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in North Sumatra**

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Self-sufficient energy community drive the protection of water-source forest in North Sumatra

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ABSTRACT

Incentives for forest protection have been discussed and considered vital to encourage participation in community based forest management, the scheme anticipated for sustainable development in rural areas. Micro hydro power plant built in Aek Matio Jae village was designed as incentive for the community. Not only did the villagers pledged their commitment to protect the forest but also contributed in the construction. This study assessed the attitude towards forest preservation as a successful community buy-in. The whole community members (100%) agreed to the importance of the sustainability of 1200 ha forest, as they understand that the forest maintain the water supply for their micro hydro. The majority (79%) are willing to serve in forest protection activities and community based forest management (CBFM) is the most preferable scheme to sustain the forest (43%). While the effectiveness of micro hydro power plant towards forest preservation needs further study, Aek Matio Jae villagers are energy self-sufficient community driven to protecting the forest. Finally, the paper tried to formulate recommendation on further CBFM development, which has to link with fulfilling basic needs of targeted community.

Key Words: CBFM, micro hydro, energy self-sufficient

1. INTRODUCTION

1.1. CBFM Definition, CBFM and Forest management / Governance

The main objective of sustainable forest management is to meet the needs and aspiration of the current generation without damaging future generation. Community based Forest Management (CBFM) is believed the most suitable model to merit the needs of sustainable forest management and fulfilling community's socio-economic needs. Bray et al (2003) concluded their study in Mexico that CBFM is an ideal tool to gain in both social and economic justice, good forest governance, and biodiversity protection.

Scheba and Mustalahti (2015, in press) redefine Community based forest management as a wide adoption scheme of the involvement of local communities in forest governance and management that will bring about socio-economic development and sustainability. Community Based Forest and Natural Resources Management arose based on the fact that people are likely to have more interest and responsibility in preserving forests or other natural resources. CBFM are recognized able to manage forests and natural resources efficiently, equitably, and sustainably (Adhikari et al, 2007). The current forest regimes has shifted toward people-oriented management and the provision of sustainable flow of multiple benefits, and this perspective has encourage local communities to voluntary get involved in the management of forests and other natural resources to protect, manage, and develop in sustainable way (Lestari et al, 2015).

In Indonesia, the current CBFM scheme was the fruit of a long period of trials in social forestry models that was initiated by Perum Perhutani since 1972 (Aji et al, 2014). The CBFM program is intended to provide directions, knowledge-sharing, and guides forest resource management to improve communities' welfare, quality of life, and economic and social capacities by coordinating and integrating the roles and responsibilities between communities and forest manager (e.g. Perum Perhutani, State) (Lestari et al, 2015).

1.2. CBFM and Participatory Sustainable Development

Campbell and Vainio-Mattila (2003) acknowledged that Community-based forest management shares similar concept to participatory development. Both concepts include vital aspects such as participatory, interaction between people and environment (forest, biodiversity, socio-economic, knowledge), benefits, access, and ownership. The concept are similarly share four key attributes for the effectiveness in implementing both sustainable development and sustainable forest management managed under Community based forest Management scheme. Buchy and Hoverman (2000) described the key attributes are: 1) Commitment and clarity, 2) time and group dynamics, 3) representativeness, and 4) transfer of skills.

Incentives for forest protection have been discussed widely and considered vital to encourage participation in community based forest management, the scheme anticipated for sustainable development in rural areas. Rahmina et al. (2011) mentioned five benefits of CBFM that may be considered as incentives in term of fulfilling community's socio economic; i.e 1) enhancing communities access in harvesting and gaining benefits from forests, 2) increasing derivate income from Non Timber Forest Products (NTFP); 3) Value added on certified forest or NTFP products; 4) institutional and individual capacity building; 5) enhancing community's capacity on forest management.

Other benefits of CBFM for the community are environmental services, such as water supply, sustainable biodiversity harvesting, carbon scheme, and landscape beauty (Arifin, 2006). Small scale hydro power plant installation, i.e. pico hydro and micro hydro, considered as incentives in providing electricity to the villagers and to maintain river flows in Bungo district of Jambi to compensate villagers on conservation agreement schemes for Community Based Forest Management initiative (Villamor and van Noorwidjk (2011). In Aek Matio Jae, the micro hydro power plant was built as an incentive for the community's commitment in protecting the Auk Rau Forest for decades and also in the future.

