CHAPTER I

INTRODUCTION

1.1 General Background

Hydropower is a method of generating electricity that uses moving water (kinetic energy) to produce electricity. Small-scale hydropower has been used as a common way of generating electricity in isolated regions since end of 19th century. Small-scale hydropower systems can be installed in small rivers, streams or in the existing water supply networks, such as drinking water or wastewater networks. In contrast with large-scale hydropower systems, small-scale hydropower can be installed with little or negligible environmental impact on wildlife or ecosystems, mainly because the majority of small hydropower plants are run-of-river schemes or implemented in existing water infrastructure. Due to its versatility, low investment costs, and as a renewable energy source, small-scale hydropower is a promising option for producing sustainable, inexpensive energy in rural or developing areas.

While water resources are valued for human health and for sustaining food production, the energy contained in moving water such as rivers or tides can also be harnessed to create energy through hydropower or mechanical uses. Hydropower schemes can either be small-scale or large scale, depending on the local conditions and the energy demand, and represented as a renewable energy source that can be implemented wherever there is running water. As running water is a resource that is globally available and renewable, harnessing its power to generate electricity can provide a sustainable source of energy to improve livelihoods and increase working productivity. Particularly in rural or developing areas, small-scale hydropower can represent a locally available, reliable source of energy where no other energy generation is feasible. (SSWM 2012)Globally, 1.4 billion people lack access to electricity, with an additional 1 billion having only intermittent access (UNDP 2012).

The power available in a river or stream depends on the rate at which the water is flowing, and the height (head) which it falls down. Hydro schemes are sometimes classified into four groups, although there's no universal agreement on the boundaries between them, and the basic principles of operation are the same for all. While large

scale hydropower plants can produce well over 100 MW, small hydropower plants generally produce less than 10 MW. Based on energy production capacity, small-scale hydropower production is broken into four size categories of pico- (<5 kilowatts), micro- (5-100 kW), mini- 100 kW-1 MW), and small (1-10 MW)(SINGH 2009).

Hydro is an indigenous and renewable sources of energy. The conversion of the potential energy of water into mechanical energy is a technology with a high efficiency (in most cases double that of conventional thermal power stations). The use of hydropower can make a contribution to savings on exhaustible energy sources. Small hydropower (SHP) is a renewable, pollution free and reliable sources of energy which can be produced easily in mountain and hillside of Nepal. So, it is the best alternative among all the available sources of energy in the context of Nepal. The first hydro plant Farping Hydropower 500 KW was installed about century ago (May, 1911AD). Due to the unique geography with scattered settlements, the national grid electricity expansion is difficult to electrify in the rural areas of Nepal. The small hydro is suitable and economizes alternative for rural electrification of Nepal. So, small-hydropower has a great potentiality for fulfilling the energy requirements of rural Nepal to a great extent (Adhikari, 2006).

Nepal is the second richest country of the world and first richest country in Asia in the context of water resources. Nepal has about 6000 large and micro rivers hurling from the Himalayas and high mountains towards the plain (WECS, 2004). The perennial nature of Nepalese river and stepped grand of the country topology provided ideal condition for the development of some of the world's largest hydropower project in Nepal. The total hydropower potential of these rivers is estimated about 83,000 MW (REDP, 2007). Although the government declared the year 2011 to 2015 is 'Energy Crisis Year' and aims to produce 2,500 MW by the end of 2015 (Vidyut, 2012).

Nepal is a landlocked and mountainous country, which is situated between two big countries India and China. It is 1127 km far from the nearest point of the sea. Nepal has immense natural resource but unable to use it properly hence, people are compelled to live under poverty. Out of the total population, about 80 percent people live in rural and remote areas. Similarly 80 percent people depend on agriculture. So, Special rural electrification scheme need to be adopted to electrify such region. Small

– Hydro means that extending the grid to isolated rural communities scattered in the hills across the nation. Due to the consciousness about the negative environment and socio-economic impact of traditional energy, commercial fuel and inaccessibility to invest on large-scale hydropower development, electrification through Small-scale decentralization small-hydropower (SHP) emerges as suitable alternative for rural electrification in Nepal.

Energy or power is the driving force for the growth and development of a nation. There are various sources of energy and each nation has its own reserve and energy policy to propel the development activities. Among the various country of the world, Nepal is one of the gifted country with a vast reserve of natural resources; particularly it is rich in hydropower resources. Over the last 100 years, the development of hydropower in Nepal has not been per expectation and the resulting effect has been the long-shedding throughout the nation reaching the perplexing figure of 16hrs a day (HDD, 2017).

Gandaki Hydropower is located on the southern belt of the Annapurna conservation area. It lies in the Revan Village Development Committee (VDC) of Kaski and is situated about 24 km northeast of Pokhara. It lies between 1,100 to 3,331 m above sea level. Gandaki Hydropower is situated on Revan but unfortunately its distributed area is in Lawnag Ghalel VDC. So all field survey is performed on Lawang Ghalel VDC. In the survey area, project affected household are 273 where only 83 sample household are taken to find the economic contribution of SHP on household, role of SHP for sustainable changes and technological progress in project affect areas.

1.2 Statement of the Problem

Generation of electricity through hydropower plant is the best alternative in context of our country. Our country is landlocked and the cost as well as supply of fossil fuels is expensive. Generation of electricity via wind and geothermal energy are still the subjects of research and development. Hence the generation of electricity via hydropower is the optimal solution because of fast flowing perennial rivers. Although establishment of hydropower is the best option for electrification, construction of major hydropower is also not feasible because of the high cost and technical hindrance. So the small hydro is the proper option for electrification. This is viable

option for micro communities in the rural areas of hilly region as it can be established by the micro investment, experts and equipments. Following are same of the major points regarding the problems on electrification

i. Because of uneven land topography NEA is not being able to bear the cost to connect every remote village in the national grid line.

ii. Construction of large hydropower is much costlier and time consuming.

iii. Current small hydropower are not sufficient enough because of the lack of investment, skilled manpower and appropriate management.

The thesis paper is concentrated on finding the contribution of Gandaki Hydropower in income, employment, health, education and uses of new technology in Lawang Ghalel VDC.

1.3 Objectives of the Study

The objectives of this study are divided into two categories viz. general objectives and specific objectives.

i. To evaluate the contribution of the small hydropower projects (SHPs) in rural development through income, saving and employment generation.

ii. To examine the economic contribution of Gandaki Hydropower Project in Lawang Ghalel VDC of Kaski district.

1.4 Significance of the Study

Hydroelectricity is the most effective and sustainable form of energy in Nepal, as it has been endowed with a lot of water resources. However, due to lack of capital, researches and technical manpower, the mega hydro projects are still not an easy and feasible source of energy in Nepal. Further, the electricity produced by the large projects has been centered on the urban area and has nothing to do with the vast mass of rural poverty. In the context, small hydropower projects hold a remarkable significance to uplift the rural poor by contributing directly and indirectly for employment and income generation with use of technology. However, one major problem of such projects is the lack of sustainability. There are number of problems

that lessen the effectiveness of such projects after the competition and lead to waste of resources. Studies on the small hydropower projects in Nepal are still lacking. Thus it is highly desirable to analyze the small hydropower in terms of its end-use efficiency, uplifting of the life of rural poor and overall socioeconomic uplifting.

The results of the study will be extremely helpful to the policy makers to formulate the appropriate policies for the development of small hydropower in the rural area. It will also be helpful to existing small hydropower projects to maintain their sustainability. The results also will be helpful to other individuals and institutions for the implementation of programs efficiently, to know the externalities of such projects in the rural area. This study will be helpful to highlight the economic contribution of SHPs in rural areas.

1.5 Limitations of the Study

This study primarily focused on the characteristics of the community and contribution caused by Gandaki hydropower at these areas. The generalization derived from this study may not be equally applicable to other sectors. This is based on primary data as well as secondary data which are completely limited to its objectives. Because of the limited time the study may not cover the analysis of long term issues and impacts in details. Due to financial constraints the study might be limited to the review of some literatures and based on limited field visit.

1.6 Organization of the Study

This section deals with how the chapters are organized hereby. Altogether this study is divided into five chapters.

The first chapter consists of the introduction of the study about Gandaki Hydropower Project. The chapter also shows that statement of problems, objectives, significance and limitation of the study.

The second chapter consists of the review of literatures focuses on the economic contribution of hydropower development in Nepal. This review based upon the gist of the past publications.

The third chapter deals with the research design, nature and sources of data, methods

of data collection, data processing and analysing. Descriptive research design has been adapted to complete this study. This study is specially based on primary data at Lawang Ghalel VDC.

Fourth chapter attempts to analyse the collected data and information for pursuing the objectives of the study and deriving the major finding of the study and presents the brief introduction of the study area with demographic feature, this study has been conducted from the direct interview method with 83 respondents. Those respondents were selected by simple random sampling, this chapter deals with the analysis of economic contribution of Gandaki Hydropower on education, health, income, and existing latest technology of the study area.

At last in the fifth chapter, I am going to make conclusion of a whole thesis and recommend to concern department (Sarokarwala) for improving, to get extra benefit from the SHP.

Bibliography and appendix are given at the end of thesis.

