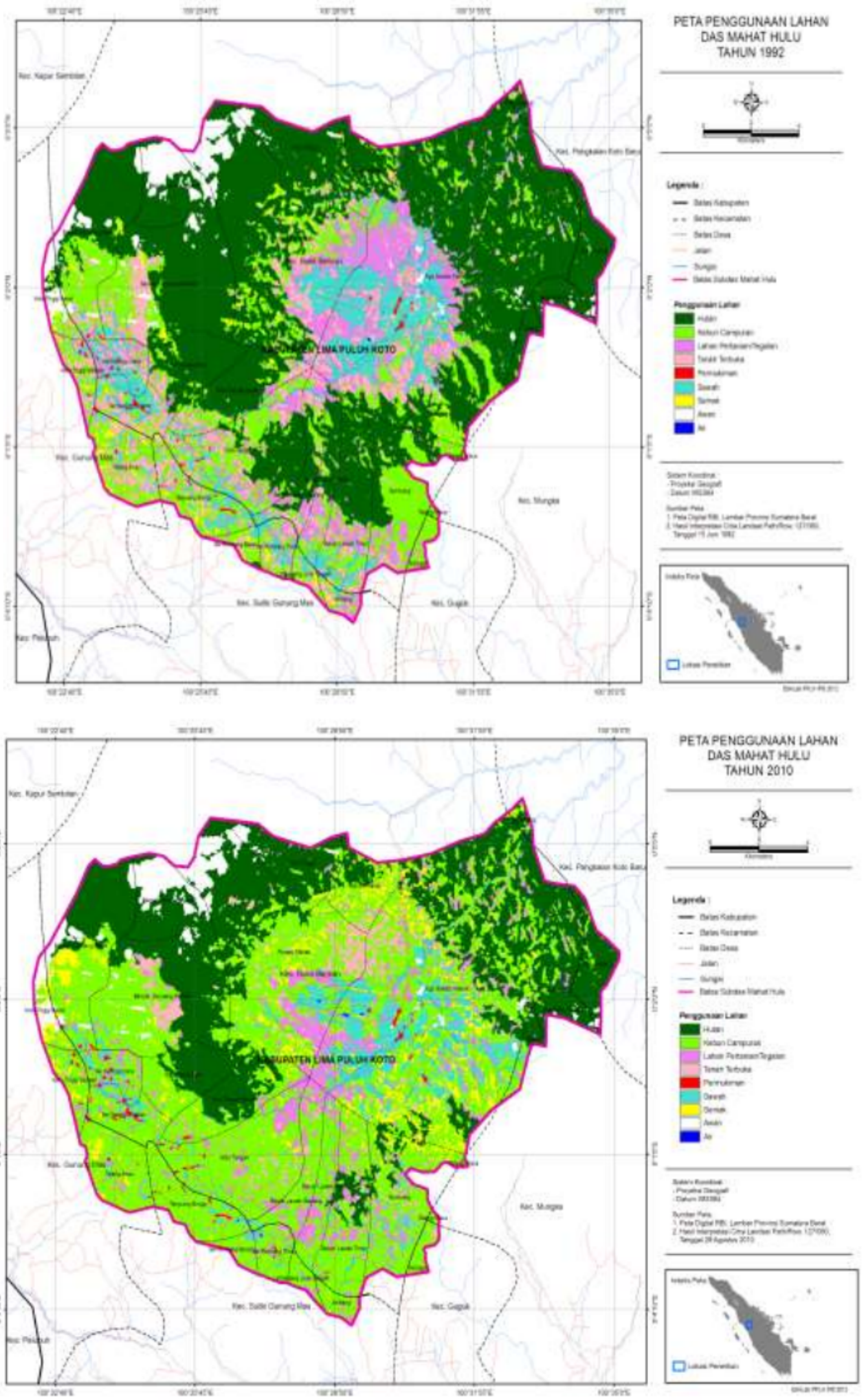

Figure 1: Land Use Map Mahat Hulu Watershed 1995 and 2010

Rainfall and Discharge at Mahat Hulu Watershed

Based on rainfall data for 15 (fifteen) years period 1995-2010, the magnitude of the average annual rainfall Mahat Hulu watershed is 1978 mm / year. Wet season generally occurs from the months of October to April, while in dry months from May to September. The highest monthly average rainfall occurred by 16 days in October and the lowest occurred in May 8th day of rain (Figure 2)

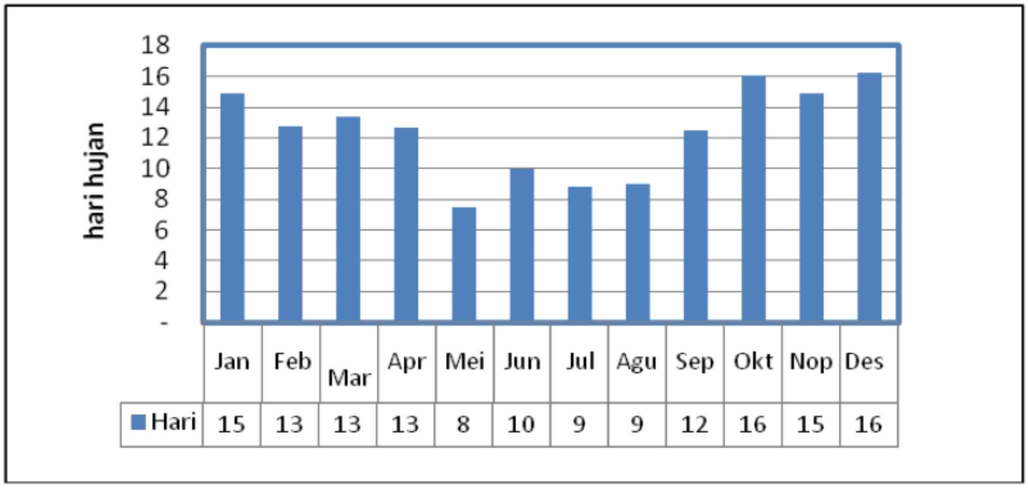

Figure 2: Day Average Monthly Rainfall Mahat Hulu Watershed (1995-2010)

