Journal of Engineering and Applied Sciences 12 (23): 7393-7400, 2017
ISSN: 1816-949X

Forest Encroachers in Dharmasraya, West Sumatra, Indonesia: An Analysis of Socio-Economic Characteristics

[1]Yurike, [2]Yonariza, [2]Rudi Febriamansyah and [3]Syafruddin Karimi
[1]Department of Agricultural Sciences, Graduate Program,
[2]Department of Agribusiness, Faculty of Agriculture,
[3]Department of Economics Studies, Faculty of Economic Andalas University,
Padang, 25163 West Sumatra, Indonesia

Abstract: Forest areas in Dharmasraya have decreased from 85% in 2000 to 18% in 2014 while plantation increased from 3.5000 ha to almost 20.000 ha an increasing of 600%. The purposes of this study are to determine the characteristics of forest encroachers in the Dharmasraya District and to identify post-encroachment local land ownership. The study used household survey, key informants interview, secondary data collection and data were analysed using descriptive quantitative. The results showed that, the forest encroachers are a category of productive age with low levels of education, land ownership in Dharmasraya is communal clan land, the ruling clan Melayu of Minangkabau ethnic. Based on the characteristics of the economy, forest encroachers in Dharmasraya classified as upper-middle households., encroachment occurs because there is an opportunity to invest in land. There is no sanction to the people who sell and buy forest land, resulting in greater ownership of land for migrants than local communities. Weak law enforcement in this area facilitates forest land encroachment, the same also hold true for the government's lack of attention and socialization to the community.

Key words: Communal land, forest management, immigrant, socio-economic, state forest, ownership

INTRODUCTION

Forests currently cover around 30% of the earth's land surface but are being lost at an "alarming rate" (FAO, 2010; Miller and Cotter, 2013). Indonesia is one of the countries in the tropical region that has the largest forest area but also the rate of loss of natural forest were great. Abood *et al.* (2015) claimed that most deforestation and degradation are human-induced, economically wasteful and environmentally negative and socially undesirable. Often, just a few individuals benefit. The process usually causes adverse effects on the social conditions of the weaker parts of society progressive ecosystem destruction (Contreras-Hermosilla, 2000).

Deforestation of tropical forests has direct impacts on global warming, the water cycle and biological diversity (Geist and Lambin, 2001). Some studies investigate a specific cause of deforestation. The main causes of fores degradation are encroachment, land use changes are influenced by agricultura expansion (Pailagao *et al*., 2010; Barona *et al*., 2010). Agricultural expansion, primarily by smallholders is the proximate cause of at least 50% of the deforestation in tropical forests (Barraclough *et al*., 2000).

The main immediate cause of forest conversion is to create space for commercial or subsistence agriculture (Angelsen and Kaimowitz, 1999). Forest encroached upon by either individual, group or institutions (Contreras-Hermosilla, 2000). Differences in actors and spatial differences in physical and economic factors also result in intra-regional heterogeneity in deforestation patterns (Aguiar *et al*., 2007).

As in other developing countries, many studies found that deforestation in Indonesia is the resulting poverty is widely considered to be an important underlying cause of forest conversion by small-scale farmers (Purnamasari, 2010). It is inversely proportional to deforestation in Dharmasraya district West Sumatra Province with an area of 302.958 and 92.150 ha or 31.12% of them designated as forest land (BPS, 2016). To strengthen the management of this forest, Ministry of Forestry decided to set up a forest management unit in the year 2013 with a total area of 33.550 ha (PFMU, 2014). Unfortunately, forest cover in Dharmasraya has lost as many as 22.584 Ha within last decade.

Dharmasraya PFMU working area has been taken over by the community and converted it into oil palm and

Corresponding Author: Yurike, Department of Agricultural Sciences, Graduate Program, Andalas University, Padang, 25163 West Sumatra, Indonesia

rubber plantations and they reclaim the land as communal lands. In the administrative level, the forest land is a state owned but in general many people recognize it as communal land. Therefore, PFMU Dharmasraya finds operating problems due to overlapping claims over the ownership of forest lands. The encroachment may be considered as a resistance by indigenous peoples to maintain their forests and prevent external interferences (Wulan *et al*., 2004). The success of the community reoccupied their communal lands do not make them manage the forest land properly. However, the final decision to encroach the forest is a household decision. It becomes a question of how the mechanism of land occupation and what kind of household characteristics that encroach the land.

