CHAPTER I
INTRODUCTION

1.1 General Background

The geographical formations of Nepal have imparted many obstacles for essential infrastructural development works, but still provide great opportunity for hydropower development. Nepal, situated along the Himalayan Range of mountains, the electricity supply is seen as a means to stimulate industrial growth, bring social benefits like improvement in literacy, health, communication etc, and encouraging government staff to work in remote areas and bring isolated communities in contact with the outside world. Hydropower is the major resources endowment of Nepal in the development of country's economy. The perennial flow of river provides many opportunities for hydropower development. Nepal's theoretical hydropower potential has been estimated at about 83,000 MW and about 43,000 MW is assessed to be economically feasible. In spite of the vast hydropower resources, Nepal has so far developed only about 964.759 MW, but only 911 MW can be generated from hydropower stations, which is less than 2.12% of its potential. Total peak power demand is 1291 MW which is 326 MW less than total power generations which causes loadshedding(DoED, 2016). About 26% of the population is still out of reach of electric power(National Planning Commission 2073, 1). In such a scenario, only accelerated development of effective hydropower project can rescue the country from this dilemma.

The altitude of Nepal varies from 70 m in the south to 8848 m in the north. The presence of perennial rivers and the steep slope topography offers an ideal condition for the development of hydropower projects in Nepal. It is presumed that the hydropower can provide the needed momentum for the overall economic growth of Nepal, but unfortunately it is underutilized till date which is due to various reasons such as inconsistent project planning and selection criteria, lack of sustainable policy mechanism, shortsighted planning for developing transmission and distribution system, optimal use of financial resources for investment and excessive dependence on multilateral and bilateral funding for its development, etc. The traditional approach of hydropower development in

Nepal has been expensive since its development has been synonymous with foreign assistance which includes almost everything required for project planning and development including engineering, project management and project financing. The most important aspect of planning and development are key decisions to be taken which the foreign consultant took with a limited understanding of local needs and conditions. Involvement of foreign consultant and contractors with limited bidding are made mandatory to achieve foreign assistance which in general is tied-aid. Several independent power producers are involved in the development of hydropower. Furthermore, the harsh mountainous terrain with insufficient infrastructure and rural population settlement in scattered isolated area has made extension of power grid network very difficult and expensive.

In the context of very poor infrastructure and financial resources and small power market available within the country, Nepal cannot launch a very large hydropower projects. But, Nepal has plenty of options and choices for developing hydropower projects of different sizes and scales. Therefore, the hydropower development strategy and policy should emphasize on developing small, medium and large hydropower projects which should not contradict each other. Upto to 14th Plan only 76% of Nepalese people have access to electricity (National Planning Commission 2073,1). As per the Hydropower Development Policy, 2058, the government envisages to maximize the private sector involvement in the hydropower development for larger, medium and small hydropower projects. Therefore, GoN intends to carry out the feasibility study of hydropower projects utilizing grant assistance from donor countries through competent technology consultant.

There are many different ways to classify the size of a HPP, and there is little agreement on what "small-hydro" is. India classifies everything with a capacity below 25 MW as small-scale, the USA uses 30 MW and China 50 MW.
The following classification is based on information from Nepal(DoED, 2016).

- Large scale: > 100 MW
- Medium Scale: 100 – 25 MW
- Small scale: 25 – 1 MW

- Micro scale: < 1 MW

Kaski District lying in Gandaki Zone of Western Development Region covers an area of 2,017 km² with elevation ranging from 450 m to 8091m in the Himalaya range. The district politically has 1 Metropolitan, 4 Rural Municipalities, and 4 electoral sectors with full of rivers such as Seti Gandaki, Modi and Madi along with other rivulets. The district headquarter Pokhara lies about 827 m above the sea level. The northern mountains, gorge of Seti River, David Falls, natural caves, Fewa Lake, Begnas Lake and Rupa Lake are important natural resources of this district with great tourism values. There is high potentiality of SHPP in Nepal as well as in my study area. In Kaski district, there are five small hydropower plant Mardi Khola, Bijayapur, Upper Madi, Seti and Fewa with the total 36.8 MW electricity generation which is connected to national. SHPP of Kaski district generate 4.05% of total electricity production of Nepal. According to the 2011 census the total population of Kaski district was 492,098. Of these 236,385 are male and 255,713 are female including Hindu, Buddhist, Muslim, Christian etc of different caste like Brahman, Gurung, Chhetri, Magar, Kami etc.(CBS, 2012).

Power may be generated using various technologies and resources. Among them the power generated by using the water is termed as hydropower where water is used to drive the mechanical equipment which is connected with generator and produces electricity that is controlled by the other equipment and then distributed to the consumer. In Nepal, more than 90% of electrical power has been produced by hydropower that we use for our industrial and commercial purpose. The developing countries like Nepal spend large proportion of their development budgets on energy. Hydropower is the only renewable energy technology, which is presently commercially viable on a large scale. It has four major advantages: it is renewable, it produces negligible amount of greenhouse gases, it is the least costly way of storing large amounts of electricity, and it can easily adjust the amount of electricity produced to the amount demanded by consumers.

The total area of Pokhara Lekhnath Metropolitan is 464.24 sq km that constitute of about 4,14,141 population. The Bijayapur SHPP located at Pokhara Lekhnath Metropolitan

ward no. 26 in the south western part of the Pokhara Valley is established with the flow of Bijayapur river and outflow of Seti canal. This SHPP was developed by Bhagawati Hydropower Development Company (P) Ltd in Bhadra 05, 2069 B.S. The total capacity of the Bijaypur SHPP is 4.5 MW, which is connected to national grid of NEA 132 kV at Lekhnath Substation.

In the past, government only was involved in developing the hydro projects with the first hydroelectric installation in 1911, but after that there was little further development until the 1960s. In 1990 the involvement of private sector in hydropower development has changed the scenario of the hydropower development in Nepal. So far, 6- 7 projects amounting around 30% of total power is developed by private sector. The present government policies are also favorable for the private sector to develop electricity and sell to government or public. Therefore, the potential of booming the private sector investment in hydropower development can be seen.

Hydropower projects are capital incentive in nature compare to some of the other sectors and gestation period is also more which depend upon project to project. So far now private companies are looking for the foreign partners to finance the project. If the foreign partner get in to the project, then the total concept get changed, which then is managed by them, which does not impart much in local development concept. On the other hand, it seems that money is available in country's money market with the commercial banks and financial institutions. Somehow till date, only one or two projects have managed to get small portion of their financing from the local money market. There seems to be some problems in mobilizing the capital available in the market towards hydropower sector.

The Government is pursuing the water resources development in Nepal from three different approaches. Firstly, to develop small and decentralized hydropower projects to meet the local demands in remote and isolated regions of the country. Secondly, to develop medium sized power projects to meet the national demands and to develop local capacity building. Thirdly, large-scale multi-purpose projects to meet the regional demand for food, energy and flood control. With this vision, the Government is finalizing

the new hydropower policy that is designed to attract both the local and foreign developers.

The Government has given priority for developing small to medium hydropower projects. A special preference is given for projects ranging up to 1MW in size by waiving a license, royalty and income taxes to operate such plants. The NEA will purchase all energy produced by such power plants at a standard rate. To promote the small hydropower developers NEA will also purchase up to 50 MW of power from IPPs operating plants in the 1 to 10 MW range after the year 2003. At the end of the financial year FY 2015/16, 27 projects with their combined capacity of 457.59 MW were combined with NEA. Similarly, 100 projects with combined capacity of 239.953 MW are under construction and out of them 6 projects with combined 99.8 MW are under construction in Kaski district. The policy of NEA aims to provide adequate and reliable electricity for the domestic market and to increase rural access to electricity by maximizing the local capacity building in hydropower development. It also provides attraction for development of large hydropower projects by allowing concessions on duties and taxes. The new policy encourages private sector participation in hydropower development as well.

To meet the likely domestic demand for the next twenty years and readying the projects for the possible regional market, the DOED, the licensing body of the Government has proposed eleven projects for development and a further eleven projects for feasibility studies.

Local developers in Nepal have been involved mostly in the smaller power plants. There are three important reasons for less development of hydropower in Nepal:

i. The risk associated with investment in hydropower projects is often regarded as being higher than the risk of developing thermal power Projects.
ii. Hydropower Project requires large amount of fund.
iii. The economic life of a hydropower project is often far longer than the repayment period for the loan.

1.2 Statement of the Problems

Nepal is located in between big and developing countries China and India which are suffering from under supply of electricity. They need electricity for their developmental and household purposes. On the other side, Nepal is rich in hydro power potential and has potential surplus electricity but it could not produce for the export of the electricity to the neighboring country. The main research problems are the issues related to the socio-economic impact of SHPP and the associated problems of Kaski district. Some research problems are:

- What contribution is made by SHPP to economic development of Kaski District?
- What impact is seen in the income level and living standard of the people in study area?
- What is the impact on individual, commercial and service activities of the area?
- What is the effect on social life including health, sanitation, education and social well being of the people in the study area?
- What is the status and trend of power production by the project?

1.3 Objectives of the Study

The main objective of the study is to study about the socio-economic impacts of Bijayapur SHPP of Kaski on income and living standard of the people in study area. Besides this, the study has following major objectives:

- To analyze the contribution of SHPP in the study area.
- To identify the impact in the income level and living standard of the people.
- To explore the impact on individual, commercial and service activities.
- To analyze the effect on social life including health, sanitation, education and social well being of the people.
- To examine the status and trend of power production by the project.

1.4 Significance of the Study

The development of all sectors of an economy depends on energy. The utilization of energy especially electricity, is centered in urban area and most of the rural areas have been ignored by the existing energy development schemes in Nepal. Generally, sources of energy are divided into broad two parts viz. Traditional and commercial. Out of the total energy consumption, the traditional resources contributed 76 to 80 percent and commercial resources contributed 20 to 24 percent during the thirteenth plan. Almost all the households are found to have consumed traditional sources specially fuel wood for domestic use and other necessary activities of human life in the hilly and mountainous areas.

Electricity can significantly diversify the daily activities and can raise the living standard of people by making the human life easier. It helps to establish different industries and creates an employment opportunity that helps to improve the overall sector of economy.

As electricity is significant in the development, so the researcher has conducted a research on hydropower project which will be helpful and resourceful in contributing to the electrification of a hilly district. The outcomes from this research may be helpful to other individuals and institutions to implement programs effectively in such type of project. The socio-economic impacts of this project inform us the role of project in the socio-economic upliftment of the area.

1.5 Limitations of the Study

The followings are the limitations of the study:

i. The study is primarily based on field survey of a Bijayapur SHPP in Kaski district. Secondary data are used in national concern as required by the study which may be limited.
ii. As the primary data interview is undertaken to suggest on the data for the current situation.
iii. Recommendations will be strictly based on the suggestions of experts and findings of data.

iv. The time frame of the study is limited, so it may not cover the analysis of long term issues and impacts in details.

v. This study covers only one small hydropower of Kaski District. So it can be representative to some extent only for hilly region of Nepal regarding small hydropower but may not be generalized to the national level as a whole.

vi. Because of financial constraints the study might be limited to the review of some literatures.

vii. The data from social survey may not provide the exact picture of the society but shows the average only.

1.6 Organization of the study

All together study is divided into five chapters. The first chapter deals with general background, statement of the problems, objectives, significance, limitations and organization of the study. The second chapter is about literature review. The third chapter is about selection of the study area, research design, sample size and procedure, nature and sources of data, data processing and techniques of data analysis. Fourth chapter deals about the analysis and interpretation of data and fifth chapter includes summary, conclusion and suggestion.

CHAPTER II
REVIEW OF THE LITERATURE

This chapter discusses conceptual framework about situation and prospects of hydropower development in Nepal, with the relevant literatures such as books, dissertations, thesis, articles, bulletins and empirical findings.

Those countries have been developed which has properly utilized their natural resources. Nepal is one of the rich countries in hydro resources in the world and GoN is giving a high priority to generate hydroelectricity. However, the natural resources endowment is not ease in developing countries as like in Nepal. The development of hydropower is one of the challenges in Nepal. The large inflow of the foreign capital is a must to establish the large scale hydro-plant as Nepal itself is deficient to mobilize the capital resources. The financing position is one of the main indicators of the effective policy instruments in generation of hydro-plant. Hydro-electricity is the fundamental aspect of the industrial base and agriculture development in the country. Further, electricity generation is the major source of energy supply that Nepal can develop in international trade in the regional area.

After the establishment of the first hydropower plant (500 KW) in 1911, the second hydropower plant (640 KW) was established at Sundarijal in 1936. Similarly the Morang Hydropower Company, established in 1939, built 677 KW Sikarbas Hydroplant at Chisang Khola in 1942 though this Plant was destroyed by landslide in the 1960s. The development of hydropower was institutionalized after the initiation of the development planning process. The First Five-year Plan (1956-61) targeted to add 20 MW of hydropower. However, the target was unmet. During the Second Three-year Plan (1962-65), some progress was achieved. Till 1962, the Electricity Department of HMG was responsible for the generation, transmission and distribution of electricity. In 1962, Nepal Electricity Corporation (NEC) was established and was given the responsibility of transmission and distribution of the electricity. The Electricity Department was responsible for the task of electricity generation. After a long gap since the establishment

of the Chisang Hydroplant, the hydropower generation capacity of the country expanded with the construction of the Panauti Hydroplant (2400 KW) in 1965 and the Trishuli Hydroplant (21000 KW) in 1967. A series of hydropower projects then followed. The Eastern Electricity Corporation was established in 1974. In 1977, Small Hydropower Development Board was established. Institutional restructuring took place again in 1985, when the merging of the Electricity Department, Nepal Electricity Corporation and all the development boards (except the Marshyangdi Hydropower Development Board) resulted in the creation of Nepal Electricity Authority (NEA). Since this arrangement, the NEA has been responsible for the generation, transmission and distribution of electricity. Other public sector institutions involved in the hydropower sector include Water and Energy Commission and its Secretariat constituted in 1976, the policy making body established in 1981, and the Department of Electricity Development. Of late, the private sector is also emerging as an important player in the hydropower development. Independent Power Producers (IPPs) have been the ongoing institutional innovations in the power sector of Nepal, with the IPPs signing power purchase agreements (PPA) with the NEA to sell electricity.

There are very few journal and institutional bulletins in the papers published by national and international institutions. Hydropower experts have written their reports for presentation in the seminar and Hydropower associations have published some booklets and magazine in the topics. Besides these, there is no any formal research, or study in Pokhara. But there are a lot of study and exploration on the topics in the country like India, China, and Norway. The researcher has reviewed and collected some information in regard to Nepal through the above said source that has been demonstrated below.

