**Firewood and Wood Carpentry Contribution for Communities of The Mutis Timau Forest Protected, Timor Island**

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***Abstract***

*The existence of the Mutis Timau Protected Forest (MTPF) has given advantages for the fulfillment of household energy needs and the source of raw materials of building houses. This research aimed at knowing the contribution of MTPF to the consumption of firewood and wood carpentry for people. The research was conducted in 9 villages around the MTPF area and occurred in October 2017 - January 2018. The method employed was survey using descriptive analysis. The samples taken were 353 households distributed proportionally in each village. The result of the study shows that the MTPF gives valuable contributions with 87.45 % dealing with the use of firewood consumed by respondents compared to privately owned land with 12.55% of the total respondents consuming firewood in 1,912,512 kg/year. Firewood consumption per capita in Noebesi village is 971.8 kg/year, Nunbena is 969.15 kg/year, Leloboko is 1,171.73 kg/year, Tunua is 1,032.42 kg/year, Ajaobaki is 1,221 kg/year, Nuapin is 1,434.88 kg/year, Nenas is 1,220.09 kg /year, Kuanoel is 1,631.79 kg/year, and Fatumnasi is 1,805.31 kg/year. Wood carpentry consumption gained from the HLMT in 15-20 years is 96.34% while gained from privately owned land is only 3.66% of 1,162.8 m3.*

***Keywords:*** *Contribution, Firewood, Wood Carpentry, Protected Forest*

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**Introduction**

Forest as a gift of God Almighty given to Indonesian people is a wealth controlled by the state. It delivers multi-advantages for human beings; we, therefore, must be grateful, take care, explore, and preserve them optimally for the greatest prosperity of people for present and future generations (Kementerian Kehutanan, 1999). As a gift created by God, forests provide enormous advantages for people welfare and ecosystem preservation. The advantages received by humans, especially for people around the forest, are the availability of timber and non-timber products, environmental services, and ecotourism, especially fresh air for the survival of all living creatures. Furthermore, as a gift for human beings’ life, forest supplies a very real advantage that submits household energy needs and raw material sources for house construction.

According to Oñate-calvín *et.al.* (2018), the use of forest resources is extremely increasing along with the market growth in urban areas. A resource taking produced by the forests is beyond the available capacity that may cause forest damages (deforestation and degradation). Consequently, it carries negative impacts, such as a long summer season, floods, erosion and landslides in rainy season. Sulaiman *et. al.*, (2017) explain that firewood consumption greatly induces forest degradation. Rehfuess *et.al.*, (2006) state that a disproportionate environmental degradation may have a direct impact to the poor who rely their subsistence lives and daily livelihoods on natural resources.

For humans, the relationship to the forest has provided enormous benefits. By the benefits received from a large forest, humans continuously strive to employ resources created by God. Along with the growth of people, it has induced social problems belonging to the needs of firewood, woodworking, environmental services, and settlements. Simon (2003) emphasizes that population growth also insists on food, firewood, wood carpentry, and settlement supplies. The diminution area of agricultural land as a result of population growth encourages people, especially around the forest areas, to work at fertile forest land to be an agricultural land. It cannot be denied that the only hope to overcome the scarcity of agricultural land is by cultivating forests. The fact continues steadily and intensively (Simon, 2001), and even the people are still dependent on the forest. Loaiza *et.al.,* (2015) state that indigenous people have a high level of dependence on forests, environment, and higher incomes compared to other social groups near to markets that have a lower dependence on forest and higher cash income because of having better access to markets and labors. The dependence level of people around the forest is very high for forests in production, conservation, and protected forests. As a protected forest area, the MTPF also gets pressure from people, mainly in supplying their daily needs for food, firewood, woodworking, and other forest products, both timber and non-timber forest products.

The MTPF area is a forest group located on Timor island, especially in forest management unit (FMU) of TTS region, and is similar to the Centre of the Timor island which is as the upstream of two-large river flow area (RFA), namely Benain RFA and Noelmina RFA. As a forest located in the highlands in the Mutis Mount, the MTPF keeps a high potential biodiversity of flora and fauna for ecological, economic, and social life of the people. Njurumana (2016) cites that the dynamic era indicated by the increase of social knowledge places comprehensively the religious value of flora biodiversity. Flora biodiversity is a main resource with various potential uses for humans. The needs on its benefits obtained from the MTPF show that the needs of firewood occur weekly, monthly, or yearly; while wood carpentry occurs in 15 - 20 years for rebuilding damaged houses, even building new houses.

