

# Deforestation in Watershed Area; Case of Jompi Watershed Area of Indonesia

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**Abstract**—Largeness of deforestation area in Indonesia tends to increase very year, and this phenomenal occurs in forest area of *Jompi* watershed in Indonesia. This research aimed at (1) identifying the perpetrators of deforestation in *Jompi* watershed area, (2) knowing the land largeness of the society within the forest area of *Jompi* watershed, and (3) knowing the factors influencing land largeness of the society in the aforementioned area. The results of this research showed that (1) the agents of deforestation in forest area of *Jompi* watershed comprised people who worked as farmers and not farmers. The people who worked as not farmers, i.e. : merchants, civil servants, and retired civil servants, carpenter/bricklayer, and drivers; (2) the land largeness of the society on the researched area was about 0.08-0.75 ha per person with the average land largeness was 0.34 ha per person; (3) largeness of deforestation in forest area of *Jompi* watershed was influenced by household income per capita, the number of family members, lack of knowledge about the function of forest, land largeness outside the forest area of *Jompi* watershed, transportation expenses to the nearest market, distance of house to the forest, and side job.

**Keywords**— Deforestation, Forest Area, *Jompi* Watersheds, Land Largeness.

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## I. INTRODUCTION

The land covering in forest area is very dynamic and changes fast which alters the condition of forest and reduces its land largeness. The data in period of 1996-2006 showed that the land largeness of forest area has reduced about 5,758.78 ha (7.26%) or 1,151.76 of total area in Muna Regency. Several activities causing the reduction of land largeness of the forest area (deforestation) are the conversion of the forest area for the purpose of the other sector developments such as: plantation and transmigration, ilegal logging, ilegal forest clearing away, illegal land occupation, and forest fires [1].

Deforestation phenomena in Muna Regency done by the society in Muna Regency were shown by the existence of the developing of farming activity on the seasonal plants in the forest area. Besides, the illegal occupancy of ex-illegal logging done by the society has happened. For example, the illegal occupancy of ex-illegal logging done by the society can become the farmland of the seasonal plants in forest area of *Jompi* watershed as the protected forest area. These both phenomena are suspected to be closely related with the motive for increasing the income of the household as well as for enlarging land tenure. Generally, several factors causing the forest conversion into farmlands are population growth, lack of knowledge of the society about ecological and economic functions of forest, condition of the society's economy (low social income or poverty), the trading trend of agricultural commodity, and the policy of economic development (regional and national).

The *Jompi* watershed has the strategic values for the society's life of Muna Regency especially in Katobu and Kusambi District. In the above mentioned area, it is found the river of *Jompi* that becomes the source of clean water and the bathing place (tourism object) in Raha Town. Besides, various interests that are in the above mentioned watershed are: 1) the upper course of the river is the farming area of the society, 2) for taking fire woods, 3) for taking wood as the building materials like building house, 4) as the source of raw material of traditional plaits, 5) as the place of the wood processing for the trading necessity both legal and illegal, 6) as the buffer of water order and the source of biodiversity, 7) as one of the identities of Muna Regency. Even though, *Jompi* watershed has a variety of the above mentioned functions, but currently its condition has been greatly concerning because it has happened the damage as the result of uncontrolled utilization. Visually, the body of the river has been going down drastically

around two meters since 1980s so that in summer, the water of the river begins to get dry and cannot fulfill the necessity of water for the society in its vicinity. Annually, there is on fire because its main vegetations are teak and bushes.

Regarding with the farming-system applied by the society in the upper course, there are some weaknesses that have direct relationship to the reduction of quality of the river body, i.e.: (1) on lands with slope topographies, the farmer does not apply the terrace system so that the above mentioned lands are easily eroded and its productivity highly goes down; 2) the plants cultivated on the farmer's fields are the seasonal plants (corns and tubers), while the gardening plants and fruits are only cultivated in the house yard. The main orientation for the farmer to cultivate the farming-plants is to meet with the food needs of the family. The implementation of such farming-system brings about the farmer lives in marginal condition, and is easily influenced by the third side to do the activity of illegal log processing in area of *Jompi* watershed due to economic reasons. In addition, the society in the vicinity of the forest area—both for those who have had or have not had the farmland outside the forest area did illegal occupancy of ex-illegal logging in forest area of *Jompi* watershed to be converted into the farm land on the plants planted with the same season.