2.1 Review of the Hydropower Studies

Acharya (1983) has mentioned the contribution of hydroelectricity to Nepalese economy. It plays significant role by developing various fields such as agriculture, industries, transportation, social services etc. Water resources are the Nepal's greatest asset but unfortunately very significant portion has been harnessed to this date. She says that there is unequal distribution of electricity in different development regions. Nepal is facing

many problems with respect to hydro-power development because of lack of capital, skilled manpower, technical knowledge, sufficient market and economic status of people as well as country.

Jha (1995) stated that one of the major reasons for poverty and backwardness of the Nepalese economy is due to the power deficit. Shortage of power creates a problem in the development of agriculture, industry, trade and other sector of economy. With the view of meeting power shortage, it is needed to generate power in small and micro level. The small and micro-hydropower play crucial role in increasing productivity of the agricultural sector and its product including its processing. The lifting up of irrigation in the hilly area is also promoted by the development of small and micro hydropower. In addition to this, the food processing and cottage industry also get benefit from the development of micro-hydropower.

By considering the fact that only two percent of the total rural population has access to electricity, the small hydropower play vital role in providing electricity to the rural areas and even to isolated pocket areas of the countries. The micro hydropower is also important from the consideration of national welfare in diverse fields, such as conservation of forest, creation of self employment opportunities and also promotion of the tourism industry.

Bhadra (2004) highlighted the problems and prospects of hydropower development in Nepal, using the descriptive analytical method. According to him, "the cheap electricity input could provide the basis for competitive manufacturing industries, which in turn lead to cheap, manufactured exports. Nepal can become rich if it is able to supply electricity in industries and water in agriculture. Furthermore, cheap electricity can be an attraction for foreign investor to locate their industries in Nepal." He mentioned the prosperity that Nepal can achieve and can accelerate the development pace by harnessing it. Along with prosperity, there are some hurdles in harnessing this large potential. Such as:

- There is a serious gap in a planning and policy making.

- Because of the bilateral monopoly-monophony situation in electricity trade that exists between Nepal and India, the price of electricity has been reduced towards the marginal cost. Therefore, it is unlikely that Nepal can make much profit by selling electricity to India.
- There is a lack of integration of hydroelectricity with the development process.

He comes to the conclusion that for the betterment of the country, instead of thinking for the export of hydropower market, we should concentrate to integrate hydropower in different aspect of economy such as small industries, transportation and communication, lift irrigation, cooking etc. Some of his findings are:

- With proper design, the investment in civil works may be at 40% of the total investment.
- The length of the road connection is about eight or nine times longer than a ropeway line between the two points separate by a fair distance.
- More electricity and fossil fuels are going to be needed to produce net unit of output. The investment in hydropower sector will have to be increased not only to cope with the rising trend in electricity demand but also for the extra demand result from the substitution of fossil fuels.

Dhital (2004) in his article entitled "Hydropower Development in Nepal" in a book Nepalese Economy: Towards Building a Strong Economic Nation-State edited by Madan Kumar Dahal, states that Nepal is though rich in water resources, very little efforts have been made towards harnessing it and developing hydropower. Hydropower is one of the renewable and non- consumptive sources of energy. Of the total potentiality of hydropower in Nepal, about 43,000MW has commercial potential. A total of 549.20MW hydropower has been produced from various projects at the end of FY 2002/03. Nepal's total installed power capacity at present is 713MW including diesel and solar plant. The existing services coverage extends to be less than 20 percent of the total population. The underdevelopment of this resource is attributed to financial constraint and inefficient management.

Pandey (2004) explained the status, problems and prospects of hydropower development in Nepal and its contribution to Nepalese economy. She has presented the quantitative data in tabular form with the help of ration and percentage. Other data presenting techniques like pie chart, bar diagram and flow chart are also used in her analysis. According to her, small scale hydropower projects seems to have advantages with a view that if natural disasters occur in project run by huge investment mainly dependant on foreign loan, there will be uncountable loss of property whereas we do not need foreign aid to run small scale project. She comes to conclusion that hydroelectricity project brings many environmental problems. It also affects the social and cultural condition of adjoining area of project.

Some of her findings are:

- Installed capacity of hydropower in Eastern, Central, Mid-Western and Far Western regions were 2.56 percent, 45.71 percent, 2.49 percent and 0.81percent respectively in 2004.
- Main sources of electricity generation are wood, coal, petroleum product, water wind, tides and waves, solar and nuclear energy. Among these sources of energy, Nepal has only wood, water resource and solar energy.
- Micro hydropower and small hydropower can provide electricity facility in isolated areas.

Sangraula (2004) explains hydropower development is one of the most prominent resources for future economic development of Nepal. Most of the developed projects have not been yielding expected output primarily due to underestimation of sedimentation problems. RoR types of hydropower projects are not able to meet the demand of power for the country especially during dry season of the year. So, there is a need for development of more storage projects in near future. NEA is studying the possibilities of development of storage projects. However, it is necessary to understand that sustainability of storage projects depending on proper handling and the management of sediments. Data on sediment loads in many Nepalese rivers is inadequate and those available data are also for a short duration. On the other hand, natural disaster is very frequent in the Nepalese Himalaya, which creates tremendous amount of sediment load.

Landslide and mass wasting are very common in Nepal during monsoon season. Every year many people are killed due to floods and landslides. Nepal lies in the earthquake active zone. Small scale earthquakes are regular in different parts of the country. These natural disasters create high sediment load in the river. Hence, proper documentation and record of such events are important for planning and designing of storage projects in the country. Sedimentation is a complex issue and to understand this process long-term data are needed. The study made by the author provides a small piece of knowledge which is the initial stage of the study and the author is planning to develop Kulekhani Reservoir database. Such database will be useful for future sediment researcher and also for the numerical modeling of sedimentation processes in the Kulekhani Reservoir.

Adhikari (2005), a critical analysis on "Problem of Financing Hydropower Generation in Nepal" shows that Nepal's electricity is expensive as the generation cost is very high and huge loss in transmission and distribution again added to electricity tariff with low per capita income, it is very difficult to increase the domestic consumption of electricity substantially to the existing customers. He compares the tariff in India. Nepal's average tariff to the consumers is almost double of India which heavily subsidized. At the end he says, Nepal has indigenous capabilities both in technical and financial resources in order to develop hydroelectricity from projects up to 20MW. Private sector should make forward in generation and distribution of HP but government continuous support is very important. There is great need of environment of peace and security, trust and confidence, co-ordination and co-operations between all the stake holders of hydropower generation to attract more and more investors in this field.

Kafle (2005), in his article "Hydropower for Sustainable Development of Nepal" in Vidyut Bulletin, argued that hydropower has contributed for poverty reduction and economic growth, seen in developing countries. Through regional development and expansion of industries even the underdeveloped countries are encouraged for prioritizing hydropower development, Economic and social development and environmental protection are interdependent and mutually reinforcing pillars for sustainable development. The multiple benefits of hydropower reliability and quality of fresh energy supply cater to a fundamental sustainability goal of poverty alleviation. In social aspects

the development of hydropower enables to make easy access of electricity to all in the communities within the reasonable price which promotes new economic activities, empowers woman by reducing their domestic work and repetitive chores as fire wood collection, improves health and education services and provides a cleaner and healthier domestic environment.

He focused on the importance of hydropower for the reinforcement of environment, social and economic aspects as it can play a key role of sustainable development resulting poverty reduction and economic growth through regional development and expansion of industry. He has written the increasing trend of electricity use due to people's awareness of improving quality of life and annually increased industrial development in the regional cells for ample opportunity to the investor. The political stability and good governance, government commitment and local and foreign investors interest based on worldwide cooperation is the basic requirement to promote hydropower development of Nepal which is very urgent in consideration of domestic as well as regional demand.

Win Rock International Nepal (2006) give the argument on the role of energy for poverty alleviation and uplift the living standard of the in terms of education, health, sustainable, environment and women's empowerment. Similarly it measured quantities efforts of different power agencies and the decades towards the national poverty reduction strategy (PRS) reviewed in detail. This study is designed to analysis PRS as well as MDH targets. The two primary objectives of this study were to undertake comparative analysis of changes before and after The Rural Energy Development Program(REDP) intervention. The program REDP achieved the improvement on several targets on the target launched are among them it gets improvement on the way of women empowerment which is the indicator of millennium development goal in which is found to be directly influenced by REDPS initiatives with the approximately half population of the total women interviewed holding higher portion in various community based organizations. This also proved with positive response from community elders recall questions also established the significant role of REDP in achieving greener and sustainable environment (MGDs) and that REDP's holistic approach plays to key role in hitting a number of MDGs targets simultaneously positive changes in many indicators confirmed the prime role of energy in

the development process of the rural communities studies. Considering that REDP is providing energy services in an integrated manner, including skills development, enterprise development, information services institutional and capacity building, fuel supply, technology many fracturing operations and maintenance etc. with encouraging outputs it can be considered as a best practice model operating so far in Nepal.

WECS (2006) described sectoral energy consumption situation of Nepal, using statistical tools such as pie chart, bar diagram, flow chart and percentage and ratio. The sectoral energy consumption pattern for the year 2004/05 has been changed only marginally as compared to the previous year. The residential account for the major share of energy consumption (90.28 percent) followed by transport (3.78 percent), industry (3.48 percent), commercial (1.45 percent) and then the agriculture and others (1.01percent). Some of the major findings of this report are given below.

- The residential sector consumes about 331 million Giga Joule (GJ) energy in FY 2004/05. The share of electricity consumption is 0.64 percent in FY 2004/05.
- The industrial sector consumes about 2.5 million Giga Joule (GJ) energy in FY 2004/05. The share of electricity in industrial energy consumption is 22 percent in FY 2004/05.
- The commercial sector consumes about 5.3 million Giga Joule (GJ) energy in FY 2004/05. The share of electricity in commercial sector is 7 percent in FY 2004/05.
- The transmission sector consumes 13.8 million Giga Joule (GJ) in FY 2004/05. The share of electricity in transportation sector is 0.15 percent in FY 2004/05.
- The agriculture sector consumes about consumes about 3 million Giga Joule (GJ) energy in FY 2004/05. The share of electricity in agricultural sector is 6 percent in FY 2004/05.

Adhikari (2006) highlighted the prospects and challenges of hydropower development in Nepal, using statistical tools such as pie chart, bar diagram, and flow chart. A huge hydropower potential becomes a key to make Nepal's economic growth scenario of brighter, gaining deep inwards into the national goal and priority of poverty reduction. According to him, "the major initiatives to be undertaken to improve power sector

development include the establishment of power development fund (PDF), creating of an independent regulatory authority and promotion of small, medium and storage hydropower projects. Hydropower policy has been accordingly revised to allow the private sector entry into a full range of power sector activities, i.e. generation, transmission, distribution". Some of his findings are:

- Micro hydro system is particularly suitable for power supplies in rural and isolated communities. These systems provide a source of cheap, independent and continuous power, without degrading the environment, so essential for a environmentally fragile country like Nepal.
- The consumption pattern of hydropower supply in Nepal display a prominent share of industrial and domestic demand which together accounts for 80 percent of the total use. Nepal's power supply and demand pattern has noticeable seasonality of imbalance in the form of power shortage during dry months and surplus during the wet month.
- Rural electrification is particularly important in a rural-based economy of Nepal. It plays an important role in accelerating both agriculture growths, especially by accelerating shallow tube well irrigation. The extension of rural electrification would also modernize cottage industries and improve the living standards of rural households.

Nepal (2007), "Current issues and desirable future course of Action in Hydropower Development of Nepal" has mentioned that the major issues in the hydropower sector include institutional, legal, financial and technical aspects, which are manifested in the form of restructuring issues of Nepal Electricity Authority (NEA), system of licensing and PPA, electricity leakage in NEA managed system, financial losses of NEA, and issues related to public, private and community/cooperatives investments in hydropower. There should be political consensus in the hydropower development frame work so that no further delay in development is caused by political disagreement. The legal and political environment should be appropriate making it compatible to new political consensus and economic reality. The result of all these activities should be reflected in the sustained, uninterrupted, and adequate supply of power at competitive as well as

affordable price. Hydropower should contribute to raise the standard of living for all Nepalese as a consequence of their participation in any one of combination of activities related to generation, transmission, distribution and productive use of power. Only this will make hydropower sector the vehicle for socio-economic transformation of Nepal.

Bhat(2008), mentioned the confusions and problems of hydropower development in Nepal. He did research with descriptive analysis and tabular form and described that although bestowed with ample hydro resources, we are facing acute power shortage and load shedding has become most unpleasant word for Nepalese consumer. This means there is something wrong in our thinking, planning, action and behavior. He highlighted that we are not good at planning resource development as we do not have strategic plan for development of hydropower, neither we are good as developer, since most of those who are holding licenses are engaged in paper trading of licenses. Some of the problems highlighted by the author are given below:

- Electricity act 2049 has no insight of electricity market model and industry structure.
- Ministry of Water Resources issues licenses of hydropower development whereas Ministry of Forest and Soil Conservation has its stringent rules and provision for hydropower development that makes it almost impossible to develop hydropower.
- Still we do not have a realistic view to meet internal demand in future. The transmission system has the natural monopoly of the state. NEA is neither responsible for managing transmission for all generation developer nor it is a transmission planner.

Paudel (2008) has explained the status, problems and prospects of hydropower development in Nepal and its contribution to Nepalese economy. He used tools like regression analysis, pie chart, bar diagram, percentage and ratio which shows the relationship between hydroelectricity contribution and economic growth in the time 1994/95-004/05 and found a positive (+ve) relationship between them. Some of his findings are:

- At present situation, low finance, improper management, high tariff regime, geographical condition etc are the main problems of hydropower development in Nepal.
- Only in the year 2003, net power expert is in favor of Nepal.
- The share of traditional fuels to the energy consumption of Nepal is estimated 87.7 percent in 2005. Remaining 12.31 percent of energy is consumed through other types of resources.

Neupane (2009) mentions Nepal has about one century long experience in hydroelectricity generation and its utilization. Hydropower development has been getting priorities in all Five Year Plan. But even after completion of Tenth Five Year Plan, development of power in Nepal is still in infancy stage. Against a techno-economically viable hydropower power of 42000 MW, actual installed capacity of Nepal is only 630MW in FY 2007/08. Out of the total population, only 48 percent people have access to electricity service by the end of the Tenth Five Year Plan. In 2008, the peak demand for electricity was 721.73MW, which shows the situation of power deficit. There is great challenge in bridging the gap between supply and demand of electricity. Therefore we can see that present status of hydropower development in Nepal is not satisfactory. The today's national interest should be given performance to mobilize domestic financial resources by encouraging private sector investment in hydropower project.