Deforestation cannot be separated from household encroachment behavior. This behavior will also be driven by the increasing openness of access to forest resources that will facilitate the activities of exploitation of forest resources (Caliskan, 2013). Therefore, efforts to restore forest conditions cannot be separated from the behavior of people around the forest but that behavior has not been revealed, so well that, the efforts of the rescue and rehabilitation of forest many failed. The debate on the underlying causes and what drives agent's behavior is more complex. The relationship between forest clearance and household and contextual variables varies depending on the arrangement (VanWey *et al*., 2005).

Lambin (1997) and also Kaimowitz and Angelsen (1998) have reviewed more than 140 economic models of tropical deforestation. They criticize cross-national studies for the poor quality of the data used, among other problems. They also emphasize the great variety of deforestation drivers in different places and the need for more research at the local level. Kaimowitz and Angelsen (1998) find that land markets are one of the "major doubts that can only be resolved by further research." They conclude that "research will probably be more productive if it concentrates on household and regional-level studies, instead of national and global studies." This study contributes to filling this need for a deforestation hotspot in Indonesia, particularly in Dharmasraya district. The purpose of this study is to determine the characteristics of household forest encroachers and to determine the level of land ownership of by characteristic of the household.

MATERIALS AND METHODS

Study area: Dharmasraya district is one of the new administrative areas in West Sumatra, it was established in 2004 as a result of Law No. 38 the year 2004. Geographically PFMU Model Dharmasraya located at coordinates 01°03'30" LS-01°22'00" LS and 101°24'30" BT-101°38'00" BT. The administration PFMU Dharmasraya model lies in two districts; Sub-District Pulau Punjung and Koto Besar.

Data collection and analysis: The research was conducted from April until August 2016 in the site of Dharmasraya Production Forest Management Unit (PFMU). This research uses a descriptive method which is designed in the form of survey research and geared to describe the behaviour of encroachers in the forest areas that lead to deforestation. The study employed varieties of data collection techniques, i.e., observation, secondary and documentary data, historical data, key informant and household survey.

The populations are all encroachers household. Given up to now there is no accurate data on the number of encroachers in PFMU and encroachers are not only local residents but also come from surrounding villages, the determination of population of encroachers was not possible, so that, the study employed a snowball sampling technique. Steps in sampling the encroachers were as follow. First, visiting the areas that are included in PFMU Dharmasraya of 33.550 ha of which consists of a local name where locals open up forest land for agriculture such as Bulangan, Sungai Jernih, Bukik Gadang, Sungai Likian, km 25, Sakaladi, Bukik Batu Basalai, Sungai Siek. Second using the method of snowball sampling until saturated. Snowball sampling is a sampling technique that initially a small amount and then enlarged. Like a rolling snowball that long to be big (Thompson, 2002). The encroachers were identified by asking who were their owners of the land around his/her plot. All in all, there are 250 respondents interviewed scattered in different villages and occupy land all over the forest land.

Data sorted by sequence analysis research purposes such as to analyze the characteristics of encroachers households with quantitative descriptive analysis and regression to analyze the level of community land ownership was analyzed with descriptive qualitative.

RESULTS AND DISCUSSION

Background of Dharmasraya District: Dharmasraya District is one of the new administrative areas in West Sumatra, it was established in 2004 as a result of Law No. 38 the year 2004. Much of forest management policy happened during the previous administrative unit of Sawahlunto Sijunjung district and the current Dharmasraya District Government forest management is

the legacy of the previous administration. However, deforestation inclines during the current administration.

Dharmasraya District is passed the Trans-Sumatra highway. This district is located at the intersection of Trails linking Sumatra Padang, Pekanbaru and Jambi Province. A third of the district's population is migrants from various regions which originally moved to exploit the idle land in this district as well as opening new jobs. This transmigration process occurred between 1976 and 2002. Previously, in this area is still largely shaped jungle. Then in 1979 began to occur transmigration. In the first year the immigrants initially only rely on the allocation of the government, after the assistance ends with crops, the community began to switch to rubber and oil palm plantations.

