

## Community Based Identification of Energy-Related Needs and Priorities of Poor Communities In Karangmojo Village, Yogyakarta



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**ABSTRACT:** The current fossil energy crisis is the right momentum to develop renewable energy potential. The purpose of this study is to identify renewable energy utilization programs in Karangmojo Village, in order to meet the energy needs of poor communities. The study uses in-depth interviews with the community to obtain various energy problems faced, especially for poor communities and farmers. We find various renewable energy development programs, including: Biogas Energy Package (BGEP) for cooking purposes, Biogas Energy Package (BGEP) for local entrepreneur, Biodiesel Energy Package (BDEP) for household and irrigation system, and Biomass Energy Package (BMEP) from rice husk. This study is also equipped with a review of stakeholder analysis

**KEYWORDS:** Renewable energy, poor community, energy crisis, Karangmojo.

### 1. INTRODUCTION

In Indonesia, people living in urban areas generally have access to efficient and modern energy supplies. However, in the rural community, are generally less fortunate and rely on traditional fuel of firewood, or energy and electricity production system are costly and inefficient. The project of Community Based Identification of Energy-related Needs and Priorities of Poor Communities is to establish the energy-related priorities of poor communities in the selected location at Province of Yogyakarta. Although previous research already provides a fairly clear picture of the energy-related needs of poor communities in Indonesia, it is still advisable to confirm these with regard to the local specifics in a participative way in the selected locations, since this is part of the process aimed at enhancing the involvement of the local communities in the project.

In this program, Karangmojo district which is located in Gunungkidul regency was chosen for project of bioenergy for Yogyakarta province. Gunungkidul district is one of 5 Regencies in Yogyakarta. The area of Gunungkidul is plateau and dominated by hilly areas. This condition has made Gunungkidul known as the hilly side of Yogyakarta (exactly reflecting the name "Gunungkidul"/southern mountains). The south border of the district is Indian Ocean or in local words "Laut Selatan". However, the community in Gunungkidul regency who lives under poverty level is a largest compared to other regencies. By this reason, the project on bioenergy will focuses in Karangmojo, Kabupaten Gunungkidul. This location was selected based on the several considered aspect, as follows:

- Low-income rural communities,
- Form of energy which is currently used for domestic activities, community services and small business is concentrated in firewood and kerosene,
- There is renewable energy potentials and sources are available locally,
- The social background and characteristics on selected communities are considered (in order to implement the energy policies successfully and sustainable).

### 2. METHODOLOGY FOR ENERGY NEED ASSESSMENT

The Participatory Rural Appraisal (PRA) method was selected as a research method for the energy need assessment in Karangmojo. The PRA is well known technique which can be an effective method for analyzing the needs of energy in rural community. When the energy policy such as increasing energy access program for poor community will be implemented, the market or needs evaluation should be conducted in order to observe in which service are actually required from the various energy technologies. This approach often means that the technology is not economically viable as it is underutilized or it is so unreliable that the communities stop using the proposed program and technology and return to their traditional energy sources. In order to

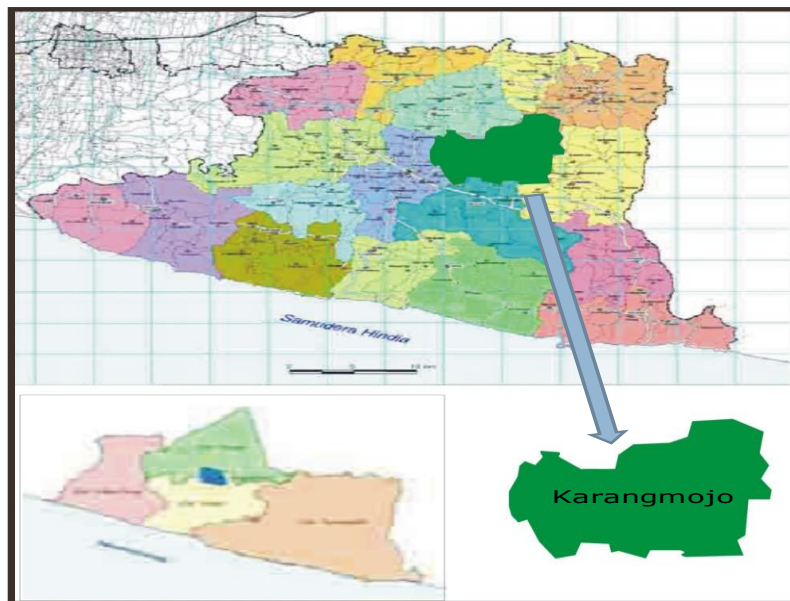
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fulfill actual energy needs successfully, the PRA approach to provision of the energy options for rural communities in selected villages must emphasize to provide the reliable analysis and assessment.

