NCCS Research Journal, 4 (1), August 2025, ISSN: 2822-1605

Socio-Economic Effects of Panauti Small Hydro Electricity Project on Panauti Municipality of Kavrepalanchok District of Nepal

Ananta Raj Dahal, Ph.D.

Department of Economics, Patan Multiple Campus,

Tribhuvan University, Lalitpur, Nepal.

Email: anantadahal38@yahoo.com /anantadahal38@gmail.com

Received: March 2025; Revised: May 2025; Accepted: July 2025

https://doi.org/10.3126/nccsrj.v4i1.84353

Abstract

There are approximately 6,000 small and large rivers in Nepal, which provide significant potential for hydropower development. Hydropower is considered one of the most important sources of energy supply for the country. The studies focus on the socio-economic impacts of the small hydroelectricity projects on local communities in the Kavrepalanchok district. Primary data were used as the main source of information, collected through a sample survey. Using a simple random sampling technique, 95 households were selected as the sample population. Descriptive statistics were applied to analyze the data. The study concludes that small hydroelectricity projects have had significant socio-economic impacts on the local people in the study area. These projects have positively influenced the lives of the sample population by increasing children's learning time and improving school education. In addition, the projects have contributed to better access to physical facilities such as safe drinking water, modern housing, improved sanitation systems, and transportation services. They have also helped enhance the pricing of agricultural products, as well as the development of industries and trade. Furthermore, small hydroelectric projects have supported improvements in income, health, and education, thereby raising the overall living standards of rural people in the project-affected areas.

Keyword: socio-economic, impact, hydro-electricity, project & small

1. Background of the Study

Although Nepal is rich in natural resources, it remains one of the poorest countries in the world. Approximately 25.4 percent of the total population lives below the poverty line (NPC Report, 2010). Hydropower projects can play a significant role in reducing poverty and improving the living standards of the Nepalese people by providing reliable and sustainable energy (AEPC, 2009). Nepal's distinct topography—with its high hills, more than 6,000 rivers, and countless rivulets—offers immense opportunities for both large and small-scale hydropower development (Siwakoti & Bhandari, 2005).

Nepal is considered the fourth richest nation in the world and the second in Asia, after China, in terms of water capital (Dahal, 2015). According to Hydro Solution's estimates, Nepal's total hydropower potential is around 43,000 MW, while a widely accepted figure is 83,000 MW (Karki, 1995). Nepal has over a century of experience in generating electricity from hydropower. The Pharping Hydropower Plant, with a modest capacity of 500 kW, began operation on May 22, 1911 (B.S. 1968, Jestha 9). While the rest of the world, including our neighboring countries, has made rapid advancements in power generation, Nepal's total installed hydropower capacity stood at just 3600 MW as of 2024 (NEA, 2024).

Energy plays a crucial role in everyday human life, from their household's work, such as cooking and cleaning, to superior industrial applications for space searching and nuclear power. Various sources—such as wind, fossil fuels, nuclear, solar, and hydro energy—are used to meet energy demands. Empirical studies have shown a strong correlation between energy consumption and economic growth (Acharya, 1983). Therefore, Nepal can accelerate its economic development by harnessing hydropower. By increasing productivity and replacing traditional biomass like firewood with electricity for cooking, heating, and lighting, hydropower can enhance economic welfare and reduce

pollution. Furthermore, it can help the country conserve foreign exchange by lowering dependence on imported petroleum products, thus contributing to a reduction in the trade deficit (Bhattarai, 2008).

In Nepal, hydropower accounts for the largest part of the energy sources. Different countries, such as Switzerland, Canada, Norway, New Zealand, and Sweden, have successfully harnessed their water resources for energy. As water is a renewable resource with almost zero emissions, hydropower is considered an environmentally friendly energy source (Dahal, 2025). The commercial sources of energy used in Nepal include coal, petroleum products, and electricity. However, Nepal lacks domestic fossil fuel reserves, resulting in heavy reliance on costly fuel imports. Additionally, the country's challenging geography hinders the transportation and distribution of petroleum products, particularly in remote areas (WECS, 2002). Therefore, hydropower is the most suitable energy source for a country like Nepal.

For developing countries like Nepal, decentralized renewable energy sources—often promoted as tools for sustainable development—can help overcome energy access challenges. They can deliver clean electricity to remote locations that are difficult to connect to the central grid (Thompson et al., 2024). Modern innovations also allow energy generation and storage through urban water systems. Researchers have explored the use of surplus energy from water and wastewater systems for micro-hydropower (MHP). Additionally, the gravitational potential energy of stored water in high-rise buildings presents a sustainable option for distributed energy storage using micro-pumped storage (MPS) systems (Boroomandnia et al., 2022). In Nepal, micro-hydro plants producing up to 100 kW have helped supply power to isolated rural communities (Bhandari et al., 2023).