Drive for deforestation and land use: The area of Production Forest Management Unit (PFMU) Dharmasraya District West Sumatra, 33.500 ha is a remaining lowland forest in the district. The government has granted several lands uses and forest use permits to private and state forestry companies. The former 66.000 Ha production forest was granted to a logging concession in 1972. After the expiration of this concession in 2002, most of this concession area became convertible production forest and has given concession to the private estates of three companies, namely PT. Incasi Raya (6.900 Ha), PT. Selago Makmur Plantation (6.066 ha) and PT. AWB (8.500 ha) a multinational private company. The third concessions cultivate palm oil. Remaining concession of PT. Ragusa is the given to three permit holders, namely PT. Inhutani, PT. Bukit Raya Mudisa (BRM) and PT. Dara Silva (PFMU., 2014).

Unfortunately, the two forest concessions failed to manage the remaining forest area. Consequently, logged over forest severely degraded. Forest land encroachment continues until this very moment. As of 2013, Ministry of Forestry deciding the establishment of production forest management unit to handle the forest management at field level. According to the law, PMU will supervise current forest concessions, empower local people and do forest rehabilitation. Unfortunately, PFMU Model Dharmasraya encounters operation problem due to overlapping claim over forest land tenure (Yonariza, 2015).

FMU Dharmasraya in West Sumatra, Indonesia, is a case of forest encroachment by locals. In last 15 years (Table 1), forest area reduced from 85% in 2000 to only 18% in the year 2014 while plantation increased from 3.5000 ha to almost 20.000 ha an increasing of 600% (Yonariza, 2015). Opened land also increased that, show land clearing continues. This shows, how the forest has been cleared and converted into smallholder plantation. Forest cover change in FMU Dharmasraya is presented in Table 1.

Table 1: Forest cover change in PFMU Dharmasraya, 2000-2014

Land cover	Units	2000	2005	2011	2014
Secondary forest	ha	28971.00	24,092.500	13,423.19	6,333.43
	%	86.35	71.810	40.01	18.89
Plantation	ha	3,436.20	7,920.500	17,750.02	19,780.06
	%	10.24	23.610	52.91	59.00
Open land	ha	1,143.60	1.537	2,376.79	3,312.09
	%	3.41	4.580	7.08	9.88
Mix farming	ha	-	-	-	4,039.92
	%				12.05
Shrub	ha	-	-	-	62.02
	%				0.18
Total	ha	33,550.00	33,550.00	33,550.00	33,550.00

Our household survey reveals that conversion of forest land tends to consist of three patterns, planted with rubber (44.0%), palm oil (21.6%) and palm oil mixed rubber (34.4%). There is still high dominant rubber plant it is based that since colonial time Dharmasraya people had planted rubber, just before the system of rubber cultivation is still a rubber forest where rubber is grown haphazardly along with forest trees but now the rubber cultivation has been tended to be monocrop rubber plantation which is also the main source of livelihood for the community because it can be harvested all year around. Around 34% of the encroachers have started to plant oil palm since the oil palm company operating in Dharmasraya it is also due to fall in rubber prices in the 2000's and steadily price of palm oil. The transformation of forests into rubber plantation (Miyamoto, 2006) and oil palm plantations (Broich *et al*., 2011) is a major cause of declining forest area in Indonesia.

Household characteristics of forest encroachers: Communities in Dharmasraya come from various Minangkabau clan such as Melayu, Piliang, Caniago, Koto Tinggi, Piliang, etc. The following characteristics of the encroacher's households in the Dharmasraya District (Table 2).

The results showed that, the average number of family members encroachers numbering 4-5 people per household with an average number of productive family members 2 people. Based on correlation (Table 3) by using multiple regression methods found that the correlation between family size and the number of family members of productive factors correlated positively with a size of land occupation in the FMU. Increasing the size of the household will certainly lead to desire improvement of living standards and will improve the higher their investment needs to open forest land.

Age of household falls into the category of productive age amounted to 94.8%. The older age level

Table 2: Household characteristics of forest encroachers

Characteristics	Frequency		Total	
	Indigenous people	Migrants	Frequency	(%)
Number of family members				
Small (2-4 people)	101	28	129	51.6
Medium (5-6 people)	77	34	111	44.4
Large (>7 people)	8	2	10	4.0
Total indigenous people+migrants		250	100	
Age				
Non-productive young	0	0	0	0.00
Productive (17-55 years)	174	63	237	94.80
Non-productive elderly	12	1	13	5.20
Total indigenous people+migrants		250	100	
Level of education				
Low (<6 years)	99	12	111	44.40
Medium (7-12 years)	77	40	117	46.80
High (>12 years)	10	12	22	8.80
Total indigenous people+migrants		250	100	
Household labor				
Labor	47	18	65	26.00
Labor	107	32	13	55.60
Labor	28	11	39	15.60
Labor	4	3	7	2.80
Total indigenous people+migrants		250	100	