Rainfall is the highest monthly average (259 mm) occurred in February and the lowest (71 mm) fell in July. Such rain patterns greatly affect the volume and distribution of river discharge. In wet season rainfall is very high and the otherwise very dry in dry season

The Influence of Land Use Change to Hydrological Aspects

Relatively high rainfall in the wet months are potentially increase runoff. This situation is also supported by a dwindling forests throughout the watershed Mahat Hulu. Changes in the use of forests to other land uses, causing the surface of the land to be open, with moderate clay content and low to moderate infiltration capacity. rain water more then at ground level or increased runoff. Similar with the statement Baver (1956) divides the influence of vegetation on surface flow and erosion into five parts, namely 1) Role in the interception, 2) Reducing speed and destructive power flow surface, 3) The influence of the root, 4) Biological aspects, and 5) Transpiration. While Arsyad (2010) says that the surface flow is strongly influenced by rainfall (amount, intensity and distribution), temperature, soil (type, type, layer of soil, and topography), watershed area, vegetation cover and soil management. However, because each factor has contributed a very complex one another, the estimation of runoff that is really close to the real situation is still relatively difficult.

Furthermore the average daily discharged for the period (1999 -2010) ranged from 11.19 to 15.07 m^3/sec Distribution pattern of the average daily discharge generally follow the pattern of rainfall in the Mahat Hulu watershed. Relationship between the magnitude of the average monthly rainfall with an average monthly streamflow upstream Mahat Hulu watershed shown in Figure 3 which shows the results of water (water yield) in the form of

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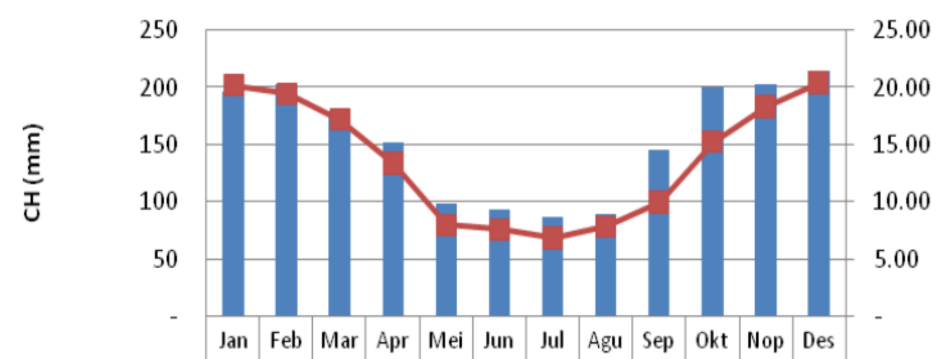
volume and distribution of discharge that occurs in addition affected by the main input (rain), also influenced by the biophysical conditions DAS is concerned as the condition of land cover, soil type, and topography.Which states the existence of forests in controlling surface and the discharge is not infinite, but there are factors outside the forest that is the amount of rainfall, slope, geology (soil) and land use. If one of the factors that are experiencing changes in the hydrological conditions in question would change include surface runoff and river discharge (Pudjiharta. 2008).

Increased runoff curve also indicates an increase of the amount of rain that turned directly into the discharge. As a result the higher discharge during the wet season (October to April) and lower in the dry season (May to September) Suryani.E and F. Agus (2005) reported that in the period 1992-2002 in Cilajupang watershed (2792 ha) has been done deforestation by 2, 35% and approximately 7.27% mix garden, but at dry land increased by 5.64% and the settlements around 5 , 11%. The impact of land-use change that occurred was an increase in total annual water yield though not significant (+0.35%). Significant changes occur in the flow components. Total runoff increased by 12.37% and the basic flow decreased by 2:54%.



	Jan	Feb	Mar	Apr	Mei	Jun	Jul	Agu	Sep	Okt	Nop	Des
CH (mm)	196	203	179	152	98	93	86	90	146	200	203	214
Debit (m³/det)	20.	19.	17.	13.	7.9	7.5	6.8	7.8	9.9	15.	18.	20.

Figure 3: The Relationship between Monthly Rainfall 1999-2010 (mm) with an Average Daily Discharge Mahat Hulu Watershed 1999-2010 (m^3 / sec)

Land use changed has increased annual runoff coefficient (C) than the average 20% to 24% (Table 3). The amount of surface runoff coefficient that describes the loss of water can not be used, because the direct flow and thrown away without being able to be used. Such a large loss of water caused by changes in the use of forest land to other land uses, especially for mixed gardens, which are supposed to reduce infiltration capacity so that the amount of rain water into the surface flow is much greater than that infiltrated. To it is necessary forest rehabilitation and the application of agrotechnology to reduce runoff and increase infiltration at Mahat Hulu watershed. Like what is proposed by Suwardjo (1981) that the use of one application of mulch Agrotechnology very effectivet to reduce runoff and soil erosion, its effectiveness depends on the amount and durability of the decomposition process, one kind of straw mulch is effective enough on land with slopes up to 26 percent.

