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Socio-Economic Impact of Micro Hydro Plants in Bhimeshwar Municipality, Dolakha District, Nepal

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Abstract

The study highlights the significant potential of Nepal's 6,000 rivers for hydropower development, which is considered a vital source of energy for the country. This research specially examines the socio-economic impact of micro-hydro projects on rural communities in the Dolakha district, with a focus on assessing whether these projects bring benefits to the surrounding population. Using descriptive research design and primary data collection as the main information source, the study employed descriptive statistics for data analysis. The findings indicate that micro-hydro projects have a substantial positive socio-economic impact on local rural populations. A notable 97 percent of respondents reported that the micro-hydro project increased children's study time and contributed to improved educational outcomes. In addition, these projects have enhanced agro-processing by saving time and money, thanks to the use of modern technology powered by electricity. Micro-hydro projects have also extended working hours by providing electric lighting for households at night. In conclusion, this study demonstrates that micro-hydro projects significantly improve the socio-economic conditions of rural communities in the sample areas contributing to both educational and economic development.

Keywords: hydro, impact, micro, plant, socio-economic.

The distinct topography of Nepal, characterized by its unique high hills and more than 6,000 rivers and rivulets crisscrossing the country, offers vast opportunities for both large- and small-scale hydropower developments (Bajracharya, 1991). Nepal is estimated to have a theoretical hydropower potential of 83,000 MW, with 43,000 MW being technically feasible (Siwakoti & Bhandari, 2005). Apart from hydropower, Nepal lacks other natural resources in economically exploitable quantities that could drive economic prosperity and improve the living standards of its people. The country has a long history of hydroelectricity generation, spanning over a century. However, despite this extensive history, Nepal has only achieved a total hydropower generation capacity of 2330.70 MW as of 2021 (NEA, 2021). Energy plays a vital role in human life, serving purposes that range from basic necessities such as cooking and washing to advanced technologies like space exploration and nuclear power plants (Alternative Energy Promotion Centre, 2009). The growing energy demand is

met by various sources, including wind energy, fossil fuels, nuclear energy, solar energy, and hydropower. Empirical studies have shown a strong correlation between energy consumption and economic growth (Nath, 2000).

Harnessing hydropower as an energy source is expected to significantly boost Nepal's economic growth. The electricity generated from hydropower has the potential to enhance economic welfare by increasing productivity levels (Malla, 2003). Additionally, it can help reduce pollution by replacing fuelwood with electricity for cooking, heating, and lighting. Furthermore, reducing dependence on imported petroleum products will contribute to conserving the country's foreign exchange reserves. Hydropower is regarded as one of the most important sources of energy. Several countries, including Norway, Switzerland, Canada, Sweden, and New Zealand, have successfully harnessed their water resources for energy production (Karki, 1995). As a renewable energy source with virtually zero emissions, hydropower is widely considered a sustainable alternative (Alternative Energy Promotion Centre, 2005).

In Nepal, commercial energy sources include coal, petroleum products, and electricity. However, due to the lack of domestic fossil fuel reserves, the country spends a significant portion of its foreign exchange reserves on fossil fuel imports. Additionally, Nepal's challenging geographical terrain complicates transportation, making it difficult for people in remote areas to access petroleum products (Acarya, 1983). Given these logistical challenges and the country's abundant water resources, hydroelectricity is considered the most viable and sustainable energy source. In Nepal, hydroelectric plants are categorized based on their installed capacity (Acarya & Shrestha, 1958). These projects are typically classified by their size (generating capacity) and the type of scheme, which can be either run-of-river, reservoir, or pumped storage. The Nepal Electricity Authority classifies hydroelectric projects into the following categories based on their electricity generation capacity:

Large-hydro: 100 MW or more, supplying power to a large electricity grid.
Medium-hydro: 20 MW to 100 MW, almost always feeding into a grid.
Small-hydro: 1 MW to 20 MW usually connected to a grid.
Mini-hydro: 100 kW to 1 MW, which can operate as a standalone system, a mini-grid, or be grid-connected.
Micro-hydro: 5 kW to 100 kW, providing power to small communities or rural industries in remote areas away from the grid.
Pico-hydro: A few hundred watts up to 5 kW.