Table 3: Result of linear regression analysis in PFMU Dharmasraya 2016

Models	Coefficients[a]/Unstandardized coefficients		Standardized coefficients (β)	t-values	Sig.
	B	SE			
(Constant)	-49.308	14.513	-	3.397	0.001
Age	0.426	0.264	0.107	1.613	0.108
Education	2.433	0.601	0.265	4.046	0.000
No. of family	2.214	1.822	0.088	1.215	0.226
Labor of household	-2.387	3.098	-0.056	-0.770	0.442
Income	7.538	4.222	0.116	1.786	0.075

[a]Dependent variable: agricultural land area (ha)

encroachers, then the tendency to open forest land increases. This is because the encroachers with a fairly old age usually have a considerable amount of land to the amount of labor and capitals are sufficient. While on the other hand, the level of their household needs was likely to increase. To overcome these problems, they usually tend to expand their plantations. The older the encroachers, the tendency towards the availability of capital and labor are increasingly adequate.

Education level in Dharmasraya still lows in human resources. However, 8.8 % encroachers also have highly educated, this means that higher education does not guarantee a reduction in deforestation if the consciousness of the individual itself to ensuring that the environment is still low. Based on observations in the field of education levels are lower in communities Dharmasraya due to lack of public awareness of the importance of education. Based on the labor force an average household consisting of two people, husband and wife, this course will increase household income.

Migration, land ownership and the expansion of land ownership: Approximately 74.4% of encroachers households are natives Dharmasraya while the remaining 25.6% are immigrants from resettlement (transmigration) program. The immigrants certainly expand their agricultural land, thus, increase the rate of deforestation. This may be due to population growth in the resettlement site, meanwhile there is no land allocation for the second generation in the site. In addition, immigrants are more aggressive in expanding land occupation inside forest area. Sisongkham *et al*. (2015) stated that, land use changes as indicated by the degradation and deforestation are attributable to a complex interaction of the socio-economic, cultural and government policies. The socio-economic factors include the population growth as affected by voluntary resettlement or in migration. Table 4 presents the size of small holder plantation area between indigenous people and immigrants.

Table 4 shows that, the average tenure native population is 10.07 ha while immigrants reached 28.89 ha. For newcomers at least 20 ha of land, the minimum is considered able to provide benefits for land buyers. Dharmasraya generally still use the customary law as the basis for land ownership. Beckmann stated that, the

Table 4: Size of small holder plantation area

Land area (ha)	Indigenous people	Immigrants	Frequency	(%)
<15	165	46	211	84.4
16-30	15	8	23	9.2
31-45	4	1	4	1.6
46-60	1	3	3	1.2
>61	2	6	9	3.6
Total (n)	186	64	250	100.0
Mean (ha)	10.07 ha	28.89 ha		
Min. (Ha)	3 ha	3 ha		
Max. (Ha)	80 ha	300 ha		

treasures owned by any group within a clan have been passed down through several generations. Community perceptions regarding land ownership in Dharmasraya are clan land, the most dominant/ruling have communal land are the Melayu Clan. The land is freely available for Melayu clan member (Yurike *et al*., 2015). There also land used by another clan members which means that the land has been donated by the land right holder (Niniak Mamak Melayu) to them. There was also a party to the other clan through certain requirements, no such thing as rent, contract/no contract planted with perennial crops or by buying the land to the communal authorities. Their association with clan determines their land possession.

Presently, the government programs in terms of forest management were minimal, although, there was state-run forest company called Inhutani to rehabilitate the *Dipterocarpaceae* called Meranti (*Shorea Leprosula*) but based on interviews and field observations, the planted Meranti have been felled by the community and there has been no firm action by the government. This resulted in diminishing forests. The total area of landholdings were the most significant variables explaining the proximate causes of deforestation. However, when we analyze land use and land cover characteristics of the landholdings, some patterns can uncover strategies that denote land speculation. The price of land rose rapidly in Dharmasraya.