The major constraints of hydropower development in Nepal are not only the financial and technological constraints but it faces the problems like local communities created problems, poor structure, insurgency, lack of skilled manpower, licensing difficulties, inadequacy of storage projects, conservation and environmental problems. In Nepal, policy deficiencies and slow making process in the electricity sector has resulted in the increased project cause and has reduced the involvement of the private sector and entrepreneur. In spite of high possibility hydropower has not contributed enough in GDP of Nepal, neither has it generated huge amount of revenue in national economy. Thus, restructuring and improvement at all policy level is required to overcome various hurdles and then only hydropower development will possible in Nepal.

Despite of various constraints of hydropower development in Nepal, there are some incentives such as prospects of hydropower based development and transportation sector development, access to external market and financial facilities. In the event of open market, by the year 2010, international banks will also enter in Nepal. This will increase the capacity of financial sector to invest in hydropower sector. To discourage the tendency of hoarding of hydropower license, DOED increase the survey license fee or small hydro project from Rs. 150 to Rs. 50,000. An agreement between Nepal and India to construct transmission links, infrastructure development helps Nepal to export electricity at lower supply cost. Every political party as well as the government has recognized development of the hydropower sector as a key for nation's development. Nepal is dream for prosperous future which can be achieved by the exploitations of the water resources. Now, it time to turn huge hydropower potentialities of our country into reality.

Awasthi (2010) in his study "Socio-Economic Impact of Chameliya Hydropower Project in the Adjoining Areas" has concluded that the socio-economic impacts of the project are moderate in absolute term and satisfactory in relative term. The project has provided sufficient drinking water and employment opportunities to the local people and electricity supply has extend the social and recreational activities like increasing educational standard, purchase of radio, television, tape recorders etc.

Nattakul, Boonrod and Roongrojana (2010), have made a study on "Socio Economic Assessment of Pico Hydropower Installations in the Northern Region of Thailand." This work assesses social impacts of Pico- hydropower applications in the Northern region of Thailand. Six existing Pico hydropower projects were selected based on different characteristics including system capacity, size of user. Normally, Pico-hydro power systems are found in rural or hilly areas. Based on the guidebook, most projects should utilize hilly and mountainous locations to site suitable projects. From a report on electrification technologies by the World Bank Energy Unit, of the options currently available for off-grid generation, Pico-hydro is likely to have the lowest cost. For mini grid power, it is likely that only biogas plants provide more cost-effective electricity than

micro hydro. Northern Thailand is filled with mountains and high level. In areas with high rainfall, there is plenty of water. In terms of economic the results is clear because most of the people have the tea gardens and coffee gardens, so they can use electricity at night time to boil tea leaves and pack it for sale. The production cost for each village in the system in addition, they have home stay service to tourists, which increase incomes. Socially, second range is high percentage of users have satisfaction in the hydropower. According to the light at night time the villager can take time for exchanging ideas with each other, the children read books for longer time and old people understood more Thai language as they can remain watching TV in the night.

Gurung , Bryceson, Jin and Sang-Eun (2011), in their research paper "Socio-Economic Impacts of a Micro-Hydropower Plant(MHPP) on Rural Livelihoods" describes the impacts of MHPP in the rural livelihoods. Although the benefits of rural electrification are immense, more than 44% of the people do not have access to electricity in Nepal. Micro-hydropower (MHP) scheme is considered the most feasible decentralized renewable energy option for providing reliable and affordable electricity to the remote and isolated areas of Nepal. This study assesses the impact of a MHP plant on socio-economic conditions in the remote village, Sikles, in Nepal. Results revealed that the village electrification had brought a series of positive changes in the rural livelihoods. Traditional kerosene lamps like Tuki and Panas were completely abandoned, and firewood consumption was reduced. Electric lights in households extended the day providing additional hours for evening reading and work. The micro hydro based electricity was used to power modern agro-processing mills in the village, which reduced drudgery for women as they no longer had to use ineffective and distant traditional water mills. Thus, micro-hydro scheme provides clean, affordable and sustainable renewable energy both locally and globally.

Joshi (2011), in his thesis "Socio-economic Impact of Surma Devi Small Hydropower Project: A Case Study of Bajhang district" has mentioned that energy is important for accelerating the pace of economic development which is impossible without hydropower development. The development of productive sector of an economy depends on development of the energy sector. In the hilly and mountainous area, almost all the

households' are found to have consumed traditional sources of energy for cooking, heating, lighting and other necessary activities. Traditional energy sources cannot be sustainable to fulfill the energy requirement. From the present analysis it has been observed that most of the people depend on forest for energy sources and livestock. As a result, the deforestation has brought about ecological and environmental hazards along with shortage of fuel wood, soil erosion, deterioration of the fertility of soil etc. Deforestation leads to the deterioration of water sources and hampers both electricity generation and drinking water.

Hydropower occupies a very eminent place in the energy sector of Nepal. The utilization of energy is concentrated on urban areas and most of the rural areas have been ignored by this power development. The hydropower project has brought about changes in socio-economic, cultural and other aspects of the people living in the project located area and its surroundings .To find socioeconomic impact and to introduce the total effect of the project at the study area is the main objective as well as quantitative method is used in the study to find the every kinds of socio-economic and environmental effect in the study area as well as surrounding area.

Poudel (2011), has published his article "Hydropower Opportunities and Challenges" in Kathmandu Post, which states that during the price like of petroleum, the debate of new hydropower projects became hot. If there is no much news, the issue falls on shadow, highlighting the present condition of demand and supply of hydropower in Nepal, he states that demand increases when supply decreases. During dry season the power becomes excess, so to overcome such imbalances on demand and supply, run off river projects are to be slotted to address base load where as peak load is to be met by storage projects like Kulekhani.

According to him, after the liberalization of the economy, private sector is still lower than the expectation due to government procedural complication, political instability and insufficient infrastructure.

Though hydropower projects are capital intensive and the government is unable to arrange adequate financial resources to finance such projects, investment of private sector

is essential. Indian interest for power trade between Nepal and India is very crucial for Nepal to be able to capture the benefit from the Indian power crisis. He comes to the conclusion that procedural communication should be simplified by the government. Government has to pay role to create favorable environment for investment by the private sector rather than regulatory and investing role.

Razan, J. I., Islam. R. S., Hasan, R., Hasan, R., & lIslam F., (2011), in their paper, "the current power crisis of Bangladesh" have discussed the necessity of exploring energy from alternative sources and impact of micro-hydro as an alternative source. Since micro-hydropower plant requires terrain and availability of high stream flow rate, so, it has a good potential in the north-eastern hilly regions of Bangladesh which is also evident from the presented data. Due to the abundance of rivers and canals, Bangladesh has a good run-off river micro-hydro potential but it is yet to be explored. Parameters in order to set up new micro-hydro plants have been discussed. A primary guideline of economic feasibility and a way of raising necessary fund have been proposed. No development strategy can be implemented without power. Bangladesh is still very much dependent on fossil fuel for power generation. But, the country has limited resources which are likely to be finished very soon. On top of that, burning of fossil fuels has very negative environmental consequences. Now -a-days, the whole world is much more concerned than ever before about not only the depletion of various energy resources but also environmental degradation caused by the existing pattern of fossil fuel use. As a popular country with small energy resources, our concern is even greater. Proper consideration of parameters to explore potential sites can also inspire the interested individuals and can work as an incentive to establish micro-hydro plant for local use. Due measures of establishing decentralized small-scale water power or micro-hydro schemes can prove it as an effective eco-friendly source of power generation, as internationally funds for green energy are available that can be a great appreciation for government to explore this option.

Shrestha (2011), has studied on Socio economic Impact of Tarakhola Micro Hydro Project which has positive impact on education, health, and awareness of people

living in Tara VDC. Tarakhola MHP has been playing crucial role in rural electrification in Tara VDC. That MHP provides opportunities to study more in night time and people are less infected from eye problem. The acquisition and use of physical assets such as electric appliances has increased access to information.

Bhattarai (2012), the article entitled "*Jalavidyut: Aarthik Vikash Ko Mul Adhar*" published in vidyut (2012). He analyzed that establishment of hydro power project opens up immense opportunities for social and economic uplift of the rural communities, if, other crucial aspects like - basic road infrastructure for transportation, promotion of income generation, tourism development rural electrification and small industrial activities based on local resource available in the local area etc. develop the rural and remote area of Nepal. This helps to reduce the migration of skilled and non-skilled manpower. Therefore there is no doubt that the hydro electricity is the key of economic development. If there is the sufficient development of hydro electricity it brings the positive change in all sector of the economy. He concluded that hydro electricity contributes to sustainable development, rural electrification, industrialization tourism development etc

Regmi (2012), analyzed the present condition of Nepalese energy system. The summary conclusions of her finding are: There should be need of proper utilization of Natural Resources like water to achieve the goal of development. By proper harvesting of water resources, by generating aptly trained manpower and investment on water resources and dependency on foreign country could be vanished. One of the alternative way to increase the energy power not only by the formation of new hydro projects but also the maintaining and optimizing the existing hydropower plants which may become panacea to control the web of problem and has been grossly overlooked for these reasons. The development of hydropower in Nepal has always been dictated by many constraints and conditions. It is too late to understand the government that private sector is not capable to develop sufficient hydropower projects to satisfy the demand so the public sector must play a sustainable and major role for implementation of hydropower project .

Benjamin Attigah and Lucius Mayer-Tasch (2013) "The Impact of Electricity Access on Economic Development" has reviewed the relevant empirical literature on the contribution of electricity to economic growth and development on the macro and micro-level. It describes the studies addressing the question of whether or how much electricity (or more generally infrastructure) matters for economic development, are often not relevant from a policy perspective (Ayogu 2007, Straub 2008a, Estache and Fay 2009). The relevant question for policy makers would be whether an optimal level of electricity provision can be identified in a specific context which could then serve to derive the corresponding investment and funding priorities. Especially macro-level data is limited in this regard. Data at that level of aggregation cannot provide guidance on detailed investment decisions for particular projects (Straub 2008b). Micro-level data will allow for a better understanding on how exactly other factors and complementary services such as BDS and access to financial services influence the economic impact of electricity. This is of particular concern for policy makers who need to understand how their policies on infrastructure interact and depend on policies relating to other sectors of the economy. It can be concluded that rather than investing more money in macro-level research on the impact of electricity infrastructure on economic development, further micro-level research is needed to investigate the indirect channels through which electricity enhances productive uses and improves livelihoods. In the energy sector, such micro-level research should comprise among others the role of complementary services such as BDS, financial and ICT services as well as other factors that create an enabling environment for the use of electricity for socioeconomic development. Future micro-level research should also be extended to analyze impacts at levels beyond firm and household level (e.g. community, district, national, regional and international levels), since the impact on one level could have intended or unintended effects on another level.

In addition, it should further explore potential negative impacts on employment opportunities and inequalities. All this can only be done with rigorous qualitative and quantitative micro-level research methods, as highlighted above.

Adhikari (2014), in her thesis "Socio-economic Impact of Micro-Hydropower Project: A Case Study of Angsarang VDC" has mentioned positive impact of MHP in use of energy,

education, income and living standard of people. The conclusions of her study are: It helps to raise the income and employment by helping in the establishment of new businesses. MHP reduces the expenditure on different energy sources like: firewood, kerosene, biogas etc. and improve the health condition. People who don't have MHP use maximum firewood as light or lamp and cooking but those people who have MHP has reduced its use which has helped to conserve the forest as well changed the living standard of the people. The status of sanitation, studying hours of students has been improved by the use of MHP. MHP can be a less expensive source of energy in the rural area whose repair, maintenance and operation is looked after by the management committee with full responsibility.

Acharya (2014), in his thesis "Socio-economic Impact of Micro Hydropower Project: A Case Study of Modikhola Hydropower Project on Deuper VDC" has described impact of the micro hydropower projects in rural development on socio-economic aspects through income and employment generation, health and sanitation, education and information technology and suggest solution for sustainable development of MHPs. The main conclusion of his study are: Modi Khola hydroelectric project has an upbeat impact on enhancement of education status and awareness on information technology of people live in Deupur VDC partially. People gain lighting facilities which helps to increase study habit of the children and helps to decrease diseases by reduce indoor pollution. The acquirement and utilize of physical assets such as electric appliances has increased access to information. MHP helps to establish industries which increase employment in the study area that helps to increase living standard of the peoples.

NEA (2016) explains the present status of hydropower development on Nepal. It analyzed information using statistical tools like pie chart, tabular form, bar diagram, flow chart etc. Some of its findings are:

- The numbers of customer availing electricity service of NEA reached 2.97 million in FY 2015/16, which is an increase than of previous year.
- The total energy available in NEA's system increased by only 1.89 % over the previous year.

- NEA increased its revenue from sale of electricity to NRs 32,210.05 million as compared to NRs. 30,798.67 million in the previous year which is 4.8% growth.

2.2 Research Gap

The literatures above shows hydro energy and hydropower project are able to uplift the economic condition of a country and are able to change the social welfare condition of a society aptly. The review to available literatures at the Nepalese context as well as the International context shows the studies about the socio economic impact of hydropower project in the mountainous and backward rural regions and their problems. Therefore, the present study aims to examine the socio-economic impact of Bijayapur SHPP in Kaski District as well as measures to economic potentialities in the project area. All of the above studies were mainly related with the study of HP generally MHP and this study is related with SHPP. SHPP are very necessary in hilly areas like Kaski District. This study is most probably the only one work in Metropolitan city which is densely populated. Most of these studies try to analysis the problem prospects, economical evaluation and technical assistance of HP. This study has analyzed the impact of the SHPP on education, health, living standard etc of the people living in the respective study area.

CHAPTER III
METHODOLOGY

Research methodology is the most important aspect of research work. Authenticity and reliability of any research depends upon the tools and methods used for data collection, processing and analysis. This chapter contains selection of the study area, research design, sample size and sampling procedure, nature and sources of data, data collection and processing and techniques of data analysis.

3.1 Selection of the Study Area

The Bijayapur SHPP is at Pokhara Lekhnath Metropolitan ward no. 26 which is located in the south western part of the Pokhara Valley. The total area of Pokhara Lekhnath Metropolitan is 464.24 sq km that constitute of around 4,14,141 total population. This SHPP was developed by Bhagawati Hydropower Development Company (p) Ltd in Bhadra 05, 2069 B.S. The total capacity of the Bijaypur SHPP is 4.5 MW, which is connected to national grid of NEA 132 kV at Lekhnath Substation. The main source of water for this project is Bijayapur river and outflow of seti canal from Fewa hydropower which is a RoR type. It used 242m long RCC closed canal for water from Bijayapur river to project head.

