Socio–Economic Impact of Chauri Ganga Micro-Hydro Power

(A Case Study of Madan Kundari VDC, Kavrepalanchok District, Nepal)

A thesis

Submitted to

The Central Department of Rural Development,

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DECLARATION

I hereby declare that the thesis entitled **Socio-Economic Impact of Chauri Ganga Micro–Hydro Power** submitted to the Central Department of Rural Development, Faculty of Humanities and Social Sciences, Tribhuvan University, is entirely my original work prepared under the guidance and supervision of my supervisor. I have made due acknowledgement 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. I assure that no part of the content of this thesis has been published in any form before.

_____

Mrs Satidevi Lama

Date : 2075-06-14

30-09-2018

RECOMMENDATION LETTER

The thesis entitled **Socio-economic impact of Chauri Ganga Micro-Hydro Power** (**A case study of Madan Kundari VDC of Kavrepalanchok District, Nepal**) has been written and submitted by Satidevi Lama in partial fulfillment of the requirement for the degree of Master of Arts in Rural Development under my supervision. I hereby forward this thesis to the evaluation committee for the final evaluation and approval.

_____

Ratna Mani Nepal, PhD

(Thesis Supervisor)

Date 2075-06-14

30-09-2018

APPROVAL CERTIFICATE

This is to certify that the thesis entitled **Socio-economic impact of Chauri Ganga Micro-Hydro Power** (**A case study of Madan Kundari VDC of Kavrepalanchok District, Nepal**) written and submitted by Satidevi Lama has been examined. It has been declared successfully for the fulfillment of the academic requirement toward the completion of Master of Arts in Rural Development.

Thesis Evaluation Committee

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Date 2075-06-21

07-10-2018

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This research report is prepared as a thesis in the partial fulfillment of the requirement for the master's degree in rural development. The basis objective of the study is to identify the socio- economic impact of Chauri Ganga Micro–Hydro Power Project of Kavrepalanchok district.

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At last, it would be patiently observed that this little contribution would help in filling up the gap in this sector providing as tonic to the researcher and policy maker.

……

Satidevi Lama

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ABSTRACT

Hydroelectricity is one of the pioneer sectors for energy development as well as a major pillar of the National capital formation of Nepal through national gross domestic production (GDP). It is gradually booming and highly opportunities in Nepal for the electricity generated via micro-hydro and Mega Hydro. Although micro-hydro is potential because of geography, residential settlement in rural areas, and investment as well. This might contribute directly to the uplift socio-economic development of the rural areas of Nepal and similarly holistic development. Therefore, the study entitled socio-economic impacts of Chauri Ganga Micro–Hydro Power has conducted a household survey, Key informant interview, and observation to carry out household electricity consumption in the project-affected area and examine the socio-economic impact of Chauri Ganga micro-hydropower project.

Based on the research result, the various impacts have seen on socio-economic aspects of community peoples of the project affected area. Altogether 160 household has benefited from the 13 kw capacity hydro-power. Basically, seemed change in their fuel consumption pattern and daily functions too. As well as they have concentrated on livelihood process which relevant with electricity. Due to the electricity, children are benefited to study and change the learning process. Which assist to get the higher education and motivate to them for further education process. Similarly, the level of awareness in people has significantly increased because of access on television and radio. The project has created abundant opportunities for knowledge and skill update. So, their economic status has become better than before.

LIST OF ABBREVIATIONS/ACRONYMS

AEPC	:	Alternative Energy Promotion Center
CBS	:	Central Bureau Statistics
CDM	:	Clean Delivery Mechanism
INGO	:	International Non Government Organization
KM	:	Kilometer
KII	:	Key Informants Interview
MA	:	Master of Arts
NGO	:	Non Government Organization
NPC	:	National Planning Commission
MW	:	Mega Watt
GW	:	Giga Watt
KW	:	Kilo Watt
MH	:	Micro Hydro
MHP	:	Micro Hydro Power
IPPs	:	Independent Power Producers
MOF	:	Ministry of Finance
NEA	:	Nepal Electricity Authority
PPA	:	Power Purchase Agreement
UNDP	:	United Nations Development Program
RED	:	Rural Energy Development
TU	:	Tribhuvan University
VDC	:	Village Development Committee
DDC	:	District Development Committee
TWB	:	The World Bank

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INTRODUCTION

1.1 Background of the Study

Energy is the basis need for all the sectors; moreover, energy is necessary in every step and moments of human life. The world has been modernized through energy. So, energy is the yardstick for the economic development of a country in modern age. The degree of economic development is largely determined by per capita energy consumption. Energy as an indicator shows the living standard of people. Demand for energy is gradually increasing along with growing population and economics activities. Adequate and affordable supply of energy is basis pre-requisite for socio economic development of a nation.

