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End Use Promotion of Micro Hydro Project for its Sustainable Development (A Case Study of Malagad Khola MHP)

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Abstract: This research is an attempt to explore the sustainability of a Micro-hydro power project. A micro-hydropower project can make a substantial impact in developing countries where significant water resources exist and where economically viable alternatives are few, such as Nepal. This research explores the opportunities to sustain a micro-hydropower project for a long period with acceptable revenues. Willingness to pay among the community and possibility of productive end uses have been studied. The study finds many possible end uses that can improve sustainability of the project.

Keywords: Micro-hydro power project, electricity, productive end uses.

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1. Introduction

The mini/micro-hydropower sector in Nepal has a long history. The formal use of micro hydropower was initiated during the decade of 1960s in Nepal. People in the rural areas use to build water mills (locally called as Ghatta) for harnessing waterpower for the purpose of processing of agricultural products. Nepal being endowed with huge hydro potential and favorable geographical set-ups, uncountable number of such Ghattas even exists today. First micro hydro power plant was installed in Godavari, Kathmandu in 1962 funded by Swiss Government it was 5 kW capacities [4]. Micro-hydro power projects typically include a water intake, a weir or dam, penstock pipes, a turbine and a powerhouse. Water flowing from a source, typically a river, is directed into the intake, which screens fish or other debris from entering the turbine. After passing through the intake water flows to the penstock pipe, which carries the water to the turbines inside the powerhouse. The water rotates the turbines, which drives the generators that produce electricity. This electricity is then transmitted to houses through transformers and transmission lines [1]. Scenario of mountain economy in Nepal is much gloomier, lacking the modernizations of agriculture and micro-enterprises, which demands electricity for efficient and better product. This study aims to perform the detailed assessment on project Malagad MHP (100 kW) located Kailashmandu VDC-Bajura district. The economy of the project and the community will be studied to research the possible end uses to promote revenue growth.

Financially self-sustaining projects have cash generating (usually day time) end-uses to produce cash flow and increase the use of the plant (load factor). Lighting-only systems will have the greatest difficulty in achieving financial sustainability [3]. Productive use of electricity can be a significant driver of economic growth and social progress in developing countries. The use of modern forms of energy can:

- underpin the creation and upgrading of value chains
- facilitate diversification of economic structures and livelihoods
- Reduce vulnerability to multiple stresses and external shocks.[2]

Government of Nepal and the user community has invested huge amount money (cash and kind equity also) during the construction of MHP. But we have not seen the effective use of micro hydro and hence found that maximum number of plants is in off position. This is due to the following factors:

a. the low plant factor.
b. the lack of technical knowledge and training for operator and manager.
c. the geographical condition of our country
d. the lack of awareness to the local users.
e. the financial problem for repair and maintenance.
f. the national policies, local politics & mismanagement.
g. the low quality equipment in some cases
h. the absence of supporting bodies after handover of the plant to UC.
i. the size of Plant capacity (smaller sized plant to the particular village can be replaced to nearest larger size reliable source project)

Nepalese government has taken a number of initiatives that they hope will foster the development of these projects. A license is not required to install a micro-hydro project as long as it produces 1000 kW or less. In addition, the government established the AEPC to promote renewable energy within the country. In addition, to help foster the development of micro-hydro projects, Nepal joined the United Nations Development Program-Rural Energy Development Program (UNDP-REDP). This relationship has encouraged INGOs to support these installations through providing capital subsidies and building greater capacity.

2. Methodology

The entire research work was carried out in the following fashion: Literature review; field study; Data analysis and report preparation. First, by studying several reports and from experience a suitable MHP was selected for the study. The study was conducted by using questionnaire method, data measurement and judgment of the plant during the field visit. FGD (focused group discussion) was also used to make the study more precise.

3. Results and Discussions

The results of this study has been separated into several sections below. The results include the findings about the financial sources of the project and its expenditures, the present tariff structure, the present electricity use scenarios, the surplus power for further potential uses, potential electricity uses scenario and financial benefits of such potential electricity uses.

3.1. Detail Cost breakdown of Project

Table 1: Detail Cost Breakdown of Project

Resources mobilazition Details	
AEPC regular subsidy(NRS)	25500000.00
VDC insvesment	2252389.00
DDC insvesment	118160.00
Malagad yakikirt mahasang	886000.00
Community contribution(kinds)	13608982.00
Additional support to be provided (NRS)	4215696.43
Total resources mobilization with additional support	46581227.23

Source-MHP Chairperson (Man Bahadur Thapa)

3.2. Present Tariff structure

The present tariff rate for domestic lighting is Rs 60 for minimum 10 unit and Rs 8 above minimum unit. This tariff rate is fixed by the mass meeting. The rate seems lower as per pre designed detailed feasibility study. The local people have invested their contribution in project so that they decided to fix lower rate which is being difficult to run the running cost.