For rural community, firewood and wood carpentry play an important role to facilitate household energy needs for cooking and warming the body when waking up in the morning, also building houses. FAO (2010) draws that as the oldest resources, firewood is used by more than two billion people in the developing countries for cooking and heating. Nuryanti and Herdinie (2007) state that energy plays an important role for people's lives since energy is to indicate developmental and economic growth. Energy sector cannot be separated from every sectors of life (industry, household, transportation, services, etc.). In household sector, energy functions to lighting, cooking, heating, and air conditioning as well as various other household activities. Dresen *et al.*,(2014) argue that energy produced by firewood is necessary to maintain people's livelihoods. Firewood is the most important product of local forests for rural communities in developing regions and scarcity of firewood creates serious problems (Cooke *et.al.,* 2008 ; Timko and Kozak, 2016). Furthermore, Arnold *et. al.*, (2006) assert that the use of firewood in many developing countries occurs in rural areas, while ebony is used in urban areas. Brouwer and Falcao, (2004) explain that people in Mozambique city (Maputo) fulfill energy needs depending on firewood.

For people living around the MTPF, the choice to get firewood and woodworking is from forests rather than gardens. Gardens owned by people around the MTPF are dominantly used to cultivate crops, horticulture, and plantations. Few gardens provide firewood and wood working. Periodically, household needs on firewood and wood carpentry for rural community, in particular for those who are living around the MTPF, cannot be exactly predicted. So, this paper is intended to explore the contribution of the MTPF with its available potential resources on firewood and wood carpentry needs for people.

**Methods**

**Place of the Study**

The study was conducted in 9 (nine) villages around the FMU of the MTPF area in TTS District. The villages are Nunbena, Noebesi, Leloboko, Tunua, Ajaobaki, Nuapin, Nenas, Kuanoel and Fatumnasi can be seen in **Figure 1**. This research took place in September 2017-January 2018.

**Data Collection and Analysis**

The method employed in this study was a survey method using descriptive analysis. The aim of the study was to create an overview of a systematic, factual, and accurate condition dealing with factors, characteristics, and correlation about phenomena that exist during the study. The population was the number of household heads (HH), and the sampling technique was based by using formula by Sevilla *et.al*.,(1993) with a tolerable error limit of 5%. Therefore, the samples taken were derived from 353 household heads (HH). The distribution of samples was taken proportionally in each village that can be drawn in **table 1**.

This study employed primary data and secondary data belonging to the use of firewood and wood carpentry. This study also focused on firewood needs taken daily by households to cook; and wood carpentry needs used to build houses. The methods of collecting data were questionnaires, observation, in-depth interviews, documentation, and library study. Data analysis consisted of firewood and wood carpentry consumption analysis. Firewood consumption was calculated by writing down the amount of firewood consumption in a week, then calculated overall for the last 1 year. Simon (2004) asserts that firewood need is calculated by weighing and counting up all respondents firewood need gained from gardens and forests and dividing it based on the number of family members of the overall respondents (kg/person/day). While woodworking consumption is calculated based on the house size approach. Wood carpentry needs are analyzed by estimating the use of wood to construct houses based on the size of the house.

**Results and Discussion**

**Respondent Characteristics**

Respondents in this study were 353 households living around the MTPF distributed proportionally in 9 (nine) villages. The main job of 353 respondents is farmers with 100%, while based on sex, men are 89.2% and women are 10.8%. The education level of respondents is that primary school is 73.4%, junior high school is 15.6%, and senior high school is 11%. The characteristics of the respondents can extremely influence how to take and use firewood and wood carpentry from the forest in 9 villages. In Dawan tribe’s life, people believe in a precious philosophy that forest is an inseparable unity from human’s and animal’s life. In taking dry wood, it is usually in a bunch with 25-30 small bars with a diameter of <40 cm and the length of the wood is erratic, and not more than 2 meters. When going home, the tied wood is carried by men on the shoulders; and women carry it on their heads covered with cloth. This habit exists until now. After arriving at home, dry wood is immediately used for cooking. Commonly, Dawan people cook using a stove consisting of three stones with the same distance formed as triangles. Cooking rice, sautéing vegetable, and heating water need 10 dried logs. Sometimes, people spend 1 bundle of dry wood a day to warm up their body, because 7 of 9 villages are cold areas. The use of firewood for cooking in each family is not the same depending on the number of family members.

**Contribution of the Mutis Timau Protected Forest to Firewood Consumption**

In addition to the income earned by the community, the MTPF provides advantages for people on firewood needs. The contribution of the MTPF using firewood consumed by the community in 9 (nine) villages is 87.45% compared to the use of firewood gained from privately owned land with 12.55%. The most use of firewood per year in the MTPF is in Leloboko with 94.28% and the lowest is in Ajaobaki with 75.98 %. Firewood consumption gained from the HLMT area can be seen in **table 2**.