Deforestation has the impact on the forest degradation, loss of forest ecosystem diversity, global warming/climate change, and other losses that affect directly or indirectly to human's life. [2] stated that global warming is caused by greenhouse gases (GHG). Forty eight percent of Indonesia's greenhouse gases (GHG) emissions come from deforestation and forest degradation. Threat of reduction in the diversity of forest ecosystems as pointed out by [3] have occurred in Southeast Sulawesi, namely the forest ecosystem changes into cocoa farming [4]. In addition to clearing forests into plantations, the community also clears the forests or utilizes sex-illegal logging land into the farmland in the seasonal farming activity. The conversion of forest into the farm land done by farmers is closely related to the motive for increasing the household income without considering the feasibility of farming of environmental aspects. In another aspect, land tenure process in forest area must be supported to develop a sustainable environment to get the sustainable development [5].

[6] stated that deforestation in Southern Mexico was affected by the number of household members, land height, largeness of land plot, the number of machine saws, the number of transportation means, the highest education of household members, the number of household members having formal education, the distance of house to the forest, distance of house to the nearest market, and land tenure time span. The similar research was conducted by [7] in Chiapas and Oaxaca, two states in Mexico that are classified poor but having the degree of biodiversity of high forest resources. Deforestation in two states mentioned above were influenced by the poverty, population density, local population percentage, the percentage of irrigated land, farmer's percentage obtaining the farming credit, range of the poverty, the total of rainfall, land slope, land height, and *dummy* protection of forest area.

[8] said that deforestation in Indonesia was influenced by the rainfall, the cost of palm oil, the price of woods, production world palm oil, rate of interest, exchange value, cellular phone network, largeness of left forest covering, percentage of land for concession, percentage of land for palm plantation, population density, and time taken for reaching the nearest city. Similar research conducted by [9] that deforestation in South Sumatera was affected by the price of coffee, rural poverty, and *dummy* law enforcement. In this research, besides being used some variables that have been employed by the other researchers [6], [7], [10], [11], [12], [13]—number of citizens, distance of house to the forest; expense of transportation to local market; and land largeness), it is also employed the variable of household income to know the impact of income change towards the land largeness of the society in forest area of *Jompi* watershed—the variable that has not been used in another research.

In addition, in previous research (for example, [14] that the sample of province was used as the unit of observation for the variable affecting deforestation. The benefit with the kind of such data is the easiness obtained in estimating the degree of deforestation for national level. Nevertheless, there is a shortcoming from the aggregation, namely it can arouse the bias because it is used the average data in every region. This is related with the province that is too large to be a sample. Overcoming the lack on the using of national level data, another researcher employed regency data (data time series) in estimating the causes of deforestation [15]. This research is different from former researches [16], [17], [18], [19], [20], [15], [21], [11], [8], [22]—were used secondary data) because it was used the farmer's level data. Regarding with the aspect of data analysis, this research was used two models of data analysis, namely (1) model of OLS—ordinary least squares and (2) model of heteroschedasticity—model of analysis that has relatively not been used by other researchers in studying the determinant factors of deforestation/land largeness of the society in forest area. Thus, the findings give the better information about the perpetrators and causes of deforestation because it was used primary data compared with former researches that were generally employed national level data (province and regency as the sample of research). Therefore, the findings are very significant to give the solution of prevention and ceasing of deforestation.

The effort of prevention and reduction of deforestation and increasing of forest conservation activities are very important to be done so that the Indonesian government's commitment to reduce emissions from deforestation and forest degradation (REDD<sup>+</sup>) can be achieved in 2020. Mechanism of REDD<sup>+</sup> is to reduce greenhouse gases (GHG) emissions by providing compensation to the parties doing the prevention of deforestation and forest degradation, conservation, and preservation of forests. Through REDD<sup>+</sup>, government of Indonesia does commitment to reduce greenhouse gases (GHG) emissions in 2020 for 26% of its own capabilities and 41% with international assistance. In this condition, dynamic strategy and links between economic, environmental, and social aspects must be considered [23], [24].

## II. RESEARCH METHOD

This research was carried out in area of *Jompi* watershed of Muna Regency, Southeast Sulawesi, Indonesia. Population of this research is all societies having the land in forest area of *Jompi* watershed. Since the number of population are not known, so the method of sample determination used was snowball sampling. Based on the above mentioned method, it was obtained the number of research samples for 31 persons (perpetrators of deforestation that are prepared to be interviewed).

