

The Act of Reforms in the Deforestation Management and forecast Estimates for Vital Parameters: A Case of Indonesia: 2001-2010

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Abstract: Indonesia is the worst affected country in the Asian region in terms of earthquakes, tsunami and other allied natural calamities. Apart from this, Indonesian forests have been threatened by factors such as deforestation. The deforestation management is the major issue in the tropical countries that have a big role in forest product and climate change in the whole world. The present study attempted to identify the impact of reforming rules on deforestation management which results from a myriad of factors such as forest fires, exchange for agricultural purpose, logging intensity, mining and transmigration in Indonesia and its surrounding islands in order to predict the parameters for the next three years. Furthermore, the patterns of deforestation due to the above influencing factors have been completely investigated. For that purpose, secondary data were collected from forestry ministry in Jakarta, capital of Indonesia, over the period between 2001 and 2010. The results revealed that management and reforming rules were major players and lead to crucial roles in the progress of diminishing deforestation during the last decade since there was a declining trend in deforestation rate not only in Indonesia as a whole but also in the vulnerable islands of Indonesia.

Keywords: Deforestation, Forest degradation, Logging Intensity, Transmigration.

INTRODUCTION

A dynamic complex of plants, animals, their abiotic environment, and micro-organism communities, is a forest ecosystem where trees are a key system component. An essential part of forest ecosystems is Humans, with their economic, environmental and cultural needs[1]. In the whole world, Asia is a rich continent in term of natural resources such as forests. Over the last ten years, its share in the wood products industry has augmented drastically with imports of total wood products is going up from US\$5. 4 billion to US\$20. 6 billion in 1990 and 2006, respectively[2]. The second-highest rate of deforestation among the tropical forest regions is South-East Asia [3]. Indonesia has almost 60 percent forest shelter displays around 105 million hectares that is estimated about 10 percent of the world. The major export earner within the agriculture segment is forestry. Indonesia is a prime producer of forest products based on hardwood types. It is a vital exporter for wood-based panels, mainly plywood and growing pulp export. In recent years, creation of paper and paperboard to sell abroad has amplified dramatically. In 1985 and 1989, Logs and raw rattan exports were forbidden respectively. However, both official orders were passed by the year 1999.

Moreover, the country is the main origin of non-wood forest products such as damar, pine resin , bamboo, illipe nuts , fruits, honey, rattan, shellac, Lawang oil, cayuput oil, flavours and condiments, and medicinal plants[4]. Indonesia is the third-largest country in green houses emission after the U.S and China and the fourth largest of carbon dioxide emitter in the world by reason of high rate of forest lost. Brazil and Indonesia, report for nearly 55% of the deforestation on the earth. Deforestation has an enormous influence on climate change[5].

Indonesia has had one of the upper most rate of deforestation since 1990 due mainly to logging, producing pulp and paper, fires, agricultural expansion, and oil palm cultivated area. The long-term tree canopy fall that cover below the lowest 10 percent threshold or an adaptation of forest to another land use is defined as deforestation. It converts forests to pasture, agriculture, urban zones and water basins. The term specially is pointed to the dismisses areas where the trees have been removed as a consequence of logging or harvesting, and where the forests are planned to renew naturally or with the silvicultural measures sustain[1].

Practical Contribution of the Research

Currently, climate changing is one of the major threats facing humanity and nature. It is the crisis influences lives and future[6]. Deforestation is one of the climate change reasons that affect species loss and ecosystem. although it varies by region and country; It is the reason of 20% of emissions of the total global GHG (global greenhouse gas). If emissions from deforestation is not curb, the success likelihood in preventing climate change will reduce[7]. This study will help this important issue to save the world in future by spotting the deforestation caused factors around the world particularly in Indonesia. Forests are including living settlements, non-living organisms, a lot of trees, and plants species is the main resources in the world. Wood products are used to heat and cook by people that are needed for the human's livelihood. Some consequences such as decrease in ground water supplies and soil fertility and extensive flooding are outcomes of forests absence.