CHAPTER II

REVIEW OF THE LITERATURE

2.1 Introduction

Nepal is a landlocked independent state located in South Asia. With an area of 147,181 square KM (56,827 sq mi) and a population of approximately 27 million, it is the world's 93rd largest country by land mass and the 41st most populous country. It is located in the Himalayas and bordered to the north by the People's Republic of China, and to the south, east, and west by the Republic of India. Kathmandu is the nation's capital. Nepal is roughly trapezoidal in shape, 497 mi long and 124 mi wide, stretching from east to west. The 56,827 sq mi area is divided into three different regions - Mountain, Hill and the Terai, paralleled to each other and stretching from east to west. They are vertically intersected by Nepal's major, north to south flowing river systems (HIDCL, 2017).

2.2 Theoretical Review

Hydro power is the most useful and cheapest source of energy. For rural application we can utilize the small hydropower up to great extent. Small Hydropwer in General for thousands of years, mankind has used the force of water to perform various tasks. Thus, the use of hydropower can be old back to Mesopotamia and ancient Egypt. Over the centuries, running water was used to power water wheels that were meant to assist in flour production, irrigation, sawing and other economic activities. As the water wheel spread around the world, people started to think about possible improvements. Over many centuries, engineers tried to vary the wheel orientation. Finally, in the 18^{th} century a French engineer named Bernard Forest de Belidor started to develop modern hydro turbines by describing the use of vertical and horizontal-axis machines in his four-volume work Architecture Hydraulique published between 1737 and 1753. In the following century, research and development of hydro turbines continued. In 1880 the Michigan’s Grand Rapids Electric Light and Power Company generated electricity for a theatre and a storefront lighting using a brush arc light dynamo driven by water turbine. This first hydroelectric power plant was also the beginning of the usage of alternating current (AC), Which is used till today (EERE,

2010). The new technology spread rapidly around the world and in 1886 the first AC (Alternating Current) hydropower plant of Switzerland was constructed near Lucerne with an installed capacity of 184 KW (Wasser Kraft Werke, 2010). In the following year, but especially between 1945 and 1970, many new and increasingly large hydropower plants were built and at the end of the 70's about 90% of electricity was produced using hydropower. Therefore, the power plants should preferably use renewable energy technologies such as wind power, geothermal energy, biomass, solar or hydropower, small hydropower plants are, as the name suggests, small-scale hydropower plants up to a certain amount of installed capacity. Small hydropower plants up to a certain amount of installed capacity.

2.2.1 Theoretical, Technical and Economical Hydropower Potential of Nepal

Nepal is a second richest country of the world after Brazil and first country in Asian the context of water resources. Nepal has over 6,000 rivers and streams flowing from Himalayan and high mountains towards the tarai region. Its water resources constitute about 2.27% of the world stock for about 0.35% of the world population (Dahal and Guru-Gharana, 1993). It is drained by 3 major river systems: the Koshi in the east, the Gandaki in the central region, and the Karnali in the west. Most major river basins originate in the Himalaya and are snow or ice glacier fed and maintains relatively high flow. Thus with such steep topography and such immense river resources, the potential for hydroelectric power is great. Based on annual run-off of rivers the theoretical potential hydropower of Nepal is estimated to be about 83,000MW. Current estimates are that Nepal has approximately 42,000 MW of economically feasible hydropower potential. However, the present situation is that Nepal has developed only approximately 846 MW of hydropower. Therefore, bulk of the economically feasible generation has not been realized yet. Besides, the multipurpose, secondary and tertiary benefits have not been realized from the development of its rivers (DED, 2016).

Table 2.1

Theoretical, Technical and Economical Hydropower Potential of Nepal

Major River Basins	Theoretical Potential in MW			Technical Potential		Economical Potential	
	Major river courses having catchments areas above 1000km^2	Small river courses having catchments areas above 300-1000km^2	Total	Number of Project Sites	Technical Potential in MW	Number of Project Sites	Economical Potential in MW
Sapta Koshi	18750	3600	22350	53	11400	40	10860
Sapta Gandaki	17950	2700	20650	18	6660	12	5270
Karnali & Mahakali	32680	3500	36180	34	26570	9	25125
Southern River	3070	1040	4110	9	980	5	878
Country total	72450	10840	83290	114	45610	66	42133

Source: Government of Nepal, Water & Energy Commission Secretariat "Electricity Demand Forecast Report (2015-2040), publish January 2017

Nepal's total theoretical hydropower potentiality is 83.29 GW. The theoretical hydropower potentiality of major river courses and small river courses are 86.99 percent and 13.01 percent respectively. The total technical potentiality is 45.6 GW which is 54.66 present and economic potentiality 42.13GW which is 50.6 present of theoretical potentiality.

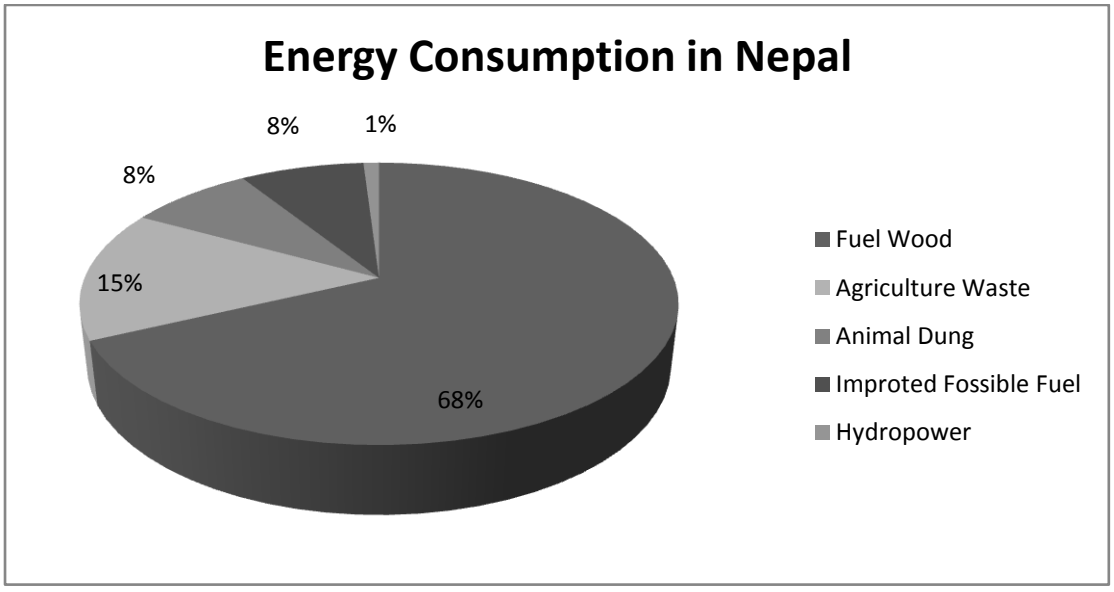
The electricity demand in Nepal is increasing by about 7-9% per year. About 84.9 % of population in Nepal has access to electricity through the grid and off grid system (WB 2017).Most of the power plants in Nepal are run-of-river type with energy available in excess of the in-country demand during the monsoon season and deficit during the dry season.

2.2.2 Energy Consumption in Nepal

Nepal's electricity generation is dominated by hydropower, though in the entire scenario (situation) of energy use of the country, the electricity is a tiny fraction, only 1% energy need is fulfilled by electricity. The bulk of the energy need is dominated by fuel wood (68%), agricultural waste (15%), animal dung (8%) and imported fossil fuel (8%). Now a day 84.9% of Nepal's population has access to electricity. With this scenario and having immense potential of hydropower development, it is important for Nepal to increase its energy dependency on electricity with hydropower development. This contributes to deforestation, soil erosion and depletion, and increased flooding downstream in the Ganges plain. Shortage of wood also pushes farmers to burn animal dung, which is needed for agriculture. Not only this, the development of hydropower will help to achieve the millennium development goals with protecting environment, increasing literacy, improving health of children and women with better energy. Growing environmental degradation adds a sense of urgency.

Figure 2.1

Energy Consumption in Nepal



Nepal's Tenth Five Year Plan (2002– 2007) aims to extend the electrification within country and export to India for mutual benefit. The new Hydropower Policy 2001 seeks to promote private sector investment in the sector of hydropower development and aims to expand the electrification within the country and export (IPPAN, 2011).

2.3 Research Review

Many scholars have written on energy development of Nepal and the rest of the countries of the world in form of books, various journals, booklets, Magazines, research papers published and unpublished thesis and dissertation.

On considering various international, regional and national experts, I here by gone through various subject of hydropower and their contribution, benefits and impact on economy. Different types of hydropower like large, small, micro, pico hydropower are take in consideration to carry out research on it.

Kellogg and Hobbs (2016), in their paper "A Case Study of Small Hydropower", in their has been paper they indicated literally possibilities of thousands of additional sites, including numerous run-of-river opportunities, and conservative estimates of potential small hydropower range. Small hydropower (<10 MW) has been gaining ground as a renewable energy source that could play a significant role in both reducing our fossil fuel use in many developed and developing countries and in helping some regions of the world that are currently handicapped by insufficient electricity supplies.

It is now widely accepted that we must take steps to address climate change by significantly reducing our global greenhouse emissions while also simultaneously addressing the energy-related inequities that continue to plague so many human populations.

They include a summary of the literature on the impacts of small hydro compared to other types of energy production and a case study of a restored, small hydro facility on a natural support in New York State. This case study speaks to the minimal environmental impacts and the broad economic and social benefits that are possible with well-planned small hydropower projects. And find out that while no energy production is perfect there will always be some level of environmental, social, and/or economic impact, the balance of the most comprehensive and data-intensive studies indicate that small hydro, especially run-of-river small hydro, can result in fewer impacts to the surrounding natural and social systems and can offer many economic benefits compared to other forms of energy production.