Why using PRA method. The PRA is effective method for analyzing the needs assessment of energy in rural community. The PRA approach aims to incorporate the knowledge and opinions of rural people in the planning and management of energy needs and program in the community. Participation is one of the key principles of community development particularly in energy policy for poor-community in rural that is seen as an essential part of human growth and often leads to the development of self-confidence, pride, initiative, creativity, responsibility, and cooperation. Without such development within the people themselves, all efforts to alleviate their poverty will be immensely more difficult, if not impossible. Many energy policies and programs have failed or not worked well because of the policy or programs were supplied to rural community without an assessment of actual energy requirements having been made. In such cases, the energy program or technology do not supply the energy services/needs that the villages or rural communities actually required.

### 3. PROFILE OF KARANGMOJO DISTRICT

Karangmojo district is administratively located in Gunungkidul Regency. Location of Karangmojo is shown in Figure 1.



**Figure 1: Map of Kecamatan Karangmojo**

Total area of Karangmojo is approximately 80.12 km<sup>2</sup> which is divided into 9 Villages, 104 Hamlets, 117 RW and 485 RT. Most area is used for plantation which includes dried farming and national forests, while the remaining area is used for rice farming and *Sultan ground*. Nine villages in Karangmojo have status of “desa swadaya” which it means that all villages is categorized as a traditional village due to the average educational level of community is still low, the production only meets to the daily household needs and the limited communication with other villages.

Based on economic activities, Karangmojo is categorized as a “backward district and slow growth. This district category usually has relative static growth of social and economic activities, It’s can be identified by the number of poor households in Karangmojo which is still relatively high, amounting to 38.2 % of the total households. Economic performance of Karangmojo district can be summarized from their GDRP (gross domestic regional products). The agriculture sector was the backbone of the local economy, contributing 43.39 % to the total GDRP. The high agricultural sector contributed in the GDRP originates from the five sub-sectors of food crops, plantation, animal husbandry and its products, and forestry. Karangmojo is one from two districts to support the rice production for Gunungkidul Regency.

The energy situation and potential of Karangmojo district presented in this section is a result of focus group discussion (FGD) and semi-structured interview from PRA analysis. Table 3 presents the type of energy which is used in community. Cooking and lighting are the principal energy services needed in the house-holds activities and constitutes approximately 85% and 15% respectively of the total energy consumption in households. Firewood and agricultural residues are still dominated as the principal energy source for cooking. An interesting observation is that the use of traditional fuels, such as firewood and agricultural residue, is prevalent to a greater or lesser extent in almost all households (is about 80 % of total households in Karangmojo, irrespective of their income level. Even among the higher income group. In most cases, this is in combination with other fuels and indicates the inclination of the households to make use of this low-cost fuel during the harvest season when it is available in plenty. Other related

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issue and phenomena from this situation is that the government conversion program of kerosene to LPG for cooking has not been effectively implemented in Karangmojo.

**Table 3: Type of Energy Used in Kecamatan Karangmojo**

No	Activities	Type of Energy			Supply		
		Electricity	Fuels	Firewoods	Electricity	Fuels	Firewoods
1	Cooking	-	√	√	-	Buy	Buy and Collect
2	Lighting	√	√	-	PLN	Buy	-
3	Production (Local Entrepreneur)	-	√	√	-	Buy	Buy and Collect
4	Ironing	√	-	-	PLN	-	-
5	Transportation	-	√	-	-	Buy	-
6	Water Pump for Irrigation	-	√	-	-	Buy	-

**Source:** In Depth Interview with community.

Description of energy consumption gathered from in-depth semi-structured interview in Karangmojo community is shown in Table 4. The consumption rate of energy listed in Table 4 is average amount of energy. There are five types of energy services that used by community for their daily activities. Petrol fuel is used by community for transportation. Transportation mode of motorcycle is a common transport which is usually available in each household. Kerosene, as mentioned before, is used for cooking.

