IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

ALTERNATIVE ENERGY MATTERS: ASSESSING THE IMPACT OF MICRO HYDROPOWER IN RURAL NEPAL

Ratna Mani Nepal, Lecturer, Central Department of Rural Development, Tribhuvan University, Kathmandu

Abstract

In Nepal only four percent energy is supplied to agriculture sector. While about 90 percent energy is consumed at household level. This shows that energy is used in less productive sector contributing significantly low to national development. In rural areas, people still use conventional sources of energy such as firewood and kerosene. Replacement of these fuels and supply of alternative renewable sources needs harnessing untapped water resource through the application of renewable energy technologies. One of such technology is micro hydropower. This study is a case study of Fakfok-II micro hydropower project in north-west Ilam district of Nepal. It explored the socio-economic impacts of the micro hydropower project. The study found that the fakfok-II micro hydropower project mobilized local resources, saved money by replacing conventional fuel such as kerosene, and encouraged socio-economic modernization by the establishment of small enterprises by the users.

Key Words: Energy, Micro Hydropower, End Uses, Social Mobilization, People Participation

I. Introduction

In Nepal only four percent energy is supplied to agriculture sector. While nearly 90 percent energy is consumed at household level. The main use of energy at household level is cooking meal and lightening. Energy supply to industrial sector is a mere 6 percent (AEPC, 2018). This shows a low productivity in agriculture and industrial sectors. Higher consumption at household level and service sector means that role of energy in economic development is not satisfactory.

Despite their human and environmental effects, conventional sources of energy such as firewood, cow dung and kerosene are the major suppliers in rural Nepal. Almost 80 percent households, mostly in rural areas, consume firewood, 6 percent get energy from cowdung and agriculture residue. The use of commercial fuels like kerosene is about 13 percent (Economic Survey, 2018). Studies show that the application of traditional sources of energy affect serious environmental as well as human health (Asian Development Bank, 2017). Firewood consumption costs forest depletion which further impacts loss of biodiversity and depletion of water bodies. On the other hand, the smoke from the firewood causes respiratory system, eyes problems, headache, and indoor air pollution. Given the availability of natural resources such as water Nepal could address these issues of underdevelopment by generating alternative sources of energy. Alternative energy succeeds conventional fuel sources in terms of saving environmental cost, financial burden, and human health.

Harnessing alternative sources of energy from locally available natural resources is a long tradition. Before the installation of Pharping hydropower plant (500 KW) in1911 AD as Nepal's first power plant (AEPC,2018), villagers had been utilizing small rivers and rivulets in the hills to generate power. The invention of water mill dates a long history which people applied for the purpose of agro-products grinding and propelling. To this date, almost 6000 traditional water mills have been transferred to improved water mills throughout the country that are supplying alternative energy source to the people (AEPC, 2018). In the modern era, however, small and micro hydropower is becoming popular among the policy makers and the users. Since its inception in the 1960, micro hydropower has emerged as a viable solution to the issues caused by the conventional sources of energy such as firewood and kerosene. Till 2017, a total of 1245 micro hydropower plant have been installed across the country with 3 MWcapacity (AEPC, 2018). Thousand households have been benefitted by the energy generated by micro hydropower.

This study is a case study of Fakfok-II micro hydropower located in the north-west of Ilam district of Nepal. In this study, socio-economic impact of alternative sources of energy generated from a micro hydropower plant is examined.