Nattakul, Boonrod and Roongrajana (2010), in their paper, "Socio Economic Assessment of Pico Hydropower Installations in the Northern Region of Thailand", assesses Social Impacts of Pico-hydropower applications in the northern region of Thailand. Six existing Pico-hydropower projects were selected based on different characteristics including system capacity, size of user. Normally, Pico-hydro power systems are found in rural and hilly areas. Based on the guidebook, most projects should utilize hilly and mountainous locations to site suitable projects. From a report on electrification technologies by the World Bank Energy Unit, of the options currently available for off-grid generation, Pico-hydro is likely to have the lowest cost, For mini-grid power, it is likely that only biogas plants provide more cost-effective electricity than micro hydro. Northern Thailand is filled with mountains and high level. In areas with high rainfall, there is plenty of water. In term of economy the result is clear because most of the people have tea garden and coffee gardens, so they can electricity use at night time to boil tea leaves and pack it for sale. The production cost for each village in the system in addition, they have home stays to service tourists which increase incomes. Socially, second range is high percentage of users are satisfaction in the hydropower. According to the light at night time the villager can take time for exchanging ideas with each other. The children read books longer time and old people understood more Thai language learnt from watching TV.

Lei (2016), In his article explained how China got this position in world through small hydropower. The Government of China paid particular attention to the small hydropower sector, promoting the people's "well-being, and safe, green, and harmonious" small hydropower development. To date, 4,400 SHP plants (up to 50 MW) have been upgraded; increasing installed capacity and annual output by more than 20 percent and 40 percent respectively. By the end of 2015, the total hydropower capacity of China reached 320 GW with an annual output of 1,100 TW.

The Government will actively promote further hydropower development considering the environmental and resettlement issues. Meanwhile, SHP development will be incorporated into a poverty alleviation strategy, and will be adapted to local conditions. By 2020, the total installed hydropower capacity of China will have reached 350 GW, of which small hydropower will account for 81 GW.

At last he concludes that hydropower plays an essential role in the energy sector of

China, contributing to the adjustment of the energy mix, emission reductions, as well as the economic development of the country, which has promoted and led hydropower development worldwide.

The World Bank IBRD.IDA (2012), According to the news, severe power shortage is one of the greatest obstacles to India's development. Over 40 percent of the country's people residing in the rural areas do not have access to electricity and one-third of Indian businesses cite expensive and unreliable power as one of their main business constraints.

India's energy shortfall of 10 percent (rising to 13.5 percent at peak demand) also works to keep the poor entrenched in poverty. Power shortages and disruptions prevent (stop) farmers from improving their agricultural incomes, deprive children of opportunities to study, and adversely affect the health of families in India's tropical climate.

Poor electricity supply thus stifles economic growth by increasing the costs of doing business in India, reducing productivity, and hampering the development of industry and commerce which are the major creators of employment in the country.

The Government of India has set the target for India's optimum power system mix at 40 percent from hydropower and 60 percent from other sources.

When developed in accordance with good environmental and social practices, hydropower plants have the advantage of producing power that is both renewable and clean, as they emit less greenhouse gases than traditional fossil fuel plants and do not emit polluting suspended particulate matter (from the high ash-content of indigenous coal).

While India plans to develop mainly run-of-the-river projects, multipurpose hydropower plants with water storage facilities can help manage critical water resources in an integrated manner by serving as flood controllers as well as sources of irrigation and much-needed drinking water. The Tehri Dam in Uttarakhand, for instance, which was commissioned in 2006, today caters to one-third of the drinking water needs of Delhi, India's capital.

Besides which, India's hydro-resources are largely available in some of the least-

developed parts of the country and hydropower plants, if designed appropriately offer significant potential for regional development and poverty alleviation. Hydropower projects that forge equitable systems of benefit-sharing and implement targeted local area development can help local communities improve the quality of their lives quite significantly.

Tshering & Tamang (2004), This paper has been highlights the role and importance of hydropower for social and economic development of Bhutan and covers aspects related to planning and policy initiatives being pursued by the hydropower sector to fulfil the national objectives.

Hydro Power is the backbone of the Bhutanese economy. Inspite of the rugged topography, and being land locked, the introductory sections provide the baseline information on hydropower resources of Bhutan, development potential and existing situation in the supply and demand of hydroelectricity. Subsequent sections cover the planning and policy interventions that the Royal Government of Bhutan is undertaking in order to maximize on the benefits from hydropower development.

The Royal Government has also prioritized network expansion in the Country. It is expected that by 2020, the entire Country will have access to electricity. Industrial activities are expected to increase with the commissioning of Tala Hydroelectric Project. The surplus generation from hydropower plants is exported to India and fetches a substantial amount of revenue that helps to meet the budget deficit. About 300 MW power and 70% of the total hydroelectric energy generation was exported to India from 2003.

Today, about of 40% of the total Bhutanese population and about 30% of the rural people have access to electricity. The per capita consumption of electricity is 949 KWh per annum (2003 data). The rural electrification process has many positive impacts. Socio-economic impact study of rural electricity project has shown that the electricity lighting has particularly improved the quality of lives of students, housewives (women) and the rural households and improved conditions in the quality of services of basic health units as well as other services like telephones. Once electricity service is made available to a rural home. It enhances their rural income activities. They find more productive time under better light. Rice cookers and water boilers have replace firewood in the kitchen, which resulted to decrease in health

hazards from smoke created by fuel wood. The quality of social life has also greatly improved once electricity is made available.

Kafle (2005), in his article "Hydropower for Sustainable Development of Nepal" in Vidyut Bulletin, has been argued that hydropower has contributed for poverty reduction and economic growth in developing countries. Regional development and expansion of industries encourages even to the underdeveloped countries for prioritizing hydropower development, economic and social development and environment protection. The multiple use benefit of hydropower reliability and quality of fresh energy supply caters to a fundamental sustainability goal of poverty alleviation. In social aspects the development of hydropower enables to make easy access of electricity to all in the communities. Asses of electricity in the reasonable price promotes new economic activities empowers woman by reducing their domestic work and repetitive chores as fire wood collection, improves health and education services and provides a cleaner and healthier domestic environment.

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

Dahal and Gharana (1998), in "Environment and Sustainable Development" Published by NEFAS, is also an important publication related with environment and sustainable development. These both aspects are inexorably interlinked with each other. They explain that the vicious circle of poverty and environmental degradation is reinforced by the growth of population. The people use traditional as well as commercial energies. Biomass energy accounted for 95 percent of total energy consumption (75.6 percent from fuel wood and the rest from agro-residue and dung-

cakes). The forest alone fulfils 96 percent of the total energy that the rural household need.

In addition to over exploitation of forest resource, there is simultaneously the problem of underutilization of many potential renewable natural resources and energy resource. Similarly, negligible share of potentialities of solar, wind, biogas have been utilized. On the one hand, there is underutilization of the available natural resources. On the other hand the demand for energy is rising day by day. People depend on biomass for the energy they need. They conclude that generation of hydropower, as a renewable energy, is required for sustainable development and protecting the environment in the context of Nepal.

Adhikari (2006), has been explained in his book "Review of Economy: Hydropower Development in Nepal", focused on use of environment-friendly technologies and implementation of sound legal and institutional issues. He suggested favourable environment for increasing investments in cost-effective projects to turn target into reality. Small hydropower as a cheap, renewable source of energy with negligible environmental impacts plays an important role in Nepal's future energy supply.

Hydropower has a number of benefits: (a) it is a continuously renewable electrical energy source; (b) it is non-polluting, i.e., no heat or toxious gases are released; (c) it has no fuel cost and, with low operating and maintenance cost, is essentially inflation-proof; (d) hydropower technology is a proven technology that offers reliable and flexible operation, (e) hydropower stations have a long life and many existing stations have been in operation for more than half a century and are still operating efficiently; (f) hydropower station efficiencies of over 90 percent have been achieved making it the most efficient of the energy conversion technologies.

Small-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. The Acts and regulations should be made to support the environment as well as the hydropower development efforts so that the environment and development go together, especially when it comes to the most important natural resource development endeavours of the nation.

The major strategies of the power sector have been appropriately identified as promoting private sector participation in power generation and distribution, unbundling the activities of the NEA as well as improving its financial viability, integrating rural electrification with rural economic development programs, and strengthening power infrastructure. 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.

Mathema, Guragain, Sherpa and Adhikari in report "Can Hydropower Drive Green Economy for Nepal: A Review", Have been found the key reason which created confusion by the hydropower policy. The policy failed to define the responsibilities and jurisdictions of the numerous government bodies involved in water management. Hydropower development is not necessarily a zero carbon technology. But, it can save a significant amount of CO_2 emissions that other energy sources are currently generating. The population of Nepal relies highly on traditional energy supplies commonly fuel wood which produced high CO_2 emissions and its gathering disrupts ecosystem functioning. Hence replacing fuel wood with hydropower can considerably reduce carbon emissions. The carbon emissions resulting from hydropower development during construction and from other sources are negligible. Besides proving resource efficient and low carbon energy, hydropower development fosters social inclusion. And royalties support social empowerment. However, there is a need to amend the hydropower policy since not all VDCs benefit in the same manner. Addressing this issue will encourage a positive and supportive attitude towards hydropower projects amongst local people one of the main reasons for conflict between hydropower projects and surrounding communities is their lack of access to royalties. Transparent royalty management and strong monitoring and enforcement would improve the impact of royalties and increase support amongst local people. This study shows that the required provisions for hydropower development are already at place, but need some adjustment. Also, Nepal has a long history of hydropower development (over a century now) along with abundant expertise, and the hydropower sector can flourish if careful attention is given to its management.