**Table 4: Energy Consumption in Karangmojo community**

No	Jenis Energi	Consumption/ month	Price Unit (IDR/Rp)
1	Petrol	60 lt/ household	Rp. 6.000/lt
2	Kerosene	10 lt/ household	Rp. 3.000/lt
3	Firewoods	6 string/ household	Rp.12.500/ string
4	Electricity	Rp. 50.000/household	Rp. 600/kwh
5	Diesel (for irrigation)	8 lt/day/farmer group	Rp. 5.000/lt

**Source:** In Depth Interview with the community.

When we conducted to the community, the price of kerosene at that time is about Rp. 3,000 (subsidized price) per liter. However, on 2009 after the government has introduced LPG 3 kg program for cooking and implemented non-subsidized kerosene. In the same time, the government has also limited the subsidized kerosene in the market. The local market price has thus reached to level of Rp. 8,000 per liter. Diesel fuel is usually used for operating the water pump generator for irrigation system of rice farming. The cost of diesel consumption per month can reach to 12 liters per day or the calculated cost is Rp. (IDR) 60,000.00 per day. Thus, the cost per month can be calculated as about Rp. (IDR) 1,800,000.00 which should be covered by farmer group. Usually, a farmer group consists of 20 to 30 farmers.

As shown in Table above, almost 80 % of household income is spent to energy. It means that there is insufficient part of income for the other household demands, such as education, health, food and etc. In depth interview was carried out for getting the information for this household expenses characteristic. The background of community is in farming sector. For food, they usually take directly from the farming products for daily foods. They also get the vegetables for food from farming. For school/education, their children have involved the educational subsidy program from government which is called as BOS program (BOS = school operational grant). In BOS program, students are provided the scholarship until SMP (junior high school) level. This condition gives a characteristic that almost education background of children/people in the community only reaches to SMP level. For health service, Puskesmas as a centre of community/public health is provided in each village. The government has provided the subsidy for poor-community health service. Therefore, community has also spent little money for health service.

#### 4. RENEWABLE ENERGY POTENTIALS

Several renewable energy potentials in Karangmojo were identified from the result of the site visit, interview and FGD as shown in Table 5.

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Table 5: Renewable Energy Potential in Karangmojo

No	Type of Energy	Source	Potential Energy
1	Wind	---	2.5 kw
2	Solar photovoltaic	---	3 kwh/m <sup>2</sup> /day
3	Bioethanol (Cassava)	Cassava plantation	48,007.67 kwt
4	Biomass	Agricultural/forest waste/residues	764.17 ha
5	Biogas	Livestock	8,199 cows
6	Bio diesel	Jatropha plant	4,282.2 ha

Source: Field Survey

The potential of wind in Karangmojo, Gunungkidul is not really high. The high speed of wind are found in the coastal area. The further investigation concerning to the wind speed and reliability and availability of the wind events should be conducted for this energy type. Solar or PV energy has high potential in Karangmojo because the little seasonal variation in isolation level even during the rainy season. Some applications such as PV water pump system, solar home system and remote household from the grid are potentially implemented. However, the high capital cost the PV installation, components supply and maintenance aspect should be considered. Cassava is one of potential plants in Gunungkidul Regency. Cassava crops are usually cultivated to supply the population's own needs. Releasable surpluses such as cassava are high and they are usually distributed in Indonesia or exported to overseas. However, environmental issues considering using bioethanol from Cassava, i.e. land degradation and food supply should be studied more detail. Jathropa plantation is also potential in Karangmojo. Referring to area of the dried-land and the not-farming land is about 4,282.2 ha; those lands can be cultivated with Jathropa for biodiesel production. Due to the limited knowledge regarding to Jathropa plantation, the building capacity on Jathropa cultivation and crop method to the community is needed.

### 5. ENERGY PROBLEM

The summary of energy problems written in this section is a result of focus group discussion for gathering information in detail for real energy problems which is faced by the community in Karangmojo. Starting from the government policy for reducing the subsidy on fuels, it has given the significant social and economic impacts to the community in Karangmojo. Increasing energy price have directly burdened to the community. The energy price increment has also impact to increasing the goods for household. Thus, household must decrease the spending for energy sector i.e. household member decreases the activities which uses the transportation, decreases the use of kerosene for cooking and changes it with firewood and decreases the lighting in household. For local entrepreneurs who are available in community such as industry of "tahu and tempe", the energy price increment causes incremental cost of the production. Thus, they decrease the production side to reduce the incremental cost. Direct effect for this situation is the decreasing of the gross income.

This increment also affects to the farmer group. This condition will influence in the income of the farmer and the Gunungkidul economy performance in the agricultural sector. The agricultural sector in Karangmojo (27 % from total area) has used the simple technology of irrigation system. Water is pumped from underground channel using the hydraulic pump system operated by a generator (Figure 2). However, increasing diesel price has caused the operational cost of water pump increases in double. The incremental operational cost cannot be covered by the income from agricultural/rice harvest. Some farmer groups cannot operate the water pump or they decrease the water supply to the farming.