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Table 3: Runoff Coefficient (C) DAS Mahat Hulu 4th Annual Periods

Period	Forest (ha)	Forest (%)	Mixed G (ha)	Mixed G (%)	RF (mm)	Disch. (m3/dtk)	RO (mm)	C (%)
1999-2002	11200.2	39.3^{a}	8443.3	29.6^{a}	$2{,}202.8^{a}$	161.6^{a}	$1{,}451.5^{a}$	20.0^{a}
2003-2006	9683.8	33.2^{ab}	10408	36.5^{ab}	$1{,}603.6^{b}$	175.6^{ab}	$1{,}558.2^{ab}$	21.0^{ab}
2007-2010	8447.6	29.6^{c}	11976	42^{c}	$1{,}744.4^{b}$	223.8^{c}	$1{,}595.4^{c}$	24.0^{c}

Remarks : Numbers followed by the same letter in the same coloum are not significantly different at α= 5%

The last periode (2007 - 2010) discharged of Mahat Hulu watershed more than the first periode (1999 - 2002) that was 223.8 m ^{3} / sec (periode 2007-2010) meanwhile in the periode 1999-2002 only 161.6 m ^{3} / s, which means rising 62.2 m ^{3} / sec. Results of water rose from 20 to 24, causing the larger the volume of water that can not be utilized and flows directly into the sea is estimated 113 million m ^{3} / sec (Figure 4)

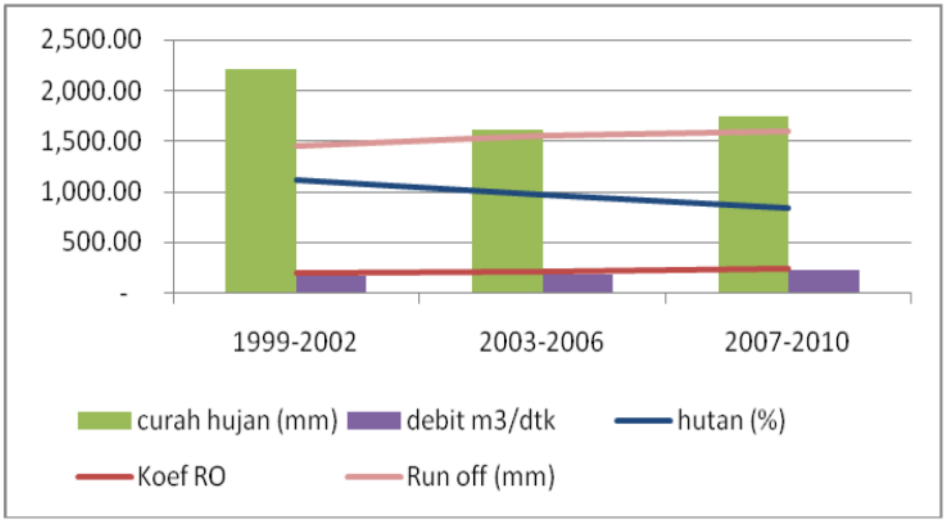

Figure 4: Forest and its Effect on Surface Runoff in Mahat Hulu Watershed

Run off Coefficient (C) during the rainy season is also different from the dry season in the same period. Table 4 shows the 1999-2002 period runoff coefficient (C%) is 20, while in the dry season 10. At the end of the period 2007 -2010 C (%) rainy season rose to 30%, while in the dry season is only 20%. This suggests that the impact deforestation during the rainy season led to increased surface flow is quite high compared to the dry season, which means also decrease the ability of the soil to infiltrate rainfall (Figure 5).

Table 4: Run off Coefficient (C) based on Season

Period	Forest (ha)		Rainy season				Dry season			
		Mixed G (ha)	RF (mm)	Disch (m3/dtk)	RO (mm)	C (%)	RF (mm)	Disch. (m3/dtk)	RO (mm)	C(%)
1999-2002	11200.2^{a}	8443.3^{a}	234.8^{a}	17.3^{a}	156.9^{a}	20^{a}	132.4^{a}	7.9^{a}	72.2^{a}	11^{a}
2003-2006	9683.8^{ab}	10408^{ab}	179.4^{b}	19.0^{a}	179.5^{ab}	27^{ab}	114.9^{b}	8.9^{ab}	80.8^{ab}	12^{ab}
2007-2010	8447.6^{c}	1976^{c}	175.8^{b}	20.4^{a}	185.1^{c}	32^{c}	111.3^{b}	11.3^{c}	102.8^{c}	24^{c}

Remarks: Numbers followed by the same letter in the same coloum are not significantly different at α= 5%

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In the period 2007-2010 the forest area has been significantly reduced with the increase of mixed garden, this change implies that the higher erosion, discharge increased which in the rainy season 20.4. m3/sec and 11.3 m3/sec in the dry season. The high level of surface roughness and organic matter in the form of sarasah and dense canopy of the forest is the main factor reducing the effectiveness of forest runoff. Surface roughness, soil porosity and infiltration increased as a result of organic matter that accumulates on the surface and at the same time able to reduce run off.

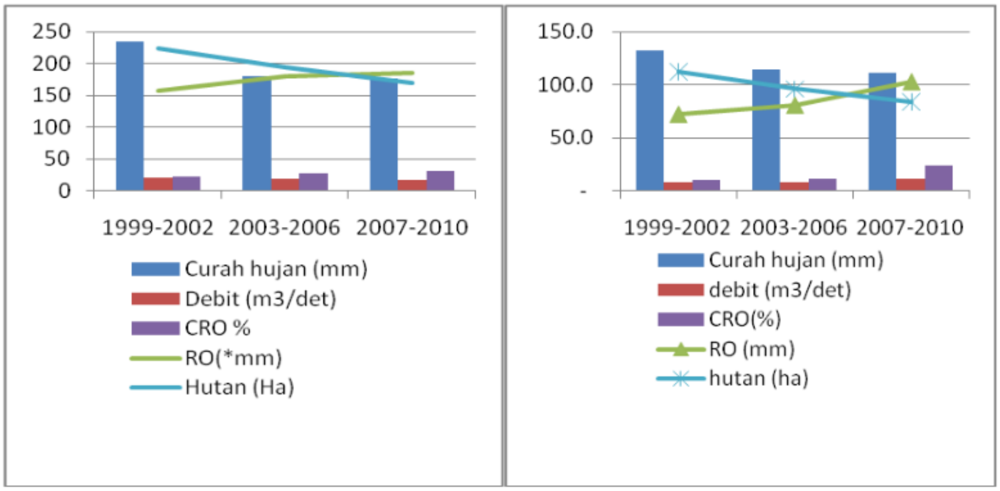

Figure 5: Forest and Run Off Coefficient (Rainy and Dry Season)