3.3. Connected and on process end use

Table 2: Connected and on process end use

S N	Name	Add	Remarks
1	Farwest Com Center	Kailasmandu 8	Running
2	Jogsuna Kutani Pasani	Kailasmandu 5	Running
3	BPS Kutani Pelani	Toli 6	Running
4	NTC computer teaching	Toli 6	Running
5	Okhalipeds Kutani Pelani	Toli 5	Running
6	Tribeni Kutani Peleni	Toli 7	On process
7	Abisek And anil Com Rep	Kailasmandi 4	Running
8	Kailasmata Tutani peleni	Kailasmandi 4	Running
9	Badimalika Com Tr center	Kailasmandu 7	Running
10	Ratna Com Center	Kailasmandi 7	On process
11	Bedmata Com Tr center	Kailasmandu 5	On process
12	Namadurga Masala Udhoyg	Toli 7	On process
13	Bipin Silai Center	Kailasmandi 9	On Process

Source-MHP Chairperson (Man Bahadur Thapa)

3.4. Present revenue structure

Table 3: Present Revenue Structure

S N	Type	Nos	Monthly Amount	Remarks
1	Household	1005	60300	158 HH not lighting
2	Mill	4	38000	Not Paying
3	Computer institute	4	60	Not paying
4	Total monthly income		93000	Only 40000 is collecting
	Monthly expenditure			Rs 38,700
	Amount loan in bank			Rs 62,00,000

Source-MHP Chairperson (Man Bahadur Thapa)

3.5. Existing End End Use & Average Load Pattern including its income

At present the project is providing power for domestic users and four Agro processing mills and four computer institute which consumes 143 KWh per day and its equivalent amount will become Rs 34320 (@8 per unit) but this amount is not collected by UC due to the different issues within the consumers. They are raising the issues of meters defect, previous labor contribution, settlement issues, and management problems. Also computer centers are being treated as domestic consumers (i.e. meter not connected) and paying only Rs 60 as per domestic users.

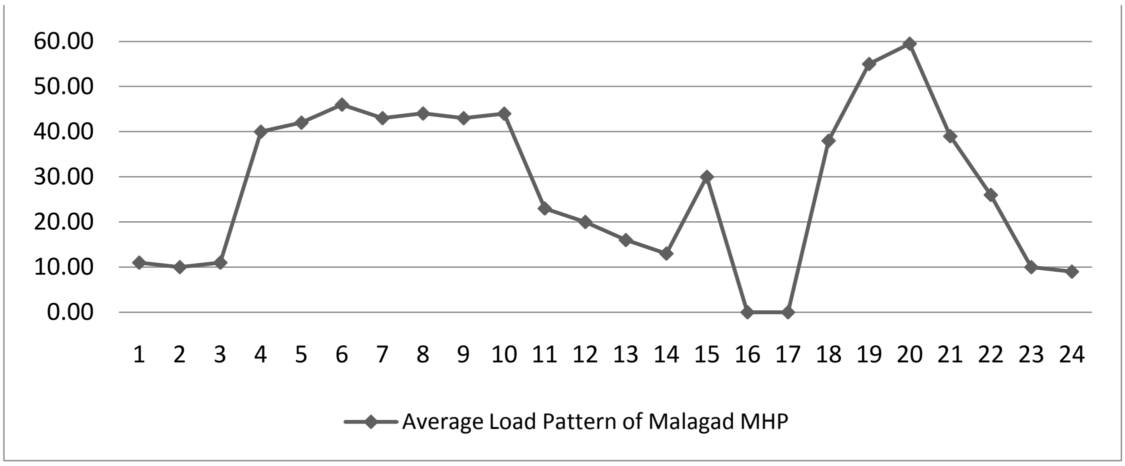


Fig. 1: Existing Average Load Pattern of MHP

The average load curve shows that around 50 % of the consumption is seen in the peak hour for lighting only and rest of the power is not utilized. On the day time around 30 % of the power is consumed.

According to the present commercial application, there are four Agro processing mill (15 HP) operating around three hour per day and four computer institutes operating around five hour per day. Only this consumption is seen in the day time and rest power is not utilized.

3.6. Consideration needed for End Use Activities

While considering the implementing chart for end use activities we should only design around 40 % of total load at a time. This is due to the inductive load of motors which will draw high current (around 3 times) during starting. Micro Hydro Plants are not well equipped for automatic adjustment and quick response system (as ELC senses only after three second of load variation) after the load variation due to this voltage and frequency becomes unstable. In case of the larger plants input is controlled by the feedback loop (automatic governor) but in case of micro hydro plant output is controlled (input is constant i.e. constant power is generated) by thyrister based electronic controller using dump load as immersion heaters. This problem to the end user site can be minimized by using slow starter (Star-Delta) which will reduce the initial current during starting. Hence by doing this we can use more (around 60%) load at a time for end use activities. Also we can use time based tariff system for the effective utilization of power converting to economic generation like NEA using TOD meters. Using a smart meter the rate at different times can be changed to promote the power use at off-peak periods.

