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Economic Modeling to Improve Energy Strategy in Selected Indonesian Villages

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Economic Modeling to Improve Energy Strategy in Selected Indonesian Villages

SEADI Discussion Paper No. 20

This paper was produced by Research Institute, Community Empowerment and External Cooperation, Darma Persada University, pursuant to a grant funded by the **USAID Support for Economic Analysis Development in Indonesia project.**

July 2013

Acknowledgments

This report presentes the results of a study on economic modeling for improving Indonesia's energy strategy in selected villages. From these results some recommendations have been put forward so that they could be implemented by related institutions. This study was conducted in three hamlets, Tangsi Jaya Hamlet, Gunung Halu of West Bandung, West Java; Banyumeneng I hamlet of Gunungkidul, Special Province of Jogjakarta; and Seriwe Hamlet of East Lombok Island in West Nusa Tenggara.

This study highlights the role that small processing centers (SPCs) can play in using local renewable energy sources to generate value-added activities. It also shows that SPCs can create job opportunities in hamlets and improve local welfare. Therefore, it is recommended that in implementing new Energy Self Sufficient Village model the approach reviewed in this study should be followed to tap local renewable energy resources and bring the benefits of sustainable economic development to rural areas.

This study would not have been possible without the help and assistance of a range of sources. We appreciate the support and assistance of Darma Persada University, which helped us to maintain rigor in our analysis. We would also like to express our highest appreciation for the support provided by local authorities and the people of the selected hamlets. In addition, we are grateful to Dr. Ahmad Agus Setiawan of the Department of Engineering Physics, Gadjah Mada University and his team, to Salnida Yuniarti Lumbessy, S.Pi,M.Si , from Faculty of Fisheries, Mataram University and her team. Finally we acknowledge the research grant provided by USAID through SEADI, which made this study possible.

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Executive Summary

Renewable energy sources can be found in most rural areas of Indonesia. Starting from solar energy, wind, hydro, biomass and geothermal to a limited extent are all available in rural areas. Renewable energy sources could provide power and fuel for the household, industry and transportation in rural area. The government program of Energy Self-Sufficient Village (ESSV) has provided rural areas with renewable energy facilities and was meant to trigger economic growth in rural areas.

Several development programs that have been planned should shed light on the economic impact of these policies. Can renewable energy (RE) really help to develop rural economies? Drawing on case studies of three villages, this report discusses common problems in rural economic development in Indonesia and finds that although RE indeed can be a driving force for economic growth it requires a complex set of supporting policies and actions as well as a long-term strategy.

Basic Concept of RE Implementation in Rural Economic Development Model

The basic concept of rural development promoted in this study is to create self-reliance in rural communities through the utilization of renewable energy sources. The goal is to use RE for productive activities that increase value-added in the community. The renewable energy sources and potential value-added activities available in the hamlets in this study were:

- Tangsi Jaya hamlet, in West Java: micro-hydro power plant is available and the electricity generated could be used to operate Small Processing Center (SPC) for ground coffee;
- Banyumeneng I hamlet in Special Province of Jogjakarta and Seriwe hamlet in East Lombok , West Nusa Tenggara: solar and wind energy are available to supply energy for shredded tobacco production (Banyumeneng) and seaweed drying (Seriwe).

To determine the appropriate form of technology, it is important to understand basic energy demand in rural areas. This was done by conducting a survey of energy demand and renewable energy available locally. The study results showed that the type of economic sectors that can utilize RE sources are sectors that have stable/established market share and are not consumed directly by the local community, for example coffee and tobacco. Instead, these products can be processed and then sold outside the village so income for the village can be generated.

RE installations can be managed by local communities and cooperatives. As our study shows, RE generator units can do more than just provide power for lights. They can provide energy for value-added activities for households or villages if supported with affordable funding schemes.

Key Challenges

The key challenges in empowering renewable energy sources in the hamlets in this study are as follows:

- Empowering institutions in the hamlets, such as Rimba Lestari cooperative in Tangsi Jaya, OPAkg at Banyumeneng I, and Cottoni cooperative in Seriwe, so that they can have easy access to working capital, market outlets and continuous monitoring and evaluation of project implementation from experts such as from universities.
- Empowering informal financial institutions and free market conditions may help to overcome the current barriers to economic development.
- Continuing to provide government as well as private sector support.

Conclusions

The renewable energy technologies in the studied villages can trigger economic development provided that existing SPCs are given access to working capital, market outlets and continuous guidance from experts. The SPC for coffee at Tangsi Jaya hamlet will be taken over by a private sector, while the SPC for shredded tobacco in Banyumeneng I hamlet and SPC for seaweed in Seriwe hamlet still require further assistance to acquire working capital and better markets for their products.

It is therefore recommended that the current SPC activities should continue to be supervised by Darma Persada University together with local governments and local universities until they can be managed locally. The government and the private sector should continue to support the existing ESSV program but some changes should be made. We recommend the following development strategy:

- ***Objective:*** Making the hamlet economy more active, dynamic and growing based on renewable energy resources by increasing economic productivity and developing alternative activities in order to increase revenues for hamlet residents.
- ***Strategy:*** Include all potential local resources as well as resources from outside of the hamlet, such as technology, funding, policy and markets. In the implementation of operations, partnerships or alliance strategies might be used.
- ***Program:*** The plan should be implemented within a period of five years and be focused on factors that can support economic activity to become more active, dynamic, growing and sustainable.

1. Introduction

Because the natural resources and social economic conditions of each island comprising Indonesia are very diverse, development strategies based on aggregate models may not work for each hamlet, province, or even island. Therefore, Darma Persada University promotes an economic development model based on distributive economic modeling. This approach focuses on locally available renewable energy resources for triggering economic growth at the village level. It seeks to establish self-supporting energy, economy and environment (E3i) communities in which local renewable energy sources power small processing centers (SPC) as a starting point for environmentally sound economic development. To realize this strategy, technology intervention must be closely monitored and evaluated through integration of such a development program with a university's academic activities such as through student field training, such as undergraduate and graduate thesis research and research by academic staff.

Coupling village development programs and academic activities until the program is self-sustaining will lead to the best result. This stepwise development strategy can then be extended to a greater area of economic development and even nationwide, though expansion to the national level requires more research and is not the subject of this study.

BACKGROUND

Energy is the driver of economic growth. As shown in Figure 1-1, an increase in energy consumption is associated with increase the Human Development Index (HDI) score.[1] Therefore, providing access to energy can trigger economic activities. A more complete vision of how energy can improve the economy of a community would include making energy available, accessible, acceptable and affordable by the community. However, barriers to the use of energy in general, especially clean and renewable energy, can be summarized as follows: P (policy, such as regulatory policy: RPS, net metering, Fit-in-tariff, etc.), E (economy, such as capital subsidy, grant, rebate, tax incentive), S (social awareness, public interest in renewable energy project, public financing), and T (technology, domestic RD&D results, cost of technology, etc.).

Regarding the policy aspect on renewable energy applications, the important issue will be the heavy subsidy on fossil fuel and electricity and on the implementation of such regulations at field level.

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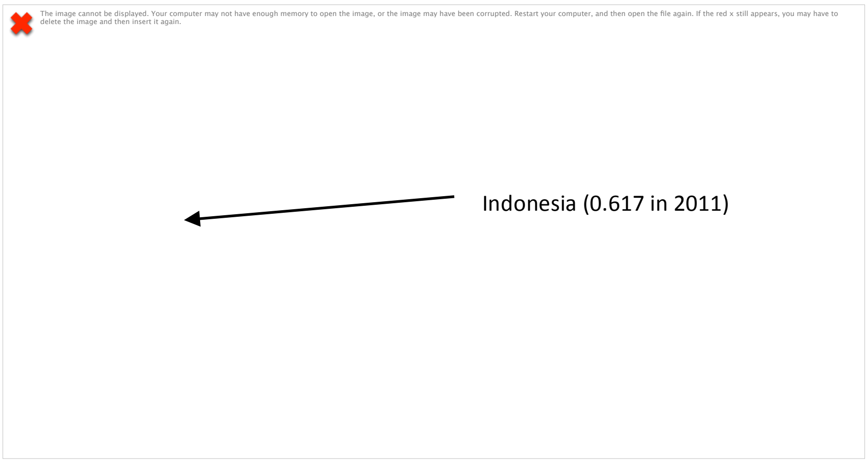
[1] http://www.hdr.undp.org

Figure 1-1
Energy Consumption by Country and the HDI



Renewable energy technologies are viewed as expensive, but this is not always so. Villages often have trouble obtaining working capital and investors are reluctant to take on the risks typical of rural economies. Renewable energy technologies are regarded as new and many people do not grasp benefit and therefore renewable energy has suffered from low priority in development financing. In contrast to R&D of renewable energy technologies in advanced economies, RD&D in Indonesia lags far behind and we are not able to substitute renewable energy for fossil fuels.

The National Energy Council (*Dewan Energi Nasional*, DEN)[2] has proposed a strategy under which Indonesia maximizes use of renewable energy by 2050. The government's target share for renewable energy in the national energy mix is 25 percent by 2025, but DEN has not decided on the optimum share for 2050—whether it should stay at a low 35 percent or >75 percent as predicted by the INFORSE, or 100 percent to maintain the CO2 level of 350 Gt, the condition of preferable equilibrium in our atmosphere.[3]

To promote the use of renewable energy sources the government has issued several regulations:

- Energy Law Number 30 Year 2007;
- Electricity Law Number 30 Year 2009
- Ministerial Regulation on Small-Scaled Power Purchase Agreement – MD No.1122/K/30/MEM/2002.
- Ministerial Regulation on Power Purchase Price from Medium-Scaled (1-10 MWe) Renewable Energy Power Plant (<10 MWe) (MEMR MD No. 002/2006).
- "Policy on Renewable Energy and Energy Conservation," also called the "Green Energy Policy." (MoEMR No. 0002/2004).
- Presidential Regulation on National Energy Policy No. 5/2006 that attempts to gradually shift Indonesia energy dependency from fossil
- Minister of Finance Regulation No. 21/PMK.011/2010 on Tax and Customs Facilities for the Utilization of Renewable Energy to sustainable power.
- Ministry of Energy and Mineral Resources Regulation No. 4/2012 on Purchasing Price by PT. PLN (Persero) of Generated Electricity from Small and Medium Scale Renewable Energy Power Plant or Excess Power.
- Presidential Regulation No. 56/2011 on Partnership of Government with Business Entity for the Provision of Infrastructure**.**

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[2] MoER & BAPENAS, 2012

[3] http://www.inforse.dk

The DEN, however, has stated that their recommendation for KEN 2050 (National Energy Policy for 2050) has been “to maximize the use of renewable energy, while minimizing the use of fossil fuel and in between, coal or nuclear will used to balance the increasing demand for energy.” Lessons learnt from the past indicate that to reach the 25 percent target may require an enormous effort not only by the government, but also jointly with private/business sector and the academia.

A recent study by the Agency for the Assessment and Application of Technology (BPPT) using MARKAL (Market Allocation Model) combined with MEDI (BPPT Model for Energy Demand of Indonesia)[4] shows that, demand for energy will increase at 3.6 percent per annum from 1050 MBOE in 1990 to 2204 MBOE in 2030 (base year 2007, low economic growth scenario of 5.5 percent/annum and 7 percent /annum for high economic growth). The estimated economic growth for 2012 was 6.5 percent/annum but with the expense of increase in oil imports that are also a function of the oil price.

It is projected that oil imports will continue to increase each year and reach a value of to 230 MBOE in 2030. Between 2007 and 2030, the industrial sector will rely mostly on electricity; the transportation sector will use fossil fuel (oil) while the household sector will predominantly use biomass energy (BPPT, 2012). The BPPT study did not specifically explain how to use the supplied energy to obtain the targeted economic growth. The model is an aggregate model that has been used by the Ministry of Energy and Mineral Resources to support the enactment of various laws and regulations.

Indonesia has become a net importer of oil and oil products since some time ago. Oil production is now declining to around 840,000 barrel/day (MoEMR 2013) while the consumption has already reach about 1.6 million barrel/day. It is therefore logical for the government to give priority in developing renewable energy sources, which are abundant but not yet being utilized.

Table 1-1
Renewable Energy Potential of Indonesia (MoEMR 2012)

No	Nonfossil Energy	Resources	Installed Capacity	Ratio Res/IC (%)
1	2	3	4	5
1	Hydro	75.670 MW	5.705.29 MW	7.54
2	Geothermal	28.543 MW	1.189 MW	4.17
3	Mini/Micro Hydro	76969 MW	217.89 MW	28.31
4	Biomass	49.810 MW	1.618.49 MW	3.25
5	Solar Energy	4.80 kwh/m2/day	13.5 MW	-
6	Wind Energy	3 – 6 m/s	1.87 MW	-

SOURCE: http://www.esdm.go.id

[4] Indonesian Energy Outlook, BPPT 2012

The government claims to have established more than 600 ESSVs and by 2014 plans to have 3,000 ESSVs in place.[5] Although monitoring and evaluation activities are included in the initial plan, many of the ESSVs have been idle, especially those meant for productive uses, due to lack of working capital, access to market for products, and insufficient managerial guidance to the beneficiaries of the facilities.

Some projects have created energy infrastructure, while others still require a follow-up program. Biogas reactors installed at Cipogo village in Boyolali and Haurgombong, Garut West Java, are examples of a complete energy infrastructure in terms of energy availability, accessibility, affordability and acceptability. Biogas facilities installed some years ago in both villages are still in use today. The same can also be said for the installed micro-hydro in several ESSVs, where the community can enjoy almost free electricity for lighting at night. It is still uncertain how the community will be able to rebuild the facility at the end of economic life of the existing micro-hydro since depreciation costs are not allocated for such purposes by the manager of the facility.

The ESSV Program serves several purposes and involves multiple institutions (at national and provincial level), as well as state and private enterprises (Coordinating Ministry of Economy, 2008).

- Providing for the basic energy needs for the household (lighting and cooking), from locally available renewable energy sources (solar PV), micro-hydro, and biomass (biogas and liquid bio-fuels). This includes conversion devises such as biomass stoves.
- Providing renewable facilities for productive uses.
- Implicitly helping the government in producing liquid biofuel (biodiesel and bio-ethanol) on the national scale.
- Providing more job opportunities for the people living in the villages/rural areas.