3.2 Research Design

Research design is the most important aspect of research work. It is a case study research. This study is based on both exploratory and descriptive research design. The research design is qualitative as well as quantitative in nature. This study investigates the socio-economic impact of SHPP and finds out how people are benefitted by this project and its impact on people. It describes the benefits experienced by HH of the project affected areas after the installation of SHPP such as economic activities, income, living standard, education etc. It covers facts and phenomenon of different questionnaire and reviews the schedule explored from the field information of SHPP. While prescribing the recommendation, the views of experts are considered in great.

Authenticity and reliability of any research depends upon the tools and methods used for data collection. The basic research methodology adopted in the study is the collection and analysis of primary and secondary data through the observation, semi-structured questionnaire and interview technique. The observation, interviews and questionnaires are the main tools for finding the result of the research while recommendations are made viewing the questionnaires. Primary data has collected by field visit, interview and questionnaire method and Secondary data has collected through the desk study.

After this the analysis of the data is done utilizing the average ratio analysis to meet the requirement of mentioned objectives for the study. Then conclusion has drawn on the basis of analysis.

3.3 Sample Size and Sampling Procedure

The total HHs of the study area is 2123. Out of them, 120 HHs were taken as sample. The sample size was taken as affected tole. Higher numbers of respondents 40 were from *Sakneri* because it is the most affected area, 25 were from *Budhi Bazaar*, 25 were from *Sangam Nagar*, 20 were from *Bijayapur* and 15 were from *Rittepaani*. This research is based on the information collected from the sample households, selected by simple random sampling method.

3.4 Nature and Sources of Data

This study uses both primary and secondary data. The nature of data required, their sources and methods of collecting primary data are briefly discussed below:

3.4.1 Primary Data

The primary data was collected during interview with resource persons. Interview was taken with the experts in research question in order to collect the required and relevant data. The study considers a set of semi-structured questionnaire to explore the information on problems and prospects of hydropower and its socio economic impacts. For these, the study considers interviews with expertise concerned and local people of study area.

- Observation: The researcher visited the project site during September to December 2016 and thoroughly observed the project site, influenced community, and its surroundings. The respondents were selected by simple random sampling method. The field visit is essential to hear the people's perception.
- Interview: Interviews were taken with the local people about the impacts of project and with the expertise about the establishment of SHPP. Interviewees were selected from the project benefited as well as affected area. The interview was conducted by applying the exploratory method to gather the information.
- Questionnaire: A questionnaire was developed prior to project visit. The questionnaire was developed in such a way that it covers accurate data from HH survey. The semi-structured questionnaire was prepared regarding the demography, health, sanitation, agriculture, animal husbandry, sufficiency of agricultural products, income, expenditure pattern, human resource, women and children, source of fuel, kind of stove and use of electricity. The respondents who were considered as directly PAFs were required to fill up the questionnaire in their own views.

3.4.2 Secondary Data

The secondary data were collected through published materials in the hydropower of Nepal. Books, paper presentation, articles, journals and reports related to the socio economic impact of hydropower are collected from different libraries. The main sources are Unpublished/published records of Hydropower generation in Nepal, related Thesis, CBS report, Internet, Newspaper, NEA Library, publications of NHA and AEPC, Brochures, company profiles and newsletters, webs sites of various hydropower companies.

3.5 Data Collection and Processing

A work sheet was prepared through the complete questionnaire incorporating the development of SHPP and its socio-economic impacts on the surrounding area. The collected data were coded, tabulated and classified according to their nature and characters. To make the analysis more reliable and easier, different data sheets have been

prepared for different variable. Field questionnaire were carefully checked for possible errors. The data were carefully edited and processed by computer program, excel then the required pie-chart, bar diagram, line graph and table was generated by using computer software program.

3.6 Techniques of Data Analysis

Both quantitative and qualitative techniques are used to analyze the data. Simple quantitative techniques such as calculation of percentage, mean, standard deviation, ratio, pie chart, bar diagram etc were used to present the data. Regarding the qualitative data, information was collected through interviews and observations and was arranged systematically and logically.

3.6.1 Statistical Tools

The statistical tools which were used in the study are discussed below:

A. Arithmetic Mean (Average): Average is statistical constants which enables us to comprehend in a single effort the significance of the whole. A mean is the average value or the sum of all observation divided by the number of observation and it is denoted and gives the formula.

   $\bar{X} = \frac{\sum X}{N}$

   Where,

   $\bar{X}$ = Arithmetic Mean of the variable

   N= Number of observations

   $\sum X$ = Sum of the value of the variables

B. Standard Deviation: Standard deviation measures the obsolute dispersion, it is said that higher the value of standard deviation, higher the variability and vice versa. It is defined as the positive square root of the mean of the square of the deviations taken from the arithmetic mean. It is denoted by the small Greek Letter σ (Sigma). It is calculated as:

   Standard Deviation $(\sigma) = \sqrt{\frac{\sum(X-\bar{X})^2}{N}}$

   Where, X= Value of the variable

$\bar{X}$= Arithmetic mean of the value of the variable

N= Number of observation

C. Co-efficient of Variation (C.V): Co-efficient of variation is the percentage variation in mean, standard deviation being considered as the total variation in co-efficient of standard deviation. The co-efficient based on standard deviation multiplied by 100 is known as co-efficient of variation (C.V.). It is independent of unit so two distributions can be compared with the help of C.V. for their variability, less the C.V. more will be the uniformity, consistency etc. and more the C.V. less will be the uniformity, consistency etc. The co-efficient of variation is defined as:

C.V. = $\frac{\sigma}{\bar{X}} \times 100\%$

Where, σ= Standard Deviation

$\bar{X}$= Average

D. Trend Analysis: The straight line trend has been calculated for total electric production and total income of SHPP. These are calculated for forecasting next three years, till 2075 B.S. The equation of straight line is:

Y= a + bX

Where,

Y= Total Electricity production/Total Income

X= Time

a= Intercept

b= Slope of the trend line.

Where, a=$\frac{\sum X^2 \sum Y - \sum X \sum XY}{n\sum X^2 - (\sum X)^2}$

b=$\frac{n\sum XY - \sum X \sum Y}{n\sum X^2 - (\sum X)^2}$

CHAPTER IV
DATA ANALYSIS

4.1 Bijaypur SHPP

The Bijayapur SHPP is at Pokhara Lekhnath Metropolitan ward no. 26 which is located in the south western part of the Pokhara Valley. The total area of Pokhara Lekhnath Metropolitan is 464.24 sq km that constitute of around 4,14,141 total population. This SHPP was developed by Bhagawati Hydropower Development Company (p) Ltd in Bhadra 05, 2069 B.S. within the area of 6 ropani. The total capacity of the Bijaypur SHPP is 4.5 MW, which is connected to national grid of NEA 132 kV at Lekhnath Substation. The main source of water for this project is Bijayapur river and outflow of seti canal from Fewa hydropower which is a RoR type. It used 242m long RCC closed canal for water from Bijayapur river to project head.

4.1.1 Installation Cost of the Project

The total installation cost of this project is about Rs 80 crores. Bhagawati Hydropower Development Co.(P.)Ltd invested 20 crores and remaining 60 crores was financed by banks where 30 crores from Rastriya Banijya Bank, 15 crores from Nabil Bank and 15 crores from Nepal Bank Ltd.

4.1.2 People Perception about Improvement of the surrounding area of SHPP

The modern facilities mostly affected all human beings, using such facilities it is expected that it change their living standard. Actually living standard refers to the higher level living quality. Of the total 120 samples, each respondent said SHPP played vital role to improve the living standard of the study area. Because of 2 km bituminous Arterial road, transport facility becomes easier. After development of SHPP, internal tourism has been promoted in this area. It also has positive impact on education and employment which change living standard of the peoples.

4.1.3 Electricity consumption in Kaski District

In Kaski District, the electricity is distributed to the households from two distribution center Pokhara and Lekhnath. The total consumed unit from Pokhara distribution center is 10262216 and from Lekhnath distribution center is 24,88,828. The total number of consumer is 107729. The total income collected by NEA office from these two distributions center is 13,57,03,934.

Table 4.1
Monthly total consumption and selling of electricity in Kaski district

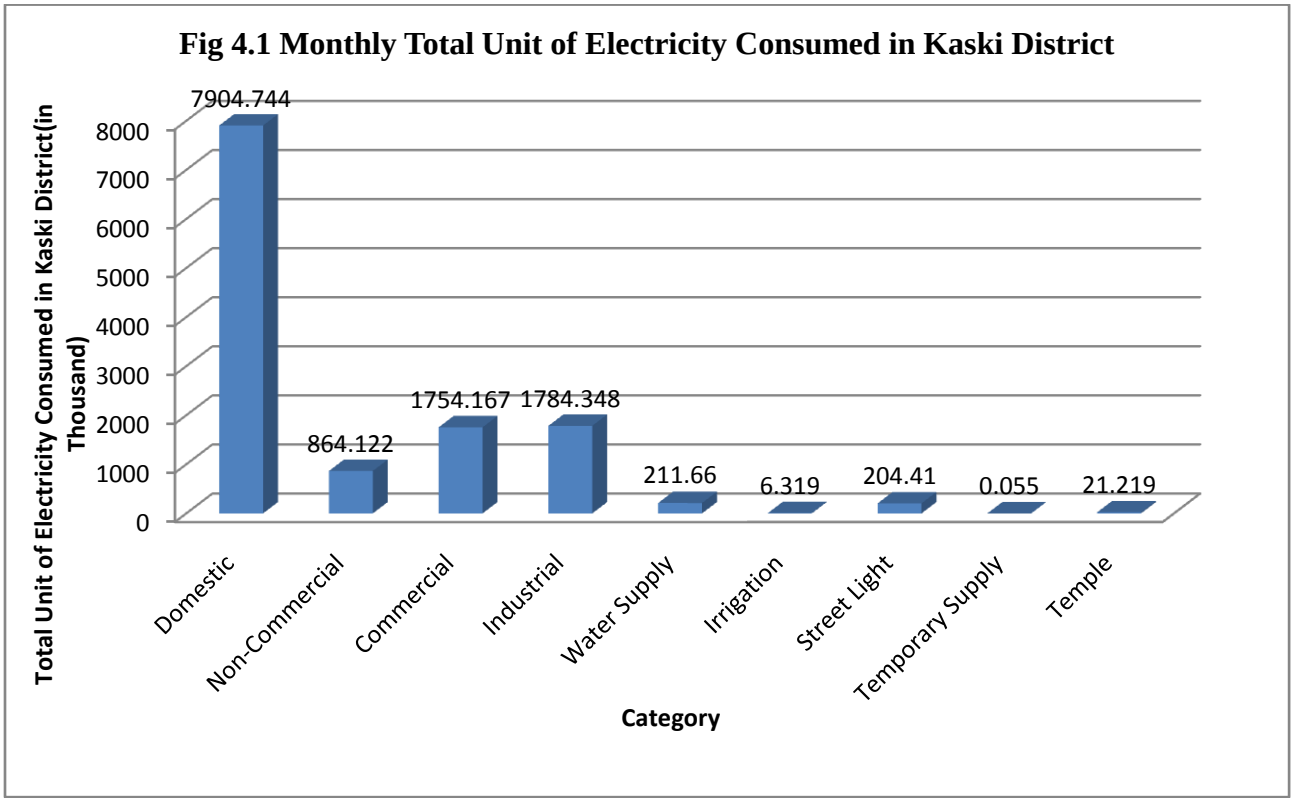
Category	Pokhara Distribution Center			Lekhnath Distribution Center		
	No. of Consumer	Consumed Unit	Total Cost	No. of Consumer	Consumed Unit	Total Cost
Domestic	67476	6402327	63467791	36722	1502417	10431560
Non-Commercial	391	810052	13011819	209	54070	815560
Commercial	765	1564991	22960203	114	189176	3101352
Industrial	1129	1152778	11343744	543	631570	6860561
Water Supply	57	149266	1083470	38	62394	580348
Irrigation	3	1747	13504	35	4572	19659
Street Light	1	165278	1552815	28	39132	331846
Temporary Supply	1	55	1089			
Temple	114	15722	95082	103	5497	33531
Total	69937	10262216	113529517	37792	2488828	22174417

Source: Nepal Electricity Authority Pokhara and Lekhnath, 2073 Poush

Table 4.2
Monthly total electricity consumption in Kaski district and total income collected by NEA Office.

S.N.	Category	Kaski District		
		Total Consumer	Total Unit	Total Cost
1	Domestic	104198	7904744	73899351
2	Non-Commercial	600	864122	13827379
3	Commercial	879	1754167	26061555
4	Industrial	1672	1784348	18204305
5	Water Supply	95	211660	1663818
6	Irrigation	38	6319	33163
7	Street Light	29	204410	1884661
8	Temporary Supply	1	55	1089
9	Temple	217	21219	128613
	Total	107729	12751044	135703934

Source: Nepal Electricity Authority Pokhara and Lekhnath, 2073 , Poush



Source: Nepal Electricity Authority Pokhara and Lekhnath, 2073 poush

4.2 Household Information of the Project Affected Area

4.2.1 The Households Participants of Ward No. 26

SHPP has played vital role for electrification in Nepal which generate 170.409 MW (DoED, 2017). To make the study more effective/reliable, questionnaires were asked to the population according to project affected tole of ward no 26 with the help of sample random sampling. The tole wise distribution of respondents shows that out of total 2123 HHs in study area, 120 HHs were taken as sample HHs where higher numbers of respondents were from Sakneri because it is the most affected area in the study area and Rittepaani was the least affected area.

Table 4.3

Tolewise distribution of respondents

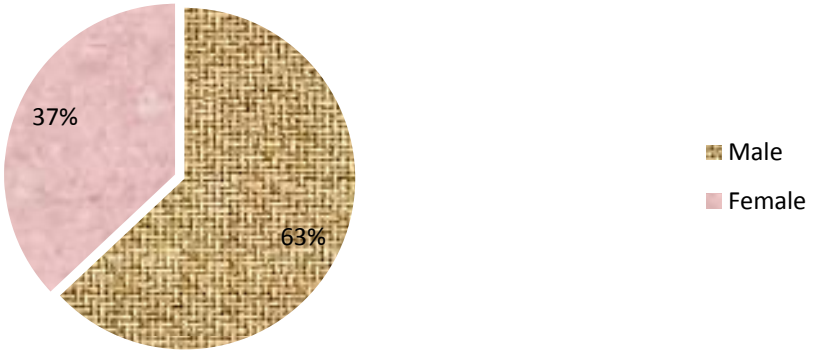
Tole of ward no 26	Sample households
Sakneri	40
Budhi Bazaar	25
Sangam Nagar	20
Bijayapur	20
Rittepaani	15
Total	120

Source: Field survey, 2017

4.2.2 Gender of the Respondents

There was a significant imbalance in the participant respondents regarding gender. The population ratio of male and female are nearly 55 and 45 percentage respectively (*National Population Census 2011,* 13). In this survey, female respondents were fewer in number than male because in many households male were head of the family and the society is patriarchal so male participation was larger in number compared to female in this sampling process. Out of the total sample, 63.33% (76) were male respondents where only 36.67% (44) were female. The gender wise participation percentage of respondents of study area has been presented in pie chart.