2. METHOD

2.1. Study Site

Our study site is the 1,200 ha Aek Rau Forest, a Production Forest that is proposed as Community Forest (Hutan Kemasyarakatan) in Adian Koting district of Tapanuli Utara, North Sumatra Province. Aek Rau forest is part of Adian Koting Forest block that identified as one of important orangutan corridors in Batang Toru forest Block of North Sumatra (USAID-OCSP, 2009). The forest lies within the Batang Toru Forest range, home to 67 species of mammals, 287 birds, 110 reptile and amphibi, and 688 floral species. The forest also considered an essential habitat for Sumatran Tiger (*Pantera tigris sumatraensis*), Malayan Tapir (*Tapirus indicus*), *Rafflesia gadutnensi*, *Amorphophalus baccari* and *Amorphophalus gigas* (Perbatakusuma et al, 2006). Batang Toru is a strategic area to the region as its function as water catchment area to run a 50 Mega Watt Power and a 330 Mega Watt Sarulla Geothermal Power plant. These power plants provide electric sources to 1.3 million people who live in 3 residential. Aek Rau forest was identified as one of essential corridors

connecting Adian Koting Forest with West Batang Toru Forest Block in North Tapanuli (Erwinsyah and Siregar, 2009).

Aek Matio Jae is a small village in the fringe of Batang Toru forest block in North Sumatra. Raised 800 m above sea level and surrounded by 4.600 ha of forest the settlement is too small a population, thus can be properly referred as a hamlet. The hamlet is home to 28 households who have struggled with the lack of accessibility to electricity for three generations now. The scarcity of this resource is felt most strongly after sunset. When night falls, electricity is supplied for only three hours via private and group-owned generators, which residents have to provide fuel for, an arrangement that is taxing on the low-income community. In some households, government-funded solar panels provide just enough to light a single electric light bulb. Ironically, electricity supply is not far off. Just three kilometers away from the village, a micro hydro system had long been installed and used by a state-owned electricity company (PT PLN) to provide electricity to Sibolga, a port city located about 60 kilometers away from Aek Matio Jae. The micro hydro system draws its power from the currents of the Aek Raisan River in the vicinity.