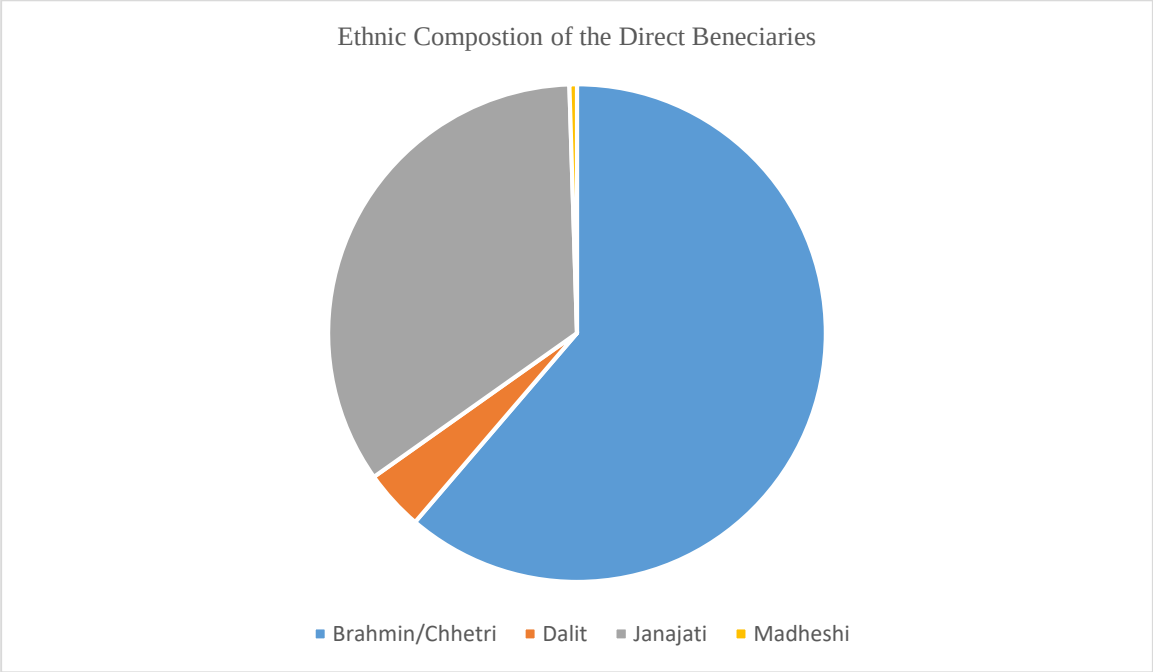
II. Methodology

This is an exploratory and descriptive study aimed at finding the status, operation and implication of Fakfok-II micro hydropower. To support the objective, primary information was collected by personal interview through semi-structured questionnaire. Simple field observation also helped in getting required data.Check list was prepared for the purpose of field observation and personal interviews.

The beneficiaries and the members of the management committee of the power plant were consulted in a three day field work in October, 2017. Snowball sampling method was applied in order to access the power beneficiaries. This study has also applied local as well as national published sources such as reports and newspaper.

III. Introduction to the study area

FakfokKhola (Chhangetar) micro hydropower is located at Fakfok village development committee ward no. 6 of Ilam district. Installed capacity of themicro hydropower plant is 20 KW. A total of 203 households in the wards 6, 7 and 8 are direct beneficiaries of the micro hydropower. It is community owned power plant registered at Ilam district development office in 2062/9/25. The office of the micro hydropower users committee is located at ward no. 7 of the VDC which collects tariff and provides necessary supports to the project.



The Fakfok-II micro hydropower is financially supported by Alternative Energy Promotion Centre (AEPC), constitutional area development fund and the fund generated by people's participation. The support amount is Rs. 14,00,000 (fourteen lakhs), 30,000 (thirty thousand) and 7,13,481 (seven lakh thirteen thousand four hundred and eighty one rupees) respectively from the three sources. The total construction cost of the micro hydropower plant was Rs. 21, 13, 481. Around one third of the total cost was generated from local people who were the direct beneficiaries of the project. The machinery parts and electrical equipment support had been arranged by universal consultancy services Pvt. Ltd. Kathmandu, Banasthali.

