

**SOCIO-ECONOMIC IMPACT OF ANDIKHOLA  
HYDROPOWER ON THE LOCAL COMMUNITY OF  
SYANGJA DISTRICT**

A Thesis

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Central Department of Rural Development

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By

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## RECOMMENDATION LETTER

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## **APPROVAL LETTER**

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## **DECLARATION**

I hereby declare that the thesis entitled **Socio-Economic Impact of Andikhola hydropower on the local community of Syangja district** submitted to the Central Department of Rural Development, Tribhuvan University, is entirely my original work prepared under the guidance and supervision of my supervisor. I have made due acknowledgements to all ideas and information borrowed from different sources in the course of preparing this thesis. The results of this thesis have not been presented or submitted anywhere else for the award of any degree or for any other purposes.

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## **ABSTRACT**

Hydropower plants have become an important source of renewable energy for the rural poor. This research papers assesses, using ethnographic methodology, how electricity from Andikhola hydro impacted the socio-economic condition, changes the life-habits of the rural poor, and explores what kinds of new enterprises have been established since the plants were established. In addition to this the research has explored the sustainability practices that have been applied by the organization till the date.

Cross-sectional research design was used to collect information with a structured questionnaire and key informant interviews. Among the 601 households of Galyang bazar, 61 households were selected using simple random sampling method due to the homogenous character of the population. Household survey was conducted with structured questionnaire to find out about the changes in life-habits and impact on entrepreneurship brought by the hydro electricity. And the KII was conducted with a mayor, hydro administrative officer, and a local teacher for finding out about the efforts for sustainability of the project.

Results revealed that the village electrification had brought positive changes in the rural livelihoods in terms of reducing hardships, providing learning opportunities, changes in behavior, along with establishment of a number of enterprises. It also reduces the drudgery especially for women as they no longer had to fetch water from far for drinking water and irrigation. Electric lights in households extended additional hours for evening reading and work which positively impacted on the education and more income. The use of communication networks like television, mobile, internet, laptop, and radio have improved the life habits of the community people. The hydro electricity based industries were established to some extent providing employment opportunity and increasing income of households through higher productivity. Thus, these kinds of small hydro schemes provide clean, affordable and sustainable renewable energy both locally and globally as well as aid in the development of the community by decreasing hardships and fostering growth of enterprises.

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## **ABBREVIATIONS**

AD	Anno Domini
BPC	Butwal Power Company
CBS	Central Bureau of Statistics
EIA	Environment Impact Assessment
FDI	Foreign Direct Investment
GJ	Giga Joule
IHA	International Hydropower Association
KGA	Kali Gandaki A
KII	Key Informants Interview
KW	Kilo Watt
MW	Mega Watt
NGO	Non-governmental organization
NOC	Nepal Oil Corporation
NEA	Nepal Electricity Authority
PPA	Power Purchase Agreement
TWh	Tetra Watt hour
UMN	United Mission to Nepal
VDC	Village Development Committee

## **ACRONYMS**

ACAP	Annapurna Conservation Area Project
DFID	Department of International Development
MIGA	Multilateral Guarantee Agency
SARI/E	South Asian Regional Initiative
TV	Television
USAID	United States Agency for International Development
VAT	Value Added Tax

# CHAPTER I

## INTRODUCTION

### 1.1 Background of the Study

The increasing global demand for energy combined with the ongoing quest for clean, renewable energy has been a topic of perceived interest amongst countries of developed and developing status worldwide. Hydropower is a renewable, economic, non-polluting and environmental friendly source of energy. It has been one of the sources of energy harnessed for centuries in different parts of the world. Hydropower has generated a great deal of interest because it is inexhaustible source of energy & a moderate method for providing electricity to far flung areas in hilly regions.

As Nepal has no proven deposits of petroleum products or natural gas, the only native supply of commercial energy is electricity (Ghimere, 2008). Nepal is granted with water resources where more than 6,000 perennial rivers and rivulets flow with an annual average water runoff of 225 billion cubic meter thereby providing huge hydropower potential (Sangroula, 2009).

One way of utilizing this potential is construction of hydropower plant. The positive socioeconomic benefits of hydropower plant can include provision of employment, welfare, and market accessibility. Alongside the negative impacts include loss of agricultural land, with adverse consequences for livelihoods of affected people, altered river flows, and loss of wildlife. Hydroelectricity projects provide physical and human livelihood assets to the community at the expense of natural livelihood assets, which may not represent a balanced approach to sustaining positive livelihood outcomes (DFID, 1999).

Hydropower is a sustainable form of energy produced solely by transforming the energy stored in water. Hydropower has gained the prestige due to low greenhouse gas emissions, long life, low operation and maintenance cost and many other benefits. However, the condition of sustainability can differ according to the country, its people and other various factors prevailing in that specific area and time.

Nepal is a small Himalayan republic with the second largest hydropower development potential and a supporting geography; still, less than 1% of its hydropower potential has been

developed today. Broadly speaking, rules regulations, project holders' intention, socio corporate responsibilities and the economic aspect define and adjust the sustainability value.

There are various ways of analyzing the sustainability of the hydropower projects. One of the best techniques is the use of the guidelines provided by the International Hydropower Association (IHA) that tries to address all the social, economic and environmental aspects related to the hydropower development. The overall values of the aspects and elements of the sustainability analysis are averaged to get one value which tells the degree of the sustainability of Nepalese hydropower. An average value above the score of three indicates the social, economical, and environmental sustainability of hydropower in the Nepalese rivers.

### **1.1.1 Hydropower in Nepal**

Of the whole world's power production, 20% of the energy is only produced from hydropower although the world has a vast amount of hydropower undeveloped. Nepal has the potential of producing 299TWh/year (83000 MW) of electricity, which is almost 3% of the whole world's capacity. Nepal is blessed with enormous amount of water and the geography for the production of the electricity.

In the context of Nepal, the government started to generate hydroelectricity since 1911 AD. The first hydropower plant of the nation was Pharping Hydropower with the capacity of 500 KW. Since its establishment the demand of electricity is increasing. Almost 96% of the electricity produced today comes from hydropower plants. Kali Gandaki-A is the largest operating hydroelectric plant in Nepal today with capacity of 144MW.

The per capita energy consumption of Nepal is 15 GJ per year. Ministry of Energy has estimated the country's demand for electricity to 1,721 MW in the year of 2017. According to the Water and Energy Commission the rise of electricity demand is estimated to rise by 15 per cent every year. The study conducted by the commission has shown that the country would require 50,000 MW electricity by 2040 according to the 7.2 percent of economic growth rate ("study projects 50,000 MW", 2017).

Diesel plants contribute less than 4% of the total power produced which implies that Nepal is fully dependent on hydropower for electricity. The existing major hydropower plants of Nepal produces about 459.159 MW of hydroelectricity which is nominal compared

to the actual hydropower potentiality. This is because of many factors such as financial requirements, planning, time and manpower, transportation of the construction material and installation of the machines.

The small hydropower plants collaborate with the large ones and contribute about 472.994MW. Other existing isolated small hydropower plants and the diesel plants produce about 58MW (NEA, 2015).

Andikhola hydropower is under operation since 1991 AD with an installed capacity of 5.1MW. It is situated in the mid-hills near Galyang Bazar, Syangja district which is 280km south-west of Kathmandu, Nepal. The project was built under aegis of United Mission to Nepal (UMN) with old used equipments from Norway. The water from Andikhola river is drawn from a point not so far Andikhola-Kaligandaki confluence and after generation of power is discharged into Kaligandaki river. This is a unique multipurpose project in Nepal; water is tapped off before the penstock and is provided for agriculture. After upgrade to 9.4 MW in 2015 AD, due to short residual life of electro-mechanical equipment, within the project area, over 17,000 consumers of electricity across 22 villages benefit from the scheme, with this number growing by 10% annually. The upgradation was financed by International Financing Corporation (IFC) and Mega Bank Limited, Nepal. It has also been providing service for agriculture, which irrigates 599 hectares of land in Tulsi Bhanjyang area of Syangja District and Asardi area of Palpa District (Butwal Power Company[BPC], 2017).



Fig. 1 Andikhola hydropower in Galyang bazar, Syangja district.



Source:

<http://www.bpc.com.np/uploads/aadhi%20khola%20upgrading%20location%20map.jpg>

## 1.2 Statement of the Problem

The scholars have different views with regards to the impact of hydropower plant. Some value its positives impact such as electrification, health benefits, reduction in carbon emissions, etc while others value its environmental impacts like disruption of ecosystem, forced population displacement, along with huge upfront cost, etc. Thus, there needs to be proper understanding of the impacts of the hydropower plant for its success and uninterrupted operation. There is a lack of ethnographic studies that focus on the electricity and development relationship. There have been studies which are limited to measuring the impact on productivity, which means a large part of the story is being left out. In addition to this, such kind of study on the Andikhola hydropower has not been previously done.

### **1.3 Research Objectives**

General objective of this research is to assess the socio-economic impact of the Andikhola hydropower plant on the local community of Syangja district.

The specific objectives of the research are:

- ) To assess impact on life-habits brought by the hydropower plant.
- ) To study the impact of the hydropower plant on entrepreneurship.
- ) To analyze sustainability practices performed by the hydropower plant.

### **1.4 Limitation of the Study**

This research is conducted among the households of the local community in Galyang bazar, Syangja district regarding the socio-economic impact of the Andikhola hydropower. So the findings of the research might or might not be applicable to other places or communities.

The status of the community prior to the construction of hydro project has not been studied. So a comparative analysis could not be made.

All households could not be surveyed due to limited resources and time which might result in deviation from the national data.

The study has considered limited variables of the socio-economic status which might affect the result. And its focus is the partial fulfillment of the requirements for the post-graduate degree in Rural Development.

### **1.5 Significance of the Study**

The findings of the study would help governments and constructors to limit the negative impacts of dams and hydropower plants while providing positive impacts to the downstream population and consumers of the hydropower plant. This study has examined the changes brought in life-styles and effects in the entrepreneurship development in the area. Thus it presents overall change brought in the society by the hydropower plant. It would be helpful for the academicians, development actors, and hydropower stakeholders to gain knowledge about the impacts brought about by the hydropower plant.

## **1.6 Organization of the Study**

This research consists of 5 chapters which are Introduction, Literature review, Research methodology, Data analysis and interpretation, Conclusion and recommendation. The introductory chapter describes hydropower plant, national status of hydropower, and need in the future. It also illustrates the objectives, significance, limitations of the study. The second chapter reviews previous literatures relating to the impact of hydropower plant and dams. The third chapter illustrates about the methodology used in this research. Similarly, the fourth chapter (analysis and interpretation) presents brief overview of the demographic and socio-economic characteristics of the population in the study area. In the fifth section, along with concluding remarks, major findings and recommendations have been mentioned for further researchers. Two annexes have supported the research. At the end, references for the literatures that have been used in this research have been provided in a sequential manner.

## **CHAPTER II**

### **LITERATURE REVIEW**

This chapter reviews previous literatures related to the hydropower plant, and their impacts on lives of people. The chapter has been categorized into theoretical review, empirical studies, national energy policy, environmental aspects of hydropower, social aspects of hydropower, economic aspects of hydropower and conceptual analytical framework of the research.

#### **2.1 Theoretical Review**

##### **2.1.1 Hydropower plant**

Typically, hydroelectric facilities consist of a hydroelectric power plant stationed within a dam. Hydropower dam can control flood patterns, divert rivers, store water for drinking and irrigation, and generate power (Workman, 2009). Relatively speaking, hydroelectric generation is an environmentally low impact form of energy production, especially in comparison to fossil fuels such as coal or natural gas.

