

Chapter One

Introduction

1.1 Background of the Study

Nepal is a country on the south Asia located between two huge countries China and India having total area of 147,180 km² with an estimated population of 30 million. According to new constitution of Nepal 2072 Nepal is divided into 7 provinces, 77 districts, 753 total local levels (293 municipalities and 460 rural municipalities). Out of the total population about 80 percent people live in rural and remote area and about 66 percent economically active people depend on agriculture (Economic Survey 2014/15).

Nepal is one of richest country of the world in the context of hydroresources. Nepal has about 6000 large and small rivers hurling from the Himalayas and high mountains towards the plain and Terai (WECS, 2004). The perennial nature of Nepali river and stepped grand of the country topography provided ideal condition for the development of some of the world's largest hydropower project in Nepal. The estimated theoretical power potential is approximately 83,000 MW. However, the economically feasible potential has been evaluated at approximately 42,000 MW. Nepal has generated about 1004.839 MW hydropower which is 2.33 percent out of such huge potentiality.

Energy can be generated from running water through the use of turbine, which can be used as mechanical power, this is known as hydropower. Hydro-projects that generates small amount of mechanical or electrical power up to 100 KW are called micro-hydro power. Generally, the projects are classified on the basis of amount of power produced into large, medium, small and micro-hydro. In Nepal, project up to 100 KW capacities are classified as micro-hydro project.

Hydro is an indigenous and renewable sources of energy. Micro hydropower (MHP) is more renewable, pollution free, reliable sources of energy which is easily available in mountain and hillside of Nepal. So, it is the best alternative

among all the available energy in the context of Nepal. Pharping Hydro power was the first plant installed way back in 1911 as Chandra Jyoti Hydro-electric power station capacity of 500 KW. In 1962 a first modern MHP was installed in the country. Nepal government have given priority to promote alternative renewable energy and given subsidies to those projects. By 1985, the Agriculture Development Bank of Nepal (ADB/N) devised 75 percent subsidy for the cost of electrical components for remote areas, and 50 percent subsidy for non remote areas to encourage development of these aids on the electric scheme as well as MHP. In 1997 Alternative energy promotion center (AEPC) was established for the reformation of the government subsidy policy.

The government policy is to give priority to expansion of the energy power through installation of small and micro hydro power (MHP) in the rural area. Therefore, MHP is the best option to improve life style of rural people as a modern technology. The size of micro hydro power scheme permit has concerned with local villagers involving in the full range of activities, from initiation and implementation to operation, maintains and management while villagers contribute to the labor and local materials.

Due to the unique geography with scattered settlements, the national grid electricity expansion has difficult. So, the electrification through micro hydro is suitable and cost effective also. Nepal is one of those country having very low per capita energy consumption.

Due to lack of access to other commercial sources of energy, the country relies heavily on traditional biomass energy sources including firewood, agricultural residues, and animal dung. Shortage of energy negatively impacts economic development by suppressing agricultural productivity, environmental sustainability, health care, education and job creation. This specifically affects poor and rural households as they spend a large part of their income and time fulfilling their basic energy needs. Households that spend 10 percent to 30 percent of their income on energy expenses are considered “energy poor”.

According to this classification, 80 percent of Nepali households are energy poor (Mini And Micro Hydro Power Applications 2015).

Development of MHP has become crucial to increase energy access for better overall development, poverty reduction and shared prosperity. Micro hydropower can substantially improve the rural economy. MHPs have been serving off-grid rural households in the hilly regions since they were introduced in Nepal in the 1960s.

According to the population census 2068, 67 percent of the country's populations have accessibility to electricity and the 'Least Developed Countries report 2017: Transformational Energy Access', by UN Conference on Trade And Development (UNCTAD), shows 84.9 percent of population in Nepal has access to electricity. Due to the consciousness about the negative environmental and socio-economic impact of traditional energy, commercial fuel and inaccessibility to invest on large-scale hydropower development, electrification through MHP emerges as available alternative for rural electrification in Nepal. The two-third land of Nepal is hilly and mountains region and 85 percent area of the country still rural. So, special rural electrification scheme need to be adopted to electrify such region. Due to the unique geography with scattered settlements, the national grid electricity expansion has difficulties. Electrification through micro hydro and mini-hydro project is the best alternative for rural area of Nepal. This is the viable option for small communities in the rural areas of hilly region as it can be established by the small investment, expert, and equipment. It is the foundation to raise the living standard of the rural people in multiple aspects such as economic, social, health, education and income level if it is properly used. So, this study focuses on the impact of micro hydro power upon the livelihood of people under KulpaSanguraKholamHP, Rolpa district.

1.2 Statement of the Problem

Nepal, one of the poorest countries in the world, having very low per capita energy consumption. Due to lack of access to other commercial sources of energy, the country relies heavily on traditional sources of energy. Shortage of energy impacts economic development by suppressing agricultural productivity, environmental sustainability, health care, education and job creation. This specifically affects poor and rural households as they spend a large part of their income and time fulfilling their basic energy needs. Economic Survey 2017/18 shows 3 families out of every 10 families of rural areas of Nepal are forced to stay in darkness due to lack of electricity supply. According to the Sustainable Development Goal, by 2030, investment must be focused to increase the share of renewable/alternative energy in order to double the improvement rate of global energy efficiency.

Most part of Nepal is hilly and mountains region and 85 percent area of the country still rural. Here are innumerable hills, peaks, mountains and plain area. Because of the diverse features of hilly and mountains regions, which are sloppy and many rivers and rivulets flow forcibly from mountains to Terai regions. So, the hydropower energy is most feasible and best energy sources. But due to the unique geography with scattered settlements, the national grid electricity expansion has difficulties. So electrification through micro hydro and mini-hydro project is the best alternative for rural area of Nepal. This is the best option for small communities in the rural areas of hilly region as it can be established by the small investment, expert, and equipment. There is plenty of scope for smaller groups of users to benefit from local micro-hydro projects. With thousands of small rivers and streams, there is vast scope for extracting clean energy from one of the planet's most naturally abundant resources. And if used carefully and at a small scale level, there is far less chance of local ecosystem being damaged. It is the foundation to raise the living standard of the rural people in multiple aspects such as economic, social, health, education and income level. This study focusses on what is the outcome of MHPs and what changes MHPs brought on rural livelihoods of Nepal. This study specifically seeks the answer of following questions:

1. How the MHP has been helping to households to make their daily life easy?
2. What is the economic impact of micro hydropower projects?
3. What changes the MHP has brought in social aspects of rural livelihoods?

1.3 Objective of the Study

The general objective of this study is to analyze the socio – economic impact of micro hydropower project on rural livelihoods. But the specific objectives of the study are as below:

1. To examine the economic impact of KulpaSanguraKholaMicro Hydropower Project in study area.
2. To find out the changes in social aspects brought by the MHP in study area.

1.4 Significance of the study

Nepal is very rich in water resources however lack of appropriate policy, due to the political instability and unable to funding, it is not utilized properly. Due to thegrowing scarcity and cost of non-renewable energy sources, search for alternative energy sources is prominent. In this context, many projects have been operated. Nepal government as well as many NGOshave been helping local communities to set up their micro-hydro plants, which are generally inexpensive to set up and low-cost to maintain once the technology is in place. Access to light, heating, cooking, and washing facilities through reliable electricity, business can operate beyond daylight hours, and a new wave of micro-enterprises has been able to set up as a result. This is bringing sustainable employment, proving just how powerful and broad the benefits of sustainable clean energy can be, particularly in place where centralized energy infrastructure is poor. MHP can play vital role to raise the socio-economic status of rural livelihoods by utilizing their own skill, labor, and resources. In fact to improve the living standard of the rural people by establishing the small

cottage industry, wood industry, cellar mill and communication development, microhydroelectricity become the milestone for these tasks. It helps to uplift the socio economic condition and consciousness through the use of technology of rural people.

But how far the projects are succeeding in terms of end-use-efficiency, how far its effect for the uplift in the life of rural poor, how far the projects is succeeding in terms of overall socio-economic uplift of the rural people in their perception are leading issues that have been tried to access by this study. The study will be useful in different sectors for the study regarding role of MHPs for socio – economic changes in rural livelihoods. This study will be helpful to decision makers, project implementers in order to develop further strategy to support rural peoples. It is hoped that the findings of this study will be key to further researcher regarding socio-economic impacts of MHPs on rural livelihoods and also helpful to the working committee of KulpaSanguraKhola MHP as well to evaluate their functions and outputs.

1.5 Limitations of the Study

This study is mainly for the academic purpose based on information from secondary data and field survey has certain limitation. The budget, manpower, theoretical and methodological limitation during research has been prevailed for the thesis work carried out by student. This study has the following limitations:

1. The study is only limited to the KulpaSanguraKhola Micro Hydropower project, since the outcome is specific one and cannot be generalized.
2. Only the people of project area have been included in the study.

The impacts occurred by the MHP is the derivation of numerous social, economic and environmental effects. Thus the study has been limited only social and economic perspective. Moreover, the social indicators are less factual which had made some difficulties to analyze social impacts and pre-

electrification information has been depended on the user groups saying and other secondary information.

1.6 Organization of the Study

The chapter one deals with introduction which includes background of the study, statements of the problem, objectives of the study, significance of the study, limitation of the study and organization of the study. Chapter two contains review of the literature. Chapter three deals with research methodology. This includes rationale for selection of study area, research design, nature and source of data for this study, sampling procedure, data collection techniques and tools, instruments of data collection and data processing and method of data analysis procedures.

Chapter Two

Review of Literature

A literature review discusses published information in a particular subject area, and sometimes information in a particular subject area within a time period. A literature review can be just a simple summary of the sources, but it usually has an organizational pattern and combines both summary and synthesis. A literature review is a text of a scholarly paper, which includes the current knowledge including substantive findings, as well as theoretical and methodological contributions to a particular topic. Literature reviews use secondary sources, and do not report new or original experimental work.

A critical review of the literature helps the researcher to develop a thorough understanding and insight into previous research works that relates to the present study. The primary purpose of literature is to learn and it helps researcher to find out what research studies have been conducted in one's chosen field of study, and what remain to be done (Poudyal, Basnet and Pant, 2069). Researcher uses different books, journals, abstracts, indexes, report, and different research studies published by various institutions, encyclopedia etc. Literature review is divided into two headings such as; Theoretical review and Empirical review.

Micro-hydropower is a promising decentralized renewable technology and its impact on rural livelihoods. Electricity generated from running water through the use of turbine is known as hydropower. Hydro-projects that generated small amount of mechanical or electrical power up to 100 KW are called micro-hydro power. Generally, the projects are classified on the basis of amount of power

produced into large, medium, small and microhydro. In Nepal, project up to 100 KW capacities are classified as micro-hydro project.