Hydropower projects are categorized based on their electricity generation capacity and project scheme. They are usually classified by size (generation capacity) and type (run-of-river, reservoir, or pumped storage).

According to the Nepal Electricity Authority, hydropower projects are classified as follows:

> -Power generation capacity 100 MW or more, feeding into a large hydropower project, 20 MW to 100 MW, almost always grid-connected is medium hydropower project, 1 MW to 20 MW, usually grid-connected small hydropower project and 100 kW to 1 MW, which may be stand-alone, connected to a mini-grid, or grid-connected is mini hydropower project (Dahal, 2024).

Though there is no commonly approved categorization for "small" and "large" hydropower projects, as definitions vary from country to country. A country's classification is often important because it determines which projects are eligible for specific support policies for either small or large hydropower development.

Panauti Hydropower Project (PHP)

The Panauti Hydropower Station is a small-scale hydroelectric project located on the Roshi Khola in Khopasi-12, Panauti Municipality, Kavrepalanchok District. It has an installed capacity of 2.4 MW and an annual energy generation capacity of 6.97 GWh. The station is situated 35 kilometers east of Kathmandu, the capital city of Nepal. The project was commissioned in 1965 with technical and financial assistance from the former Soviet Union, at a total cost of NPR 27 million. It was designed to operate with only two generating units at a time, while the third unit serves as a standby. A power canal, 3,721 meters long and capable of discharging 3.2 m^3/s, runs from the head works

to the reservoir. This canal also includes seven outlet gates used for irrigation purposes in the Khopasi area (NEC, 1983).

The Government of Nepal is currently supporting the rehabilitation of this plant. Under the rehabilitation program, rewinding of stator coils, replacement of switchgear and protection systems, and mechanical repairs in Units No. 1 and 3 are underway. In addition to these works, the plant also requires refurbishment of the excitation and governing systems, as well as the replacement or repair of outdoor transformers and switchyard components.

2. Objective

The major objective of this study is to find out the socio-economic status of small hydroelectricity projects in the rural people of Nepal, with reference to Panauti Municipality of Kavrepalanchok District.

3. Research Methodology

This study employed various methods to achieve its objectives. Some of them are:

3.1. Research Design

It aims to examine the socio-economic status of the respondents, using some determinant variables, such as electricity usage, its impact on education, savings, and income, as well as time and other economic activities (Dahal, 2022 & 2024). The study is designed within an exploratory, descriptive, and analytical framework to evaluate the impact of a small hydropower project. Primary data were collected through a questionnaire survey using semi-structured questionnaires for information gathering (Dahal, 2022 & 2024). Data management and analysis were conducted using the

Statistical Package for the Social Sciences (SPSS) software, with descriptive statistics employed as the main analytical tool (Dahal, 2025).

3.2. Sampling design

This study analyzes the socio-economic effects of a Small Hydroelectricity Project (SHEP) on the rural population of Khopasi, Ward No. 12, Panauti Municipality, in the Kavrepalanchok District. It focuses on assessing the impact of the project on the affected communities surrounding the project area. The study adopts an exploratory, descriptive, and analytical framework to examine the socio-economic effects of the project on the local community.

3.3. Sample Size

The entire number of households in Khopasi, Panauti Municipality, constitutes the population (universe) of this research. A sample comprising approximately 10% of these households was selected using a simple random sampling technique. The total population is 950 households, and the sample size is 95 households. Information collected from the sample households was entered into the Statistical Package for the Social Sciences (SPSS) software and analyzed using descriptive statistics.

4. Result and Discussion

4.1 Energy Consumption for Lighting Purposes

Electricity and kerosene are the main sources of energy used for lighting in the project-affected area. The number of households (HHs) using electricity has increased, while the number of HHs using kerosene has decreased after the completion of the project, as shown in the following table.

Table 1.

Energy Consumption

S. No.	Sources of Energy	Before Project (%)	After Project (%)	Percentage Change
01	Electricity	86	100	+14
02	Kerosene	14	0	-14
	Total	**100**	**100**	

Source: Field Survey, 2019

Table 1 shows that only 14 percent of households used kerosene for lighting purposes, which has now dropped to zero. After the implementation of the project, the number of households using electricity increased by 14 percent, and currently, all households (100%) use electricity for lighting. It is the optimistic impacts of the project on the local community.

