

MINI-HYDRO POWER PLANT IN CANTILAN, SURIGAO DEL SUR

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ABSTRACT: This study was conducted to propose some guidelines in the use of the proposed Mini-hydro Electric Power at Sipangpang Falls, Cabangahan, Cantilan, Surigao del Sur during the calendar year 2010. The study sought to assess the mini-hydro power plant project on the extent of influence on social services, economic development services, and environmental protection services. The contribution of the project in improving the quality of the lives of the people in the affected areas was assessed. The perceived problems in the implementation of the mini-hydro power plant were also examined. The study was descriptive research employing purposive quota sampling. Findings showed that the project was influential in the extension of basic services to the people. Community folks also believed that the project was influential in the extension of social services to the people. Respondents believed that the project had a strong influence on the environmental protection services of the local units and other concern agencies including government organizations.

Keywords: mini-hydro power plant, power plant

1. INTRODUCTION

Electric power is essential to modern society. Economic prosperity, national security, and public health and safety cannot be achieved without it. Communities that lack electric power, even for short periods, have trouble meeting basic needs for food, shelter, water, law, and order. The economic significance of electricity is staggering. It is one of the largest and most capital-intensive sectors of the economy.

Harnessing and utilization of Renewable Energy (RE) comprises a critical component of the Philippines government's strategy to provide energy supply for the country, the Philippine power sector has increased generation from geothermal and hydro resources and therefore lessened the country's independence on imported and polluting fuels. In the government's rural electrification efforts, on the other hand, renewable energy sources such as solar, micro-hydro, wind and biomass resources are seeing wide-scale use.

Now that the Republic Act No. 9513 (Renewable Energy Act of 2009) and its Implementing Rules Regulations (IRR) are in full effect, the Philippine government is enthusiastic about how this will impact the energy mix of the country in the future and how this will reduce greenhouse gas emissions.[1] Renewable energy application seemed to have kicked in 2009 as 93 service contracts were signed, a total of 57 for hydropower projects. The Department of Energy (DOE), even with the realization that it contributes to global greenhouse gas emissions minutely, has endeavored to deal with the issue of climate change by putting into place effective and implementable renewable energy projects.

In-stream hydro and mini-hydropower based on a run of river design are the most efficient and ecologically balanced renewable energy systems available today. They are 5 times better cost to energy output and a corresponding reduction in total emissions including manufacturing and installation than other renewable technologies.[2]

(<http://www.doradovista.com/DVPower2.html>)

The economic development of the rural areas, the availability of adequate energy supply is one of the key factors of this study. Besides domestic uses such as lighting and household appliances, energy is essential for small scale industrial purposes. The use of energy for industrial purposes supports economic development contributing to the improved overall welfare of rural areas. Appreciating its fundamental importance to the economic development of rural areas, the

government has long been committed to a program of rural electrification.

The Sipangpang Falls Mini-Hydro Power Project is a one mega-watt mini hydroelectric power project of Cantilan LGU financed by LANDBANK through the World Bank-fund Support for Strategic Local Development and Investment Project or S2LDIP that would give benefits to the towns of Carrascal, Cantilan and Madrid, Surigao del Sur. The power generation project will complement the existing electricity requirement of about 12,500 households in the area at reduced rates. The project is also expected to generate additional income for Cantilan which LGU can use to provide other basic services to its constituents and the protection and preservation of the watershed covering the Sipangpang Water Falls. The primary purposes of the Sipangpang Falls Mini-Hydro Power Project are the following: to be energy self-sufficient and be independent from the distant NPC operated Agus Hydroelectric Power Complex in Iligan City, the main source of power for Mindanao Grid; to have an assurance against power outages except during the periods of annual plant maintenance, or during typhoon and other natural disturbances; to improve or maintain a good quality supply of power with negligible voltage fluctuation since the Plant will serve as stabilizer having a separate Sub-station adjacent to the Powerhouse; to generate significant income for the Municipality as the Mini Hydropower Plant will last for more than 50 years and insure more priority infrastructure projects especially hospital/farm to market roads/bridges to encourage investors to the Municipality, especially small and medium-scale enterprises (SME's) since power supply will be reliable and eventually cheaper which in turn should trigger economic uplift; to provide jobs and training for semi-skilled and skilled workers during and after construction; to provide assistance and livelihood to the host Barangay and Indigenous People's (IP's) to preserve its watershed through continuous tree planting with funds coming from a percentage of the Power Plant's annual gross revenues; to improve access especially to Barangays Lobo and Cabangahan; to provide full development and potential tourist attractions in the project area; to incorporate other productive water use projects such as water supply, irrigation and tourism and recreation; to provide an alternative to diesel-fed power plants thus helping reduce CO₂, gas emissions associated with fossil fuels which is harmful to the