Tropudult typic soil types are dominant in the upstream watershed Mahat is also one type of soil that is dominated by clay and the ability to pass water infiltration is low to moderate (5.8 to 18.6 cm / h), permeability at speeds from 3.0 to 12 , 5 cm / h which characterizes the condition of the soil to pass a slow to moderate water, and dominated the slopes above 25% quasi characterize the biophysical conditions are not easily stored water and surface flow is quite high.

Further analysis of the impact of land use change on hydrological conditions is to look at the relationship (correlation) between the value of C (%) with watershed land use Hulu Mahat (%). First with multiple regression analysis (multiple regression) are presented in the following equation. C (%) = 975 - 11.2 Forest - 15.3 mixed G - 10.9 shrubsr + 0.43 dryland dan R-Sq = 42.4%, Stepwise Regression presented in the following equation C (%) = 31.5 - 0.370 dan R-Sq = 5,3%.

For regression was tested with a single and get the following equation: C (%) = 31.5 - 0.370 dan R-Sq = 5,3%..Conclusion forest turns negative effect on runoff. The more extensive the forest, the less runoff proved that the hypothesis is accepted (Figure 6)

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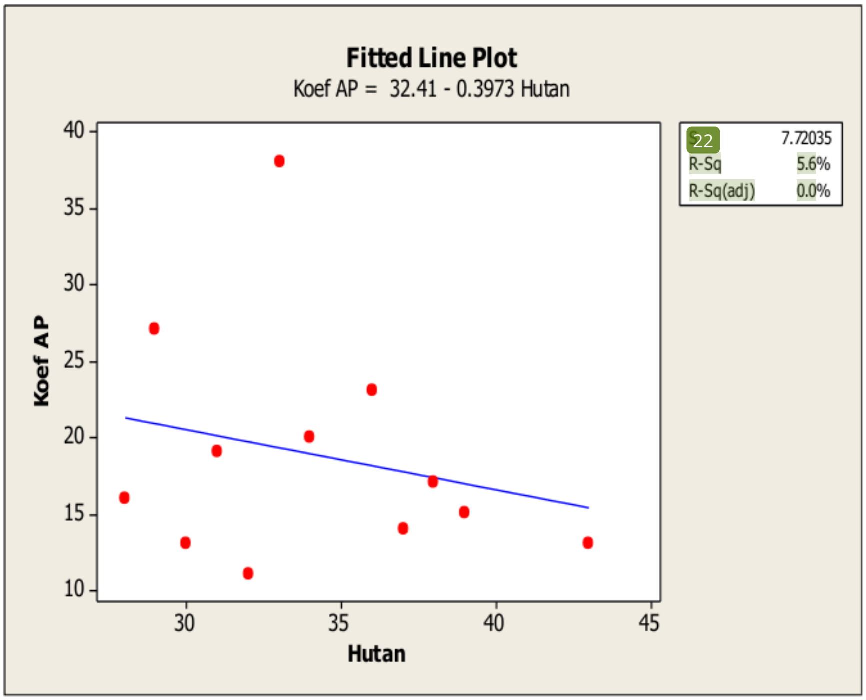

Figure 6: Simulation of Forest and Run Off

Furthermore, by the equation C (%) = 31.5 - 0.370 Forest on simulation to estimate the impact of changes in land use change in the proportion of forest cover in particular the runoff coefficient (C) and estimates the value of lost water and that can be exploited Table 5

Table 5: Simulation of Forest Land Use Change on (C) and the Estimation of Water Lost

No.	Forest (%)	C (%)	RF (M / yr)	Water is lost million m³ / yr	Value of water Billion / yr	Water used million m³ / yr	Value of water (Billion / yr)
1	20	24.5	1.6	113.0	67,801.6	387.0	464,396.8
2	25	22.5	1.6	103.8	62,299.3	396.2	475401.4
2	30	20.5	1.6	94.7	56,797.0	405.3	486,406.0
4	35	18.5	1.6	85.5	51,294.7	414.5	497,410.6
5	40	16.5	1.6	76.3	45,792.4	423.7	508,415.2
6	45	14.5	1.6	67.2	40,290.1	432.8	519,419.8
7	50	12.6	1.6	58.0	34,787.8	442.0	530,424.4

Sources: H acyl simulated forest area and runoff

price per m^3 of water = Rp. 1200. - (2012)

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The increase forest cover in a watershed can reduce surface runoff coefficient (C), which in turn can increase the amount of water that can be utilized. This is because the forest is able to reduce runoff and increase infiltration capacity (Table 5). In accordance with the statement of Hewlett and Nutter (1969) that the upstream region is covered with forests better then 80-85% of the total flow from the base flow is sustained by the flow slowly from the *zone of aeration* the rest is direct flow (15-20%). Thus, the development of water resources with forest rehabilitation activities (reforestation) are implemented on watershed Mahat Hulu will be able to increase the availability of water for downstream communities, especially for hydropower Koto Panjang. In accordance with Law No. 41 of 1999 on forest area in the watershed of at least 30%,. on research conducted fairly low runoff coefficient reached 20.5 %. To reduce runoff coefficient to be 1 0-15%, forested watershed areas to 45-50%. This is consistent with the results of the study Arief et, al (1991) showed that the *pine* forest watershed *Merkussi* have ground water reservoir thickness 312 mm and in agricultural watersheds on geological and topographical conditions of the same total soil water reservoir is only 27 mm while the watershed land cover mix in the area Cikapundung Gandok thick 241 mm soil water reservoir and the area Cigulung Marivaya on condition of mixed land cover 254 mm total water content, thus saving more forested watershed groundwater.