Limited research has been conducted on energy, economic impacts of micro-hydropower scheme projects. There are many studies in other sector of micro-hydro projects. Generally, the studies on medium and large, small and micro-scale hydropower projects have been conducted to identify various types of impacts created by the rural development of micro-hydropower projects. Many specialists and authors discussed about the Micro-hydropower projects in different researches and journals. Micro-hydro project is the feasible and cost effective plant which can generate the multiple opportunities for rural poorest communities and the peoples. MHP generates energy from small rivers, rivulets. This chapter provides the review of both national and international study published on different books and journal.

Rijal (1994) has analyzed the scope of micro hydro in Nepal. There is immense potential for the development of mini-micro hydropower in Nepal with 6,000 rivers and streams criss-crossing its mountainous terrain. Mini and Micro Hydropower (MMH) schemes combine the advantages of large hydro plants, on the one hand, and decentralized power supply, as with diesel sets, on the other. They do not have many of the disadvantages, such as costly transmission and environmental problems, of large hydro plants and dependence on imported fuel and need for highly skilled maintenance personnel, as in the case of diesel plants. Moreover, harnessing small hydro resources, being decentralized, lead to decentralized use and local implementation and management, thereby making rural development possible through self-reliance and the use of local natural resources. The scattered settlement patterns in the hills and mountains of Nepal, MMHP, is one of the viable option for providing energy to the rural hill areas by decentralized energy system, which exploits the indigenous energy resources base and knowledge system by appropriate integration local management skills. It help to generate employment opportunity and reduced electricity tariff, help to increase the living standards

and awareness of rural people as well as help to rectify the ecological imbalance. It substitutes the fuel wood for cooking and in the commercial, residential sector and agro-based rural cottage industries. It also helps to reduce of human drudgery, especially of women, by substituting manual agro-processing. Likewise, to increase in income generation activities MHP plays significant role. Similarly, it helps to reduce emission of oxides of carbon as well as the rate of deforestation.

Junejo (1994) has examined that Mini and Micro Hydropower (MMH) is the best energy sources for electrification in the rural area of the Hindu Kush-Himalayan Region (Afghanistan, Pakistan, India, Nepal, China, Bhutan, Bangladesh, and Myanmar). The plight of the people can be alleviated only through socio-economic development of the region. To run the economy in progressive way energy is the basic foundation. Electrification to the rural area, micro hydro is cost effective, pollution free, environmentally protectable, suitable for decentralization, best for stimulate the local economy. The small scale hydropower in the HKH range has comparative advantages, it over large hydropower. Its appropriateness integrated with rural development is an important one. It is possible to develop MMHP as decentralized systems. They are simple in design, can be installed quickly, and are easier to manage and operate. Unfortunately, only a small portion of the MMHP potential utilized in the Hindu-Kush Himalayan (HKH) region, where rapid development of a cheap and non-polluting source of energy to meet the challenges of development and a deteriorating environment are warranted.

Hora (1994) explains that among the alternative energies more popular and available, continuously renewable, non-polluting, efficient widely distributed and based on simple as well as flexible energy sources is micro-hydropower (MHP) in Nepal. It is technically feasible as well as economically viable and the most appropriate technology for Nepal indeed. Although micro-hydropower projects are not sufficient to meet the national demand of electricity, due to lack of large economic investment, technology and skilled

manpower to install large-scale hydropower project, small scale hydropower projects can play very important role in uplifting socio – economic status of rural livelihoods.

ITDG (1997) report says that the MHPs have impacted on the behavioral pattern of the people, particularly their perception of business. In Ghandruk the impact is more prominent on tourism and hotel business, while in Barpark, it is more prominent on industrial establishment. However, in both villages the people strongly believed that only their entrepreneurial. ITDG further says that because of instillation of MHP, female role has changed in both villages. There is a more role sharing in business undertaking between male and female than in their household activities. The process of empowering both male and female alike has yet long way to go. Life style has also changed by increase of electricity such as use of Radio/cassette player, TV, Video in the villages. With their use, people have been exposed to modern songs, dance and films. This has given the younger generation man and women, boys and girls are testing their choices for new fashion design and readymade garments. Females have own their organization for a new role and responsibility with community base organization like AmaSamuh to preserve and promote the indigenous culture. In the both villages, the discrimination of resources and opportunities is uneven.

Study says that the users observed the positives effectiveness of electricity use on their health habits and overall sanitation of villages. The report adds that electricity has improved the reading habit of children. In the former case, the school teachers reported that the pass percentage is high in school results. The boarding school in the Ghundruk, it has observed used electricity to teach music to the students.

Rijal (1999) says that traditional energy forms predominate in the energy sector in Nepal. About 91 percent of the total final energy consumption (260 million GJ) in 1994/95 was met by traditional forms of energy such as fuel wood 81 percent, agricultural residues 4 percent and animal waste 6 percent, the rest

came from commercial resources such as petroleum products 7 percent, coal 1 percent and electricity 1 percent. There has been little change in energy transformation over the last decade. The share of traditional energy has declined only marginally, from about 95 percent in 1984/85 to 91 percent in 1994/95.

Khennas & Barnett (2000) have said, a major theme in the development of micro-hydro technology has been the huge effort put forth in participative approaches to create, nurture and capacitate communities to build, own and operate micro-hydroplants. This theme has resonated throughout countries that now employ community-based micro-hydro projects. In Pakistan, the Aga Khan Rural Support Programme (AKRSP) has established 28 micro-hydro plants for research.

A micro-hydro project implemented by the Mallanadu Development Society (NGO), in the village of Thulappaly in the western Indian state of Kerala, has also been successful with regard to its environmental benefits, capacity development, reduced community drudgery, and improved opportunities for education. For this project, community involvement was the main factor that led to success, with the local residents feeling a high degree of ownership toward the project.

ITDG (2002) describes about different kinds of aspects of strategies for the livelihood which shows change of social, cultural, financial and human assets at the related project. The villagers worked very hard, co-operating well, during the MHP installation. This has served to greatly increase social unity. Moreover, the experience of working closely together on the project has made people aware of the potential benefits. Due to improved unity, there has been increasing in mutual help among the community members. Personal conflict and personality clashes among the group members are often resolved in meeting and group decisions are respected. The villagers have increased access to outside news from Radio and T.V. sets. They feel more entertaining, comfortable and happy life, they are patently better informed. The advent of

electricity has had a pronounced effect on the cultural and spiritual life of the village. Previously, villagers had not sufficient time to perform ritual as often as they would have liked. The day light were taken up with agriculture work. The prospect of gathering in evening for ill-lit events was often inconvenient and uninviting. Study has shown that after the installation of MHP, villagers feel easy and comfortable engaging in cultural activities under the electric light. Despite the arrival of modern entertainment TV, Radio, Video, Keyboards etc. villagers claim that have not forsaken traditional activities. They still organize folk dance, singing and outdoor games.

Kim and Karky (2003) explain that removing smoking from traditional cooking fire or use of kerosene through the using of electricity is better for health. Using electricity to power mill oil presses, husking machines and other agro-processing units reduce drudgery and save time. Time and drudgery are also saved by not having to collect fire wood, which taken even longer with increased deforestation. Good quality lighting allows later working hours and increased study time for children. Radio and television allow access to information. They add that electricity generation should not be just for consumption, but also for production. Income generating from electricity is important for continued financial sustainability. They compared to Chhomring where over half of electricity is use to generate income through the tourist lodges, skill and one wood-finishing machine. They focus also that using of electricity should be expanded to include more productive income generating activities.

Saud (2005) explains that over 50 percent of population lives in hill and mountain regions of the country. They scatter over several mountain and this lands are vulnerable and less productive for cultivation. Rural villagers have been left behind: no electricity, no toilet, no paved roads, no health service and better education and no chance to spend better life. Due to the lack of electricity, they have to wake up of sunrise and sleep with sun set. So, author further says that the installation of micro hydro power is necessary to solve

these problems. According to him, hydro-power plays crucial role for the sustainable development and progress in socio-economic growth. His argument is that installation of micro hydro plant is suit scheme for the alleviation of poverty in rural level, because it is a major renewable source and this widely seen as means of reducing foreign exchange payment for the imported energy and fuels. By providing investment opportunities for local entrepreneurs and communities, private sector. MHP installation can be contributed to the local economy for subsistence daily life, to rural institution building and to the dissemination of technical and managerial skills.

Adhikari (2006) insists, in the present global scenario where the oil prices are remaining higher and future provides an uncertain outlook with respect to oil, optimal utilization of the abundant natural endowment, viz., hydropower, would reduce Nepal's import cost substantially, contribute in improving the relative competitiveness of the economy both on a regional and global basis, and fulfill the desire of double-digit sustainable growth in the coming decades and argues that as a cheap, renewable source of energy with negligible environmental impacts, small hydropower has an important role to play in Nepal's future energy supply. Micro-hydro systems are particularly suitable for power supplies in rural and isolated communities, as an economic alternative to extending the electricity grid. These systems provide a source of cheap, independent and continuous power, without degrading the environment, so essential for a mountainous and environmentally fragile country like Nepal.

Koirala (2007) has explained about the contribution of micro hydro in reducing the fuel wood consumption. A policy recommendation for the promotion of micro hydro in the rural areas of Nepal is ensued. Study shows that communities are more inclined to harvest fuel wood from government forest, which is another crucial finding for policy recommendation. He found that after the installations of MHP children have significantly less intensity to go for fuel wood collection and MHP provides light at night for study so that children can spend their nighttime on study. Nepal is dominated by patriarchal cultural, men

want more household work done by female. So, MHP can't significantly change the women drudgery but it helps to reduce the female workload in rural Nepal.

Important finding of his study on income side, he explained that the MHP has positive impact on income. The study discovers that the micro hydro has multidimensional positive impacts on socio-economic development. With the given socio-economic conditions, topographical variations and available technical feasibility, the study finds that the micro hydro is a promising technology for rural development in Nepal.

Ghimire (2008) provides insight on hydropower development in general and mini-scale hydro power in particular, for rural electrification in Nepal. It also analyses the opportunities and challenges in the development of mini-scale hydropower to supply reliable electricity in remote rural areas of the country as an aid to poverty reduction and economic progress. To alleviate the misery of the rural people and to raise their minimum living standards, a supply of adequate and reliable electricity is essential. Due to the unique operating characteristics of hydropower plants, reliability and stability of power grid can be achieved. For economic and social development, a dependable supply of electricity is a necessity. Apart from hydropower, no other natural resources in economically exploitable quantities are available in the country that can boost economic prosperity and raise the living standards of the people.

Further, he explained that electrification may not be a big problem where the national grid can be extended economically. So, the group of interconnected mini-hydropower plants seems to be a viable proposition for the total electrification of the country. But, with its limited technical ability and financial resources, Nepal even is not in a good position to construct mini-scale hydropower plants and establish local grids in all remote hilly areas of Nepal. So, the government of Nepal should create a conducive environment for foreign assistance and should request developed countries of the world to offset investment under carbon swaps and clean development mechanisms. Acquired

experiences and technological as well as managerial achievements in this sector can be one of the agendas for mutual cooperation among the SAARC countries. Nepal also can benefit from friendly countries of the SAARC region that have experience in the field of larger hydropower schemes.