Hydropower is a versatile, flexible technology that at its smallest can power a single home, and at its largest can supply industry and the public with renewable electricity on a national and even regional scale. In terms of generation capacity, hydro accounts for eight of the world's ten biggest power stations.

There are four broad hydropower typologies:

1. Run-of-river hydropower: It is a facility that channels flowing water from a river through a canal or penstock to spin a turbine. Typically, a run-of-river project will have little or no storage facility. Run-of-river provides a continuous supply of electricity (base load), with some flexibility of operation for daily fluctuations in demand through water flow that is regulated by the facility.
2. Storage hydropower: It is typically a large system that uses a dam to store water in a reservoir. Electricity is produced by releasing water from the reservoir through a turbine, which activates a generator. Storage hydropower provides base load as well as the ability to be shut down and started up at short notice according the demands of

- the system (peak load). It can offer enough storage capacity to operate independently of the hydrological inflow for many weeks or even months.
3. Pumped-storage hydropower: It provides peak-load supply, harnessing water which is cycled between a lower and upper reservoir by pumps which use surplus energy from the system at times of low demand. When electricity demand is high, water is released back to the lower reservoir through turbines to produce electricity.
  4. Offshore hydropower: It is a less established but growing form which employs technologies that use tidal currents or the power of waves to generate electricity from seawater.

These technologies can often overlap. For example, storage projects can often involve an element of pumping to supplement the water that flows into the reservoir naturally, and run-of-river projects may provide some storage capability (International hydropower association[IHA], 2016).

Hydropower plant facilities range in size from large power plants that supply many consumers with electricity to small and micro plants that individuals operate for their own energy needs or to sell power to utilities. On the basis of the power generation hydropower plants can be classified as:

- ) Large Hydropower: These facilities have a capacity of more than 30 megawatts (MW).
- ) Small Hydropower: These plants generate 10 MW or less of power.
- ) Micro Hydropower: These plants have capacity of up to 100 kilowatts. A small or micro-hydroelectric power system can produce enough electricity for a home, farm, ranch, or village.

### **2.1.2 Household**

Household refers to a single person living alone or a group of persons, who may or may not be related, usually living in a particular housing unit and sharing meal with common resources (Central Bureau of Statistics[CBS], 2005).

The concept of household is based on the “arrangements made by persons, individually or in groups, for providing themselves with food or other essentials for living” (CBS, 2016, p 14). A household may consist of one person or a group of two or more persons. The persons

in the group may pool their incomes, may have a common budget or may constitute a combination of persons both related and unrelated.

An individual usually residing for more than six months in a place is considered as a member of the household, though he or she may be temporarily absent. Institutional households, such as barracks of military and police, orphanage, old age homes, jails, and foreign nationals residing in hotels and lodges also do not come under this concept of household.

### **2.1.3 Life-habits**

Life-habits are regular activities and social roles that ensure a person's survival and well-being in society throughout the lifetime. The regular activities include eating meals, communicating with others, moving around, etc while the social roles include holding a job, studying, etc. The accomplishment of the life-habits depends upon the person's age, expectations off the environment, and the cultural factors (Fougeyrollas and Noreau, 2003).

## **2.2 Empirical Studies**

### **2.2.1 National studies**

According to Adhikari (n.d.) hydropower would reduce Nepal's import cost sustainably, contribute in improving the relative comparativeness of the economy both on regional and global basis, and fulfill the desire of double digit sustainable growth in the coming decades.

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

WECS (1995) examined the needs of energy in our lives. The study indicated that survival cannot be thought without energy. Energy is compulsion for the development purposes. Only after the utilization of the energy properly and aptly then the status of

education, condition of health, development of infrastructure, transportation facilities will gear up which leads a country on the prosperous way of development. The shortage of biomass fuels has forced urban households and industries to switch from biomass fuel to imported fossil fuels and other commercial form of energy.

Hamal (2001) has explained that rural and hill areas have undergone deforestation due to insufficiency of alternative energy; i.e. electricity. The author has further explained that energy is required to fulfill day-to-day needs, which includes cooking, heating, lighting and productive activities such as transportation, irrigation, cottage industries, etc. Energy shortage has been recognized as major constraint in economic development and it contributes to further deteriorate the environment, creating a vicious cycle in rural life. Women are the main users of household energy. They are responsible for collecting fuel wood or managing of other energy sources such as doing crop residues etc. Deforestation has made the women's work harder as long walking distance to fetch fuel materials has proven to be a work burden.

The study of the impact of Khimti-I hydropower project in Nepal on the fisherman's livelihood revealed mixed opinion. Out of the 50 respondents surveyed, 51.4% believed that the project has brought positive impacts by providing electricity and establishing schools. Whereas, 48.6% consider negative effects of the project in terms of loss of fish species in river due to low flow hence affecting the livelihood of the fishermen. People who are involved in both farming and fishing thought the project has brought positive impacts, whereas those dependent only on fishing for their livelihood consider negative impacts of project (Sharma, Banjade, & Bhandari, 2007).

Likewise, Thanju (2007) concluded that Kali Gandaki 'A' Hydroelectric Project had brought about improvement of public infrastructure, enhanced educational facilities and employment of local populations, including affected families during project construction and operation phase, and have enhanced the quality of rural lives. The KGA operation has contributed significantly to Nepal's power system and has boosted the economic development of the country.

Joshi (2011) has mentioned that energy is important for economic development. The pace of economic development cannot 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 were found to have

consumed traditional sources of energy for cooking, heating lighting and other necessary activities. Traditional energy sources cannot be sustainable to fulfill energy requirements. From his 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 concentrated 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 area.

The study by Gurung et al (2011) in Sikles, Nepal showed that a micro-hydro plant had a significant impact on the reduction in the consumption of firewood and use of *tuki, panas* in rural households, enabling students to study more during night, and decreasing hardships for women, and powering modern agro-processing mills. The research revealed that village electrification had brought a series of positive impacts in the rural livelihoods. The negative aspect of the micro-hydro plant was that the community had to rely entirely on Annapurna Conservation Area Project (ACAP) due to lack of expertise.

Bista (2011) has compared users and non-users group of Tarakhola micro-hydro project in Tara VDC, Baglung to examine its impact on education, health and access to information. The study showed the positive impact of the hydro plant on education, health and information. The number of the passed students were more in users group than in non-users group, and school dropout students were less in users group. The no. of ill household members from respiratory and eye related problems were less in users group. The households of users group owned electronic devices and information technology.

In the same manner, study of role of micro-hydro in the local development of the Yangsijung and Barabise villages in Sankhuwasabha district, Nepal by Shrestha (2012) concluded that power mills had reduced hardships of women by reducing time for grain and fodder processing, electricity had extended hours of light and reduced use of kerosene, enabled access to electrical equipments like television, cell-phones, radios, etc., and increased the number of saving groups. Apart from these changes in life-habits, the micro-hydro plant had provided jobs for plant operators, managers, electricians, and enabled



establishment of furniture factory, power-mill, chicken farm, store, hotel and cable television service. According to this study, electricity from micro hydropower plants have had significant impact in terms of altering the life habits of households but the impact on entrepreneurship was minimal.

### **2.2.2 International studies**

Bose (1997) has mentioned that the construction of big dams in mountain lead to great controversial issue. The construction of such large dams in the mountain in seismic zones create a great sensitive issue for further disaster and hazards, like the Tehri Dam project in Uttarparadesh, India.

The benefits of dams include irrigation, flood prevention, including power generation while the adverse effects include forced population displacement, boomtown formation causing social/health/economic and cultural problems in the local community, changes in agro-production system, and loss of cultural heritages (Cernea, 2004).

Gonzalez et. al. (2007) studied the impact on development and environment due to micro-hydro projects in Bolivian communities. The study examined nine hydropower projects in Bolivia. The gist of the study was there was significant change on the education, health status, comfort level, self confidence and feeling of owners due to the micro-hydro project. Hydropower was able to reduce 54 percent of the household expenditure for energy related expenditure such as candles, kerosene, LPG and batteries. There were creation of part time job as well as establishment and enhancement of the quality of small business. Due to the electrification education status of student was uplifted as study hours increased. There was continuing of basic literacy for adults in 5 communities additionally. New educational tools have been purchased such as computer rooms, TVs, DVDs, projector etc. The health status of local people improved due to the reduction of smoke generated by firewood at home and there is reduction of risk of fire.

A micro-hydro project implemented by the Mallanadu Development Society, an 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.

Study of the impact of hydropower dams on the communities of the Macal river valley, Central America by Bird (2012) has shown the Chalilo Dam produced overall negative impacts on the downstream communities. The 9 indicators showed negative impact while only 5 indicators showed positive impact. The greatest negative impact was reflected by the river use as a common natural resource, cost of electricity, and well being of the local economy.

Kochar (2013) has concluded in his study of the socio-economic impacts of Sorang hydroelectricity power project in Kinnaur, Himachal Pradesh, India that hydropower projects have made an important contribution to the human development and the benefits derived from them have been considerable, but along with this such developments had altered and diverted the natural river flows, affecting existing rights and access of the locals to water and resulting in significant impacts on livelihood and the environment. He suggested that before construction of hydropower plants the World Commission on Dams recommendations must be taken into consideration, which has stressed four fundamental values regarding the dam building, these are; equity, efficiency, participatory decision-making, sustainability and accountability

### **2.3 National Energy Policies**

Nepal hydropower projects come up through bilateral donor financing in combination with soft loan financing from multilateral development financing institutions. In Nepal it is estimated that the government developed medium-sized hydropower cost an average of US \$ 2, 800/KW, while private generators are producing in US \$ 1000/KW. Making Nepal one of the safest and business destinations in the world. Besides this Nepal became a member of multilateral Guarantee Agency (MIGA). There are about 905 foreign direct investment project in Nepal that worth approximately US \$ 1.65 billion. The domestic investment is \$ 75. 5million and foreign Investment is \$ 233. 6 million in the hydro power in Nepal. Foreign direct investment (FDI) is defined as cross-border investment done by foreign companies in host country. Nepal has good investment prospects in hydropower, tourism, agriculture and information and technology. Hydropower is one of the areas with immense potential to attract FDI. Nepal's hydropower sector has been attractive to FDI particularly after the

construction of large Khimti and Bhotekoshi hydropower projects that were funded primarily by foreign investment (Sharma, Shouqi, Yujian, and Jinfeng, 2014).

The element national energy policies provide the criteria for the compatibility of the hydropower schemes. Without effective policies, no foreign companies and investors will be willing to risk their money in hydropower. The Nepalese government has some policies that are of mixed behavior i.e. that looks beneficial if looked from one angle and awful if looked from another angle. Some of the main laws that govern the investment and hydropower laws are as follows:

- ) Foreign Investment and Technology Transfer Act – 1993
- ) Foreign Investment and One Window Policy Act – 1993
- ) The Hydropower Development Policy – 1992
- ) Water Resources Act – 1992
- ) Water Regulation Act – 1993
- ) Electricity Regulation Act -1993

The 10-year hydropower development plan of 2009 has formulated a program for developing 10000 MW in the following 10 years to overcome the ongoing energy crisis. Other policies involve license freedom for hydropower up to 3 MW, public private partnership in the hydropower for capital mobilization and 15 Foreign Direct Investments. Nepal is an attraction for investors who want to invest in some area for a certain period of time. Also, as a part of the South Asian Regional Initiative (SARI/E) under USAID, Nepal has been promoting energy security program through:

- ) Cross boarder energy trade
- ) Energy market formation
- ) Regional clean energy development

The energy policy of Nepal has focused on the efficient regional energy utilization, transparent and profitable energy production and practice. Also, attempts have been made to address environmental protection concerns, increased regional access and security in energy by means of the government policies (FITA,2015).