However, there is no universally agreed-upon classification for "small" and "large" hydropower projects, as definitions can vary from country to country. The classification of small hydropower systems is important, as it often determines which projects qualify for support policies aimed at small hydro and which fall under regulations governing large hydro (Water and Energy Commission Secretariat, 2002).

The main objective of this study is to assess the socio-economic effects of micro-hydro plants on the rural population of Nepal, with a specific focus on Bhimeshwar Municipality in Dolakha District.

Methodology

This study aims to analyze the socio-economic status of the surrounding community using key determinants such as the impact of electricity, its effect on education, and financial savings resulting from the micro-hydro project. In this context, the micro-hydro project serves as the independent variable, while electricity consumption, educational impact, and financial savings act as the dependent variables. The study follows an exploratory, descriptive, and analytical framework to evaluate the impact of the micro-hydro plant. Primary data were collected through a household survey using a semi-structured questionnaire. The data management and analysis were conducted using the Statistical Package for Social Sciences (SPSS) software, with descriptive statistics as the primary analytical tool.

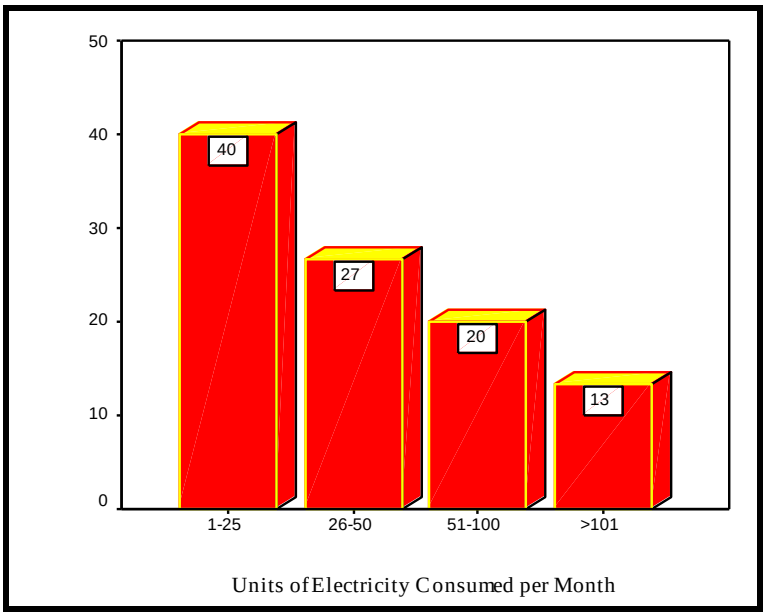
This study analyzes the socio-economic impact of a micro-hydro plant on the rural population of Jhyaku, Bhimeshwar Municipality-6, in Dolakha District. Dolakha District is home to more than a dozen hydroelectric power projects of varying capacities. However, this study focuses on specifically on Jhyaku as the sample area, as it is directly impacted by a micro-hydro plant. The research follows an exploratory, descriptive, and analytical framework to assess the socio-economic effects of the micro-hydro plant on the local population. The total number of households in Jhyaku, Bhimeshwar Municipality-6, represents the population (universe) of this study. A simple random sampling technique was employed to select approximately 10% of households for the sample. Out of 305 total households, 30 households were selected for the study (Kothari, 2004).