Korkeakoski (2009) has examined the long term impacts of renewable energy from micro-hydropower on poverty reduction. The main objectives of the study are: to examine the short term and long term impacts of electrification on rural livelihoods and to find out the villagers experiences from electricity and impacts related to electrification.

The study has found that people have felt better and wanted to develop themselves and their surroundings, social status has increased with the introduction of electricity and electrical devices; electricity has enabled access to information and learning and made communication easier within and outside the community. Women and children have less workload, more productive time and choices when to work, improved status and safety after the electrification. Children have more choices when to study, studying is easier and they have become smarter and more active. Electricity has created choices when to work and given people more productive time especially in the evening and mornings. Electricity has enabled increase in income through new livelihood activities and by making old likelihood activities carried out easier and quicker, workload and working time have decreased for all. Life has become more convenient, healthy and safe. People have been spending more time on watching TV, interaction amongst the community members has lessened and cultural ways of dressing, singing and living have changed especially amongst teenager. Community life has benefited from electrical devices such as karaoke sets, TVs, CDs etc.

Further, the micro hydropower dam has not have negative impacts, but the introduction of electricity has encouraged more people to move into the village, thereby causing less forest resources animals, plan and fish available and reduction in water quality. Electrification has not improved access to health and

educational facilities: it has not improved access to markets of banking facilities, but has been helpful in preparing products for markets. Access to information and knowledge has improved. Access to new activities and income generation has also improved.

Gurung, A., Ian, B., & Oh, S.E. (2011) have stated that Nepal, one of the poorest country in the world, is characterized by very low per capita energy consumption. Due to lack of access to other commercial sources of energy, the country relies heavily on the traditional biomass energy sources including firewood, agricultural residues, and animal dung. In recent years, Nepal's government has initiated the production and distribution of several renewable energy technologies in order to solve the energy problem in rural areas as well as to provide clean and sustainable energy for rural households. Among several renewable technologies, micro-hydropower (MHP) has been one of the most promising and commonly adopted decentralized (off-grids) technologies in Nepal. Improved health, environment, and agriculture are some of the major benefits to the users. It reduces drudgery for women by increasing access to modern agro-processing mills in rural areas, and can save enough time that can be used for other household activities. Similarly, electric lights in rural households extended the day providing additional hours for evening reading to students. In addition, it provides economic benefit to the country through reduced deforestation. Thus, MHP technology provides a renewable, sustainable and clean source of energy to poor rural households in Nepal.

Joshi (2011) has mentioned that energy is important for economic development. The pace of economic development. The pace of economic development cannot be accelerate 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 fulfil 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 deterioration of water resources and hampers both electricity generation and drinking water. The utilization of energy is concerted on urban areas and most of the rural areas have been by passed by this power development. The hydropower project has brought about change in socio-economic, cultural and other aspects of people living in the project located.

Miyoshi, Raghuvanshi and Camarao (2011) analyze that micro – hydropower plants serve as a move to greener environment. They use the power of running – water in generating electricity. They are introduced and used in developing countries to reduce carbon emissions and other greenhouse gases. Moreover, they are the source of electrification in rural areas in countries like Nepal. Their presence develops and improves the socio – economic aspects of every household in rural areas. With electricity in place people start to engage in different economic activities such as business and industries emerge. And, villagers start owning essential household appliances.

However, in the case of the Daunekhola micro – hydropower plant, the benefits of having a hydropower plant is hard to recognize because the community cannot sustain the maintenance of the plant. Given that the annual revenues both from residential and industrial usage cannot cover the annual total running cost. And since the demand for the electricity is highly inelastic, increasing the price or tariff on kilowatt per hour would only burden the villagers by making them pay a higher tariff as well as making their agricultural products expensive. Thus, the best way is for the government to give subsidies and grant in order to help the community meets the operational and maintenance cost of the plant. Furthermore, other industrial use such as micro – enterprises and small cottage industries should also be promoted aside from the existing use on huller and oil expeller and of household lighting purpose only. In support to

this, the government through the help of non- governmental organizations (NGOs) should conduct livelihood seminars and trainings in order for the community to venture to small cottage industries or businesses. This is to take advantage of having electricity during the day that would promote and enhance. Economic activities and thereby generate additional revenues for each household and community as a whole. With this, the community will be self – sufficient and need not to depend on government subsidies in the future

SamuhikAbhiyan(2011) conclude that mini grid is not only a major source of electricity in rural areas but also has a positive impact on various socio economic variables. The acquisition and use of physical assets such as electronic appliances has increased access to information. Findings suggest increase in livestock income and income from small business. Electrification has improved educational outcomes of children. Both direct and indirect health benefits are seen as a result of electrification. The empowerment of women is yet another impact of electrification, which is vital in ensuring that the development path of the communities encompasses gender equality.

Community has gained a new sense of optimism for their future as result of the entire process of micro hydro installation and mini grid electrification. Through this new found optimism, and in combination with better outcomes in the area of access to information, education, health and income electrification has in turn improved rural livelihoods as a whole. With contribution to such critical aspects of human life, it is reasonable to conclude that mini grid electrification has improved the living standard of the people in rural areas and has played a vital role in the development effort.

Shrestha (2012) says Electricity is a crucial element in fostering local development. Micro hydropower stations, a form of Appropriate Technology, have allowed poorer regions of the world to transform their lives by using a piece of technology that is suited to their needs. This study argues that electricity from micro hydropower plants have had significant impact in terms of altering the life habits of households in the research sites but the impact on

entrepreneurship is minimal. Micro hydropower plants that rely on fast-flowing streams with minimum infrastructure and small investments, compared to large power plants that require large sums of capital and have major impact on the environment, have been able to meet some of the energy needs of hundreds of rural communities throughout the mountains of Nepal.

AEPC (2012) report explains since Micro Hydro Schemes are targeted in the areas where national grid is not available these schemes have mainly benefited rural population. It acts as an alternative means of electrifying the rural villages instead of waiting for the extension of national grid. Besides electrification, promotion of small business in the village is another main objective of the program which has helped to generate income through small business in rural areas and that has helped to reduce the poverty. Micro Hydro Scheme has generated employment in two ways. First, few people are employed by the scheme itself as staff such as manager, operator etc. Secondly, end-use induced after the MHS has also generated employment opportunity in the villages. A study (Impact of mini grid electrification: AEPC: 2011) has shown positive impact of mini-grid on number of socio economic areas like health, education, access to information, income etc. So, higher income, better health, improvement in educational outcomes, better ways of accessing information, replacement of kerosene have led the rural livelihoods to the better life.

Techno-Socio-Economic Study of Baglung Mini Grid (2013) concludes that formation of the Mini Grid Network through the interconnection of nearby isolated Micro Hydro Plant can be the best method of solving the various issues of standalone MHP. Affordable and reliable supply to the rural communities of Nepal can be given through the construction of such local grids. Implementation of Baglung Mini grid opens the floor for the construction of such community managed projects. In a given context, such projects require suitable choice of technologies and implementation strategies right from the design stage. Mini Grid project has resulted much positive impact regarding

technical, economic and social aspects to the localities in the short period of implementation.

Dahal and Shrestha (2014) have discussed, since energy is widely needed for almost all human activities, it is necessary to make a balance of pros and cons related with hydropower generation. No universal recipe can be here established, since regional peculiarities will play a striking role in the decision process. In the case of Nepal micro-hydropower is essential in rural area. More than 27 MW power is generating from micro-hydropower of Nepal and going on progress for more MW power. The benefits of rural electrification are incontestable, especially for the enhancement of rural people's livelihood. Evidence from other developing countries reveal that access to electricity in combination with simultaneous access to markets and other infrastructure has contributed to growth of rural areas in clear and compelling ways.

World Bank Group (2015) report shows Nepal is one of those country having very low per capita energy consumption. Households that spend 10 percent to 30 percent of their income on energy expenses are considered "energy poor". According to this classification, 80 percent of Nepali households are energy poor. Due to lack of access to other commercial sources of energy, the country relies heavily on traditional biomass energy sources including firewood, agricultural residues, and animal dung. Shortage of energy negatively impacts economic development by suppressing agricultural productivity, environmental sustainability, health care, education and job creation. This specifically affects poor and rural households as they spend a large part of their income and time fulfilling their basic energy needs.

Development of renewable energy technologies (RETs), both on-grid and off-grid, has become crucial to increase energy access (including electricity) for better overall development, poverty reduction and shared prosperity. Isolated RETs such as micro hydropower, solar photovoltaic (SPV) and biogas can substantially improve the rural economy. Specifically, micro hydropower plants

(MHPs) have been serving off-grid rural households in the hilly regions since they were introduced in Nepal in the 1960s.

Siuthani (2016) concludes that lower scale MHP might be most useful in rural and remote areas of our country. There is sufficient feasibility of such types of lower scale MHP. Installation of MHP has increased in income and employment by helping in the establishment of new businesses. Also availability of electricity has reduced the expenditure on different energy sources like: firewood, kerosene etc. So, it can be a less expensive source of energy in the rural area. Health condition also has been improved. People get access to modern medical equipment due to electricity. Education habit of children in study area has been improved as well. It is found that less use of traditional energy like firewood installation of MHP has helped to conserve the community forest, status of sanitation has improved which means MHP is very essential from environmental perspective as well. MHP has significantly improved the living standard of rural people.

CBS: Economic Survey (2017) shows, by the time, 3 families out of every 10 families of rural areas of Nepal are forced to stay in darkness due to lack of electricity supply. According to the Sustainable Development Goal, by 2030, investment must be focused to increase the share of renewable/alternative energy in order to double the improvement rate of global energy efficiency. So far 11 municipalities and 103 rural municipalities have no access to electricity from the national transmission grid. Alternative energy has been used in some areas of these municipalities and rural municipalities which are not linked to the National Grid.

About 18 percent of the total population have an access to electricity from the renewable energy sources. In addition, 31 percent of the population have utilized clean renewable energy for different purposes. For the first eight months of the FY 2017/18, 26.5 MW of renewable energy from solar and wind power plant and 30 MW of energy from micro and small hydropower project have been utilized as an alternative energy.

Kunwar (2018) has said, installation of MHP has brought many changes in rural lifestyle. Use of electric amenities has been significantly increased after the electricity. Traditional amenities have been replaced by modern one in the studied area. Actually, Radio user household are significantly decreased after electricity due to other means of communication in this way, television and computer user households have significantly increased compared to the past due to regular supply of electricity. Similar types of changes are also seen in the field of cassette player and mobile user households. Actually, mobile user households are high percent than other types of amenities. It means most of people have access over the communication due to regular efficiency power supply by project.