### **2.3.1 Policy inconsistencies**

The incentive Hydropower Policy of 1992 had made provisions for license validity for 50 years, tax holiday for 15 years, income tax (applicable after 15 years) at the rate of 10% below prevailing corporate income tax, an allowance of 25% return on invested share capital, 1% customs duty on imported goods for the project, exemption on import license, exemption on sales tax and the easy availability of government land to be leased for the duration of license.

Khimti Hydropower Project-60 MW, Bhote Koshi Hydropower project-36 MW and a few locally financed projects such as Indrawati project came into existence because of this progressive policy of Nepalese Government.

The new Hydropower Policy that came into effect in 2001 was a catastrophic policy in the history of the Nepalese hydropower policy sector. The catastrophic aspects of the policy were the reduction of license validity from 50 years to 35 years, incremental royalty payment, scrapping of income tax holiday, bringing the hydropower projects under the usual corporate tax net of 21.5% and the introduction of Value Added Tax (VAT) for the projects above the capacity of 3 MW (WRA,1993).

The existing hydropower projects are expensive due to heavy reliance on bilateral and multilateral financing agencies, costly foreign consultants and contractors, limited manufacturing capability of power generation, transmission and distribution and related equipments. The power transmission network seems to be the major bottle neck in the Nepalese electricity sector. The Nepalese electricity sector is currently struggling with low generation capacity and a poor transmission network, resulting in long and frequent power cuts in area of high demand. The most critical impact of climate change in Nepal is related to its water resources and hydropower generation from glacier retreat, expansion of glacial lakes. Electric power transmission and distribution losses in Nepal are 981000000 KWH in 2009, according to a World Bank report published in 2010. Electric power transmission and distribution losses include losses in transmission between sources of supply and points of distribution.

## **2.4 Environmental Aspects of Hydropower Projects**

The factor environmental aspects involve the overall and integrated environmental issues of the impact of hydropower projects. The environmental issues may arise because of many factors and at various stages of time. There are many environmental issues that must be analyzed during analyzing the sustainability criteria.

The IHA suggests the following basic and important elements of the environment factor to be assessed: Environment Impact Assessment (EIA) procedure, water quality, sediment transport and erosion, downstream hydrology and flow, rare and endangered species, construction activities, health issues, flora and fauna. The most important environmental sustainability factors for the Nepalese hydro power are described briefly in the following paragraphs.

### **2.4.1 Environmental Impact Assessment (EIA)**

EIA is an assessment conducted to inform decision makers of the projects of the positive and negative effects of a project upon the environment and help in developing the associated mitigation measures against the effects. The environmental impacts of hydropower project are considered during the planning, construction, operation and demolition time of the project and may vary with time as it must be carried under various clues and directives. EIA determines project impact by virtue of its nature, size, location, codes of practice, interested group's participatory approach, environment protection and factual information from the local level and from the government level.

Transparent and collaborative decision making, true and factual information collection creates a good EIA report. In Nepal, the developers consult with local and national resource agencies first to get assistance in the environmental issues to be addressed and to clarify the timelines that apply. Authorities need following information for approval:

- ) Project description
- ) Objectives, targets and success indicators definitions
- ) Existing environment of the proposed area
- ) Project justification and evaluation of project alternatives
- ) Economic, social and environmental considerations
- ) Mitigation measures of environment impacts

) Transparent communication and consultation with stakeholders

EIA reports measure the performance against the targeted objectives and the proposed indicators of the project and suggests the mitigating solutions for the conflicting issues. The best way of mitigating the public conflicts is by the negotiations with the public for anonymous or at least majority public acceptances.

The Nepalese government's EIA Guidelines of 1993 and the Environment Protection Act of 1997 are the basic guidelines for carrying out EIA in Nepal. 'Formulation of Environment Protection act 1997', 'Establishment of Ministry of Environment', 'development of EIA guidelines', 'Considerations of environment concerns in Hydropower Projects' have helped a lot to enforce EIA procedures in Nepal during project proposal and enactments. Simultaneous consultation of Professional Development Programs (PDP), Nepal's regulations and user friendly manuals with local expertise can be used during the EIA procedures of hydropower and distribution.

Ministry of Water Resources (MoWR), Ministry of Environment Science and Technology (MoEST), DoED, and Nepal Electricity Authority (NEA) are the official bodies that evaluate and approve the EIAs of hydropower projects in Nepal (EIA Guidelines 1993).

## **2.4.2 Environment management of existing hydropower schemes**

Continual improvement by review, audit and gradual changes is the aim of the environment management of the existing hydropower schemes that can be controlled or influenced. Despite some contradictions in the scenes, Nepal has provided the investors with all relevant laws, policies, permits, agreements and codes of practice for the jurisdictions in which they must operate. The basic laws and standards for hydropower comply with the following hydropower policies along with the internationally accepted Environment Management System provided by the International Organization for Standardization (ISO) referred to as ISO 14001:

) Electricity Act 2049

) Water Resources Regulation act 2050

) Energy Regulatory Commission Act

) Environment protection Act 1997 (EIA and emission regulations from the existing projects)

) Conservation and threatened species legislation

) Nepal Company Act 1964 (Guide for the national or international investors to establish, transfer shares, merge or transfer the project to the new people or company)

## **2.5 Social aspects of Hydropower Projects**

Hydropower schemes must have significant role in poverty alleviation, and raise the economic standard of the society. Electricity approach, children and women empowerment and the infrastructure development are the positively influencing factors for making the society welcome the project. Multiple benefits such as fresh drinking water and irrigation water, flood control, fishing profession development has convinced the people on the positive side of hydropower development in Nepal and many places have seen the uplifting of the overall social status. The main ensuring issue of the hydropower sustainability is based on the motto that ‘All individuals of the affected communities must benefit in one way or the other’. Important social elements of this factor are presented in the following subsections.

### **2.5.1 Managing social impacts**

Managing social impacts is a collective set of the socio cultural impacts and the treatment and address of the impacts that must be done in same way. For example, in the construction of the Kaligandaki Project, 1468 families lost 208.68 ha of land due to project structures. Also the 21 local fishermen were affected by their profession and the religious site named ‘Setibeni Seela’ was submerged with the stoppage in white water rafting.

These impacts were mitigated by offering the cash compensation for those who lost their land, house and property. Alternative indirect mitigation measures were also taken in the projects including the rehabilitation of the affected families, providing the replacement land and house and providing the job in the project according to their skill and qualification. Also the introduction of the microcredit revolving fund, profession oriented skills and various other things have kept the social harmony with the projects and some of them have become the examples for other projects in the world.

This is the trend in Nepal and till today almost all the displaced people are rehabilitated. Nepalese are socially conscious people and know the rules and national and international provisions that the project must make to the society and what they must contribute to the projects to make the hydropower projects more sustainable. Hence, the cooperation of people

and society with the hydropower developers is always positive, which is the best factor suggesting the sustainability of the hydropower projects.

### **2.5.2 Outcomes for new developments**

Mostly proactive during the planning phase, the element involves the following considerations to ensure the sustainability of the project:

- ) Improved life conditions
- ) Improved health conditions
- ) Direct or indirect project benefits distributions
- ) Information and economics transparency

As per the above mentioned considerations, the hydropower development has contributed to the development and establishment of new hospitals and health care centers in many parts of the hydropower developed areas. This has created a positive output to the new developments in those areas. It can be concluded that the hydropower development has brought many new development opportunities in the areas. The new outcomes such as jobs, infrastructure, education, health care and electricity can always be considered as the supporting tips to advocate the sustainability of hydropower project in Nepal.

### **2.5.3 Strategies to achieve proposed outcomes**

The project proponent may promise many advantages and benefits with the society, but making a promise is not important, the implementation of the promises is the main thing. Therefore, the strategies should be made in such a way that adequate consultation and decisions at all levels are made to gain the best possible impacts during the planning, designing and the implementing phases. This can be done by the direct representation of the affected party in the different stages of project development.

In general community acceptance of a project, particularly in its early phases, will greatly assist in the successful implementation of that project. This has been the strategy of major hydropower projects in Nepal. Therefore, the projects are almost conflict free during the life stage of the operation. But there are also some examples where the project proponent has not taken their promise seriously and the local people also sometimes change the way of dealing their priority with the project holders.



## **2.6 Economic Aspects of Hydropower Projects**

The factor economic aspect means the seen and unseen monetary aspects during any stage of the project. In the case of hydropower projects, almost all the investment comes at the start of the project. All the mechanical, electrical and civil engineering construction has to be done at the start of the project. It looks expensive at the first glance. But, after the initial investment, it doesn't need any investment except for a nominal operation & maintenance cost.

Also, the Power Purchase Agreement (PPA) is always carried out in the forehand of the project completion; hence the whole project has not any concerns from inflations and market prices. Instead, a good payback period has empowered hydropower not to be decommissioned. Continuity, reliability and flexibility are the mechanisms that help in the multipurpose development activities. Also, the good electricity market and the good price of the produced electricity are motivating factors that determine the sustainability of hydropower in Nepalese land and rivers.

### **2.6.1 Institutional framework**

Hydropower in Nepal not only interests the Nepal government, the public and the private sectors of Nepal, but also many foreign people and companies who have direct and indirect interest and invest in this sector. With almost 100 years of Foreign Direct Investment (FDI) history, bilateral and multilateral funding has entered the Nepalese hydropower sector. Mostly the Indian and Nepalese companies are actively investing in hydropower projects due to their resonance on the socio economic culture and their low overall cost. Nepal's hydropower policy is confusing in some ways but there are some institutional special features such as the 'policy of economic liberalization' that draws the investors' attention to hydropower in Nepal.

Nevertheless, the institutional framework in Nepal is seldom available at its best or in an integrated approach; instead there are individual approaches. If all the individual approaches could be integrated with clear good governance and transparency, the development of hydropower would increase geometrically. Hence, institutional frameworks are neither good nor bad.

## 2.6.2 Identifying costs and benefits

Cost and benefits analysis include the income and outcome of the hydropower projects. An approach of cost and benefit analysis must be made during the construction, operation and the maintenance of the project to know the benefit or the loss obtained by the project implementation. The cost of the hydropower projects may be the cost due to land acquisition, environmental and social mitigation cost, maintenance of the civil engineering structure while the benefit can be the payback from the project.

Along with the payback, benefits such as the quantitative measurement of greenhouse gas emission cutting and income of the carbon tax from the other polluters, job creation, recreation, tourism, water supply and irrigation, transfer of technology, power export, etc must be taken as the benefits of the project.

The following scenario should be considered, If we harness 10,000MW hydropower, in the process, every year 132,000 people (13000 persons on construction phase and 32000 in operation phase, assuming 2000 person for 750 MW) can get employment. If Nepal could fast-track projects to generate just 10,000 MW in ten years, consume 2,000 MW itself and export the rest to India, it could earn \$2.7 billion a year. According to Nepal Oil Corporation (NOC), in the fiscal year 2005/06, NRs 2.45 billion has been spent to import petroleum products. If the same amount of money were spent for developing hydropower, we could generate 29.9 MW hydropower electricity (for instance, in Chilime Hydropower Project, 1 KW production cost = \$1550 = NRs.108500). This extraction indicates that Nepal has very good benefit to cost ratios in hydropower development thereby boosting the sustainability (Majagaiya, 2009).