Table 1: Contribution to Fakfok-II micro hydropower

Contributors	Type of Contribution			
	Cash (Rs.)	Labor	Kind	Others
Community	7,13,481	√	Electric poles, stone, bricks	
AEPC/REF	14,00,000			
Constitutional Area Development Fund	30,000			
NCDC, Ilam		√		Technical, Social mediation, knowledge sharing etc.
Total	21,43481			

Source: Field Survey, 2017

The Namsaling Community Development Center (NCDC), an NGO assigned as a focal point of Alternative Energy Promotion Center in Easter region, had provided technical support. The center also supported through social mediation, institutional development, and post operation management. The micro hydropower plant was first demonstrated in 2063/9/14.

IV. Results and discussion

This study found multiple impacts of Fakfok-II micro hydropower in the project area. The impacts have been studied under areas as social mobilization and people participation, economic mobilization through end uses, income generation, and replacement of conventional fuel.

4.1 Social mobilization and people participation

The inception of the concept of Fakfok-II micro hydropower plant was the concept of the local residents. The initiated the idea and visited to the concerned agencies to materialize. The villagers consulted the technical person in the NCDC to determine the location and capacity of the plant. A group of five young energetic youths namely NaradLimbu, ParsuramLuitel, DronaThap, LalBahadurThapa and RudraThapa informed the local residents of the need and the benefits of the power plant. In several occasions meeting and discussion were held where people participated and satisfied their queries. The group also travelled to Butwal and Kathmandu in order to observe mode of micro hydropower plant operation. This process was assisted and mediated by a social mobilizer deployed from NCDC, Ilam.

Local people enthusiastically participated in the all phases of the project. They jointly decided the project site. Electric poles for transmission line were supported by the locals. They also participated through labor while delivering project machinery parts. The tariff and wage rate of end uses have been fixed after the wider discussion with the direct beneficiaries. The micro hydropower plant's operation and maintenance is the another avenue where local people are mobilized and participated.

The direct beneficiaries have formed a user committee comprising fifteen members. The committee is an executive body to operate the power plant. It manages the resources, maintains occasional technical errors, fixes tariff of using power from the plant and collects the revenue. The committee also consults technical experts outside the village while necessary.

As per the rule fixed by the user committee, an individual user received 100 watt power for lightening purpose. In the study area, the committee distributed 50 watt power to those who were financially weak. The two category of the users participated with different amount during the phase of the power plant construction. The users consuming 100 watt power needed to pay Rs. 10, 800 (ten thousand eight hundredrupees) and those consuming 50 watt power paidRs 5400 on an installment basis. It showed an example in terms of financial mobilization from the users of various economic status.

The better application of the micro hydropower plant depends if the power is applied for the purpose beyond lightening. More the end uses, better the micro hydropower plant status. The purpose of end use operation is commercial use of power generated from micro hydropower, women's workload reduction in household works such as agricultural products processing. In the study area, the management committee encouraged local residents to start small enterprises that could reduce time and labor involved in traditional workshops.

4.2 Status of end uses

End uses are workshops and enterprises where electricity produced from micro hydropower is utilized. These are the avenues of small investment, jobs, and interaction centers.

In the study area, power produced from Fakfok-II micro hydropower had been supplied to small businesses as well as various service centers. The power to these businesses is supplied during the day hours whereas beneficiary households get the power during the night hours starting 6 pm. The status of the end uses in the project area is given below.

Table2 :Status of end uses in the project area

S.N	Name of the Business	Proprietor	Address	Electricity consumption	Operation hours	Miscellaneous
1	Luintel Rice Mill	K P Luitel	Ward-9	7 KW	4 hrs for 15 days	Operated by diesel earlier
2	Sharma Rice Mill	R.S Dhungana	Ward-9	7 KW	3 hrs for 15 days	Milling and Grinding
	Pashupati Rice Mill	B BRai	Ward 7	7 KW	7 hrs for 25 days	Milling and Grinding
4	Gaichan Electronics	T Tamang	Ward 8	1 KW	7 hrs for 25 days	Kolbote
5	Kolbote Computer, photocopy and photography	P Rai	Ward 8	1 KW	2 hrs for 25 days	Extra time
6	Fakfok Furniture Centre	T B Rai	Ward 8	1KW	3 hrs for 30 days	Planner
7	Computer Training Center, Rastriya Secondary School	B BRai (Head Master)	Ward 7	2 KW	7 hrs for 22 days	5 computers and 2 printers

Source: Field Survey, 2017

In the project area, some power induced small enterprises were established, some other were emerging. The majority enterprises were founded for service purposes. A majority of the enterprises were found for the purpose of electrical gadgets maintenance, computer training, printing and photocopy service.