Table 2 above indicates that total consumption of firewood respondents in Nunbena is 88.36% gained from forest and 11.64% is from gardens; in Noebesi, firewood consumption gained the forest is 90.94 % and 9.06% is from gardens; Leloboko is 94.28% from forest and 5.72% from gardens; Tunua is 86.65% from forest and 13.35% is from gardens; Ajaobaki is 75.98% from forests and 24.02% is from gardens; Nuapin is 94.79% from forests and 5.21% is from gardens; Nenas is 86.99% from forests and 13.01% is from gardens; Kuanoel is 87.55% from forests and 12.45% is from gardens; and Fatumnasi is 86.33% from forests and 13.67% is from garden. Overall, the contribution of the MTPF using firewood consumed by respondents in 9 (nine) villages is 87.45% compared to the use of firewood obtained from privately owned land with 12.55%. The contribution of firewood from the MTPF area can be seen in **Figure 2.**

**Contribution of the Mutis Timau Protected Forest to Wood Carpentry Needs**

Wood carpentry from the MTPF area is usually used for housing construction. Based on the result of survey, the type of wood carpentry used by people for building houses is *Casuarina equisetifolia, Eucalyptus alba and Swietenia macrophylla*. The result shows that when houses have been 15-20 years old, people tend to rebuild damaged wood, so that the need for woodworking does not occur periodically every year. Most of the wood used for house construction ((96.34%) are exactly obtained from forest, while 3.66% is gained from gardens. Wood carpentry derived the MTPF used for house construction in 9 (nine) villages in 15-20 years is 1,120.3 m3 that the highest consumption is in Fatumnasi with 176 m3 and the lowest is in Nunbena with 78.5 m3. On the other side, the largest amount of wood carpentry gained from gardens is in Tunua with 23 m3 and the lowest is in Nunbena and Ajaobaki with 0 m3 (all is from forests). The consumption of wood carpentry produced by the MTPF can be drawn in the following **table 3**.

Table 3 above explains that wood carpentry consumption in Nunbena is 100% from forest, Noebesi is 93.06% from forests and 6.94% is from gardens, Leloboko is 98.54% from the forests and 1.46% is from gardens, Tunua is 87.11% from forests and 12.89% is from gardens, Ajaobaki is 100% from forests. Wood carpentry consumption in Nuapin is 99.71% from forests and 0.29% from gardens, Nenas is 96.09% from forests and 3.91% is from gardens, Kuanoel is 97.98% from forests and 2.02% is from gardens, and Fatumnasi is 97.51% from forests and 2.49% is from gardens. Wood carpentry consumption gained from the largest forests in Nunbena and Ajaobaki is 100% and the smallest one is in Tunua with 87.11%.

Wood carpentry consumption varies between respondents in each village, and depends on the size of the house area. It can be shown in **table 4**.

The contribution of wood carpentry from the MTPF area for 15-20 years can be seen in **Figure 3.**

**Discussion**

Forests as a part of natural resources and God's creation have enormous functions and benefits for the life of living creatures on earth; and their existence must be conversed by all countries throughout the world. For the people throughout the world, forests supply oxygen, absorb carbon-dioxide, and provide various elements that can be produced by all living creatures, such as income for humans, firewood, wood carpentry, animal feed, and other non-timber forest products. All these advantages are experienced by all social levels either traditional or modern society.

Berger *et.al.,*(1988) assert that people with traditional (old) cultures are highly integrated and firmly united relying on religious rules, while modern society has a segmentation or plurality process. In line with the use of firewood and wood carpentry, people in fact with traditional cultures join and depend on the MTPF for cooking and house construction. It is supported by the religious rules adopted by the people who live around the MTPF dominated by Protestants that encourage people living in a united community to utilize the surrounding resources. In addition, they together use firewood and wood carpentry as sources of household energy and house construction. Besides, modern society has differentiation in using firewood and wood carpentry because of the heterogeneity of the people and the two commodities. Therefore, there is an option to substitute both commodities to other types, such as kerosene and liquid propane gas for cooking, or light steel for building construction. Hence, it is clearly depicted that a base of traditional-society is in rural areas (periphery) and outskirts of city (semi periphery); and a base of modern society is in the city (core).

Hopkins & Wallerstein (1988) divide the economic progress of the world community into three parts, namely developed economy (*core*), developing economy (*periphery*), and between them. In the context of the use of firewood in Indonesia, especially in the place of the study, the use of firewood is actually more dominant in *periphery* and *semi-periphery* regions. The Villagers around the MTPF belong to the category of periphery areas, and the people in Fatumnasi, Nunbena, and North Mollo of TTS district belong to *semi-periphery* category. The people in the capital city of South Central Timor (TTS), namely in So'E are categorized as *core*. Likewise with the use of wood carpentry for house construction, for *periphery* and *semi-periphery* societies, wood carpentry is the main commodity, while in *core* society, it can be substituted by other materials, such as light steel.

For rural societies and the poor who live in urban areas, firewood is used as the main energy source in facilitating their daily needs for cooking and warming up the body or other needs. It depends on its supply found in the forest. Nepal *et.al*. (2017) state that most rural and agricultural households in Nepal depend their life on forests for firewood and animal feed. Also, Asfaw *et al.*, (2013) cite that firewood is the most forest product, which is widely used with the largest proportion (79%) of the total of forest income. Kebede *et.al*.,(2010) describe that firewood gives 70% for energy consumption followed by petroleum and most industrial activities make use of some firewood forms. Most of the people in the FMU of the MTPF area, TTS district use firewood for cooking purposes. The result of survey denotes that every day and at least 2 days later, the people take firewood from the MTPF. The activity of taking firewood has taken place for long times ago until now, and even firewood is the main energy source for cooking activities for rural communities around the MTPF area.