environment and the ozone layer, as well as contribution to government dollar savings; And most importantly, for every Cantilangnon to eventually avail of inexpensive power, especially after full payment of loan amortization.

The harnessing and utilization of renewable energy (RE) comprise a critical component of the government's strategy to provide energy supply for the country. This is evident in the power sector where increased generation from geothermal and hydro resources has lessened the country's dependency on imported and polluting fuels. In the government's rural electrification efforts, on the other hand, these renewable sources of energy are seeing wide-scale use:

Wind Energy – energy received from the movement of the wind across the earth. This energy is a result of the heating of our ocean, earth, and atmosphere by the sun. The wind will blow as long as the sun shines down on earth. As more efficient wind harnessing technologies become available, we will be able to take advantage of this clean, renewable energy source.

Solar Energy- energy received by the earth from the sun. This energy is in the form of solar radiation, which makes the production of solar electricity possible. Solar electricity relies upon man-made devices such as solar panels or solar cells to provide a source of clean, and low-cost renewable energy.

Biomass energy- any organic materials that can be burned and used as a source of fuel. It is a renewable energy source that makes use of such biofuels as methane (biogas) generated by sewage, farm, industrial, or household organic waste materials. It relies on combustion and therefore produces carbon dioxide; its use would not, therefore, alleviate the greenhouse effect.

Most developed nations are dependent on non-renewable energy sources such as fossil fuels (coal and oil) and nuclear power. These sources are called non-renewable because they cannot be renewed or regenerated quickly enough to keep pace with their use. Some sources of energy are renewable or potentially renewable.

Fossil Fuels- sources of electricity include fossil fuels that are found within the rocks of the earth's surface. They are called fossil fuels because they are thought to have been formed many millions of years ago by geological processes acting on dead animals and plants just like fossils.

Coals, oil, and natural gas are fossil fuels. Because they took millions of years to form, once they are used up they cannot be replaced.

Oil and Natural Gas- sources of electricity include oil and gas are chemicals made from molecules containing just carbon and hydrogen. All living things are made of complex molecules of long strings of carbon atoms. Connected to these carbon atoms are others such as hydrogen and oxygen. A simple molecule, called methane (CH₄), is the

Coal- sources of electricity can include coal, which mainly consists of carbon atoms that come from plant material from ancient swamp forests. It is a black soil that is reasonably soft. You can scratch it with the fingernail, it is not as soft as charcoal, however, and is quite strong. It can be carved into shapes. There are different types of coal. Some contain impurities such as sulfur that pollute the atmosphere further when they burn, contributing to acid rain.

Goals of the Power Industry

Raising new capital- traditional electric companies and independent power producers are major utilizers to capital to finance and build new capacity, replace or renovate old equipment, and retrofit plants and delivery equipment for environmental and reliability considerations. Projected industry construction in the next decade runs into hundreds of billions of dollars. Competing demands for capital and its high cost encourage and justify precise planning, design, and operations.

Plant investment- utilities must spend very large sums in generating plants and transmission facilities. Present-day decisions on such additions, together with the proper selection of plant sites and the acquisition of transmission rights of way, have long-range financial implications affecting earnings. At present, the industry is experiencing difficulties in the selection of plant sites and obtaining rights of way, licenses, and permits, with the results that the industry seldom obtains new plant sites and is forced to expand existing generating sites. Demand-side options must be properly weighed against generation expansion alternatives. Independent power producers (IPPs) must take precise investments, and utilities must properly invest in facilities needed to utilize and accommodate IPPs. This situation compounds the problems of system modeling and system losses and increases transmission system dependency.