Descriptive analysis method was used to determine the deforestation in forest area of *Jompi* watershed. The using of this method was expected to be able to give the description about land largeness of the society in forest area of *Jompi* watershed. For the analysis of the factors influencing the land largeness of the society in forest area of *Jompi* watershed was conducted by including the farmer's demographical variable, farmer's social economy, and physical condition of the land so that it was obtained general equation as follows:

$$LLFA = f(INCOME/C, LLOFA, LCEFA, TENM, FA, EHH, NFM, KFF, DVHF, DVSFA, DVSJ) \quad (1)$$

where: *LLFA* (Land Largeness in forest area/deforestation) in hectares (ha); *INCOME/C* (family income per capita in Indonesian Rupiah per capita per year (IDR/capita/year); *LLOFA* (land largeness outside forest area in hectares (ha); *LCEFA* (land clearing expenses of forest area ) in Indonesian Rupiah per capita per year (IDR/capita/year); *TENM* (transportation expenses to the nearest market in Indonesian Rupiah per capita per year (IDR/capita/year); *FA* (farmer's age) in year (year); *EHH* (education of household head in year (year); *NFM* (the number of family members (Person)); *KFF* (knowledge of forest function); *DVHF* (dummy variable between house and forest (1 = distance between house and forest  $\leq$  2 km; 0 = Distance between house and forest  $>$  2 km); *DVSFA* (dummy variable for the slope of forest area (1 = slope  $>$  15%; 0 = slope 0-15%); *DVSJ* (dummy variable for side job (1 = having side job; 0 = not having side job).

Models of Ordinary Least Squares (OLS) and heteroscedasticity were used to estimate the equation (2). This OLS model was used when the data that were used to have normal distribution, and the violation of classical assumption (multicollinearity), collinearity, autocorrelation, and heteroscedasticity) on the using of double linear regression model did not happen. However, heteroscedasticity model was used when the violation of classical assumption happened. Equation (1) for model of OLS was formulated in the form of double natural logarithms [25], [26], as in the following equation (2).

$$\begin{aligned} \ln(LLFA) = & \beta_0 + \beta_1 \ln(INCOME/C) + \beta_2 [\ln(INCOME/C)]^2 \\ & + \beta_3 \ln LLOFA + \beta_4 \ln LCEFA + \beta_5 \ln TENM \\ & + \beta_6 \ln FA + \beta_7 \ln EHH + \beta_8 \ln NFM \\ & + \beta_9 \ln KFF + d_1 DVHF + d_2 \ln DVSFA \\ & + d_3 DVSJ + u \end{aligned} \quad (2)$$

While, heteroscedasticity model was used in the following equation (3) [27].

$$Y_t = X_t b + e_t \quad (3)$$

Where:  $Y_t$  is dependent variable,  $X_t$  is independent variable,  $b$  is unknown parameter,  $e_t$  is zero mean or error term, a serial

process that has not any correlation on variance stated by the function of  $h_t$ .

The function of variance ( $h_t$ ) or dependent variable of heteroscedasticity is  $h_t = (X_t b)^2 a^2$ ; where  $a$  is parameter of scalar.

Next, flexibility obtained from specification of variance is the function of exogenous variable ( $z_t$ ), so that  $h_t = z_t a$  (variance is a linear function of exogenous variable-VARLIN) or  $h_t = (z_t a)^2$  (standard of deviation is a linear function of exogenous variable-STDLIN) where  $a$  is unknown vector parameter. Another form is the model of "multiplicative heteroscedasticity" elaborated by Harvey, namely  $h_t = \exp(z_t a)$

To select an approach form from heteroscedasticity, the approach that was recommended was: 1) doing regression of Ordinary Least Squares (OLS) and then applying Lagrange Multiplier (LM) test. On the order of DIAGNOS/HET was reported the number of test used. For example, the test for MODEL=DEPVAR is a form of regression from residue of quadrate of OLS with the prediction value of quadrate from dependent variable. The test for MODEL=STDLIN or MODEL=VARLIN is given by the test of Breusch-Pagan-Godfrey and the test of MODEL=MULT is given by Harvey Test. The test for autoregressive (1) 'ARCH (1)' was also reported by the order of DIAGNOS. The test for ARCH (q) can be formed by actuating the regression of residue of quadrate of Ordinary Least Squares (OLS) towards the constant and lag  $q$  and compared the value of  $N.R^2$  with distribution of  $\chi^2$  on free degree of  $q$  [27]. Where  $q$  is quantity of lag,  $N$  is quantity of sample,  $R^2$  is determination coefficient,  $\chi^2$  is chi square.

## III. RESULTS AND DISCUSSION

### A. General Description of Deforestation of *Jompi* Watershed Area

Protected forest area of *Jompi* watershed was one of the protected forest areas that included in working area of Forestry Office of Muna Regency and since 2004 has been changing into the Organizer Unit of Office Technique. Geographically, the protected forest area of *Jompi* lies on latitude line  $4^\circ 45' 38,18''$  to  $4^\circ 58' 18,28''$  of South Latitude and  $122^\circ 46' 8,67''$  East Longitude. Administratively, the protected forest area of *Jompi* watershed is in area of Muna Regency having direct relation with five districts, namely Batalaiworu, Katobu, Duruka, Kontunaga, and Watupute Districts. The protected forest area of *Jompi* has largeness about 1,927 ha or 4.2% from the largeness of the protected forest area in Muna Regency. From the largeness of the above mentioned protected forest area of *Jompi* watershed, approximately 1,233 ha or 64% are teak forest and about 694 ha or 36% are mixed forest. It was shown in figure 1.