Ranabhat and Paudyal (2016), **i**n "Sustainability Of Micro Hydro Projects In Lalitpur District, Nepal", found only 25 micro hydro are working out of 33 due to various region.

He concluded that the project has mixed impact. Change in water availability is one of the prominent issues in micro hydro development. The construction of micro hydro is carried out for lighting but inadequate water has shortened the lighting time and decrease in the expected generation. Climatic as well as non climatic factors are also responsible for low discharge in the streams. The lack of the interlink planning between different water use complicates the water resources and increases conflicts. Six micro hydro stations are shut off mainly due to lack of community management and grid connection. Also the majority of the operator perceives climate change and correspondingly perceives the change in water timing and availability altering the hydrology. At last sustainable development is a broad concept so further research is necessary for the overall sustainability of the systems. There is a need of better interdisciplinary water resources management planning and integrating in the energy development to increase the sustainability of these plants with respect to increasing demand and environmental problems.

Jha, HB. (1995), In his article "Sustainable development of small Hydropower in Nepal" has conclude that the rural energy development in general and small hydropower development in particular, should be viewed as an opportunity to overcome energy constrains in agriculture, cottage industry, tourism, transportation and communication. The provision of electricity provides a new imputes for sustainable rural development through the infusion of modern technology and new skills. This results in higher labour productivity.

Modernization of agriculture and promotion of cottage and small scale of industry are essential to bring about the transformation of all the hill economy of Nepal towards a more sustainable form. The generation of off-farm employment and off farm income is more appropriate than extending sustainable farming activities.

Given the essentially environment friendly nature of small hydro, the goal of environmental preservation can be readily enhance through the strengthening of local and central level regularity institution, find tuning of regularity framework, and

setting up funding mechanism and organization, Therefore setting up of a "Small Hydropower Development Fund (SHPDF)".

At the present, the focus should be put on the regularity and institutional dimensions of small hydropower development. Thus may provide more benefits and help towards sustainable rural development in long run, provided the rural electrification is able to provide the "comparative advantage" to rural hills in Nepal.

Barnes, Fitzgerald and Peskin (2002), have been presented the paper "The Role and Importance of Small Hydropower and Rural Electrification case-study, Uttaranchal, India". This technical paper deals with the areas supplies with electricity from small hydropower are mostly mountainous areas, which are hard to reach with large national grids and which have suffered from the lack of or shortage of electricity. This has severely restrained the economic development in these areas. The exploitation rural small hydropower not only solves the problem of water supply to mountainous rural small hydropower not only solve the problem of water supply to mountainous agriculture, but also solves that of electricity supply for pumping water for agricultural use including irrigation. It accelerates the construction of infrastructure, improves the development, agriculture in mountainous areas, and guarantees a stable and high output of grain. Small hydropower eliminates electricity shortages in rural areas and this supports the rapid growth local industry, township and village enterprises and agro-industry. It promotes the exploitation the mountainous resources and turns resources advantages into an economic advantage. This creates a employment opportunities for rural residents.

The future of development of SHP in Uttaranchal state is bright and in view any power statins shall come up in future which will facilitate the development of far off areas of the state and will provide quality power to the people of area. It is the need of time that the small hydro power development should take place keeping all the parameters of safety and quality management in place so that the problems which are hampering the operation and maintenance of existing power stations may not re-occur.

2.4 Research Gap

From the review of many national, regional & international literature, I found that

nearly all the researcher explain about its economic benefit from the agricultural sector, health sector, production sector, employment sector, sanitation sector, poverty alleviation as well environmental sector. But they have not explained about the use of technology. So this research has tried to analyse the trend and pattern of use of new technology after electricity in the study area.

CHAPTER III

METHODOLOGY

This study has been carried out on the basis of primary as well as secondary data.

3.1 Research Design

Research design aims to analyse the economic contribution of hydropower project to the local people on the basis of the specific objectives of this research. It serves as a framework for the study, guiding the collection and analysis of the data, the research instruments to be utilized, and the sampling plan to be followed. This study is mainly based upon descriptive analysis. This descriptive type of research is based on both primary and secondary data. The research is primarily based upon primary data collected from primary sources like household interview, key information interview, field observation and questionnaire.

3.2 Sources of Data Collection

3.2.1 Primary information

Primary information was collected from the field survey. For this purpose the following tools have been applied in this research.

i) Observation:

Project site was visited and factors influencing community, market, places and its surroundings were also observed.

ii) Interview:

Interviews were taken with educated as well as layman about the impact of project. Interviews were selected from the project catchments area as well as neighbouring villages.

iii) Questionnaire:

A questionnaire was developed prior to project visit. The questionnaire was developed in such way that it covered demography, health and sanitation, agriculture and animal husbandry, sufficiency of agriculture product, income and expenditure pattern, human

resource, women and children source of fuel, kind of stove and forest and electricity. The project occupied total 83 household who were considered as directly project affected families and they were selected to fill up questionnaire.

3.2.2 Secondary information

Secondary information has been collected from different governmental and non government organization such as Ministry Of Water Resource (MOWR), Ministry Of Finance (MOF), Water Energy Commission Secretariat (WECS), Central Bureau Of Statistics (CBS), Nepal electricity authority (NEA), department of electricity development (DOED), Asian Regional Environment Assessment Program (AREAP), Centre for Economic Development And Administration(CEDA), office of Village Development Committee (VDC), related bulletins, journals published reports, knows and official. Also some of the important theoretical as well as quantitative information are collected from websites and international publications.

3.3 Sampling Technique

Data for the study was collected from the field survey. In this project, 273 households were taken as universe. Among them 83 household were taken as samples from Lawang Ghalel VDC. The Sampling method that I use in this thesis is simple random sampling as household are taken randomly for sample survey for descriptive and analytical research point of view

This study is mainly based on primary data. The data analyzed the economic, environmental and technological impact of small hydropower. The study was conducted through the formal method of interview, observation, structured questionnaire.

3.4 Data Processing

It is very important and necessary to reduce the errors of raw datas. Field questionnaire is carefully checked for possible errors. The data are carefully processed by

- editing,
- coding,

- classification and
- tabulation methods

3.5 Data Analysis

Primary as well as secondary data have been used in this study. Since this study is a case study and data analysis has been focused particularly on the primary data, which were collected by using primary data collection procedure. secondary data as well as primary data have been presented in the table, pie chart, simple bar diagrams, sub-divided or component bar diagrams and multiple bar diagrams have been used.

CHAPTER IV

DATA ANALYSIS

4.1 Introduction

This chapter attempts to analyse the collected data and information for pursuing the objectives of the study and deriving the major finding of the study. First of all, it presents the brief introduction of the study area with demographic feature. This chapter deals with the analysis of economic contribution of Gandaki Hydropower on education, health, income, and existing latest technology of the study area. The contribution of Gandaki Hydropower was analyzed by comparing gradual changes with and without use of electricity. The questionnaire and observation was analysed in the descriptive form.

The economic characteristics such as education, employment health and environmental situation have a significant influence in the economy of the village and living standard of the people.

The hydropower's electricity is distributed mainly on Modi Hydropower for the connection with main grid line of NEA where as total of 44kw electricity is distributed on some ward of Lawang Ghalel VDC.

4.2 Interpretation

4.2.1 Ward wise population distribution of the study area

According to Government of Nepal, Population census survey 2068, Lawang Ghalel had 110 HH with 434 Population, 66 HH with 272 population and 97 HH with 359 Population for ward no 4, 7 and 8 respectively. From this I take only 83 HH as a random sampling that is only 30.04% of total household (Table 4.2.1).

Table 4.2.1

Ward wise population distribution of the study area.

Ward	Total House hold (HH)	Male (M)	Female (F)	Total Population
4	110	199	235	434
7	66	135	137	272
8	97	162	197	359
	273	496	569	1065

Source: Population Census survey, 2068

4.2.2 Ward wise population distribution of the sample survey

The ward wise distribution of respondents of this research is shown on table 4.2.2 Out of total 83 respondents 34 HH were taken from ward no. 4 which is called Lumregaun, representing 50.79% of the total sample survey. Similarly 23 HH taken from ward no.7 called Kuibhangaun and 26 HH taken from ward no.8 called Saidhighattagaun which are 23.03% and 26.18% respectively of total sampling survey. Further, total sampling population is 443 which only represent 41.59%of total population (Table 4.2.2)

Table 4.2.2

Ward wise population distribution of the sample survey

Ward	Responded House hold (HH)	Male (M)	Female (F)	Total Population	Representative Percentage
4	34	109	116	225	50.79
7	23	60	42	102	23.03
8	26	47	69	116	26.18
Total	83	216	227	443	100

Source: Field survey, 2074

From the survey, it is seen that total number of females is greater than total number of males.

4.2.3 Age wise Distribution of Respondents and Their Family Members

The respondents are divided into five groups as 0-15, 15-30, 30-45, 45-60 and 60 above. Collectively, 15-30 age group have highest population 34.09% whereas age group 60 above have the least population. Similarly, age groups 0-15 and 30-45 have nearly same population where as percentile of 45-60 age group is nearly double of 60 above age group in the study area (Table 4.2.3).