## 2.6.3 Allocation of benefits

Nepal is a democratic country with the concept of capitalistic market. The construction of the hydropower project ensures the infrastructure development i.e. health care, education and the electricity becomes available to people of all caste, creed and race. It creates jobs and local transformation which results in cash flow at the local level and raises the life standard of the people. Thus, this clean energy will not only generate the green and clean energy, but will also transform the country as a whole, and the benefits reach all the aspects of life. The

only requirement for this is the transparency, regular audits and the feeling of the socio corporate responsibility on the project developers.

In Nepal, the benefit is allocated in two ways. One is the capitalist way; the more you have taken the risk, the more will be your benefit. This applies specially to the direct investment. But if the project is of general interest and all parties have an equal share of the investment or the risk, then the benefit is given to all of them in a solidary system. Hence, the allocation of benefit is very systematic and rational, so that everyone on the project area are neither leftover nor repeated for proper allocation of the hydropower projects benefits.

## **2.7 Problems of Hydropower Projects**

These projects suffer from social/managerial, technical, and financial constraints.

### **2.7.1 Social and Managerial problems.**

Project managers often fail to understand the communities they are working with, especially from a social standpoint. According to Maginn (2007), "Policymakers often set up local partnerships with insufficient knowledge of the 'culture' g (i.e., structure, processes, practices, relations, and agents) of the neighborhoods and communities they seek to regenerate, and involve in decision making." Gupte (2003) identified that women are those most directly impacted by micro hydro project installation, but are rarely present in the participatory process. While the decision-making process does not formally exclude women, gender inequality is still rampant. Risal (2002) supports this view by recommending that private investors take the lead in managing hydro projects.

### **2.7.2 Financial problems**

For a hydro project to be financially successful, they must carry a high load factor (i.e., a project must fully utilize the produced energy). In most of the rural Nepalese villages, domestic lighting use provides the largest electricity demand, followed by television and radio. These amounts to a low load factor. It is for this reason that it is essential to use hydro power for income-generating activities to achieve long-term viability (Paish, 2002). Due to a lack of knowledge and skills, this is not always possible. Most projects are dependent upon donors like the UNDP-GEF, NGOs, and high interest loans provided by the ADB (Risal,

2002), which often discourage establishment of a hydro project. Due to social and economic hardships, communities often do not have the tools to alter their infrastructure. As management is often weak, the communities will suffer because they are unable to establish income-generating projects which would increase their load factor and, in turn, the long-term viability of the project.

### **2.7.3 Technical problems**

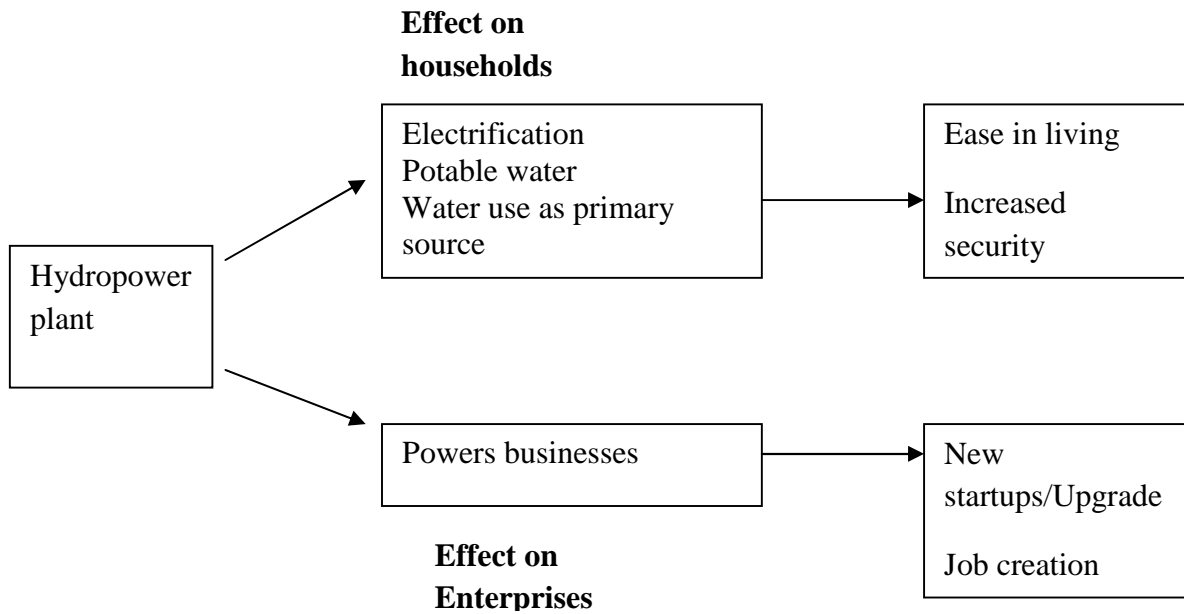
Hydro projects often suffer due to a lack of trained individuals. Nepal manufactures and repairs turbines locally, a practice which is cost-effective, but leads to turbines of low quality, adversely affecting the efficiency of many micro-hydro projects (Smith, 1994).

## **2.8 Conceptual Framework**

This study is based on the concept of socio-economic impact. An impact is a measurable change in the characteristic or property of resources. Socio-economic impact involves analysis of strategies to manage these impacts. Because socio-economic impact is designed to estimate the effects of a proposed development on a community's social and economic welfare, the process should rely heavily on involving community members who may be affected by the development.

This research has analyzed how hydropower plant affected the life-habits and entrepreneurship in the Galyang bazar under the framework that hydropower plant has effect on the households as well as enterprises. The electricity, water from dram, and protection from floods ensures ease in livelihood whereas establishment and running of enterprises enables the community to earn and employ jobs as well. This framework has been adopted in this research:

Fig. 2: Conceptual Analytical Framework



The above literature proves that there exist several impacts related with the hydropower plants. The need of assessing changes brought about by the hydropower plant, impact on the entrepreneurship, and the problems faced during operation of the hydropower plant is justified by these literatures.

## **CHAPTER III**

### **RESEARCH METHODOLOGY**

#### **3.1 Research Design**

Cross-sectional research design has been used to collect information with a structured questionnaire and key informants' interview. The research has been conducted using ethnographic methodology which is mostly qualitative in nature.

#### **3.2 Rationale for the Selection of the Study Area**

The study area, Galyang bazar is familiar to the researcher and the hydropower is the subject of interest to the researcher as well. In addition to these there has been no such kind of research about the Andikhola Hydropower Plant.

#### **3.3 Nature and Sources of Data**

The research has made use of the quantitative and qualitative data which have been collected through both the primary and secondary sources.

##### **3.3.1 Primary sources**

The primary sources of the data are household survey questionnaire and the key-informants interview (KII).

##### **3.3.2 Secondary sources**

The secondary sources are books, journals, articles, internet, reports, etc.

#### **3.4 Study Population**

The 608 households of the Galyang Bazar, Galyang Municipality, ward no.3 were the universe for this research. The target population were the households in Galyang bazar using electricity or water services from the Andikhola Hydropower.

#### **3.5 Sampling Procedure and Sample Size**

Simple random sampling has been employed to select household sample for the research. A 10% sample size has been selected at random which totaled to 61 households for the primary data collection.

### **3.5.1 Validation of the tools**

The developed household survey questionnaire and key-informants' interview (KII) guidelines had been checked for the validity among 6 households prior to conducting of the research. The findings were shown to the experts in the department for its validity during the research.

### **3.6 Techniques and Tools of Data Collection**

Primary data was collected through two techniques. The first was the household survey with structured questionnaire for collecting data on changes in life-habits and impact on the entrepreneurship. The other was the key-informants' interview (KII) with KII guidelines which was the tool for finding the sustainability practices of the project.

### **3.7 Analysis and Interpretation of Data**

The collected data has been categorized and analyzed in simple descriptive manner and presented in tables, charts and diagrams in this report.

### **3.8 Ethical Considerations**

The research has been conducted only after receiving informed consent from the respondents while the KII was conducted after receiving written consent from the participants. The participants and respondents did not receive any monetary gains but the knowledge would indirectly benefit all. During the course of conducting the research careful attention was taken not to disturb the social cohesion and state of the community.

## CHAPTER IV

### ANALYSIS AND INTERPRETATIONS OF DATA

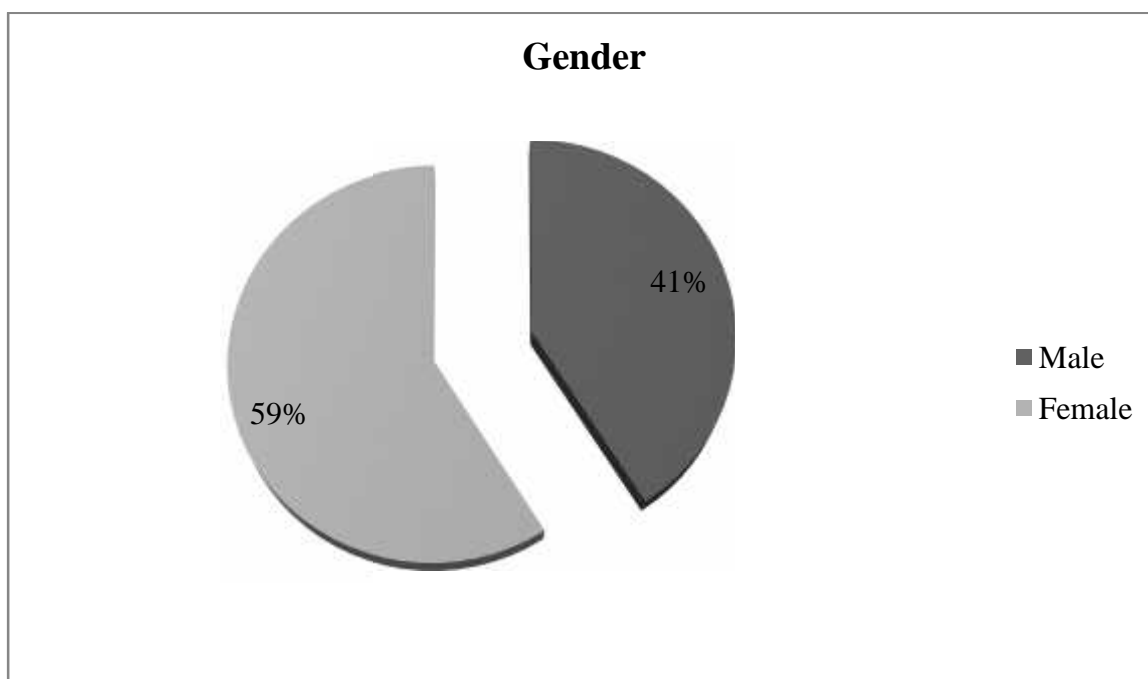
#### 4.1 Household Information

There were total of 608 households in the Galyang bazar according to the record obtained from the electricity board office among which 61 were included in the survey. The distribution of households has been found to be according to the caste, religion, occupation which is represented in tables and figures below.

##### 4.1.1 Gender of the Respondents

Of the total sample, 41 percent (25) were male respondents and 59 percent (36) were female. The gender wise percentage of respondents of study area has been presented in the following pie chart.

Fig. 4.1 Household distribution by gender



Source: Field Survey, 2017.



The above higher percentage of female to male is in accordance with the population of the Galyang municipality provided by the CBS in National Population and Housing Census 2011. According to the document, the percentage of female was 56 and that of male was 44 percent. The higher number of male respondents in the research might be the patriarchal norms of the society which limits interaction of female household members with an outsider.