In addition, the Ministry of Energy and Mineral Resources through a collaboration with the Dutch government has developed an energy-planning program called CAREPI (Contributing to Poverty Alleviation through Regional Energy Planning in Indonesia) for the purpose to formulate KED (Regional Energy Policy) in North Sumatera, Central Java, Special Province of Jogjakarta and West Nusa Tenggara (CAREPI, 2012).[6] The study, however, focuses on understanding the energy mix for the study area but paid little attention to its impact on economic development.

OBJECTIVES

The objectives of the research project are as follows:

- To determine barriers to high economic growth, respectively, in three sample regencies (Kabupaten) in West and Central Java and in West Nusa Tenggara.
- To determine key elements (institution, technology, energy and natural resources), which could trigger economic growth and have an impact on MDG target especially at the village level
- To assess the current state of energy infrastructure (availability, accessibility, affordability, and acceptability) of all available energy resources including local renewable energy sources to supply

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[5] Coordinating Ministry of Economy, Strategy Plan of ESSV 2008: In 2007, the government has launched a national program called, the Energy Self Sufficient Village (ESSV) or the Desa Mandiri Energy (DME) according to Indonesian abbreviation.

[6] http://www.carepi.info

the energy needed for households, agriculture, small industry, commercial sector, and transportation.

- Determine the economic benefit of existing SPCs as models for productive uses using locally available renewable energy sources.
- By determining leading economic sectors providing the greatest contribution to Gross Village Product from the constructed I/O Tables, the effective application of renewable energy technology for value added activities can be recommended.
- Formulate probable development scenarios using LEAP model software for the three hamlets containing the change overtime of important energy economic parameters such as the elasticity of demand of energy (fuel) option, population growth, energy consumption for each economic sector in the form of Reference Energy System (RES), energy mix, current income level, employment opportunity, Gross Village Product, sustainable parameters of the existing SPC, etc.)
- To develop energy security strategies for the three villages.
- To formulate alternative development policies as important material for the KED (Regional Energy Policy), of the respective regencies in relation to the National Energy Policy (KEN-2050)
- Data obtained can be used to explore future tools and technology for enhanced US –Indonesia trade.
- Recommend regulatory policies, fiscal incentives, and public and development financing to accelerate the adoption of renewable energy in Indonesia.

SCOPE OF ACTIVITIES

The activities of the project are as follows:

- Survey the three project sites, one regency in West Java (Tangsi Jaya Hamlet, Gunung Halu), one regency, in DIY-Special Province of Jogjakarta(Banyumeneng, hamlet in Gunung Kidul) and one regency in West Nusa Tenggara (Seriwe Hamlet in East Lombok), by explaining clearly the vision and mission of the project in a workshop to local authorities, financial institutions and universities.
- Establish MoUs with local energy management facility (office), established previously under the Energy Self Sufficient Village, at the project sites.
- Help management to obtain access to working capital and markets fro products of the SPC.
- Formulate workable implementation policies for sustainable economic development based on LEAP software analysis for the respective 3 regencies. Estimate the future impact of renewable energy technology applications on gross domestic products of the hamlets, sustainable parameters, RES, optimum energy mix, data on GHG level, etc.

This report discusses the progress achieved on benchmark indicators of project activities:

- Data and information on current socio-economic status of the communities in the selected regencies (income, GVP, population, population growth, dominant economic sectors, potential natural and renewable energy sources, innovative financial schemes and market of products.
- I/O tables and road map of economic growth for the selected regencies.
- Specifications on selected appropriate renewable energy technologies and their respective economic parameters based can be made available.

- Specification of the existing SPCs, including the applied renewable energy technologies, in the regencies could be made available and to ensure that they are operating efficiently and bringing benefits to the users.
- Future development scenarios and road maps using LEAP software can be formulated and the impact of technology applications to increase “gross village product” (GVP) of the hamlets/regencies under study can be determined.
- Regular monitoring and evaluation and maintaining sustainability of the project by inclusion the project site into academic programs of universities. The project site then can be adopted as field laboratory for the university where the university can use the facility and the community as a place for student field training, and as research material for theses (both for undergraduate and graduate students). The laboratory can also be used for academic staff together with students or fellow faculty to conduct research activities in order to improve the quality of their lectures and where they can apply and test new RD&D results.
- Recommended development strategies to local and central government regarding the adoption and implementation of: regulatory policies, fiscal incentives, public financing

This report also explains the strategy in developing of rural area in Indonesia with approach in utilizing the renewable energy as a main driver of rural development. It is hoped that the site projects can be examples for revising the Energy Self Sufficient Village (ESSV) program in Indonesia.

METHODOLOGY

Methodology used to examine and analyze the above objectives will be based on quantitative and qualitative methods. The quantitative methods used include I-O table, use of LEAP (Long Range Energy Alternative Planning System) and multiple regression analysis. Whilst the qualitative analysis will be based on data and information collecting from field observation, focus group discussions (FGDs), interviews, and questionnaires. These primary data and information will be used, for instance, to determine key elements (institution, technology, energy and natural resources) that could trigger economic growth and affect MDG targets at the village level, to obtain the current state of energy infrastructure (availability, accessibility, affordability and acceptability) of all available energy resources including those of local renewable energy sources to supply the energy needed for households, agriculture, small industry, commercial firms, and transportation and to develop energy security strategy in the selected three villages/regencies.

In addition to the above primary data, data related to socio-economic condition of the hamlet needed for the construction of the I/O table of the hamlets and energy consumption patterns in each economic sector within a hamlet will also be collected. Regarding the policy suggestions, advocacy will be undertaken to persuade local and central government officials to support the recommendations. This advocacy is important to ensure successful deployment of renewable energy sources.

REPORT ORGANIZATION

This report consists of several chapters that will explain the use of RE for rural development model in Indonesia. This report also discusses the direct implementation of the model developed in the hamlets.

- Chapter 2 describes how RE can be used and be a driving force in the rural economy. The E3i Village concept is also described as the basic model in rural development and application of small processing units as an industrialization model in rural area.

- Chapter 3 describes the economic planning and infrastructure in rural areas. Problems and problem-solving mechanisms that commonly arise in rural energy planning, are also discussed in this chapter.
- Chapter 4 contains the development procedure which serves as guidance in determining the success of rural economic development model
- Chapter 5 contains the case study in the model development in rural economic of three selected hamlets

2. Embedded Renewable Energy in the Rural Economy

ADVANTAGES AND PROBLEMS IN RENEWABLE ENERGY OF RURAL AREAS

Rural development is aimed at sustainable and environmentally friendly development of the region. The development can be implemented by utilizing all forms of energy sources available. Development by implementing RE, has the following advantages:

- The development of economic activity and small-medium scale industries and cooperatives. Many RE technologies can provide great opportunities for the growth of entrepreneurial activity because the investment costs are relatively small.
- The development of the region. RE sources are generally located in rural areas and are not overly dependent on the presence of infrastructure. In addition, the availability of natural resources in rural areas requires further processing to improve the quality and to give more added value. RE, which is environmental friendly, can also help supply energy generation in tourist destinations.
- Job creation. Promotion of RE development will bring employment to the area and prevent the occurrence of urbanization. Development of RE is generally labor intensive. Therefore, it can absorb employment and reduce unemployment.
- Advantage of environmental aspects. Increased use of renewable energy sources can help decrease greenhouse gas emissions.
- Competitiveness and export opportunities. In the medium- and long-term, it is estimated that renewable energy will compete with conventional energy.
- Renewable energy such as biomass, micro-hydro, and solar thermal, are already cost effective and cost competitive for the purpose of energy generation and businesses in remote areas.

However, many obstacles still hinder the use of RE as described as follows:

- ***Policy constraints and coordination between institutions***
  - Legislation and energy policy are not yet favorable to the development of RE. Some policies and programs for RE development are already contained in the Public Policy of Energy Sector (Kebijakan Umum Bidang Energy/KUBE), but the implementation is not supported by the commitment of the parties involved. In addition, the existing budgeting and funding system are not yet sustainable, consistent or coordinated.
- ***Funding constraints***
  - Funding to conduct feasibility study is not available. The ability of private parties to go directly into the RE business is still weak. Investment funds from banks are hard to obtain. In

addition, there is a misunderstanding in the society about RE technology, which tends to assume that all RE are expensive.

- ***Technical constraints***
  - Some components of RE technology still have to be imported because it is likely site-specific and require specifications which raise costs.
  - Investment costs are high due to the lack of experience and mastery of the RE technology and the lack of ability in design. In addition, baseline data for purposes of design and feasibility study (survey of hydrology, geology, map measuring solar radiation, wind speed, etc.) are not yet available so that adds to the investment costs.
  - Even tough community involvement is important for small-scale RE projects, the community is often less involved in the development of the project.
  - Productive power consumption is still insufficient.
  - The lack of management, operation and maintenance ability of RE project in rural areas.

CONCEPT OF ENERGY SELF-SUFFICIENT VILLAGE

To support development, a village needs to be equipped with the infrastructure needed to cultivate the potential of natural resources in the village. This is to ensure the means of production and living needs of rural communities, such as the supply of energy and water, manufacturing facilities, means of communication, transportation and others. The infrastructure must also be supported by the financial institutions and adequate marketing, in addition to health facilities, education and places of worship. Thus, the villagers can live a better life without having to find a job and move to the city or abroad.

In this regard, renewable energy technologies can also serve as the trigger for the development of the region, as well as the development of the ideal rural infrastructure. Through the concept of E3i (Energy, Economy, Environment) Self-Sufficient Village, energy can be used to stimulate economic growth while at the same time protecting the environment.

Infrastructure for E3i Village

Rural spatial management is not only intended to create zones for residential and production areas, but also includes related spatial systems. Spatial arrangement of production in rural areas has been more focused on producing raw materials for industry. In the future, agricultural policy should implement the concept of gradual industrialization, by placing such Small Processing Center (SPC) close to the production area and rural settlements. With SPC in rural areas, additional employment opportunities can be created to enable the younger generation to work in rural areas. The following are recommended success indicators of rural infrastructure development:

- Improve the quality of life for local people.
- Increase employment.
- Increase independence of the community in all areas, both in technology and development funding.
- Promote justice and equal opportunity.
- Create togetherness and local community participation.
- Preserve the environment and natural resources.

Eco-Village as E3i Independent Village

The Eco-village is a rural concept planned on the basis of ecological balance. The regional eco-village concept is a form of village infrastructure design with a layout designed to produce a comfortable residential area combined with an industrial area as a place for work. This concept is expected to prevent the urbanization that would interfere with the supply of basic human needs for food and shelter, due to productive labor in agricultural migrating to urban areas.

To realize the Eco-Village, basic support should be provided. This effort can be started by determining the engineering and design of housing that utilizes local materials to create a comfortable atmosphere. In addition, industry should promote agroindustry to create jobs and additional income for rural communities.

One of the key elements of creating an eco-village settlement is the selection of the eco-house shape and design in accordance with the local architecture. An eco-house can be defined as a home designed and built based on ecological insights. An eco-house can be equipped with renewable energy technologies which are clean and environmentally friendly.

DEPLOYMENT OF LOCAL RENEWABLE ENERGY SOURCES THROUGH SMALL PROCESSING CENTER

A small processing center (SPC) is a kind small industrial activity that processes local products such as cash (estate) crops, food crops, horticultural products, and marine products to increase the income of the community. Through effective deployment of the installed SPC using renewable energy generating facilities, the quality and the market value of local products can be improved; their shelf life can also be extended. At present SPCs are already available at the selected villages. At Gunung Halu (West Java) village and Batu Dulang village (NTB), SPC for coffee processing already exist from previous project activities, while in Banyumeneng I village, no SPC has been made available but the village now has a drinking water supply facility constructed jointly by the KAMASE[7] (a group of Gadjah Mada University students) and the local community. This latter project has been used as field laboratory for annual practical training of all students from different disciplines.

Under the current conditions, these SPCs lack working capital, managerial know how and market access for their processed products. It is expected that by providing assistance to overcome these problems a concrete ESSV/E3i community model can be created, and may be used and extended to the remaining 600 ESSVs. To test the sustainability of such efforts, however, several studies must be conducted.

First, it is necessary to conduct a financial analysis (cash flow) of the SPC to identify sustainability parameters should they be provided with access to working capital and markets and after training to their managers. This analysis should not be static but should cover a longer time period.

Solar energy, wind, biomass and micro-hydro are available at almost all rural areas in Indonesia. Therefore, renewable energy technologies should be used to stimulate the creation of rural industries which can be scaled to the capacity of local human resources (HR) and accessibility of the available investment capital.

The main objective of the of small processing unit development is to enhance the community's ability to develop superior local products, especially products derived from agricultural and marine sectors. Processed products will have higher competitiveness and added value. Thus, villagers are expected to

[7] http://kamase.org

be able to improve their welfare by utilizing technologies developed by research institutes or universities for the SPCs.

To complement the technology package, basic managerial and operation training programs must also be developed, both for the personnel directly involved in these activities as well as other interested parties, such as NGOs and the private sector.

In addition to initial capital assistance, assistance is also intended for further development of SPCs, especially in developing a market for the product. In addition, management capacity building is done through training and counseling. The program still requires regular monitoring activities, before it can be released as the embryo of rural industry which will keep growing in the future.