The Rastriya Secondary School located at the center of the project area owned five computers. The school owned two printers. These computers are used to train students of higher classes. The school also applied the computers and a printer to perform printing activities. The computers are used for training to the teachers, question setting, data saving and documentation of examination system. Once the power was generated on a sustainable basis, parliamentary development fund provided adequate fund to the school to buy and operate the computers.

The Gaichan Electronics and Kolbote Computer and photography Center have got busy schedule during the day hours. The electronics centers are serving people by maintaining radio, television, watch and mobile. People are happy to have their electronicequipment maintained in a walking distance. On the other hand, Kolbote computer is serving mainly the photography. Side by side computer is training is also provided to those who are interested. These electronics center were found to be significant development to transform the rural village.

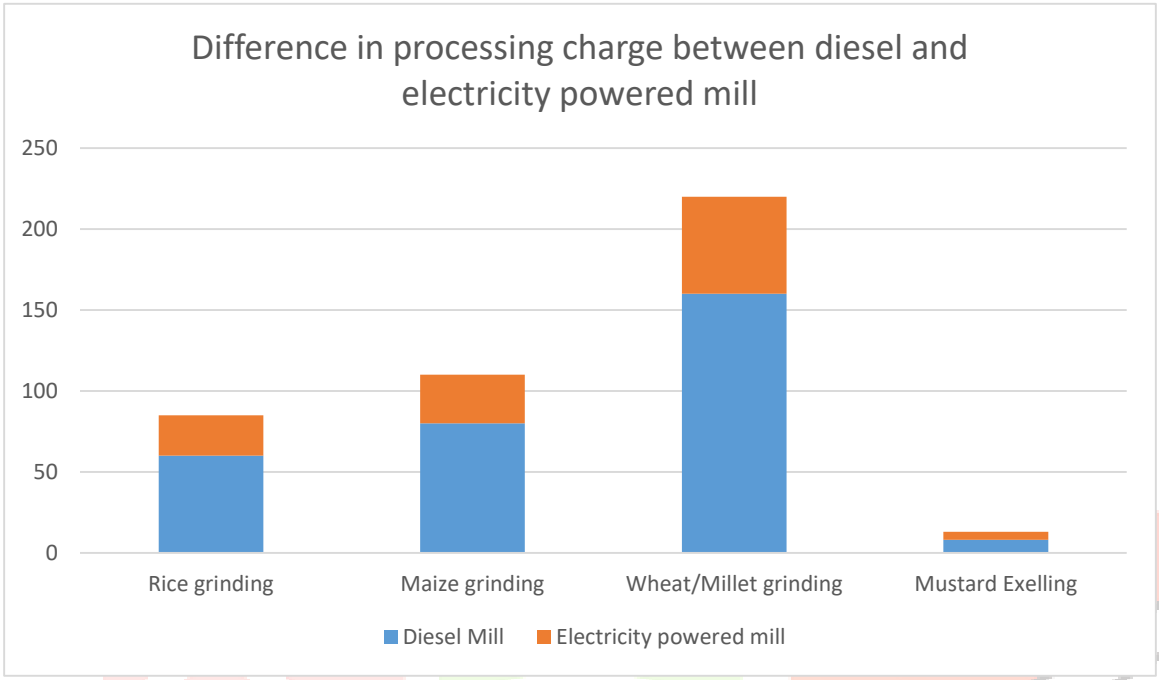
The remaining firms were mechanical in nature. These mechanical enterprises served the beneficiaries for grinding and expelling agricultural products such as maize, rice, and mustard. Before the installation of the Fakfok-II micro hydropower plant, the Luitel Rice Mill and Pashupati Rice Mill were diesel operated mechanical mills. These mills consumed 7 KW power and operated for 4 to 7 hours during a day. Rice mills are busy during the day hours. These workshops have also benefitted households outside the project area. Customers from project area and beyond visit the mills for grinding and expelling the farm produces.