Additionally, in form of decaying plant matters, forests store massive carbon quantity in vegetation, trees and within the soil. A large area of forests is destroyed by deforestation and it is generated a lot of problems on the earth that one of them is climate changes. An enormous quantity of carbon dioxide and other greenhouse gases are released into the air by reason of deforestation which accelerates the climate change rate. Furthermore, deforestation has a massive effect on climate change[5]. Forests are so important because they protect lands against drought and flooding specially in Indonesia with a huge amount of forests cover. They reduce erosion of soil and landslides, particularly in the mountain areas. Forests are the main sources of foods, medicines, and materials. Moreover, they absorb carbon dioxide that is so important to fight with climate change and provide a stable water supply. Unfortunately, rainforests of Indonesia have been destroyed recently. Services decreases , non-wood forest products and supplies of timber from natural forests, forest rehabilitation, and developed plantation become essential to the forestry division in this country [8]. carbon dioxide is changed into oxygen by trees that is vital for life of plants and animals and they keep the atmosphere stable as well.

LITERATURE REVIEW

One of the foremost forested countries is Indonesia where deforestation is going on. This study sought to find the effective factors roles to restrain speed of deforestation and save the natural resources to the next generations[9]. The collective action theory explains the relationship between the conservation of natural resources and common based property systems[10]. Management unit boundaries, appropriate

participation, and proper rules fitting have been recognized as important official design values for sustainable collective use of resources[11]. During 1990s, the World Bank reassessed the policy condition and deduced that the prime challenge to sustainable forest management is government strategies and logging in Indonesia.

One of the dynamic elements of changing land-use in the forest areas is Fire and must be measured as the main deforestation factor. Forested areas that pasture or burn have been classified as intentional deforestation[12]. Burning forests in favour of removing the lands for agricultural purposes can release a large quantity of greenhouse gases and it has caused deforestation. Currently, it is a big concern, particularly in dry season in this country, since plantation developers and loggers have destroyed a huge amount of forests. Loggers and farmers have found Fire as a cheap and easy way for clearing forest. Setting of deliberate fire has led to uncontrolled wildfire intensity[13].

Changing forest areas for agriculture purposes is currently considered as an unsustainable land use exercise by reason of the accumulated population and the shorter fallow period[14]. Agricultural growth followed by loggers has known as one of the main reasons of deforestation[15]. Small scale shifting cultivators have carried out agriculture conversion[16]. Exchange forests to agriculture purposes would have a stronger effect, not only on forest degradation, but also on deforestation[17]. One of the key elements of unsustainable forest activities is illegal logging that is explained as a government failures[18]. Illegal logging is defined as the logs extraction and felling from forests without any official license and permission[19]. In Southeast Asian countries, logging commercial has the crucial influence on deforestation rate. In some countries such as Indonesia, the loggers are educated to harvest by public authorities[16]. One of the vital and old activities for many countries economic sectors is mining . It is recognized as a hazardous factor for the environment[20]. Contaminants pose is defined as the potential risk to the human health globally. A high quantity of contaminants are created by human activities like industrial manufacturing, mining operation, and agricultural practices[21-25].

In some cases, likelihood of deforestation increases as the total population, the marginality levels, and percent of forest covered areas augment due to building town around mines in remote areas[26]. Also, the road network should be considered as the unique characteristic[10]. The transmigration program is setted up by the Indonesian government which is forced people to relocate from densely populated Java to the

rest islands. Since 1960, it was the reason for forest clearance of 2 million hectares until the end of this program in 1999. Moreover, since 1997, migration and settlement of illegal farmers have increased at the logging allowance margin, alongside of roads, and even in the national parks; however, there is no a reliable estimate in this regard[13]. Forest conservation is one of the government's duties; to do so; they should support the traditional farming system that it is in line with the conservation of long-term forest[27]. Forestry Ministry has established the following policies to stop

deforestation: overcoming of forest fire, eliminating illegal logging, forest sector restructuring by escalating effectiveness of management of forest resource, conserving forest resources to regenerate forests, and decentralizing forestry sector[28].