3. Energy for Sustainable Rural Development

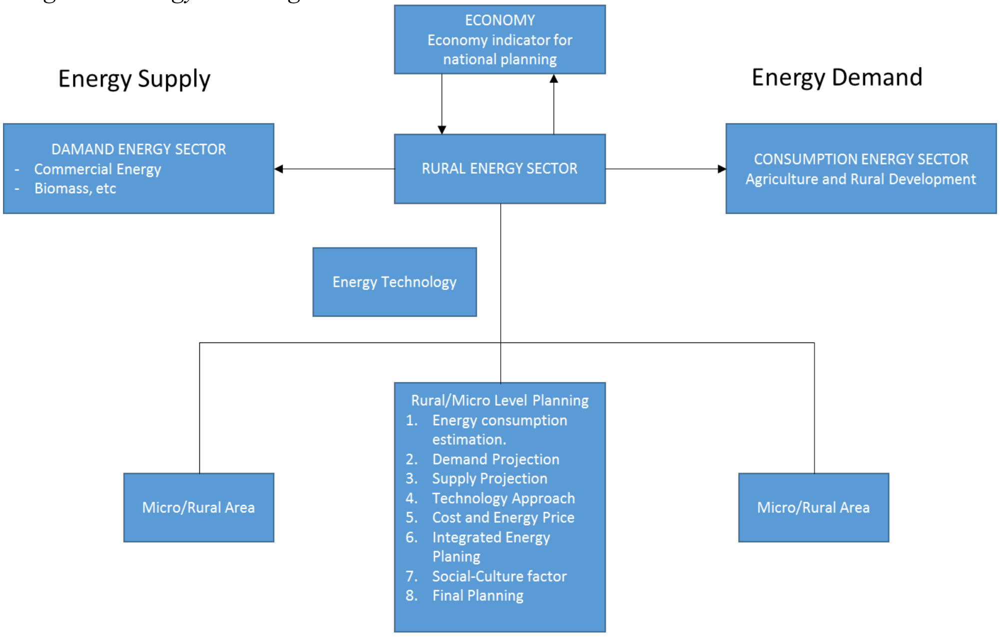
DESIGN OF INTEGRATED ENERGY PLANNING

A multidimensional integrated approach requires a framework. The framework should be able to explain the relevance of energy issues and their impact on agricultural and rural economic growth and its relation to economic planning and public policy at the national level. The relationship between energy planning at the local level for rural development with energy planning at the micro level is described below. The special characteristic of this framework is the preparation of energy planning at the village level based on a regional approach. Planning preparation steps are as follows:

- Site selection
- Estimated energy consumption patterns in the region
- Projected needs and demand for energy at a certain planning period
- Estimation of energy sources supply, derived from within and outside the region under study.
- Technical-economic calculation of the energy conversion technologies.
- Calculation of transport costs and prices of alternative energy in the planning period.
- Preparation of an integrated energy plan for the development of the area, taking into account the constraints of the availability of energy sources and technologies, environmental impacts, socio-cultural, ecological and agro-climatic of the region.

Figure 3-1

Integrated Energy Planning between Micro/Rural and Macro/Nation



CONCEPT OF RURAL ENERGY PLANNING

The rural energy planning system must involve all sectors of economic development, such as energy supply sector itself, the household sector, small industries in rural areas, agriculture and other economic sectors. In practice, each program will also involve various departments or stakeholders that require coordination and synchronization to achieve targets efficiently and effectively. Therefore, we need a unified organization that connects development planning implementation, monitoring, and evaluation of programs/projects, both at central and regional levels, as well as the involvement mechanism of financial and related institutions, such as banks or other private institution.

Kamaruddin Abdullah (2007) has developed the rural development planning model that has as its goals:

- Creating an effective and efficient system of energy provision that can maintain and ensure the balance between supply and demand in rural areas in coordination with stakeholders.
- Optimally using local energy sources in an environmentally sound manner, while at the same time preserving natural resources.
- Promoting the use of energy toward the fulfillment of household basic needs, promoting productive business for the provision of a wider employment, and increasing the rural people income.

The preparation and implementation of energy sources based on local resources to meet basic household needs and for productive purposes will be the main strategy to implement an integrated approach

The integrated energy planning can also connect the micro-level planning with the national development planning. Micro-level planning includes the energy and agriculture sectors, while national level planning includes energy, agriculture and development of rural areas. This step can also raise the issue of environmental conservation at the local level to the national level.

MODEL OF RURAL ENERGY PLANNING

Rural Energy Demand

Calculation of rural energy demand is needed as part of rural development planning. The study of energy demand planning is similar to the calculation method of the energy mix for larger areas, such as a country. However, for rural areas, it can be simplified by considering the existing renewable energy potential as well as the daily energy demand of rural communities.

In rural areas, family energy demand is mainly used for cooking. The results for the studied hamlets are as follows. In Mount Halu, for cooking purposes, in average, family uses 12 m3/household/year of firewood. A Kerosene-to-LPG conversion program has been successfully carried out in the rural areas as a substitute energy for cooking. For example, more than 90 percent of the population in the Seriwe hamlet have been using LPG with an average LPG demand per family is 144 kg/household/year. The conversion program will be successful if the government guarantees the availability and ease to get LPG in rural areas. Results of simulation studies in Tangsi Jaya hamlet shows that household energy conversion to LPG can save 60 percent of rural energy demand. Another advantage is the preservation of the rural environment due to decrease in the use of firewood.

Another energy demand is electricity used for lighting or to power other electrical equipment. Calculation of electric demand is necessary to determine the number of electric generating units that are need and to be provided to a village and how much local renewable energy is needed to meet the electricity needs of the rural community. In the Tangsi Jaya case study, the average electricity demand is 800 kWh/household/year which is mostly used for lighting.

Energy demand from fossil fuel/gasoline in the country is now beginning to decrease. Previously, people still depended on kerosene for cooking and lighting. Now, people use fossil fuel/gasoline for transportation. The source of energy for the processing of industrial agriculture is mostly thermal energy. By calculating the energy demand of households and small industries in rural areas, the total energy needed can be calculated for each village.

Survey of Potential Electricity Demand

A feasibility study or survey of the service level and potential power demand should be done before installing a power plant such as micro-hydro, in rural areas. This feasibility study is needed to determine whether the level of power demand is higher than the existing production and service capacity of grid electricity. This is one of the considerations related to efficiency. The feasibility study is conducted to determine the electrification ratio or the ratio between the number of households that are already connected to grid electricity and those who are not yet connected.

In the case study in Tangsi Jaya, MHP plant was constructed at the same time with the distribution of grid electricity in the village main street grid so that 6 households are already connected with electricity. However, because the grid has not yet entered the highlands parts of the village, the micro-hydro power (MHP) is still feasible to be built. The villagers still prefer to use MHP since they pay less for the electricity.

Unlike the case in Seriwe, although wind and solar potential is quite abundant, it is not feasible to exploit the RE potential to provide electricity for households, since the installation of grid electricity networks has already started. RE cannot compete with grid electricity. It is better to focus on using RE for electricity supply in productive activities, such as seaweed drying.

IMPLEMENTATION

Obstacles and Constraints

Implementation of integrated energy planning framework for rural development and sustainable agriculture are faced with several obstacles and constraints which are summarized as follows:

Coordination

In Tangsi Jaya, sectoral constraints occur between stakeholders due to lack of coordination in the management of existing MHP plant. It would be better if in RE projects, joint management institutions are established. For example, a cooperative could be given full authority to manage and maintain existing installations. Local governments can play a role as coordinator of each stakeholder. In the case of Tangsi Jaya, sectoral constraints occur between stakeholders due to lack of coordination in the management of existing MHP plant.

Imbalance between Demand and Supply of Energy

This occurs if the energy supply planning does not correspond to the growing need. In energy supply planning, the increase in energy demand should also be taken into account. This happens in the case of the management of solar water pumping in the hamlet Banyumeneng that is not able to serve the needs of all residents of the village. The same goes for the dryer unit in Seriwe Hamlet that cannot function optimally due to the limited capacity of the dryer unit. The results of simulation calculation also found that the supply of electrical energy in micro hydropower Tangsi Jaya is also feared insufficient in the coming five years if the power consumption continues to rise due to changing lifestyles that is not coupled with the provision of adequate electricity.

Lack of Community Participation

People should also be addressed as the subject of development by involving them in the activities of RE projects; people's participation is directed to the independence of RE installation management. Some rural communities have formed cooperatives such as Cooperative Rimba Lestari in Tangsi Jaya, Cooperative Society Cottoni in Seriwe and Water Management in Banyumeneng.

Lack of Participation of Financial Institutions

Financial institutions shall have a role in providing soft loans or financing schemes that support RE programs in rural areas that are aimed at financing productive activities that generate added value.

Lack of Skilled Labor as a Development Agent.

Darma Persada University through community service has provided managerial training for cooperative management in Tangsi Jaya so it can properly manage the cooperative.

Mechanism to Overcome Problems and Constraints

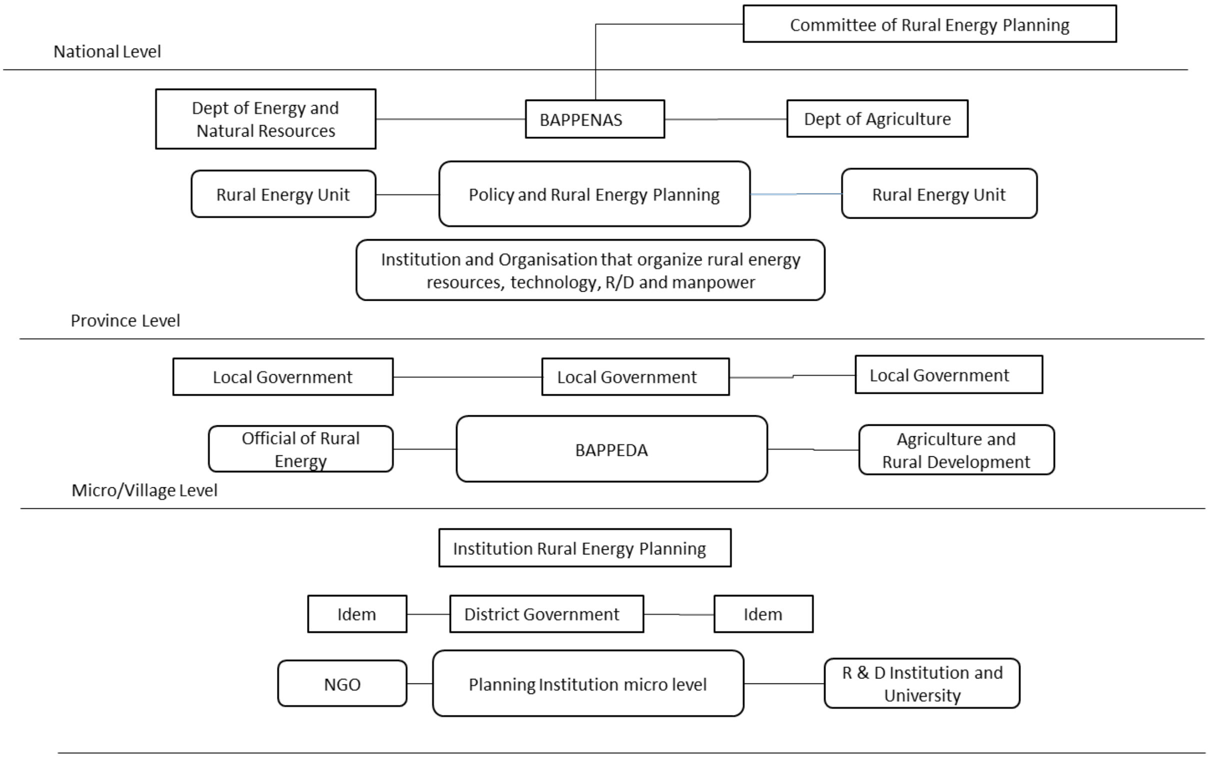
As an initial step to address a variety of issues and the application of integrated energy constraints, we have conducted a review of the existing national institutions, agreements and cooperation in rural energy programs. Based on our review of existing programs, we believe that a new program should be designed and developed with the following characteristics:

- An institutional mechanism, e.g. in the form of a pilot project for integrated rural energy planning which is oriented to the main problem and the solving of urgent problems in rural areas.
- A group of planning and policy makers at the national level who give support for energy policy and provide technical and financial assistance to support the energy projects at the local level. This group can be formed in an existing institution, such as BAPPENAS or the Department of Mining and Energy.
- A planning unit at the national level that is responsible for setting up a rural energy plan based on data and feedback from workshops at the local level and is also capable of setting allocations for various other programs based on the plan.
- Coordination mechanisms at the central, provincial and district/village levels to organize a variety of inputs and technical assistance to support an integrated rural energy program. This would also support input from R & D agencies, universities, and industry at national and regional levels.
- Coordination mechanisms at the local/village level that can increase the active participation of non-governmental organizations and individuals in order to foster active participation and the creation of a "sense of belonging" of people who use an integrated energy program.

Figure 3-2 indicates an institutional relationship order of integrated rural energy planning. The flow can be compared with a system of rural energy planning which is advisable for Indonesia.

Figure 3-2

Framework of Integrated Rural Energy Planning



4. Development Procedure

ALGORITHM FOR APPLICATION OF RENEWABLE ENERGY TECHNOLOGY FOR ECONOMIC DEVELOPMENT

The economic model referred to here is an algorithm or procedure to estimate how renewable energy technology can be used effectively to generate economic activity as shown in Figure 4-1. The area covered may be the size of a hamlet, a village, a regency or even a province. First one must know the barriers to effective utilization of locally available renewable energy sources. This is done using the PEST method: P (policy issue), E (economy), S (social awareness) and T (the renewable energy technology).