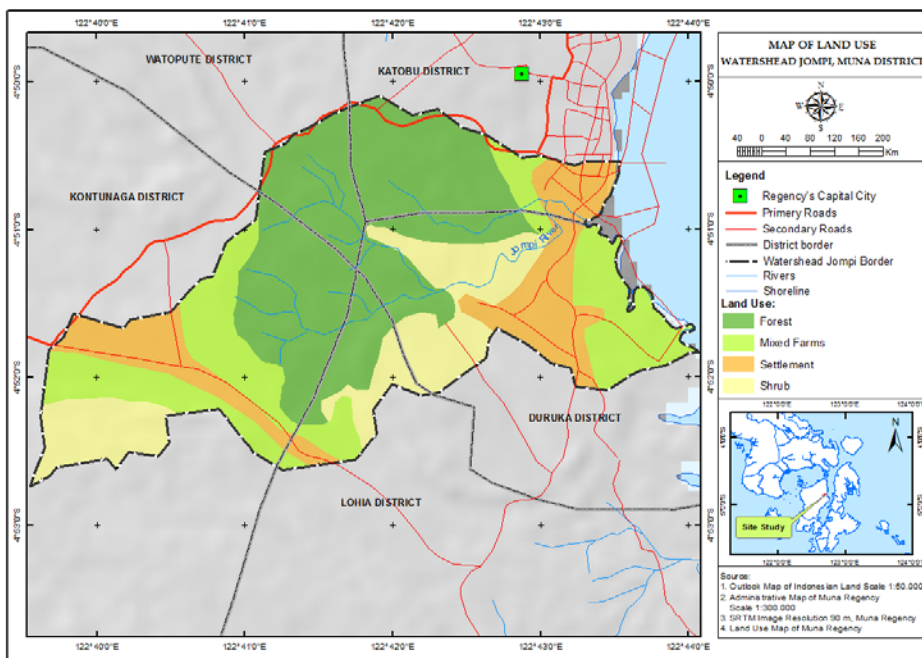


Figure 1. *Jompi* Watershed

The position of the protected forest area of *Jompi* watershed as the system of buffer of the society's life was because the area of the protected forest area mentioned above was crossed by some rivers, namely the river of *Jompi*, Tula, and Labalano. The above mentioned rivers are the source of clean water for a majority of the citizens of Muna Regency. The source of water that is in the protected forest area of *Jompi* watershed was known with the name the Spring Water of *Jompi* that nowadays it has been in critical condition. The forest area that becomes its buffer has broken as the consequence of human's deed that is not responsible. The debit of its water increasingly reduces along with the time goes and the damage of forest in its vicinity.

One of the causes of the damage of forest area of *Jompi* watershed was illegal logging done the certain sides. Nowadays, a majority of ex-illegal logging areas mentioned above have been dominated by the society. The period of illegal occupancy of forest area of *Jompi* watershed by the society was divided into two periods, namely 1) the illegal occupancy that happened since 2003-2009, with the distance about 200 to 500 meters from the Highway of Raha-Watopute, 2) the illegal occupancy that occurred since 2010-now, beginning from the right side of the Highway of Raha-Watopute to the distance about 200 meters into the forest area. From the both periods mentioned above, there has been two types of illegal occupancies that are classified based on the characteristics of area largeness per person, namely (1) the first group, its area largeness is 0.5-0.75 ha (50 x 100 m<sup>2</sup> to 75 x 200 m<sup>2</sup>) and (2) second group, its area largeness 0.08-0.4 ha (20 x 30 m<sup>2</sup> to 50 x 80 m<sup>2</sup>).

In the period of 2003-2009, illegal land occupancy was done individually or small group having the members of individuals that still have the bonds of kinship. In the period of 2010-now, the illegal land occupancy was conducted by the

organized group because having the group chief and organizational structure. The society combined into the second group frequently held the meeting to discuss the issues related to the regional government policies of Muna Regency towards the status of land in the protected forest area of *Jompi* watershed.

By virtue of the kind of plants and livestock animal that were cultivated, the society doing the illegal land occupancy in the period of 2003-2009 have cultivated long-term plants, for instance cashew nut and coconut, that averagely have the age around 4-7 years, while the kind of livestock that was cultivated was chicken and duck. This was different from the society in the second group (period of 2010-now), the kind of plants that was cultivated was the plants planted in the same season, like cassava and corn, and have not cultivated the long-term plants yet and have not bred yet.