3.7. Projected Income form End Use and Available Surplus Power

The different end use activities are projected on the basis of its financial return per year and we found that, we can generate approximately Rs 33, 76,800 per year. For this we need to make operational schedule to get the desired output.

Table 4: Projected Income form PEU

S.N.	Type of Business	Nos	Capacity (kW)	Operating Hours/day	Operating Days	Total Energy Consumption (kWh)	Tariff (Rs per kWh)	Total Income (Rs.)	Remarks
1	Herbal Processing	2	6	5	250	15000	8.00	120000	
2	Crusher industry	1	30	4	200	24000	8.00	192000	
3	Stone Cutting	1	3	8	300	7200	8.00	57600	
4	Dairy Udhyog	1	10	12	300	36000	8.00	288000	
5	Furniture	3	3	5	300	13500	8.00	108000	
6	Mill	9	11	3	300	89100	8.00	712800	
7	Bakery	3	10	7	300	63000	8.00	504000	
8	Medical Lab center/health post	2	3	12	300	21600	8.00	172800	
9	Cloth recycle processing	1	5	5	300	7500	8.00	60000	
10	Pottery form	3	1	20	300	18000	8.00	144000	
11	Press	1	15	4	200	12000	8.00	96000	
12	Communication Center	6	1	6	300	10800	8.00	86400	
13	Video Hall	1	1	3	300	900	8.00	7200	

14	Irrigation	2	30	6	250	90000	8.00	720000	
15	Computer Institute	5	1	4	300	6000	8.00	48000	
16	Metal Workshop	1	5	5	300	7500	8.00	60000	
Total esti mated income from End Use Activities is Rs 33,76,800 per year									

Table 5: Available Surplus power for PEU

Hour	Power Consumed at present(kW)	Generation Capacity(kW)	Surplus Power(kW)	Power That can be used for End use i.e. 60 % of surplus power(kW)	Remarks
1	11	100	89	53.40	
2	10	100	90	54.00	
3	11	100	89	53.40	
4	40	100	60	36.00	
5	42	100	58	34.80	
6	46	100	54	32.40	
7	43	100	57	34.20	
8	44	100	56	33.60	
9	43	100	57	34.20	
10	44	100	56	33.60	
11	23	100	77	46.20	
12	20	100	80	48.00	
13	16	100	84	50.40	
14	13	100	87	52.20	
15	30	100	70	42.00	
16	0	100	100	60.00	
17	0	100	100	60.00	
18	38	100	62	37.20	
19	55	100	45	27.00	
20	59.5	100	40.5	24.30	
21	39	100	61	36.60	
22	26	100	74	44.40	
23	10	100	90	54.00	
24	9	100	91	54.60	

About 1036.5 units of energy can be generated from the surplus power that can be used for end uses daily. At the rate of Rs 8 per unit, it amounts to Rs 8292 daily and Rs 3026590 annually. So potentially more than 30 lakhs rupees can be earned through the MHP without putting any strain on the plant.

4. Conclusion

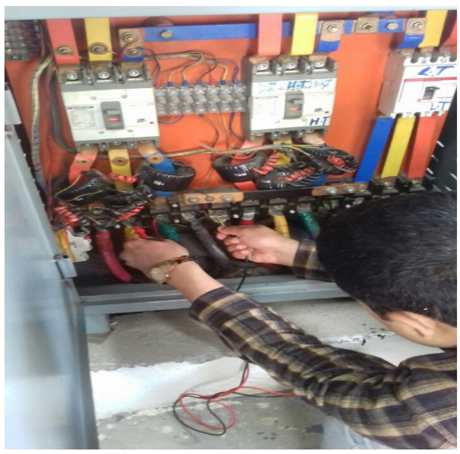
The study of Malagad MHP shows that the micro-hydro projects in Nepal are not used to their full potential and sufficient revenues are not being generated for sustained operation of those projects. In this MHP the capacity of the plant has not been fully utilized. There is an extra power of more than 40 kW at all hours of the plant operation even after leaving 40% of the actual extra power as reserve. Hence modern energy use in existing economic activities that currently operate without energy input – e.g. tailors, etc. can be introduced. Also new subsectors, goods and/or services for local consumption; e.g. photocopying and internet access can be induced into the community. Such PEUs also promote local production of goods that are currently imported to the area, e.g. high quality carpentry, processed food. The study has identified the lack of long-term planning over the use of power from the plant as one of the major reason for the underutilization of the plant. Also the reluctance of the local households to pay for the used energy and for further expansion of their businesses has resulted in the full capacity of the plant being unused. Energy consumption in the community can be managed to improve the load curve and increase the average daily consumption. A smart meter or TOD meter approach can be taken to change the load curve into a flatter profile. This along with a routine of energy use among local industries can improve the sustainability of the plant without putting any strain on it.

Some Photographs of During Study

Headrace Canal of Project

Project Overview

EM Parts inside Power House



Data Measurement

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