Subsequent analysis showed that changes in land use (PPL) or a decrease in forest area and increasing the use of mixed gardens and other cause the discharge increases the average daily maximum (Q max) and minimum discharge lowers the average daily (Q min) DAS Mahat Hulu. In this research, the testing of multiple regression analysis unakan use it again and get the equation Qmax HTN = 18 + 0.23 + 0.08 + 0.37 kbn.cmprn smk.blkr - 0.92 tgln. R-Sq = 1.0%. Results obtained turned out to woods, gardens and shrubs mixed Q shrub positive effect on the maximum and just moor negatife influential. But through a single regression test which turned out to increase forest cover affects the maximum increase in Q while decreasing forest area does not affect the increase in maximum Q. Regression equation as follows. Qmax = 26.8 - 0.042 kbn.cmprn. R-Sq = 0.5%

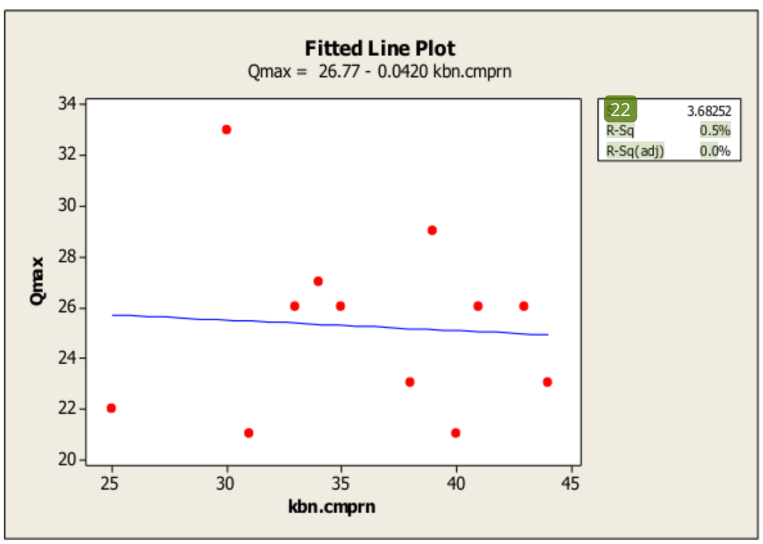

Fig. 7: Simulation Q max with Mixed Garden

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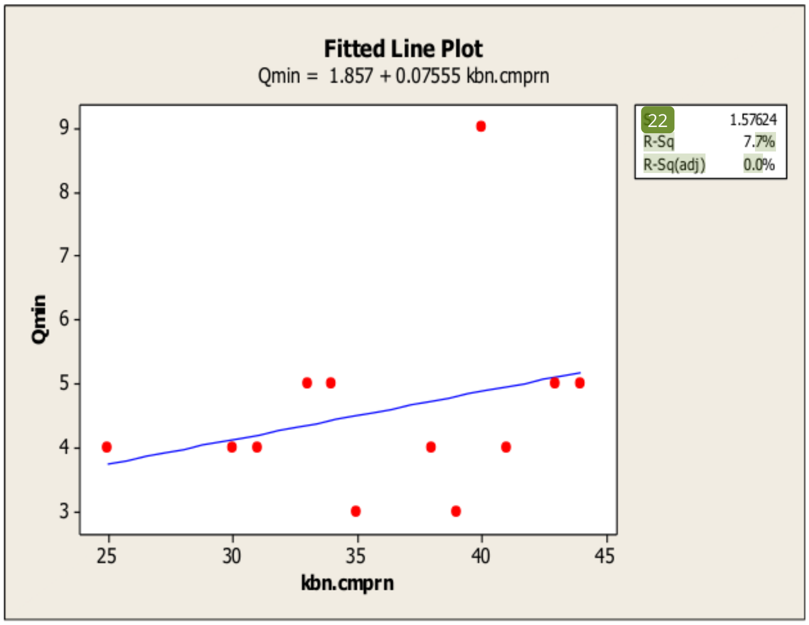

Fig, 8: Simulasi Q min with a Mixed Garden

Effects of changes in land primarily due to declining forest cover and increasing mixed gardens will also affect the minimum discharge (Q min). Regression test to get the following equation: Qmin = - 55.1 + HTN + 0.61 0.98 + 0.72 kbn.cmprn smk.blkr 0:35 tgln +, R-Sq = 19.0%. These results have not shown a variable effect on the minimum flow. To further stepwise test, but did not show satisfactory results, the next process via a single regression test found that the minimum Q would increase along with the breadth of mixed gardens (Figure 7 and 8). But the forest is inversely proportional, Qmin = 1857 + 0.07555 kbn.cmprn. R-Sq = 7.7%

According to Noordwijk VM. et al, (2004) Land cover by the tree in all its forms can affect water flow (discharge). Tree cover may be either a natural tree, plant or natural regeneration in the forest. Cultivated trees, trees as a hedge or tree monocultures (industrial plantations). Further, they say that the tree cover affects the flow of water in different stages such as: 1) interception, 2) protection of soil aggregates, 3) infiltration, 4) water uptake, and 5) landscape drainage.