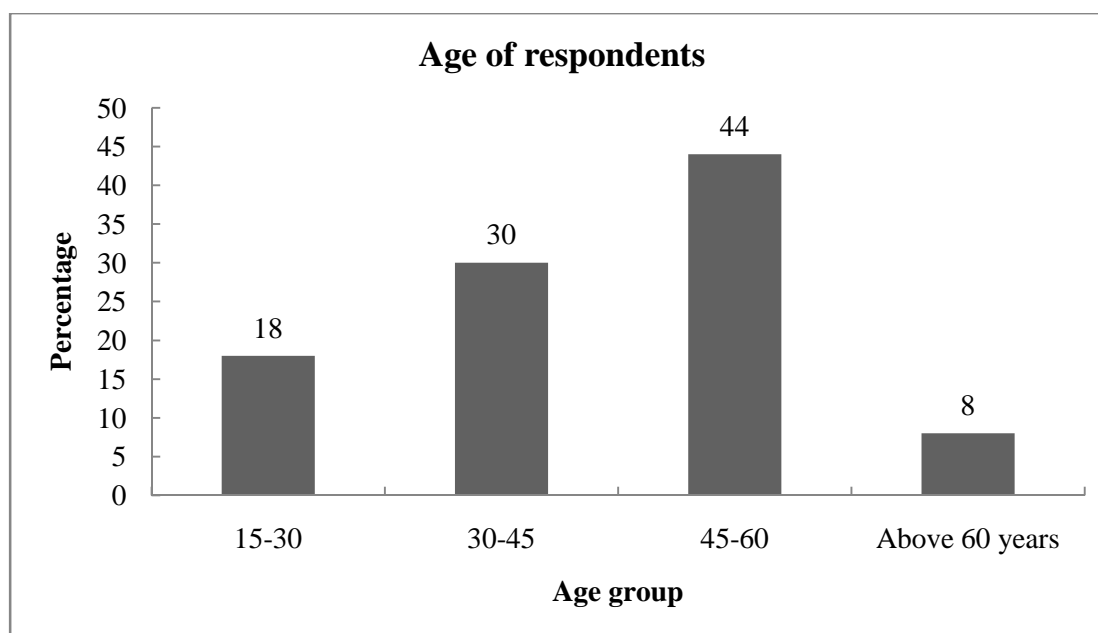
#### 4.1.2 Age group of respondents

According to the age, the respondents were divided into four groups. The questions were asked to the respondents aging above 15 years which is shown below.

Table 4.1 Age group of respondents

Age	Frequency	Percent
15-30	11	18
30-45	18	30
45-60	27	44
Above 60 years	5	8
Total	61	100

Fig. 4.2 Household distribution by age of respondents



Source: Field Survey, 2017.

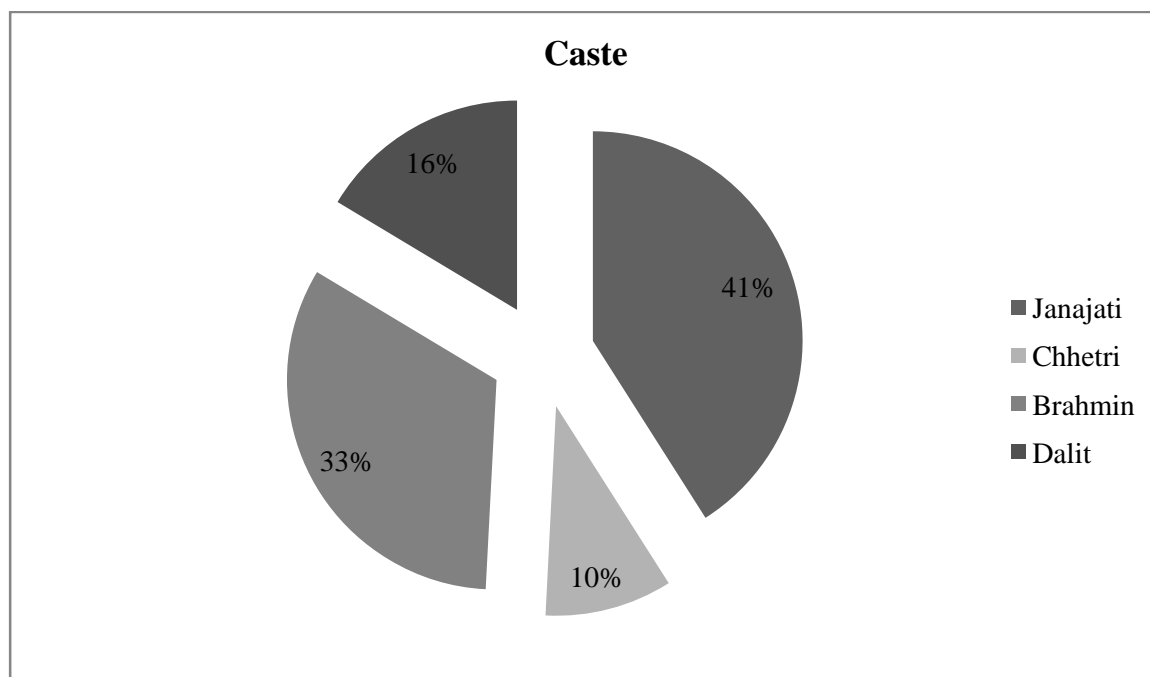
The figure indicates that the age group 45-60 years old was the highest with 44 percent followed by 30-45 years old at 30 percent and the lowest was above 60 years with 8 percent. The reason behind this could be that the population above 15 years up-to 45 years of age were school or college goers, service holder, or business person and had been out of the households.

### 4.1.3 Caste of households

Table 4.2 Caste of households

Caste	Frequency	Percent
Janajati	25	41
Chhetri	6	10
Brahmin	20	33
Dalit	10	16
Total	61	100

Fig. 4.3 Household distribution by caste



Source: Field Survey, 2017.

The higher percentage of Janajati i.e. 41 percent followed by Brahmin 33 percent and the lowest Chhetri 10 percent in Galyang municipality is in accordance to the data provided in the CBS, National Population and Housing Census 2011.

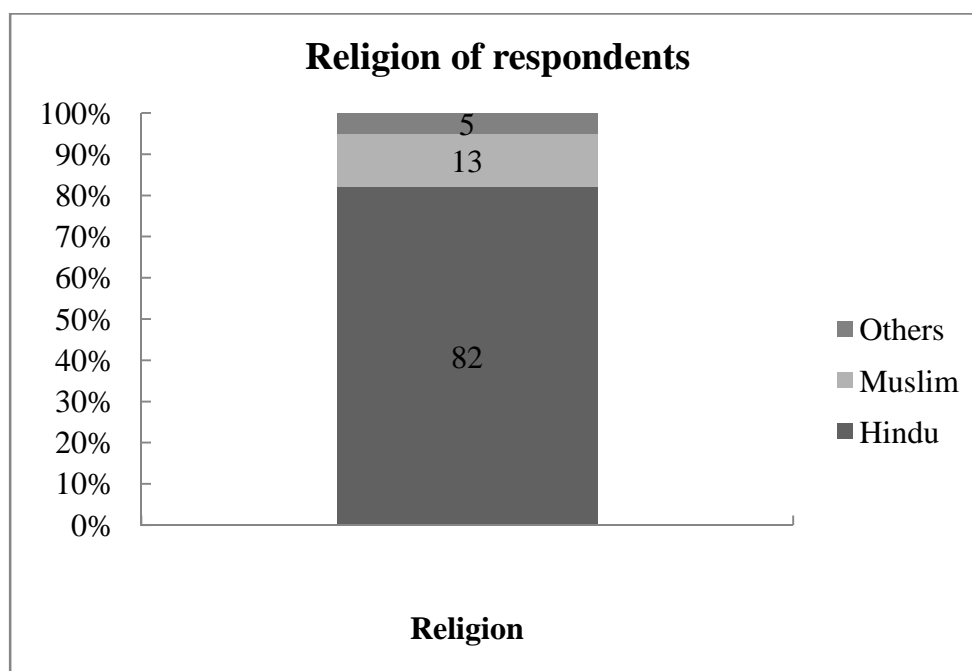
#### 4.1.4 Religion of households

The households were found to follow Hinduism, Muslim, and others including Christianity, Buddhism. The respective numbers of household with religion being followed are provided in the following table:

Table 4.3 Religions followed in Galyang bazar

Religion	Household	Percent
Hindu	50	82
Muslim	8	13
Others	3	5
Total	61	100

Fig. 4.4 Household distribution by religion



Source: Field Survey, 2017.

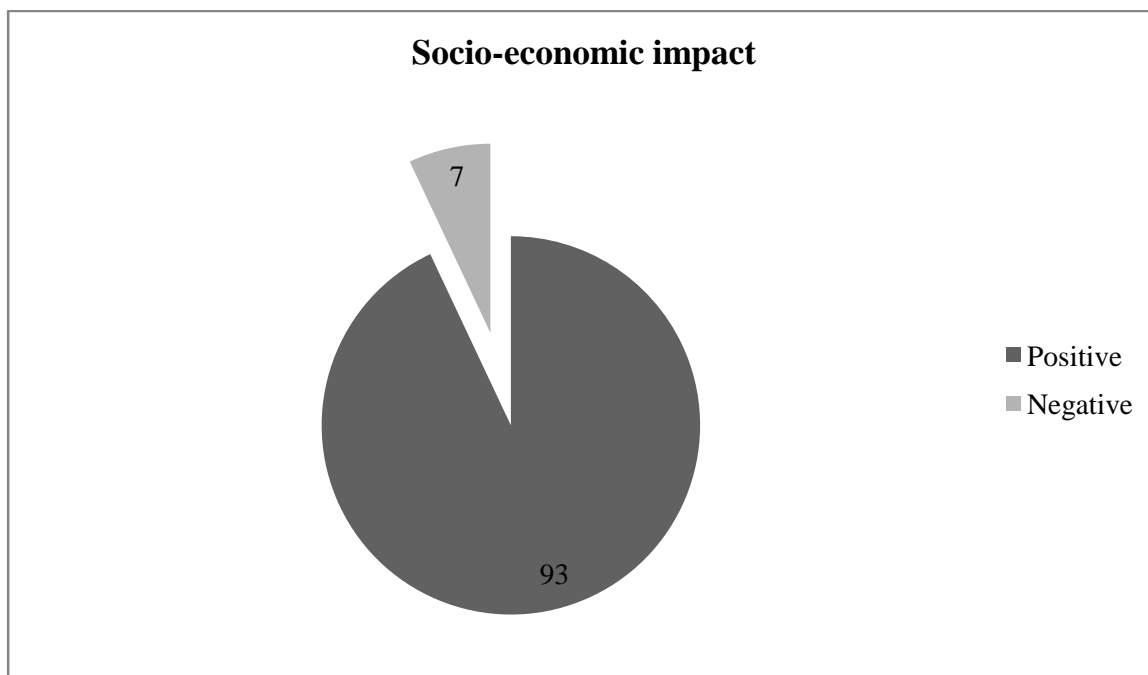
The 82 percent of the respondent households in Galyang bazar were Hindu followed by Muslim 13 percent and others 5 percent. The higher percentage of Hinduism is in accordance with the high percentage of Hindu in Nepal i.e. about 81.3 percent.

## **4.2 Socio-economic Impact**

This section presents the socio-economic condition of the project-affected area and sustainability of the hydropower project. The sociological and economic characteristics such as education, major occupation, income sources, and health have a significant influence in the economics of the village and living standard of the people. The survey households were all connected with electricity lines distributed by BPC. These aid in easing the livelihood of people of the Galyang bazar with processing, networking, water pumping, etc. It has enabled to create education supportive environment for students who can easily read in the dark as well. The communication towers of mobile networks, radio stations and cable-tv have joined the research site with the world through the electricity generated from the Andikhola hydro. The hydro has enabled many residents to diversify their income by establishing enterprises and also added to their source of income.