The society conducting the illegal land occupancy on land of the forest area of *Jompi* watershed has different professions or jobs. Some of the societal citizens have the profession as the farmer, but others have the professions as Civil Servant, including Army and Police, merchants, carpenter/bricklayer, and the other professions. The people doing the illegal land occupancy have different motive in doing the above mentioned thing. It was supported by [28] who said that variables affecting land use functional structure of the city namely: geographical, economic, urban, laws and legislation, political, environmental, social, public interest, and demographic variables

One of the motivation factors of the society did the illegal land occupancy in the forest area of *Jompi* watershed is the position of land of the forest area of *Jompi* that is very strategic –very near with Raha Town, the Capital of Muna Regency..

Another factor encouraging the society did the illegal land occupancy in the forest area of *Jompi* watershed was the unfinished conflict of the illegal land occupancy of the forest area in this location, for example the case of *Kontu*, the case of *Kombikuno*, and that of *Napabalano*. On the above mentioned three cases, the government did not do an emphatic action, so that the society kept doing the farming activity even there were the societal citizens have built the permanent house. Based on the above mentioned thing, the society doing the illegal land occupancy of the forest area of *Jompi* watershed suspected that the government will never do the condemnation to them. The allegation was supported by the fact that currently the government of Muna Regency tends to legalize the action of the illegal land occupancy of the forest area of *Jompi* watershed.

One of the actions that has been done by the Regional Government of Muna Regency to legalize the illegal land occupancy of *Jompi* watershed was the existence of the agreement letter on the fourteenth of January in 2013. The agreement letter between the societal citizens doing the illegal land occupancy in the forest area of *Jompi* with regional development through forestry Office of Muna Regency also involved all of the related elements like commander of the army administrative unit at the level of district, Resort Police, State Attorney, and State Court of Muna Regency. The above mentioned agreement must be seen from the origins or what back grounded it. The cause was that the society dominated the land in forest area and did the farming activity.

By virtue of Part 50 Chapter 3 Letter (a) Statute Number 41 in 1999 about the Forestry that "Everybody is forbidden to do and or use and or occupy the forest area illegally". For that reason, the activity done by the society in forest area of *Jompi* watershed is the form of law violation. On the other hand, the existence of the contract between Regional Government of Muna through Forestry Office of Muna Regency with the society can be perceived that the Regional Government actuated the function of government and is obligatory to protect its citizens. Thus, the illegal logging of land in the forest area by the society can be seen from two aspects, namely 1) that the land tenure largeness of the forest area by the society can be perceived as the form of law violation, 2) it can also be seen as the form of "forestry conflict".

In the organizing of forest resources, there are the rights of the local community. Therefore, the overcoming related to the forestry conflict can be carried out through two steps simultaneously, namely the problem-solving of the conflict or by preventive way and law action on the violation or by means of criminal law. The Agreement of Regional Government of Muna Regency with the society basically was legal in terms of regional government aspect to do the duty and function of government in this case to protect its citizens as the step of finishing the forestry conflict. Nevertheless, the above mentioned agreement did not have law power to arrange the sides holding the agreement because the land object of forest area of *Jompi* watershed is state-owned land with the forest area of *Jompi* watershed as the protected forest. Thus, the agreement letter mentioned above becomes legal if it is not against with the higher rule.

In relation with the above mentioned agreement letter, it is suspected that it will show the problems, some of them were the absence of guarantee on the rights of plants/trees planted by the society especially the forestry plants, and the heir and other rights. The above mentioned problems will happen because the organizing of forest is the authority that was carried out based on the rule and Statutes and must be established by the Forestry Minister. For that reason, the agreement letter mentioned above only functions as the "interval period" from the step of finishing the forestry conflict, but substantively it did not have law power that arranges the parties holding the agreement mentioned above—the government of Muna Regency and the society dominating the land of forest area of *Jompi* watershed.

### B. The Perpetrators of Deforestation of *Jompi* Watershed Area

The society that cleared away the land in the forest area of *Jompi* watershed comes from the region in the vicinity of *Jompi* watershed, namely the ones living in Katobu and Kusambi District. From the main job aspect, the perpetrators of deforestation in area of *Jompi* watershed are categorized into two, namely (1) farmers and (2) not farmers. It was shown in Table I.