As the main raw material for household energy in daily cooking needs and for house construction and rebuilding in 15-20 years, the two raw materials for firewood and wood carpentry are absolutely needed by the people around the MTPF supported by the supply of plants producing firewood and wood carpentry in the MTPF area and Mutis nature reserve. Some vegetation plants, such as *Eucalyptus alba*, *Melaleuca Leucadendron*, *Casuarina equisetifolia* and some minority plants, such as *Cassia siamea, Swiethenia macrophylla, Tectona grandis* and *Acacia leucophloea* grow in the MTPF to provide raw materials for firewood and wood carpentry.

The collecting of several types of plants by people for firewood and woodworking needs is supported by the distance which is near the residential area to the MTPF area. As in Nunbena, the respondents’ residence is next to the forests that 0-2 km is 57.7%, > 2-4 km is 38.5%, and > 4 km is 3.8%. In Noebesi, the respondents’ residence is near the forest that 0-2 km is 54.28%, > 2-4 km is 25.71%, and > 4 km is 20%. In Leloboko, the nearest distance to the forest is <1 km, even the residence is directly adjacent to the MTPF area and is one of the enclave villages. In Tunua, the respondents’ residence is that 0-2 km is 74%, > 2-4 km is 4%, and > 4 km is 22%. In Ajaobaki, the respondents’ residence is close to the forest that 0-2 km is 70.83%, > 2-4 km is 22.9% and > 4 km is 6.3%. In Nuapin, the respondents’ residence is near the forest that 0-2 km is 96.23%, > 2-4 km is 1.87%, and > 4 km is 1.87%. In Nenas and Kuanoel, the respondents’ residence is that 0-2 km is 100%. In Fatumnasi, the respondents’ residence is that 0-2 km is 96%, >2-4 km is 2%, and >4 km is 2%. Overall, > 57.7% of respondents’ residences are around 0-2 km and 90% of respondents' residences are <1 km.

Having a close distance to the MTPF and being far from market access in urban areas that provide various commodities used as the source of household energy and house construction, firewood and wood carpentry are partners that cannot be separated from their lives over time. In the MTPF area, there is a lot of firewood produced by various types of plants in the form of dry wood spread out of the forest. The total need on firewood consumed by respondents is 1,912,512 kg/year. Firewood provided by gardens is only 12.55% or 239,952 kg/year and 87.45% (1,672,560 kg/year) is taken from dry wood that falls spread around the forest floor or cuts branches, twigs and even trees in the MTPF area. In line with firewood needs, the total wood carpentry consumption of the respondents used for house construction in 15-20 years is 1,162.8 m3 that 3.65% is supplied by privately owned land (gardens) and 96.35% is gained from the MTPF. Firewood consumption in 9 villages around FMU of the MTPF in TTS Regency average 1,273.13 kg/capita/year. Those vilages are that Noebesi has 971.8 kg/capita/year, Nunbena has 969.15 kg/capita/year, Leloboko has 1,171.73 kg/capita/year, Tunua has 1,032.42 kg/capita/year, Ajaobaki has 1,221 kg/capita/year, Nuapin has 1,434.88 kg/capita/year, Nenas has 1,220.09 kg/capita/year, Kuanoel has 1,631.79 kg/capita/year, and Fatumnasi has 1,805.31 kg/capita/year. Astana (2012) says that firewood consumption for rural households in Sukabumi District is 256 kg/month, Banjarnegara District is 206 kg/month, and Lebak district is 165 kg/month. Win *et al.*, (2018) state that consumption of firewood per capita in Myanmar is 780 kg per year.

In fact, the use of firewood for households in 9 sampling villages around the MTPF area is very high (100%). In contrast to the result of Dwiprabowo studi (2010), households that consume firewood in Banjarnegara is 90%, Sukabumi is 70%, and Lebak is 50%. Firewood obtained by the respondents from the FMU of the MTPF area and gardens is totally used for cooking. The same use of firewood as in Guinea Central Africa. Gelabert *et.al.,*(2011) state that most firewood collected from gardens is used for cooking. The way of collecting firewood is an integral part of social-economic life for pre-modern society. Reyes *et.al.*,(2018) illustrates that firewood is the main use of original wood (93% of the total wood taken from native forests) and 70% of the forests grown in privately owned land.