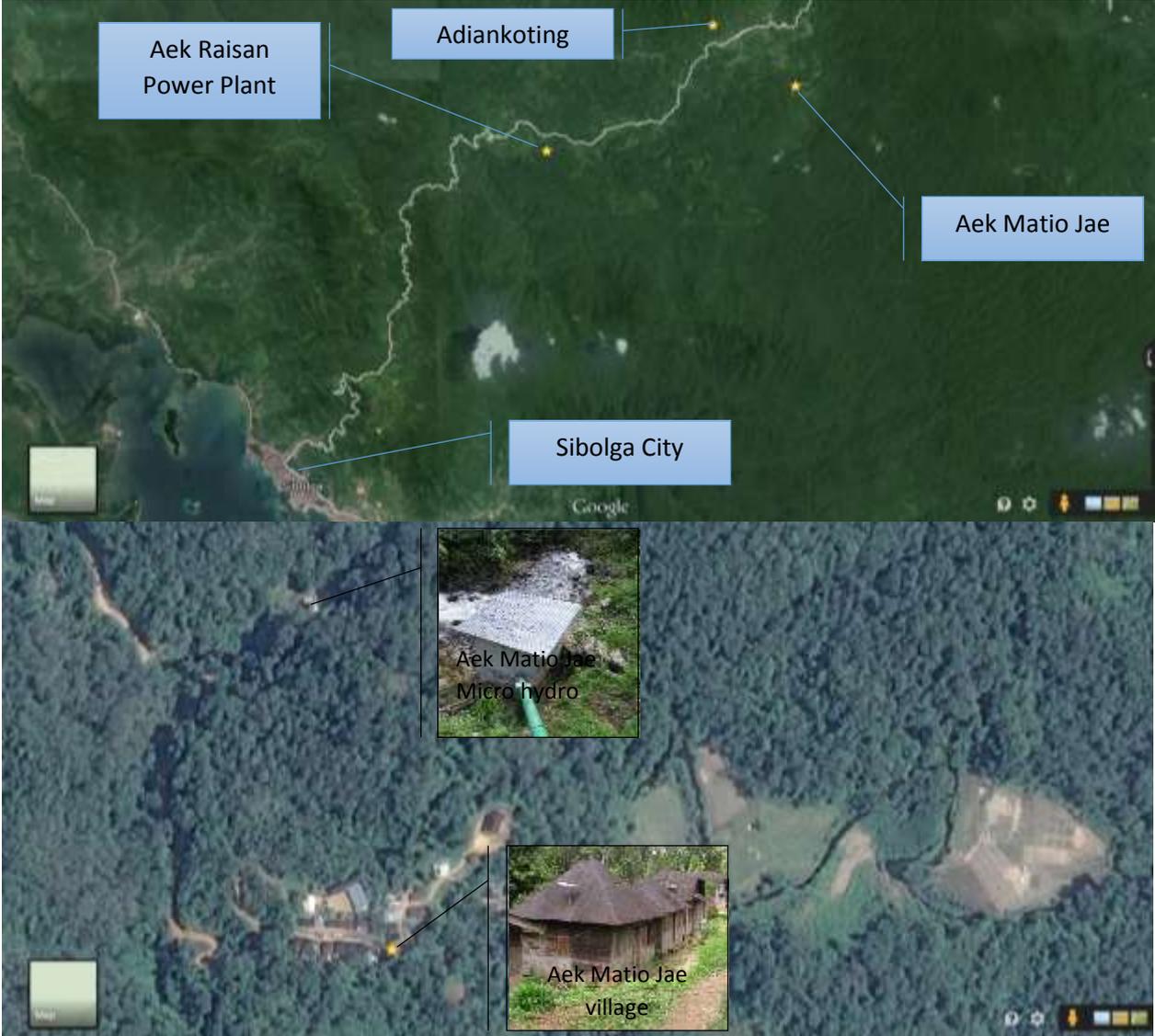


Figure 1. Map of Aek Matio Jae. Above: Aek Matio Jae location; below: Aek Matio Jae condition. (Source; Google Map).

The year 2013 will be seen as historic moment for the Aek Matio Jae villagers. In that year, TFCA-Sumatera Program through cooperation with PETRA (a local NGOs in North Sumatra) designed strategies for forest conservation program in the area. Addressing the issue of community buy-in towards conservation, an immediate impact incentive has to be incorporated within the strategies. With the condition of Aek Matio Jae, pico hydro power plant installation was deemed the most suitable incentive for the community.

The tightknit community enthusiastically pulled together resources (gotong royong) and completed construction of the micro hydro power plant within 3 months. Men and women, youth and elderly, poured their passion to construct the power plant. Nearly every day, the residents were discussing and arguing, designing and constructing, gathering the rocks and setting the apparatus. It would be a history for the Aek Matio Jae residents, for at the same time they were the architect and the construction workers of their own power plant. PETRA was consistently provided their assistance throughout the process. Aek Matio Jae residents should be proud of themselves; their strong determination had enabled an IDR 500 million (US\$ 38,461) worth micro hydro power plant constructed, with only IDR 225 million (US\$ 17,30) real budget supported by TFCA-Sumatera. Whereas the micro hydro generated 10.6 KWh during the trial, 6 KWh is sufficient to light up 28 households, a school, a church, and a public facility in the hamlet, with each of the house is powered with 220 Watt of electricity. On February 12th, 2014, the representative of the Head of District of North Tapanuli officially launched the micro hydro power plant of Aek Matio Jae.

As the micro hydro power plant depends heavily on water coming from the upper stream forest, Aek Matio Jae villagers are more than willing to protect the upper stream forest in order to sustain the electricity. To compensate the micro hydro construction and to ensure stable water flow rate, the upper stream forest has to be secured, thus villagers agreed to propose Community Forest as the scheme to manage the upper stream forest. Until this paper is published, the permit for Community Forest management is still in the process in the Ministry of Environment and Forestry.