Even though low scale power project, it has been affected on all aspects that social, economic, education and cultural life are being affected. Specially, this types of project has made direct impact in livelihood of people. Children have cultivated reading habits and involve in reading and doing homework for long time. Unlike to past they are eager to learn something new. In the past they were relied on school education. Due to use of kerosene lamp and firewood with smoking, people were suffered from respiratory and eyes problem, especially children and female were suffered. But after installation of project, health of family members and their houses sanitation are improved under the quality light. Different local institutions and organization, skill development, animal husbandry, social issues have been significantly changing through the micro hydro project.

Research Gap

Different studies have been done in the national and international level regarding to Micro Hydropower Projects. By reviewing the literatures regarding Micro hydropower projects the researcher came to know that MHP is playing essential role to raise lifestyle of rural people. MHP has been proved as important factor to improve socio-economic conditions like education, health and sanitation, employment and income generation and living standard of rural livelihoods. Different researchers have done similar researches of different MHPs located in different rural part of Nepal but nobody has done research to analyze socio-economic impact of KulpaSanguraKhola Micro Hydropower Project on the people of project site which is a research gap for the researcher. This study helps to find out socio-economic changes on study area brought by the MHP.

Chapter: Three

Research Methodology

Methodology involves methods and techniques of data collection and analysis followed in the study. Methodology is also defined as a process of completing the study. It describes the steps carried out during the research work. It clarifies the concept and provides path to the study.

3.1 Rational of Selection of the Study Area

Pariwartan Rural Municipality is situated at northwest part of Rolpa district and the whole Rural municipality is still not connected to the national grid. Based on the nature of the study ward no. 3 and 6 of Pariwartan Rural Municipality of project area are selected for the study where most of the people are Magar, Chhetri, Dalit. KulpaSanguraKholamHP is playing vital role to enhance the earning capacity of people and also to uplift the living standard. KulpaSanguraKholamHP was installed by funding of AEPC, then DDC Rolpa, then VDC and WUPA in 2013 A.D. The site is suitable for the researcher to

find out the how MHPs changing the lifestyle of rural people economically as well as socially.

3.2 Research Design

This study is carried out on the basis of both the explanatory and descriptive research design. The study is focused on how MHPs play role to change socio – economic status of rural people. It has also tried to discover the economic activities and social changes of the people of the study area.

3.3 Nature and Source of Data

Data and information for this study was gathered from the field survey. However, information obtained from secondary source is also used for the research work. Primary data was collected through interview; questionnaire, observations etc. Thus, the primary data was collected from user households of the study area and MHP administration and secondary data was derived from different journals, reports, books, publications, universities and websites.

3.4 Sampling Procedures

The total number of user households affected by the project is 403 and out of the total number of user households 65 were picked up for the sampling using simple random sampling method to fulfill the purpose of the study. This research is based on the information collected from the sample households. Some people were selected for the key informant interviews, who were teacher, businessman, women, farmer, youth and so on.

3.5 Data Collection Techniques and Tools

Both quantitative and qualitative data were collected for the study from project affected area. To collect primary data and information questionnaire, field survey, key informant interviews and informal interviews were done.

3.5.1 Questionnaire

A comprehensively designed questionnaire was prepared and administered to the users in order to obtain required data. The respondents were requested to fill up questionnaire. To find out the respondent's attitude regarding the impact of MHP in different sectors like establishment of industries, direct job creation, electricity consumption pattern, uses of several electric instruments, income and employment condition in the village etc., Questions were provided them to fulfill in their own views.

3.5.2 Field Observation

Direct observation was also done in order to get additional information of the activities of people of study area. Observation was done on how the establishment of MHP enhancing to raise life standard of people of project area, how installation of MHP has brought changes in their life.

3.5.3 Key Informant Interview

Experts, scholars, educated person, users committee and administrative were the sources of key information in this survey. The sampled experts were interviewed with the help of unconstructed interview questions and their response was noted to collect the information about the project and its impact on the affected area.

3.5.4 Informal Interview

To get fact data Informal interactions with number of people of the project affected area was also made during study. The respondents were asked about the changes in day to day life of people before and after establishment of MHP.

3.6 Method of Data Analysis

Data or information collected has been processed scientifically. Data and Information were analyzed using computer software like excel as well as manually. Different tables and figures are prepared for different socio-economic variables. Statistical and mathematical operation, calculation and test have been carried out for quantitative information. Qualitative information has

been adopted in descriptive way. To present and visualize the collected information different diagrams, charts, and figures are prepared.

Chapter Four

Data Analysis And Presentation

This chapter analyzes the collected data and information for pursuing the objectives of the study and represents major finding of the study. First, it presents the brief introduction of KulpaSanguraKhola Micro Hydropower project site with demographic features. The second part deals with the analysis of impact of KulpaSanguraKhola Micro Hydropower Project on income and employment creation includes socio-economic profile of the user households.

4.1 Profile of Project Area

Rolpa is a hilly district of province 5 where the study area is located, surrounded by Pyuthan, Baglung, Salayan, Eastern Rukum and Dang and district headquarter is Liwang. According to the population census 2011

total area of district is 1,879 sq. km with the population of 2,24,506 where the population proportion is 54.1 and 45.9 percent female and male respectively. There are 10 local levels in the district and the project for this study is in Pariwartan rural municipality which is located in northern west of Rolpa.

Due to geographical difficulties and obstacles as well as lack of government priority less than one third household of the district are able to get electricity from national grid which clearly shows the very poor in modern energy consumption and how backward the district is. According to NEA Rolpa distribution center (2018) only 30 percent of district households are electrified through national grid of electricity. None of amongst 10 local levels even only Municipality of the district is fully electrified. Amongst 10 local levels only 7 of them: Rolpa municipality, Suwarnawati, Sunchhahari, Lungri, Runtigadhi, Triveni and Gangadev Rural Municipality are partially electrified through national grid and 3 other Pariwartan, Thabang and Madi Rural Municipality are still not connected to the national grid which shows very miserable condition of the Rolpa in electrification. But AEPC, REDP, NGOs have been working in many those rural villages isolated from national grid to provide renewable energy through like MHPs, Solar system etc. which are playing vital role for electricity access to raise the lifestyle of those rural livelihoods.

Pariwartan Rural Municipality which is still isolated from national grid is one amongst 10 local levels of Rolpa district where the MHP has been installed. KulpaSanguraKhola MHP which was installed in 2013 is in Pariwartan rural municipality- 3, Kewari. Total area of Pariwartan Rural municipality is 163 sq. km with the total population of 20,778. The total capacity of the plant is 60 Kw, ward no. 3 and 6 of Pariwartan Rural municipality and ward no. 6 and 7 of Gangadev rural municipality which consist of 738 households and 9 public institution are using the electricity generated from the MHP. Most of the households use electricity for lighting and watching TV. Some households have used for cooking purpose and some other installed small scales industries/firms. The plant is operating about 15 hours a day. Minimum fee for

using 6 unit of electricity is Rs 100, and for using above the minimum unit of electricity Rs.10 per unit is charged to both households and small scale industries.

Installation Cost of the MHP

The production capacity of KulpaSanguraKhola MHP is 60 KW was installed by the grant provided by AEPC, then VDC, WUPAP and then DDC. The total installation cost of this project is Rs 3,15,00,159 where AEPC had provided the grant of Rs2,76,76,572, then VDC had provided Rs 28,23,587, UPAP had provided Rs 6,00,000 and then DDC Rolpa had provided Rs. 4,00,000 and rest was contributed by the households as avolunteer. The total household users of this project is 738 and 9 public institutions. Users Committee has decided to charge Rs 25,000 forconnection to the households who volunteered or contributed to the project and Rs. 50,000 who did not volunteered or contributed nothing for the project installation.

4.2 Household Information of Project Affected Area

KholaKulpaSanguraMHP is installed in ward no. 3, Kewari of Pariwartan rural municipality. Along with ward no. 3, ward no. 6 of Pariwartan rural municipality and ward no. 6 and 7 of Gangadev rural municipality are electrified through the MHP. The total number of user household of the project is 738 but for this study ward no.3 and 6 of Pariwartan Rural Municipality have been selected which consists 403 households and out of that 65 households have been selectedas sample population by using simple random sampling for this survey.

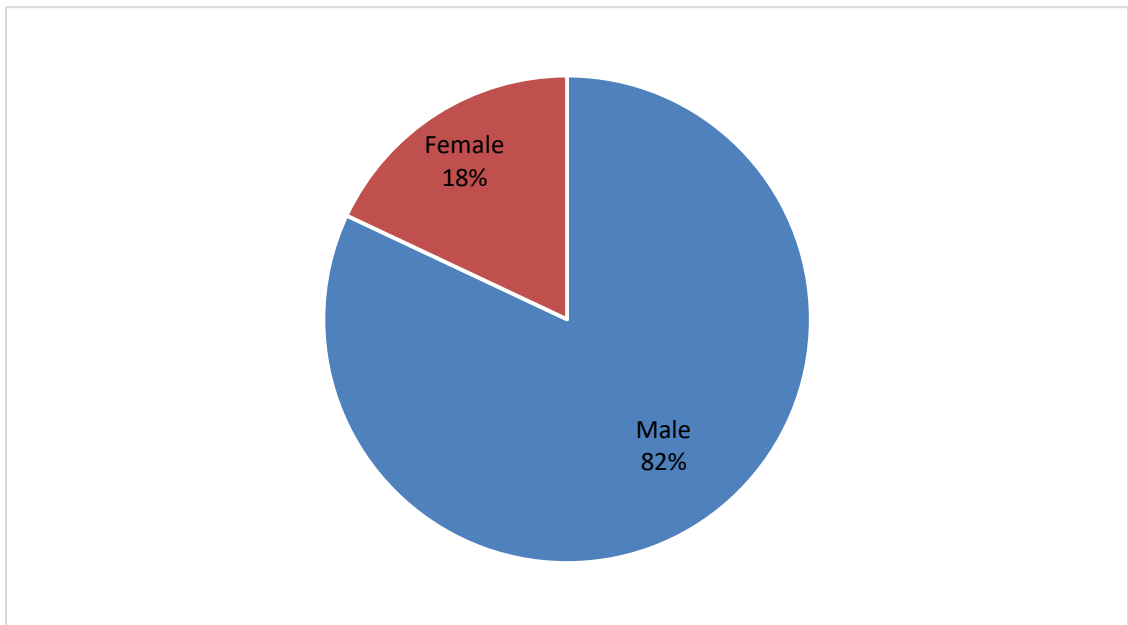
4.2.1 Gender Composition of the Respondents

There was a significant imbalance in the participant respondents regarding gender composition. Of the total sample size 82 percent were male respondent whereas only 18 percent were female. The population ratio of female is higher than the male but female respondents were fewer in numbers than male in this research because in many households male were head of the family, the society

is patriarchal also rural female are shy to interact with outsiders so male participation was larger number compared to female in this sampling process. The gender wise participation percentage of respondents of study area has presented in pie chart 4.1 below.