Considering the contribution of the MTPF to the firewood consumption for respondents is 87.45% and wood carpentry is 96.35%, it cannot be denied that the MTPF in FMU of TTS District on Timor Island has provided lots of advantages to rural and urban societies dealing with the supplies of firewood as the main raw material for household energy for cooking and house construction. In line with the theories, the people living around the forest area are dominated by the poor who are dependent on firewood for cooking and woodworking for house construction. The huge contribution of the MTPF for firewood and woodworking needs encourages management and community to keep the existence of the MTPF and avoid such impacts that can damage the protected forests, mainly anthropogenic damage. However, population growth around the MTPF in 9 (nine) villages affects the level of firewood consumption. Perhaps, in the future, the supply of firewood gained from the MTPF will decrease. Thereby, government is demanded to design policies concerning the management of protected forests with the social forestry principles based on local wisdom. Viewed from the principal philosophy of the local community (the Dawan tribe) about forests, humans and animals are greatly united that cannot be separated by *“mansian, mu’it, nasi kan bisa batief, faut makono, hau makono, fatu nane on au nuif fa kuk, o’el na au na’e kuk, nasi nane au nak fun fa kun, pao kuan*, *pao nasi*. This utterance means that forest, humans, and animals are inseparable because of bearded stones, bearded trees, that have the same features as humans. The Philosophy of stone symbolizes bones, water symbolizes blood, forest symbolizes hair. They always guard the village and the forest. By believing on this philosophy, people around the MTPF are strongly expected to protect the existence of protected forests since forests provide various advantages for either human prosperity or the preservation of forest ecosystems.

Having a slogan above, social forestry should be expected to be a solution to solve problems experienced by people living around the forest, especially poverty. In social forestry, it can guarantee forest sustainability for humans are managers and users in facilitating human needs on forests and animals. In implementing the social forestry strategy to overcome the scarcity of firewood and wood carpentry, not only the MTPF area, but also agricultural community land must be grown various plants that produce firewood and woodworking. Hence, a social forestry program is implemented by growing plants in order that the main essence of forest preservation and community prosperity can be achieved.

Pique *et.al.*, (2016) note that social needs play an important factor in planning strategies of supplying timber and firewood rather than adapting to the only environmental availability. Sahoo (2015) also argues that social forestry programs provide not only food, animal feed, shelter for people, but also valuable incomes to the government. The social forestry program can increase socio-economic conditions of the people and the country; and have an impact for the nation and the world. Thereby, the spirit of social forestry is a collaborative pattern that is very beneficial for community welfare, and besides, forest sustainability must be preserved. Waka and Awang (2017) state that collaborative management is the most appropriate strategy to accommodate the interest of the surrounding community in conservation management areas. In addition, Paudel (2018) argues that forests managed properly by people can be an effective way in overcoming food scarcity in rural households with lower levels of social capital. Again, Kurniadi *et al.*, (2017) prescribe that the development of protected forests is considered as a way to conserve biological diversity and ecosystem services. To maintain the sustainability of the MTPF with the spirit of social forestry programs, it is intended, certainly, to provoke government's commitment in order to pay attention on social welfare around the forest through the programs of social empowerment and Setiajiati *et.al*.,(2017) state that social empowerment program is effective in changing people's attitudes to converse protected forest.

**Conclusion**

The MTPF gives significant advantages to the use of firewood consumed by respondents in 9 (nine) villages with 87.45% (1,672,560 kg/year). Besides, the use of firewood gained from the privately owned land is only 12.55% (239,952 kg/year) and the total firewood consumption is 1,912,512 kg/year. The highest use of firewood per year from the MTPF is in Leloboko with 94.28% and the lowest is in Ajaobaki with 75.98%. Firewood consumption in 9 villages average 1,273.13 kg/capita/year that Noebesi is 971.8 kg/capita/year, Nunbena is 969.15 kg/capita/year, Leloboko is 1,171.73 kg/capita/year, Tunua is 1,032.42 kg/capita/year, Ajaobaki is 1,221 kg/capita/year, Nuapin is 1,434.88 kg/capita/year, Nenas is 1,220.09 kg/capita/year, Kuanoel is 1,631.79 kg /capita/year, and Fatumnasi is 1,805.31 kg /capita/year. Wood carpentry consumption gained from the MTPF used for house construction of houses in 15-20 years is 96.34% (1,120.3 m3), while gained from privately owned land is only 3.66% (42.5 m3) of the total of 1,162.8 m3/year. The highest consumption is Fatumnasi with 176 m3 and the lowest is in Nunbena with 78.5 m3. The highest consumption gained from gardens is in Tunua with 23 m3, and the lowest is in Nunbena and Ajaobaki with 0 m3 or overall is from forests.

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**References**

**Journal article**

Arnold, J.E.M., Gunnar Kohlin. & Reidar Persson. 2006. Woodfuels, Livelihoods, and Policy Interventions : Changing Perspectives. *World Development* Vol. 34, No. 3, pp. 596–611, 2006. Available at: http://dx.doi:10.1016/j.worlddev.2005.08.008

Asfaw, A, Muluguta Lemenih, Habtemariam Kassa, Zeleke Ewnetu. 2013. Forest Policy and Economics Importance, determinants and gender dimensions of forest income in eastern highlands of Ethiopia : The case of communities around Jelo Afromontane forest. *Forest Policy and Economics*, 28, pp.1–7. Available at: <http://dx.doi.org/10.1016/j.forpol.2013.01.005>.