Among the 61 households surveyed, about 93% indicated the status of the community had been improved through the cheap electricity, establishment of enterprises, long study and work hours, accessibility to the world through media, easing lives through use of electrical appliances, irrigation and drinking water facility, increased farm productivity, along with support from the project itself. But the 7% of the households indicated some negative impacts of the hydro project. The negative impacts included displacement of people from Majhuwa region, decrease in number and variety of fishes from the river, public use of river for recreational purpose, and accidental drowning of people.

Fig. 4.5 Socio-economic impact of Andikhola hydro project



Source: Field Survey

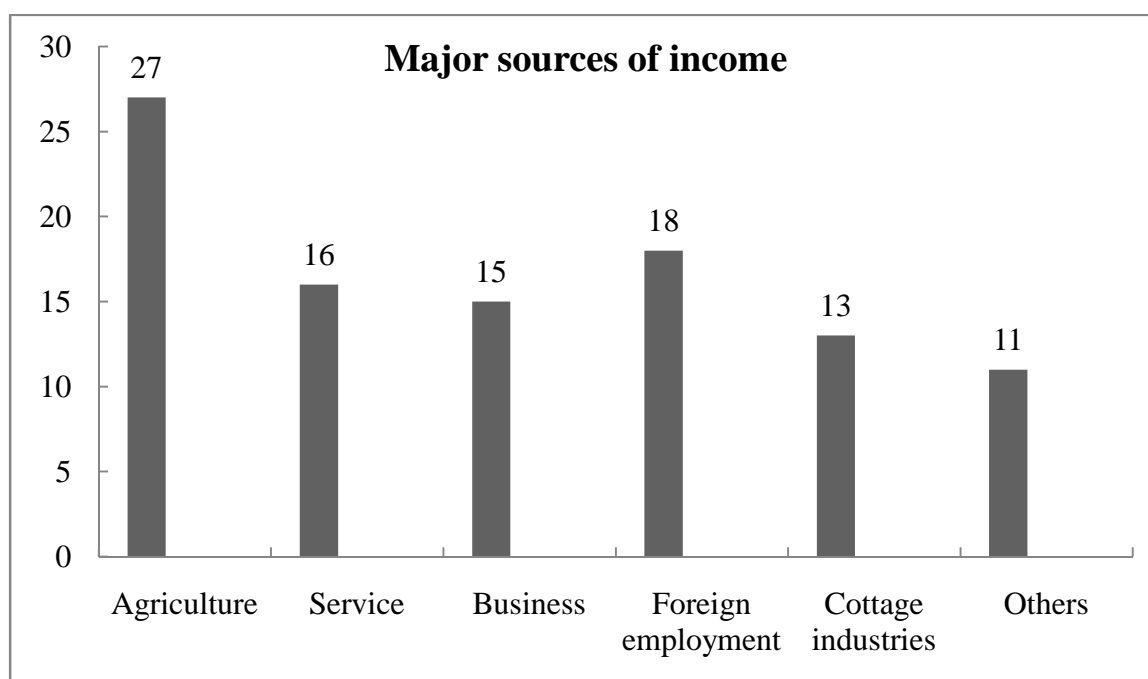
#### 4.2.1 Major income source

The main income sources had been categorized into agriculture, service, business, foreign employment, cottage industries, and others. The respective frequency has been presented in the table below:

Table 4.4 Income source of the households

Income Sources	Frequency	Percent
Agriculture	16	27
Service	10	16
Business	9	15
Foreign employment	11	18
Cottage industries	8	13
Others	7	11
Total	61	100

Fig. 4.6 Major sources of income of Galyang bazar



Source: Field Survey, 2017.

The main occupation of the households of the Galyang bazar was found to be agriculture (27%), followed by foreign employment (18%). The high percentage of foreign employment indicates the trend of out-migration of labor force from the district.

#### 4.2.2 Electricity consumption by households

Table 4.5 Electricity consumption by households

Households	Minimum Units	Maximum Units	Cost per month	NEA rate
0	1	20	Rs 2 - Rs 40	Rs 3 – Rs 60
17	20	50	Rs 70 – Rs 175	Rs 140 - Rs 425
18	50	100	Rs 200 – Rs 400	Rs 500-Rs 1000
20	100	150	Rs 400 – Rs 750	Rs1000-Rs1500
6	150	More than 150	Rs 1050 - more	Rs 1650 – more

Source: Field Survey, 2017.

Majority of households of Galyang bazar i.e. 33 % used electricity between 100 to 150 units per month and paid Rs 400 to Rs 750 followed by 30% of household consuming 50 to 100 units per month and paying Rs 200 to Rs 400 per month. The percentage of households consuming 150 or higher electrical units per month was just 10% indicating low number of cottage industries and other types of industries. The electricity tariff of Andikhola hydro power distributed by BPC is lower than that distributed by NEA gridlines as seen in the above table.

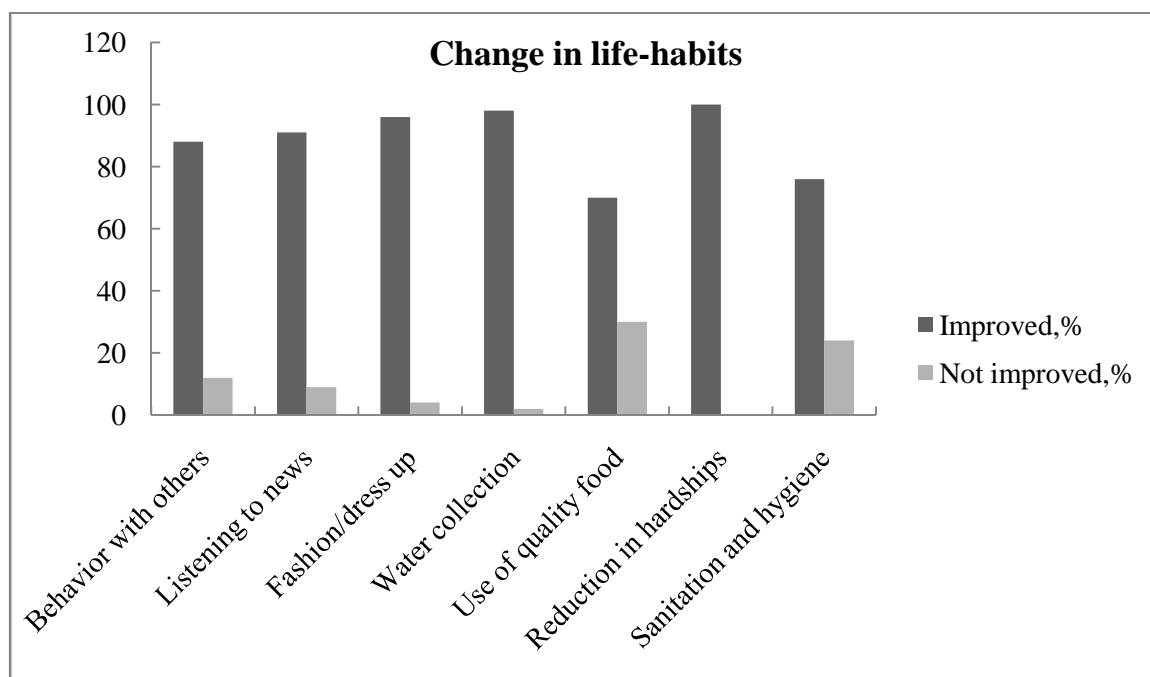
### 4.3 Change in life-habits

Following changes in life-habits have been indicated due to hydro electricity.

Table 4.6 Change in life-habits

S.N.	Activities	Improved,%	Not improved,%
1.	Behavior with others	88	12
2.	Listening to news	91	9
3.	Fashion/dress up	96	4
4.	Water collection	98	2
5.	Use of quality food	70	30
6.	Reduction in hardships	100	0
7.	Sanitation and hygiene	76	24

Fig. 4.7 Change in life-habits



Source: Field Survey, 2017

The improvement in behaving with others, latest fashion trends, access to news have been made possible due cheap and accessible electricity. The use of TV, radios, computer/laptop, and mobile phones have increased the access of people to outside world through media and internet. In addition, it has resulted in improving lives of people by affecting their health and reducing hardships. Residents can now make better decisions about what food to eat, precautions to take against diseases etc.

Mahat (2004) notes that women in rural Nepal spend between two and four hours daily to process grain. The establishment of agro mill has enabled women's work while processing grains in traditional tools like *Okhal*, *Janto*, *Khal*, etc. This also meant few hours of rest to the women spending up to 12 hours doing household chores. This time can be utilized by women to engaging themselves in income generating works.

### 4.3.1 Possession of various electrical home appliances

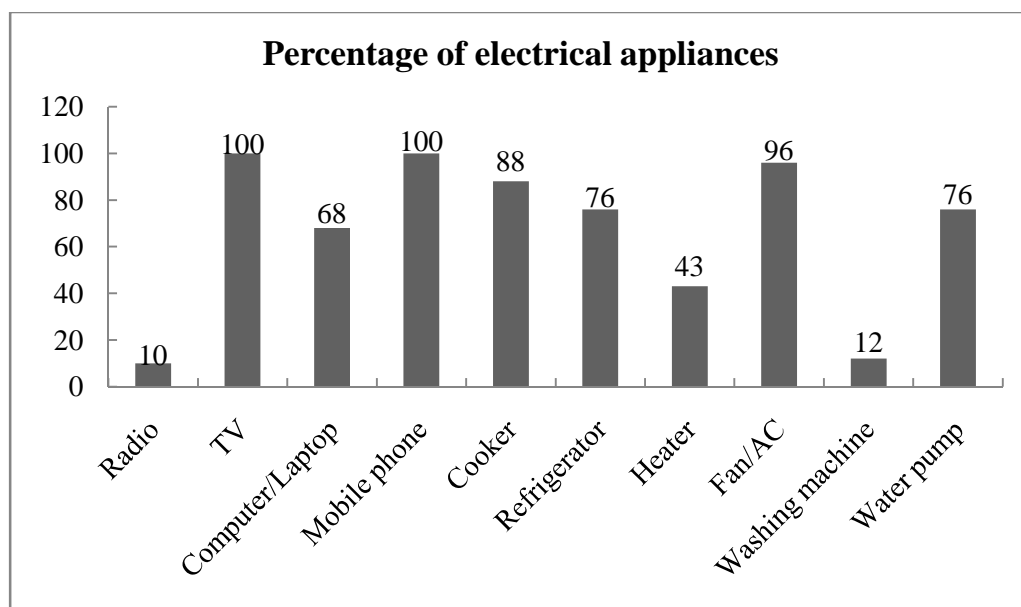
Daily life of local people of Galyang bazar is made easy with the use of various electrical appliances which aid and augment the quality of life. The use of electrical appliances by the households of the community of Galyang bazar has been provided as below:



Table 4.7 Possession of various electrical home appliances

S.N.	Electrical instruments	Possession, percent
1	Radio	10
2	TV	100
3	Computer/Laptop	68
4	Mobile phone	100
5	Cooker	88
6	Refrigerator	76
7	Heater	43
8	Fan/AC	96
9	Washing machine	12
10	Water pump	76