Figure 4.1

Participation Percentage of Respondent by Gender



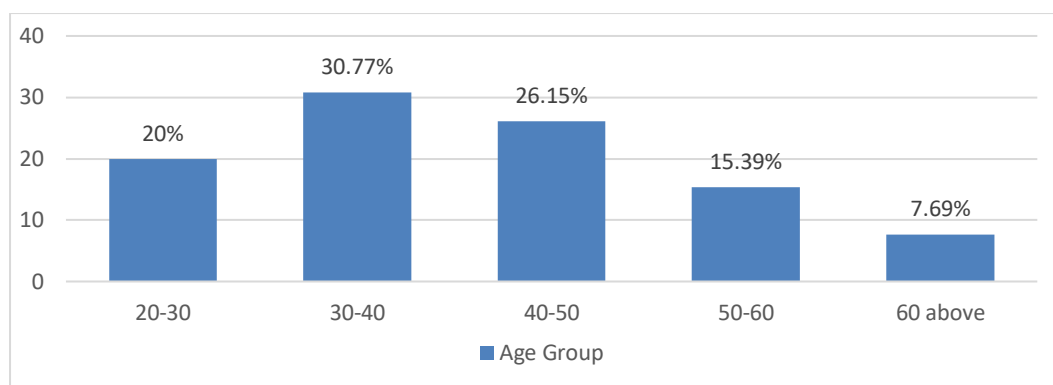
Source: Field Survey, 2018.

4.2.2 Age Group of Respondents

According to the age, the respondents were divided into four groups. The questions were asked to the respondents aging above 20 years. Then it divided into four groups as 20-30, 30-40, 40-50, 50-60 and above 60 which is shown in the chart below:

Figure 4.2

Age Group of Respondents



Source: Field Survey, 2018.

The figure 4.2 shows that, the high portion 30.77 percent respondents are from age group 30-40 and 26.15 percent are from 40-50. Similarly, from age groups 20-30, 50-60 and above 60 are 20 percent, 15.39 percent and 7.69 percent respectively.

4.2.3 Caste of Survey Households

Multi-caste is the feature of the society of study area where people belong different caste like Magar, Chhetri and Dalits. Although most of the people are from Magar in the district as well as in the whole rural municipality, Chhetris are in dominant position than other caste in project affected area. Nepali language is the common communicative language of all caste but some people from Magar caste also speak their native language called Magar Kham languages. The table 4.1 shows the distribution of respondents by caste/ethnic.

Table 4.1

Caste of Survey Households

Caste	Frequency	Percent
Chhetri	32	49.23%
Magar	26	40%
Dalit	7	10.77%

Brahmin	0	0
Total	65	100%

Source: Field Survey, 2018.

From the above table, the highest portion 32 (49.23%) respondents are Chhetri, 26 (40%) are Magar and 7 (10.77%) are Dalit whereas no one from Brahmin.

4.2.4 Religion Practice in Survey Households

Major population of Nepal follow Hinduism in Nepal, about 80 percent Nepali people practice Hinduism and whereas about 11 percent Nepali practice Buddhism, 4 percent practice Muslim, 3 percent are Kirat and rest of other practice Christianity, Bon etc.

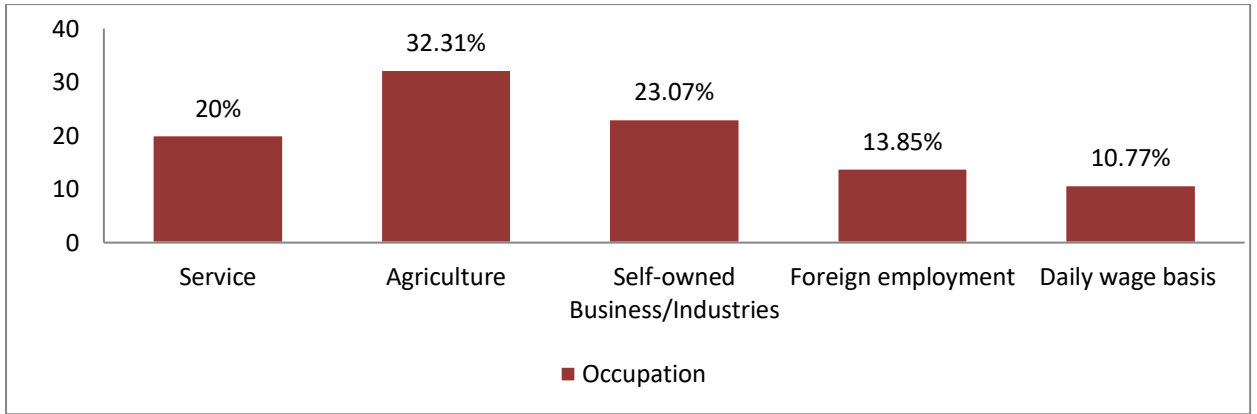
In Project area, about 99.99 percent people are Hindu and insignificant population practice other religion like Buddhism and Christianity whereas 100 percent respondent of sample population were Hindu.

4.2.5 Main Income Sources of Households

Most of the households of the project area are depended on agriculture to run their daily life. Also some of them are involved in services, self-business, foreign employment, daily wage basis and some people run their own small industries like sawmill, mill, poultry farm etc. Thus agriculture, service, self-owned business/industries, foreign employment etc. are the main occupation or business for the people of the study area. Although, all the 65 households are involved in agriculture but only few of them are totally depended on agriculture.

Figure 4.3

Main Income Sources of Households



Source: Field Survey, 2018.

The figure 4.3 shows that, agriculture and self-owned business/industries are main occupation of study area followed by service few of them are in foreign employment and some of them are depended on daily wage basis to run their family. Amongst the sample population 21 (32.31%) are depended on agriculture, 15 (23.07%) run their own business/industries, 13 (20%) are engaged in service, 9 (13.85%) are in foreign employment and 7 (10.77%) of them do daily wage basis for betterment of their family.

4.3 Economic Impact of MHP

4.3.1 Role of MHP in Rural Electrification.

All 65 respondents accepted that MHP playing the very essential role to electrification in the rural area. Before this project, they compelled to live under the kerosene lamp light. If villagers were waiting to central grid, they still would be in the dark night as the national grid is not connected to the place till this date. They have no easy access to get central grid due to the scatter settlement and topographical difficulties also lack of budget NEA is not able to spread the grid line to the rural places. Hence, MHP is the best energy sources for rural areas electrification. Due to unique land topography, where thousands of big rivers and small rivulets falling from mountain to plain area, micro hydro project can be easily lunched in low and reasonable cost in needed area. These projects are particularly effective when operated through the involvement and ownership of communities-clean energy locally

produced and locally consumed. Rural electrification in Nepal is very expensive due to the topographical conditions and many other obstacles, hence, MHP is the easy reasonable way to provide electricity in remote areas of Nepal.

4.3.2 Impact of MHP on Rural Economy

Installation of MHP brings multi-dimensional impacts (light, education, employment sanitation, health, communication) in project-affected areas. Most of the people use it for lighting purpose, which makes their nightlife comprehensively easier and healthier. The reliable and affordable electricity supply provided courtesy of the MHP has brought visible changes in the community. Because of the Kulo of MHP, people are getting irrigation facility, which help to increase agriculture production. Establishment of many small-scale industries like mill, sawmill, furniture, agricultural farm etc. creating employment, enhancing for income generation as well as making people life style easier than before. People attitude and behavior have changed by using the electrical devices (radio/TV/Computer).

4.3.3 Electricity Consumption for Various Purposes

People use electricity mainly for lighting purpose; very few numbers of households use it for productive works like installation of small-scale industries/firms. Due to the insufficiency of power as public demand, the MHP is unable to supply the power 24 hours. They are compelled to run the installed firms in alternate time due to the insufficiency of power.

Table 4.2

SN	Uses of electricity	Households	Minimum (hours)	Maximum (hours)
1	Lightening	65	4	8
2	TV/Radio	61	2	10

3	Industries/Business	15	4	12
4	Personal Uses	65	2	4
5	Cooking	25	2	4
6	Other Uses	65	1	6

Electricity Consumption for Various Purpose

Source: Field Survey, 2018.

Mainly, household use electricity for lighting purpose min 4 to max 8 hours a day. From 65 samples, 15 households run business/farms where they use electricity 4 to 12 hours a day.

For TV/radio purposes, they use 2 to 10 hours, about 2 to 4 hours for personal cooking and 2 to 4 hours for personal uses whereas 1 to 6 hours for other (Iron, refrigerator etc.) purposes.

4.3.4 Possession of Various Electric Instruments before and after MHP

Before establishment of the MHP, only few people of project area had electrical devices like Radio, Tape recorder using battery. After electrification, the possession of the electrical instruments like (TV, radio, phone etc.) has increased significantly. People have now access different information and entertaining facilities. The table below shows that the possession of electrical instruments before and after electrification.

Table 4.3

Possession of Various Electric Instruments before and after MHP

S N	Electrical	Possession %,	Possession %,
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Source: Field Survey, 2018.	Instruments	before	after
1	Radio	90	100
2	TV	0	70
3	Laptop/Computer	0	27
4	Cell Phone	35	100
5	Chargeable Torch	0	75
6	Other Instruments	0	30

Before MHP, 90 percent households used to possess radio/tape recorder but now almost all the households (100%) have. We can see no significant difference in using radio because radio can be run by using battery without electricity. Lack of electricity no household used to have TV and other electrical instruments. But now 70 percent households have TV in their house and 27 percent have laptop/computer. Before installation of MHP 35 percent people used to have Mobile Phone who had installed solar panel, now the Mobile users are almost 100 percent. Without electricity it was impossible to have any other electric instruments like chargeable torch, rice cooker, iron, refrigerator etc. but now almost 75 percent household possess chargeable torch and about 30 percent households own different kind of electric instruments as per their need like rice cooker, torch,, iron etc.

4.3.5 Establishment of Industries after MHP

Electricity is the basic and first condition for any development. It is the foundation to generate any socio-economic activities. Life is very difficult in the absence of electricity. People can't use modern devices and technologies in the absence of electricity which is one of the prior reason being rural life so difficult and miserable. But MHPs are giving some hopes to the rural livelihoods for better and improved lifestyle. After MHP, people have launched various industries and firms in the study area, which has helped to raise income

level of the people as well as making the villagers way of living much better and easier. The firms that lunched after MHP in village are presented in the table below.

Table No 4.4

Establishment of Industries after MHP

S.N.	Firms	No. of industries/ firms
1	Sawmill/Furniture	2
2	Mill	5
3	Poultry farm	4
	Total	11

Source: Field Survey,2018.

Above table presents that, villagers have installed 11 industries/firms where 19 villagers have part-time/ full time job. The villager's life has become easier after installing mill, furniture and other small-scale firms which is creating employment and income generation as well. The others business such as food shop, stationary, medical has been run which generate the income as well as make the social life easy.