Results and Discussion

Electricity Consumption per Month

The electricity generated from the micro-hydro plant is primarily used for lighting, agro-processing, and operating small cottage industries**.** Due to the availability of electricity, most households in the study area have replaced kerosene lamps with electric lighting. Households that use electricity solely for lighting purposes tend to consume fewer units. This trend is illustrated in the figure below:

Figure 1: Monthly Electricity Consumption



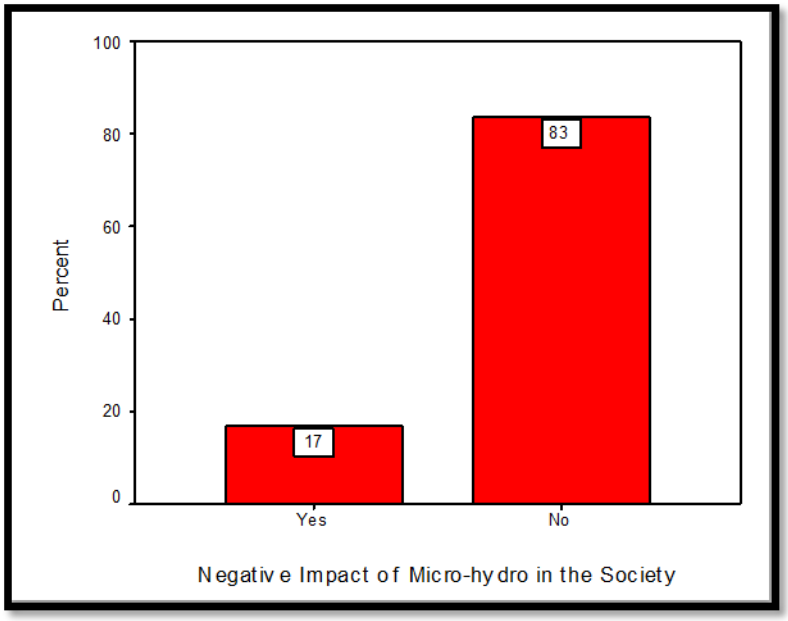
Source: Field Survey, 2021

The simple bar diagram in Figure 1 illustrates the monthly electricity consumption of respondents. It shows that 40 percent of respondents consume 1-25 units**,** 27 percent consume 26-50 units**,** 20 percent consume 51-100 units, and the remaining 13 percent consume more than 101 units of electricity per month. Electricity is primarily used for lighting, cottage industries, and small businesses such as sawmills, agro-processing mills, and other family-based industries**.**

Effect of Electricity on the Community

Electricity in the village is used for lighting, heating, cooking, battery charging, and operating sawmills, grinding mills, oil-expelling mills, and other small industries. While electricity has brought significant benefits, it also has both positive and negative impacts. Accidents may occur due to improper wiring and poorly erected electric poles. The impact of the micro-hydro project (MHP) is illustrated in the figure below:

Figure 2: Effect of Electricity



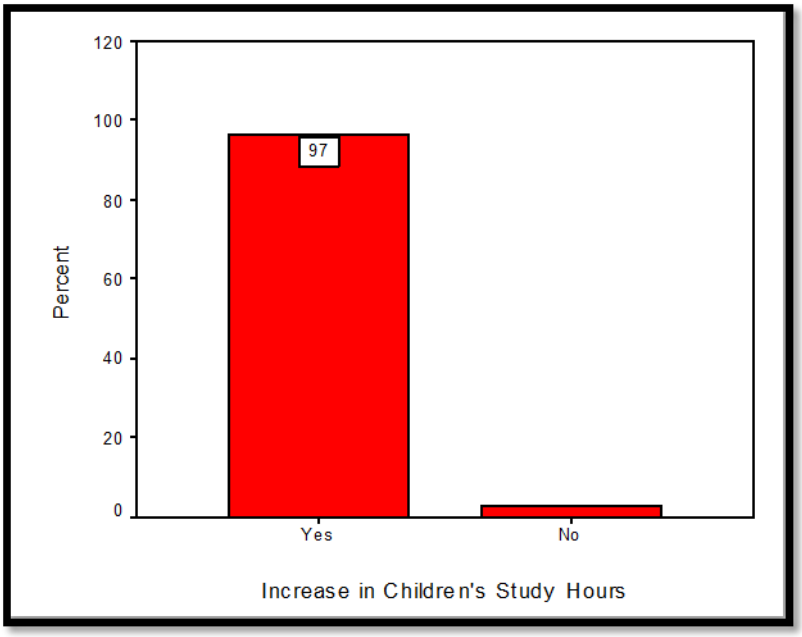
Source: Field Survey, 2021

Figure 2**,** represented by a bar diagram**,** shows the perceived impact of the micro-hydro power project. From the total respondents 17 percent believe that the project has had a negative effect on the community. They feel that it has led to various accidents and has also reduced the demand for firewood negatively affecting those who rely on firewood sales for their livelihood. However, the majority of respondents (83 percent) stated that the electricity generated from the micro-hydro plant has had many positive impacts on the village.

Effect on Study Hours of Children

To assess the socio-economic effects of the micro-hydro project on the rural population in the sample area, an important indicator is whether the project has led to an increase in children's study hours This research analyzes this indicator based on the information provided by the respondents. The data gathered from the rural respondents indicates whether the micro-hydro project has had an impact on their children's study time. The following figure illustrates the results:

Figure 3: Increase in Study Hours of Children



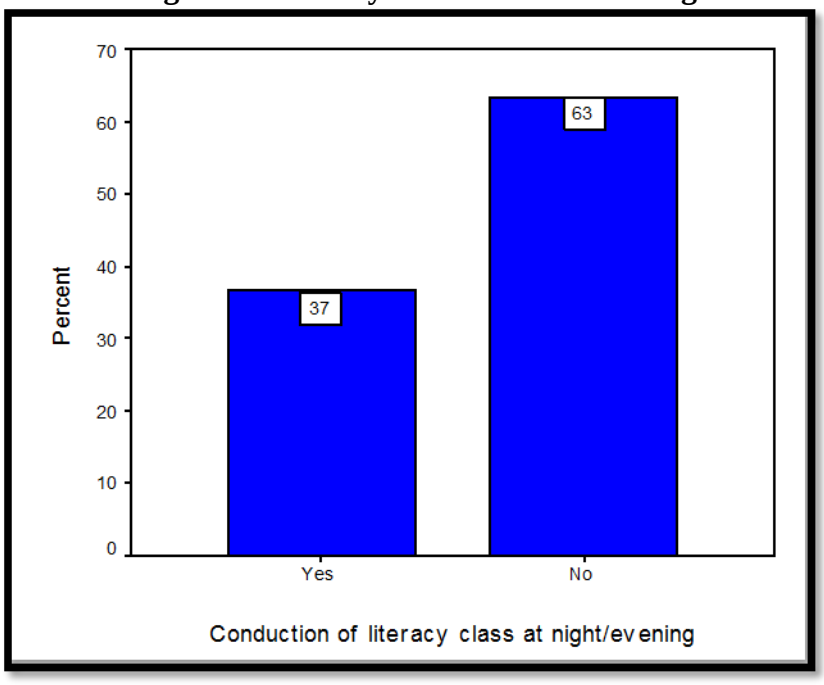
Source: Field Survey, 2021

Figure 3, presented as a simple bar diagram, illustrates that 97 percent of respondents believe there has been a significant increase in study hours since the village was electrified. Children who previously went to bed early can now study for several hours with the help of electric lighting. This improvement has also indirectly benefited their health, as the reduced use of firewood for lighting has minimized the risk of smoke-related health problems.