This is consistent with the results of Pramod, I, B et.al (2010) who conducted a study in basin made from limestone parent KPH Cepu said that the peak discharge will change significantly involved in the event that the original forest area change 80% of the watershed area decreased to 53% watershed area, discharge peak rise of 30 l / sec / km ² becoming 67 l / sec / km ². fact shows that the changes in the use of forest land to other uses contributed immensely to the increase in the maximum discharge average and volume of runoff. Furthermore, identifying activities pentupan land, needs to be deepened to measure the quality of its closure. This is because according to its function as a regulator of the water system, the possibility of mixed gardens can work together with forest, in other words the response of vegetated land cover types may be similar to rain On the other hand this leads to decreased soil water storage that will directly lower the minimum flow daily average.

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Asdak, (2007) said that the function of the forest vegetation in regulating the hydrological environment occurs through the soil surface protection against the onslaught of rain kinetic energy, ie, through the 3 (three) layers of water storage areas, either by canopy strata (canopy) Sarasah forests, as well as pores forest soil, so that the water flow can be regulated. This is consistent with the proposed Sinukaban (2007), that the reduction in soil infiltration capacity erosion in the upper watershed caused replenishment (*recharge*) water under the ground (*ground water*) is also reduced, resulting in droughts in the dry season and floods during the rainy season .

Table 6: The Effect of Land Use Change to Discharged

Period		Discharged (m3/sec)		
	C (%)	Rainy season	Dry season	Fluctuation Disch. (Qmax/Qmin)
1999-2002	20[a]	17.3[a]	7.9[a]	2.4-5.5[a]
2003-2006	21[ab]	19.0[b]	8.9[b]	5.6-5-8[a]
2007-2010	24[c]	20.4[b]	11.3[b]	5.9-10.7[b]

Remarks : Numbers followed by the same letter in the same coloum are not significantly different at α= 5%

Land use changes in also causes increased fluctuation of the average daily Mahat Hulu watershed (1999-2010) that divided into 3 periode. For the first period (1999-2002) fluctuation of discharged only 2.4-5.5 but for the last periode (2007-2010) increased to 5.9-10.7. This proves that the land use change on the KRS is not only caused by reduced forest area but also due to the increased use of other mixed garden during the 12 years of observation of forest land use change to other land uses have made critical for Mahat Hulu watershed.

Ilyas (2000) reported that, the decline in the forest area in East Kalimantan Karangmumus watershed of the area of 18% to 10% can cause an increase in flood peak rate of 7.6% of the original condition. While Sinukaban N, Satjapradja, and Wastra (2007) states that the change in land use bush into *agroforestry* (mixed gardens) in Sub-watershed Manting East Java has led to an increase in the coefficient of river regime (KRS) or fluctuations in surface runoff from 9.7 in 1987 to 10.1 in 1988 and to 13.1 in 1999. This is because agroforestry or mixed gardens that applied causing some land to be open, so the impact on the increase in surface runoff.

IV. CONCLUSION

1. Mahat Hulu watershed forest decreased significantly over the last 15 years. During the early period 1999-2002 still dominant forest area is 11200.2 ha (39.3%), and mixed garden 8443.3 ha (29.6%), and another 8891.5 ha (31.111%), but in the last periode (2007-2010) the forest area decreased to 8447.6 ha (29.6%) fell 9.6% (2752.6 ha), mixed gardens increased to 11976 ha, up 12.4% (3532.7 ha) and another 8111.4 ha (28.43%).

2. Deforestation has been influence aspects of hidrology eg, a) Run off coefficient increasing from 20% in the 1999-2002 period to 24% in the period 2007-2010. b) increasing discharged from 161.6 m^3/sec (1999-2002) to 223.8 m^3/sec. c) Deforestation also increasing Q max.and d) Increasing discharged fluktuation from 2.4-5.5 (1999-2002) to 5.9-10.7 (2007-2010 and the last, water lost around 113 million m^3/year (Rp.67.8 M/year) cause by increasing run off coefficient

3. Land use change (deforestration) has led to high sedimentation in reservoirs PLTA Koto Panjang Koto

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Panjang. Its impact is loss of hydropower from 3 GWh -30 GWh in a month.

4. Improving traditional mixed gardes systems by using agrotechnology strip cropping and mulch systems reduce erosion rate under tolerable erosion is 32.82 ton/ha/year meanwhile E-tol is 39.6 ton/ha/year.

SUGGESTION

1. Deforestation should stopped and to all stakeholders in the catchment area of the Mahat Hulu watershed already should cooperate in watershed management for the foreseeable future in order to avoid further. .
2. The concept of maintaining upstream and downstream pay compensation is a strategic step for DAS Mahat Hulu continues to function and the availability of water resources remain available. payment environment services especially for utilizing water

REFERENCES

[1] [DITJEN RLPS] Directorate General of Land Rehabilitation and Reforestation, 2009. Guidelines for Monitoring and Evaluation of Watershed No.: P.04/V- SET.2009 Date March 5, 2009 *the Ministry of Forestry, Jakarta*

[2] Ahmad, I., & Verma, D. (2016). Surface Runoff Estimation using Remote Sensing & GIS based Curve Number Method. *International Journal Of Advanced Engineering Research And Science,* 3(2), 73-78.

[3] Anandakumar, H., & Umamaheswari, K. (2017). An Efficient Optimized Handover in Cognitive Radio Networks using Cooperative Spectrum Sensing. *Intelligent Automation & Soft Computing,* 1–8.

[4] Anandakumar, H., & Umamaheswari, K. (2018). A bio-inspired swarm intelligence technique for social aware cognitive radio handovers. *Computers & Electrical Engineering,* 71, 925–937.

[5] Arief MI, F. Effendy. and HR Kayo. , 1991. Relationship with the land cover (forest) to Low Debit In areas Cikeruh Sumedang. West Java. *Water Research Development Centre . Bandung*

[6] Arsyad S. 2010. *Soil and Water Conservation* . Bogor: *Library Serial, IPB Press*.