There was a significant reduction in the wage rate between diesel powered mills and electricity powered mills. The differences in the wage rate is given below.

Table 3:Variation in wage rate between diesel and electricity powered mill

Type of Products	Wage Rate		Percentage change
	Diesel Mill	Electricity powered Mill (Rs.)	
Rice Milling	60	25	58
Corn Grinding	80	30	62.5
Wheat/Millet Grinding	160	60	62.5
Mustard Expelling	8	5	37.5

Source: Field Survey, 2017



The wage rate in products processing significantly decreased depending upon the type of processed products. The wage rate in wheat and millet grinding reduced by almost two third. The rice processing wage decreased by around sixty percent. In case of mustard expelling, the rate reduced by around forty percent. This shows a very good application of power generated from micro hydropower in the remote village.

Simultaneously, local residents were attracted much towards electric power induced mills. Those who used to process farm products on their own mechanical devices (Dhiki, Jantoetc) were turned to electric mills. It had surprisingly saved their time and money. Women's household workload had been significantly reduced.

Besides the above mentioned end uses, other electronics devices such as mobile, emergency light, CDMA phone, battery among others were massively applied by the micro hydropower beneficiaries. These end uses had had significant impact on their livelihood.

4.3 Mobile charging a source of earning

Among various power usages, mobile charging had been an effective source of earing for local people. They took Rs. 5 for charging a mobile full. Especially, people from neighboring villages where there was no electricity were subjected to pay the charge fee. Similarly, charging for emergency light, acid battery, CDMA phone was also subjected to pay charge, though not mandatory. Those who provided this service were earning average Rs. 100 per month

4.4 Replacement of commercial fuel and income saving

By the application ofthe end uses from the power generated from Fakfok-II micro hydropower, a significant reduction in the use of kerosene and diesel had been observed in the project area (See table 4). Before the micro hydropower plant operation and use of electric power, the consumption of kerosene per family had been 4 litre per month. After the plant operation and use of electric power, the household consumption of kerosene reduced sharply to 1 liter per family per month. The relative cost of 4 liter kerosene was Rs. 240 (Rs. 60 per liter). Hence, net Rs. 180 was the amount a family could save replacing 3 liter kerosene per family per month. Rs. 80 was the tax for the use of electricity from the micro hydropower plant than Rs. 100 becomes net monthly saving. It meant Rs. 1200 per family per year net saving. This saving excludes labor and time saving the consumer had to apply to buy kerosene from a nearby market center.

Simultaneously, users were also saving out of processing their farm products in electricity powered mills. In an average, the difference in wage rate in diesel and electrical agro-processing mills was Rs 10 per 40 kg product. This cost in total amounted to beRs. 200 if a family processed 800 kg (20 man) farm products per year.

Table 4: Replacement of conventional energy and net saving

Particulars	**Consumption/Family/ Month**		**Replacement**	**Expenditure/month on electricity**	**Saving/family/ month**	**Net Saving/family/year**
	Before Mhp	After Mhp				
Diesel and Kerosene	4 liter (Rs. 240)	1 liter (Rs. 60)	3 liter (Rs. 180)	Rs. 80	Rs.100	Rs. 1200
Farm processing		Saving from 800kg farm products processing/year				200
Total saving by a family after Mhp						1400
Total saving by Fakfok-II micro hydropower beneficiaries (203 households) in the project area was Rs. 2, 84,000 (Two lakhs eighty four thousand per year).						