Fig. 4.8 Percentage of electrical appliances



Source: Field Survey, 2017

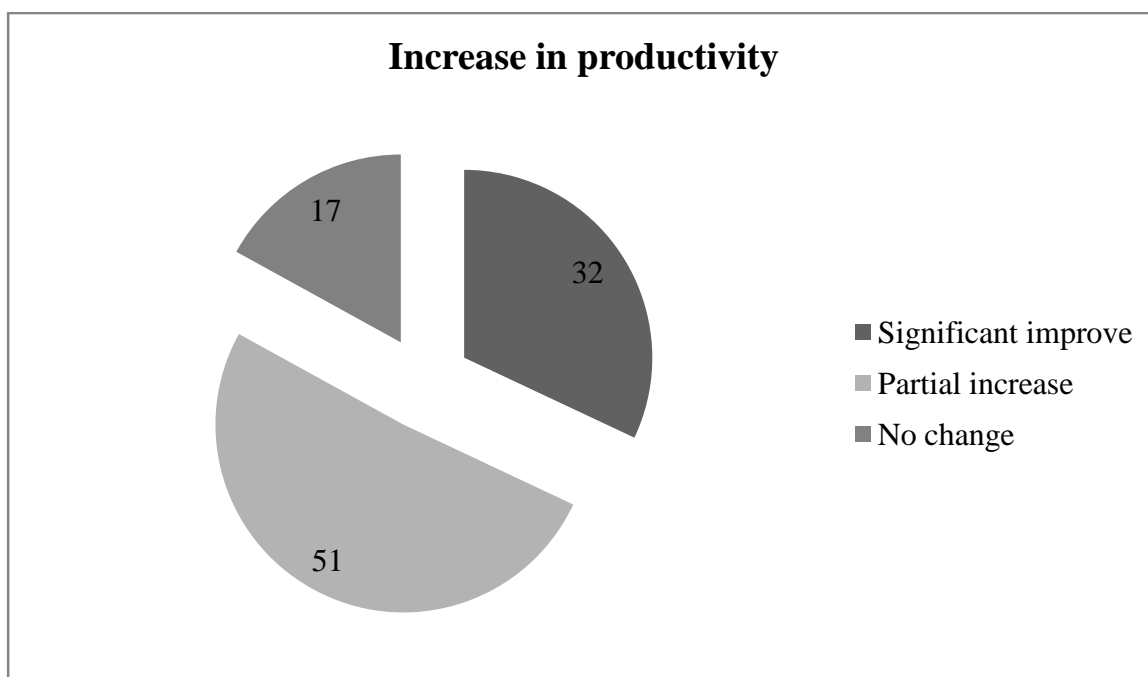
The households of Galyang bazar are equipped with electrical appliances to ease their livelihood as shown in the above diagram. About 70% of households used tv,

computer/laptop, mobile phone, cooker, refrigerator, fan, and water pump. And only 10% used radio, 12% used washing machine, and 43% used heater. The low percent of radio is evident due to availability of radio in mobile phones, low percent of washing machine and heater might be low purchasing power of the households due to dependency in agriculture for income.

### 4.3.2 Increase in productivity

The establishment of 9 small and cottage industries with the hydroelectricity has been able to employ more than 27 people. Out of 61 respondents, 32% indicated that their income level has improved significantly, 51% indicated partial increase in income level and 17% indicated no change due to hydro power.

Fig. 4.9 Increase in productivity



Source: Field Survey, 2017

The increase in productivity has been possible due to establishment of small and cottage scale industries, possibility of more working hours due to abundance of electricity and electrical appliances. The large portion of the households i.e. 51% has indicated partial

increase in the income which might be due to lack of investment in enterprises and production sectors.

Out of the total respondents, 82% referred to increase in the agricultural produce due to direct irrigation facility and water-pump irrigation.

### **4.3.2 Effects on study hours of children**

Table 4.8 Effects on study hours of children

S.N.	Increased hours	Frequency	Percent
1	Upto 1hr per day	12	20
2	1 to 2hrs per day	32	52
3	2 to 3hrs per day	3	5
4	Can't say	14	23

Source: Field Survey, 2017

Out of the 61 households, 52% indicated that the study hours of children was increased by 1 to 2 hours per day with the electrification and avoidance of load shedding in Galyang bazar. The opportunity of education services is the backbone of the development of the community. The chances of education possibilities would help remove the bottleneck of failure to get an urban job by raising skills and increase prospects of rural non-farm employment (Cook, 2011).

### **4.4 Entrepreneurship Development**

In ascertaining whether the rural electrification was associated with the increase in the number of businesses in the community, the research sought to identify the number of enterprises have been opened up, how has the hydro electricity aided in the value addition, and how the business has been expanded.

#### 4.4.1 Households with industries using hydroelectricity

The industries that had been established using the Andikhola hydro power have been tabulated as below.

Table 4.9 Households with industries using hydroelectricity

S.N.	Firms	Household
1	Motorcycle service center	1
2	Saw mill	1
3	Metal workshops	1
4	Agro mill	1
5	Dairy	2
6	Communication center	2
7	Bakery	1

Source: Field Survey, 2017

A total of 9 small and cottage industries were being run among the 61 households with 2 communication centers, 2 dairy, motorcycle service center, saw mill, metal workshop, agro mill, and bakery each single. The percentage of entrepreneurship in the Galyang bazar is found to be 15%. This indicates the potentiality of entrepreneurship in the area to accommodate the needs of the households. In addition no large scale investment was found among the households which showed the low risk bearing capacity and willingness to open up large scale industries.

#### 4.4.2 Value addition by the industries

The connection of electricity at subsidized rate from the BPC has enabled dairy center to use refrigerator, bakery to use driers and kneading machine, communication center to provide facilities of internet, photocopy, print, computer, and cable tv, mills and workshops to use electrical equipments which has resulted in serving lots of customers. The savings from shift from petroleum fuel run equipments to electric machines have resulted in increasing income of the entrepreneurs. Sen (1999) argues that development cannot be achieved unless freedom is achieved and in this case, there is a clear indication that once electrical connection was introduced, the constraint of having to rely on other source of unreliable energy was over.

Another factor the respondents included was the sense of security that came with the lightning and electricity which enabled running business at night also. The ease in connection with the customers by the business firms has enabled to provide quality services, like customers can order through telephone or internet, pay bills electronically, get feedback, etc.

#### **4.4.3 Expansion of enterprises**

The access to electricity services from Andikhola hydro has lead to the expansion of micro-enterprises by expanding their services. In the study areas entrepreneurs were found to have incorporated different dairy products, bakery items, increased number of electrical equipments, installed modern mills and equipments, and able to serve more customers in a day,etc. All this was possible because there was availability of electricity services.

#### **4.5 Sustainability of the Project**

The information on the sustainability of the project was obtained through interviewing key informants. These included 1 administrative officer of the Andikhola hydro, 1 Mayor of Galyang municipality, and 1 local teacher of Galyang Multiple Campus.

##### **4.5.1 Local forest resources**

The decrease in dependence on firewood as fuel has decreased due to abundance of hydro electricity and petroleum gas. The use of electricity for cooking also provides the benefit of smokeless kitchen which in the case of firewood kitchen possess health risks. This has improved the status of forests in the Galyang bazar as people do not cut trees for fuel wood.

##### **4.5.2 Water and environment benefits**

The dam of Andikhola hydropower has enabled farmers to irrigate their 282 hectares of farms with the collected water even in the summer season. This has caused in higher productivity of the land throughout the year. Additionally provision of clean and reliable drinking water supply lines to project affected citizens has not only reduced the time required to fetch water., especially for women, but also provide clean and reliable water sources to households. Before, it used to take a lot of our time to fetch water from distant springs, but now, due to the Aadhi Khola project, every community has a water supply.

### **4.5.3 Unit cost of the electricity**

The Andikhola hydropower project had been providing the residents of Galyang bazar with subsidized electricity through BPC distribution. BPC provides a subsidized tariff to local affected citizens in Andikhola..

The consumers used to pay Rs1.75/watt of electricity consumed which has recently been upgraded to Rs 2/unit for upto 20 units of electricity, while the Nepal Electricity Authority charges Rs3/unit of the electricity consumed for upto 20 units.

### **4.5.4 Local livelihoods**

The hydropower plant has employed local residents and has provided vegetable farming training to the project-affected people as well. Such small hydropower projects has proved that it can meet the energy and food security demands of project-affected communities. Local people from Aadhi Khola have demanded shares of the hydro plant as well which is yet to be shared by BPC. During its construction phase priority was given to the locals for employment and after the construction 85 locals were employed in the Andikhola hydro project.

### **4.5.5 Royalties**

The hydropower project pays Rs 100 per KW as capacity royalty and energy generation royalty per KW hour of 2% upto 15 years of commercial operation to the Department of Electricity Development according to Electricity Act, 1992. Besides this, the project has community development fund under corporate social responsibility.

The development activities include construction of health posts, organization of health camps, cash and in-kind support to schools, literacy programs, reconstruction of temples, financial support to mother's groups, expansion of irrigation system and canal maintenance. Allocation of Rs 25 lakhs every year is made to invest in different development activities.

## **CHAPTER V**

### **SUMMARY, CONCLUSION AND RECOMMENDATION**

#### **5.1 Summary**

Hydro power is a nonpolluting, environmentally 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 sources of energy are not sufficient to meet the energy demand. The use of petroleum fuel is also costly and it negatively pressurizes on the balance of payment in the economy and use of fuel-wood creates pressure on forests.

This study reflects the overview of Nepalese hydro power status and discusses their various socio-economic impacts through a case study of Andikhola hydropower, Galyang bazar. The study has discussed various impacts of hydropower; it not only provides energy for lighting but also helps in improving health condition, saves time, makes easy to study and work at night, is more efficient, increases income as well as agricultural productivity.

This cross-sectional research with ethnographic method of study among 61 households of Galyang bazar in Syangja district has taken the objective to assess the socio-economic impact on the local community, impact on life-habits, and entrepreneurship. The households were selected using simple random sampling. The major findings of the study are as follows:

The main caste in the study area is Janajati (41%) and Brahmin (33%) with 82% households practicing Hindu religion. Agriculture (27%) and Foreign employment(18%) are the main income sources of region. The establishment of the hydro power has enabled people to start up industries such as agro mill, saw mill, communication center, workshops, dairy, bakery, etc. The entrepreneurship was found to be just about 15% with 9 industries. It has made possible to create the employment opportunities where 83% households has raised their income. Agriculture production has been increased by irrigation facility provided by the hydro plant. The cent percent households utilized electricity generated from the Andikhola hydro power with appliances such as TV, laptop/computer, fan, mobile phones, water pump, etc. which make the villagers life-easy and help to change the life-habits of people. The study hour of children has been increased at home. The sanitation and hygiene status, food

consumption pattern, behavior, fashion trend have been found to be improved through the electricity, drinking water, and irrigation facility provided by the hydro plant.

## 5.2 Conclusion

Andikhola hydropower project has positive impact on socio-economic development of the local community of Galyang bazar. Electricity is closely related with human life that aids in the improvement of living standard. Following conclusions can be drawn from the above discussions:

- ) Socio-economic development of the community has been supported by the hydro power project with the royalties, and development fund under corporate social responsibility along with the economic development through establishment of enterprises.
- ) Use of river as a common natural resource for water, cheap electricity, has resulted in decreasing hardships of local community by the Andikhola hydro power.
- ) Agriculture production has been positively affected with the irrigation facility provided by the dam of the Andikhola hydro power plant.
- ) It helped to raise income and employment by helping in the establishment of new businesses.
- ) By utilizing the electricity from the hydro project studying hours of students have increased, changes in behavior, fashion trend, along with improvement in hygiene, and use of nutritious foods have been made possible due to use of communication media through the hydro electricity generated by Andikhola hydro.