Fig 4.2 Gender of the respondents



Source: Field Survey, 2017

From this pie chart, we can say that the study area was male oriented. In the social work and activities male had played the leading role because female feel shy to speak, female respondents were less in number than the male respondents.

4.2.3 Age Group of Respondents

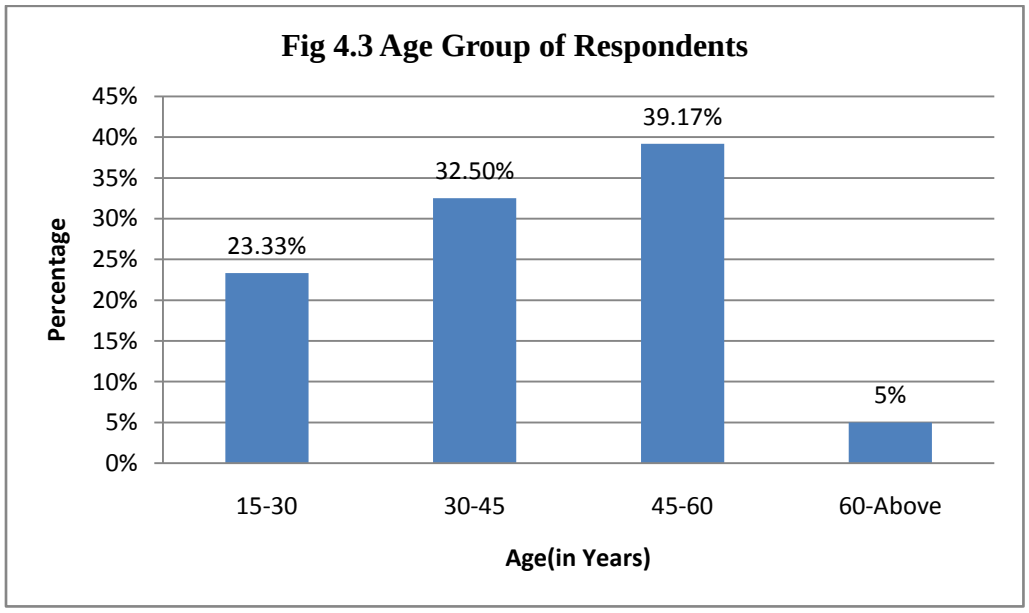
According to the age, the respondents were divided into four groups. The questions were asked to the respondents ageing above 15 years. The percentage of 45-60 age group is higher and 60 above is lower.

Table 4.4

Age group of respondents

Age(in years)	Frequency	Percentage
15-30	28	23.33
30-45	39	32.5
45-60	47	39.17
60-Above	6	5
Total	120	100

Source: Field Survey, 2017



Source: Field Survey, 2017

4.2.4 Population Distribution of Study Area by Ethnics Group

In the study area, ethnics group like Brahmin, Chhetri, Magar, Gurung, Newar and Dalit are in existence. Among the total population of the study area Brahmin and Chhetri are dominant caste group compared to Janajati and Dalits. Nepali language is common communicative language of all caste. Among total HHs, the highest portion 42 (35%) respondents are Janajati, 35(29.17%) are Chhetri. Brahmin and Dalit respondents are only 28 (23.33%) and 15(12.5%) respectively.

Table 4.5

Population Distribution by Ethnics Group

Caste	Frequency	Percentage	Cumulative Percentage
Brahmins	28	23.33	23.33
Chettri	35	29.17	52.5
Janajati	42	35	87.5
Dalit	15	12.5	100

Source: Field Survey, 2017

In addition, Janajati and Chhetri are in highest portion. Nepal is rich in castes/ethnics. Nepal is also known as common garden of different castes/ethnicity and languages.

4.2.5 Main Income Sources of Households

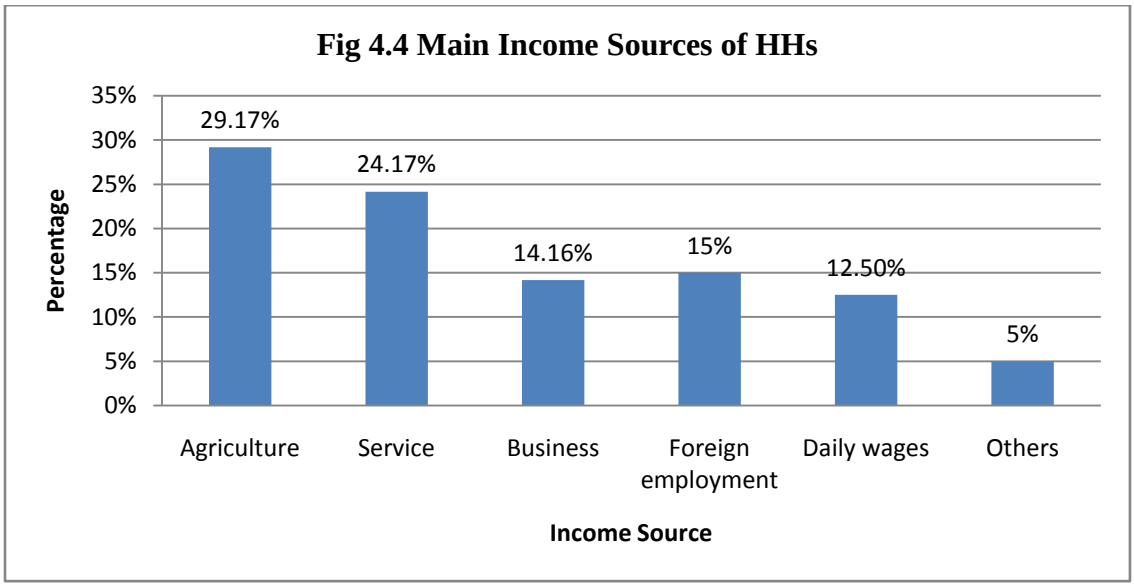
Agriculture, service, self oriented business, foreign employment, daily wages are the main occupation/income sources of the survey HHs. Other occupation includes labour work and broker of land in study area. The frequency and the percentage of survey HHs has been presented in the table below. Most of the HHs are depend on agriculture. Although, out of 120 HHs, more HHs were involved in agriculture as main income source. Among them 35 (29.17%) HHs are dependent on agriculture, 26(24.17%) totally depend on service, 17(14.16%) are involved in business, 18(15%) people are engaged on their foreign employment, 15(12.50%) HHs are engaged in daily wages and 6(5%) are in others such as labour work and land broker.

Table 4.6

Main Income Sources of HHs

Income Source	Frequency	Percentage
Agriculture	35	29.17
Service	29	24.17
Business	17	14.16
Foreign employment	18	15
Daily wages	15	12.5
Others	6	5
Total	120	100

Source: Field Survey, 2017



Source: Field Survey, 2017

4.3 Socio-Economic Impact of Bijayapur SHPP

This chapter presents the analysis of data and their interpretation with the help of table, bar-diagram and pie charts. Section 4.3 presents the socio-economic condition of the project-affected area and sustainability of the project as well as the sustainable change in the study area after the establishment of SHPP. Section 4.3.1 presents the socioeconomic impact of SHPP and 4.3.2 presents the sustainability of SHPP and impact of SHPP for

sustainable change in study area**.** The questionnaire and observation was analyzed in the descriptive form.

Socio-economic feature of study areas depicts the development status of the surroundings of the SHPP where 2069 B.S is taken as base year. The sociological and economic characteristics such as religion, education, employment, health and environmental situation have a significant influence in the economics of the study area and living standard of the people. In the survey area, project affected households are 2123 where, only 120 sample HHs(along with one school) were taken to find out the socio-economic impact of SHPP on study area, role of SHPP for sustainable change in project affected areas and people's activities.

4.3.1 SHPP Role in Electrification

Cent percent respondents accepted that SHPP plays the vital role for electrification in the study area. Before Bijayapur SHPP connected to the central grid, people in the study area were compelled to live under the loadshedding which was about 15 hrs a day but after completion of SHPP, loadshedding in this area become less compared to other area which is about 10-13 hrs. 100% of the people in the study area have access to central grid. Hence, SHPP is the best energy sources for electrification. Due to our unique land topography, thousands of big rivers and small rivulets falling from mountain to plain area, small hydro project can be easily lunched in low and reasonable cost. Mostly, people use electricity for lighting and playing radio, TV etc. Compared to rural area, utilization of electricity is high in urban areas.

4.3.2 Uses of electricity for various purposes

Sample data was taken from 120 HHs of study area. Out of them 100% house were connected to central electricity grid. They used electricity for lighting purpose for min 3 hrs and max 11 hrs. 90 HHs used min 0.5 hrs and max3 hrs for cooking purpose. 110 HHs use min 2 hrs to max 10 hrs for TV, Radio, Computer. 55 HHs use min 2 hrs to max 24 hrs for other electronic and electrical devices like internet router, mobiles. 118 HHs use min 2 hrs to max 4 hrs for personal use. 118 HHs use min 1hrs to max 12 hrs for other purposes in study area (Table 4.7).

Table 4.7

Use of electricity for various purposes

S.N	Use of electricity	Total household	Min hours	Max hours
1	Lighting	120	3	11
2	Cooking	90	0.5	3
3	TV/Radio/Computer	110	2	10
4	Other Electronic/Electrical devices	55	2	24
5	Personal use	118	2	4
6	Others	118	1	12
	Total Average		1.75	10.66

Source: Field Survey, 2017

4.3.3 Change in Consumption of Energy

Most of the communities in the study area heavily rely on firewood and L.P.G Gas. Over exploitation of firewood for household purpose (cooking and heating) leads to the degradation of natural forests that ultimately results in scarcity of local resources. Before SHPP, firewood was used in most of the household to cook the food. After heavy electric loadshedding, use of solar was increased for lighting in study area.

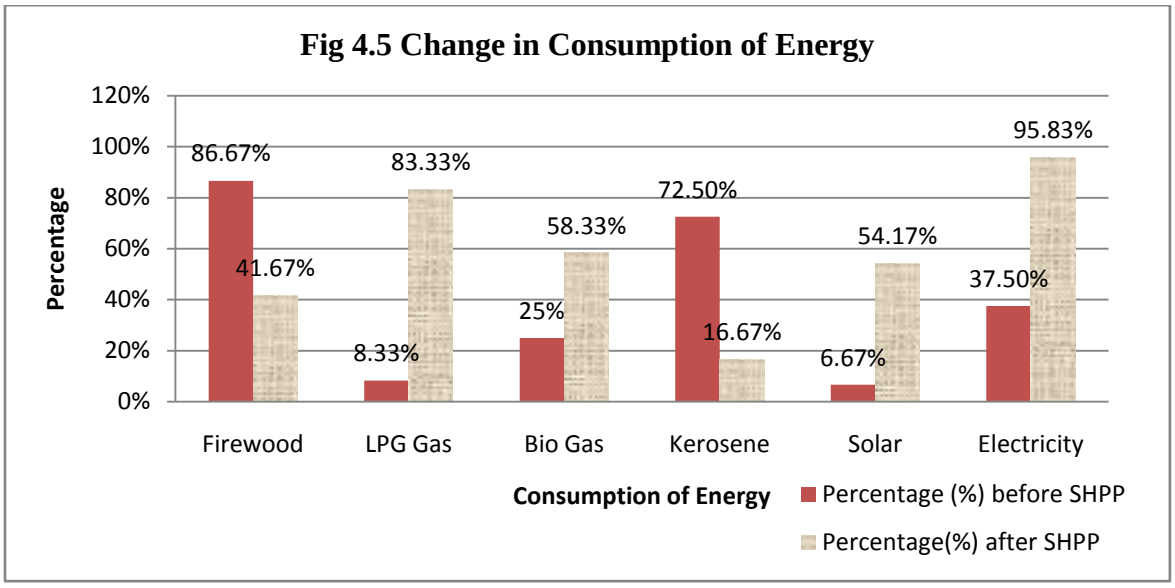
Various technologies have been used in residential sector in study area, some of which are given below. In residential sector, traditional, improved cookstoves and LPG stoves are dominantly used for cooking and water boiling. For lightening, CFL and tube light are primarily used along with charging light and finally for heating and cooling fans, heater and air conditioner are generally used. In the study area, consumption of different sources of energy has been changed after the development of SHPP. Before the development of SHPP consumption of firewood and kerosene was high but after the development of SHPP, the consumption of electricity and LPG gas is high.

Table 4.8

Change in consumption of energy

S.N	Source of Energy	Before SHPP		After SHPP	
		No. of HH	Percentage	No. of HH	Percentage
1	Firewood	104	86.67	50	41.67
2	LPG Gas	10	8.33	100	83.33
3	Bio Gas	30	25	70	58.33
4	Kerosene	87	72.5	20	16.67
5	Solar	8	6.67	65	54.17
6	Electricity	45	37.5	115	95.83

Source: Field Survey, 2017



Source: Survey Field, 2017

4.3.4 Effects on education

After development of this SHPP, Ramjyoti Lower Secondary School has been upgraded into Secondary level, as HPP has built RCC building with 5 rooms which cost was about 50 lakhs. They also have donated money for buying the needed infrastructure like bench, desk, table, chair etc. It also pays Rs. 8 lakhs as rent of land per year to the school which has been used to pay salary to 5 secondary level teachers.

Due to this, extra classes have been run smoothly in the school which has increased the study hours and performance of the students. Proper power supply in schools has attracted the teachers to use different multimedia tools. Computer subject was added as a compulsory subject upto class 8. The level of illumination provided by the modern electric lights in the households is more efficient and brighter. After availability of proper electricity, different modern technology is being used in local area which enhanced the knowledge of the student as they used internet and different educational website to access information related to their curriculum. They can learn from online tutors and videos also. According to parents and principal of Ramjyoti Secondary School, the study habit of the students has been changed. 40% of the students study time is two to three hours a day. After the development of SHPP, the infrastructure of the Ramjyoti Secondary School has been increased with education quality which directly affected the number of students in the school. The total number of students has been increased by 177 in Ramjyoti Secondary School after the development of SHPP.