Figure 2: Diesel water pump for irrigation system used in Karangmojo

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Therefore, renewable energy development in conjunction with the integrated economic development at Karangmojo is needed to assist the energy access in the community and then can directly impact to the economic improvement. Some renewable energy potentials have been identified in the survey and FGD activities which can be developed as a solution for energy source alternative in Karangmojo.

### 6. POTENTIAL PROPOSED ENERGY PROGRAMMES

Based on the available energy potentials and the needs assessment from the PRA results, several energy service programs were proposed. These potential energy programs were also planned and designed in relationship with important issues of (1) the sustainability of the programs through cultural and social approach, (2) the optimization of the available renewable energy sources, and (3) the improvement of the better quality of life through the energy programs. The potential proposed energy programs in Karangmojo are described as follows:

1. **Biogas Energy Package (BGEP) for cooking purposes.** Biogas is obtained by anaerobically digesting (in an air free environment) organic material to produce the combustible gas methane. Animal and municipal wastes are common feedstocks for anaerobic digestion. The digestion of animal waste yields several benefits, i.e. methane is produced and can be used as a fuel; the waste is reduced to slurry which has a high nutrient content which makes an ideal fertilizer (in some cases this fertilizer is the main product from the digester and the biogas is merely a by-product); and during the digestion process, bacteria in the manure are killed which is a great benefit to environmental health. In case of the proposed technology used in the Kecamatan Karangmojo, the proposed digester biogas was designed for producing the combustible gas methane from the animal waste of cattle livestock (cows), that his availability was abundant enough in this region.

This program was proposed due to this energy service is high portion of energy used in Karangmojo community. The packet consists of three sub-programs which are:

- a. Development a pilot installation for complete biogas energy infrastructure which is efficient and low-cost construction based on the capacity of 2-4 cows for household level.
  - b. Community assistance in terms of cultural approach for transferring the knowledge and implementing the biogas energy program. The program is also followed by the extension for the cow husbandry.
  - c. Assistance on fertilizer process from the biogas residue. The fertilizer can be used by former group for farming or can be sold as the additional income for household.
2. **Biogas Energy Package (BGEP) for local entrepreneur.** The packet is to develop a pilot installation for complete biogas energy infrastructure which is efficient and low-cost construction based on the capacity of 5-10 cows for local entrepreneur/small industry level.

3. **Biodiesel Energy Package (BDEP) for household and irrigation system.** Jatropha oil currently has been developed well in many countries such as India, Brazil, Africa and Myanmar for biodiesel fuel. When jatropha seeds are crushed, the resulting jatropha oil can be processed to produce a high-quality biodiesel that can be used in a standard diesel car, while the residue (press cake) can also be processed and used as biomass feedstock to power electricity plants or used as fertilizer (it contains nitrogen, phosphorous and potassium). The second proposed energy program in Karangmojo is the use of Jatropha oil for energy services of water pump generator on farming and cooking for household. Main considerations for implementing this program are (1) lessons learned from the successful of biodiesel program in India and Karangmojo district has huge potential for Jatropha plantation as raw material for producing biodiesel due to many marginal lands exist in Gunungkidul regency, (2) Jatropha is not for food materials (3) Jatropha can be planted on dry/marginal lands, so it has a potential to change a dry land into a productive land. Jatropha is a valuable multi-purpose crop to alleviate soil degradation, desertification and deforestation, which can be used for bio-energy to replace petro-diesel, for soap production and climatic protection, and hence deserves specific attention. Jatropha can help to increase rural incomes, self-sustainability and alleviate poverty for women, elderly, children and men, tribal communities, small farmers in Karangmojo. It can as well help to increase income from plantations and agro-industries.

The packet consists of two sub-programs which are:

- a. Development a pilot installation of complete simple-biodiesel process for oil production in order to replace or mix-biodiesel and diesel fuel for water pump generator. For household, the oil from Jatropha can be used for kerosene stove or modified kerosene stove.
  - b. Community assistance in terms of cultural approach for transferring the knowledge and implementing the Jathropa cultivation.
4. **Biomass Energy Package (BMEP) from rice husk.** Biomass gasification of energy package program using the rice husk is a last proposed program in the energy needs assessment in Karangmojo. The idea of this program comes from the lesson learned from rice husk gasification project facility at Haurgeulis, West Java. The packet is to develop a pilot installation of biomass

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process for energy from the rice husk ash or other agricultural residues for local entrepreneurs. Rice husk (Figure 5.5) is a potential source widely located in Karangmojo. It is residue/waste from rice farming process which can be taken from rice milling. There are 22 local entrepreneurs of rice milling located in Karangmojo. These rice millings have limited production of rice husk due to their service only provide for local famer groups. Average production of each rice milling is about 400 kg/day. Thus, the rice husk has proportion of 25 % of production. This is a potential source in terms of biomass feedstock for conducting the biomass gasification. Based on research conducted by ITB 3 to 4 kg of rice husk can produce amount energy which is similar (conversion) with 1 liter of diesel fuel.