2.2. Research Method

The survey was conducted between February and March 2015 by a team of KEHATI and PETRA. Early survey in February identified the potential respondents and finally determined the technical method (interview). There are 14 out of 28 households of Aek Matio Jae interviewed for the survey. The interview was led by questionnaire incorporating open-ended question model. The respondents are randomly selected from the numbered list of the head of the families, which is generated with the help of Random Generator (www.random.org). In addition to the interview, several community figures are also engaged in in-depth discussions in order to enrich the information. To gain respondent perception, by means of semi-structured interview, we explore community's perception over forest value, pico hydro value, and their commitment toward future sustainable forest management.

The survey was carried out in the Aek Matio Jae hamlet. The hamlet lies within the range of Batang Toru Forest Landscape. The hamlet was located approximately 60 km from Sibolga, the capital of Tapanuli Utara. Three kilometers from Aek Matio Jae, Aek Raisan II micro hydro power plant is installed on and generated its power from the current of Aek Raisan River supplying (provided by PT PLN – state power company) power for Sibolga. This study assessed the attitude towards forest preservation as a successful community buy-in.

3. RESULTS AND DISCUSSION

3.1. Social Statuses and Agricultural Pattern in Aek Matio Jae

This survey involved 14 out of 28 families of Aek Matio Jae villagers. The respondents comprise 13 male and 1 female. The majority of the respondents (50%) have their secondary education certificates (Junior high school/SMP and senior high school SMA), while 28.57% only elementary school graduates, and the rest 21.4 % never finished their elementary school (Figure 1a). Approximate monthly income of every household in Aek Matio Jae is IDR 953,000 (equal to USD 74) with the lowest is on IDR 300,000 (equal to USD 23) and the highest is on IDR 3 million (equal to USD 230). There are only 7.7 % of total respondents with monthly income more than IDR 3 million, while the majority (53.9%) earns less than IDR 1 million (equal to USD 76.9) per month, and the income for the rest 38.5% are ranging IDR 1-3 million (Figure 2a).

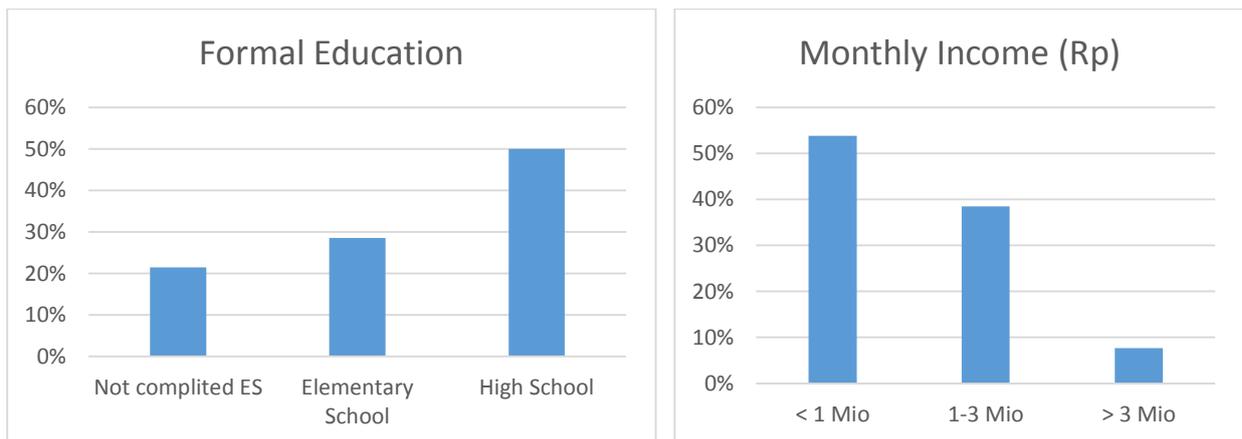


Figure 2. Graphics showing respondents' characteristics on formal education and Monthly income.