Theoretical Framework

The conceptual framework (Figure 1) has shown the crucial factors affected forests over the time period in Indonesia in spite of governmental reforming rules and legislation on deforestation.

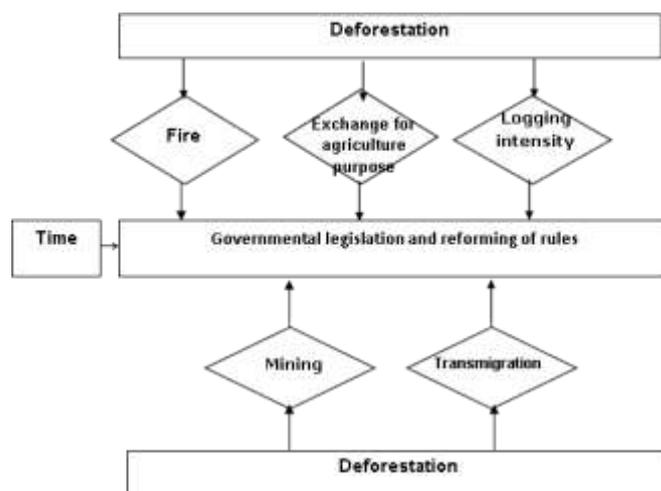


Fig-1: Research Framework

Hypothesis Development

Referring to the developed theoretical framework, propositions are made due to determine the significance of the relationships among the variables. Based on the five types of influencing factors (i.e. fire, exchange for agricultural purpose, logging intensity, mining and transmigration) six propositions are constructed to study the positivity and negativity of relationships among the rest. In addition, the propositions are developed to study the relationship among the reforming rules and management generated through deforestation due to these variables.

H1: Fire due to natural calamity is negatively influencing deforestation over the study period of 10 years (2001-2010). Indonesia is the third greenhouse emitter on earth which 75% of its emission comes from as the result of deforestation. More than 2000 million tons of CO₂ is released from the peat lands decomposition and forest fires in the atmosphere per year[29].

H2: There is a negative relationship between exchange for agriculture purpose and deforestation since 2001 to 2010. Shifting cultivation refers to long term rotational system and probably is the oldest farming system[30].

H3: Logging intensity due to natural calamity is negatively affected on deforestation over the study period of 10years (2001-2010). Logging is considered as an activity cause of both forest degradation and deforestation[31-34].

H4: The mining factor and deforestation are negatively related over the study period of 10years (2001-2010). Mining operation causes a great environmental and human health risk by reason of generating certain kinds of contaminants[35-39].

H5: The transmigration factor is negatively influenced on deforestation over the study period of 10years (2001-2010). Influences of human activities are observed in the low elevation areas. The fundamental explanation of deforestation is population density in Indonesia[40].

H6: There is a positive relationship between governmental reforming rules/legislation and deforestation during 2001 and 2010. Analysts of deforestation public policy have argued although development is beneficial and essential, environmental protection to ensure sustainability should be considered. According to Malcom Gillis who is studying on development of economic and taxation among Asian countries, the policy reforming are necessary for the well-organized development, better management,

greater government financial returns and less forest damages[41].

RESEARCH METHODOLOGY

The present study aims to acquire quantitative data through data collection regarding to the extract statistic. The methodological tool is in line with the guideline principle introduced by business research method[42]. The time series analysis was used to future values prediction based on previous values in this study. The providing data is involved values for ten years since 2001 till 2010 in Indonesia. We evaluated dependent variables such as, fire, exchange for agricultural purpose, logging intensity, mining and transmigration to evaluate deforestation management and this measurement prediction in the future. Moreover, we intended to examine the influence of governmental legislation and reforming the rules as moderators in the effective factors relationship on deforestation by detecting any increase or decrease in the factors' outcome data. This study analysis is started with the year-wise data interpretation. The social sciences (SPSS 20) software is required to use the statistical package regarding to find a proper time series model.