Table 4.9

Impact of electricity on children studying habit

S.N	Increased hours	Sample households	Percentage
1	Less than one hours	13	10.83
2	One to two hours	42	35
3	Two to three hours	48	40
4	More than three hours	17	14.17
	Total	120	100.00

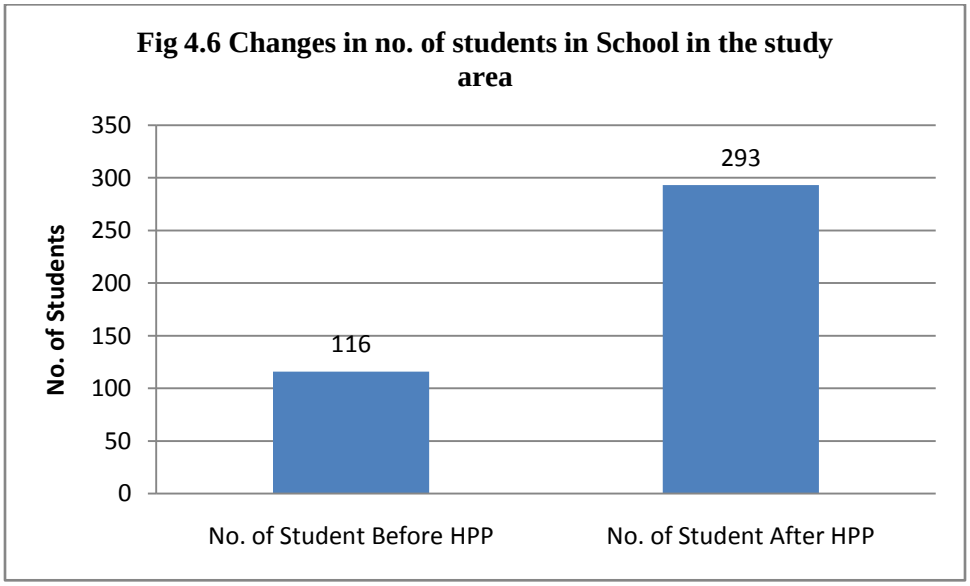
Source: Field Survey, 2017

Table 4.10

Changes on no. of students in School

S.N	No. of Students Before SHPP (2069 B.S)	No. of Students After SHPP(2073 B.S)	Total no. of Increment
1	116	293	177

Source: Field Survey, 2017



Source: Field Survey, 2017

4.3.5 Access to Modern Technology

In present situation most of the households are connected to the national electricity grid. After electrification modern technology like TV, Radio, Refrigerator, Washing machine, Computer, Laptops, Mobile phones, and also electric scooter, rickshaw, and motors were accessible to the people in study area. Almost every household visited in the study area have owned at least one television, and nearly every adult member of the family owned a mobile phone. Modern communication systems and devices have done drastic change in study area. Nowadays they have access to internet, and using different social networking websites for communication and information exchange. They are using different mobile application for video calling and using mobile data for accessing internet. After the development of SHPP, 100% of the respondents use Radio, TV and Mobile. The use of

Iron is 80%, Computer/Laptop is 43.33%, Refrigerator is 30.83% and Washing Machine is 10%.

Table 4.11

Access to modern Technology

S.N.	Devices/Instrument	Before SHPP		After SHPP	
		Households (Total 120)	Percentage	Households (Total 120)	Percentage
1	Radio	110	91.67	120	100
2	TV	78	65	120	100
3	Refrigerator	7	5.83	37	30.83
4	Washing Machine	-	0	12	10
5	Iron	37	30.83	96	80
6	Computer/Laptop	17	14.17	52	43.33
7	Mobile Phone	98	81.67	120	100

Source: Field Survey, 2017

4.3.6 Impact on source of Income

Agriculture, Livestock and Husbandry were the key sources of income in the study area before the SHPP. After development of SHPP, company invested about Rs. 50 lakhs to build 2 km bituminous road from Buddhi Bazaar to SHPP area. It invested about 7 lakhs for gravelling sub road in study area which improves transport access to fields so that farmers can use tractor and other machinery tools for cultivation. They use modern agricultural tools and grow unseasonal cash crops which increase their income. Before SHPP, people in this area used to play cards, ludo and carrom board to pass their time but now among the 35 peoples employed in SHPP, 28 employees were local people. In study

area, after electricity grid connection, people choose other alternative source of income like working in industries, mills, and business organization.

Table 4.12

Total job creation from SHPP

S.N	Types of Employees	Total no. of employees
1	Local	28
2	Outsider	7

Source: Field Survey, 2017

4.3.7. Impact on Female Participation in Social Activities

SHPP generated electricity has reduced the time that females spend on household tasks such as collection of firewood so, they have more time to spend in other useful works. They have formed different *Aama Samuha* which played significant role on women empowerment. SHPP donated about Rs. 25 lakhs for 25 *Aama Samuha* in the SHPP affected area. Public lighting has improved public safety in the area, which is very important for locals. SHPP has donated money to built *Samaj Ghar* for *Buddha Aama samuha* and Sakneri *Aama Samuha*.

4.3.8 Impacts on Health, Child Health and Maternal Health

Use of electricity has decreased the indoor air pollution of kerosene/gasoline smokes, candles and has improved the safety around house along with the health condition of people. In addition to the better diet and more hygienic cooking conditions, mothers and children are benefitted from improved health. The electricity supplied by the SHHP enables refrigeration, adequate lighting, telecommunication and use of medical technology, which in turn, permit vaccination, sterilization and improvement in time and quality of the medical service. Electricity supply also allows the use of ground water pumps, thus water borne diseases due to contaminated surface water was decreased. By the use of modern electric technology and devices there is great improvement in health sector in study area.

4.3.9 Establishment of Industries and Direct Job Creation

Electricity is the basic prerequisite of development. It is the foundation to generate any socio economic activities. The life is very difficult as well as backward if we are unable to use modern technology in the absence of power. After SHPP and electrification, people launched various industries in the study area, which helps to raise the income level of the people as well as employment which change the way of their living.

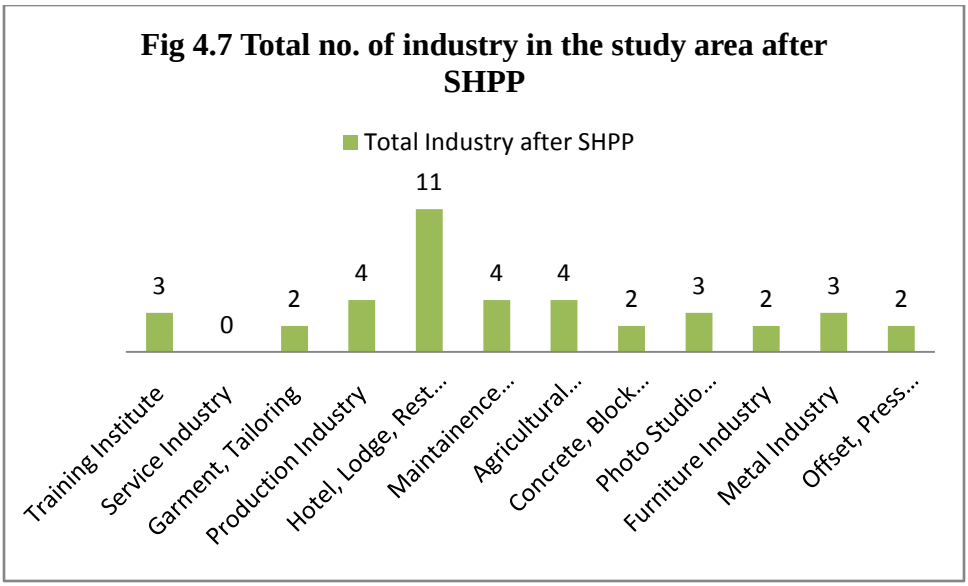
After the development of SHPP, the number of industry has been increased with high increment in number of hotel, lodge, and restaurant. There is no change in service industry. These firms have increased the job opportunities in the study area. The firms that are registered in the study area according to Cottage and Small Industry Office, Kaski are listed below:

Table 4.13

Firm registered in study area

S.N	Firm Type	No. of Industry/Firm		Registered firm after SHPP
		Upto 2069 B.S	Upto 2073 Poush	
1	Training Institute	2	5	3
2	Service Industry	1	1	0
3	Garment, Tailoring	1	3	2
4	Production Industry	4	8	4
5	Hotel, Lodge, Restaurant	15	26	11
6	Maintenance Industry	7	11	4
7	Agricultural Industry	6	10	4
8	Concrete, Block Industry	3	5	2
9	Photo Studio Colorlab	2	5	3
10	Furniture Industry	2	4	2
11	Metal Industry	2	5	3
12	Offset, Press Industry	1	3	2
	Total	46	86	40

Source: Cottage and Small Industry Office, Kaski, 2017



Source: Cottage and Small Industry Office, Kaski, 2017

4.3.10 Environmental Impact of SHPP

Bijayapur SHPP is ROR type which is generally less damaging than reservoir power plants. The reservoir power plants causes flood, change the water quality due to the lack of dissolved oxygen near the bottom of reservoirs which is toxic to fish and can lead to the death of aquatic life. It is also corrosive to turbines. SHPP dam and reservoir is the cause of wild lands, wetlands and wildlife habitat loss. There is always danger of landslide near SHPP and water reservoir. In study area, two houses near SHPP were victims of landslide and HPP has paid Rs. 25 lakhs for each household. About 16 crores loss was caused by landslide.

4.3.11 Impact on promotion of Internal Tourism

In study area, people from different places come here to visit SHPP. Many people come here for picnic. Many local people went to SHPP area for jogging and morning walk. Students from different schools and colleges came to SHPP for educational visit. A new restaurant with party palace has been opened recently also promote internal tourism. Mostly, in evening time many people came there and pass their free time in calm environment for refreshment.

4.3.12 Impact on Migration Rate

After the development of SHPP in study area, numbers of people who migrate to study area has increased than migrated from study area. Price of land also becomes high near the SHPP. After development of SHPP, the migration to study area is higher than outgoing. In the year 2071, migration rate of HHs to the study area is high which is 21, whereas in the year 2073 is low which is only 5. Likewise, none of the HHs has migrated from study area in 2069 whereas in 2073 it becomes 4 (Table 4.14).

Table 4.14

Migration Rate in Study Area

S.N	Year	Migrated households to Study Area	Migrated households from Study Area
1	2069	10	0
2	2070	19	1
3	2071	21	1
4	2072	20	2
5	2073	5	4

Source: Pokhara Lekhnath Metropolitan Ward 26 Office, 2017

The mean population migrated to study area is 15 with Standard Deviation 7.12 whereas the mean population migrated from the study area is 1.6 with Standard Deviation 1.52. The Coefficient Variation of migrated HHs to study area is 47.47% whereas migrated HHs from study area is 95%. The dispersion of migrated HHs to study area is lower than migrated HHs from the study area (Table 4.15).

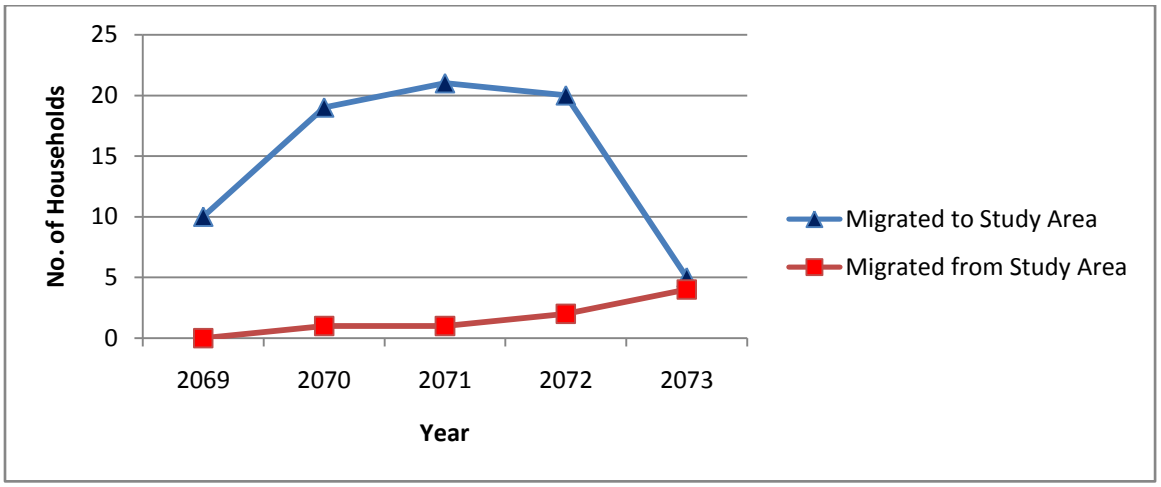
Table 4.15

Mean and Standard Deviation of Migrated HHs

	Migrated HHs to study area			Migrated HHs from the study area		
	Mean	Standard Deviation	Coefficient Variation(%)	Mean	Standard Deviation	Coefficient Variation(%)
No. of HHs	15	7.12	47.47	1.6	1.52	95

Source: Field Survey, 2017

Fig 4.8 Migrated HHs of the Study Area



Source: Pokhara Lekhnath Metropolitan Ward 26 Office, 2017

4.3.13 Investment by SHPP in development of society

In study area, SHPP had conducted different programs along with investment in different sectors. The SHPP had constructed and improved the transportation facilities in study area. They also have donated certain amount in the betterment of education and health of surrounding people. SHPP invested about Rs. 7 lakhs for improving condition of *Bhir Gaudi* which joins local people to SHPP and Bijayapur river. This is also a way to walk animals to river bank for grazing. They have donated 7 lakhs for gravelling of road and about 50 lakhs to construct 2 km bituminous Arterial road. They gave 25 lakhs for 20 *Aama Samuha* and about 7 lakhs to local youth club. They have done plantation for conservation of land from landslide near cliff area.

4.3.14 Impact on Children Playing Area

After the development of SHPP, we can find both positive and negative impact on society. People near SHPP were benefitted from the development, whereas it also decreases the playing area of children. SHPP area is not safe for children to play because different instrumental materials like nails, rod pieces are left over near the surrounding area of SHPP, which may hurt to the children.