Table 4.2.3

Age wise Distribution of Respondents and Their Family Members

Age group in years	Gender		Total	Percentage (%)
	Male	Female		
0-15	54	37	91	20.55
15-30	64	87	151	34.09
30-45	35	57	92	20.77
45-60	38	34	72	16.24
60 above	25	12	37	8.35
Total	216	227	443	100

Source: Field survey, 2074

Overall, female population outnumber the males. It is because in age group 15-30 and 30-45 the number of female populations is greater than males. Particularly male population of this age group have out migrated to other countries for earning or job or other sort of businesses.

4.2.4 Change in study habits after SHP

It is basic concept that people specially children (0-15 age group) increase those study time with increase lighting facility than murky or darkness. But in this case there is already hydropower before they born. So this calculation is calculated by difference between lighting available (at normal time) and non-available (Some time through some technical or natural problem lighting is unavailable in required or study area) time (Table 4.2.4).

Table 4.2.4

Change in study habits after SHP

Increasing hours	Frequency	Percentage
0-1 hrs	12	14.46
1-2 hrs	46	55.42
2-3 hrs	21	25.3
More than 3 hrs	4	4.82
	83	100

Source: Field survey, 2074

In study area, 12 HH responded that children studied less than one hour, 46 HH responded that children behaviour towards study raised more than 1 to 2 hour, 21HH responded that study habit raised to 2 to 3 hours and 4HH responded that study increase to more than 3 hour in their children. It can be said that, most of student's education status is improved after SHP installation because most of the guardian of schooling children found that their children have been studying at the night time using electricity. There is the positive affect by SHP in the study area. Adults also involved in informal education at night. Such as: literacy class.

4.2.5 Teaching Methodology use in school after SHP

Teaching methodology and tools also changed with change in time. There is one government school in one village using white chalk & black board before the hydropower installation. Nowadays, all school have white board and black marker for teaching, but some schools have integrated multimedia for teaching special course like science which is 15.38% out of survey of school level population. (14 out of 91 at age group 0-15 yrs) (Table 4.2.5).

Table 4.2.5

Teaching Methodology use in school after SHP

Methodology Use	Before %	After %
White Chalk & Black Board	100	0
White Board & Black Marker	0	100
Multimedia	0	15.38
Other Technique	-	-

Source: Field survey, 2074

4.2.6 Number of employed in family

Employee means that those person who involve in economic activities that why I do not include 0-15 age group. We also have known that Nepal is male dominant country that common means that economically active male population is definitely more than female population. From the field survey 90 out of 352 male are employed which is 25.57% of the total population. Where only 17.90% female population are involve in economic activities. There are 58.13% people are unemployed where male and female are 20.45% and 36.08% respectively (Table 4.2.6) and (Figure 4.1).

Table 4.2.6

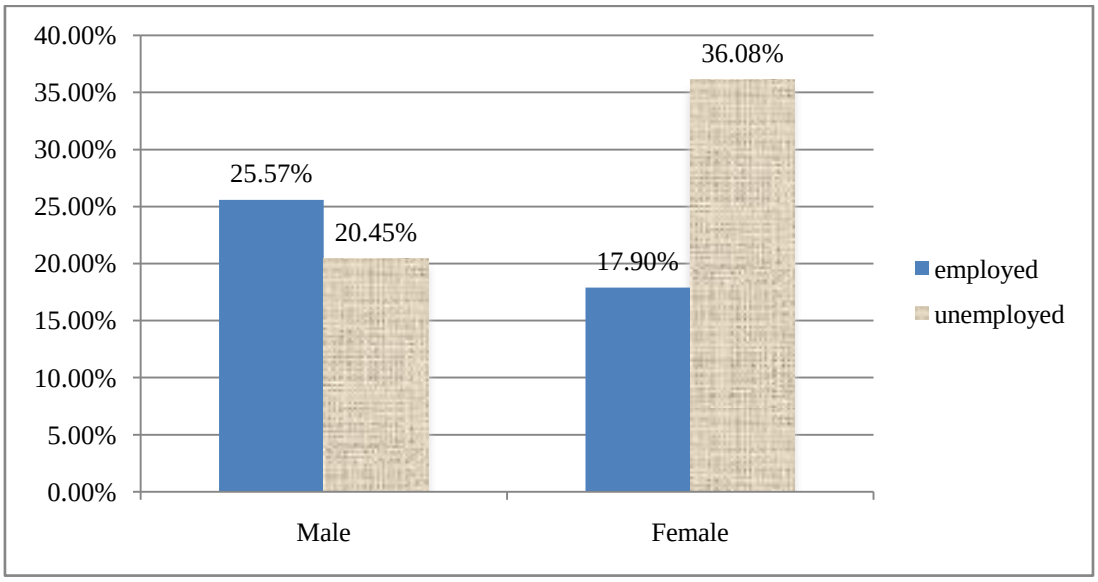
Number of employed in family

Gender	Employed	Unemployed
Male	90(25.57%)	72 (20.45%)
Female	63(17.90%)	127(36.08%)
Total	153(43.47%)	199(58.13%)

Source: Field survey, 2074

Figure 4.1

Number of employed in family



This report shows that females are more unemployed than male which represents the Nepalese trend and culture where female are just confined to housewife. Nowadays, this pattern is gradually changing but not sufficient.

4.2.7 Main Occupation of Household

We all have known Nepal is agricultural country. This area also existing in agriculture before the hydropower installation, now a day this area also depends upon the agriculture and livestock but less than before. From the field survey report 2074, 71.08 % household's agriculture is the main occupation before the SHP but it is change by 36.15 % which is major in negative (Table 4.2.7).

Table 4.2.7

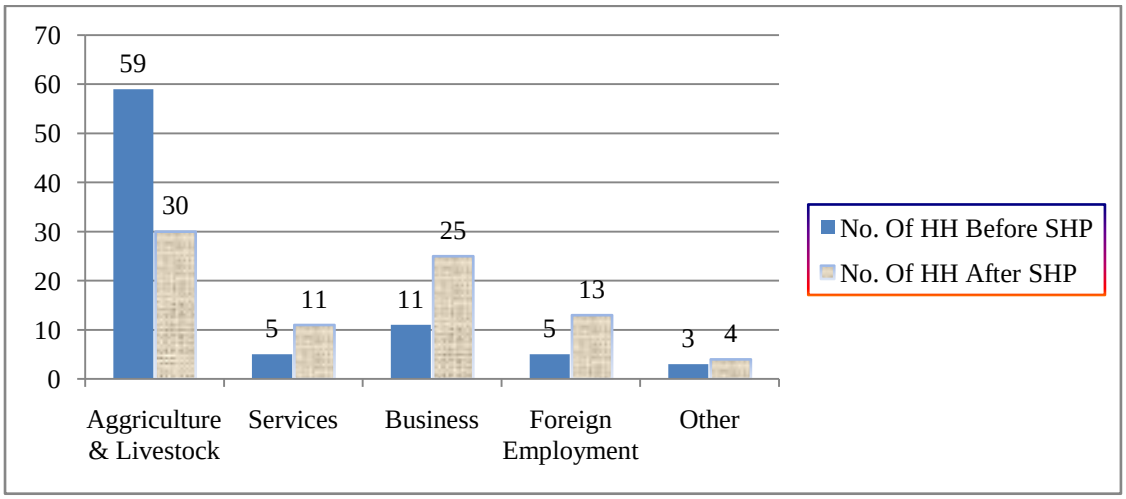
Main Occupation of Household

Occupation	No. of HH Before SHP	No. of HH after SHP	Change in percentage
Agriculture & Livestock	59(71.08%)	30(36.15%)	-34.93%
Services	5(6.03%)	11(13.25%)	7.23%
Business	11(13.25%)	25(30.13%)	16.88%
Foreign Employment	5(6.03%)	13(15.66%)	9.63%
Other*	3(3.61%)	4(4.82%)	1.21%
Total	83(100%)	83(100%)	00%

Source: Field survey, 2074

Figure : 4.2

Main Occupation of Household



This all means many households change the occupation after hydropower because people get new idea from many sources like television, radio, mobile, internet and flow of the new visitor in village as well education. But this is full fill by other occupation services, business, foreign employment & other occupation by 7.23, 16.88, 9.63, 1.21present respectively which is in positive sign which means people are attract on these occupation.

*Other includes labour wages, self-employed like electrician, social worker, tourist guide, lugger etc.

4.2.8 Side occupation of Household

Today's generation can't have only one occupation, that's why I calculated other side occupation of household. From them I have 66 household out of 83 do other side occupation which helped them to earn extra income. There are only 13.64 % household having side occupation in term of agriculture & livestock this is because male person connected with other occupation and female are engaged in agriculture and livestock. There are foreign employments also in side occupation which specially means that persons working at agriculture in season and goes to india in off season. There are 40.91% household engaged in business, specially kiranapasal, making alcohol, restaurant, making cloth (vangra), silaibunai (stitch cloths) etc (Table 4.2.1) and (Figure 4.3).