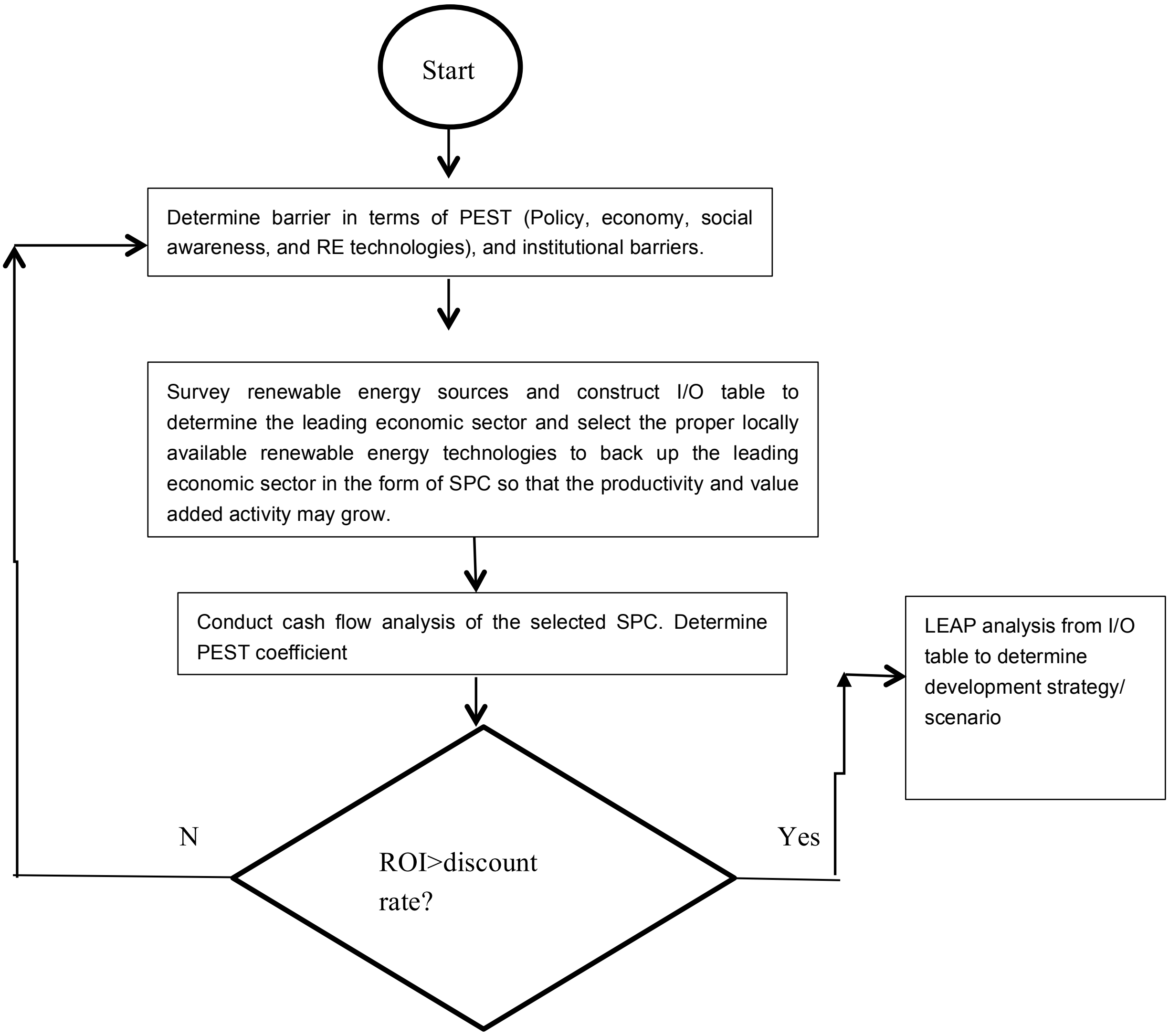
Policy issues relate to regulatory activity such as the feed-in-tariff, etc. The feed-in-tariff is the price that PLN (state electricity company) must pay for power from alternative generation facilities that is based on local cost of production of renewable energy. This should be negotiated among the government, utility and IPP. In the case of Tangsi Jaya, the feed–in–tariff of Rp 1004/kWh was not applied due to the poor condition of the local community. Instead, they are paid around Rp139 /kWh for electricity generated by the micro-hydro power plant. In such a case there will not be enough money to take care of the O/M cost of the micro-hydro power plant.

The economic issues address government policy regarding capital subsidy, grant, rebate, and tax incentive. In the current case studies, the funding for facilities for power and energy generation either for micro-hydro and SPC for ground coffee at Tangsi Jaya hamlet and SPC for seaweed drying at Seriwe hamlet are in the form of grants from the government. But the existing cooperative the Rimba Lestari at Tangsi Jaya hamlet has not been provided with working capital, access to markets, or necessary training to manage the SPC and the micro-hydro facility. For this reason the SPC has been idle for some time.

The same can be said for the case of Cottoni cooperative at Seriwe hamlet although a cash flow analysis has been provided to the latter case. Under the SEADI Project, however, effort has been made to get the private sector involve in empowering the SPC at Tangsi Jaya hamlet and a cash flow analysis has also been provided to back up the business venture. All cash flow analysis has shown the benefit of using the recommended SPC even when using the commercial interest rate of between 14 percent to 18 percent, including taxes.

Social awareness may refer to the number of people involved in the SPC, while the technology aspect deals with renewable energy technology to support the existing SPC. Institutional barriers refer to those barriers related to institutions such as local cooperative, local government, and private sector that have been neglecting the potential of the natural resources available in the hamlets. Institutional barriers may include market conditions as in Seriwe where the market is managed by collectors and the farmer has ability to bargain for a better price.

Figure 4-1
Algorithm for Application of Renewable Energy Technology for Economic Development



The next step is to determine the available local renewable energy sources as well as the economic structure of each hamlet by constructing an I/O table so as to be able to select the leading economic sector where the renewable energy technology could be applied. Then the cash flow analysis of the established SPC could be conducted to check the viability of the SPC.

If the ROI is lower than the discount rate, the electricity tariff and discount rate has to be modified in such a way so that the ROI can become greater than the discount rate. Next step will be on determining each coefficient of PEST to see the impact of the variation of electricity tariff, discount rate, number of people involved with the SPC and the cost of technology used for the SPC on the benefit gained by the SPC.

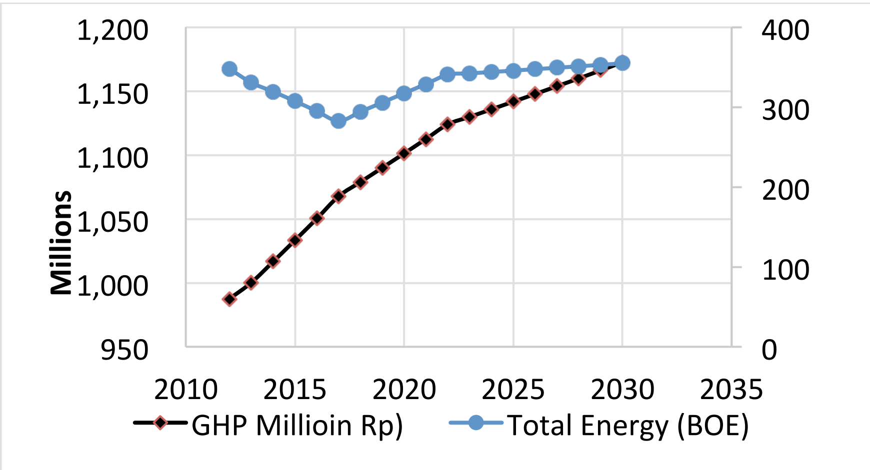
By knowing such relation, the manager of the SPC can be in a better position to bargain for a change in the electricity tariff or discount rate given the number of people involved in the SPC and the current technology. For the case of Tangsi Jaya hamlet, the SPC is profitable under an electricity tariff from Rp.139/kWh to Rp.920/kWh, with a discount rate between 6 percent/annum to 18 percent/annum. In Seriwe hamlet the SPC can be profitable if the electricity tariff is between Rp.610/kWh to Rp.1800/kWh and the discount rate is between 12 percent/annum to 16 percent/annum.

Now from the LEAP analysis and the I/O table one can formulate development strategy, one under high economic growth and the other under lower economic growth condition. This information can also be used as valuable input for KED (local energy policy).

From the above analysis it can be recommended that all renewable energy facilities should be provided on grant basis by the government with easy access to working capital even with commercial loan, access to market and with varying electricity tariff of up to Rp1800/kWh.

Figure 4-2 shows the relationship between GHP and energy consumption based on BAU (business as usual scenario) but here there is a fuel shift from firewood to LPG until 2017. The energy mix then is as shown in Figure 4-3, below. The figure indicates that the LPG consumption for household increase beyond gasoline and electricity consumption

Figure 4-2
Relation between GHP and Energy Consumption in Tangsi Jaya Hamlet



FEASIBILITY STUDY

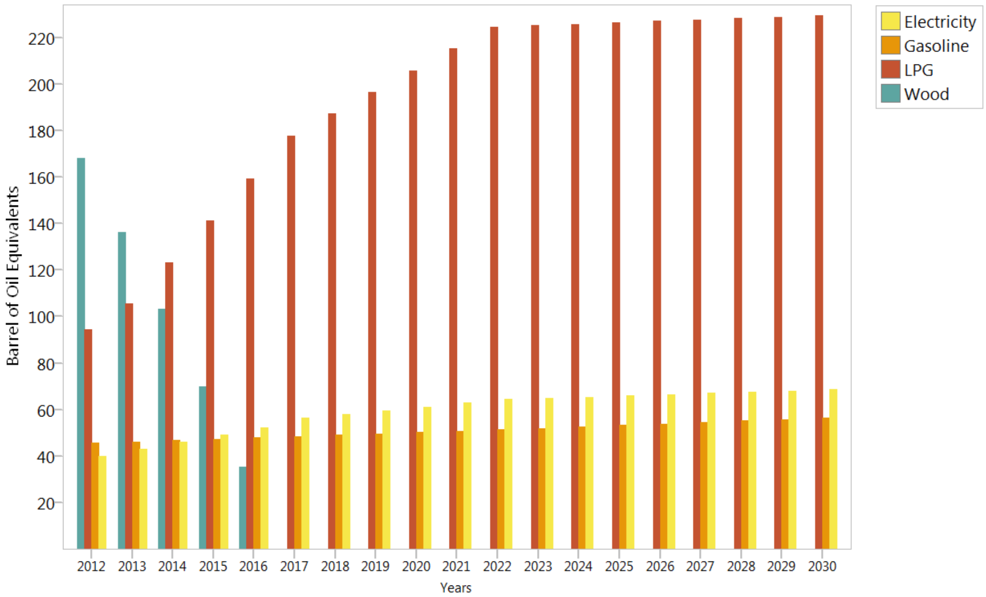
The feasibility study requirement in the Rural Energy Planning is aimed at the group of decision maker (local government, private company/CSR, etc.). A feasibility study requires consideration of the technical, environmental, and economic feasibility of the RE project. Closely related to the technical and economic preconditions are organizational, social culture, and sustainability aspect[8].

- Technical evaluation is performed to see if it is possible to use the system, whether it has less environmental impact than other solutions, and whether the devices can supply energy demand for long lifetime.

[8] See: Feasibility study guidance of micro hydro Indonesia provided by Integrated Micro hydro Development and Application Program (IMIDAP)

Figure 4-3

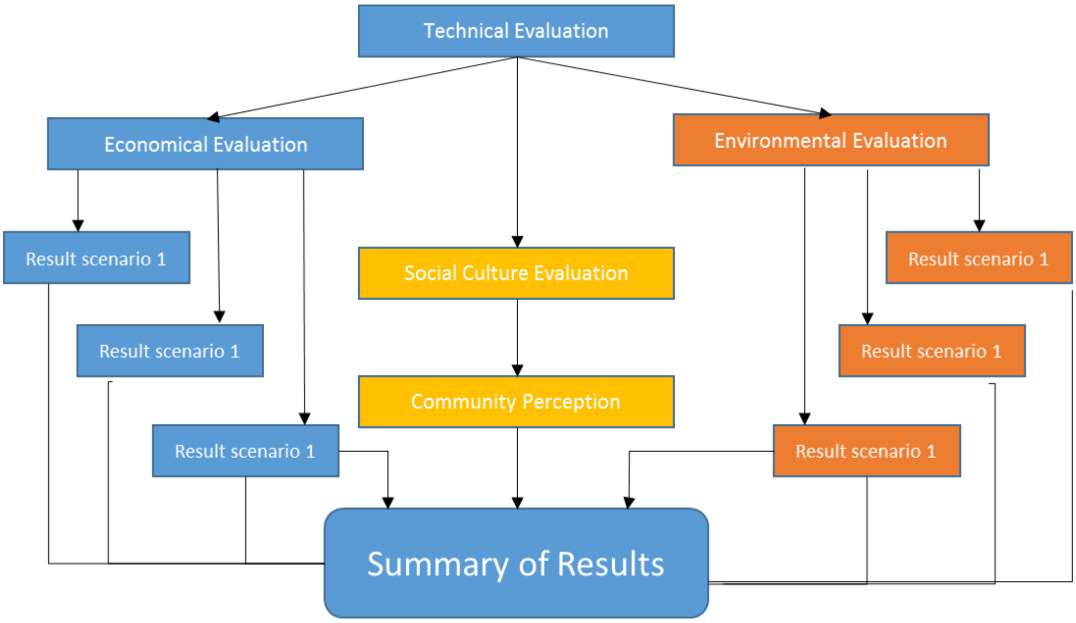
Energy Mix of Energy Consumption in Tangsi Jaya Hamlet



- Economic evaluation considers different price scenarios as well as investment and operational costs. In addition, a projection of possible financing schemes has to be available. There are different ways of calculating the cost of energy-saving actions. Examples of methods of calculation include:
  - The present-value method: future yearly expenses/costs and incomes, savings are converted into their values as of today. The present value depends on the costs of capital, changes in energy prices, and the period of calculation that has been chosen. The present value of future payments in and out, minus the original investment cost, is referred to as capital value. If the capital value is above zero the investment is profitable.
  - Annual cost per kWh (saving costs): energy cost which leads to a capital value that equals zero is also called the saving cost. If the value of this cost is lower than today's variable energy cost, the investment is considered as profitable
  - Internal rate of return method: the actual cost of capital, which results in a capital value that equals zero is called the internal rate of return. If the internal rate of return exceeds the chosen actual cost of capital, the investment is considered as profitable.
  - Social Culture Evaluation, A feasibility study also includes a community participatory process that examines the social condition of the community to determine the readiness of the community, local customs, and life relationships.
  - The environmental evaluation is made for different mixes of energy resources, and for different scenarios of future changes in the environmental impact of different energy sources.

Figure 4-4

Overview of Different Evaluations in a Feasibility Study9



SUSTAINABILITY PLAN

The crucial factors affecting the sustainable operation of applied renewable energy technologies for economic development are:

- Qualified institutions and managers of the installed SPC powered by renewable energy technologies. For this purpose special training both for the manager and the operator should be conducted. At present most of the selected villages/hamlets have their own institution to manage the energy generation facilities. They then can be given additional responsibility to manage the productive uses of the generated energy either in the form of electricity or fuel.
- The existing renewable energy technology applied should be proven to be functional and should bring benefit to the users. (ROI >current interest rates, NPV, positive, BEP < 5 years)
- The availability of working capital (using soft loan, commercial loan, or grant). To ensure the sustainability of the project special assistance such as exemption from taxes before spin-off, bank guarantee, or grace period treatment may be applied
- Access to market for the product produced by the installed SPC should be identified, especially when captive market can be made possible
- Monitoring and evaluation by an university academic program jointly with local authorities. The academic programs are geared such the students, can perform their practical training at the projects sites, including for research activities for their undergraduate and graduate theses.

In order to evaluate the sustainability of operation of SPC, sustainable parameters for the production function of the SPC must be determined. Such parameters should be obtained during monitoring of project activities until spin-off can be obtained and are described below.