4.3.15 Impact on Grazing Land

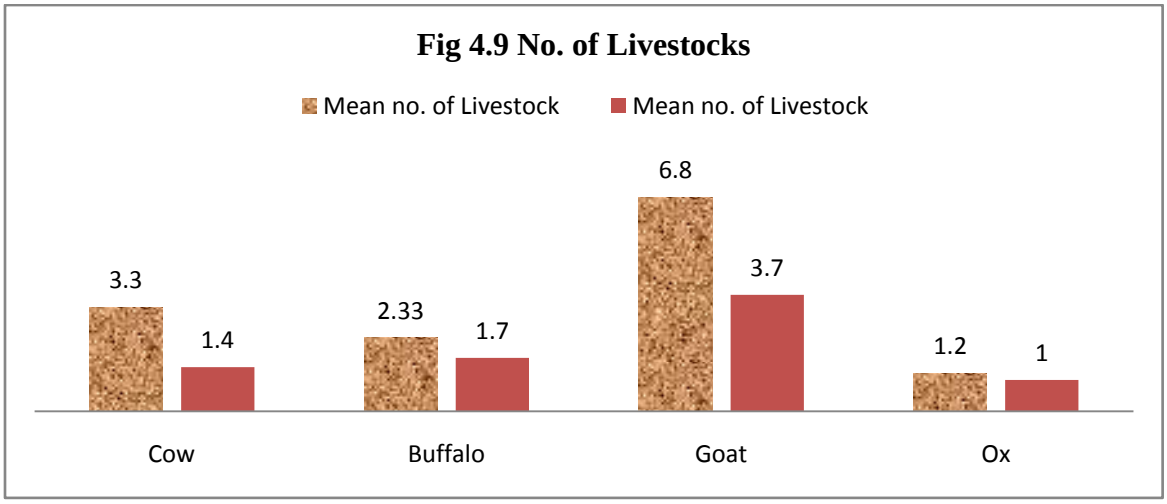
Due to the establishment of SHPP, the grazing land has been decreased. Most of the area of grazing land has been occupied by the infrastructural development along with road. Because of decreasing grazing land the number of livestock also has been decreased in the study area. Before the commencement of SHPP, the number of HHs rearing cows was 60 which decreased to merely 23 HHs after SHPP. Likewise, buffaloes were kept in 47 HHs which substantially reduced to 18 houses. The mostly affected animal rearing was found in oxen which were reared in 30 HHs before and merely 4 after SHPP was established (Table 4.16).

Table 4.16

Number of Livestock in study area

S.N	Domestic Animal	Before SHPP		After SHPP	
		No. of Households	Mean no. of Livestock	No. of Households	Mean no. of Livestock
1	Cow	68	3.3	23	1.4
2	Buffalo	47	2.33	18	1.7
3	Goat	37	6.8	16	3.7
4	Ox	30	1.2	4	1

Source: Field Survey, 2017



Source: Field Survery, 2017

4.3.16 Impact on Water Resource

Due to the establishment of SHPP the water resources have been degraded. There was plenty of water before the establishment of SHPP where children used to swim but now such place has been degraded. The flow of the spring near the SHPP has been decreased after development of SHPP. Some of the springs near SHPP were destructed by landslide.

4.3. 17 Electric Power Generation from SHPP

The power generation capacity of SHPP is 4.5 MW. But, it is less in Falgun, Chaitra, Baisakh and Jestha in comparision to other months. It is because of not enough water in the river. The outflow from Seti canal is mixed in Bijayapur river which increases the flow of water in the river. In the year 2069 B.S., total energy generation of SHPP was 2,28,03,956 kWh. It was less compare to other year, because power generation started only from Bhadra 2069 B.S. In the year 2070 B.S., 2,90,41,413 kWh was generated whereas in the year 2071 B.S., 2,78,06,817 kWh was generated and 2,97,86,578 kWh was generated in 2072 B.S. Power generation of SHPP was high in the year 2072 B.S. Out of total generation, some power was consumed by SHPP and remaining power was distributed to NEA grid (Table 4.17).

Table 4.17

Electric Power Generation from SHPP

S.N	Year(in B.S.)	Total Energy Generation kWh	Internal Consumption kWh	Energy to NEA Grid kWh	Total Income from NEA
1	2069	2,28,03,956	56313	2,22,51,560	13,09,92,369
2	2070	2,90,41,413	71911	2,90,58,930	15,13,60,872.4
3	2071	2,78,06,817	71034	2,74,69,180	16,63,17,439.6
4	2072	2,97,86,578	72012	2,97,14,566	17,20,00,000

Source: Field Survey 2017

The electric power generation of SHPP in 2069 B.S is 22251560 kWh whereas in 2070 the production was 29058930 kWh. The power generation increased in 2071 B.S and 2072 B.S which was 27469180 kWh and 29714566 kWh respectively. Based on production of 2069, 2070, 2071 and 2072, trend value of electric generation is 24003668.8 kWh, 26083595.6 kWh, 28163522.4 kWh, 30243449.2 kWh, 32323376

kWh, 34403302.8 kWh and 36483229.6 kWh for the year 2069, 2070, 2071, 2072, 2073, 2074 and 2075 respectively (Table 4.18).

Table 4.18

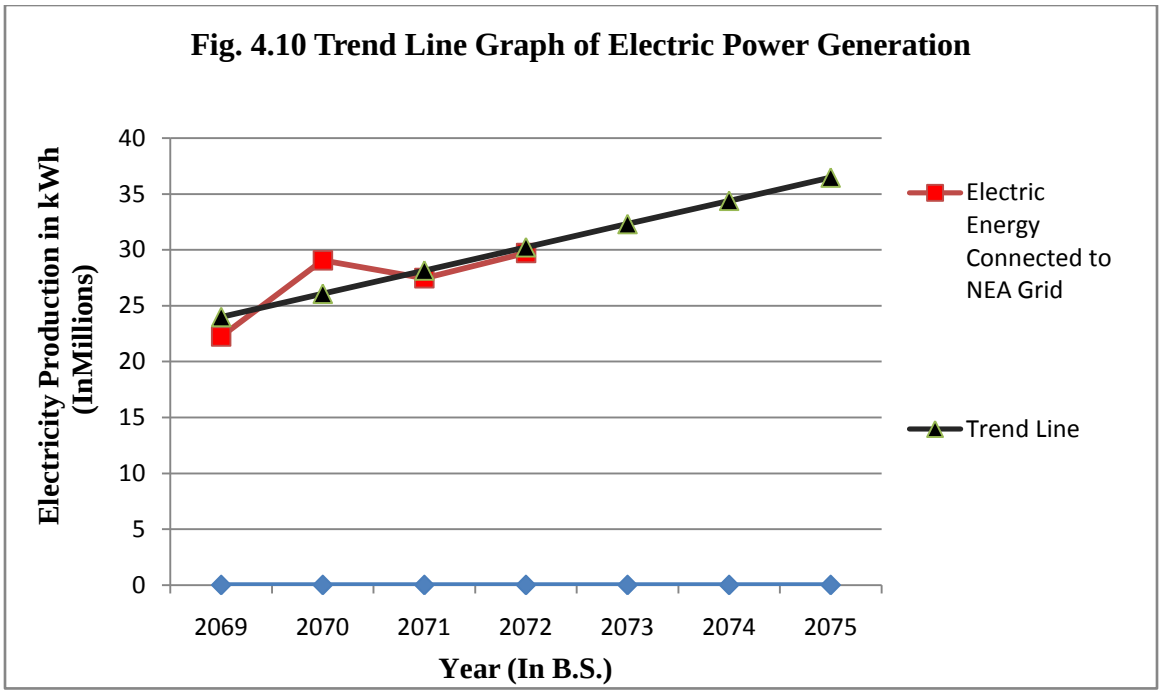
Trend of Electric Power Generation from SHPP

Year	Electric Energy Connected to NEA Grid(kWh)	Trend Value
2069	22251560	24003668.8
2070	29058930	26083595.6
2071	27469180	28163522.4
2072	29714566	30243449.2
2073	-	32323376
2074	-	34403302.8
2075	-	36483229.6

Source: Bhagawati Hydropower Development Co.(P.)Ltd

The straight line trend is Y= 21923742+2079926.8X

The intercept is 21923742 and the coefficient of X is 2079926.8 which means that change in X by one unit will lead to change in Total electric energy connected to the NEA will be change by 2079926.8 kWh. The trend values for 2069, 2070, 2071 and 2072 are 24003668.8, 26083595.6, 28163522.4 and 30243449.2. On the basis of the above straight trend line , the expected values of total electric energy connected to NEA grid for the year 2073, 2074 and 2075 are 32323376, 34403302.8 and 36483229.6.



Source: From Table 4.18

4.3.18 Revenue from SHPP

Although, construction of SHPP needs a lot of money but it is the great source of revenue. The total installation cost of this project is about Rs 80 crores which can be returned back within 9-10 years after production starts. The table depicts total revenue of the SHPP from NEA and expenditure of SHPP including Salary paid to employee, maintenance and operational cost and bank installment. In the year 2069 B.S., profit of SHPP was 27006127.6 whereas it was increased in 2070 B.S. by 46374631.In the year 2071 B.S, profit was 44331198.2 whereas in the year 2072 B.S. it was 66613758. SHPP has to pay installment of bank for 10 years and after that profit will be increase (Table 4.18).

Table 4.19

Revenue of SHPP

Year (B.S)	Revenue received from NEA	Expenditure of SHPP			Profit
		Salary (yearly)	Maintenance and Operational Cost	Bank Installment	
2069	130992369	8820000	2000000	93166241.4	27006127.6
2070	151360872.4	8820000	3000000	93166241.4	46374631
2071	166317439.6	8820000	20000000	93166241.4	44331198.2
2072	172000000.0	8820000	3400000	93166241.4	66613758.6

Source: Field Survey, 2017

The straight line trend is Y= 120672805.2+13797946.02X

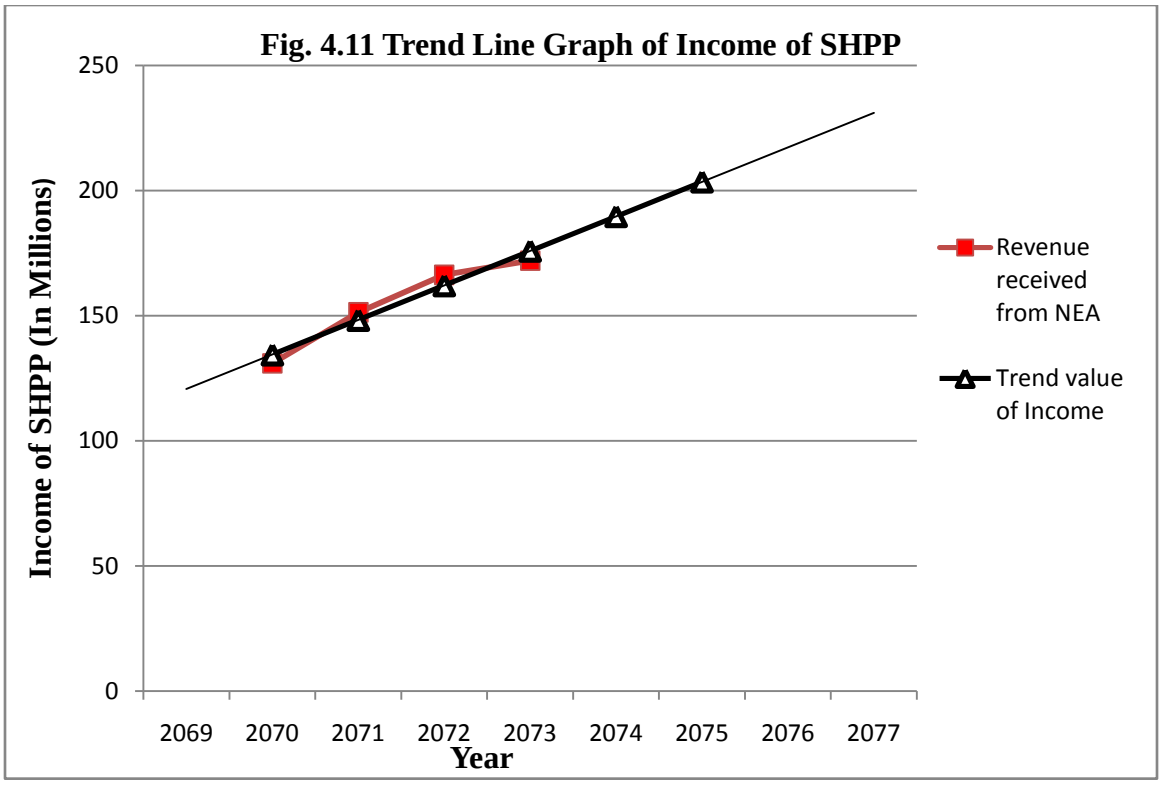
The intercept is 120672805.2 and the coefficient of X is 13797946.02 which means that change in X by one unit will lead to change in total income will be change by 13797946.02. The trend values for 2069, 2070, 2071 and 2072 are 134470751.22, 148268697.24, 162066643.26 and 175864589.28. On the basis of the above straight trend line, the expected values of total income of SHPP for the year 2073, 2074 and 2075 are 189662535.30, 203460481.32 and 217258427.34(Table 4.20).

Table 4.20

Income trend value of SHPP

Year (B.S)	Revenue received from NEA	Trend value of Income
2069	130992369	134470751.22
2070	151360872	148268697.24
2071	166317440	162066643.26
2072	172000000	175864589.28
2073	-	189662535.30
2074	-	203460481.32
2075	-	217258427.34

Source: Derived from table 4.19



Source: From table 4.20

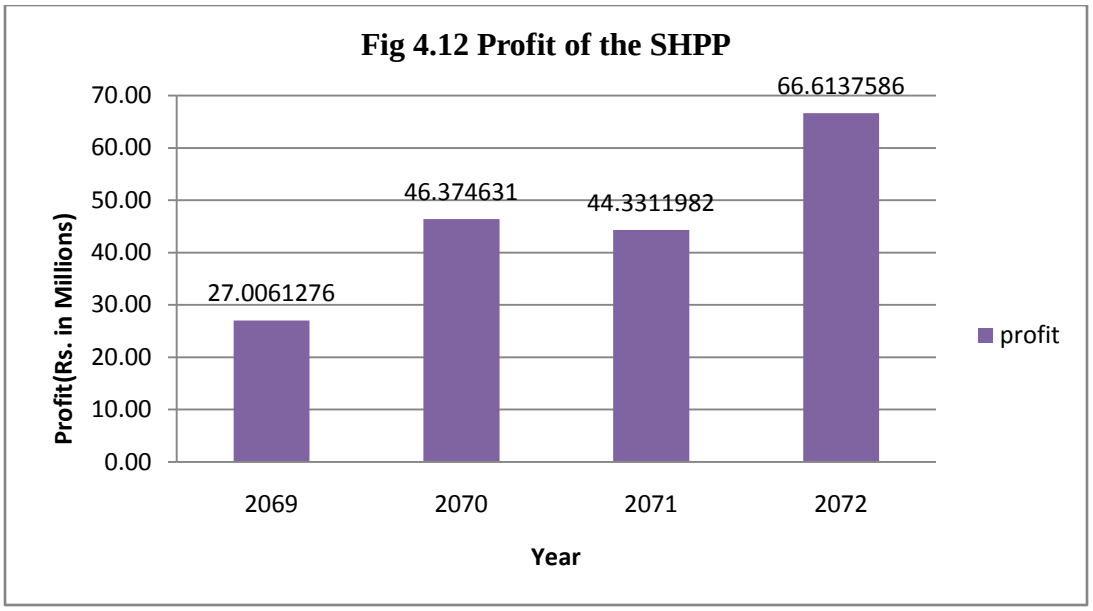
The Mean revenue of SHPP is Rs. 155167670.3 with Standard Deviation of the revenue is 18317401.4. Mean profit from 2069 to 2072 is Rs. 46081429 with Standard Deviation of the profit is 16213090.98. The coefficient variation of revenue of SHPP is 11.8% where as coefficient variation of profit of SHPP is 35.18% (Table 4.21).