The price of communal land varies according to its location. If located far into the forest, the price of around IDR 1-2.5 million/ha, whereas if the location is close to the village of about IDR 8-10 million/ha. As for the medium range of about IDR 5-8 million/ha. Besides communal land prices are also influenced by the slope of the land, the sloping land, the lower the price and the price is in accordance with the agreement of communal authorities.

Income and investment in forest destruction: The poor and shifting cultivation seen as the main driving force behind deforestation a few years ago. Governments are likely to be at least as concerned with increasing the incomes of rural households as slowing the rate of deforestation. For example, the view of most tropical deforestation being caused by poor "shifting cultivators" (Myers, 1994) does not fit well in Dharmasraya, where most deforestation is the research of the middle-class household.

The main research encroachers are farmers (55.6%), entrepreneur (18.8%), military (2.8%), employees (20.0%), etc. (2.8%). This shows that for 47.2 % of the respondents who are not farmers, gardening is an investment for them not as a primary source of income, they are middle class to grab the land. Those who have a lot of capital tend to use outsourced work to cultivate his land. Typically, the workers will be paid a revenue sharing system or a system of daily wages salary. As for the farmers whose main job farming, they are not classified as poor farmers where, we can see in the table that most of the respondents were high-income (64.4) and 35.6% classified as middle-income (Table 5). The more income, the more people will buy, use and dispose of natural resources. Based on the income level of the majority of encroachers are relatively high 64.4% of them has an income more than IDR 3,500.000/month (USD 260). The poverty line according to BPS (2016) is IDR 333.034/capita/month. Asian Development Program in Indonesia categorizes the upper middle class to include in the income category above IDR 2.6 million/month. Boston Consulting Group (BCG) released projections of the number of middle class in Indonesia, that for middle ranged from IDR 2,000.000-3,000.000 and for Upper middle above IDR 3,000.000. Hence, the forest encroachers belong to middle class.

Encroachment in Dharmasraya classified as upper-middle households. The higher the income the higher the desire to clear land for investment. Increasing in financial capital may then support additional land clearing to produce cash crops beyond consumption needs. The similar finding was reported by Zwane (2007) using a longitudinal household survey in Peru that, the poor were using additional income for land clearing. Angelsen and Kaimowitz (1999) review farm and regional empirical evidence from Latin America that links increased credit to greater deforestation rates. Thus, farmers may initially clear more land as income rises but above a certain income level, instead intensify production. In the latter setting, lowering poverty could lower deforestation too. However, intensification can also be consistent with using more land in production. And more generally, increasing income may not be the most effective way to combat deforestation. In fact, indeed, it is the driver of deforestation.

Based on the results of the regression analysis shows that, the characteristics of respondents, i.e., age, the number of family members, education and income

Table 5: Income of encroachers household (1 USD = 13.500 IDR)

Income levels	Frequency (n)	(%)
Low (2,500.000 IDR)	0	0.0
Medium (2,500.000-3,000.000 IDR)	89	35.6
High (>3,000.000 IDR)	161	64.4
Total	250	100.0

positively affects the land holding. It can be concluded that the first, deforestation has occurred not only because of people with low education and low income or poor. Secondly, high levels of education of encroachers with productive age must be at the level of income belonging to the upper middle where now of their own savings and ideas to increase their investment by clearing forests into plantations.

Respondents with old age tend to expand his agricultural land occupation. They provide capital and management of the garden and pay worker outside of the household members, a wage of workers is typically in the system of monthly salary or profit sharing. The numbers of domestic workers are negatively correlated with the land. This is due to the encroachers tends to use paid worker outside of the household members and land clearing is done by using the machinery.

The drivers of deforestation vary a great deal between continents: cattle and soy are important only in Latin America while, palm oil plantations are found almost exclusively in Indonesia and Malaysia. Deforestation in Southeast Asia is inseparable from the role of the timber industry where, logging is often followed by forest conversion to plantations to produce pulpwood or oil palm (Boucher *et al*., 2011).

Forest degradation and deforestation happened in the study site by forestland encroachment. Land ownership by the clan and the authority of a clan leader (a Datuak) and the land selling to outsider increasing possibility to increase the rate of deforestation. As in other developing countries, many studies found that deforestation is the resulting poverty is widely considered to be an important underlying cause of forest conversion by small-scale farmers. Poor socio-economic condition and thirst for the land of people aggravate the condition critical (Myers, 1994; Chomitz and Kumari, 1998; Zwane, 2007).