Long-term contract- fuel constituents about 3.5% of the industry's total annual operating expenditures. A typical modern power plant consumes about 500 tons of coal each hour, and its average life is about 30 years. At nuclear power plant of a similar size requires an initial nuclear core costing hundreds of millions of dollars plus a significant annual refueling expenditure for the next 30 years. Independent power producers supply energy under contract for varied periods and conditions. The goal is to procure energy supply and these fossil and fissile fuels through long-term contracts providing a continuous supply of fuel at reasonable cost throughout the plant's 40 to 60 years life.

Growth through affiliation- there have been a significant number of corporate mergers between large and small utilities. The goal in these affiliations is to meet the growth in demand for energy by taking advantage of economy of scale, consolidation of administration, engineering, construction, research, and development; and increasing reliability of bulk power supply.

Economy and reliability- the industry has achieved significant improvement in the economy of operations and in the reliability of power systems either through direct operational pool functions or with contractual economical agreements.

Energy management is important for many reasons; economic, environmental and social. It makes economic sense because energy is a commodity that all cannot afford to waste. The shortage of electrical energy supply in the Philippines is a major consideration of why electrical energy should be used wisely. Because of the oil crisis, the government could save cost-effectively by investing in energy conservation. The money would boost the economy when spent on other goods and services [3].

Energy management can only be realized if companies or institutions look into their existing energy

management policies, practices of the personnel of energy utilization and existing maintenance practices.

The social benefits of investing in electric power include (a) provide additional generating capacity to displace the country's dependence on very expensive imported fuel, (b) provide income to the people or consumers since the owner is a Local Government Unit (LGU) and Electric Cooperative, with all benefits or income going back to the people thru various projects, (c) provide reliable and eventually cheap power thereby enticing investors to invest in the community, (d) provide an environmentally friendly source of power, (e) protect the watershed thru extensive tree planting program with funds coming from the power plant revenues, and (f) provides jobs and livelihood to the host community.

A systematic energy management process effectively promotes energy conservation. Depending on the level of energy cost in the final product, the technology, the policies and the type of organization, three stages of action are possible; a "housekeeping stage", an information collection stage and an investment stage [4].

Energy conservation requires the cooperation of all workers. To make the program success it is important to create a climate which is favorable to generating suggestions at all levels, encouraging ideas and promoting awareness: all the workers should understand why the program cannot function without them, to involve workers in the energy conservation program, it is important to explain how escalating energy prices will affect the survival of the enterprise and their employment; to stress their crucial role in the conservation; to show inconsistency between excessive energy, consumption and the values held by workers [5].

The success of any energy conservation program depends largely on the commitment of everyone within an organization, in the households, and on the habits and lifestyle of each worker. People, therefore, are the key to an effective conservation program. Since workers take their cue from management, management must initiate energy conservation efforts [3].

Energy Conservation (ENERCON) committees are primarily responsible for formulating and implementing energy conservation programs. An energy coordinator or full-time energy manager may be appointed to report to top management. Some ENERCON committees are even headed by a company president or vice president. Typical ENERCON committee functions include planning and participating in energy-saving surveys, developing uniform record-keeping, report an energy accounting, including conservation goals and communicating ideas on how to achieve them, developing ideas and plans for enlisting staff support and participation; planning and conducting a continuing program of activities to stimulate interest in energy conservation efforts (International Energy Agency:2004)

The National Power Corporation is the biggest government-owned corporation in the Philippines. It was established more than seventy years ago by Commonwealth Act No. 120, which was signed into law by then-President Manuel L. Quezon.

NPC, being the largest government-owned corporation in the Philippines, was originally established to construct power

plants and supply electricity to the country. Its mission is to achieve and maintain the highest standards of generation and transmission practices of the power industry. It aims to make optimum use of indigenous resources of energy and work for the continuous improvement of processes and technologies.

NPC also envisioned itself to be a world-class, globally competitive Filipino power corporation. It commits itself to the highest standards of customer satisfaction by providing quality and reliable electricity.

The National Transmission Corporation is a government-owned and controlled corporation created in 2001 by the Electric Power Industry Reform Act. It started operating independently from NPC in March 1, 2003. The company handles the planning, construction and centralized operation and maintenance of high-voltage transmission facilities, grid interconnections and ancillary services.