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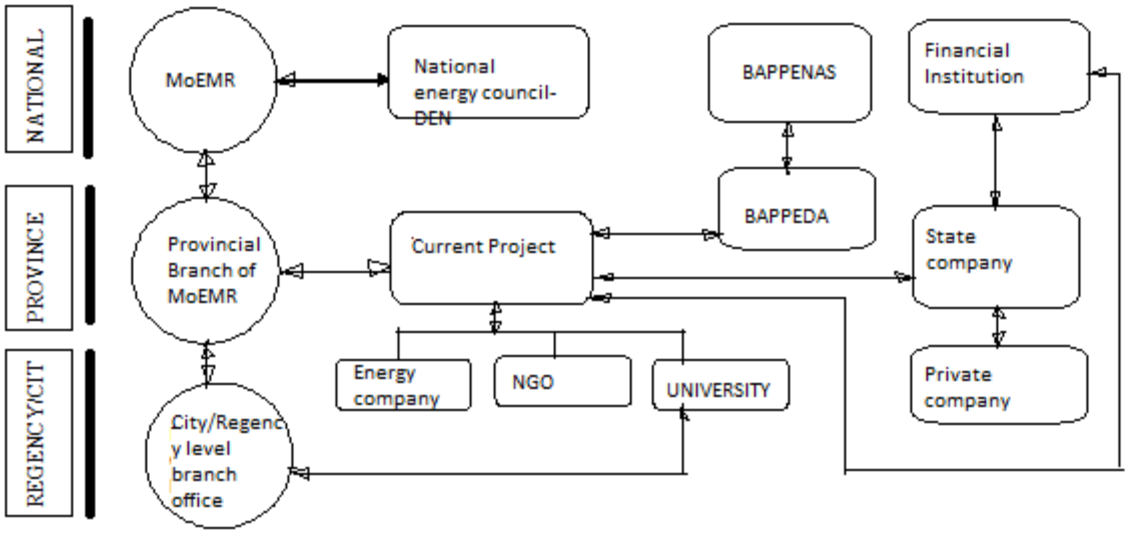
[9] See: SENTRO-WP4-Handbook for Performing Feasibility Studies of Alternative Energy Systems

Another effort to make the activity sustainable is to strengthen the relationship between stakeholders and the project as shown in schematic diagram in Figure 4-5. Besides involving NGOs, university academic programs involving both students and academic staff can make use the Project as field laboratory for conducting field practices, and research for undergraduate and graduate theses. In this way regular and continuous care of the project can be maintained.

Figure 4-5
Interrelation between the Project and Stakeholders



Success Benchmark of Rural Economic Development Model

As a measure of the success of the creation of RE-based rural economic development, there are five indicators known as the magic pentagon that should be measured:

- Existing growth
- Adequate availability of employment for all villagers
- The creation of development based on community participation
- The creation of an independent society
- The creation of conditions of togetherness and justice

Through measurable indicators, these can be monitored and evaluated periodically to determine the effectiveness of the implementation of the ESSV. Thus, the impact of technology and the acceleration of the industrial processes to create a sustainable development climate can be analyzed more systematically. Therefore, this program can be integrated into the curriculum of higher education so that the data measuring the success of this concept is scientific and is enriched with practical experience in the field.

5. Lessons Learned from Project Sites

We chose three hamlets to be part of this study. One of them was Tangsi Jaya hamlet, G. Halu West Java. This hamlet was selected since it is one of the Energy Self-sufficient Villages under the government program. Another hamlet was the Banyumeneng I hamlet, of Gunung Kidul, located in Special Province of Yogyakarta. This hamlet was selected since it is one of Gadjah Mada University's field laboratories for student's practical training. The last hamlet selected was Seriwe hamlet, in East Lombok of West Nusa Tenggara.

BARRIERS TO HIGH ECONOMIC GROWTH

Lack of Productive Land

The main source of income of the people at Tangsi Jaya hamlet is paddy farming with average ownership of 3 *gawang* (0.12 ha)/ HH. The farmers grow a local variety of rice which can only be harvested after 7 months. The yield is about 0.6 ton/gawang or 1.8 ton/ year per family on average. Most of the paddy grown in the village is for own consumption. Total area of paddy field was +/- 8.8 Ha and for coffee plantation of 20 Ha owned by 74 household each having area of +/- 0.27 Ha.

Table 5-1

Agricultural Production in Banyumeneng I Hamlet

Product	Sold (kg)	Self Consumed (kg)	Average Price (Rp/kg)	Income (Thousands Rp)	Self Consumed	Cost for Seed and Fertilizer (Rp/kg)	Cost for Seed and Fertilizer	Harvest Time (months)
Rice	23170	8350	3000	69510	25050	240	7564.8	3
Corn	18540	25	3000	55620	75	920	17079.8	3
Tobacco	1421	0	60000	85260	0	6000	8526	3
Cassava	9215	1000	1000	9215	1000	250	2553.75	9
Peanut	1857	25	10000	18570	250	2800	5269.6	3
TOTAL	238175	26375		40993.95				

About 20 households grow rice but also cultivate various vegetables with an average harvest time of 3 months. They sell the vegetables to middlemen who come to their farm to collect the vegetables and buy at relatively low price. The average income received from these vegetable was around Rp. 2 million/HH/season. Almost all of the harvested vegetables were sold to the nearby market.

Besides rice farming and vegetables cultivation, 70 households also own a coffee plantation. The plantation is located mostly within the forestland owned by Perhutani, a state enterprises. Each household has an average of 0.12 ha planted with 300 coffee trees. Each tree can bear 600 kg of coffee berries during each harvest. The coffee, unprocessed, is sold to the middlemen. The average income from a coffee plantation is Rp.1,800,000/HH/year. Some, 14 households own 5 goats or sheep, while 9 others are rearing some other animals based on a leasing scheme with the owners. In Tangsi Jaya hamlet there are some small kiosks which sell daily necessities and a market about 6 km away in Gunung Halu village.

Although having a limited area of production most people of Banyumeneng I hamlet engage in agriculture, growing rice, tobacco, corn, cassava and peanut on their own land. During the rainy season people grow rice, corn, peanuts and cassava while during the dry season, they grow tobacco. Most these products are sold to the market except some of the rice and cassava is consumed by the households. Shredded tobacco has been a popular commodity since it has a good value being sold at Rp 60,000/kg.

Lack of Basic Needs and Infrastructure

While in Tangsi Jaya hamlet all basic needs could be supplied from inside the hamlet, most of daily necessity including rice in Seriwe hamlet must be supplied from outside. Here there is no access to clean water or to electricity. In Banyumeneng hamlet, water is scarce and infrastructure both for transportation and communication needs further improvement.

Figure 5-1
Root Way in Banyumeneng

Low Quality of Product

At Tangsi Jaya hamlet, the quality of ground coffee is low and producers need guidance on how to produce better quality product. The current machine that is used to process the beans is not made of stainless steel as required in food processing industry.

The shredded tobacco in Banyumeneng I hamlet is dried under direct sun so variation in quality is a problem. In addition this traditional processing method is hugely dependent on weather conditions.

Most of seaweed in Seriwe hamlet is sundried and are susceptible to dirt and foreign materials. The presence of SPC in the form of hybrid solar dryer may help to improve the quality.

Figure 5-2
Direct Sun Drying of Seaweed in Seriwe Hamlet

Market Access

For Tangsi Jaya hamlet, there is no difficulty for market access to Sindangkerta, which lies within 5 km from the hamlet. Most transport activity is by motorcycle. In Banyumeneng I, a market is available in Pasar Silok Imogiri about 2 km away.

In Seriwe hamlet, the market for seaweed at this time is within the hamlet itself since the collector comes to the hamlet for the transaction. The problem here is that the price of sundried seaweeds is then set by the collector.

Elements (Institution, Technology, Energy, and Natural Resources), that could Trigger Economic Growth and Affect MDGs

The key element to trigger economic growth in each hamlet would be the empowerment of the existing cooperative. Through these cooperatives important resource of the hamlet can be managed. Recently, with assistance from a team from Darma Persada University, Rimba Lestari cooperative in Tangsi Jaya hamlet was officially established. Previously the cooperative had been idle, and could not manage the existing SPC properly, due to lack of access to working capital and market outlet of their product, especially the processed ground coffee. It is anticipated that with its new status, Rimba Lestari cooperative may begin to manage the SPV in a more professional manner. In addition to the effort for triggering economic growth through the empowerment of the cooperative, through assistance from the Darma Persada team, a private company is willing to work with the cooperative take care of the SPC for ground coffee production. With the involvement of the private sector, it is anticipated that economic growth will begin soon.

In Banyumeneng I hamlet, OPAkg manages the water supply to the village. It was recommended that this institution become a full pledge cooperative so that it can also manage an SPC for shredded tobacco production.

Figure 5-3
Cottoni Cooperative Seriwe-East Lombok

In Seriwe hamlet, Cottoni cooperative was established to manage the SPC for seaweed drying. It was advised that the Cottoni cooperative dry seaweed from the farmer from 45 percent wb to 35 percent wb using a leasing scheme and later sell the dried seaweeds in markets in Surabaya, where the price is higher.

DESIGNING MODEL FOR ADOPTING RENEWABLE ENERGY

Determining Leading Economic Sectors from Constructed I/O table

To determine the leading economic sector of each hamlet, an I/O table for each hamlet was constructed. In Tangsi Jaya hamlet, rice production is the leading economic sector with share of 28.6 percent of total output or the Gross Hamlet Product (GHP) as shown in Appendix A. It appears from the I/O table, that in total, from supply side, Tangsi Jaya Village is able to supply 79.1 percent of their needs, while 20.9 percent is imported from other regions. Furthermore, from the total rice sector has the greatest share in production with 28.6 percent followed by chili 26.3 percent, vegetable 19.7 percent while coffee production with share of 14.0 percent.

In Banyumeneng I hamlet the agricultural sector contribute 79 percent of the total GHP, followed by the animal husbandry sector with 19 percent and forestry sector of 5.6 percent. Within the agricultural sector tobacco production has the greatest share to the total income from the agricultural sector as shown in the Appendix A.

In Seriwe hamlet the constructed I/O table is as shown in Appendix A shows that the leading economic sector is the seaweed production with an 85 percent share of GHP, followed by fisheries with 7.3 percent and corn 0.34 percent.

Fiscal Incentive

RE installation development in rural areas has been designed to improve the lives of rural communities. It is unfortunate if the RE energy projects are unable to operate a few years after the operation.RE development should be sustainable and not stop when the plant is built. Instead, the rural communities should continue operating the installation independently. An example, is the Micro Hydro Power (MHP) in Gunung Halu, where dues collected from the villager are used to pay for the cost of maintenance operations. Unfortunately, the actual cost for maintenance, depreciation, and operators' salary is higher than the dues collected. Thus, this project is not feasible with current negative cash flow.

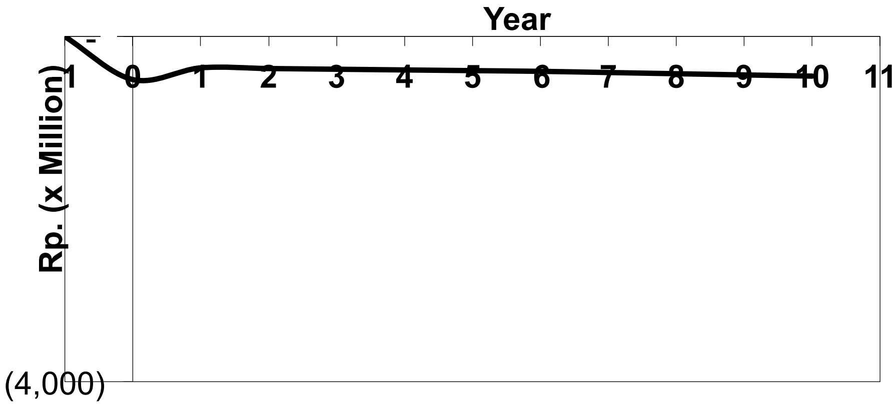
Case Study: MHP Gunung Halu

Currently, a community group manages the MHP. The analysis assumes an initial value investment for the MHP installation of Rp. 500,000,000 and a rate of interest of 12 percent. Operating costs are borne by residents, such as operator labor costs, maintenance and depreciation, and the cost/tariff of the electricity of Rp. 25,000, -/month for 1A usage and Rp. 30,000, -/month for 2A usage. Simulation results indicate that the MHP would be feasible to operate if there were additional funding to subsidize the cost of installation operation for two years. After two years of operation, cash flow will be positive and it means the villagers are ready to independently operate the plant.

Table 5-2
Feasibility Study of Micro-Hydro without Subsidy, 2012

Item	Value
Investment	Rp. 500,000,000,-
Loan	-
Interest	12%
NPV	Rp. (357,814,999)
IRR	-
NPM Sales/EBIT & Zakat	-1574.09%
NPM Sales, EAZ	-951.03%
NPM to Investment	-45.97%
B / C Ratio	-
Period	5 Years

Figure 5-4
Discounted Cash flow Curve



The feasibility study as shown in Table 5-2 indicates that the MHP is not profitable with the assumptions mentioned previously, because the MHP financial condition will suffer continuously. (Appendix B) In order for MHP unit to remain viable, it requires a healthy financial condition. It is assumed that after two years of operation, the cash flow will become positive (MHP viable operation). Table 5-3 shows the results of calculations assumed as follows:

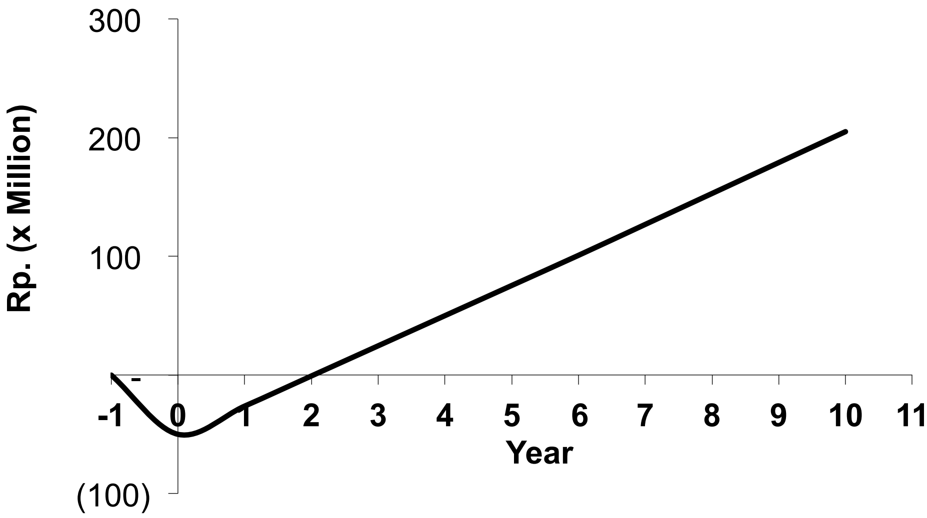
- Government investment value of MHP is Rp. 500,000,000. It is a grant for hamlet residents, and all costs incurred by the residents for maintenance and landslide disaster in October of 2012 which is + / - Rp. 50.000.000, is considered as the value of investment.
- Regular costs for the monthly energy expenses such as operator, maintenance and depreciation are Rp, 32.5 million/month and is still subsidized by the government for two years.