Deforestation in Bangladesh is caused due to encroachment and conversion to non-forest use. Factors driving the encroachment due to socio-economic including the availability of land is limited and unemployment became the main cause of land encroachment (Iftekhar and Hoque, 2005) but it is different in Dharmasraya district where, the upper middle households larger role in deforestation. For community, the main purpose is to develop plantations, clearing forest land for economic reasons as to increase investment.

Plantation development is strongly influenced by the motivation of farmers which has been dominated by economic motivation not to survive but to increase household income.

Our study, supports (Kaimowitz and Angelsen, 1998) that there is a need for more research at the local level within our sample of small-to medium-sized farmers, we find little support for forest clearing being driven by extreme asset poverty. Rather, households with high asset holdings (upper-middle household) are more land-use expansionary. Deforestation is largely related to agricultural conversion and is not necessarily a symptom of poverty. In general, poverty causes deforestation to be only partially accurate and a poor policy guide. Deforestation is done by the poor and the rich for big and small profits, sustainable and unsustainable.

It can be concluded that, firstly the land selling to outsider increasing possibility to increase the rate of deforestation. Second, over time it can cause the outside community could have a bigger area than the natives if the natives did not change the way they manage the land by only seeing the land as a quick way to earn cash.

CONCLUSION

The number of household members with an average of 4-5 people by the number of productive family members on average 2 people/households. The average age of encroachers is 41-year-old and 94.8% of them are in the productive work age. The level of education is low. The majority of revenue encroachers were in the middle class. Socioeconomically, forest encroachers in Dharmasraya classified as upper-middle households. The higher the income the higher the desire to clear land for investment. Increases in capital may then support additional clearing to produce cash crops beyond consumption needs.

In the decision of the government to sanction the rogue elements who sells forest land traded also cause land ownership by migrants is greater when compared with the local community. Weak law enforcement in this area, so as to facilitate community activities to encroachment as well as the government's lack of attention and socialization to the community and weak governance appear to be major factors contributing to the land accumulation.

The growing consolidation of land in larger and more capital-intensive properties indicates the potential for high rates of deforestation in the future. This complexity of relationships among the actors involved in deforestation needs to be represented in models of land use dynamics to project the future course of deforestation in the Dharmasraya District.

ACKNOWLEDGEMENTS

We owe a debt of gratitude to the Ministry of Research, Technology and Higher Education in the Republic of Indonesia for funding support for this research under the Program Magister Menuju Doktor Sarjana Unggul (PMDSU) an accelerated Ph.D. Program, Under Grant No. 01/UN.1 6/PL-PMDSU/2014.

REFERENCES

Abood, S.A., J.S.H. Lee, Z. Burivalova, J. Garcia-Ulloa and L.P. Koh, 2015. Relative contributions of the logging, fiber, oil palm and mining industries to forest loss in Indonesia. Conserv. Lett., 8: 58-67.

Aguiar, A.P.D., G. Camara and M.I.S. Escada, 2007. Spatial statistical analysis of land-use determinants in the Brazilian Amazonia: Exploring intra-regional heterogeneity. Ecol. Modell., 209: 169-188.

Angelsen, A. and D. Kaimowitz, 1999. Rethinking the causes of deforestation: Lessons from economic models. World Bank Res. Obs., 14: 73-98.

BPS., 2016. Social and population. Badan Pusat Statistik, Indonesia.

Barona, E., N. Ramankutty, G. Hyman and O.T. Coomes, 2010. The role of pasture and soybean in deforestation of the Brazilian Amazon. Environ. Res. Lett., 5: 1-9.

Barraclough, S.L., K. Ghimire, K.B. Ghimire, 2000. Agricultural Expansion and Tropical Deforestation: Poverty, International Trade and Land Use. Earthscan Publications Ltd., London, UK., ISBN:9781853836664, Pages: 150.

Boucher, D., C. May-Tobin, K. Linenger and S. Roquemore, 2011. The Root of the Problem What's Driving Tropical Deforestation Today?. UCS Publications, Cambridge, UK.

Broich, M., M.C. Hansen, P. Potapov, B. Adusei and E. Lindquist *et al.*, 2011. Time-series analysis of multi-resolution optical imagery for quantifying forest cover loss in Sumatra and Kalimantan, Indonesia. Intl. J. Appl. Earth Obs. Geoinf., 13: 277-291.