Table 4.2.8

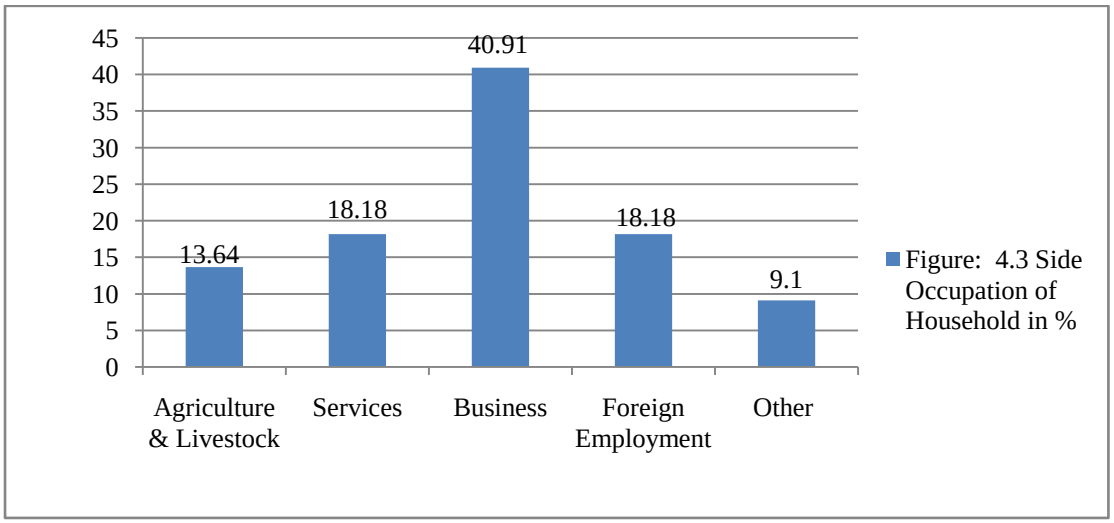
Side occupation of Household

Occupation	No. of Household	Percentage
Agriculture & Livestock	9	13.64
Services	12	18.18
Business	27	40.91
Foreign Employment	12	18.18
Other	6	9.1
Total	66	100

Source: Field survey, 2074

Figure 4.3

Side occupation of Household



Basically we found service is the main occupation, but in this context as father or mother doing any sort of economic activities is the main occupation and children adopting economic activities other than their parents is also kept under services. For example parents do agriculture and children are involved in services like nursing, driving, teaching etc. Other occupation includes labour wages, self-employed like electrician, social worker, tourist guide etc.

4.2.9 Extra time spend in productive activities after the project

From the other above discussion we know that after electrification, we have extra time. Study area is especially agricultural area. From the survey report, 18.07% household spend less than 1 hours in agriculture, 13.25 % household spend 1 to 2 hours, 13.25 % HH spend 2-3 hours and 7.23% household spend more than 3 hours time in agricultural sector (Table 4.2.9).

Table 4.2.9

Extra time spend in productive activities after the project

Productive Activities	Household	Percentage
A. Agriculture and livestock		
i. Less than 1 hrs	15	18.07
ii. 1-2 hrs	11	13.25
iii.2-3 hrs	11	13.25
iv. more than 3 hrs	6	7.23
B. Business		
i. Less than 1 hrs	1	1.2
ii. 1-2 hrs	18	21.69
iii.2-3 hrs	7	8.44
iv. more than 3 hrs	10	12.05
C. Services		
i. Less than 1 hrs	3	3.62
ii. 1-2 hrs	1	1.2
iii.2-3 hrs	0	0
iv. more than 3 hrs	0	0
Total	83	100

Source: Field survey, 2074

I found that there is only 1.2% spend less than one hour in business sector, where 21.69%, 8.44% and 12.05% household spend 1 to 2 hours, 2 to 3 hours and more than 3 hours respectively on business sector.

Similarly in the service sector there is only 3.62% people spending less than 1 hours and 1.2% spend 1 to 2 hours on that sector.

4.2.10 Impact of project on human health

The grid connection in the village has improved the general health conditions significantly as SHP provides clean and smoke free energy unlike firewood. The use of kerosene lanterns for lighting completely stopped, and the use of firewood reduced significantly in the village. The connection of electricity in the households reduced

indoor air pollution and hence reduced the incidence of vision and several diseases. To estimate the impact of on health outcomes, each individual of a household was asked whether they had suffered from respiratory disease and eye related infection such as respiratory tract infection, bronchitis, ENT irritation or allergy, eye infection, headache etc (Table 4.2.10).

Table 4.2.10

Impact of project on human health

Impact	HH	Present
Positive	76	91.57
Negative	0	0
No Change	7	8.43
Total	83	100

Source: Field survey, 2074

4.2.11 Place of Treatment

From the field survey I found enough health post facility in the study area. People there treated on health post, but 13.25% people visited health post as well opted for Dhami and jyotis.

Table 4.2.11

Place of Treatment

Treated on	HH	Percentage
Dhami/Jyotis	11	13.25
By Local Herb	15	18.07
Health Post	83	100
Hospital	30	36.15

Source: Field survey, 2074

From field survey 2074, 18.07% people used both medicine and local herb like Tulsi, Jhwano, Murelo, Gholtapre, himali local herb etc. Specially Kuibhan and Saidhighatta's villager visit hospital only if major health issue arises where as

Lumre's villagers visit hospital and health centres in major and minor health related problems.

4.2.12 Change in expenditure after SHP per month

How many people get economic benefit from the SHP that's the most important part of the analysis. For this analysis I measure cost of that product which are use for energy source.

Table 4.2.12

Change in expenditure after SHP per month

Source	No. of HH	Quantity Before (*)	Quantity After (*)	Difference in amount
Firewood	83	902(902 x 400=3,60,800)	241(241 x 400 = 96,400)	264400
Electricity	83	0	2490 (2490x 1.5= 3735)	-3735
Charging Battery	83	(1575)	0	1575
Candle	83	838 (838 x 10= 8380)	127 (127x10 = 1270)	7110
Kerosene	83	405 (405 x 80 = 32400)	70 (70 x 80 = 5600)	26800
LP Gas	83	10 (10 x 1350 =13500)	80(80 x 1350 = 108000	-94500
Total	83	416655	215005	201650

Source: Field survey, 2074

* Quantity goods converted into amount

Not only study area, all over Nepal has a first source of energy is firewood. There is also fire wood is basic source of energy. Before the project started 83 HH used to consume approximately 902 bhari wood over a month, price of fuel wood Rs. 400 per bhari at current time (equivalent Rs. 3,60,800). After the completion of the project those household consume only 241 bhari (equivalent Rs. 96,400). In average they save 2,64,400 rupees per month only from fuel wood.

After the electrification, sampling household are use 2490 unit electricity per month

which market value is 1.5 rupees* (equivalent Rs. 3735). This is calculated in negative sign.

People also get benefit Rs. 1575 and Rs. 7110 per month from charging battery and candle respectively. People change there charging patten from battery to electricity and decrease to use of candle for lighting.

People use kerosene in lamp and tuki for lighting, as well starting fire for cooking before hydropower installation. Household use 405 litre kerosene per month, price of kerosene Rs 80 per litre (equivalent Rs. 32,400). After hydropower, its uses decrease upto 70 litre per month (equivalent Rs 5600), that means save Rs 26800 per month from only kerosene.

Now a days people use LP gas which is not easily available in village area at that day where hydropower not installed. Before hydropower installation there is only 10 cylinder gas use in study area but now its increase to 80 cylinder per month, the current value of per cylinder is RS 1350, and difference between after and before saving amount is in negative sign 94500.

Finally people save Rs. 2,01,650 per month that special region is hydropower installation as well time change day by day.

* 1.5 rupees per unit is the compensation amount for only those villagers.

4.2.13 Electricity using for various propose

Electricity is easy source of getting energy and main cause of hydropower installation is lighting. From the field survey report 100% household use electricity for lighting purpose. Due to insufficient supply of power, people are unable to lunch various types of cottage industries as well as electronics equipment as they want to use. Villager haven't knowledge that how electricity use in agriculture that why only 13.25% people use electricity in agricultural field. Similarly 44.58% and 18.07% people use electricity for business and services respectively. Hotel, restaurant, glossary shop, stitching cloth, making cloth like vangra, making alcohol etc are the business site where electricity is use. Also making report, order new medicine on health post, use computer/laptop on school and office, use mobile and internet for search root map by tracking guide are the example of services field where electricity use. Also 97.56%

people are use electricity for various type of personal use like using electrical or electronics instrument (Table 4.2.13).

Table 4.2.13

Electricity using for various propose

Propose	Household	Percentage
Lighting only	83	100
Agriculture and Livestock	11	13.25
Business	37	44.58
Services	15	18.07
Personal use	81	97.56

Source: Field survey, 2074

4.2.14 Advantage through SHP

All over household are answers that they get advantage through electricity, Where 100% people are able to work at night. 25.3 % household get advantage through SHP on agriculture and livestock at poultry firm, irrigation on land, At the time of hydropower formation there is not only canal formation there is also formation of canal for irrigation which is main advantage for the locality. People saving their 2 hours' time per day on aggregate, which is 8.33 % as compare to 24 hours in a day. 91.57% household felled that improve on health through electricity. Through electricity, 97.59% people have an opportunity to use new technology (Table 4.2.14).