The trend of energy consumption is predominated by tradition sources particularly fuel wood. Over utilization of forest creates serious environmental problem. However, the water resource is immensely available in Nepal and hydropower is clean renewable, pollution free, reliable and easily available. It is the best alternative among all the available energy in the context of our country.

Nepal is the first richest country in the water resource in Asia and second richest in the World. Nepal has about 6000 large and Small River hurling from the Himalayas and high mountains towards the plain and Terai. Total length of those large and small rivers is about 45000 kilometer. The perennial nature of Nepalese river and the steep gradient of the country topography provide ideal conditions for the developments of some of the world largest hydropower project in Nepal. The total hydropower potential of these rivers is estimated about 83000MW of and which 45000MW and 43000MW are technically and economically feasible (Pradhan, 2009).

There are four scales of hydropower projects in Nepal i.e. mega, large, medium and small. The aim of installation of mega and large medium and small hydropower project is fulfill long-term national demand and export to India and other SAARC countries (Alam, etl. 2017). The major energy sources of Nepal are forest organic matters, petroleum products, hydro-electricity, thermal plant, electricity and coal. Other alternative energy sources are wind, solar and biogas, which are gradually being used. However, Nepalese energy sector is dominated by traditional sources of energy such as fuel wood, agriculture residue and animal dung. The process of converting the solar energy into electricity and other kind of energy in order to meet the need of modern industry, transport, household and others in general has been found to be very costly.

Context of Nepal Micro Hydropower Development Association was established, in 1992, by eight privately run micro hydropower development firms/companies to set as an umbrella organization of those dedicated to serve the nation with micro hydropower technology, skill and expertise. The Association is also to support formulating policies, plans and program to concerned agencies. Likewise, professional welfare is one of its objectives. Electricity is one of the key determinants for economic growth of a nation. Although the benefits of rural electrification are immense, more than 44% of the people do not have access to electricity in Nepal (Mainali, & Silveira, 2011). Therefore Micro-hydropower (MHP) scheme is considered the most feasible decentralized renewable energy option for providing reliable and affordable electricity to the remote and isolated areas of Nepal. This study assesses the impact of a MHP plant on socio-economic conditions in the remote village, Madan Kundari, in Nepal.

Context of global, after Tennessee Valley's big hydroelectric project was built in America this is established the most popular energy source of the world. Many invention and researchers are proved that Hydroelectricity is renewable non-polluting and

sustainable source of energy and it is generated in low social and economic cost. It is generated internally; hydropower can substitute the import of fossils fuel. The demand of traditional energy is rising and it is closely related with the population growth. Due to high fertility rate of 2.6 percent with low crude death rate of 6 per thousand, the growth rate of population is 1.4 percent per year (DHS, 2011). Thus the pressure of energy demand is increasing day by day with the increasing pressure of population. At the same time uplift lighting of living standard of the people is a challenge for Nepal, which calls for modernization of agriculture practices and the other activities. This in turn requires intervention of the rural activities through introducing the commercial form of energy such as electricity services sectors and urban development are all factors leading to an increase in overall energy requirements. Without petroleum products reserves and with limited capacity energy from solar and wind sources, Nepal is depending on hydropower and traditional sources to sustain its increasing energy needs.

Nepal, located on the lap of the mighty Himalayas, has no proven deposits of petroleum products or natural gas, and hence the only native supply of commercial energy is electricity. Nepal is stowed with water resources where more than 6,000 perennial rivers and rivulets flow with an annual average water runoff of 225 billion m3 thereby providing huge hydropower potential. Despite having huge hydropower potential, by the end of fiscal year (FY) 2013/2014, only 791 MW including 22MW from thermal plants of electricity has been generated in Nepal. Although it has very low electricity consumption rate averaging 87 kwh year-person.