Caliskan, E., 2013. Environmental impacts of forest road construction on mountainous terrain. Iran. J. Environ. Health Sci. Eng., 10: 23-30.

Chomitz, K.M. and K. Kumari, 1998. The domestic benefits of tropical forests: A critical review. World Bank Res. Obs., 13: 13-35.

Contreras-Hermosilla, A., 2000. The Underlying Causes of Forest Decline. Center for International Forestry Research, Indonesia.

FAO., 2010. Global forest resources assessment. Food and Agriculture Organization, Rome, Italy.

Geist, H.J. and E.F Lambin, 2001. What Drives Tropical Deforestation?: A Meta-Analysis of Proximate and Underlying Causes of Deforestation Based on Subnational Case Study Evidence. LUCC International Project Office, Belgium, Europe,.

Iftekhar, M.S. and A.K.F. Hoque, 2005. Causes of forest encroachment: An analysis of Bangladesh. GeoJ., 62: 95-106.

Kaimowitz, D. and A. Angelsen, 1998. Economic Models of Tropical Deforestation. A Review. Center for International Forestry Research, Bogor.

Lambin, E.F., 1997. Modelling and monitoring land-cover change processes in tropical regions. Prog. Phys. Geogr., 21: 375-393.

Miller, C. and J. Cotter, 2013. An impending storm: impacts of deforestation on weather patterns and agriculture. Greenpeace, Amsterdam, Netherlands.

Miyamoto, M., 2006. Forest conversion to rubber around Sumatran villages in Indonesia: Comparing the impacts of road construction, transmigration projects and population. For. Policy Econ., 9: 1-12.

Myers, N., 1994. Tropical Deforestation: Rates and Patterns. In: The Causes of Tropical Deforestation: The Economic and Statistical Analysis of Factors Giving Rise to the Loss of the Tropical Forest, Brown, K. and D.W. Pearce (Eds.). University of British Columbia Press, Vancouver, Canada, pp: 27-40.

PFMU., 2014. Long-term forest management plan 2015-2025. Production Forest Management Unit, Dharmasraya, Indonesian.

Pailagao, C.T., M.V.O. Espaldon, M.A. Dorado, D.C. Catacutan and C.M. Rebancos, 2010. Drivers of land use change in Lantapan, Bukidnon, Philippines. J. Environ. Sci. Manage., 13: 1-11.

Purnamasari, R.S., 2010. Dynamics of small-scale deforestation in Indonesia: Examining the effects of poverty and socio-economic development. Unasylva, 61: 14-20.

Sisongkham, B., C.M. Rebancos, A.J. Alcantara and M.V.O. Espaldon, 2015. Land cover changes and resource use patterns of selected communities in phou phanang national protected area, Sangthong District, Vientiane Capital, Lao PDR. J. Environ. Sci. Manage., 18: 33-43.

Thompson, S.K., 2002. Sampling. 2nd Edn., John Wiley and Sons, New York, USA., ISBN-13: 9780471291169, Pages: 367.

VanWey, L.K, E. Ostrom and V. Meretsky, 2005. Theories Underlying the Study of Human-Environment Interactions. In: The Forest and the Trees: Human-Environment Interactions in Forest Ecosystems, Moran, E.F and E. Ostrom (Eds.). MIT Press, Cambridge, Massachusetts, pp: 23-56.

Wulan, Y.C., Y. Yasmi, C. Purba and E. Wollenberg, 2004. [Analysis of forestry sector conflict in Indonesia 1997-2003]. Center for International Forestry Research, Bogor, Indonesia. (In Indonesian).

Yonariza, Y., 2015. Negotiating with land owners for forest restoration in Indonesia: A case from Dharmasraya District, West Sumatra, Indonesia. Proceedings of the National Conference on Management of Natural Resources and Environment, August 20, 2015, Diponegoro University, Semarang, Indonesia, pp: 1-14.

Yurike, Y., R. Febriamansyah and S. Karimi, 2015. Land grabbing and deforestation: Community perception on forest land ownership in Dharmasraya District, West Sumatra, Indonesia. Proceedings of the 2015 Confernce on BRICS Initiatives for Critical Agrarian Studies (BICAS'15), June 5-6, 2015, Chiang Mai University, Thailand, pp: 1-19.

Zwane, A.P., 2007. Does poverty constrain deforestation? Econometric evidence from Peru. J. Dev. Econ., 84: 330-349.