With the above assumptions, the simulation show that MHP Unit continues to operate with the assumption of fixed subsidies for two years. After two years, residents can independently manage the unit to support productive activities such as for the installed SPC for ground coffee.

Table 5-3
Feasibility Study by Subsidy Scenario for Five Years, 2012-2017

Item	Value
Investment	Rp. 50,000,000,-
Loan	
Interest	12%
NPV	Rp. (35.820.163)
IRR	48.88%
NPM Sales/EBIT & Zakat	96.70%
NPM Sales, EAZ	107.83%
NPM to Investment	52.12%
B / C Ratio	30
Period	5 Years

Figure 5-5
Discounted Cash Flow Curve by Subsidy Scenario



Small Processing Center

We found that renewable energy works best in rural community when it develops functional linkages with core rural businesses, in particular agriculture, forestry, fisheries and other economic potential sector by means of a small processing center (SPC). Some examples of how renewable energy technologies are being well integrated into rural development through the SPC are given in this study. The SPC will be used to add value to the leading economic sector of a village.

Trigger for Rural Economic Development

The obstacle in implementing an SPC is that the development plan lacks sufficient details, such as on how to obtain raw materials, how to select the proper technology, and an estimation of operation and maintenance cost. SPC development of coffee processing in Tangsi Jaya hamlet is one of example of this case. The SPC for ground coffee has not operated for some time. This can be seen in Figure 10 below which shows that the production line is now used as a warehouse. It shows the condition of the machinery was under heavy corrosion. This was probably due to:

- Lack of proper management. The processing facility does not meet the standard of production of food / beverages.
- Improper selection of engine (engine and motor sizing).
- Some engines are damaged.
- The supply of raw materials from the farmer could not be maintained continuously because the existing Rimba Lestari cooperatives was not able to purchase raw materials from the farmer due to limited working capital, while the people need cash for everyday life.
- The quantity of the coffee harvested in the hamlet is still small, therefore, it cannot keep the machine operating continuously..
- The produce market would not accept the output of the SPC as it doe not meet quality standards.
- The SPC is hesitant to produce and market products in the form of ground coffee because it must have permission from the Food and Drug Supervisory Agency (BPOM). Meanwhile the existing Rimba Lestari cooperative that manages the SPC still does not have legal status and so cannot apply

for production permission from BPOM or apply for working capital from financial institutions (bank/nonbank).

The existence of coffee SPC in Tangsi Jaya hamlet is actually worth the investment and is needed by the community as they own a coffee plantation. In addition, many residents outside of the hamlet but still within the village of Gunung Halu also grow coffee.

The existing SPC of coffee needs to be fundamentally restructured, including plant infrastructure, human resources, financial resources, and market access. A development approach using an aid/grant seems no longer suitable here. It is high time to change the approach into a business method which generates profit.

Figure 5-6
SPC Coffee Conditions, No Longer Operating and Turned into Warehouse, December 2012

A new SPC facility must be constructed to replace the old facility that is no longer operational. (As shown in Figure 5-6, the existing machines cannot be operated.) The new SPC must have machines that meet food industry standards such as cleanliness and hygiene. In addition, the machines at the old facility are inefficient because of the power used is very large and does not fit with the electric energy provided by the MHP. Therefore, machines selection should also be adapted to the availability of the existing electrical energy. Below is the feasibility study with the following assumptions:

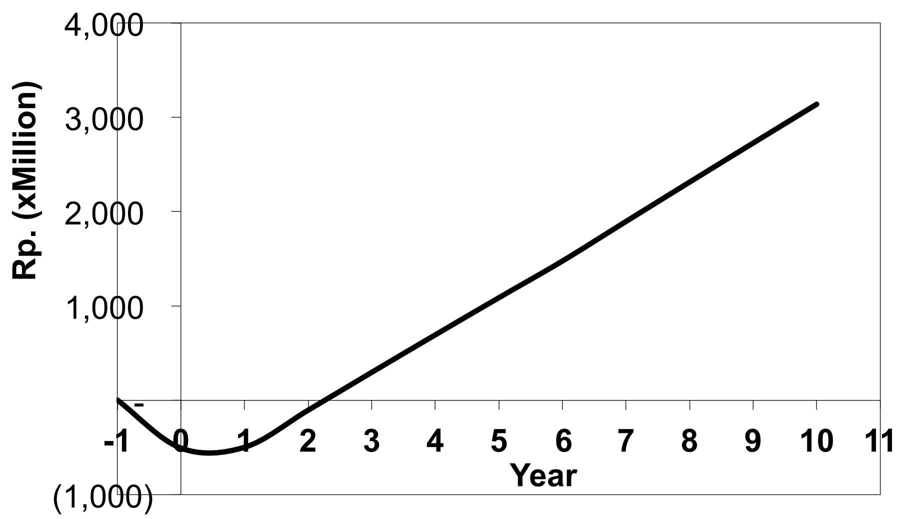
- Rp. 505,750,000 is need for investment in production facilities and infrastructure and Rp. 190,137,500 is needed for three months of working capital
- Coffee beans should be provided at minimum of 400 kgs per day at a price of Rp. 3,000/kg for Robusta variety and Rp. 5,000/kg for Arabica variety. Operating days will be 25 days per month. The cash flow analysis will be conducted for the next 5 years.
- Production is set to produce ground coffee with 20 percent recovery. The selling price of Robusta coffee will be Rp. 50,000/kg and Arabica coffee will be Rp. 60,000/kg. Bank interest rate will be 12 percent and the loan value will be Rp. 250 million.

- The results of cash flow analysis for SPC for ground Coffee investment feasibility study can be seen in Table 5-4 and Figure 5-7.

Table 5-4
Feasibility Study Small Processing Centre Powder Coffee, 2012-2017

Item	Value
Investment	Rp. 505.750.000
Loan	Rp. 250.000.000
Interest	12.00%
NPV	Rp. 514,156,309
IRR	51.27%
NPM Sales/EBIT & Zakat	37.97%
NPM Sales, EAZ	23.58%
NPM to Investment	64.29%
B / C Ratio	2
Period	5 Years

Figure 5-7
Discounted Cash-Flow Curve for SPU Coffee Powder



Impact on Value Added

The industrialization process in a hamlet can be started by SPC development. An SPC aims to increase the value added of agriculture products (raw material) in order to increase farmers' income. For instance, quality of dry seaweed in Seriwe hamlet is better and has higher selling value when dried in the SPC than when dried through the conventional method.

As solar and wind energy are available in the hamlet, it was considered better to use these energy sources to increase value added of seaweed. Although relatively cheap, direct sun drying is susceptible to contamination from dirt and other foreign materials, which results in a low quality product. Therefore, in order to increase value added of the leading economic sector, a solar drying facility with 10 m x 6,9 m dimension has been constructed in the hamlet. As shown in Figures 5-8 and 5-9, it is a transparent structure with wind vortexes installed on its roof. Within the transparent structure three parallel racks were provided on which seaweeds will be spread for drying purposes.

Figure 5-8
Overview of Hybrid Solar Dryer

Figure 5-9
Internal View the Dryer Showing Drying Racks

Impact on GDP

As the agricultural sector has the highest contribution to the GDP, it was considered that a solar energy supported Small Processing Center for shredded tobacco would be a proper choice in Banyumeneng I hamlet. Currently the people of the hamlet use the traditional method of shredding and drying using direct sun drying. The solar dryer, one of the component of the SPC can also be used to dry corn and since it has biomass stove back up it could be operated during rainy days in the harvest season.

Table 5-6 also shows the effect of SPC installation on the increase in GDP and energy supply within five years of operation. It shows the increment in GDP and for energy as well as their respective annual increment. At the end of the first year, the installed SPC can generate revenue for the village. In addition, the SPC can also drive other sectors of the economy that led to the economic growth shown by the significant increase in the GDP of the village. From the table, it can be seen that the SPC produces 11 percent increase in GDP, compared to without SPC installation in the first year. Furthermore, in the 2nd year and so on, SPC can continue to drive the process of agricultural industrialization which generates more added value and can maintain GDP growth in the range of 5.8-6.8 percent year-to-year (Y / Y).

Table 5-6
Effect of SPC Installation on GDP and Energy Consumption

Year	SPC	GDP			Energy	
		Value (Rp)	Increment (%)	Annual Growth (%)	Amount (Rp)	Increment (%)
0	0	504,331,634	0.0	0.0	48,424,000	0.0
1	-125,000,000.00	560,048,206	11.0	11.0	60,627,542	25.2
2	-85,104,400.00	592,464,108	17.5	5.8	63,945,725	32.1
3	-40,075,416.00	629,050,978	24.7	6.2	67,690,861	39.8
4	10,801,105.00	670,389,079	32.9	6.6	71,922,346	48.5
5	66,867,100.00	715,943,722	42.0	6.8	76,585,448	58.2

The economic growth must be supported by energy requirements as shown by Table 5-6. The table also indicates that every 1 percent increase in GHP growth needs 3,8 percent of energy supply. Figures 5-10 and 5-11 show the effects of the changes in the composition of the SPC for each sector of the economy. It can be seen that after 5 years of operation, the industrial sector now has increased from 4.2 percent to 29 percent and the agriculture sector now has decreased from 79 percent share to 58 percent.

Figure 5-10
Annual Increment of Energy and Water as a Result of SPC Installation and Operation

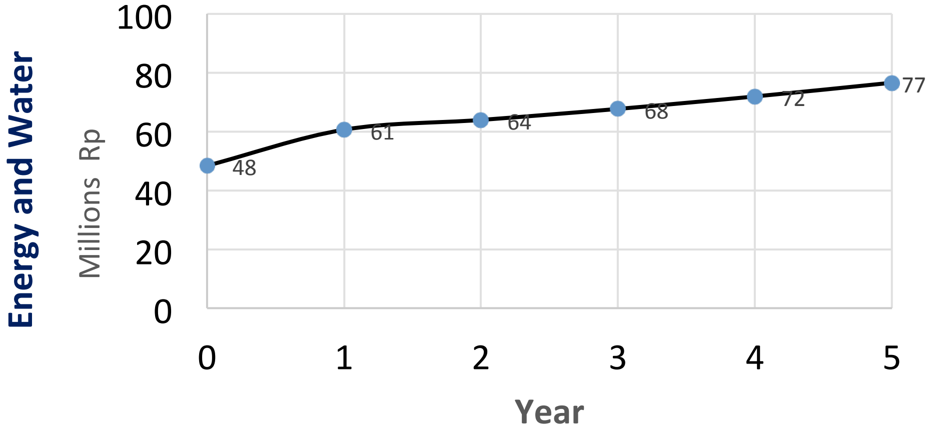


Figure 5-11
Annual Increment of GDP as a Result of SPC Installation and Operation

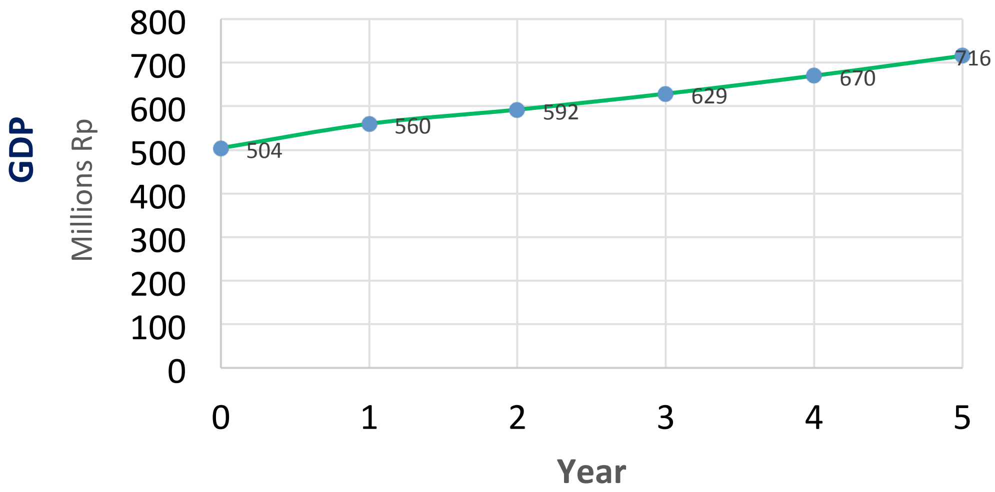


Figure 5-12

Condition of Each Sector and Its Contribution to GDP (Year-0)