4.3.6 Direct Job Creation by the MHP

To some degree micro hydropower project have been successful at creating some jobs like manager, accountant who keeps records of income and expenditure of the MHP, operators who operate daily to apply and cut electricity, engineer who maintain the plants. Since users committee members of the MHP work on a voluntary basis, they receive no compensation they are not supposed to be employed. The following post-holding persons are directly employed due to establishment of MHP.

Table No. 4.5

Direct job Creation by the MHP

S.N	Post	Number
1	Manager/ Accountant	1
2	Operators	3
3	Engineer	1
	Total	5

Source: Field Survey,2018.

Engineer/Mechanic has been called on part time basis for routine maintenance and in the case of emergency failure of the plant and other are full time employer.

4.3.7 Condition of Employment after MHP

After installation of the project, the employment opportunities in the village have been created directly and indirectly. Three operators and one manager/ accountant are employed in this project. Availability of electricity has helped to install small industries or firms encouraging villagers to be self-employed which ultimately created job opportunities for others too. About 45 peoples are directly involved in those firms like poultry farming, knitting, furniture, mill, shops etc. where there other people are able to get partial job. So significant creation of employment can be seen after MHP.

4.4 People Perception on the Micro Hydro Project

4.4.1 People Perception about Improvement of the Village after MHP

The impact of project and the installation of micro-hydro system not only provided electricity power to the households, but also improved the quality of

life of the entire village by providing opportunities for income generation and education. Apart from lighting, it also provided mechanical energy for milling, husking, grinding, spinning etc. in the village which paid off in the form of higher local incomes. After using such facilities it is expected that there must be changed in living habits of the people. Actually, living standard refers to the higher living. Out of total 65, each respondent shared their experience that MHP has played vital role to improve the living standard of the villagers. Because of light in night, nightlife has become easy and healthier and children reading habits improved significantly. The installation of agro mill, furniture, knitting industry, etc. have helped to make the life style very easier and most of the people participate in economic activities. By using electrical instruments (TV/Computer/Radio) people are experiencing other way of entertainment and also learning many new things and are well aware of national and local issues which has changed their overall lifestyle like talking style, dress up, behave to others and care about the sanitation etc.

4.4.2 People's perception about the Increase in their income after MHP

Traditional sources of income have been changed after project. Installation of micro-hydro system not only provided electricity power to the households, but also improved the quality of life of the entire village by providing opportunities for income generation and education. Apart from lighting, it also provided mechanical energy for milling, husking, grinding, spinning etc. in the village which paid off in the form of higher local incomes. According to the respondents income of the households has increased along with the occupational change. According to them, people were heavily relied on agriculture and animal husbandry in the past for their survival where income was barely sufficient for household requirement. It means beside agriculture, there was no any opportunity to generate income within the village, fewer people were engaged in private and government services and some people used to go abroad to earn money otherwise there was no any opportunities for income generation. But after MHP project, various types of businesses became

possible due to availability of electricity at village such as small industries, small hotel, electronics centers etc. People of the study area are gradually shifted from agriculture to other occupation too, which helped to increase income generation and employment within the village. Although not all the people of project area are benefited in the case of employment and income generation but the project has definitely helped the ones who want to do something within their village in some extent. Respondents have also agreed that although all the households are not benefited in the case of increase in income and employment but it is obvious that life has become more easier and healthier for every household than before. Females have also got good opportunity to generate income using their leisure time, old age women prepare the thread from filament of fibers of hemp under the light at night and sell them market as extra income. Women are busy in knitting muffler, socks, sweater, glove and bag by taking each other among family members for domestic use and selling. It indicates that their family unity also has become strong as well as income. The income level of the villagers has increased after the MHP. All the respondents have shared that the general income of the households has increased.

4.4.3 Agriculture Product Promotion due to MHP

Even though the trend of changing the traditional occupation is increasing, household family members have still involved in agriculture as well. Availability of electricity has helped the farmers for accomplishing their task in the late evening and early in the morning. According to the respondent, they can store crop late evening and early morning. In the past they have to wait for day light for the storing the crops. Before project, they were busy at day time and used to go to bed early evening due to no proper lighting facilities. Availability of many facilities like milling, husking, spinning, grinding etc. they don't have to spend more time on that so people have enough time for agriculture production. Now after MHP, people can use motor for irrigation

which resulted increase in production. Thus MHP is helping to promote agriculture in the study area as well.

4.4.4 Households' Main Sources of Energy before MHP

Before electrification, kerosene lamps were widely used for lighting purpose during night, and firewood was used in every household to cook the food. Batteries were used for torchlight and to run radio/tape recorders. The energy sources of households before MHP presented in table 4.

Table 4.6

Households' Main Sources of Energy before MHP

S N	Name of Energy Sources	Frequency or Households no.	User Percentage
1	Firewood	65	100%
2	Kerosene	65	100%
3	Others	13	20%

Source: Field Survey, 2018.

Here, 100 percent households used firewood and kerosene for cooking and lighting purpose respectively. Similarly, 100 percent respondents used batteries for torchlight and radio/tape recorder purpose. Whereas 13 households use others alternatives likes solar etc.

4.5 Financial Sustainability of the Project

Sustainable mean that how the project can be last long and it seeks the continuity or discontinuity in between the long period of the project. Construction of infrastructure and installation of plant only does not work for a long period. It also requires routine maintenance, maintenance during failure of the plant, maintenance of the project if it failed to work due to natural calamities like landslide, flood, thundering etc. To sum up the meaning of

sustainability of the project is to make the project to generate continuously. In the absence of sustainability, there is no meaning of construction of the project. For many communities living in remote corners of Nepal's hilly and mountainous regions, out of reach of the national grid, community-owned and managed micro-hydropower plants (MHPs) have comprised a reliable alternative source of energy. Thousands of such MHPs have mushroomed all across the country, transforming lives and livelihoods. Most of the costs was granted by AEPC to install the MHP. The then VDC, then DDC and UPAP have also contributed for the installment cost and rest was contributed by communities as voluntary. For the sustainability of the project 23 member users committee has been formed for the regular management of the project consisting of chief, vice chief, fund chief, secretary and 19 other members. The committee determines the electricity bills, recommendation for new industries and pricing of electricity, availability of electricity, appointing necessary manpower, keeping records of income and expenditure of the project, etc. Project was installed by grants and community voluntary contribution so no loan to be clear. So till date the project is being run smoothly. Project is fully handed to community it is hoped that the project will last long as they need it most so the committee formed by project affected households has been managed and run the project properly.

4.6 Other Changes Brought By the MHP

4.6.1 Hours Spent By Households to Collect Firewood before and after MHP

Every households has used less quantity of firewood after MHP, so that the time for collection firewood reduced significantly than before. Before MHP, people used to spend more time to collect firewood as they totally depended on traditional energy. But after MHP still they use firewood but the use of firewood has become significantly less. Also before MHP there was not any

options for entertainment in leisure period of time so people used to spend in front of the firewood woven and kill the time by gossiping in night which used to cause unnecessary consumption of firewood. Now, people watch TV instead of staying before firewood woven for long time. Some houses used gas as well as rice cooker which reduced the collection and consumption of firewood quite significantly.

4.6.2 Local Forest Condition after MHP Operation.

All the respondent have shared their experience the forest condition before and after MHP and according to them forest condition is improved than before. The infrastructural development may affects in natural resources like forest, due to the less consumption of firewood, use of gas, electrical Instruments for cooking as well as community forest programs help to save the forest. Due to awareness regarding forest preservation from TV/Radio programs people are consciousness to improve and preserve the forest. This is the positive symptoms of electricity in conservation of natural resources and environment

4.6.3 Sanitation after MHP.

Human health has been risky without sanitation. . Before project, maximum people used to have lamp for lighting using kerosene. Due to use of kerosene lamp and firewood with smoking, people used to suffer from respiratory and eyes problems so that, they were affected from different types of disease like cough, asthma skin problem and eyes disease before project. Specially, children and female were suffered. After installation the project, health condition of household and their house sanitation inside and outside both are improved under the quality light. Besides kitchen room, all decoration of rooms was seen clean of neatness instead of dirty and dark wall of ceiling inside the houses. Now people are more aware and sensitive about sanitation after using modern electrical instrument. During the survey time of this project, the aid organization has lunched the awareness programs about sanitation in the village and every household had compulsion to build toilet before the completion of the project. By using the electrical instruments like TV/radio the concepts of the

people have changed and have begun to care indoor and outdoor sanitation. After this MHP, 100 percent respondents said that the village become neat and clean than it used to be before.

4.6.4 Impact on Health after MHP

Smoke from firewood and kerosene had made the health condition of the people poor in village. Staying in front of firewood for long time caused the housekeepers health worse and children health also damaged by kerosene used as a means of light to read. Indoor air pollution could lead to serious health problems such as respiratory diseases and eye infection. Having micro hydro electricity supply at home reduces indoor air pollution by reducing the use of kerosene and firewood, which lessen the risk of respiratory problems and eye infection. By using electrical instruments, people have been listening/watching about health tips and educational program, which help to change their health condition, and they tend to use fresh and healthy things. The expenditure on treatment has reduced and the saving amount cans use in others productive purposes. Thus, MHP has impact on multidimensional way; it helps to uplift the living standard of the people in village.

4.6.5 Communication Condition of the study Area after MHP

This is the era of science and technology so the internet, communication are the basic need of the people. Most of the people of this study area introduced with mobile phone and youth are familiar with internet in mobile. The communication of this area is significantly improved than before the MHP. Unavailability of electricity there was proper communication. Only fewer people used to have mobile phones whose household had installed solar panel. Now communication is much better compared to before MHP as most of the individual own mobile phones. So the installment of MHP has become blessing for the people in the case of communication and information.

4.7 Regularity in Electricity Supply

MHP has playing very essential role for rural electrification in the remote villages of Nepal. Due to the technical problems like unable to work by machine, landslide on 'Kulo', supply pole crack due to air or being old etc. has been seen occasionally disturbance on power supply, otherwise MHP is regular in electricity supply. The average regularity in electricity supply is 75 percent per month. Beside any kind of technical and nature caused damage respondent have been experiencing no disturbance in power supply. The power supply duration from the MHP is 15 hours a day which follows the routine below

Morning: 4 AM - 8 AM

Day: 10 Am - 4 PM

Evening: 6 PM - 11 PM

4.8 Advantage of the MHP in Locality

MHP has played important role to uplift the living standard of the household as electrification in the village reduced difficulties of their day to day life. After this project, people are able to live in light in night, which made the nightlife easier and healthier. Before MHP, people were compelled to use Dhiki, Jato, Ghatta for grinding and husking, this consumed more time of villagers as well as make villagers' life complicate. Now, by lunching the agro mill villagers' life has become easy and helped to reduce the difficulties of women. By lunching the furniture, poultry farms, knitting, medical and others business MHP is changing the life of households towards prosperity as economic activities is increased. MHP is helping to raise the social condition and health of the people. The projectalso helping in education, electrification has increased in reading habits of children of the village as they can now read in nights and early morning and also they are learning many thingsfrom TV/radio. So children education and others social activities hasdefinitely improved after MHP.