[7] Arulmurugan, R., & Anandakumar, H. (2018). Early Detection of Lung Cancer Using Wavelet Feature Descriptor and Feed Forward Back Propagation Neural Networks Classifier. *Lecture Notes in Computational Vision and Biomechanics,* 103–110.

[8] Asdak C. 2007. *Hydrology and Watershed Management* . Gadjah Mada University Press. Yogyakarta.

[9] Banuwa IS, 2008. Development of Alternative Farm-Based Coffee For Dryland Agriculture Sustainable Development in the Sekampung Hulu watershed [dissertation]. Bogor: Graduate School, University of Agriculture Bogor.

[10] Baver ID, 1956. Soil Physics . 3 rd ed. John Willey and Sons Inc.. New York

[11] Choudhary, S., R. B., S., M.P., o. and R. B., S. (2016). Distortion Analysis of CMOS Based Analog Circuits. *International Journal of Advanced Engineering, Management and Science,* 2(6), pp.633-636.

[12] Deepa, N., Gunasekaran, D., & Kausalya, G. (2016). A Survey-Cotton Leaf Disease Detection Using Image Processing. *International Journal Of Advanced Engineering Research And Science,* 3(2), 52-60.

[13] Desfiandi, A., Suman Rajest, S., S. Venkateswaran, P., Palani Kumar, M., & Singh, S. (2019). Company Credibility: A Tool To Trigger Positive Csr Image In The Cause-Brand Alliance Context In Indonesia. *Humanities & Social Sciences Reviews,* 7(6), 320-331.

[14] Dr. Laxmi Lidiya. S. Suman, Rajest, "Correlative Study and Analysis for Hidden Patterns in Text Analytics Unstructured Data using Supervised and Unsupervised Learning techniques" in *International Journal of Cloud Computing (IJCC),* (Paper accepted)

[15] Dr. P. Suresh and Suman Rajest S (2019), "An Analysis of Psychological Aspects in Student-Centered Learning Activities and Different Methods" in *Journal of International Pharmaceutical Research* , Volume: 46, Issue 01, Page No.: 165-172.

[16] Dr. P.S. Venkateswaran, Dr. A. Sabarirajan, S. Suman Rajest And R. Regin (2019) "The Theory of the Postmodernism in Consumerism, Mass Culture and Globalization" in *The Journal of Research on the Lepidoptera* Volume 50 (4): 97-113

[17] GO Schwab, RK. Frevert, TW. Etminster, and KK Barnes. , 1981. *Soil and Water Conservation Engineering* . Third Edition. John Wiley & Sons. Inc. Canada.

DOI: 10.37200/IJPR/V24I5/PR201799
Received: 13 Feb 2020 | Revised: 07 Mar 2020 | Accepted: 23 Mar 2020

[18] Haldorai, A., & Kandaswamy, U. (2019). Supervised Machine Learning Techniques in Intelligent Network Handovers. *EAI/Springer Innovations in Communication and Computing*, 135–154.
[19] Haldorai, A., Ramu, A., & Murugan, S. (2018). Social Aware Cognitive Radio Networks. *Social Network Analytics for Contemporary Business Organizations*, 188–202.
[20] Hewlett JD and WL Nutter. , 1969. An Outline of Forest Hydrology , School of Forest Resources University of Georgia. *University of Georgia Press.pp* 1-132
[21] Ilyas MA. In 2000. Assessment and Evaluation of Impact Forestry Damage in the Karangmumus Watershed East Kalimantan, the Systems Approach. *Proceedings of the Symposium PERHIMPI*. 19 to 20 October 1999. Bogor
[22] Irianto G, 2003. *Flood and Drought*. "*Cause, Anticipation and Solutions*" CV. Universal Media Library. Bogor
[23] K.B. Akhmanov, S. Suman Rajest, Mustagaliyeva Gulnara, Khairzhanova Akhmaral (2019), "A Short View on the Backdrop of American's Literature". *Journal of Advanced Research in Dynamical and Control Systems*, Vol. 11, No. 12, pp. 182-192.
[24] Kawiana, I. G. P., Dewi, L. K. C., Martini, L. K. B., & Suardana, I. B. R. (2018). The influence of organizational culture, employee satisfaction, personality, and organizational commitment towards employee performance. *International Research Journal of Management*, IT and Social Sciences, 5(3), 35-
[25] Lal R. 1994. Soil Erosion by Wind and Water: Problems and Prospects . inclusive Lal, (Ed). *Soil Erosion Research Methods* . Soil and Water Conservation Society. Florida. p 1-10
[26] Maba, W., Perdata, I. B. K., Astawa, I. N., & Mantra, I. B. N. (2018). Conducting assessment instrument models for teacher competence, teacher welfare as an effort to enhance education quality. *International Research Journal of Management, IT and Social Sciences*, 5(3), 46-52.
[27] Md. Salamun Rashidin, Sara Javed, Bin Liu, Wang Jian, Suman Rajest S, "Insights: Rivals Collaboration on Belt and Road Initiatives and Indian Recourses" in *Journal of Advanced Research in Dynamical and Control Systems (JARDCS)*, Volume: 11, Special Issue 04, 2019, Page No.: 1509-1522.
[28] Muchson, -, & Sihwahjoeni, -. (2018). Business process reengineering in increase brand awareness SKYZ Bird. *International Research Journal of Management, IT and Social Sciences*, 5(3), 62-68.
[29] Nikhar, S. and Karandikar, A. (2016). Prediction of Heart Disease Using Machine Learning Algorithms. *International Journal of Advanced Engineering, Management and Science*, 2(6), pp.617-621.
[30] Noordwijk VM, A. Fahmuddin,. Suprayogo D, K Hairiah, G Pasya., B Verbist, and Farida. , 2004. The role of Agroforestry in maintaining the function of Watershed Hydrology. *Agrivita vol. 26, No. 1 March 2004 p. 1*. *ISSN: 0126 - 0537* 1) *World Agroforestry Centre, ICRAF SE Asia*, Bogor.
[31] Patidar, V. and Sharma, S. (2016). A Technical Review of Efficient and High Speed Adders for Vedic Multipliers. *International Journal of Advanced Engineering, Management and Science*, 2(6), pp.628-632.
[32] Pramono AA. , 2009. Forest Environmental Services for Local Communities in the *Upstream Ciliwung watershed BPPT Journal Vol III* No. 2 Th.2009. Pakuan Ciheuleut.Bogor
[33] Pramono IB *et al* .2010. Optimum vast teak forests as water arranging at watershed with Lime RegionISSN 1410-0657, *Journal of info Forests*, Vol VII No. 5 of 2010
[34] Pudjiharta A. , 2008. Effect of Forest Management on Hydrology. ISSN 1410-0657, *Journal of Forest Info*, Vol V. number 2. In 2008. PUSLITBANGHUT and Conservation. Bogor, 2008
[35] Putra, I. M. E. L., & Rasmini, N. K. (2018). Style of leadership and organizational culture as moderator of influence of competence and internal control system towards report quality. *International Research Journal of Management, IT and Social Sciences*, 5(3), 22-34.
[36] Rajest, S. S., Suresh, D. (2018). The Deducible Teachings of Historiographic Metafiction of Modern Theories of Both Fiction and History. *Eurasian Journal of Analytical Chemistry*, 13(4), emEJAC191005.
[37] Risdiana, H., Martiana, T. and Indriani, D. (2016). Comparison Cortisol Level Before and After Exposed Noise. *International Journal of Advanced Engineering, Management and Science*, 2(6), pp.637-639.
[38] Roose EJ. , 1986. Runoff and Erosion B efore and After Clearing D epending on the Type of Crop in Western Africa. p. 317-330. inclusive R. Lai, PA Sanchez, RW Cummings, JR (Ed .) *Land Clearing and Development in the Tropics* . AA, Balkemal Rotterdam / Boston.
[39] Saxena, M. and Gupta, S. (2016). Influence of Bi Concentration on Major Physical Parameters of Ge14BixSe76-xTe10 Based Chalcogenide Glasses. *International Journal of Advanced Engineering, Management and Science*, 2(6), pp.622-627.
[40] Singh, J., & Brar, G. (2016). Meter Data Acquisition System Implementation: (a lesson learned). *International Journal Of Advanced Engineering Research And Science*, 3(2), 47-51.