Curve Estimation

To fix which model is suitable for design the data, this paper has employed the curve estimation regression models. If the mentioned variables are related to each model of curve estimation, we can select the fitting model. First of all, the linear model is attempted by this study. We transformed the data to a more complex model when the variables are not linearly related. For instance, we use a powerful model if the data fits to a power function. Also, the data Scatterplot shows the fitting model. If the plot is similar to a mathematical function that has been recognized, this model could be appropriate and fitted. We use time series model, if the transformation does not help. In this study, the mean rating and one-way Anova test were used to analyse the data. An exploratory factor analysis was carried out on these variables as a result of reforming rules and legislation on deforestation management due to the influence factors that were generated to validate the findings[50]. Autoregressive integrated moving average (ARIMA) model is defined as a linear models class that is achieved by not only representing stationary but also non-stationary time series [43].

Identification, Estimation and Testing of ARIMA Models

According to Johnston and DiNardo [44] one can recognize that the used time series is stationary or needed to be different once or twice to produce a stationary series after stationary testing. The final

outcome is the Autoregressive identification combined with moving average model. Johnston and DiNardo [44] have explained packages of software that offered different estimation measures for the ARMA models. These estimation includes least squares, or maximum probability. The resultant equation testing is the final stage after the ARIMA model estimation. Firstly, the tests can be used to the coefficient estimation of the model and they needed to test the significance of the variables. Secondly, the test the residuals of the model is required which propose the key information. Three important aspects of residuals is represented to be autocorrelation, fractional autocorrelations and the values of Ljung-Box Q statistics tests.

Accuracy Measuring

The prediction of the deforestation management in terms of the four variables will not be trustworthy with no measuring the precision of the generated model. This procedure used the mean absolute percentage error (MAPE) and root mean square error (RMSE) [45].

$$RMSE = \sqrt{\frac{e_t^2}{n}} \quad MAPE = \frac{|e_t|}{Y_t} \cdot 100$$

In the time period t , e_t is the forecast error, Y_t is an actual value and n is the forecast observations number. The Statistical Package of Social Science (SPSS) version 21 has been employed to determine all the forecast estimation.

Description of data

In this study, the seven selected islands of Indonesia have been scheduled merely for the years 2001 onwards and it has been conducted over ten years as data was available only for those years. The islands yearly data were considered for the construction model and there were yearly data for each province that included the islands correlated with the considered variables. Data were gathered from the statistical database of the Forestry Ministry. The deforestation information and independent variables affecting on it were not easily accessible. Thus, in the last variable (transmigration) the data was not yearly data and appropriate to predict for using the time series model.

FINDINGS

Deforestation due to Fire

Table 1 shows the deforestation estimation due to fire in Indonesia anticipated at 95% confidence limits from 2011-2014. The revealed actual data for the year 2011 was 2794.44 hectares that are less and close to 3826.81 hectares anticipated by data after the actual with estimated data are compared. It is increased from the better management quality which is higher than what has been estimated in the real world.

Table 1: Forecasting Estimates (in Ha) for Deforestation due to Fire -Indonesia overall

Year	Actual Fire	Predicted
2001	28160.00	176828.83
2002	166234.69	120526.20
2003	52048.03	82150.43
2004	208303.18	55993.58
2005	142039.00	38165.12
2006	130801.93	26013.27
2007	6974.62	17730.60
2008	6625.33	12085.14
2009	6862.57	8237.21
2010	4948.58	5614.47
2011	2494.44	3826.81
2012	---	2608.35
2013	---	1777.84
2014	---	1211.78

The statistics associated with these years are declining has shown by the following Logistic model. There was a strong declining movement in numbers that

revealed the proper maintained deforestation management.