TRANSCO has a unique and crucial role of transmitting bulk electric power from power plants owned by the National Power Corporation and Independent Power Products (IPP) to the distribution utilities, industries, and other customers.[6]

Overhead transmission of electric power remains one of the most important elements of today's electric power system. Transmission systems deliver power from generating plants to industrial sites and to substations from which distribution system supply residential and commercial service. It also interconnects electric utilities, permitting power exchange when it is of economic advantage and to assist one another when generating plants are out of service because of damage or routine repairs.

Power Crisis

Cebu is a major industrial hub second only to Metro Manila. Known for its export and tourism industries, it has the fastest annual economic growth rate in the country.

The power crisis, however, hampers business activity and investments in the region. Some privately owned businesses have resorted to using their generators during scheduled power interruptions.

"The energy situation is tight. The power supply is just enough to meet the customer's needs. However, if any plant goes down, then there will be outages because there is no more reserve supply," said Jaime Jose Aboitiz, Visayan Electric Co. (Veco) executive vice president.

According to government data, peak power demand is 1,175 megawatts, while the power supply is only 1,140 megawatts.

Cebu has rotating brownouts as much as three times a day because of the aging and inefficient power plants.

"When there is a shortfall due to a breakdown or maintenance of power plants, we have outages, which are happening right now", said Ethel Natera, Veco spokesperson. "If we don't interrupt our costumers' power supply, there will be a problem in the whole system, resulting in a breakdown."

Energy officials are hopeful that with the PEP project and new power plants in place by 2010, the critical power situation will be tempted. (Philippine Daily Inquirer: January 3, 2010)

2. METHODS

A letter of request asking permission to conduct the study was prepared addressed to the Municipal Mayor of Cantilan, Surigao del Sur. With the approved letter request, the researcher distributed the researcher-made questionnaire. The townpeople of Cantilan and its local officials were briefed concerning the inclusion and exclusion criteria in the choice of the respondents and the number of respondents to be given with the questionnaire and check all entries in the questionnaire before retrieving them from the respondents. Data obtained were collated, tabulated, statistically analyzed and interpreted.

The data gathered were analyzed and interpreted using the following statistical treatment:

The Weighted Mean was used to describe the status of the project in terms of community power resources, the capacity to generate energy, community needs, and sustainability and in the extent of influence of the project along with social services, economic development services, and environmental protection services.

For the analysis and interpretation of data that were gathered, weights were assigned to each category on the different variables with a corresponding verbal description

3. RESULTS AND DISCUSSION

The project aims to influence the livelihood of the community folks in the community by enhancing their way of living by providing enough power supply during needy times like typhoons, minimizing the cause of livelihood in the community thus levels up the tourist destination.

The project was evaluated by the respondents in terms of the extent of influence on social services, economic development services, and environmental protection services. The contribution of the project in improving the quality of the lives of the people in the affected area was assessed.

Social Services. The influence of the project on social services is presented in Table 1. According to the local officials, the project was influential in the extension of basic services to the people with an average weighted mean of 22.28 or influential.

Likewise, the community folks also believed that the project was influential in the extension of social services to the people with an average weighted mean of 2.23 or influential. The respondents perceived that the project influences the social services with an average weighted mean of 2.26 or influential.

Economic Development Services. The ultimate objective of economic development is a better quality of life of the people. In this study, the respondents were made to perceive the influence of the project on economic development services. These perceptions are shown in Table 2.

According to the local officials and the community folks, the project was influential in the extension of economic development services to the people with an average weighted mean of 2.54 or influential and 2.32 or influential, respectively.