Table 4.2.14

Advantage through SHP

Type	No. Of Household	Frequency	Percentage
Agriculture and Livestock	83	21	25.3
Easy to work at night	83	83	100
Time saving	83	2 hrs per day	8.33
Improving Health	83	76	91.57
Improve in uses new technology	83	81	97.59

Source: Field survey, 2074

4.2.15 Uses of new instruments or Electronics devices after SHP

From the field survey 2074, 100% household use electric bulb for lighting. Similarly, 97.59 % i.e. 81 out of 83 household is using both television and mobile which is necessary electronic equipment of new generation as well old citizen. The lack of sufficient power of Gandaki Hydropower is unable to supply the power according to public demand. Therefore the authorized electricity minicommittee banned to use rice cooker so there are no any household to use this. Household used Computer, fan and radio by 20.48%, 24.1% and 18.02%, respectively. 24.1% and 18.07% uses respectively grinder and refrigerator which are specially use in hotel and grocery shop. There are 52 household to use charging light which is basically use while walking in street during night as there is no light in electric pole (Table 4.2.15).

Table 4.2.15

Uses of new instruments or Electronics devices after SHP

Electronics Devices or instruments	No. of Household	Frequency	Percentage
Television	83	81	97.59
Mobile	83	81	97.59
Rice cooker	83	00	00
Computer/laptop	83	17	20.48
Fan	83	20	24.1
Grinder	83	20	24.1
Electric bulb	83	83	100
Refrigerator	83	15	18.07
Radio	83	15	18.02
Charging Light	83	52	62.65

Source: Field survey, 2074

4.2.16 Family who use internet

The table shows that, out of 83 respondents maximum proportion i.e. 48 (57.83%) reported that use internet through mobile and computer. Where minimum proportion i.e. 35 (42.17%) not use internet (Table 4.2.1) and (Figure 4.4).

Table 4.2.16

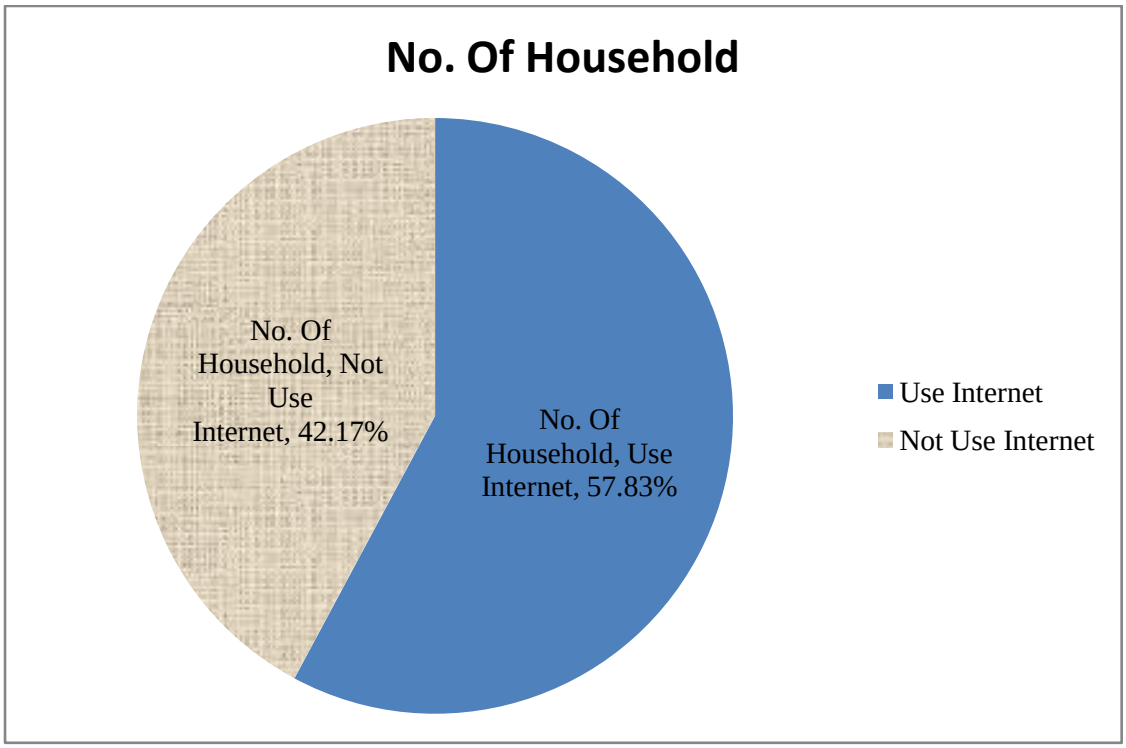
Family who use internet

Use internet	Household	Percentage
Yes	48	57.83
No	35	42.17
Total	83	100

Source: Field survey, 2074

Figure 4.4

Family who use internet



4.2.17 Purpose for use internet

Internet is most necessary and essential part of this generation. People use internet for various purpose. Form the field survey, 22 out of 48 use internet for news. Only 8.33% people use internet for business purpose, mostly in hotel site. Where 16.67% people use internet services special at medical site like use medicine, use by staff nurse and Health Assistance. Most of people use internet for social sites and for entertainment purpose like facebook, messenger, viber etc (Table 4.2.17).

Table 4.2.17

Purpose for use internet

Purposed	Household	Percentage
News	22	45.83
Business	4	8.33
Services	8	16.67
Social sites /Entertainment	42	87.5
Other	3	6.25

Source: Field survey, 2074

4.3 Major Findings

Energy is an important factor in rural development. Lack of energy is often a constrain that holds people back from achieving a better life-style. Hydro electricity is the most versatile source of energy and provides infrastructure for economic development of a country due to its advantage over other sources of energy. Electricity is easy source of getting energy than other.

- Out of 273 households, 83 households i.e. 30.4% of total household are considered for survey in which 443 individuals are includes. Out of 443 individual 216 i.e. 48.76% are male and 227 i.e 51.24% are female.
- The maximum age group is from 15-30 years which is 30.09% and the minimum age group is above 60 years which is 8.35% of total 443 individuals.
- Student's education status is improved after SHP installation because most of the guardian of schooling children found that their children have been studying at the night time using electricity.
- Multimedia and white board with marker are use on teaching methodology after hydropower installation.

- There are only 43.47% economically active population are employed.
- After installation of hydropower the rate of agriculture activities is decrease from 71.08% to 36.15% only and non-agriculture specially business activities are increased much.
- It found that, people have save extra time and spend on side occupation which helps to get more extra income.
- Before electrical facility people have been using the flaming, fire wood and kerosene at the night, after electricity they are reduced such types of material and hence positive impact is found in human health.
- All people are treated on health post, but some of them not satisfy only by health post treatment so they use local herb or few people call Dhami/jotis. Where many people gone at hospital for special treatment.
- People reduce to use firewood, battery, candle, kerosene as a result total expenditure is decrease to buy them.
- Electricity is using for various propose, which gives positive impact on agriculture, business, services, human health, working at night, uses of new technology etc.
- People are habituated to use new electrical or electronics instrument but they are unable to full utilize due to insufficient power supply.
- There are only 57.83% household use internet, must of them use it for social sites.

CHAPTER V

SUMMARY AND CONCLUSION

5.1 Summary

This study is focused on the economic contribution of Gandaki Hydropower project. It is based on the primary data collected through the field survey. It is expected that the results from this study will provide valuable information on the policy makers or utilize the resources in the most positive sector for energy generation.

The first chapter consists of the introduction of Gandaki Hydropower Project with statement of problems, objectives, significance and limitation of the study. The general objective of the study is to evaluate the contribution of the small hydropower projects in rural development through income, saving and employment generation and specific objectives is to examine the economic contribution of Gandaki hydropower project in Lawang Ghalel VDC of Kaski district.

The second chapter consists of the review of literatures focuses on the economic contribution of hydropower development in Nepal. This review based upon the gist of the past publications. i.e. books, journals, research paper, intellectual studies, government and non-government publication, financing institutions issues.

The third chapter deals with the research design, nature and sources of data, methods of data collection, data processing and analysing. Descriptive research design has been adapted to complete this study and choose simple random sampling method for data collection. This study is specially based on primary data at Lawang Ghalel VDC.

Fourth chapter attempts to analyse the collected data and information for pursuing the objectives of the study and deriving the major finding of the study and presents the brief introduction of the study area with demographic feature, this study has been conducted from the direct interview method with 83 respondents. This chapter deals with the analysis of economic contribution of Gandaki Hydropower on education, health, income, and existing latest technology of the study area. We found that there was established different kinds of industries and commercial activities which help to increase their income sources, employment, personal hygiene and living standard and

the rate of agricultural activities is decrease from 71.08% to 36.15%. The result also shows that there is positive impact on education and health.

The fifth chapter deals with summary of the finding related to the study conclusion and suggestion to overcome the existing of the impact of hydropower project for its economic development. We show that electricity is closely related with human life. The project has positive impact on the development of infrastructures. Finally, electricity made the life easier and comfortable.

5.2 Conclusions

The efforts to promote small hydropower in Revan VDC have substantially contributed in the development efforts of the villagers as whole. This village is just an example. SHP has brought significant economic benefits to their communities.

People can work late night and studying hours of students have increased by SHP. Teaching methodology of school has been changed. Use of Blackboards and chalks have been replaced by multimedia, interactive whiteboards and board-markers which is possible through SHP

Though, agriculture is the main occupation, different types of businesses like grocery, poultry faming and small scale cottage industry flourished after electrification which has raised their income level.

SHP has contributed on the reduction of expenditure on different energy sources like firewood, kerosene, candle, battery etc. as the net cost of electricity is much cheaper than those sources.

After SHP, health condition of villages improved as they discontinued kerosene lamp for lighting and firewood for cooking.

Before electricity people have been using maximum firewood as light or lamp and cooking but when SHP established the condition of forest is improved.