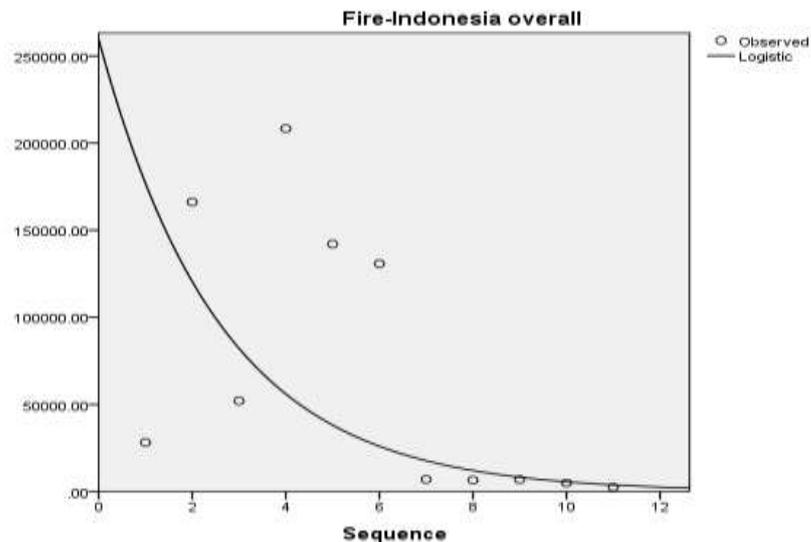


Fig-2: Projected, deforestation due to fire-Indonesia overall

Deforestation due to Exchange of Forests for Agriculture Purposes

Table 2 shows an estimation on deforestation due to forests exchange for agriculture purposes in Indonesia projected from 2011-2014 with 95% confidence limits for the exchange for agriculture purposes-Indonesia overall. As a result, there was no

prediction in 2012 and 2014. As it is revealed, in this regard, there nothing happened in these two years. As follow up to a conversation with forestry ministry, this study could not compare this important issue with the actual data because the 2012 data has not been released yet.

Table 2: Forecasting Estimation (in Ha) on Exchange of forests for agriculture purpose- Indonesia overall

Year	Actual	Predicted
2007	73.67	83.50
2008	70.33	93.34
2009	116.79	96.68
2010	8.61	50.22
2011	183.69	158.40
2012	--	171.05
2013	--	183.69
2014	--	177.37

Figure 3 presented the Partial Autoregressive Correlation Function (PACF) and residual Autoregressive Correlation Function (ACF) graphs for yearly-wise deforestation due to Exchange for agriculture purposes- Indonesia overall. The results

show that the residuals were well within limits at all lags per year. It is worthwhile to state that the ARIMA (1,0,0) model fits well for yearly-wise deforestation due to exchange for agriculture purposes- Indonesia overall data from 2001 to 2010.

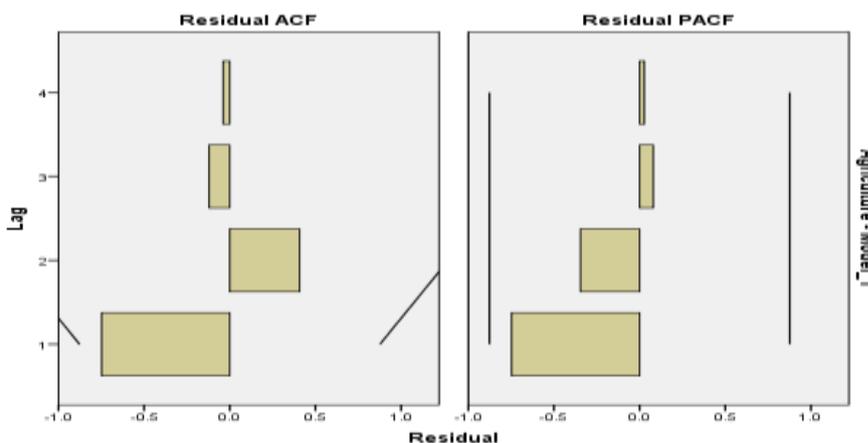


Fig-1: Residual Graph for Exchange for agriculture purpose- Indonesia overall

The projected average share price per week with 95% confidence limits from 2001 till 2010 is

exhibited by Fig 4 . The fitted (in Ha) and observed were very close to each other in the same direction.