Electricity has contributed to changing their lifestyles and daily activities. For example, it has helped children to study in the evening and made other tasks easier. According to the local people, electricity has also contributed to forest conservation and helped control soil erosion, which otherwise worsens flood and landslide risks. As a result, the local people are happy with the Panauti Hydropower-Electricity Project, which has started generating electricity.

4.2. Effect on Drinking Water Facility

The availability of drinking water facilities for people in the sample area serves as an indicator to measure the economic impact of the hydroelectricity project. In the study area, there are mainly two sources of drinking water: supplied (piped) water and natural

sources such as rivers (Khola) or wells. The impact on the drinking water sector before and after the implementation of the project is presented in the table below.

Table 2.

Drinking Water Facility in the Study Area (%)

S. No.	Sources of Water	BP)	(AP)	Percentage Change
01	Piped Supplied	54	86	+32
02	Khola/Well	46	14	-39
	Total	**100**	**100**	

Source: Field Survey, 2019

Table 2 shows that after the implementation of the project, the number of households with access to supplied drinking water increased from 54 percent to 86 percent, while the number of households using water from Khola (streams) or wells decreased from 46 percent to 14 percent. This indicates that the hydroelectricity project played a vital role in providing safe drinking water to the sampled households. The improvement is attributed to the project's financial support for purchasing GI and HDP pipes, constructing water tanks, and other necessary infrastructure for safe drinking water. As a result, some households have gained access to improved water facilities. Therefore, the project has played a positive role in the drinking water and sanitation sector.

4.3 Effect on Sanitation

Sanitation facilities are an important indicator for measuring the socio-economic effects on people in the sample area, as they also reflect the living standards of the population. From the survey conducted in the sample area, it was found that people using modern types of toilets are more aware of sanitation issues, and their living standards are

relatively better. The impact of the small hydroelectricity project on the use of modern toilets as a form of improved sanitation is described below.

Table: 3

Toilet Used in Sample Area Households (%)

S. No.	Types of Toilet	Before Project	After Project	% Change
01	Pakki/Modern	36	44	+08
02	Kacchi (Deepwhole cover)	44	48	+04
03	Opened	20	08	-12
	Total	**100**	**100**	

Source: Field Survey, 2019

Table 3 indicates that the people of the study area use three different types of toilets. Among the total households of the sample area, the use of modern (permanent) toilets increased by 8 percent after the project, and the use of kachchi (temporary) toilets increased by 4 percent. Meanwhile, the number of households practicing open defecation decreased by 12 percent after the project. The project conducted various consciousness programs on sanitation and environmental conservation for households in the surrounding area. As a result, the overall number of households using toilets increased, which is a positive impact of the project.

4.4 Energy Used for Cooking Purposes

The main source of energy for cooking in the study area is firewood. However, there has been a slight change in the energy consumption pattern after the implementation of the project. The number of consumers using biogas and electricity for cooking has increased in the project area, as shown in the table below.

Table: 4

Energy Used for Cooking Purpose (%)

S. No.	Source of Energy	Before Project	After Project	Percent Change
01	Fire wood	90	74	-16
02	Bio-gas	02	12	+10
03	Kerosene	08	06	-02
04	Electricity	00	08	+08
	Total:	**100**	**100**	

Source; Field Survey, 2019

Table 4 indicate that the number of families using firewood as a source of energy for cooking has decreased by 16 percent, and the use of kerosene has also decreased by 2 percent. In contrast, the number of users of biogas and electricity has increased by 10 percent and 8 percent, respectively, after the completion of the project. Previously, no households used electricity for cooking, but now 8 percent of the 95 households use electric heaters for this purpose. This indicates that electricity and biogas have become the main alternative sources of energy for cooking in survey times.

4.5 Housing Condition in the Sample Area

In the hilly and mountainous regions of Nepal, houses are typically made of stone, mud, and wood. Most of the houses in the study area are two-storied and constructed using stone and mud. However, there are also some cemented houses in the area. The shift from traditional stone-mud-wood houses to cemented houses is another indicator used to measure the socio-economic impacts. The changes in housing conditions in the project area due to the Panauti Small Hydroelectricity Project are presented below.

Table: 5

Housing Condition in the Sample Area (%)

S. No.	Particulars	Before Project	After Project	Percentage Change
01	Kachchi (Stone)	80	68	-12
02	Pakki (Cement)	20	32	+12
	Total	**100**	**100**	

Source: Field Survey, 2019

Table 5 shows that before the project, 80 percent of the houses were kachchi (stone/mud) and 20 percent were pakki (cemented). However, after the project, the number of kachchi houses has decreased to 12 percent, while pakki houses have increased correspondingly. Following the construction of the access road, many people replaced their kachchi houses with cemented ones. As a result, the area is gradually beginning to take on an urban appearance. Additionally, the number of local contractors has increased after the project. Therefore, the project has had a positive effect on the housing conditions of the local people in the study area.