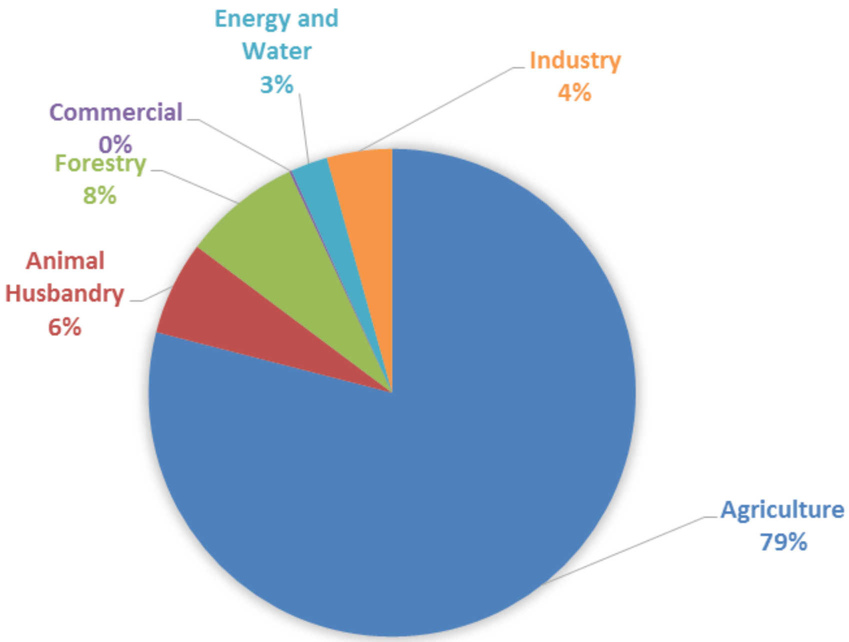
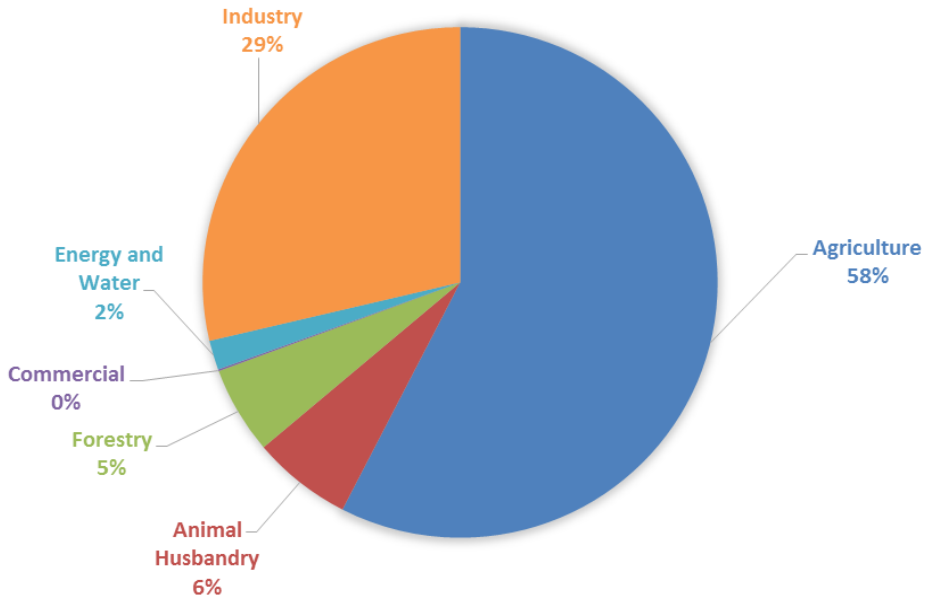


Figure 5-13

Change in Share of GDP as a Result of SPC Installation and Operation (Year-5).



Perception

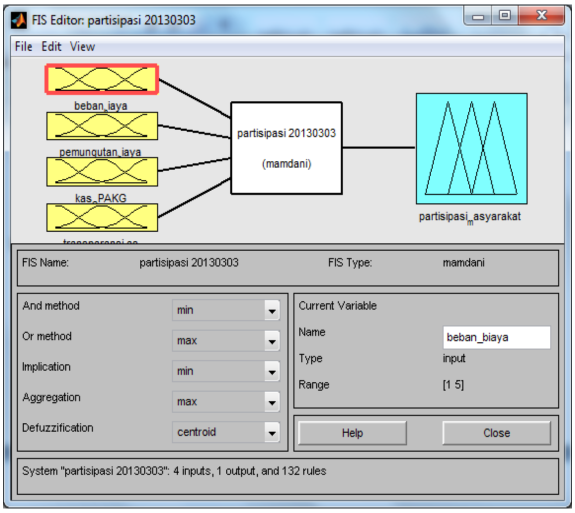
Before installing any RE facilities in the hamlet it would be better to study the perception of the community which will be involved in the project. This activity is imperative in order to guarantee the sustainability of such a project. In this section an example of such study will be given.

Perception of the Solar Water Pumping Technology at Banyumeneng I Hamlet

As existing water pumps cannot meet the demand for water in the Banyumeneng I hamlet, consider is being given to installing another solar water pumping system (SWPS). Before providing another solar water pumping unit, it is necessary to see how current users feel about the system. For this purpose a fuzzy logic has been applied after collecting data regarding perceptions of the aspect of technology, management, utilization, participation and development as shown in Figure 5-14. The score was divided into 5 classes, 1=poor, 2= fair, 3=good, 4=very good and 5=excellent and the results can be seen in Figure 20. It shows that the perceptions of people regarding the SWPS were generally good with the participation having the highest score indicating the importance of the facility to the people of Banyumeneng I hamlet. The lowest score was on technology, probably due to some problems in pumping system which once disturbed the supply system.

Figure 5-14

Consumer Perception on SWPS Technology Application

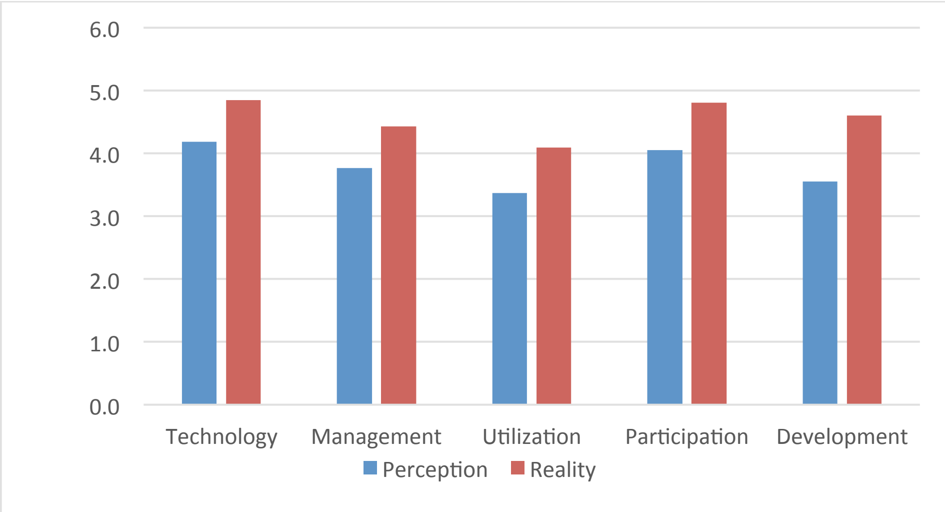


No	Aspect	Value
1	Technology	2,83
2	Management	3,0
3	Usefulness	3,0
4	Participation	3,29
5	Development	3,0

Perception of the SPC for Coffee and Micro-Hydro at Tangsi Jaya Hamlet

When asked about 5 traits of micro-hydro and SPC for coffee, 1, on technology used, 2, on management, 3, on the utilization, 4, on people's participation, and 5, on the development, there were difference in people perception and reality as shown in Figure 5-15. It shows that all judgment were above 4.0 which means they were satisfied with the presence of micro-hydro and SPC for coffee. Figure 5-15 also shows that their judgment was beyond expectation.

Figure 5-15
Perception versus Performance on Micro-Hydro and SPC for Coffee



Policy, Economy, Social awareness, Technology

The four main barriers to effective utilization of renewable energy technology for rural development are the Policy, Economy, Social awareness and Technology. As mentioned in the previous section, the policy issue may refer to electricity tariff, the economy to discount rate, social awareness is the number of people using the SPC and the renewable energy technology used by the SPC.

For the case of Tangsi Jaya hamlet the variation in electricity tariff and discount rate is as shown in Table 5-7, below. The PEST coefficients were found as follows:

$$C= -0.5947P+0.995\ E+43{,}416\ S+2{,}056T$$

Table 5-7
PEST Table

Electricity Tariff (Rp/kWh)	Interest rate (%/annum)	Number of Participants	Technology (Mill. Rp)	Net Benefit (Mills. Rp)
920	18	10	335	569
920	16	10	335	568
920	14	10	335	568
920	11	10	335	567
920	6	10	335	565
139	18	10	335	1039
139	16	10	335	1038
139	14	10	335	1037
139	11	10	335	1036
139	6	10	335	1035
139	18	16	185	999
139	16	16	185	998
139	14	16	185	997
139	11	16	185	996

Electricity Tariff (Rp/kWh)	Interest rate (%/annum)	Number of Participants	Technology (Mill. Rp)	Net Benefit (Mills. Rp)
139	6	16	185	999
920	6	10	335	565
750	11	10	335	757
500	14	10	335	975
250	16	16	185	991
139	18	16	185	999

Which means that further increase in electricity tariff will result in loss to the SPC, while the increase in discount rate, number of people involve and the technology used within the range shown in the table still make the SPC gain benefit.

For the case of Seriwe hamlet, the coefficient found was as follows:

$$C = -0.001P + 0{,}014E + 0.047S + 0.077T \qquad (1)$$

and the range of parameters is as shown in Table 5-8. The similar trend can be found hei increase in electricity tariff beyond the value listed in policy column of Table 5-8 will result in the loss of benefit of the SPC.

Table 5-8
PEST Parameters for Seaweed Drying Facility

Policy, (electricity tariff Rp/kWh)	Economy (interest rate-%/annum)	Social awareness (no. of people involved)	Technology	ROI	Calculated ROI
960	14	20	60	0.247	0.264
610	16	40	120	0.81	0.827
1800	15	60	180	1.22	1.278
720	13	20	60	0.262	0.302
810	12	40	120	0.832	0.863
1000	14	60	60	0.246	0.448

6. Conclusions and Recommendations

CONCLUSIONS

Renewable energy development in rural areas is part of the over all sustainable national development effort and therefore, Indonesia should continue to conduct monitoring and evaluation on how renewable energy technology could fit into the long range National Development strategy and goals

In the three villages studied, renewable energy can be used to develop rural economies. These cases could become valuable lessons learned to improve our strategy in R/D, pilot project implementation, dissemination and commercialization of R/D results to provide sustainable supply of primary energy especially in rural areas.

Renewable energy technologies could bring benefit in triggering economic growth by establishing Small Processing Centers. Using the I/O Table one could determine the leading economic sectors in each hamlet, where in Tangsi Jaya hamlet, coffee production was the leading economic sector, in Banyumeneng I hamlet it was tobacco production and in Seriwe hamlet it was seaweeds production. Finally, The renewable energy technologies applied could be accepted by local community in the three hamlets

RECOMMENDATIONS

From the research findings, and based on the identification of the potential, condition and limitation of available resources, it is advisable that in designing a development strategy for a village to become E3i Independent Village in the next 5 years, scenario, strategy and program should be specified as follows:

Scenario. In order for village economic activity to become more active, dynamic and expansionary, renewable energy technology should be directed toward the main economic sectors with development potential. Alternative economic activity is an essential effort in order to increase revenue for the welfare of the hamlet community

Strategy. Include all potential local resources (natural resources, resource-made, human resources) as well as those from outside of the hamlet, such as technology, funding, policy and markets. To integrate all the resources in the implementation of operations, partnerships or alliances might be used.

Program. Programs to be achieved within a period of five years, should be focused on two important factors that can support economic activity to become more active, dynamic, growing, and sustainable. Such programs are as follows:

- Increasing productivity of the main economic activities output

— Increase output of agricultural production: rice and vegetables;
— Rearrangements and optimization of SPC;

- Build Alternative Potential Economic activity:
  - — Determine alternative agricultural commodities that have added value over existing commodities;
  - — Develop existing potential nature tourism (waterfall).
  - — Legal status of cooperative.
  - — Establish partnerships (Cooperative-Government-Private Sector) with the organizations from outside hamlet that have the technology, funding, and resources to allow greater integration to a potential market.
- Program Implementer :In order to integrate potential elements from the hamlet with resources from outside the hamlet, the program implementer should be composed of the following institutions :
  - — Research Institute, UNSADA as initiator and facilitator for empowerment and partnerships; as well as the planning consultant.
  - — Cooperative
  - — Government / local government / village government / hamlet government
  - — Private institution with markets and technology potency;
  - — Financial institutions bank / non-bank;
  - — Donors / grants institution from the domestic and or overseas.
- Stages of Implementation Program
  - — **First year:** Socialization to stakeholders on the draft of scenario, strategy and development program for five years.
    - Develop concrete programs based on the identification of existing potential resources with a target to be achieved in the next five years.
    - Involving resources potential from outside the hamlet that have access to markets, and or technology, funding and other potential related to programs designed.
    - Develop legal aspects, covering scope of duties and responsibilities of each stakeholder with the principle of mutual benefit based on proportions.
    - Establish a leadership institute that will manage the joint venture.
  - — **Year two:** Technical and administrative implementation by all relevant stakeholders.
  - — **Third year:** The first year of continuous production, control, and evaluation stages, according to a predetermined design.
  - — **Fourth year:** The year of internal and external evaluation of market response.
  - — **Fifth year:** The year of improvement and stabilization based on the results of internal and external evaluation.
- Source of Funds, potential funding sources can be obtained from the financial institutions bank or non-bank, local government, cross department, grant of donor from domestic and abroad, and private investors.

In order to realize a partnership program with an alliance structure of economic actors (cooperative-village government-private) that will support the economic development of hamlet, factor and perception analysis must be conducted to know how to encourage the people to be willing to cooperate in the partnership program.