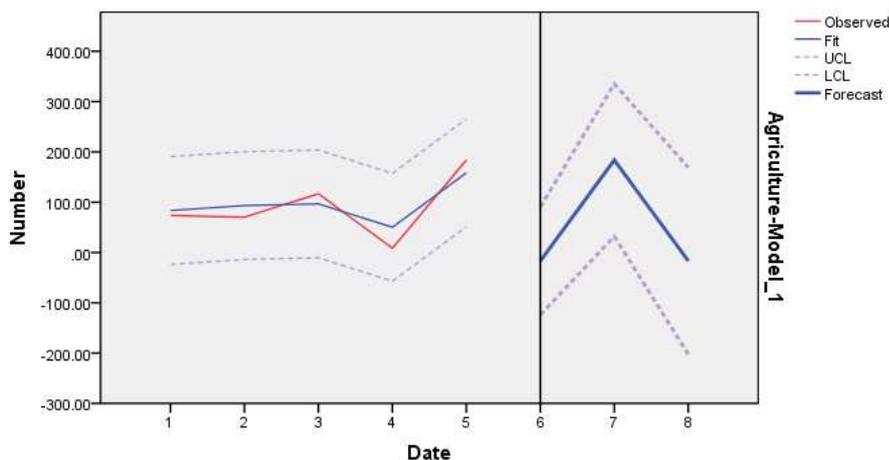


Fig-2: Projected, deforestation due to exchange for agriculture in Indonesia overall

Deforestation due to Logging Intensity

Table 3 shows the estimation of deforestation due to logging in Indonesia expected from 2011-2014

with 95% confidence limits for logging – Indonesia as a whole.

Table 3: Forecasting Estimation (in Ha) for logging –Indonesia overall

Year	Actual	Predicted
2001	1028958.04	435171.49
2002	1416.10	7586.91
2003	681.15	1967.28
2004	1366.14	1001.76
2005	818.07	668.20
2006	1914.50	510.11
2007	219.14	420.65
2008	729.77	364.01
2009	--	325.28
2010	--	297.29
2011	--	276.19
2012	--	259.75
2013	--	246.61
2014	--	235.88

The S-model fitted well for the data with respect to Indonesia as a whole. As a result of strong

declining trend in numbers, the deforestation management has been properly maintained.

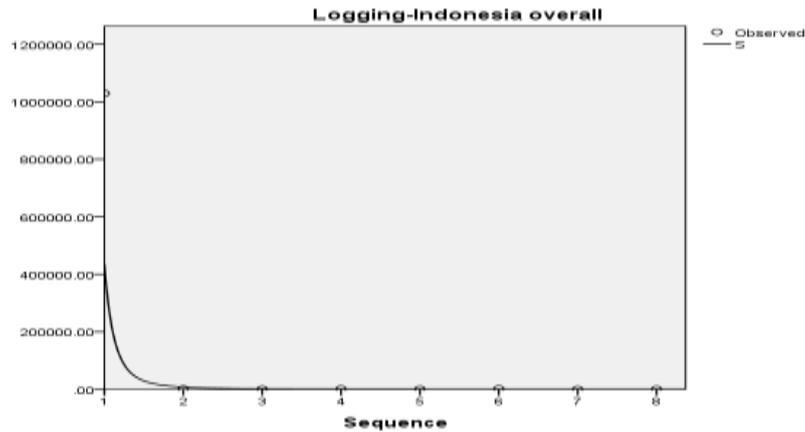


Fig- 5:Projected, deforestation due to logging-Indonesia overall

Deforestation due to Mining

Table 4 shows the estimation of deforestation due to mining in Indonesia expected from 2011-2014 with 95% confidence limits for mining – Indonesia as a

whole. After comparing the actual with estimated data, the revealed actual data was 604103.33 hectares for 2011 that is closed to 530357.22 hectares predicted by data.