DOI: 10.37200/IJPR/V24I5/PR201799
Received: 13 Feb 2020 | Revised: 07 Mar 2020 | Accepted: 23 Mar 2020

[41] Sinukaban N, D Satjapardja, and S Wahyu. 2007. Effects of Vegetation Cover Changes Against Hidrology Response at Manting sub Watershed , Konto Watershed. East Java. In Soil and Water Conservation. For Sustanable Development. *DGRLPS Forestry Departement and Dept*. ITSL-IPB Bogor.

[42] Sinukaban N. 2007 . Role of Soil and Water Conservation in Watershed Management. In Agus.F; N.Sinukaban, AN Gintings, H. Santoso and Sutadi (Editor) *Bunga Rampai Soil and Water Conservation* , The Central Board of Soil and Water Conservation Society Indonesia from 2004 to 2007. Jakarta

[43] Suarda, I. W., Yadnyawati, I. A. G., & Suda, I. K. (2018). Portrait of Hindu religious teacher performance certified educator in junior high schools Denpasar. *International Research Journal of Management, IT and Social Sciences*, 5(3), 53-61.

[44] Suganya, M., & Anandakumar, H. (2013). Handover based spectrum allocation in cognitive radio networks. *2013 International Conference on Green Computing, Communication and Conservation of Energy (ICGCE)*.

[45] Sugitha, R., & Moses, M. (2016). Survey on Security Architecture for 4G Wireless Networks. *International Journal Of Advanced Engineering Research And Science*, 3(2), 68-72.

[46] Suman Rajest S, Dr. P. Suresh, "Galapagos: Is Human Accomplishment Worthwhile" in *Online International Interdisciplinary Research Journal*, Volume: VII, Special Issue II, September 2017, Page No.: 307-314.

[47] Suman Rajest S, Dr. P. Suresh, "The Dialog On Postmodernism Intertextuality, Parody, The Talk Of History And The Issue Of Reference" in *International Journal of Recent Technology and Engineering (IJRTE)*, Volume-7, Issue-5C, February 2019, Page No.: 244-251.

[48] Suman Rajest S, Dr. P. Suresh, "The white Tiger by Aravind Adiga: Depiction of Fermentation in Society" in *International Journal of Information Movement*, Volume: II, Special Issue VI, October 2017, Page No.: 189-194.

[49] Suryani E. and F. Agus, 2005. Land Use Change and Its Impact on Hydrological Characteristics (Case Study: Cijalupang watershed, Bandung, West Java, *Proceedings of Multifunctional Agriculture* , Bogor.

[50] Suwardjo.1981. The Role of Crop Residues to Soil and Water Conservation in Annual Farming Plants. Dissertation. *Graduate School of IPB. Bogor*.

[51] Wadageri, C., & Kurahatti, R. (2016). Review of Enhancement in Mechanical Properties using Austempered Ductile Iron (ADI). *International Journal Of Advanced Engineering Research And Science*, 3(2), 61-67.

DOI: 10.37200/IJPR/V24I5/PR201799
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