People visited health post, sought for health facilities and hospital instead of using local herbs and visiting dhami/jotis. Villagers are being habituated for internet and electronics. Thus, SHP has changed the health and living standard of villagers.

Hydropower provides a reliable, efficient, safe and economic source of power for increasing effectiveness of the migration system.

Obviously, SHP have a many benefit to villager, but due to lack of sufficient electricity they can't improve their living standard which they want. They are unable to use new electronics instrument, even which they can afford.

5.3 Suggestions

Nepal does not have any fossil fuel reserve nor coal mining. Technological development of the country does not allow development of nuclear power. The development of alternative energy such as solar or wind is also limited due to the cost involved in such development. Hence, for all commercial energy needs, Nepal has to depend either on imported fossil fuels or indigenous hydropower. The industrial, transportation and urban household energy needs are predominantly met by imported fuel. Hydropower has been exploited only in a limited quantity because of the lack of investment. If we can emphasize on rural electrification, that uplift education as well as life standard of rural people. Some policies can adopted by policy maker are as follows:

- The current financial and life standard of rural household is poor and critical. Nepal Government makes many strategy and schemes to improve the life status of rural people. If we can emphasize on rural electrification through SHP, we can uplift education as well as life standard of rural people.

- The development and promotion of SHP has strong relation between poverty alleviation and social upliftment of the people. By introducing small Hydro at their doorstep as stand-alone schemes people can make use of electricity for lighting, cottage industries, agriculture and livestock, other business, computer, health equipment, TVs, Radio, mobile, internet etc.

- Also, it is necessary to give the ownership of electricity to the community level. This encourage to manage, collect saving for investment, stops the leakage and theft of electricity which helps to reduce the problem of load shedding.

- Carefully designed small-scale hydro schemes take only a limited amount of water from a river or stream, have a small storage volume, and return the water a short distance downstream, and thus have very little environmental impact. Several small hydro systems have less environmental impact than a single large hydro scheme supplying the same power.

- The discussion and the overall result shows that Nepal's hydropower is at a sustainable level. It is to be considered that the score of Nepal was drawn down only because of the political and the governmental factors. Hydropower is welcomed and supported by the local people as a beneficial project. If Nepal gets good and stable governance with reduction in red tape politics and administration, the score will surely rise. Although the sustainability score is above the accepted level, Nepal needs to develop many sustainability measures and continuous sustainability management so that it can reach a most satisfactory level of sustainability.

APPENDIX

QUESTIONNAIRE

DEPARTMENT OF ECONOMICS

Prithvi Narayan Campus

Pokhara

A survey on economic contribution of Gandaki Hydropower, a case study of Revan VDC. Kaski.

This questionnaire is primarily designed for the thesis writing purpose of M.A Economics of T.U.

You are kindly requested to fill up this questionnaire as instruction below.

1. Household Information					
1.1 Name of Head:				1.2 Ward No:	
1.3 Gender				1.4 Age:	
1.5 No. Of HH Member	M	F	T	1.6 Main Occupation Of Head of Family	

2. Educational status

2.1 Family Information

No.	Name	Relation with head of family	sex	Age	Education
1					
2					
3					
4					
5					
6					
7					
8					

2.2 After electrification, can it easy to study or your children's increase study time (please tick√)

Yes [...] No [...]

If yes how much time has been increased? (please tick√)

a. less than one hour [ ]	b. One to two hour [ ]
c. Two to Three hour [ ]	d. More than three hour [ ]

2.3 Have you conduct any literacy class at night (please tick√) Yes [ ] No [ ]

If yes, what type of program conducts? (please tick√)

a. Adult literacy class [ ]

b. Woman literacy class[ ]

c. Pre-primary class [ ]

2.5 What type of methodology is used in school /college for teaching of your children's?

a. white chalk & blackboard	b. Marker & white board
c. From Multimedia	d. other (Specify)……..

2.6 Can school/college provide a computer classes to your children's? (please tick√)

Yes [ ] No [ ]

If yes? From when This facilities started (Please tick√)

a. Last 1 year [ ] b. Last 2 year[ ]

c. Last 5 year[ ] d. More than 5 year [ ]

2.8 Which technology is advantageous for your children from study view point

Technology	On priority basis
a. Radio/Television	
b. computer	
c. mobile	
d. other (Specify)	

3. Business sector

3.1 How many members are employed in your family? [....]

Number of Male [....] Number of Female [.....]

3.2 What type of occupation where they involve

a. Agriculture [ ]	b. Services Government[ ] Private [ ]
c. Business [ ]	d. Foreign services[ ]

3.3 Can SHP help in your occupation : Yes [ ] NO [ ]

3.4 How many aggregate extra time you spend in productive activities after the electrification?

a. less than 1 hrs [ ]	b. 1 hrs to 2 hrs [ ]
c. 2 hrs to 3 hrs [ ]	d. More than 3 hrs [ ]

3.5 Have you involve in any kind of side occupation. Yes [ ] NO [ ]

If yes, Specify.....

3.6 Can you do business work at evening or night? Yes [ ] NO [ ]

If yes, in which business do you work at night

a. saw mill	b. Rice mill	c. animal firm
d. spice mill	e. oil expeller	f. small industry
g. furniture industry	h. Restaurant & hotel	h. other (Specify)…….

3.7 Did you find that after the involving on productive work it help to increase your income level?

a. Yes	b. No	c. To some extent	d. Difficulty to say

If yes, how much (approx.) Rs. ……

4. Agricultural sector

4.1 How many time you spend in agricultural production

a. less than 5 hrs [ ]	b. 5 hrs to 6 hrs [ ]
c. 6 hrs to 8 hrs [ ]	d. More than 8 hrs [ ]

4.2 What type of instrument or machinery use in agriculture

a. Halo [ ]	b. Hand Tractor [ ]
c. Tractor [ ]	d. Advance Machine [ ]

4.3 Can this project help you on irrigation: YES [ ] NO [ ]

If yes how many land is irrigated

a. All I have	b. half which I have
c. only khet	d. just some where

4.4 What type of technique use to making cannel for irrigation.

a. small kulo by hand	b. pakki with cemented
c. through pipeline	d. other (Specify) ……

4.5 Can this project help on animal husbandry? YES [ ] NO [ ]

If yes, specify propose…….

5. Health Sector

5.1 What type of impact face after SHP Positive [....] Negative [....]

5.2 Is there any changes in disease after electrification?

Disease	Decreases (please tick√)	Increases (please tick√)
Respiratory		
Eye-aching		
Headache		
Heart diseases		
Asthma		
Other		

5.3 Does any family member suffer from any kind of illness in past one year?

(Please tick√)

Yes [ ] No [ ]

If yes, where or by whom they were treated (please tick√)

a. At Dhami [ ]

b. At home by local harbe [ ]

c. At Health post [ ]

d. At hospital [ ]

5.4 Did any birth of child take place on your family in past one year? (please tick√)

Yes [ ] No [ ]

If yes, where she gave birth (please tick√)

a. At home [ ]

b. At Health Post [ ]

c. At hospital [ ]

6.	Daily propose

6.1 What was your main source of energy before hydro project?

a. Fire wood	b. Kerosene
c. Bio gas	d. LP Gas
e. Animal Dung	f. From Electricity
g. Other (Specify)…….	

6.2 What is your main source of energy after hydro project?

a. Fire wood	b. Kerosene
c. Bio gas	d. LP Gas
e. Animal Dung	f. From Electricity
g. Other (Specify)…….	

6.3 What is the main propose of using electricity?

a. Agriculture & livestock	b. Lighting only
c. Business	d. Services
e. Personal use	f. Other (Specify)

6.4 How units of electricity do you consume in one month?

.....units, Per unit rate.....

6.5 How much money do you spend on these energy sources? Specify total in Rs. Per month

	Before	After
1. Kerosene		
2. Battery		
3 Candle		
4. Firewood		
5. Electricity		

6.6 How did you charge your Electronics devices before electrification?

a. Charge by electricity	b. Charge by battery
c. Charge by solar	e. Other (Specify)

6.7 How did you charge your Electronics devices after electrification?

a. Charge by electricity	b. Charge by battery
c. Charge by solar	e. Other (Specify)

7. Extra purpose

7.1 Did you feel environment pollution after the project? Yes [ ] No [ ]

If yes, what type of pollution is increase?

a. Water Pollution	b. Air pollution
c. Landslides	d. Duets
e. Deforestation	f. Others (Specify)

7.2 What is the status of sanitary after electricity?

a. improved	b. worse
c. Same as before	d. Drastic change

7.3 Is there regularity in the electricity distribution? Yes [ ] No [ ]

If No. What is the alternative source of electricity (Specify)…….

7.4 What advantage of SHP attracted you must?

a. Improve health	b. Time saving	c. Easy to work at night
d. Increase in reading habit	e. Effective in Agricultural production	f. Improve on use of new technology
g. Other specify (……)		

7.5 Is there any change occurred in government, non government services in VDC stabilization of the project? Yes [ ] No [ ]

7.6 What type of change has been observed after SHP in your personal view?

……

……

7.7 List that which devices or instrument you borrow for daily propose after the project.

a.	b.	c.
d.	e.	f.
g.	h.	i.
j.	k.	l.

7.8 Does your family use internet facility? Yes [ ] No [ ]

If yes than how many member use this …….

If use than for what propose…….

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

From the government site:

……....…….

From users

site:…….....…….……..

Form Management Site:

…….....……

At last you have any other remakes (Comment), Please mention.

……

……

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