Table I. Perpetrators of Deforestation in Forest Area of *Jompi* Watershed

No	Perpetrators of Deforestation	Number (person)	Percentage (%)
1.	Farmer	13	41.94
2.	Not Farmer	18	58.06
Total		31	100.00

Perpetrators of deforestation in forest area of *Jompi* watershed largely were the society having the main job as not farmers (table 1). Agents of deforestation are not farmers have the different primary job, namely civil servant, merchant, carpenter/bricklayer, and drivers. The society having the professions as the merchant was the most perpetrators of deforestation, namely for 50% from the number of perpetrators as not farmers. It was due to the merchants had the financial resources that were big enough to be compared with the other perpetrators to hire the persons cleared away the land of the forest area of *Jompi* watershed. Therefore, the intervention of governmental policy related to the ceasing of deforestation must be done continuously primarily on the societal group besides the farmers. Nevertheless, the government needs to take emphatic actions towards all perpetrators of deforestation without differentiating the group of deforestation perpetrators through law enforcement. The importance of considering environmental issues on an ongoing basis is also presented on the results research results of [29] that Environmental Management Systems (EMS and EMAS) of the organization should be address primarily those organization's environmental impacts that are most significant and which the company can influence by its operations, management, activities, products and services to environment and sustainable growth.

### C. Largeness of Deforestation in Forest Area of *Jompi* Watershed

The land in forest area of *Jompi* watershed that this time is used by the society to do the farming activity largely is illegal logging. The land largeness used to do the farming activity varied between 0.08 ha to 0.75 ha with the average of land largeness 0.34 ha. It was shown in Table II.

Table II. Largeness of Deforestation in Forest Area of *Jompi* Watershed

No	Deforestation Largeness (ha)	Number (Person)	Percentage (%)
1.	0.08-0.30	18	58.06
2.	0.31-0.53	8	25.81
3.	0.54-0.75	5	16.13
Total		31	100.00



The difference of land tenure largeness/deforestation was due to: (1) the motive in using ex-illegal logging land; (2) land tenure year; and (3) agreement in the societal group. The society having the motive of land tenure to do the farming activity has the broader land largeness than the society having another motive, for example to be made as the settlement place. The society clearing away the land between in 2003-2009 had the broader land (0.5-0.75 ha) than the society clearing away the land after the above mentioned years, namely 0.08-0.4 ha—since 2010, the land largeness that has not been dominated by the people was relatively limited. The society clearing away the land in groups had a relatively same land because of the presence of the agreement in the societal group itself.

#### D. Determinant Factor of Deforestation Largeness in Forest Area of Jompi Watershed

The result of testing with the method of Ordinary Least Square (OLS) to the factors influencing the deforestation largeness in forest area of Jompi watershed showed that there is an indication of the presence of violation signal of homoscedasticity assumption or heteroscedasticity problem, but there is no multicollinearity and autocorrelational problem. Correlation of both inter independent variables and coefficient determination  $R^2$  auxiliary regression of inter independent variables did not reach 0.80. It showed that there was no problem of multicollinearity. Test value of Durbin-Watson (DW) test was bigger than value of the critical value of the upper limit  $d_U$  on statistics Durbin-Watson value  $d$  for the test of autocorrelation showed that there was no problem of autocorrelation.

The testing of non-heteroscedasticity towards the equation (1) was done by using regression of *Varlin* model (variance is a linear function of exogenous variable). The result of analysis of the above mentioned model regression showed the problem of heteroscedasticity. This was shown by the existence of variance of independent variable that is significant statistically. The above mentioned test result consistently showed that there is a violation of non heteroscedasticity assumption so that the using of OLS is not efficient. Based on the above mentioned thing, the model of heteroscedasticity was used to explain the effect of explainer variable towards the farmer's land largeness in forest area of Jompi watershed. It was shown by the value of Likelihood Ratio (LR) that was significant statistically on the level of mistake 5%. Coefficient value of determination ( $R^2$ ) for 0.6635 showed that 66.35% of the variation of the farmer's land largeness in forest area of Jompi watershed was influenced by the explainer variable and only 33.65 % were affected by the variation of variables that were not included in the above mentioned model. It was shown in Table III.

Table III. Factors Influencing the Largeness of Deforestation in Forest Area of Jompi Watershed

No	Source of Variation	Model	
		OLS	Heteroscedasticity
1	Household Income per capita (ln <i>INCOME/C</i> )	0.188**	0.194***