Major source of income of Aek Matio Jae villagers is small plantation (agroforestry) with commodities ranging from benzoin resin, rubber, and rice. Styra tree and rubber are agroforestry cultivation planted in the same plot of land bordering their village and the forest, while rice fields are on the more accessible location, i.e. nearby village roads. The majority of the respondents (42.9 %) disclosed to have less than 1 ha cultivated land, while respondents with 1-3 ha and more than 3 ha cultivated lands are 28.7% each (Figure 3).

In the rural areas of North Sumatra, agroforestry is the most common method of cultivating the land and frequently is the main source of income, with rubber, cacao, coffee and benzoin resin as the main commodities. Styra tree (*Styra benzoin*) is known as native plant of this area. Tata (2013) reckoned that North Tapanuli produced 3.634 ton of benzoin resin from styra tree annually, contributed to 31% of Adian Koting income, besides rubber from agroforestry cultivation (25%), coffee (22%), cacao (11%), and rice (17%).

In 2013, Tata described a similar pattern in several villages in Adian Koting district (Aek Matio Jae was not included in the study). The majority of the family own 1-4 ha of arable land per household and planted with styra tree, cocoa, and rubber. However, coffee is not grown in Aek Matio Jae. Official data published by Statistic Office of Tapanuli Utara district in 2014, listed rubber and benzoin resin as the major commodity for the region, with a total of 2.790 ha and 2,088 ha are cultivated for rubber and styra tree respectively, out of 5,640 ha plantation in total (BPS Tapanuli Urata, 2014).

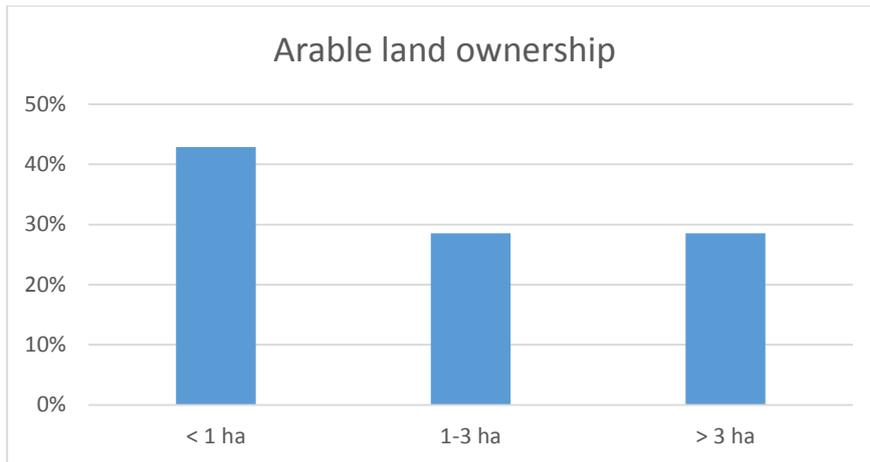


Figure 3. Graph on land ownership based on agricultural system.

3.2. Forest Value and Micro Hydro Contribution Toward Energy Self-sufficiency, Sustainable Forest Management and Rural Development

The whole respondents expressed high awareness (100%) on the essential value of Aek Rau forest as source of water supply to light up the village and for daily necessities. Similar to the forest value, most of the people expressed high appreciation of micro hydro (85.71 %) for their life in the village and very optimistic that they will have sustainable energy resource for the hamlet. With the availability of their own electricity supply from micro hydro, there is no reason for Aek Matio Jae to plea for an electricity grid from the state (PLN) neither to be depended on the generator that run by wasteful and costly gasoline.

