An Efforts to Maintain the Sustainability of Renewable Energy System in Rural Area through Green School Education Model

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Abstract. Indonesia has hundreds of renewable energy systems as a source of electrical energy that is spread in rural area. This is done as a government effort to provide electricity access for people who do not have access to electricity from the National Electric Company. The technology built in the village managed by the community. Community preparation in technical and non-technical is needed, thus the renewable energy system can provide electricity for a long time. The Green School is a place for the community to learn from each other and discuss about the renewable energy system in their village. The Green School is designed to have three curricula consisting of Basic Training, Intermediate Training and Advanced Training. The training should consist of participants from various background, education and also notice on gender perspective. Basic training’s main goal is making participants braver to express their opinions in front of the forum. The material is about their daily problem. Intermediate Training’s goal is increasing capacity building of community on managing renewable energy technology, e.g. how to handle the problem. Advanced Training’s goal is networking with outside parties to get more ideas and experiences thus community ready to collaborate in managing technology.

1. Background
The Indonesian government regulates national energy planning in Presidential Regulation Number 22 of 2017 concerning the General Plan of National Energy. In this regulation, several issues and problems of national energy are mentioned, one of which is limited energy access and infrastructure [1]. This is due to the geographical conditions of Indonesia which consists of thousands of islands. The National Electricity Company (NEC) also has difficulties in providing access to energy to communities in remote areas and outer islands in Indonesia.
In 2018, the national electrification ratio according to NEC data in Figure 1 is 98.3%. In 2019, NEC try to increase the electrification ratio up to 99%. One of the efforts through the Ministry of Energy and Mineral Resources (MEMR) is providing electricity access to rural area using off-grid system (not connected to the NEC electricity grid).

Based on data from www.remap-indonesia.org as shown in Figure 2, up to 2017 there have been 973 locations for Micro-hydro Power Plants and Solar Power Plants in Indonesia. The number of houses connected to this plant is 107,182 houses with a total installed capacity of 29,427 kW. The RE-Map contains information about micro hydro power plants (MHP) and Photovoltage for Village Program (PV-VP) which are supported by the Energizing Development Indonesia Project (EnDev ID). This project in collaboration with the Directorate General of New Renewable Energy and Energy Conservation (DGNREEC), under the Ministry of Energy and Mineral Resources of Indonesia to supports the off-grid rural electricity program using renewable energy [3].

The majority of MHP and PV-VP those are installed in rural area are managed by the community. The community should have management team who has the authority to decide on the cost of electricity, management fees, managing system daily, weekly, monthly, and they also expected to be able to repair the damage that occurs in the electricity generation system. Renewable energy program that implemented in rural area is expected to also be able to increase public knowledge about renewable

Figure 1. Electrification ratio in 2018 [2]

Figure 2. Micro-hydro power (MHP) and Photovoltage for Village Program (PV-VP) in Indonesia until 2017. Source: http://remap-indonesia.org/
energy. There will be knowledge transfer from the government / program implementors to management team in rural areas. Therefore, when the implementor is no longer in the village, the system could run well because it has good management team in community.

However, based on the results of several research, the fundamental problem of villages in Indonesia is lack of knowledge of community regarding science and technology. This problem had huge implications for the slowness of business innovation, small economic value added, and village dependence on intermediaries from outside the village, including universities and non-governmental organizations (NGOs) [4].

This condition gave the idea of developing a model of education (school) based on community independence and carried out collectively by the community. Schools that will become consultants for village development plans and various programs/projects that come to the village. In addition, this school is also expected to be able to maintain the sustainability of the system that has been exist the village.

2. Method

Figure 3 shows some of the problems that occur in renewable energy systems in rural areas. The main issue regarding sustainability is very important to be discussed due to a risk of system unoperated after the implementor finished the program/project. The sustainability of the system depends not only on technical / technological aspects, but rather more interventions of management, social and other supporting aspects. Many authors reflect that ensuring the sustainability of PV systems in rural areas stands for socio-cultural, rather than technological challenges [5, 6, 7, 8, 9, 10, 11]. In Figure 3 it can be seen that the root of the problem is the lack of knowledge of the community, both because of the low level of education, there is no socialization or training from the project implementor.

![Figure 3. Problems tree of sustainability of renewable energy in rural area](image)

Green school offer a solution to solve the problem. Green schools can be one alternative education model by promoting local potential and sustainable resources. The main mission of the Green School is to build a green development movement in the village. As an institution, Green School Organizations facilitate increased capacity of the community to encourage various productive economic business that are developed collectively and community-based.

The educational method used in the implementation of the Green School is taken from the best practices in adult education that are oriented towards real problem solving. The teaching approach uses the Participatory Action-Research (PAR) method, which is an approach where participation is the right of the people and provides an opportunity for the community to be more active in building their own independence. The teaching methods applied in the Green School include: class discussions, group discussions, classroom practices, coaching, field observation and field practice.
Based on Green School Roadmap, firstly the community will be introduced about green knowledge which includes how to maintain the environment, what is renewable energy meant, how it is used, what is the purpose, etc. In this step, community is expected can change the mindset related to energy which has been familiar in their lives. Afterwards, community will be introduced about the Green School Organization. Community will learn about why organization is important, who managed the organization and how it works. The last step of Green School roadmap is Green Network. After the institution is established, the organization can develop many networks to connect with other institutions. This network will support community to grow as a small business in a village and also as management of renewable energy system in rural area.