## 5.3 Recommendations

Following recommendations are made considering the findings and conclusion of the research:

The surplus power generated by the Andikhola hydro plant should be utilized in productive sectors for which the BPC could establish a core fund and invest in potential projects with priority to local entrepreneurs. Capital can be generated from the locals through issuing project shares so the community would benefit in return through high performance and productivity of the power project.



For future researches following recommendations are made:

- ) Constitute a larger number of households in the research.
- ) Establish this research as the baseline status and study the impact from this point of time.
- Ñ Conduct similar research with comparison to other similar hydro power projects.
- ) A long term i.e. 3 to 4 months of study would be more productive.

## REFERENCES

- Adhikari, D. (n.d). *Hydropower development in Nepal: Economic review*. Nepal: Nepal Rastra Bank. Retrieved from [https://www.nrb.org.np/ecorev/pdf/vol18\\_art4.pdf](https://www.nrb.org.np/ecorev/pdf/vol18_art4.pdf)
- Bird, E. (2012). *The socioeconomic impact of hydroelectric dams on developing communities: A case study of the Chalillo dam and the communities of the Macal river valley, Cayo district, Belize, Central America* (Undergraduate thesis). University of Vermont, Environmental Program & Honors College, USA.
- Bista, B. (2011). *Socio-Economic Impact of Tarakhola MHP Tara VDC, Baglung* (Master's thesis). T.U., Central Department of Economics, Kirtipur, Nepal.
- Butwal Power Company. (2017). *Andikhola Upgrading Project*. Retrieved from [http://www.bpc.com.np/index.php?option=com\\_page&task=details&id=24](http://www.bpc.com.np/index.php?option=com_page&task=details&id=24)
- Bose (1997). *Population Environment and Development: The Tehri Dam Project and issue of population and environment*. New Delhi: Tata Energy Research Institute.
- Central Bureau of Statistics. (2005). Housing and Household Characteristics and Family Structures. In: *Population Monograph*, Vol 1, p 176.
- Central Bureau of Statistics. (2016). *Annual Household Survey 2014/15*. Nepal: National Planning Commission Secretariat, p 14.
- Cernea, M.M. (2004, October). Social impacts and social risks in hydropower programs: Preemptive planning and counter-risk measures. In *Session on Social Aspects of Hydropower Development*. United Nations Symposium on Hydropower and Sustainable Development, Beijing, China. Retrieved from <http://rlarrdc.org.in/images/Social%20Impacts%20and%20Social%20Risks.pdf>
- DFID. (1999). *Sustainable Livelihoods Guidance Sheets*. London: DFID.
- Fougeyrollas, P. & Noreau, L. (2003). *Assessment of Life Habits*. Canada: INDCP.  
Retrieved from:  
[http://www.ripph.qc.ca/sites/default/files/uploads/documents/M\\_1499\\_ANa\\_Mhavia\\_14-99\\_anglais\\_abrege\\_no-reproduction.pdf](http://www.ripph.qc.ca/sites/default/files/uploads/documents/M_1499_ANa_Mhavia_14-99_anglais_abrege_no-reproduction.pdf)
- FITA, (2015). *Foreign investment and technology assessment*. Kathmandu: MFA.

- Ghimere, H.K. (2008). Harnessing of mini scale hydropower for rural electrification in Nepal. *Hydro Nepal: J. Water Energ. Environ.*, 1(1), 26-28.
- Gupte, M. (2003). Reexamining participatory environmental policy: social and gender dimension. *Society and Natural Resources*, 7(5), 327-334.
- Gurung, A., Joo, J.H., Oh, S.H., & Bryceson, I. (2011). Socio-economic impacts of a micro-hydropower plant on rural livelihoods. *Scientific Research and Essays*, 6(19), 3964-3972.
- Hamal, S. (2001). Energy and rural women. *WCS Bulletin*, Vol. 6.
- IHA, (2016). *Types of hydropower*. London: IHA Central Office.
- Jha H.B. (1995). *Sustainable development of small hydropower in Nepal*. Nepal: Center for Economic and Technical Studies.
- Joshi, K.P. (2011). *Socio-economic impact of Surma Devi hydropower project* (Master's thesis). T.U., Central Department of Economics, Kirtipur, Nepal.
- Kochhar, N. (2013). Socio-economic impacts of Sorang hydroelectricity power project in District Kinnaur, Himachal Pradesh, India. *Journal of Environment and Earth Science*, 3(3), 54-62.
- Koirala, B. (2007). *A community based micro hydro: A promising technology for rural development in Nepal* (Master's thesis). University of New Mexico, Department of Economics, USA.
- Maginn, P. J. (2007). Towards more effective community participation in urban regeneration: the potential of collaborative planning and applied ethnography. *Qualitative Research*, 7(1), 25-43.
- Majagaiya, K.P. (2009). FDI in Nepal's hydropower sector: A focus on the product. *Nepal Monitor: The National Online Journal on Media and Public Affairs*. Retrieved from: [http://www.nepalmonitor.com/2009/01/fdi\\_in\\_nepals\\_hydropower.html](http://www.nepalmonitor.com/2009/01/fdi_in_nepals_hydropower.html). Accessed on 23rd Nov, 2017.
- NEA, (2015). *Nepal electricity development report*. Kathmandu: Nepal Electricity Authority.
- Paish, O. (2002). Micro hydro power: Status and prospects. *Journal of Power and Energy*, 215(A1), 31-40.
- Rijal, K. (2002). Mini and micro-hydro development: Status, issues and strategies for the Hindu Kush himalayan region. *A Journal of Engineering*, 9, 1-8.

- Sangroula, D.P. (2009). Hydropower development and its sustainability with respect to sedimentation in Nepal. *J. Inst. Eng.*, 1,1-9.
- Sen, A. (1999). *Development as Freedom*. London: Oxford University Press.
- Sharma, B., Shouqi, Y., Yujian, F., & Jinfeng, Z. (2014). Survey and analysis about the status and future trends of hydropower development in Nepal. *International Journal of Civil Engineering and Mechanics*, 1, pp. 1 – 10.  
Retrieved from: [http://www.irphouse.com/jcem/jcemv1n1\\_01.pdf](http://www.irphouse.com/jcem/jcemv1n1_01.pdf).
- Sharma, S., Banjade, S., & Bhandari, R. (2007). Impact of Khimti-I hydropower project in Nepal on the ecological status of river and fishermen's livelihood. *International Conference on Small Hyrdopower – Hydro Sri Lanka 22-24 October, 2007*. Retrieved from:  
<http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.526.1616&rep=rep1&type=pdf>
- Shrestha, V. (2012). *Role of Micro Hydropower plants in Local Development: A Case of Two Villages in Shankhuwasabha District, Nepal* (Master's Research Paper). Institute of Social Studies, The Netherlands.  
Retrieved from [https://thesis.eur.nl/pub/13254/Vivek%20Shrestha\\_vivekshrestha-RP-final\\_1509.pdf](https://thesis.eur.nl/pub/13254/Vivek%20Shrestha_vivekshrestha-RP-final_1509.pdf)
- Smith, N.P.A. (1994). Key factors for the success of village hydroelectric programs. *Renewable Energy*, 5(5-8), 1453-1460.
- Study projects 50,000 MW of electricity by 2040 in Nepal. (2017, January 9). *the Kathmandu post*. Retrieved from <http://kathmandupost.ekantipur.com/news/2017-01-09/study-projects-50000-mw-electricity-demand-by-2040-in-nepal.html>.
- Thanju, R.P. (2007). Kali Gandaki 'A' Hydroelectric Project in Environmental Perspectives. *Hydro Nepal: Journal of Water, Energy and Environment*, (1), 15-21.
- Workman, J. (2009). *Dams Encyclopedia of Environmental Ethics and Philosophy (Vol. 1)*, Detroit: Macmillan Reference USA, 197-200.
- WECS. (1995). *Socio-Economic Issues in Energy Development*. Nepal: Water and Energy Commission Secretariat.
- WRA. (1993). *Water Regulation Act*. Kathmandu: Ministry of Water Supply and Sanitation.

## APPENDIX

### Appendix A: Survey Questionnaire

#### 1. General information of Respondents

S.N.	Questions	Code/Answer
1.1	Name of respondent	
1.2	Gender	1.Male 2.Female
1.3	Age of respondent	
1.4	Number of household members	Male..... Female.....
1.5	Caste	1.Brahmin 2.Chetteri 3.Janjati 4.Dalit 5.Others
1.6	Religion	1.Hindu 2.Buddhist 3. Christian 4. Kirat 5.Others
1.7	Main occupation of household members	1.Agriculture 2.Services 3.Selfowend business 4.Foregin employment 5.Others

## 2. Hydropower and Electrification

2.1 How many units of electricity do you consume per month?

Maximum..... Minimum.....

2.2 How much money do you pay for electricity per months? Write in total Rs.

Maximum..... Minimum.....

## 3. Socio-Economic Impact

3.1 Do you think the project has improved the status of the community?

1. Yes

2. No

3.2 If No, what negative impacts have you seen in the community?

.....

3.3 Have you done the productive work by using hydropower system?

1. Poultry farming                      1. Yes                      2. No

2. Furniture                              1. Yes                      2. No

3. Sawmill                                1. Yes                      2. No

4. Dairy                                    1. Yes                      2. No

5. Agro mill                               1. Yes                      2. No

6. Computer                              1. Yes                      2. No

7. Other specifies                      1. Yes                      2. No

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

1. Significantly increased

2. Partially increased

3. No change

3.5 How does the electricity add value to your business?

.....  
.....

3.6 How has the electricity helped in the expansion of the business?

.....  
.....

3.7 Does the project helps to promote the agriculture product?

- 1. Yes
- 2. No

3.8 Do you possess these electrical instruments in your household?

- 1) Radio .....
- 2) TV .....
- 3) Refrigerator .....
- 4) Computer .....
- 5) Cell phone .....
- 6) Chargeable battery .....
- 7) Others specify .....

3.9 What is the status of your family income using hydro electricity?

- 1) Increase
- 2) Decrease
- 3) No change

4.0 How many additional hours have your children been studied due to access to electricity?

.....

4.1 Have you seen any changes in following activities in household members using electrification?

1) In fashion	1. Yes	2. No
2) In behavior	1. Yes	2. No
3) In thinking	1. Yes	2. No
4) Listening to news	1. Yes	2. No
5) Sanitation and hygiene	1. Yes	2. No
6) Quality food intake	1. Yes	2. No
7) Others (please specify)		

Name of the Facilitator .....

Date: .....

\*Thank you for your time\*



## **Appendix B: KII guidelines**

### **Key Informants Interview (KII) guidelines**

My name is \_\_\_\_\_ from the Tribhuvan University, Kathmandu. I am a graduate student at the Central Department of Rural Development with an aim to study the impact of Andikhola hydropower plant.

Anything you tell me is confidential. Nothing you say will be personally attributed to you in any reports that result from this interview. All of our reports will be written in a manner that no individual comment can be attributed to a particular person.

Are you willing to answer my questions? Do you have any questions before we begin?

1. What is the sustainability of the project?

(Probe: What activities were done to ensure the sound operation of the plant? )

2. What efforts are in place for the sustainability of the project ?

(Probe: Think back to the challenges faced in the past.)

3. In the future, what would you suggest the hydropower plants should do?

(Probe: On the matters related to compensation, tariffs, benefits, water services, etc.)

**Thank you for your time!**

## Appendix C: Photos taken during the survey and KII



Fig. I. Visit to the Andikhola hydro plant.



Fig. II. Conducting KII with the hydro administrative officer



Fig. III. Conducting household survey



Fig. IV. Conducting household survey 2