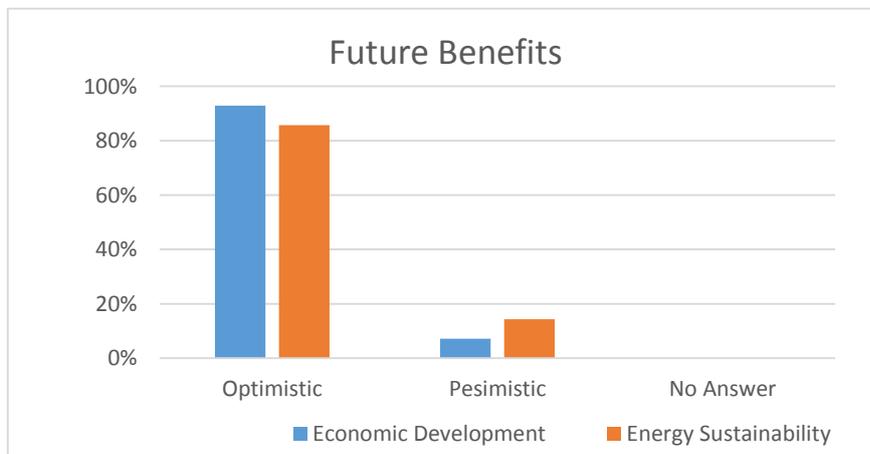


Figure 4. Perception on sustainable development and energy resources.

Facing the future, almost the entire respondents (92.86%) optimistic that the Community Forestry scheme that will be applied over the Aek Rau Forest and the micro hydro facility for the village will bring them into better economic and social development. Furthermore, the whole community members (100%) agreed to the importance of the sustainability of 1,200 ha forest, as they understand that the forest maintain the water supply for their micro hydro. The majority of the respondents (79%) are willing to serve in forest protection activities, while community based forest management (CBFM) is the most preferable scheme to sustain the forest (43%). They believed that the whole community has an obligation to protect, maintain and conserve the forest, thanks to the micro hydro. While the effectiveness of micro hydro power plant towards forest preservation needs

further study, Aek Matio Jae villagers are energy self-sufficient community driven to protecting the forest.

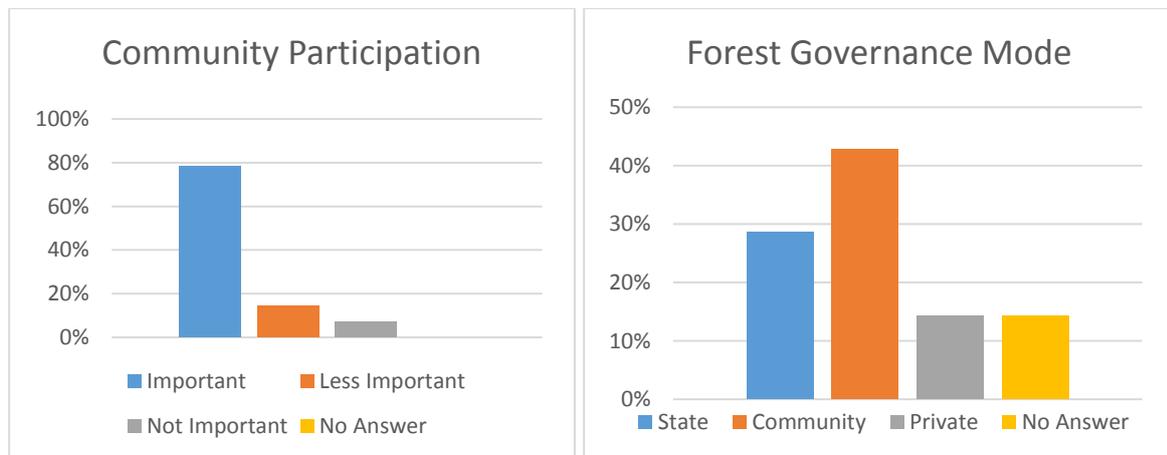


Figure 5. The Important of Community participation (Left) and preferred Model of Forest Governance

The high commitment of the Aek Matio Jae community in preserving and implementing good forest governance for Aek Rau forest within Community Forestry scheme will potentially preserve the forest in the long term, at least for 30 years ahead (the permit validity period). However, to measure the effectiveness of the scheme in the future, a base line and monitoring system have to be established, and further study is necessary.