Table 4: Forecasting Estimation (in Ha) for mining –Indonesia

Year	Actual	Predicted
2006	58616.01	80783.69
2007	249520.78	117698.96
2008	109441.89	171483.21
2009	264555.49	249844.94
2010	307426.94	364015.21
2011	604103.33	530357.22
2012	--	772711.63
2013	--	1125813.40
2014	--	1640270.13

The revealed compound model fitted well for the yearly associated data in this island. It has shown the

deforestation management has been working appropriately as there was a strong declining trend.

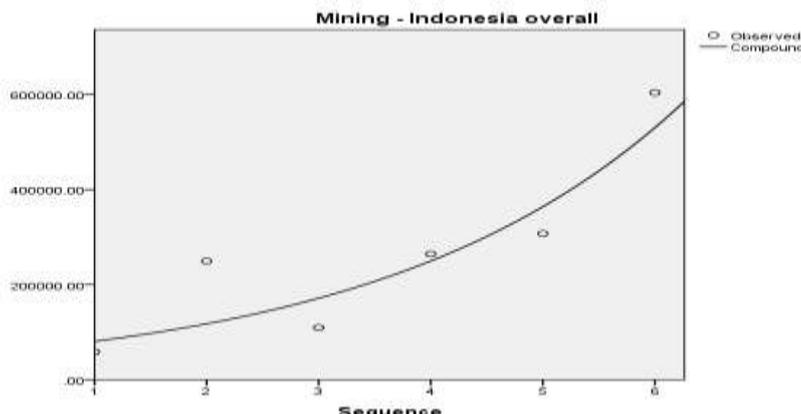


Fig-6: Projected, deforestation due to mining-Indonesia overall

Deforestation due to Transmigration

According to Table 5, the founded data for conversion due to transmigration (in ha) were comprehensive but the information collection period was not clear. For example, it was written that data have been collected up to 2000 at the first stage; however, it was not revealed which year the data collection was

started. As a result, the available data for the transmigration section were non-analysable. Based on the data during 2011, the efficiency of conversion for reason of transmigration (in ha) had a reduction. Accordingly, it emerged that this variable was very important in the theoretical framework.

Table 5: Transmigration on seven main Islands in Indonesia (in Ha)

Year	Indonesia	Kalimantan	Sumatera	Sulawesi	Maluku	Bali Nusat Tenggara
Up to 2000	584,252.65	155,119.14	311,490.92	91,716.01	22,464.58	3,462.00
Up to 2002	5,277,073.34	1,706,381.10	3,232,206.20	288,386.98	45,258.70	4,840.36
Up to 2006	838.84	198.66	505.09	107.23	23.78	4.09
Up to 2011	842.57	199.77	507.00	107.23	24.48	4.09

DISCUSSION AND CONCLUSION

Numerous initiatives have been made to reduce deforestation risk in line of climate change but much more needs to be done. The present study focused on the forests conservation while deforestation remains unsolvable in Indonesia. By the year 2009, the president of Indonesia has set the target to reduce greenhouse gas emission and deforestation. The government has passed a resolution on green economy to shift Indonesia towards a green country. Norway offered \$1 billion to help Indonesia to reduce deforestation in 2010. The two-year leeway or ban on logging permits in rainforests and peat land is launched by Indonesia during the year 2011. To the better environment protection purpose, some Indonesian companies have declared certain policies. In spite of all these efforts, still lots need to be done in Indonesia to protect forests [46].

protection and management to safeguard forests in this country. Towards this, if a country intends to adopt integrated approaches to managing ecologically and socially acceptable ways, its global monitoring and national system should be improved[48]. The salient management roles in deforestation has been highlighted in this study and it is one of the main crucial factors for deforestation in this part of the world.