Astana, S., 2012. Konsumsi Kayu Bakar Rumah Tangga Pedesaan dan Faktor-faktor yang Mempengaruhi di Kabupaten Banjarnegara Jawa Tengah, Sukabumi Jawa Barat dan Lebak Banten (Fuelwood Consumption of Rural Households and Its Determinant Factors in Banjarnegara Central Java, S. *Jurnal Ilmu Kehutanan Penelitian Sosial dan Ekonomi Kehutanan*, Vol. 9 No., pp.229–241.

Brouwer, R. & Falc, P., 2004. Wood fuel consumption in Maputo, Mozambique. *Biomass and Bioenergy* 27 (2004) 233–245. Available at: http://dx doi:10.1016/j.biombioe.2004.01.005

Cooke, P., Köhlin, G. & Hyde, W.F., 2008. Fuelwood , forests and community management – evidence from household studies. *Environment and Development Development Economics*, Volume 13,(1), p.pp 103-135. Available at: http://dx.doi: 10.1017/S1355770X0700397X

Dresen, E, Ben DeVries, Martin Herold, Louis Verchot, Robert Müller. 2014. Fuelwood Savings and Carbon Emission Reductions by the Use of Improved Cooking Stoves in an Afromontane Forest, Ethiopia. *Land* 2014, 3, 1137-1157; doi:10.3390/land3031137

Dwiprabowo, H., 2010. Kajian Kebijakan Kayu Bakar Sebagai Sumber Energi di pedesaan Pulau Jawa ( Study of Policy on Firewood as Source of Energy in Rural Areas In Java ). *Jurnal Analisis Kebijakan Kehutanan*, Vol. 7 No., pp.1–11.

Gelabert, L.., Asouti, E. & Marti, E.A., 2011. The ethnoarchaeology of firewood management in the Fang villages of Equatorial Guinea , central Africa : Implications for the interpretation of wood fuel remains from archaeological sites. *Journal of Anthropological Archaeology*, 30, pp.375–384. Available at:<https://doi.org/10.1016/j.jaa.2011.05.002>

Karki, A. & Berrens, R.P., 2017. Where gathering firewood matters : Proximity and forest management effects in hedonic pricing models for rural Nepal. *Journal of Forest Economics*, 27, pp.28–37. Available at: http://dx.doi.org/10.1016/j.jfe.2017.02.005.

Kebede, E., Kagochi, J. Jolly, C.M., 2010. Energy consumption and economic development in Sub-Sahara Africa. *Energy Economics*, 32(3), pp.532–537. Available at: http://dx.doi.org/10.1016/j.eneco.2010.02.003.

Kurniadi, R, Herry Purnomo, Nurheni Wijayanto,Asnath Maria Fuah. 2017. The Refusal of Livestock Owners Towards Exclusion Policy In Protected Area. *Jurnal Manajemen Hutan Tropika*, 23(April), pp.16–24. doi: 10.7226/jtfm.23.1.16

Loaiza, T., Nehren, U. & Gerold, G., 2015. REDD+ and incentives : An analysis of income generation in forest-dependent communities of the Yasuní Biosphere Reserve , Ecuador. *Applied Geography*, 62, pp.225–236. Available at: http://dx.doi.org/10.1016/j.apgeog.2015.04.020.

Njurumana, G.N., 2016. Masyarakat Desa dan Manajemen Biodiversitas Flora pada Sistem Pekarangan di Kabupaten Sumba Tengah (Village Community and Flora Biodiversity Management in Home Garden System at Central of Sumba Regency ). *Jurnal Penelitian Kehutanan Wallacea*, (1), pp.25–36.

Oñate-calvín, R. De, Oviedo, J.L. Salo, M., 2018. Forest Resource-based Household Economy in the Communities of the Nanay River Basin , Peruvian Amazonia. *Ecological Economics*, 146(August 2016), pp.218–227. Available at: https://doi.org/10.1016/j.ecolecon.2017.10.012.

Paudel, J., 2018. Community-Managed Forests , Household Fuelwood Use and Food. *Ecological Economics*, 147(August 2017), pp.62–73. Available at: https://doi.org/10.1016/j.ecolecon.2018.01.003.

R. Pique , J. Revelles , F. Burjachs , L. Caruso Ferme, R.P.-O., 2016. Interdisciplinary approach to the landscape and fi rewood exploitation during the Holocene at La Garrotxa (Girona ,NE Iberia). *Quaternary International*, pp.1–13. Available at: https://doi.org/10.1016/j.quaint.2016.11.025

Reyes, R., Nelson, H. & Zerrif, H., 2018. Firewood : Cause or consequence ? Underlying drivers of fi rewood production in the South of Chile. *Energy for Sustainable Development* , 42, pp.97–108. Available at: <https://doi.org/10.1016/j.esd.2017.10.006>

Sahoo, B., 2015. Social Forestry - A Case Study Of The District Of North 24-Parganas In West Bengal. *International Journal of Research Granthaalayah*, 3.

Setiajiati, Fitta, Hardjanto, H., 2017. Strategies of Community Empowerment to Manage Protection Forest Sustainably. *Jurnal Manajemen Hutan Tropika*, 23(August), pp.71–80.