Table 1 Extent of Influence on Social Services

The extent of influence on Social Services	Weighted Means of Perceptions		Ave.	Desc.
	Brgy Officials	Community Folks		
Uplift to the economic	3.00	2.23	2.62	VI
The project will enable Cantilangnons to must avail of inexpensive power	3.00	2.29	2.65	VI
Provides the constituents with better social services due to an increase in revenues	3.00	2.09	2.55	VI
Funds sources donations and funds for social services coming from a percentage of the power plant's annual gross revenues	2.27	2.08	2.18	I
Generates more jobs to the local populace	2.13	2.19	2.16	I
More and more infrastructure projects like roads and bridges	2.00	2.30	2.15	I
The project will help the people in the community to be more environmentally friendly and increase their concerns for environmental conservation and preservation	2.93	2.34	2.64	VI
The project means more income to the people hence more resources for necessities in life like food, clothing, and shelter	2.93	2.38	2.66	VI
The project will encourage an increase in goods and services to be operating in the municipality	2.60	2.32	2.46	I
The operation of the project will eventually improve the lives and the standard of living of the people in general	2.07	2.06	2.07	I
Average	2.29	2.23	2.26	I

The overall response of the respondents had an average weighted mean of 2.43 or influential. The projects encourage more entrepreneurs to invest in the municipality with a weighted mean of 2.55 or very influential. With the project, more and more economic activities of the people both direct and indirect were realized with a weighted mean of 2.57 or very influential.

According to the respondents, the project encouraged more investors to the municipality, especially small and medium scale enterprises since the power supply was reliable and cheaper with a weighted mean of 2.47 or influential. The project provided assistance and livelihood to the host barangays and indigenous people with a weighted mean of a 2.31 or influential.

Table 2 Influential on the Economic Development Services

Influential on the Economic Development Services	Weighted Means of Perceptions		Ave.	Desc.
	Brgy Officials	Community Folks		
The project encourages more investors to the municipality, especially small and medium scale enterprises since power supply will be reliable and eventually cheaper	2.53	2.41	2.47	I
Provide assistance and livelihood to the host barangays and indigenous people	2.33	2.29	2.31	I
The project is an alternative to diesel-fed power plant thus can contribute to government dollar savings	2.67	2.34	2.51	VI
The LGU can afford to pay with ease the loan amortization	2.60	2.36	2.48	I
The project will encourage more entrepreneurs to invest in the municipality	2.73	2.36	2.55	VI
The project will generate more revenues for the municipality	2.60	2.32	2.46	I
The estimated annual energy generation is greater than the estimate project cost	2.27	2.03	2.15	I
The use of local materials and supplies in the construction of the project will invigorate its local economy	2.33	2.54	2.44	I
The LGU is ready to manage the emerging increase in commercial and service establishments due to the influx of population with the project	2.53	2.54	2.44	I
With the project, more and more economic activities of the people both direct and indirect will be realized.	2.80	2.34	2.57	VI
Average	2.54	2.32	2.43	I

The LGU can afford to pay with ease the loan amortization with a weighted mean of 2.48 or influential. The project generated more revenues for the municipality with a weighted mean of 2.46 or influential. The estimated annual energy generation was greater than the estimated project cost with a weighted mean of 2.15 or influential. The use of local materials and supplies in the construction of the project will invigorate its local economy with a weighted mean of 2.44 or influential.

The LGU was ready to manage the emerging increase in commercial and service establishments due to the influx of population with the project with a weighted mean of 2.39 or influential.

It can be deducted from the responses that the project had helped the local government unit implement economic development services geared towards improving the quality

of life of the people. The project invited investors and increase the job generation of the local folks. Increased revenues from the project resulted in the implementation of more economic development services in the municipality.

Environmental Protection Services. Environmental protection is one of the major activities of all stakeholders to sustain the project. To ensure the continuous flow of water in the river which is the source of energy, the forest and watershed must be conserved and protected. The forest trees and the water are the lifeblood of the project and must be protected by everybody for ecologically balanced development.

The perceptions of respondents on the influence of the project on environmental protection services are presented. It was observed that all issues raised in the influence of the project in the environmental protection services were rated by either groups or respondents as very influential. The project helped preserve the watershed had a weighted mean of 2.76 or very influential. The project encouraged continuous tree planting with a weighted mean of 2.74 or very influential. The project provided an alternative to diesel-fed power plant thus reducing CO2 gas emissions associated with fossil fuels which were harmful to the environment and the ozone layer with a weighted mean of 2.74 or very influential.