Sovacool et al (2011) demonstrated that hydro power plant systems are incredibly important in providing electricity for small, rural, isolated, mountainous terrain, and off-grid areas in Nepal, a similar geographical condition also apply to Aek Matio Jae. The plant systems are also able to reduce deforestation by displacing fuel woods, and reduce pollution and climate change from its lack of combustion characteristic. Crawford (1982) calculated the impact of installed 12 kilo watt micro hydro, that provide electricity over 100 houses in a rural country in Everest, could reduce the use of firewood and save 10.950 trees annually or 547.5 cubic meters of firewood annually. Before the establishment of Micro hydro, electricity in Aek Matio Jae was mostly relied on 4 generators to light up the villages. In a night, each generator consumed about 4.5-liter gasoline, and in total 18 liter was burned to light up the village for about 2-4 hours nightly. In rough comparison, the operational of micro hydro may reduce approximately 7,200-liter gasoline consumption in Aek Matio Jae per annum. With the operational of the micro hydro, the people in Aek Matio Jae are no longer depend on the generator that wasting expensive gasoline. However, further assessment on how micro hydro power plant contributes to reduce deforestation and carbon emission in Aek Matio Jae is an essential question to be further studied.

In Addition, the community is no longer had to pay high cost on generator. To provide the maintenance cost for the plant, the community agreed that each household contributes as much as IDR 15,000 (equal to USD 1.2) in the form of monthly fee, cheaper than the cost they had to pay for generator, which was costly IDR 60,000 (equal to USD 5) per month. Simple calculation on the amount they have to pay for electricity, having micro hydro operated, each household in Aek Matio Jae could save approximately IDR 45,000 (equal to USD 4.2), approximately 75% less than previous expenses. However, the community has no habits for saving. This was possibly caused by the very low income they earn (less than IDR 1 million or equal to USD 76.9), which mostly spent for basic needs.

3.3. Community's Expectation beyond Micro hydro

Improving the institutional management and asset maintenance of micro hydro facility are the priority for the majority (54.55%) of respondents, followed by speeding up the implementation of Community Forestry (27.27%), while the rest (18.18%) did not answer the question. However, the whole respondents unanimously agreed that PETRA is expected to assist the village for at least 3 to 5 years ahead, ensuring the community to be self-sustain. The expectation indicates that assistance is very essential, particularly in terms of strengthening forest community institution, which supported the sustainability of designed incentives and economic development for rural and isolated communities like Aek Matio Jae.

However, discussion on forest and development is addressed with some concern in the Community Forestry Implementing Guidelines, published by the Department of Forestry of Gambia (2005). The linkages between rural development interventions in the non-forestry sector and the protection and management of the forest resources should never be applied in the sense that villagers' interest in Community Forestry participation is bought by providing assistance in the non-forestry sector. This is where the crucial part of PETRA's homework will continue. While assisting the community to obtain permit for Community Forestry, PETRA's major challenge is that the participation on Community Forestry is built upon community's buy-in instead of bought-by over forest value. The permit is aspired to uphold the community's right in term of access over forestland of the water basin area along the river and around the headwater.

4. CONCLUSIONS

As an incentive to the community, micro hydro can be considered plays important role in encouraging and sustaining local commitment in protecting the forest through Community Based Forest Management scheme. In Aek Matio Jae, micro hydro demonstrates to the villagers an unobstructed link between the energy they depended upon and a well-preserved forest. Similar scenario may be applied in other rural areas with more adaptable approach to address the inevitable different conditions. Eventually, the enhancement of local community participation in promoting sustainable forest governance, local economic development, and sustainable energy is the expected result of its implementation.

Even though the community is confidence over their energy self-sufficiency for future development of Aek Matio Jae, PETRA is still needed to continue their assistance. Community empowerment in specific aspects such as implementation of CBFM, maintenance of micro hydro and sustainable development for the village should be highlighted in their assistance. During the process, innovations in creating social and economic incentives have to be promoted. It is important to encourage more community participation as well as local government role in CBFM implementation, for the process to be smoother and to ensure the sustainability.

This study concludes a positive relation between forest utilization through micro hydro with commitment of the community to preserve their forest by incorporating CBFM, i.e. Community Forestry. Finally, the paper tried to formulate a recommendation on further CBFM development, which has to link with fulfilling basic needs of targeted community. Forest utilization with direct benefit for community should be preferably considered as an incentive which could strengthen their commitment and participation in forest conservation, i.e. CBFM scheme. Capacity of the community in managing their forest is one of the biggest challenge which should be addressed by intensive assistance. Promoting community buy-in has to be the vision of such assistance.

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