Sulaiman, C, A.S. Abdul-Rahim, H.O. Mohd-Shahwahid, Lee Chin. 2017. Wood fuel consumption , institutional quality , and forest degradation in sub-Saharan Africa : Evidence from a dynamic panel framework. *Ecological Indicators*, 74, pp.414–419. Available at: http://dx.doi.org/10.1016/j.ecolind.2016.11.045.

Timko, J.A. & Kozak, R.A., 2016. Energy for Sustainable Development The in fl uence of an improved fi rewood cookstove , Chitetzo mbaula , on tree species preference in Malawi. *Energy for Sustainable Development*, 33, pp.53–60. Available at: http://dx.doi.org/10.1016/j.esd.2016.04.002.

Waka, A.. dan S.A.Awang., 2017. Skenario Pengembangan Pengelolaan Kolaborasi Taman Nasional Bantimurung Bulusaraung, Provinsi Sulawesi Selatan (Development Scenario of Collaborative Management at Bantimurung Bulusaraung National Park, South Sulawesi Province). *Jurnal Penelitian Kehutanan Wallacea*, 6, pp.31–40.

Win, Z.C. Nobuya Mizouec,∗, Tetsuji Ota, Tsuyoshi Kajisa, Shigejiro Yoshida, Thaung Naing Oo, Hwan-ok Ma,.2018. Biomass and Bioenergy Di ff erences in consumption rates and patterns between fi rewood and charcoal : A case study in a rural area of Yedashe Township , Myanmar. *Biomass and Bioenergy*, 109(May 2017), pp.39–46. Available at: <https://doi.org/10.1016/j.biombioe.2017.12.011>.

**Books**

Berger, PL.Brigitte Berger., H.K., 1988. Pluralitas Dunia Kehidupan Sosial. In Hans-Dieter Evers, ed. *Teori Masyarakat: Proses Peradaban Dalam Sistem Dunia Modern*. Jakarta: Yayasan Obor Indonesia. Jakarta.

Hopkins, T.K, Wallerstein, I., 1988. Pola-pola Pembangunan Sistem Dunia Modern, Usulan Penelitian. In H.-D. Evers, ed. *Teori Masyarakat: Proses Peradaban Dalam Sistem Dunia Modern*. Jakarta: Yayasan Obor Indonesia. Jakarta.

Sevilla CG, Tuwu A, Syah A.1993. Pengantar Metode Penelitian. Jakarta. Universitas Indonesia Press

Simon, H., 2001. *Pengelolaan Hutan Bersama Rakyat (Cooperative Forest Management).Teori dan Aplikasi Hutan Jati di Jawa*, Yogyakarta: Bigraf Publising Yogyakarta.

Simon, H., 2003. *Hutan Jati dan Kemakmuran. Problematika dan Strategi Pemecahannya*, Yogyakarta: Bigraf Publising Yogyakarta.

Simon, H., 2004, Aspek Sosio-Teknis Pengelolaan Hutan Jati di Jawa. Yogyakarta: Penerbit Pustaka Pelajar

Kementerian Kehutanan, 1999. *Undang-Undang Nomor 41 Tahun 1999 Tentang Kehutanan*, Jakarta: Kementerian Kehutanan Republik Indonesia.

**Proceeding**

FAO, 2010. *What woodfuels can do to mitigate climate change.* In *FAO Forestry Paper 162*.Food And Agriculture Organization Of The United Nations Rome, 2010,

Nuryanti, Scorpio.S.Herdinie., 2007. Analisis Karakteristik Konsumsi Energi Pada Sektor Rumah Tangga di Indonesia. *Seminar Nasioanl III SDM Teknologi Nuklir Yogyakarta, 21-22 November 2007 ISSN 1978-0176*, (November), pp.21–22.

Rehfuess E., 2006. *Fuel for life: household energy and health. Geneva, Switzerland:World Health Organization*, World Health Organization.

**Figure**

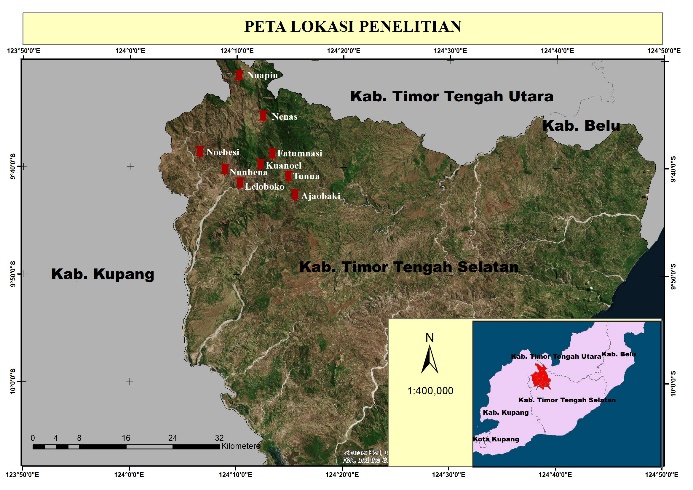


Figure 1. Place of the Study

Figure 2. Firewood Consumption of the Respondents (kg/year)