Conducting Literacy Classes in the Evening

Literacy classes are now being held in the village in the evening, particularly for women, thanks to the availability of electric lighting at night. These classes have contributed to increasing the knowledge and awareness of rural Villagers on various aspects of their daily lives. This serves as an important indicator of the socio-economic impact of the micro-hydro project (MHP) on rural community. The following figure illustrates this impact:

Figure 4: Literacy Classes in the Evening



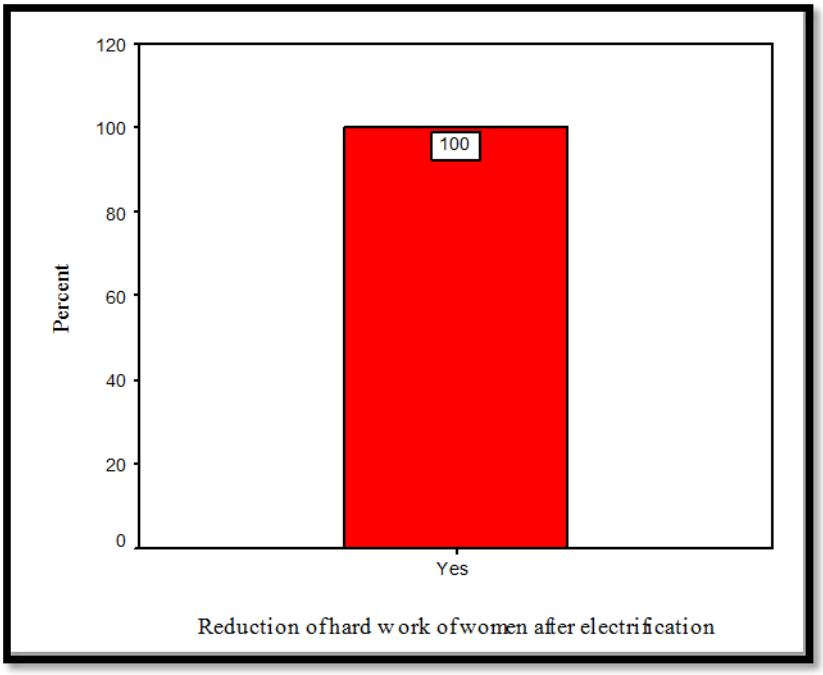
Source: Field Survey, 2021

Figure 4, depicted as a bar diagram, illustrates participation in evening literacy classes. Of the total respondents 37 percent indicated that they are attending and actively participating in the program. In contrast, 63 percent are not involved in such programs, citing reasons such as being busy with household chores, taking care of children, or lacking interests in the program.

Saving Time

Time savings due to electricity is another important indicator for assessing the socio-economic impact of the micro-hydro project (MHP) in the sample area. Prior to the MHP, villagers relied on traditional methods for agro-processing. However, with the availability of electricity, they now use modern technology, significantly reducing the time spent on these activities. This time saved is then reallocated to other economic activities. The following figure illustrates the time saved by the villagers in the sample area due to the MHP:

Figure 5: Time Saved from MHP



Source: Field Survey, 2021

Figure 5, presented as a simple bar diagram, illustrates the time-savings experienced by the people in the sample area due to the micro-hydro project (MHP). All respondents reported saving time as a result of the MHP, which has positively impacted their daily household chores and business activities. This is clearly represented by a single bar in the diagram, indicating unanimous agreement among respondents.

Conclusion

The micro-hydro plant has had a positive socio-economic impact on the people in the study area through various activities. It has supported local business, cottage industries, and small-scale production by reducing operational costs, thereby stimulating economic activity and improving the socio-economic status of the community. Additionally, he micro-hydro plant has positively influenced the consumption of petroleum products, as households have replaced kerosene lamps with electricity, leading to savings for the villagers. The use of modern technology in agro processing has also saved time, allowing villagers to engage in other economic activities. Furthermore, the plant has enhanced the educational environment for students, providing more comfortable study conditions and increasing study hours. It has also facilitated women's participation in evening literary classes, boosting their efficiency and awareness. Overall, based on the data and information gathered from the electrification project in Jhyankhu, Bhimeshwar Municipality, it can be concluded that the

rural electrification has had a positive impact on the area.

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