Based on the law of the republic of Indonesia [47] the environment quality has been diminishing, which is threatening the survival of human life. Consequently, we need to have environmental

It is revealed that government has used some actions to protect the forests and prevent deforestation. Decentralization of government activities and responsibilities from central to the local level have been strongly encouraged by national management and agencies. It will bring better service provision, more effective local governance, and greater generation of resource for investment in economic expansion[49]. Afforestation and reforestation are the others actions. FAO [49] statistics has shown that Indonesia is the second country after china with 250,421 hectares afforestation on the earth by the year 2005. The action of creating forests including seeding and planting on

lands that are not categorized as forests is afforestation like the action after fire and storm. In 2005, Indonesia was the seventh country in reforestation with 153,941 hectares in the world. Reforestation refers to the forests re-formation through planting on lands considered as forests [49]. Regarding the dependent and independent variables namely time (in terms of year), the yearly data have been collected for building up the fitted model. This study has captured the objectives about the act of reforms on the deforestation management and its forecasting by paraphrasing the data, which is the core of this study.

It is interesting to note that the significant independent variables in the mentioned areas differ from the other islands. As shown above, the ARIMA model parameters for the conversion of agriculture purposes, S model for logging, Logistic model for fire and compound model for mining in Indonesia overall are fitting well. On the contrary, in the remaining islands analysing these variables are impossible because the statistics have shown nothing from 2001 to 2010. The time series modeler and curve estimation are used in this study for predicting the upcoming years were not significant in the analysis. The last influencing factor is transmigration and by reason of lacking the organizing data, it could not be used in the analysis. However, the data outcome shows that conversion for the transmigration purposes by government reforming rules and legislation has followed to be diminishing. It has offered the influence degree of these factors on deforestation. All the propositions in section 2.2 are

supported and it would explore the influence and relative importance of government legislation and reforming rules on deforestation. The six propositions are significantly based on the collective action theories that point out why monitoring must be applied and how valid commitment can be made on management of deforestation.

The strong declining trend in numbers pointed out in data analysis shows that the deforestation management has been properly maintained. Deforestation due to natural calamities such as fire, earthquake, tsunami, and so on are purely at random and neither can be measured nor can be controlled. Thus, the propositions stated in section 2.2 are supported.

According to Table 6, some illegal cases such as fire, mining, logging and encroachment for extra information are decreasing. This study has reached this point through the mediating effect of governmental efforts on the relationship between effectual factors and deforestation. According to the indicated data there is a declining in terms of crime cases happened in the forests. This result shows that the helpful monitoring and management of forestry is the main reason for any decrease in these kinds of crime cases. Following these practices would result in the protection of deforestation. A good instance can be the fire case happened in the forests from 2007 till 2011. It is obvious that in Indonesia crime case reduction was unbelievable.

Table 6: Crime cases in Indonesia-overall

year	Illegal logging	Mining	fire	Encroachment*
2007	1424	18	33	235
2008	660	12	6	155
2009	447	24	6	216
2010	294	24	0	117
2011	177	3	3	174

Note: *Burn and clear the land to use it for paddy, oil palm and so on (encroachment)

Source: Indonesia forestry ministry

The current study tried to compare the predicted data with the real data for coming years by following actual data from forestry ministry. The management behaviour pattern of the deforestation due to fire, exchange for agricultural purpose, logging intensity, mining, and transmigration was systematically studied from 2001 to 2010. It was observed that the deforestation due to these factors is in the declining trend. Furthermore, the study concluded that via the effort of deforestation management we can decrease the risk of deforestation. Although it could affect the climate change but more actions need to be done to overcome climate change and save the endowment resources. In order to explain this finding, it

should be said that the government efforts every year, its willingness and transparency to decrease the climate change rate are useful parameters to indicate deforestation in the world in general and in the surrounded areas in particular.

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