3. Implementation

Energi Mandiri Lestari (Kemala) Consortium consist of LAKPESDAM-PBNU, Center for People Economic Studies, Universitas Gadjah Mada, Center for Energy Studies, Universitas Gadjah Mada and Center for Civic Engagement Study (CCES) Yogyakarta received a grant from the Millennium Challenge Account Indonesia (MCAI) in 2016-2018 through Program Increasing Income of Poor Households Through Green Business Practices Supported by Renewable Energy. This program become one of the pilot projects for the implementation of Green Schools in three remote villages and has not received electricity access from PLN, namely, (1) Jorong Tandai Bukik Bulek, Nagari Lubuk Gadang Timur, Sangir District, South Solok Regency, West Sumatra Province; (2) Sungai Rambut Village, Berbak District, Tanjung Jabung Timur Regency, Jambi Province; (3) Rawasari Village, Berbak District, Tanjung Jabung Timur Regency, Jambi Province.

The main activity in this program was built Solar Home System (SHS) to electrify households as well as centralized PV system to support small businesses in the village. Green Schools are expected to be a place for people to learn from each other to manage the renewable energy. Firstly, KEMALA consortium had to choose people who can join as a first group of volunteers that then expected to invite more people to join the Green School.

There were program socialization and introduction followed by dialogue to discuss about voluntary activities and why it is important in village. Discussions about the village and the importance of community participation were also carried out to open people's insights about the ideal village. Through several discussions and interviews, assessments were conducted to determine the community who have the potential to become volunteers in Green School. Several names are discussed with stakeholders in the village to ensure that the individual has a good track record.

After determining the first 10 people as green volunteers, KEMALA Consortium invited 10 people from each village to take part in the Green Visioning activity in Yogyakarta. Green Visioning was conducted for 5 days by taking the location on UGM Campus and the socio-economic cultural village in Nglanggeran Village, Patuk District and the Solar Water Pumping System (SWPS) village in Banyumeneng Hamlet, Giriharjo Village, Panggang District. This activity is expected to be able to provide an overview of developing villages that they can also do in their villages by developing the potential of existing natural resources.

![Figure 4. Community participation in training](image)

After Green Visioning, the Green School stage began by presenting experts in various fields to share knowledge with villagers. The Basic Training participants were ten green volunteers who had
participated in the Green Visioning, and also fourteen other volunteers chosen to represent several groups of communities and professional groups in the community in each village or jorong.

Basic Training is set as a training of trainer’s activity with six prepared materials / modules. The six material touches aspects of basic economic, social and environmental knowledge as part of the introduction to the basic knowledge of green. Twenty-four (24) green cadres then disseminated training materials to at least 56 other residents through existing community forums, for example recitation forum, social gathering, youth forum, etc.

Afterwards, in the intermediate training, education is developed at the community level. Training was conducted to develop green institutional schemes through green entrepreneurship training. Participants of this activity, not only green volunteers but also groups in the village who representing community groups in the region.

Table 1 shows the Intermediate Training curriculum in three villages, Sungai Rambut Village and Rawasari Village have the same curriculum because the potential of existing natural resources has similarities each other, the needs of the community are almost the same. In Jorong Tandai Bukik Bulek, there are several social problems that activities cannot be carried out completely.

| No. | Sungai Rambut Village dan Rawasari Village | Jorong Tandai Bukik Bulek |
|-----|------------------------------------------|----------------------------|
| 1   | Organizing village advocacy regulations and budgets for solar power system | Management and business planning |
| 2   | Village regulations and budget advocacy | Corn cultivation and post-harvest |
| 3   | Paddy and cocoa cultivation | Food processing of jengkol |
| 4   | Making husk briquettes | Coffee cultivation |
| 5   | Gender equality | Coffee post-harvest |
| 6   | Hatching eggs and poultry cultivation | |
| 7   | Making banana chips and fish crackers | |

The continuation of intermediate training is advanced training that includes material (1) integrated agriculture and (2) product marketing and business networking. These two themes were chosen because they are directly related to the activities of the community in the village. It is expected that in advanced training, the related stakeholders can be a resource person to accompany the training with the aim that the process of mentoring activities in the community does not stop after the KEMALA activities are finished. The presence of advanced training which is the closing of a series of Green Schools is expected to be able to overcome the problems faced by the community in the village.

4. Conclusion
Within 1.5 years, Green Schools has been implemented in three villages / jorong. This program also faced various challenges during the process of knowledge sharing and learning. Afterwards, its strengthen the idea of a Green School model. Reflections are carried out through evaluation of processes and pairing with knowledge of the local context and then formulating solutions to respond the challenges for community empowerment. Some learning notes during the Green School run in Rawasari Village - Sungai Rambut Village in Tanjung Jabung Timur Regency and in Jorong Tandai Bukik Bulek, South Solok Regency are summarized as follows.

- Community empowerment, is a process of learning with the community, it is not a short process. Empowerment must be carried out simultaneously and continuously. Community empowerment must also consider internal issues in the community.
- Projects usually has short duration. It has very strict in managing time and resources. This often clashes with the daily activities of the community. It is become a challenge in carrying out activities. Time compromise, compaction of the agenda is sometimes an inevitable choice. This certainly makes the achievement of the activities not optimal.
- On the other hand, empowerment programs are not wise to "force citizens" to implement activities for the sake of program achievements. Compromise must be done so that all development targets in the village can be achieved. This is also really what "strengthens volunteer’s capacity" in negotiating skills while being involved in project management.

- Green Schools quite good in method, but it was not work well in implementation regarding the time limit of the program. There should be cut training activity and more of discussion with community. Changing mindset is about continuously activities, it can not be expected only from training.

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