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Appendix A. Input/Output Tables

Table A-1

Tangsi Jaya Hamlet (x 1000 Rp)

Sector	Intermediate Demand	Final Demand	Total Demand	Import	Total Output	Total Supply
1. Paddy/Rice	13,038	289,777	302,815	43,740	259,075	302,815
	28.5%	26.4%	26.5%	18.3%	28.6%	26.5%
2. Chili	364	270,167	270,532	31,964	238,568	270,532
	0.8%	24.6%	23.6%	13.4%	26.3%	23.6%
3. Vegetable	364	223,943	224,307	45,610	178,698	224,307
	0.8%	20.4%	19.6%	19.1%	19.7%	19.6%
4. Coffee Plantation	14,130	214,269	228,400	101,918	126,481	228,399
	30.9%	19.5%	20.0%	42.7%	14.0%	20.0%
5. Transportation	13,350	73,531	86,881	12,020	74,861	86,881
	29.2%	6.7%	7.6%	5.0%	8.3%	7.6%
6. Energy	4,543	289,777	294,320	3,640	290,680	294,320
	9.9%	26.4%	25.7%	1.5%	32.1%	25.7%

Table A-2

Banyumeneng I Hamlet (x 1000 Rp)

Sector	Inter-mediate Demand	Household Consump-tion	Total Final Demand	Total Demand	Import	Total Output	Total Supply
Agriculture	142,529	132,630	314,695	457,224	58,788	398,436	457,224
	97.64%	60.85%	56.50%	65.04%	29.60%	79.00%	65.04%
Animal Husbandry	-	-	135,157	135,157	103,760	31,397	135,157
	0.00%	0.00%	24.27%	19.23%	52.24%	6.23%	19.23%
Forestry	-	39,560	39,560	39,560	-	39,560	39,560
	0.00%	18.15%	7.10%	5.63%	0.00%	7.84%	5.63%
Commercial	600	200	200	800	-	800	800
	0.41%	0.09%	0.04%	0.11%	0.00%	0.16%	0.11%
Energy and Water	2,838	45,586	45,586	48,424	36,072	12,352	48,424
	1.94%	20.91%	8.18%	6.89%	18.16%	2.45%	6.89%
Industry	-	-	21,786	21,786	-	21,786	21,786
	0.00%	0.00%	3.91%	3.10%	0.00%	4.32%	3.10%

Table A-3

Seriwe Hamlet, Expressed in Term of Money Transaction (Mill. Rp)

Sector	Intermediate Demand	Final Demand	Total Demand	Import	Total Output	Supply
1.Seaweed	3,910.00	6,881.60	10,791.60	1,742.73	9,048.88	10,791.60
	71.40%	63.33%	66.04%	30.74%	84.78%	66.04%
2. Fisheries	0.00	777.60	777.60	0.00	777.60	777.60
	0.00%	7.16%	4.76%	0.00%	7.29%	4.76%
3 Corn	6.93	33.37	40.30	4.00	36.30	40.30
	0.13%	0.31%	0.25%	0.07%	0.34%	0.25%
4. Commerce	1,179.00	2,404.80	3,583.80	3,066.00	517.80	3,583.80
	21.53%	22.13%	21.93%	54.08%	4.85%	21.93%
5. Transport	196.00	0.00	196.00	6.00	190.00	196.00
	3.58%	0.00%	1.20%	0.11%	1.78%	1.20%
6. Energy	184.45	0.00	184.45	850.20	(665.75)	184.45
	3.37%	0.00%	1.13%	15.00%	-6.24%	1.13%

Appendix B. PLTMH Investment Feasibility Analysis without Subsidy

A. Revenue

No.	Description	Price/KWH (Rp.)	Sales/month (KWh.)	Sales/year (Rp.)	Percent of Sales
1	House Hold (70 %)	379	5,184	23,563,636	100.00%
2	Industry / UPSK Kopi (30 %)				0.00%
Revenue of Sales			5,184	23,563,636	100.00%

B. Costs and Expenses

No.	Description	% From Items	Cost/month (Rp.)	Cost/year (Rp.)	% to Sales
RAW MATERIAL COST					
1	Raw Material / Water		64,800	777,600	0.20%
2	Others material				0.00%
			64,800	777,600	0.20%
OPERATING COST					
1	Foreman & Operator	[71373.5sales]	3,700,000	48,100,000	12.19%
2	Indirect Labor & Staff (KOPERASI)	[0.0% sales]			0.00%
3	Laboratorium QC				0.00%
4	Trans.& Communication				0.00%
5	Maintenance	[2.0% equipment]	10,800,000	129,600,000	32.85%
6	Factory Overhead & QC				0.00%
7	Depreciation				
	Equipment	[5% equipment]	7,500,000	90,000,000	22.81%
	Building	[5% bangunan]	10,500,000	126,000,000	31.94%
			32,500,000	393,700,000	99.80%
Total Cost of Production			2,564,800	394,477,600	100.00%

No.	Description	% From Items	Cost/month (Rp.)	Cost/year (Rp.)	% to Sales
EXPENSES					
1	Operational of Main Office				0.00%
2	Marketing				0.00%
3	Bank				0.00%
2. Total Expenses, Rp.					0.00%

Delivery/Distribution

			Rp	Rp	0.00%
TOTAL COST & EXPENSES (1+2+3)			Rp 32,564,800	Rp 394,477,600	100.00%

C. Profitability

REVENUE				
	Sales	Rp 5,184	Rp 23,563,636	100.00%
COST & EXPENSES				
a.	Production Cost	32,564,800	394,477,600	100.00%
b.	EXPENSES	Rp-	Rp-	0.00%
TOTAL COST & EXPENSES		32,564,800	394,477,600	100.00%
	E.B.I.T.Z (Zakat)	(32,559,616)	(370,913,964)	-1574.1%
	TAX		(141,069,887)	
	E.B.I.Z.		(511,983,851)	-2172.77%
	INTEREST		0	
	E.B.Z		(511,983,851)	-2172.77%
	Zakat		(12,799,596)	
	E.A.Z.		(499,184,255)	-2118.45%

Appendix C. PLTMH Investment Feasibility Analysis without Subsidy (cash flow 2012-2021)

Year	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Discount Rate	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12
End of Year Number	-	1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00
Production Capacity	-	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Investment	(500,000,000.00)									
Working Capital		97,694,400.00								
Sales		23,563,636.36	23,563,636.36	23,563,636.36	23,563,636.36	23,563,636.36	23,563,636.36	23,563,636.36	23,563,636.36	23,563,636.36
Production Cost		(394,477,600.00)	(394,477,600.00)	(394,477,600.00)	(394,477,600.00)	(394,477,600.00)	(394,477,600.00)	(394,477,600.00)	(394,477,600.00)	(394,477,600.00)
Cash Colateral Cost		-	-	-	-	-	-	-	-	-
Loan Repayment		(5.51)	(6.21)	(7.00)	(7.89)	(8.89)	(10.02)	(11.29)	(12.72)	(14.33)
E.B.I.T. & Zakat		(273,219,569.15)	(370,913,969.85)	(370,913,970.64)	(370,913,971.52)	(370,913,972.52)	(370,913,973.65)	(370,913,974.92)	(370,913,976.35)	(370,913,977.97)
Tax		(90,715,870.74)	(141,069,889.45)	(141,069,889.72)	(141,069,890.03)	(141,069,890.38)	(141,069,890.78)	(141,069,891.22)	(141,069,891.72)	(141,069,892.29)
E.B.I. & Zakat		(182,503,698.40)	(229,844,080.40)	(229,844,080.91)	(229,844,081.49)	(229,844,082.14)	(229,844,082.87)	(229,844,083.70)	(229,844,084.63)	(229,844,085.68)
Interest		11.70	11.00	7.00	7.89	8.89	10.02	11.29	12.72	14.33
E.B.Z		(182,503,710.11)	(229,844,091.41)	(229,844,087.91)	(229,844,089.38)	(229,844,091.03)	(229,844,092.89)	(229,844,094.99)	(229,844,097.35)	(229,844,100.01)
Zakat		(4,562,592.75)	(5,746,102.29)	(5,746,102.20)	(5,746,102.23)	(5,746,102.28)	(5,746,102.32)	(5,746,102.37)	(5,746,102.43)	(5,746,102.50)
E.A.Z		(177,941,117.36)	(224,097,989.12)	(224,097,985.72)	(224,097,987.14)	(224,097,988.75)	(224,097,990.57)	(224,097,992.61)	(224,097,994.91)	(224,097,997.51)
Cash Flow (add back depreciation)	(500,000,000.00)	135,753,282.64	(8,097,989.12)	(8,097,985.72)	(8,097,987.14)	(8,097,988.75)	(8,097,990.57)	(13,844,083.70)	(13,844,084.63)	(13,844,085.68)
Cummulative Cash Flow	(500,000,000.00)	(364,246,717.36)	(372,344,706.48)	(380,442,692.19)	(388,540,679.34)	(396,638,668.09)	(404,736,658.66)	(418,580,742.36)	(432,424,826.99)	(446,268,912.67)

NET PRESENT VALUE (NPV)		
Investment	Rp	(500,000,000)
NPV	Rp	(357,814,999)

INTERNAL RATE OF RETURN (IRR)	
IRR Prediction	12%
IRR Actual	#NU
Conclussion	#NU

PROFITABILITY	
Profit (% sales/EBIT & Zakat)	-1574.09%
Profit (% sales, E.A.Z)	-951.03%
Profit (% to Investment)	-45.97%

INVESTMENT, Rp.	500,000,000
WORKING CAPITAL (3 Month)	(97,694,400)
Total Invest & Working Capital	402,305,600

UNIT PLTMH	
Existing Th 2012	
INVESTMENT	Rp. 500,000,000,-
LOAN	
Interest	12%
NPV	Rp. (357,814,999)
IRR	-
NPM Sales/EBIT & Zakat	-1574.09%
NPM Sales, EAZ	-951.03%
NPM to Investment	-45.97%
B / C Ratio	-
Period	5 Years

Appendix D. PLTMH Investment Feasibility Analysis with Subsidy

A. Revenue

No.	Description	Price/KWH (Rp.)	Sales/month (Rp.)	Sales/year (Rp.)	Percent to Sales
1	House Hold (70 %)	379	1,963,636	23,563,636	100.00%
2	Industry / UPSK Kopi (30 %)	-	-	-	0.00%
Revenue of Sales			1,963,636	23,563,636	100.00%

B. Costs and Expenses

No.	Description	% From Items	Cost/month (Rp.)	Cost/year (Rp.)	% to Sales
Raw Material Cost					
1	Raw Material / Water		64,800	777,600	100.00%
2	Others material		-	-	0.00%
			64,800	777,600	100.00%
Operating Cost					
1	Foreman & Operator	[0% sales]		-	0.00% (subsidy)
2	Indirect Labor & Staff (KOPERASI)	[0% sales]		-	0.00%
3	Laboratorium QC			-	0.00%
4	Trans.& Communication			-	0.00%
5	Maintenance	[2.0% equipment]		-	0.00% (subsidy)
6	Factory Overhead & QC			-	0.00%
7	Depreciation				
	Equipment	[5% equipment]		-	0.00% (subsidy)
	Building	[5% bangunan]		-	0.00% (subsidy)
					0.00%
Total Cost of Production			64,800	777,600	100.00%

2. Expenses					
1	Operational of Main Office		-	-	0.00%
2	Marketing		-	-	0.00%
3	Bank		-	-	0.00%
Total Expenses, Rp.					0.00%
3. Delivery / Distribution					
	Delivery / Distribution		Rp -	Rp -	0.00%
TOTAL COST & EXPENSES (1+2+3)			Rp 64,800	Rp777,600	100.00%

C. Profitability

REVENUE				
	Sales	**Rp 1,963,636**	**Rp 23,563,636**	**100.00%**
COST & EXPENSES				
a.	**Production Cost**	**Rp 64,800**	**Rp 777,600**	**100.00%**
b.	**EXPENSES**	**Rp -**	**Rp**	**0.00%**
TOTAL COST & EXPENSES		**Rp 64,800**	**Rp 777,600**	**100.00%**
	E.B.I.T.Z (Zakat)	**Rp 1,898,836**	**Rp 22,786,036**	**96.70%**
	TAX		**Rp (3,274,887)**	
	E.B.I.Z.		**Rp 19,511,149**	**82.80%**
	INTEREST		**0**	
	E.B.Z		**Rp 19,511,149**	**82.80%**
	Zakat		**Rp 487,779**	
	E.A.Z.		**Rp 19,023,370**	**80.73%**

Appendix E. MH Investment Feasibility Analysis with Subsidy (cash flow 2012-2021)

Year		2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Discount Rate	12%	12%	12%	12%	12%	12%	12%	12%	12%	12%	12%	12%
End of Year Number		0	1	2	3	4	5	6	7	8	9	10
Production Capacity		0%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Investment		(50,000,000)										
Working Capital			(194,400)									
Sales			23,563,636	23,563,636	23,563,636	23,563,636	23,563,636	23,563,636	23,563,636	23,563,636	23,563,636	23,563,636
Production Cost			(777,600)	(777,600)	(777,600)	(777,600)	(777,600)	(777,600)	(777,600)	(777,600)	(777,600)	(777,600)
Cash Colateral Cost			-	-	-	-	-	-	-	-	-	-
Loan Repayment			(6)	(6)	(7)	(8)	(9)	(10)	(11)	(13)	(14)	(16)
E.B.I.T. & Zakat			22,591,631	22,786,030	22,786,029	22,786,028	22,786,027	22,786,026	22,786,025	22,786,024	22,786,022	22,786,020
Tax			(1,972,511)	(3,274,889)	(3,274,890)	(3,274,890)	(3,274,890)	(3,274,891)	(3,274,891)	(3,274,892)	(3,274,892)	(3,274,893)
E.B.I. & Zakat			24,564,142	26,060,920	26,060,919	26,060,919	26,060,918	26,060,917	26,060,916	26,060,915	26,060,914	26,060,913
Interest			12	11	7	8	9	10	11	13	14	16
E.B.Z			24,564,130	26,060,909	26,060,912	26,060,911	26,060,909	26,060,907	26,060,905	26,060,903	26,060,900	26,060,897
Zakat	2.50%		614,103	651,523	651,523	651,523	651,523	651,523	651,523	651,523	651,522	651,522
E.A.Z			23,950,027	25,409,386	25,409,389	25,409,388	25,409,386	25,409,384	25,409,382	25,409,380	25,409,377	25,409,375
Cash Flow (add back depreciation)		(50,000,000)	23,755,627	25,409,386	25,409,389	25,409,388	25,409,386	25,409,384	26,060,916	26,060,915	26,060,914	26,060,913
Cummulative Cash Flow	0	(50,000,000)	(26,244,373)	(834,987)	24,574,402	49,983,790	75,393,176	100,802,560	126,863,477	152,924,392	178,985,306	205,046,219

NET PRESENT VALUE (NPV)		
Investment	Rp	(50,000,000)
NPV	Rp	35,820,163

INTERNAL RATE OF RETURN (IRR)	
IRR Prediction	12%
IRR Actual	48.88%
Conclussion	Feasible

PROFITABILITY	
Profit (% sales/EBIT & Zakat)	96.70%
Profit (% sales, E.A.Z)	107.83%
Profit (% to Investment)	52.12%

INVESTMENT, Rp.	50,000,000
WORKING CAPITAL (3 Month)	194,400
Total Invest & Working Capital	50,194,400

Appendix F. Micro-hydropower Generation, Tangsi Jaya Hamlet

Crossflow Turbine T14 with 300 mm diameter used to generate 18 kW of electricity.

Micro-hydro power generation in Tangsi Jaya hamlet

Tangsi Jaya hamlet

Appendix G. Shredded Tobacco Production, Banyumeneng I, Hamlet

Tobacco production in Banyumeneng I hamlet

Tobacco shredding in Banyumeneng I hamlet.

Appendix H. Seaweed Drying, Seriwe Hamlet

Solar Drying

Installation of hybrid solar-wind dryer