4.6 Price of Agro Products

The most important profession of the households in the sample region is agriculture. The prices of agricultural products influence their income and living standards. After the hydroelectricity project, the market expanded due to the construction of the project's link road. The situation of agricultural product prices before and after the project is shown in the table below.

Table: 6

Agro Products Price in the Sample Area (Rs)

S. No.	Agro Products	Unit	Before Project	After Project	Change
01	Rice (Mota)	P/Pathi	65	140	+ 75
02	Maize	P/pathi	50	100	+ 50
03	Wheat	P/Pathi	65	120	+ 55
04	Kodo	P/Pathi	35	80	+ 45
05	Tori	P/Pathi	150	250	+ 100

Source: Field Survey, 2019

Table 6 expresses that the main agricultural products in the study area are rice, maize, wheat, kodo, and tori. The table indicates that the price of each product has approximately doubled over the past five years. The project has had a direct impact on the prices of agricultural products.

During and after the construction of the Panauti Small Hydroelectric Project (PSHP), many people lost interest in agriculture as they found alternative sources of income, such as jobs and small businesses. Some individuals even changed their profession from agriculturists to contractors after the project. Additionally, the loss of cultivable land due to the project contributed to the rise in agricultural product prices.

4.7 Meat Products Price

Milk and meat production are supplementary occupations to agriculture for the people in the sample area. Specifically, local people raise various animals and birds for meat. The hydroelectric project has affected the prices of these meat products, which has helped increase the income of the local people in the sample area. The prices of meat products in the study area before and after the project are shown in the table below.

Table: 7

Meat Product of the Sample Area (Rs)

S. No.	Meat Products	Unit	Price (BP)	Price (AP)	Change
01	Goat	P/Dharni	500	800	+ 300 (60%)
02	Chicken (Local)	P/Kg.	250	400	+ 150 (60%)
03	Buffalo	P/Dharni	300	500	+ 200 (67%)
04	Pigs	P/Dharni	300	500	+ 200 (67%)
05	Chicken (Boiler)	P/Kg	150	250	+100 (67%)

Source: Field Survey, 2019

Table 7 presents that the prices of goat, local chicken, broiler chicken, buffalo, and pig meat have increased by approximately 65 percent after the project. In the study area, the unit of measurement for goat, buffalo, and pig meat is Dharni, while for other types of meat, it is measured in kilograms. People's interest in animal husbandry has increased, as dairy products now provide them with better returns. This indicates that the hydroelectric project has had a positive effect on the income and living standards of the people in the sample area.

4.8 Effect on Cottage and Small Industries

Changes in cottage and small industries such as water mills, rice mills, bakeries, furniture making, tailoring, gold-smithing, and blacksmithing are important indicators to measure the socio-economic effects of the project. The following table represents the situation of these industries before and after the Panauti Hydroelectricity Project.

Table: 8

Industrial Status of the Sample Area

S. No.	Type of Industries	Before Project	After Project	Change
01	Water Mills (Ghattas)	10	04	-06
02	Rice Mills	01	03	+02
03	Bakery	01	02	+01
04	Furniture	02	04	+02
05	Tailoring	05	08	+03
06	Goldsmith	01	01	No change
07	Blacksmith	01	01	No change

Source: Field Survey, 2019

Table 8 expresses the development of the industrial sector in the PHEP area due to the hydroelectricity project. Except for water mills (Ghattas), other industries such as rice mills, bakeries, furniture making, and tailoring have increased in the sample area. After the project, six out of ten Ghattas have closed due to the hydro project. The remaining four Ghattas operate only during the months of Asadh, Shrawan, Bhadra, and Aswin.

Thus, the project has had a negative impact on Ghattas. However, other industries like rice mills, bakeries, and furniture workshops have benefited positively from the project. The table indicates that the PHEP has had a positive effect on increasing industries in the surrounding area, which has, in turn, created employment opportunities and improved the income and living standards of the local people.

5. Conclusion

The Small Hydroelectricity Project is very important in terms of investment, construction capital, and the technology used. Nepalese technology and capital are sufficient for implementing such projects. This research is based on the Panauti Small Hydroelectricity Project, located in Panauti Municipality of Kavrepalanchok District, Nepal.