Figure 3. Wood Carpentry Consumption of the Respondents (m3/15-20 years)

**Table**

Table 1. Samples of Respondents in Each Village

|  |  |  |  |
| --- | --- | --- | --- |
| Villages | Population Number | Number of HH | Sampels (HH) |
| Noebesi | 1,378 | 300 | 35 |
| Nunbena | 894 | 229 | 26 |
| Leloboko | 781 | 193 | 23 |
| Tunua | 1,798 | 421 | 50 |
| Ajaobaki | 1,893 | 407 | 48 |
| Nuapin | 2,249 | 545 | 53 |
| Nenas | 1,230 | 267 | 31 |
| Kuanoel | 1,231 | 316 | 37 |
| Fatumnasi | 1,589 | 425 | 50 |
| Total | 13,043 | 3,103 | 353 |

Table 2. Respondent’s Firewood Consumption

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Villages | Firewood consumption (kg/week) | | | Firewood consumption (kg/year) | | | |
| Forest | Garden | Total | Forest | Garden | Total |
| Nunbena | 1,816 | 239 | 2,055 | 87,168 | 11,472 | 98,640 |
| Noebesi | 2,952 | 294 | 3,246 | 141,696 | 14,112 | 155,808 |
| Leloboko | 2,142 | 130 | 2,272 | 102,816 | 6,240 | 109,056 |
| Tunua | 3,980 | 613 | 4,593 | 191,040 | 29,424 | 220,464 |
| Ajaobaki | 4,239 | 1340 | 5,579 | 203,472 | 64,320 | 267,792 |
| Nuapin | 6,198 | 340 | 6,538 | 297,504 | 16,320 | 313,824 |
| Nenas | 3,158 | 472 | 3,630 | 151,584 | 22,656 | 174,240 |
| Kuanoel | 4,290 | 610 | 4,900 | 205,920 | 29,280 | 235,200 |
| Fatumnasi | 6,070 | 961 | 7,031 | 291,360 | 46,128 | 337,488 |
| Total | 34,845 | 4,705 | 39,944 | 1,672,560 | 239,952 | 1,912,512 |

Source: Primary Data, 2018

Table 3. The Respondents of Wood Carpentry Consumption ((m3/15-20 years)

|  |  |  |  |
| --- | --- | --- | --- |
| Villages | Wood Carpentry Consumption (m3) | | Total |
| Forest | Garden |
| Nunbena | 78.5 | 0 | 78.5 |
| Noebesi | 94 | 7 | 101 |
| Leloboko | 67.5 | 1 | 68.5 |
| Tunua | 155.5 | 23 | 178.5 |
| Ajaobaki | 156 | 0 | 156 |
| Nuapin | 172.5 | 0.5 | 173 |
| Nenas | 98.5 | 4 | 102.5 |
| Kuanoel | 121.5 | 2.5 | 124 |
| Fatumnasi | 176.3 | 4.5 | 180.8 |
| Total | 1120.3 | 42.5 | 1162.8 |

Source: Primary Data, 2018

Table 4. Total Area of Respondents’ Houses

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Villages | Total Area of Respondents’ Houses (m2) | | | | | | | | | | | | | |
| 20 | 24 | 28 | 30 | 35 | 42 | 48 | 56 | 63 | 70 | 72 | 80 | 96 | 120 |
| Nunbena | - | - | - | 11.54% | 7.69%, | 30.77% | 23.08% | 3.85%, | 3.85% | 3.85% | 11.54% | 3.85% | - | - |
| Noebesi | - | - | - | 14.29% | 8.57% | 25.71% | 31.43% | 5.71% | 8.57% | - | 2.86% | - | - | 2.86% |
| Leloboko | - | - | - | 13% | 17.4% | 34.8% | 21.7% | 4.3% | - | - | 8.7% | - | - | - |
| Tunua | - | 14% | 6% |  | 16% | 20% | 24% | 10% | 6% | - | 2% | 2% | - | - |
| Ajaobaki | - | 6.3% | - | 4.2% | 37.5% | 6.3% | 33.3% | 2.1% | 8.3% | - | - | - | - | - |
| Nuapin | 5.66% | 15.09% | 1.89% | 13.20% | 15.09% | 16.98% | 18.87% | 3.77% | 5.66% | - | 3.77% | - | - | - |
| Nenas | 3.22% | 16.13% | - | 3.22% | 22.58% | 16.13% | 19.35% | 9.68% | 9.68% | - | - | - | - | - |
| Kuanoel | - | 5.4%, | - | 21.6% | 8.1% | 37.8% | 18.9% | - | 8.1% | - | - | - | - | - |
| Fatumnasi | - | 4% | - | 14% | 28% | 8% | 30% | 4% | 2% | - | 2% | - | 4% | 4% |

Source: Primary Data, 2018