No	Source of Variation	Model	
		OLS	Heteroscedasticity
2	Quadrate of Household Income per capita (ln( <i>INCOME/C</i> ) <sup>2</sup> )	0.376***	0.547***
3	Land Largeness Outside the Forest Area (ln <i>LLOFA</i> )	-0.146 <sup>ns</sup>	-0.413***
4	Land Clearing Expense of Forest Area (ln <i>LCEFA</i> )	0.127 <sup>ns</sup>	-0.013 <sup>ns</sup>
5	Transportation Expense to the Nearest Market (ln <i>TENM</i> )	0.325*	-0.365***
6	Farmer's Age (ln FA)	0.249 <sup>ns</sup>	0.341 <sup>ns</sup>
7	Education of Household Head (ln EHH)	-0.083 <sup>ns</sup>	-0.114 <sup>ns</sup>
8	Number of Family Member (ln <i>NFM</i> )	0.186 <sup>ns</sup>	0.425***
9	Knowledge of Forest Function (ln KFF)	0.142 <sup>ns</sup>	-0.264**
10	Dummy Variable between House to the Forest ( <i>DVHF</i> )	0.253 <sup>ns</sup>	-0.262**
11	Dummy Variable for the Slope of Forest Area ( <i>DVSFA</i> )	-0.065 <sup>ns</sup>	-0.192 <sup>ns</sup>
12	Dummy Variable for Side Job ( <i>DVSJ</i> )	-0.099 <sup>ns</sup>	-0.253*
13	Constanta	3.368***	5.235***
		$R^2$	
		0.6521	0.6635
		$F_{hitung} = 23.188$	LR = 88.328**

Notes: \* = significant at  $\alpha$  10%;  
 \*\* = significant at  $\alpha$  5%;  
 \*\*\* = significant at  $\alpha$  1%;  
 ns = insignificant at  $\alpha$  10%.

Household income per capita gave positive impact towards the largeness of deforestation in forest area of Jompi watershed. It showed that the increasing of household income led to the enhancing of land largeness of the society in forest area of Jompi watershed. The increasing of household income encouraged the society to allocate their income in the activity of clearing away the forest (deforestation) to add the land largeness of the farming activity, particularly corn plants. If the land largeness of the farming activity in forest area was used as the proxy of environmental degradation, the result of this research was against with what was hypothesized by Kuznets through the empirical study called with Environmental Kuznets Curve (EKC) [30]. EKC has the form of upside down U indicating the higher the income per capita, so the environmental degradation will increasingly go down. Meanwhile, the result of this research indicated that EKC has the form of U—the higher the household income, the largeness of deforestation per capita increasingly goes up—the increasing of environmental degradation. Nevertheless, the result of this study was in line with that of [30] that the effect of time from EKC was estimated at first difference and from the model of econometrics of emission decomposition showed that the reduction of degree of sulfur happened along with the time according to the category of country on various incomes. In some cases, the turning point is in minimum point and other

cases happen on maximum point, and the result of this study showed that the curve of EKC not always proven inverted U-shaped.

In the case of proving EKC in China, it was found that the relationship of income per capita and the damage of environment is the form of inverted U-shaped. Nevertheless, some results showed the form of N-relationship, namely in coefficient of estimation on water contamination. The findings also found that along with the growth of economy, the problem of environmental contamination increasingly gets worse. Thus, the curve of Kuznets is clearly not as the “patent result” and must not be made as the “standard model”. At any rate, it does not mean that the contamination cannot be reduced [30].

Land largeness outside the forest area has the negative impact towards the largeness of deforestation in forest area of *Jompi* watershed. The increasing of the farmer’s land largeness outside the forest area caused the reduction of the land largeness of the society in forest area. It can be understood because the enhancing of land largeness outside the forest area led to the society tended to cultivate intensively the land outside the forest area. In addition, with the limitedness of labor’s resources from within household brought about all labors of family were allocated to cultivate the farmland outside the forest area. This will lead to the society does not add the land tenure largeness that has been owned by converting the forest area into the farmland. The result of this research confirmed the findings of [6] that the enhancing of land largeness outside the forest area reduces the probability of the society does deforestation –reduces the rate of deforestation.

The transportation expense to the nearest market has the negative impact towards the largeness of deforestation in forest area of *Jompi* watershed. The increasing of transportation expense to the nearest market led to the reduction of land largeness in forest area. It was due to the transportation expense from the farmland to the nearest market was one of the considerations of the society in converting the forest area into the farmland. The distance of the forest that is a long way from the settlement becomes the consideration of the society in converting the forest area into the farmland—a far distance of land in forest area brings about the enhancing of transportation expense to the nearest market, so that it reduces the interest of the society to do deforestation. The result of this research confirmed the findings of [6] that the distance of house with the nearest market has the negative impact towards the probability of the society to do deforestation—the increasing of distance of house with the nearest market reduced the rate of deforestation in Southern Mexico. [10], [11] stated that the increasing of transportation expense to local market has the impact on the reduction of deforestation in Bolivia. The policy of abolition or discontinuance of the oil subsidy, the kind of premium was the proper policy choice to cease the activity of the farmers to do deforestation.