4.9 Change Seen in Village after MHP

There is a saying that "Society in energy poverty cannot be poverty free, reducing energy poverty is fundamental to development". For the development, electricity is must. But electrification in rural hills is very difficult due to geological and technical difficulties as well as lack of fund for investment. But installation of MHP in far rural hills approaches has become blessing for the rural development. MHP has changed the holistic scenario of the study area. It has played vital role for infrastructure development in village. By listening to respondent regarding the condition of village before MHP there can be seen many changes in the study area. The project has significantly changed the social and economic status of households. Village is clean after MHP. Health and education condition have significantly better now. Installation of different industries, business, firms such as Milling, furniture, knitting, poultry farm, small restaurant, shop, medical etc. have created employment and also generated the income which helped change in economic status of the households. Also life of the people of the project has become easier than it used to be before MHP.

4.10 Household's Experience and Perception on the way of MHP Working

People have either satisfaction or dissatisfaction toward any project. Researcher has attempted to find out what they have been experiencing after the MHP established and what is the perception of people towards electricity in the study area. The households who only use MHP for lighting purpose has got satisfaction as their needs for basic purpose only but the households who run the industries has not fully satisfied with it because the MHP cannot supply electricity for 24 hours. Also, the insufficient of power supply people are unable to installed new firm in the village. But nonetheless electricity has make the life of villagers easy and comfortable. In rural hill areas, electricity connection from national grid is still like dream. So most of the respondents were satisfied by electricity supplied by MHP and those who were dissatisfied were also agreed that life has become so easier after the MHP.

4.11 Related Factors Responsibility about Sustainability of the Project

To sum up, it is known that repairing and maintenance is necessary for every non-living things. Therefore, MHP must need repair and maintenance that makes things sustainable. Although the project is community based and after the completion it was fully handed to the community it is necessary that the government or related donor agencies not only provide aid but they must supervise the project whether the project is in well condition or not. They must regularly enquiry to the users committee as well as households and also have to inform to them continuously about the condition of the project. Also community has to be very responsible and accountable regarding the condition of MHP as it is handed to them for their better life.

There is necessity of regular operation and maintenance/repairing schedule in powerhouse to make it sustain. User concise and community participation is compulsory to sustain the project. During the research time, all the respondents become ready to do any things for the betterment of project if needed. Women participation on project is also crucial because the life of women has become easy after electrification and they have experience of doing work in those dark nights and facing the real difficulties in the days before electrification. So, equal opportunity and participation is necessary in maintenance and use of electricity which ultimately help to sustain the plant.

Users committee must be responsible and accountable to run the project well. Someone must have to accountable when he/she get certain responsibility. Most of the respondents said that the community has handed all the responsibility to the users committee and they should take the responsibility of the project and should also run the awareness program in community as well as maintain the project in time.

ChapterFive

Summary, Conclusion And Recommendation

This study is focused on studying the economic and social impacts of KulpaSanguraKholamicro hydro project. It is based on the primary data collected through the field survey and secondary data for some of data and information. It is expected that the results from this study will provide valuable information to the policy makers to utilize the resources in the most productive sector for energy generation. The main objectives of the study are to To examine the economic impact of KulpaSanguraKhola Micro Hydropower Project in study area, to find out the changes in social aspects through MHP in study area, to explore the problems associated with the MHP and suggest solution for its sustainable development. This chapter is the concluding chapter of the study. The first part summarizes the finding from the study, the second part draws some conclusions, and third part lists some recommendation.

5.1 Summary

It is foreseen that the people of remote areas will continue to remain beyond the reach of large power systems (i.e. outside the reach of national grid), because of the high cost of extending the national grid over a difficult terrain and scattered settlement pattern of Nepal. Decentralized energy systems based on locally available renewable energy resources, have shown promise to be an appropriate solution to increase access to energy services as well as promoting the socio-economic well being of the people living in rural and remote areas, ensuring environmental sustainability. Hydropower is a nonpolluting, environmental friendly, renewable, locally available and reliable source of energy. To meet the national energy objectives, small-scale hydropower plants are effective for the electrification of remote areas. Traditional source of energy are not sufficient to meet the energy demand. The use of fuel is also costly and it negatively pressurizes on the balance of payment in the economy. Over pressure on forest creates various problems.

Electricity is the basic prerequisite of development. Energy consuming pattern is also regarded as one of the important indicators of measuring development status of the village. In the Nepali context, micro hydropower seems as an important energy source, especially in the rural hills region of Nepal. In recent years there has been much debate over the appropriate scale of hydro power. Many argue that large hydro is not only environmentally damaging (as large areas of land are flooded) but that there is also a negative social impact where large imported technologies are used.

However, small scale hydro power avoids the negative social and environmental impacts of large hydro. Micro hydro can deliver many social and economic benefits to isolated communities who otherwise would not have access to modern energy.

This study reflects the overview of status of Nepali rural energy sources and discusses various energy issues through the case study of KulpaSanguraKhola MHP, Pariwartan rural municipality -3, Rolpa. The study has discussed various merits of MHP system; the project not only provides energy for lighting but also has helped to improve health and education condition of the households. The project has made the life of households easy by saving time, making easy to work at night, being more efficient in income generation as well as productive work etc.

This is the descriptive study designed to find out the economic impact of KulpaSanguraKholaMHP project of KulpaSanguraKhola. This study has been conducted from the direct interview method with 65 respondents. Those respondents were selected by simple random sampling. The major finding of the study area pointed as follows:

- The main cast in the study area are Chhetri (49.23%), Magar (40%) and Dalit (10.77%)
- 99.99 percent households practice Hindu religion and rest follow other religion like Buddhism etc.

- The main sources of energy before MHP were firewood for cooking and kerosene for lighting purpose for almost all the households in this area. Now MHP being the main sources of energy in the village, it has reduced the over expenditure on traditional energy sources
- After MHP, people installed industries such as furniture, milling, knitting, sawmill, poultry farms etc. and create the employment opportunities and income generation.
- Most of the respondents realized that their income has increased significantly and partially.
- Most of the respondents said that MHP has been successful to increase employment in the village by creating direct jobs as well as by helping to establish self-owned business and industries.
- From this field visit we can see that there are various problems that hinder to sustainable development of MHP.

5.2 Conclusion

In country like Nepal lower scale MHP may be most useful where due to geographical difficulties as well as scattered settlement in rural hills extension of national grid is almost impossible. Micro hydro can deliver many social and economic benefits to isolated communities who otherwise would not have access to modern energy. There is sufficient feasibility of such types of lower scale MHP in rural hills of Nepal.

MHP has positive economic impacts on rural livelihoods. It has helped to create income and employment by helping to install new businesses/industries/firms. Electrification has reduced the expenditure on other energy sources like: firewood, kerosene etc. So, it can be a less expensive and clean source of energy in the rural area. Living standard of the project affected area has been changed after MHP. Health condition has been also improved by the use of clean energy from MHP. The expenditure on health has gone down due to the reduction in the number of respiratory diseases from smoke of firewood and kerosene lamp. People get access to modern medical

facilities due to electricity. Electricity supply has extended the use of electric instruments and devices like mobile phones, cassette player, Radio, TV, Refrigerator, Iron, Computer/laptop, rice cooker etc. Communication has been easy and affordable, also significant reduction on use of traditional energy sources due to MHP has helped to conserve the community forest. The status of sanitation has improved after electricity facility.

Normally, small-scale hydro installations in rural areas of developing countries can offer considerable financial benefits to the communities served, particularly where careful planning identifies income-generating uses for the power. In recent years there has been much debate over the appropriate scale of hydro power. Many argue that large hydro is not only environmentally damaging (as large areas of land are flooded) but that there is also a negative social impact where large imported technologies are used. However, small scale hydro power avoids the negative social and environmental impacts of large hydro. Micro hydro can deliver many social and economic benefits to isolated communities who otherwise would not have access to modern energy.

5.3 Recommendations

The following recommendation can be made by considering the finding and conclusions of this study.

- Micro hydro can deliver many social and economic benefits to isolated communities who otherwise would not have access to modern energy.
- The electricity power generation should be increased by further investment as demand is high than supply.
- Lack of qualified and experienced technician timely maintenance is another problem. So, the technicians should be provided by Government to maintenance MHP.
- The dam and 'Kulo' should be repaired for more securely.
- People should use electricity for more productive activities.

- Small industries need to be established in the village. So that the MHP's revenue can be increased and further investment can be made.
- Finally, government needs to formulate appropriate policy and should allocate resources for MHP to maintenance and repair.

References

- Adhikari, D. (2006). Hydro power development in Nepal. *NRB Economic Review*, 18, 70-94.
- AEPC (Alternative Energy Promotion Center)(2013). *Techno-Socio Economic Study of Baglung Mini Grid*.Lalitpur: AEPC.
- AEPC (Alternative Energy Promotion Center) (2012). *Mini Grid Outlook*. Ministry of Energy.Lalitpur: AEPC.
- AEPC (Alternative Energy Promotion Center) (2011).*Impact of Mini Grid Electrification*.Lalitpur: AEPC.
- AEPC (Alternative Energy Promotion Center) (2010). *Specification of Energy Meter for Micro Hydro Project*. Lalitpur: AEPC.
- AEPC (Alternative Energy Promotion Center) (2005).*Micro Hydro Data of Nepal*. Lalitpur: AEPC.
- CBS (Central Bureau of Statistics) (2011). *Population Census 20011, National Report*,Thapathali. Kathmandu: CBS.
- Dahal, S., & Shrestha, R. (2014, October). *Sustainability of micro-hydropower inNepal: A case study of Rukum district*.Paper presented at IOE Graduate Conference of Institute of Engineering, Tribhuvan University, Kathmandu, Nepal.
- Ghimire, H.K. (2008). Harnessing of mini scale hydropower for rural electrificationin Nepal.*Hydro Nepal: Journal of Water, Energy and Environment*, 2, 26-28.