Table 4.21

Revenue and Profit of SHPP

Revenue of SHPP(yearly)			Profit of SHPP(yearly)		
Mean	Standard Deviation	Coefficient Variation(%)	Mean	Standard Deviation	Coefficient Variation(%)
155167670.3	18317401.4	11.8	46081428.85	16213090.98	35.18

Source: Field Survey, 2017



Source: Field Survey, 2017

4.4 Major Findings

- Out of total respondent, the uses of electricity for lighting and for using electronic devices were high but for cooking are low.
- Before installation of SHPP firewood and kerosene were the main source of energy for lighting and cooking purpose but after SHPP the use of electrical appliances has been increased because of proper electricity.
- After development of SHPP, study hours of students increased by 2-3 hours.
- The number of students increased by 177 in Ramjyoti Secondary School after the infrastructural development of school by SHPP.
- After the installation of SHPP the use of electronic devices like radio, TV, mobile phone is 100%.
- In SHPP local people were given high priority than outsider where out of 35 employees 28 were local people.
- Women's participation in social activities has been increased after the installation of SHPP as it has donated money for *Aama Samuha*.
- After installation of SHPP number of hotel and restaurant has been increased that create job opportunities in the study area.
- Due to constructional work of SHPP, two families were shifted away because of

landslide.

- After installation of SHPP internal tourism in the study area has been increased.
- Migration to study area is higher than migration from study area.
- SHPP has been helped to improve the condition of the roads in the study area.
- Playing area for children has been decreased and has become unsafe near SHPP.
- Number of livestock has been decreased after degradation of grazing area.
- Water resources near the SHPP has been degraded due to landslide which also affects the aquatic lives.
- The investment of SHPP is returned back within 9-10 years after production starts.

CHAPTER V

SUMMARY AND CONCLUSIONS

This study is focused on studying the socio-economic impact of Bijayapur SHPP. It is based on the primary data collected through the field survey. It is expected that the results from this study will provide valuable information for utilizing the resources in the most positive sector for energy generation. The main objective of the study is to examine the socio-economic impact of Bijayapur SHPP on income and employment generation in Kaski District and to explore the problems associated with the SHHP along with suggesting solution for its sustainable development.

5.1 Summary

The first chapter deals with general background, statement of the problems, objectives, significance, limitations and organization of the study. The second chapter is about literature review. The third chapter is about selection of the study area, research design, sample size and procedure, nature and sources of data, data processing and techniques of data analysis. Fourth chapter deals about the analysis and interpretation of data and fifth chapter includes summary, conclusion and suggestion.

The summary of the study is given below:

Hydropower is a nonpolluting, environmentally friendly, renewable, locally available and reliable energy source. To meet the national energy objectives, small hydropower plants are effective for the electrification. The traditional sources of energy are not sufficient to meet the energy demand and the use of fuel is also expensive which negatively pressurizes on the balance of payment in the economy. In such condition electricity is the basic prerequisite of development in which the energy consuming pattern is regarded as one of the important indicator for measuring development status of the study area. The SHPP has been able to bring about profound socio-economic changes. This study reflects the overview of Nepalese hilly energies sources, status and discusses various energy issues through a case study of Bijayapur SHPP, Kaski. The study has discussed various merits of SHPP system; it not only provides energy for lighting but also helps to develop surrounding area.

This is the descriptive study designed to find out the socio-economic impact of Bijayapur SHPP of Kaski district. This study has been conducted from the direct interview method with 120 respondents which were selected by simple random sampling. The major findings of the study area are pointed as follows:

The main caste in the study area are Janajati (35%), Chettri (29.17%), Brahmin and Dalit (23.33%) and (12.5%) respectively. The main source of income is agriculture (29.17%) in the study area. The SHPP is the source of energy which reduce the over expenditure on traditional energy sources like firewood, kerosene etc. The development of SHPP helps to improve the health condition of the people and minimize the respiratory disease and eye infection. By the use of SHPP different industries like rice mill, saw mill, computer institute, poultry firms etc have been installed which create job opportunity to the locals.

The use of various electrical instruments has increased after the establishment of SHPP, which make the life easier and help to change the living standard of the people. The study habit of children and their performance in the school has been improved in holistic ways.

The situation of local forest condition has improved. The sanitation status of the surroundings has been improved using this SHPP.

5.2 Conclusions

HP plays vital role for the development of the country. There is high potentiality of SHPP in Nepal as well as in my study area. SHPP has positive impacts on income and employment. It helps to raise income and employment by creating job opportunities for local peoples by helping in the establishment of industry and businesses. SHPP reduces the expenditure on different source of energy like firewood, kerosene, biogas, LPG gas etc. So it can be a less expensive source of energy in this area. It helps to increase infrastructure of school which increased no. of students and their performance in the study area. It also helps in promotion of internal tourism. Migration rate of study area is also affected by SHPP where immigration is higher than emigration i.e migration to the study area is higher than migration from study area. After the establishment of SHPP the environment of the surrounding area has been degraded because of landslide and two houses at the cliff have been shifted away. The grazing area is also affected which has decreased the no. of livestock in study area. Accumulation of soil in the river has also

affected the aquatic life. Due to the accumulation of leftover unneeded materials the sanitation of surrounding area is affected. SHPP played vital role in improving the transportation facility of surrounding area by constructing road and infrastructure of surrounding area which helped in increasing agricultural products by using different modern tools.

5.3 Recommendation

The primary concern of this study is to look into the present socio economic impacts of small hydropower development in Nepal generally of Kaski district; and to suggest on the basis of findings:

- In the study area, the electricity power generation should be increased by further investment as demand is high then supply.
- Lack of timely maintenance of the project is another technical problem. So, the experienced technicians of Government should look after the maintenance of SHPPs.
- The dam constructed in SHPP is located at weak area as well as the canal is built on sloppy area, so there is the fear of landslide. Thus the constructed dam and canal should be repaired timely and properly for security and sustainability of SHPP.
- The produced electricity should be utilized for more productive activities which will reduce the need for biomass, that decrease deforestation and reduce pollution.
- Proper access and reliable supply of electricity raise the standard of living which raise the national education and equality level.

APPENDIX- I

Questionnaire for Respondents

Survey on Socio Economic Impact of Bijayapur SHPP in Kaski District

This questionnaire is primarily designed for the fulfillment of the requirements for thesis writing purpose of M.A. in Economics.

You are kindly requested to fill up this questionnaire as instructed below:

1. General Information

<table>
<tr><td colspan="3">1.1 Name:</td><td colspan="2">1.2 Ward no:</td></tr>
<tr><td colspan="3">1.3 Gender:</td><td colspan="2">1.4 Age:</td></tr>
<tr><td rowspan="2">1.5 No. of Member:</td><td>Female</td><td>Male</td><td colspan="2" rowspan="2">1.6 Occupation:</td></tr>
<tr><td></td><td></td></tr>
<tr><td colspan="3">1.7 Caste:</td><td colspan="2">1.8 Religion:</td></tr>
</table>

2. HP and electrification

S.N	Question	Code/Answer	Comment
2.1	Do you agree SHPP has played vital role in electrification?	1. Yes 2. No	
2.2	How much units of electricity do you consume per month?	Maximum: Minimum:	
2.3	How many hours per day do you access electricity for the following purposes? (Write in hours.) a) Lightening b) Cooking c) TV/Radio/Computer d) For business purpose e) For agricultural purpose f) Personal use g) Other(specify)	....	
2.4	How much money do you pay for electricity per month?	Maximum : Minimum:	

3. Socio economic impact

3.1 Do you think SHPP has improved your family status?

1. Yes
2. No

3.2 Have you done the productive work by using SHPP and electrification system?

1. Poultry farming	1.Yes	2. No
2. Furniture	1.Yes	2. No
3. Sawmill	1.Yes	2. No
4. Dairy	1.Yes	2. No
5. Agro mill	1.Yes	2. No
6. Computer	1.Yes	2. No
7. Other (specify)	…….	

3.3 Do you find that after involving on productive work it helped to increase your income?

1. Yes
2. No
3. to some extent
4. difficult to say

3.4 Number of employed person at SHPP ,if any?

……..

3.5 Does the project helps to promote the agriculture product?

1. Yes
2. No

3.6 In your opinion, how it helped?

1. Regularly
2. Sometimes
3. Irregularly

3.7 What type of industry is installed in your area?

1) Milling
2) Furniture
3) Food
4) Drinking water
5) Knitting
6) Hotel/Lodge/Restaurant
7) Electronics maintenance center

8) Other specify ……..

3.8 How many electrical instruments do your household posses? What are they?

…….

Instruments

1) Radio

2) TV …… …….

3) Refrigerator …… …….

4) Computer …… …….

5) Cell phone …… ……..…

6) Chargeable battery ……. …….

7) Washing Machine ……

8) Others specify ……. …….

3.9 Will you please specify the annual income of your family?

Total in Rs. Before…….. After ……

3.10 What is the status of your family income after SHPP ?

1) Increase

2) Decrease

3) No change

3.11 How much money do you spend on these energy sources? Specify in Rs.

1) Kerosene ……...

2) Battery ……...

3) Candle …… ……...

4) Firewood …… ……...

5) LPG …….

3.12 What is the main source of energy in your family?

1) Firewood

2) Bio-gas

3) Solar

4) Kerosene

5) LPG

6) Others

3.13 After SHPP installation is there any increment in your children's study hours ?

1) Yes

2) No

3.14 How much time has been increased?

1) Up to 1 hour

2) 1 to 2 hours

3) 2 to 3 hours

4) More than 3 hours

3.15 Has their performance at school increased?

1) Yes

2) No

3.16 Have you seen any of the following changes in the activities of your children due to utilizing modern tools running through electricity?

1) Talking style	1.Yes	2. No
2) Dress up	1.Yes	2. No
3) Sport	1.Yes	2. No
4) Reading habit	1.Yes	2. No
5) Dance	1.Yes	2. No
6) Others	1.Yes	2. No

3.17 Have you seen any changes in your household members after SHPP development?

1) In fashion	1.Yes	2. No
2) In behavior	1.Yes	2. No
3) In thinking	1.Yes	2. No
4) Others	1.Yes	2. No

3.18 What is the impact of SHPP in infrastructural development?

Positive……

Negative……

3.19 Is there regularity in the electricity distribution?

1. Yes

2. No

3.20 Are you satisfied with the way SHPP is working?

1. Very satisfied
2. Satisfied
3. Neutral
4. Non-satisfied

3.21 What is the impact of SHPP in no. of livestock?

Livestock	Before	After
1. Cow	……	……..
2. Buffalo	……	……..
3. Goat	…….....	……..
4. Ox	……	……..

3.22 What is the impact of SHPP in children playing area?

Positive ……

Negative ……..

3.23 What should be done for the sustainability of the project?

From government side …….

From user side……

From developer side……..

3.24 Is there any change in the flow of river water after the development of SHPP?

1. Yes
2. No

3.25 What is the impact of SHPP in Environment?

Positive……

Negative……

APPENDIX- II

Questionnaire for the owners/company's share holder

1. What is the total estimated cost of the HP?

   ……

2. What is the total installation cost of the HP?

   ……..

3. Which company has been involved in establishing this HP?

   ……

4. Is the project constructed in private or public area?

   ……

   i) If it is private how much rent is paid?

   ……

5. Are any banks involved in financing the project?

   a) Yes b) No

6. How many banks are involved in financing the project?

   ……

7. How much money is financed by the bank?

Bank	Money
……	…….
……	……..
……	……..
…….	……...

8. How much money is financed by the company itself?

   ……

9. Is this project involved in the development of the society?

   a) Yes b) No

   i) If it is involved then what it has done?

   ……

   ……

……

10. How many employees are involved in this project?

    …….

11. Are the locals given priority? If then how many are locals?

    …….

12. Has this project started any program to conserve the environment of surrounding area?

    a) Yes b) No

13. What is the yearly income of the project?

    …….

14. How much tax is paid to the government by this project?

    ……..

Thank You

APPENDIX- III

Questionnaire for the school management

1. What was the total number of student in the school before SHPP?

   …….

2. What is the total number of student in the school after SHPP?

   …….

3. Is the condition of school improved after SHPP?

   a) Yes b) No

4. What are the improvements done by SHPP? And how much money have they invested?

Work	Money Invested
……	……..
……	..……
……	……..
……	……...

5. Is there any improvement in the performance of the student after SHPP?

   a) Yes b) No

6. How much area of the school is utilized by the SHPP and how much rent does it pay yearly?

   ……

7. For what purpose that money is utilized?

   …….

   …….

   …….

8. What are the positive and negative impact of SHPP in school and education?

Positive	Negative
.....	.....
.....	.....
.....	.....
.....	.....

APPENDIX- IV

Trend Value analysis of Yearly Total Electric Energy Generation from SHPP

Year	Electric Energy Connected to NEA Grid(Y)	X	X^2	XY	Y=a+bX
2069	22251560	1	1	22251560	24003668.8
2070	29058930	2	4	58117860	26083595.6
2071	27469180	3	9	82407540	28163522.4
2072	29714566	4	16	118858264	30243449.2
N=4	$\sum Y$ =108494236	$\sum X$ =10	$\sum X^2$ =30	$\sum XY$ =281635224	

Where a=21923742 and b=2079926.8

Y=21923742+2079926.8X

APPENDIX- V

Trend Value analysis of Yearly Revenue of SHPP

Year (B.S)	**Revenue received from NEA**	**X**	**X^2**	**XY**	**Trend value of Income**
2069	130992369	1	1	130992369	134470751.22
2070	151360872.4	2	4	302721744.8	148268697.24
2071	166317439.6	3	9	498952318.8	162066643.26
2072	172000000	4	16	688000000	175864589.28
N=4	$\sum Y$ =620670681	$\sum X$ =10	$\sum X^2$ =30	$\sum XY$ =1620666432.6	

Where a=120672805.2 and b=13797946.02

Y=120672805.2 +13797946.02X

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