### 7. STAKEHOLDERS ANALYSIS FROM FGD ON ENERGY DEVELOPMENT IN KARANGMOJO

As mentioned before, the energy program can be implemented well if the rural community can participate in the program for deciding the needs of energy services. Some result discussions related to “hopes” or expectations on energy services which will be planned and implemented between stakeholders can be written down. Stakeholders inhere consists of community and local entrepreneur (Karangmojo) representative, local administrator (local government), regional office of Dinas and technical team/university. Identification of these expectations is an important aspect to understand and set up the role and participation of each stakeholder which is involved in the energy development program. The result of stakeholder analysis is listed in Table 6.

**Table 6: Stakeholder Analysis for Institutional Set Up and Financing Scheme of the Proposed Energy Programs in Karangmojo**

NO	STAKEHOLDERS	CONTRIBUTIONS
1	<b>Community, farmer groups and local entrepreneurs</b>	Owner and take responsibility for managing the installed energy infrastructure in Kecamatan Karangmojo
2	<b>Local administration office/government</b>	Provide an energy facilities and infrastructure Budget allocation from Village Budget/Anggaran Dana Desa (ADD) for development of energy alternative at each region. Supervising the implementation of the proposed energy project.
3	<b>Regional Mining and Energy Office of Gunungkidul Regency</b>	Continue and focused on programs in next fiscal period (APBD/APBN) related with energy alternative development in region includes infrastructure provision and capacity building.
4	<b>Banking, Micro Finance Institution, Usaha Kecil and Menengah (UKM), Koperasi (Cooperation/Economic Enterprise)</b>	Commitment to provide Kredit Usaha Rakyat (KUR) and other scheme of credits for farmers in building an energy infrastructure. Capacity building for famer groups especially in finance management aspect. Possible to be one of investors for energy infrastructure development.
5	<b>University</b>	Provide training and education facilities for capacity building in development of energy alternative. Mentoring and assisting in operational of energy alternative. Improving an applied research and development of energy alternative.

### 8. FINANCING SCHEME FOR THE PROPOSED PROGRAMS

Many studies show that the key constraint to energy supply by the renewable energy for rural community is access to the initial capital needed to purchase the equipment or to build the infrastructures to harness the resource. This leads rural communities to choose energy options that are cheap on a day-to-day basis, but which offer a poor quality of energy supply and are expensive over the longer term. In addition, the current economical condition in community of Karangmojo, particularly for poor household show that they cannot finance the proposed energy program (i.e. Biogas for Cooking) based on their income. Thus, financial way by other institutions/sources is need in order to implement the proposed program to the community. Several alternative formal sources for financing the proposed program are Banking, Micro Finance Institution, Micro and Small Business. For this proposed scheme program, the financial breakdown of the proposed combination scheme is shown in Figure 3.

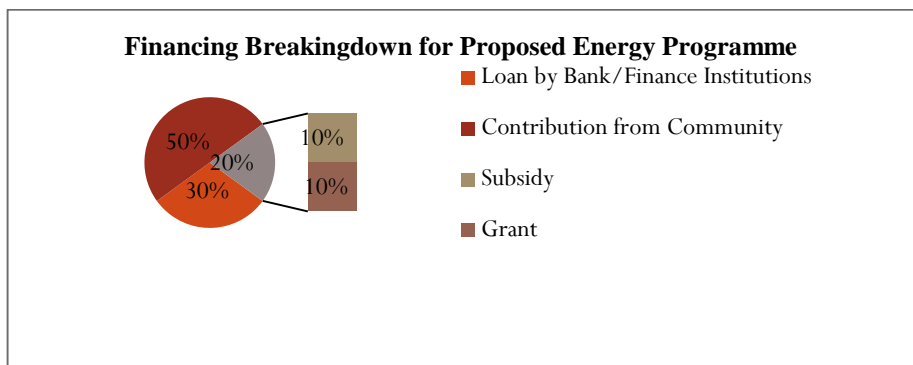


Figure 3: Financing Breakdown for Financing Scheme of the Proposed Energy Programs in Karangmojo

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