- Gurung, A., Ian, B., & Oh, S.E. (2011). Micro-hydropower: A promising decentralized renewable technology and its impact on rural livelihoods. *Academic Journals:Scientific Research and Essays*, 6, 1240-1248. Retrieved from <https://academicjournals.org/journal/SRE/article-abstract/7B3DC7E22348>
- Hora, P. (1994). *Role of micro hydropower in the rural electrification of Nepal*. Master's thesis in geography, Central Department of Geography. Tribhuvan University, Kirtipur.
- ITDG (International Technology Development Group)(1997). *Impact and Implication of Rural Electrification Through the Micro Hydro Power in Nepal, (With Specific Reference to Barpark and Ghandruck)*.Kamaladi Kathmandu: ITDG.
- ITDG (International Technology Development Group) (2002). *Evaluation of Impact of Renewable Energy Programme on the People, (Final Report)*. Pulchowk, Lalitpur: ITDG.
- Joshi, K.P. (2011).*Socio-economic impact of Surma Devi hydropower project*. Master's thesis in economics, Central Department of Economics, Tribhuvan University, Kirtipur.
- Junejo, A. A. (1994). Mini and micro-hydropower development in the Hindu-Kush-Himalayan region: Achievements, impacts and future. In Joshi, R.D., &Amatya, V.B. (Eds.), *Mini- and micro-hydropower development in the Hindu-Kush-Himalayan region: The Nepal prospective*. Kathmandu: InternationalCenter for Integrated Mountain Development (ICIMOD).
- Khennas, S.,&Barnett, A. (2000). *Best practices for sustainable development ofmicro hydropower in developing countries: Final synthesis report*.

London, UK: The Department for International Development and The World Bank.

Kim, E., & Karki, B.S. (2003). *Water resources use in the Annapurna conservation area: Case study of micro-hydropower management in Sikles and Chhomrong*. Kathmandu: King Mahendra Trust for Nature Conservation (KMTNC).

Koirala, B. (2007). *A community based micro hydro: A promising technology for rural development in Nepal*. USA: Department of Economics, The University of New Mexico.

Korkeakoski, M. (2009). *Impact of micro-hydropower based electrification on rural livelihood: A case study of Nam Mong in Luang Prabang Province, Lao PDR*. Unpublished post graduate thesis submitted to the department of biological and environment science, University of Jyväskylä, Lao PDR.

Kunwar, N. (2018). *Impact of Ghartigaun micro hydropower project on the livelihood*. Unpublished master's thesis in sociology, Central Department of Sociology and Anthropology, Tribhuvan University, Kirtipur.

Miyoshi, Y., Raghuvanshi K., & Camarao, I.C. (2011). *Micro-hydropower plant in Nepal, A case study of Daunnekhola micro-hydropower plant*. Tokyo: Graduate School of Public Policy, University of Tokyo.

MOF (Ministry of Finance) (2010). *Economic Survey, Fiscal Year 2009/10*. Kathmandu: MOF.

MOF (Ministry of Finance) (2014). *Economic Survey, Fiscal Year 2013/14*. Kathmandu: MOF.

MOF (Ministry of Finance) (2017). *Economic Survey, Fiscal Year 2017/18*.

Kathmandu: MOF.

MOFAGA (Ministry of Federal Affairs and General Administration)(2015).

Description of Local Level. Kathmandu: MOFAGA. Retrieved from <http://mofald.gov.np/>

NEA (Nepal Electricity Authority) (2008). *Nepal Electricity Authority Fiscal Year 2007/8: A Year in Review*. Kathmandu: NEA.

NEA (Nepal Electricity Authority) (2009). *Nepal Electricity Authority Fiscal Year: 2009: A Year in Review*. Kathmandu: NEA.

NEA (Nepal Electricity Authority) (2018). *District Report of Nepal Electricity Authority Rolpa Distribution Center*. Rolpa: NEA.

Poudyal, G., Basnet, D., & Pant, K. (2009). *Research methodology*. Kathmandu: Dreamland Publication.

Rijal, K. (1994). Perspective on mini-and micro-hydropower development, report of a national seminar. In Joshi, R.D., & Amatya, V.B. (Eds.), *Mini and micro-hydropower development in the Hindu-Kush-Himalayan region: The Nepal prospective*. Kathmandu: International Center for Integrated Mountain Development (ICIMOD).

Rijal, K. (2000). Mini- and micro- hydro power development: Status, issues, and strategies for the Hindu Kush Himalayan region. *NESS Journal of Engineering*, 9. 86-92.

Samuhik Abhiyan, (2011). *Impact of Mini Grid Electrification, Second Draft*. Lalitpur: Alternative Energy Promotion Center Energy Sector Assistance Programme.

Saud, N. B. (2005). *Development of micro hydropower in Nepal*. Unpublished

master's thesis in rural development, Central Department of Rural Development, Tribhuvan University, Kirtipur.

Shrestha, V. (2012). *Role of micro hydropower plants in local development: A case of two villages in Sankhuwasabha district, Nepal*. Master's thesis in development studies, International Institute of Social Studies, Hague, Netherland. Retrieved from https://thesis.eur.nl/pub/13254/Vivek%20Shrestha_vivekshrestha-RP-final_1509.pdf

Siuthani, T.M. (2016). *Socio-economic impact of micro hydropower project: A case study of Taman Khola micro hydroelectricity project Taman VDC Baglung*. Unpublished master's thesis in economics, Central Department of Economics, Tribhuvan University, Kirtipur.

UNCTAD (United Nation Conference on Trade And Development)(2017). *Least Developed Countries Report 2017: Transformational Energy Access*. New York and Geneva: United Nation.

WECS (2010). *Energy Sector Synopsis Report 2010*. GoN. Kathmandu: Water and Energy Commission Secretariat.

WBG (World Bank Group)(2014). *Nepal: Scaling Up Electricity Access Through Mini and Micro Hydropower Applications, A Strategic Stock-Taking and Developing a Future Roadmap*. Kathmandu: World Bank Group.

Appendix
Questionnaire
For Household Survey
Socio-Economic Impact of MHP on Rural Livelihoods

1. Household information

Q.N	Questions	Code/answer
1.1	Name of household head	
1.2	Name of the village	
1.3	Ward no.	1 2 3 4 5 6 7
1.4	Sex	1. Male 2. Female
1.5	Age of the respondent	
1.6	Number of household members	1) male 2) female ----- -----
1.7	Caste	1. Brahmin 2. Chhetri 3. Dalit

		<p>5. Magar</p> <p>6. Others</p>
1.8	Religion practiced	<p>1. Hindu</p> <p>2. Buddhist</p> <p>3. Christian</p> <p>4. Muslim</p> <p>5. Kirat</p> <p>6. Others</p>
1.9	Main occupation of household members	<p>1. Agriculture</p> <p>2. Services</p> <p>4. Daily wage basis</p> <p>5. Self owned business</p> <p>6. Unemployed</p> <p>7. Foreign employment</p> <p>8. Other specify</p>

2. MHP and rural electrification

Q.N	Question	Code/answer
2.1	When was the MHP set up? (year)	-----/-----/-----
2.2	Do you agree MHP system has played vital role in rural electrification?	1. Yes 2. No
2.3	<p>How many hours per day do you use to electricity for the following purpose? (write in complete hours)</p> <p>1. Lightening 2. Cooking 3. TV/ Radio 4. For business purpose 5. For agriculture purpose 6. Personal use 7. Other specify</p>	<p>-----</p> <p>-----</p> <p>-----</p> <p>-----</p> <p>-----</p> <p>-----</p>
2.4	How many electrical instruments do your household possess before and	Instruments before after

	after electrification? Write in number.	1. Radio ----- ---- --- 2. TV ----- ---- --- 3. Refrigerator ----- ---- --- 4. Computer ----- ---- --- 5. Cell Phone ----- ---- --- 6. Chargeable battery ----- ---- -- 7. Others specify ----- ---- --				
2.5	How much money do you pay for electricity per month? Write in total Rs.	<table border="0" style="width: 100%;"> <tr> <td style="width: 50%; text-align: center;">maximum</td> <td style="width: 50%; text-align: center;">minimum</td> </tr> <tr> <td style="text-align: center;">-----</td> <td style="text-align: center;">-----</td> </tr> </table>	maximum	minimum	-----	-----
maximum	minimum					
-----	-----					

3. Status of Employment and Income

Q.N	Question	Code/answer
3.1	Do you think participation in the project has improved the status of the village?	1. Yes 2. No
3.2	Is any member employee on MHP?	1. Yes 2. No
3.3	Is MHP helpful to create employment?	1. Yes 2. No
3.4	Are there any industries after MHP?	1. Yes 2. No
3.5	What type of industry is installed in your village?	1. Milling 2. Furniture/sawmill 3. Irrigation 4. Drinking water 5. Knitting 6. Other specify
3.6	What occupation do you adopted after MHP?	1. Agriculture 2. Service 3. Foreign employment

3.7	<p>Have you done the productive work by using MHP system?</p> <ol style="list-style-type: none"> 1. Poultry farming 2. Knitting 3. Furniture 4. Milling 5. Saw-mill 6. Dairy 7. Computer-institute 8. Other Specify 	<p>1. Yes 2. No</p> <p>1. Yes 2. No</p> <p>1. Yes 2. No</p> <p>1. Yes 2. No</p> <p>1. Yes 2. No</p> <p>1. Yes 2. No</p> <p>1. Yes 2. No</p>
3.8	<p>Do you find that after involving on productive work or after MHP, it helped to increase your income level?</p>	<p>1. Yes 2. No</p> <p>3. To some extent 4. Difficult to say</p>
3.7	<p>Number of employed persons at the project affected area:</p>	<p>Before After</p> <p>----- -----</p>
3.8	<p>Does the project help to promote the agricultural product?</p>	<p>1. Yes 2. No</p>
3.9	<p>Specify the annual income of the family.</p>	<p>Before After</p>

	Total in Rs.	-----	-----
3.10	What is the status of your family income after having electrified?	1. Increased	
		2. Decreased	
		3. No change	
3.11	How much money do you spend on these energy sources? Specify total in Rs. 1. Kerosene 2. Battery 3. Candle 4. Firewood	Before	After
		-----	-----..
		-----	-----
		-----	-----
		-----	-----
3.12	What was the main source of energy in your family before installation of MHP?	1. Firewood	
		2. Bio-gas	
		3. Solar	
		4. Kerosene	
		5. Others	

Social Aspects

1. Is there facility of drinking water in your community?

- a) Yes b) No

2. Is electricity used to supply water?

- a) Yes b) No

If yes, specify travel distance

If no, what is the alternative?

Reason for:

3. Has your day-to-day work been comfortable after electricity?

- a) Yes b) No c) don't know

4. With the use of electricity, is there any change in the society?.....
.....

5. What about your children's study hour after electrification?

- a) Increased b) Decreased c) Both d) don't know

Reason for:

6. Have you felt that your children's health has been improved after electrification? a) Yes b) No c) Don't know

7. Is your family member out-migrated now?

- a) Yes b) No

If yes, i) Destination..... ii) Duration.....

8. Which of the energy source do you use for cooking?

- a) Fire wood b) Kerosene c) Biogas
c) Electricity d) Animal waste/dung e) others.....

9. Which type of energy do you use to lighting purpose?

- a) Electricity b) Biogas c) solar d) Others.....

10. How long time do you spend to collect the firewood in a day?

11. Has the electricity improved the social integrity of your community?

a) Yes b) No Reason for.....

12. Do you think that the electricity has made your cultural function, Program more interesting?

a) Very much b) to some extent c) not so much d) not at all

13. How often do you consult the local doctor (Dhami/Jhankri)?

Thank You