The water coming out from the powerhouse was used for future water supply application and irrigation projects with a weighted mean of 2.72 or very influential. The project had no adverse effect on the course of potable water in the municipality with a weighted mean of 2.62 or very influential. The following were rated very influential by respondents: the project had no adverse effect on agriculture and other fresh water-based industries, the logging and timber industry in the area had no adverse effect to the project, the project had favorable seismic analysis and had a good design of the proposed auxiliary, the project had a well-designed waste disposal system and was pollution-free, and there was no stream flows at the proposed diversion site with weighted means of 2.73, 2.67, 2.70 and 68, respectively.

The respondents believed that the project had a strong influence on the environment protection services of the local government units and other concern agencies including non-government organizations. All stakeholders were believed to be aware and conscious of environmental protection with the establishment of the project in the municipality. It can even be said that the town folks were even aware of resource conservation and protection with the project. They became environmentally conscious of the project. Because of the benefits they get from the project, they also understood the importance of resource and preservation to ensure a long-lasting benefit from the project.

The least serious problem encountered by the project was looting and stealing of electrical supplies and equipment. Despite the benefit their community benefited from the project, there were still ill-mannered members of the community that indulge in foolishness perhaps for fun. Rated 9 of the most serious problem is garbage, waste disposal management, and pollution. This problem is common when the place starts to develop. More and more non-biodegradable wastes are disposed of by people. Although, this, not a problem providing the local government unit is ready to implement efficient solid waste management.

The eight problems identified as serious was cultural differences. Although this problem is more of a social-cultural constrain in the development process, we cannot discount the occurrence of this problem because the municipality has indigenous people. The ethnic group may have a different perspective in developing the place. It might be that this development runs counter with their beliefs. They might consider the development as a means of pushing them further from their ancestral land. This problem will eventually be eliminated with efforts to educate more and more indigenous people. Natural calamities were also identified as the seventh most serious problem. This is natural because the place is not exempted from natural calamities. The place is not spared from typhoons, storms and "El Nino" phenomena. The hot season may kill the trees in the newly reforested areas. Too much downfall may bring flash floods and landslide that may destroy the falls which is the lifeblood of the project. Ranked sixth in the serious problem were peace and order. This problem will never be resolve for as long as there is a misunderstanding between the Muslim and Christian in the area. However, the socio-economic development and the equitable distribution of the blessings to everybody regardless of religion will soon end this friction. Illegal cutting of trees was identified as the fifth serious problem in the place. Although many are now are or forest conservation and protection, there are still inhabitants who continue to cut the trees as a livelihood. Some are cutting trees for wood or charcoal. The national government agencies tasked to enforce that no illegal cutting of trees must enforce the law to preserve and protect the forest resources. Providing the people engaged in illegal cutting of trees with more gainful economic activities will surely help this problem. The third problem was the poor road condition. Unless the government will establish a good road network, all other economic activities in the place will not prosper. But with the increase in revenues with the project, road networks will be addressed by concern government agencies. Before the project, the municipality experience frequent power fluctuations. But this problem was minimized with the project. The most serious problem encountered by the municipality were insufficient potable water and financial problems (for example: loan repayment and operations. People taught that potable water became insufficient with the project because the project requires water resources to generate power. But for as long as the watershed is healthy, the fear of no potable water is far from being a problem.

As the most serious problem, some residents perceived that the project will soon experience financial problems particularly in the loan repayment of the project. But for as long as the project properly managed and be able to generate increased revenues, then repayment problems may not be a problem.

4. CONCLUSION

The study was conducted to come up with the proposed guidelines in the use of the proposed Mini-hydro Electric Power Plant at Sipangpang Falls, Cabangalan, Cantilan, Surigao Del Sur during the calendar year 2010. Specifically, the study sought to answer the following: (a) What is the status of the project in terms of community power resources, capacity to generate energy, community power resources, capacity to generate energy, community needs, and sustainability; (b) what is the extent of influences of the project along with social services, economic development services, and environmental protection services; (c) what are the problems encountered by the project; and (d) based on findings, what proposed guidelines of implementation could be formulated?

On the extent of influence on social services, economic development services, and environmental protection services, respondents believed that the project was influential. It can trigger an economic lift to the people living in the municipality.

5. REFERENCES

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