Source: Field Survey, 2017

The table above shows that a single user was saving Rs. 1400 (12 plus 200) per year which was satisfactory amount in a remote rural area. Consequently, total saving from total users amounts to be Rs 2, 84, 200 per year (Rs 1400 *203). The users were using the saved money for children's education, family health and other buyingmeans of information and entertainment like TV, Radio, and Mobile. The total amount saving was enough to run a cooperative in the project area.

4.4 Enterprises as center of social interaction

In the project site, researcher observed that the enterprises had been emerging as the centers of social interaction. Local people visit the electricity powered mills and electronics center. They let the mills to process their farm products. The surplus time thus saved had been utilized by them to exchange social, cultural and political information. The farmers kept on chatting and expressing their views about national and local politics. They also exchanged their views regarding the micro hydropower project, health and educational status of their family members and capacity of local and district level institutions.

The gathering had been a focal point where NGOs, political parties and government agencies use to disseminate information they wanted to disseminate. Notices related to vaccination day, vitamin day, pamphlet distribution, letter handover by a post-man occurred in these centers.

V. Problems in the project area

In the project area, the frequent fall of electric poles due to rugged terrain was one of the serious problems. During the rainy season, the heavy rain fall causes land slide affecting electric poles and power cut-off. Sometimes, wind breaks off the poles into two disrupting the power flow. In these cases, users cut down either their private forest or the community forest to replace the electric poles. This act has affected forest depletion.

During the rainy season the heavy water flow in the river affected hydropower plant constructed at the bank of Fakfokriver. The water flow impacted fore bay tank and water channel. The members in the user committee said that they were not able to train or provide employment to a technical person to maintain if some technical issues emerge.

VI. Conclusion

This study concludes that a small micro hydropower project, Fakfok-II, in the north-west of Ilam district of Nepal has significant socio-economic impact. It was solely an alternative source of energy to conventional sources like firewood and kerosene. However, the electricity produced from the power plant was not applied for cooking. Lightening was the main purpose of the power generation.

In the project area, the installation of the power plant had been materialized due to wider social mobilization and participation. In all phases of the project, local people's involvement led a sustainable management of the power. The formation of user committee had been a good example of grass root management of the micro hydropower plant.

The small startupsas rice mills, oil expeller and electronics centers run by the power generated from Fakfok-II micro hydropower plant had been the means of social transformation. The enterprises created jobs and provided modern services to the villagers. The electric power had been a source of small earning that could supplement financial crisis of rural families. The mechanical enterprises such as rice mills reduced labor and time to process the farm products. These firms also helped saving money because the difference between the wage rates in processing the farm products was higher than half of the charge in diesel powered mills. This showed that the Fakfok-II micro hydropower project encouraged entrepreneurial activities in the villages. The net financial saving by the total beneficiaries was around three lakhs. The firms acted as the centers of social interaction. This way they served the process of social and economic modernization.

References

[1] Annual report (2015). Ilam: Namsaling Community Development Center (NCDC).

[2] Aryal, R. et.al. (2011). Feasibility study on Hydropower potential of Rataun Micro Hydropower, Chamranbeshi, VDC. A paper published in proceedings of Third International Conference on Addressing Climate Change for Sustainable Development through Up-Scaling Renewable Energy Technologies. Kathmandu: CES/IoE.

[3] Government of Nepal (GoN) (2017). Economic Survey Report, 2016/17. Ministry of Finance: Kathmandu.

[4] Government of Nepal (GoN) (2018). Economic Survey Report, 2017/18. Ministry of Finance: Kathmandu.

[5] *Nepal energy sector assessment, strategy, and road map* (2017) Asian Development Bank: Manila.

[6] *Poor people's energy outlook*, 2012. Warwickshier, UK. Practial Action

[7] *Progress at a glance: A year in review (2017/18).* Alternative Energy Promotion Center (AEPC): Kathmandu.