With more than 6,000 small and large rivers in Nepal, there is vast potential for constructing many small hydroelectricity plants. However, all small hydroelectric projects do not have the same socio-economic impact on the people living in the surrounding areas. This study analyzes the socio-economic impact of the Panauti Small Hydroelectricity Project and compares its results with those of other similar projects.

The main objective of this research was to study the socioeconomic impact of the Panauti Small Hydroelectricity Project on the local population. As suggested in the summary above, the local people have gained much more than they have lost from the project. After the completion of the project, all the sampled households started using electricity for lighting in their daily lives. This made their lives more comfortable, helped extend the learning hours for children, and improved school education.

The project has had a positive socio-economic impact on the sample area by providing safe drinking water, improving sanitation, and introducing modern toilet systems. Similarly, the project contributed to market expansion through the construction of link roads. These roads facilitated the transportation of agricultural products and supported the growth of small and cottage industries, thereby creating employment and self-employment opportunities.

Furthermore, the link roads improved transportation facilities, giving local people better access to higher education and health services. The Panauti Small Hydroelectricity Project has played a vital role in increasing income, improving living standards, raising awareness, and enhancing access to health and education facilities, transportation, market expansion, agro-based production, trade, and industries in the study area. These are the positive socioeconomic impacts of the project.

Acknowledgements:

I would like to thank the entire Research Division of the University Grants Commission and also express my gratitude to the experts who played a vital role at the time of evaluation to select my proposal for the mini-research grant. This grant has supported me in publishing this article. I also extend my honest appreciation to all people in the sample area who participated as respondents and gladly provided important information with no hesitation. Support of the respondents was instrumental in enabling me to complete this study on time.

References

Acharya, K. (1983). *Hydroelectricity development in Nepal and its contribution to Nepalese economy.* Kathmandu: Tribhuvan University.

Alternative Energy Promotion Centre. (2009). *Renewable (Rural) energy subsidy policy, 2063.* Kathmandu: Alternative Energy Promotion Centre.

Bhattarai, B. P. (2008). Contribution of small hydropower in national development. *Vidyut.* Nepal Electricity Authority, Kathmandu.

Boroomandni, A. B. A., Rismanchi, A. B., & Wu, W. (2022). A review of micro hydro systems in urban areas: Opportunities and challenges. *Renewable and*

Sustainable Energy Reviews, 169, 112866. https://doi.org/10.1016/j.rser.2022.112866

Dahal, A. R. (2015). Impact of irrigation in the command area of Bagmati Irrigation Project. *Economic Journal of Development Issues*, *15*(1-2), 1–14. https://doi.org/10.3126/ejdi.v15i1-2.11854

Dahal, A. R. (2022). Livelihood Impacts of Kulekhani Hydropower Station-II Project on the Surrounding Community. *Patan Pragya*, *10*(01), 1–7. https://doi.org/10.3126/pragya.v10i01.50518

Dahal, A. R. (2024). Livelihood Impacts of Micro-Hydro Electricity Project of Rural People of Nepal. *Patan Pragya*, *13*(1), 1–10. https://doi.org/10.3126/pragya.v13i1.71177

Dahal, A. R. (2025). Socio-Economic Impact of Micro Hydro Plants in Bhimeshwar Municipality, Dolakha District, Nepal. *Historical Journal*, *16*(1), 1–9. https://doi.org/10.3126/hj.v16i1.76355

Thompson, B. C. R., Makees, A., & Wang, C. Z. H. (2024). Decentralized renewable energy to grow manufacturing? Evidence from micro-hydro mini-grids in Nepal. *Journal of Environmental Economics and Management, 130,* 103092. https://doi.org/10.1016/j.jeem.2024.103092

Karki, M. D. (1995). Small-hydro power and the development of the agriculture sector. *Small Hydropower in Nepal.* Kathmandu: Centre for Economic and Technical Studies.

Kothari, C. R. (2004). *Research methodology: Methods and techniques.* New Delhi: New Age International (P) Ltd.

National Planning Commission. (NPC) (2010). *Tenth five-year plan.* Kathmandu: Author.

Nepal Electricity Authority. (NEA) (2021). *A year in review: Fiscal year 2019/2020.* Kathmandu: Author.

Nepal Electricity Authority. (NEA) (2024). *A year in review: Fiscal year 2022/2023.* Kathmandu: Author.

Nepal Electricity Corporation. (NEC) (1983). *A year in review: Fiscal year 1982/1983.* Kathmandu: Author.

Water & Energy Commission Secretariat. (2002). *Energy balance sheet of Nepal 2001 (Draft).* Kathmandu: Water & Energy Commission Secretariat.