The number of family members had the positive effect towards the largeness of deforestation in forest area of *Jompi* watershed. This showed that the enhancing of the number of family members caused the increasing of land largeness in forest area. The number of family members was one of the

factors determining the society’s decision in increasing the land largeness owned. The enhancing of the number of family members caused the increasing of land necessity for the farmland and to be inherited to the family members. If the land largeness outside the forest area has the border, so the forest area becomes the only alternative to fulfill the land necessity for the farmland and later it can be inherited to family members. The result of this research confirmed the findings of [6], [7], [12], [13] the enhancing of the number of household members/population density has the impact on the increasing of deforestation. Therefore, the restriction of the number of births through the family planning program must be intensified its implementation in rural regions, so that it can reduce the number of land necessity and lower deforestation.

The increasing of knowledge of forest function caused the reduction of land largeness in forest area. Regarding with that, the society know that the forest has economic, social, and environmental functions. The knowledge of forest function was obtained from various sources. Some of them were forestry guider, media of television, and so forth. The increasing of knowledge of forest function led to the society tended to reduce the conversional activity of forest area into the farmland. For that reason, the government must increase the explanation of information about the benefit of forest and negative impact of forest damage to the farmers through printed and electronic media.

The enhancing of distance of the society’s houses with the forest caused the reduction of land largeness of the society in forest area. It was because of the distance of the society’s houses with the forest was more than 2 km that led to the society reduced the land largeness of the forest were converted into the farmland. The far distance of house with the forest brought about the society must expend the big expenses to be able to convert the forest into the farmland, for example transportation expense.[6] stated that the elevating of distance of house with the forest reduced the probability of the society to do deforestation. Therefore, the developing of new settlement must be in a long way location from the forest area as the effort of reducing the society’s access towards the forest area.

Side job has the negative impact towards the largeness of deforestation in the forest area of *Jompi* watershed. The society having side job in forest area that is relatively small compared with the society members not having side job. Side job gives incentives for the people for not expanding the farmland that they have. But, the society not having side job tended to broaden the land that they have by converting the forest area into the farm land to increase the household income. At any rate, the society having side job tends not to convert the forest into the farmland because they have had the earnings out of the farming activity. For that reason, the government must provide the job for the rural society by allocating the budget to carry out the work whose implementation requires the labors in huge numbers, for instance the road making of the farming activity and rural roads.

Deforestation done by the society in area of *Jompi* watershed led to the damage of environment and forestry

conflict involving the government and society dominating the land in forest area of *Jompi* watershed. Environmental damage can be overcome by law enforcement for the perpetrators of deforestation and implementation of environmental conservation program (social forestry and rehabilitation movement of the forest and land). Regarding with the forestry conflict, so it is expected the regional government of Muna Regency immediately does an emphatic and wise action to overcome the above mentioned conflict. One of the alternatives that can be employed is the agreement to borrow and use the area. By this system, the government has the responsibility to conserve the forest area. By this system, in this event, the people have responsibility to convert the forest area that is used as the farmland. Implementation of various policies highly supports the goal achievement for the purpose of Reducing Emissions from Deforestation and Forest Degradation (REDD+) program in 2020—commitment of Indonesian Republic Government towards the reduction of emission of greenhouse gases (GHG) for 26% from self-capability and 41% with international assistance and the increasing of the society's welfare.

#### IV. CONCLUSION

The perpetrators of deforestation consist of farmers, Civil Servants, –including the apparatus of Indonesian Army and Indonesian Republic Polices, a retired Civil Servant, merchants, carpenter/bricklayer, and drivers. The land largeness of the society in forest area of *Jompi* watershed ranges from 0.08-0.75 ha per person with the average of land largeness 0.34 ha per person. The land largeness of the society in forest area of *Jompi* watershed is influenced by household income per capita, the number of family members, knowledge of forest function, land largeness outside the forest area, transportation expense to the nearest market, distance of house to the forest, and side job. The effort of reducing the impact of environmental damage as the consequence of forest clearing away in *Jompi* watershed, so it is necessary to be implemented the program of environmental conservation (social forestry and movement of forest and land rehabilitation) by the society facilitated by the government. Regarding with that, the forestry conflict that has happened between the government and society dominating the land in forest area of *Jompi* watershed is highly expected for the regional government of Muna Regency to do an emphatic and wise action that immediately to overcome the above mentioned conflict.

The relevant policies to cease deforestation/clearing away the forest area of *Jompi* watershed consist of: (1) law enforcement; (2) abolition or discontinuance of oil subsidy; (3) the restriction of the number of births through the family planning program; (4) the increasing of the explanation of information about the benefits (positive sides) of the forest and negative impacts of forest damage to the farmers through printed and electronic media; (5) the job providing for rural community through the labor intensity program; and (6) developing of new settlement must have a far location from the forest area. The implementation of various policies mentioned above must be done simultaneously, so that it will have the impact on: (1) conservation of the forest resources; (2) goal

attaining of REED+ program in 2020; and (3) the increasing of the society's welfare.

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