During 2010, the total national annual energy demand was met through available resources; there was a power deficit of 677.86 GWh, which caused lockouts 16 h per day country wide. Power deficits are further exaggerated ruing the long dry period October to

March as most of the larger hydropower projects are based on the seasonal flow of rivers. (Sangroula, 2009)

In the present condition of Nepal, energy plays the vital role of fulfillment of resources. It is the primary need for all economic and social development. Energy itself is not a sustainable used connect to diverse process such as lighting bulbs charging battery is burning fuels and propelling machines. Usually, the trends of energy consumption is predominated by traditional resources particularly fuel wood. Over utilization of forest create serious environmental problem. Nepalese people are using 300 kg to 900 kg fuel wood per head per year for cooling and heating. Fuel wood consumption in mountain has been estimated 640 kg/person 1 year. While for the Terai it is 479 kg/person per year (Lekhak, 2003: 205).

But the water resources is immensely available in Nepal and hydropower is clean renewable among this micro-hydropower is more than more renewable pollution free, relievable and easily available. So that the region in mountain and hillside of Nepal. So micro-hydropower is the best alternative among all the available energy in the context of our country. So, energy can be generated from falling water through the use of turbine, which can be used as mechanical power. This is known as hydropower. This power can be used directly to run various milling machines or can be converted into electricity by using generator. Electricity generated in this way can be used for lighting, heating and operating machines. Hydro-projects that generated that small amount of mechanical or electrical power up to 100 KW are called micro-hydro power. Generally, these projects are classified on the basis of amount of power produced into large, medium, small and micro-hydro. In Nepal, project up to 100 KW capacities are classified as micro-hydro project, (AEPC, Booklet, 2000: 3).

1.1.1Energy Source of Nepal

a. Traditional Energy Source

It is clear that sustainable energy is supplied by firewood, animal dung agriculture residue; which cover 78.87 percent of total energy consumption leaving 20.14 percentages to commercial and renewable source in FY 2012/13. Supply of fuel wood cannot be maintained from uncontrolled destroy of forest which is the main source of traditional energy shared 71.26 percentage. In rural area energy is substituted by agriculture residues and cattle wastage. Human labors and animal draft power is also referred to traditional energy (MOF, 2014).

b. Hydro-Electricity

It is the main resource, which will ultimately become the dominate source of indigenous energy resource. It has been calculated the size of theoretical hydropower potential based on average flow of six thousand rivers are 83,000 MW where as technically potential 114 major schemes are identified total capacity of those schemes are 45610 MW. Those are economically potential major hydropower schemes whose benefit cost ratio is more than one amount 42330 MW (Mishra, 2000). With such capacity current utilized Hydro electricity is 769 MW (NEA, 2014). Nepal has 6000 rivers having capacity to generate electricity. So Nepal is rich energy sector if all that resource will be utilized, Hydropower development required high initial investment, infrastructure like road etc. Electricity generated in Nepal essentially consists of both in the interconnected system and remote isolated areas, which is backbone of our economic development and earning foreign currency (Thapa & Pradhan, 1995).

This study will be sketched the impact of a MHP on the rural livelihood in the remote village, Madan Kundari, Kavrepalanchok in Nepal. Thus, micro-hydro scheme

provides clean, affordable and sustainable renewable energy both locally and globally. Presently energy consumption appears to be directly related to the living standard of the people and the degree of industrialization of country. Therefore, energy is the basic requirement of development without which the peace of economy cannot be accelerated.

1.2 Statement of the Problem

Nepalese economy is based on traditional agriculture. In addition to agriculture other sectors of economy such as industry, trade, transportation, communication and tourism development yet due to their inadequate electric power and financial resources. The pattern of energy consumption is based on traditional sources particularly fuel wood, dung etc..The over exploitation of forest creates serious environmental problems; petroleum products are utilized for transportation operation of machineries and so on. The demand of petroleum product is growing day by day and sometimes we have to face the crisis in their supply in the international price too market as well as wind energy is still of the state of research and survey. Micro hydropower and its development is said to be inevitable in kavrepalanchok, because supply from the national transmission line of electricity is not being sufficient to cover every area of the country especially remote areas. Development history of Kavrepalanchok energy sector is much developed than other districts taking the advantage of being adjoining district of Capital Kathmandu and also having abundant water resources and feasible for generating hydropower. There are many large and small hydropower stations established in the districts most of them are connected to national grid with PPA agreement with NEA and others are providing services to local level. But even there are large scales of hydropower in the area; the rural part of the district is still facing energy problems. Most and faced a host of problem needless to say, some of these challenge and problem still very much around. Due to the lack of management, lack of adequate government budged, lack of transportation for

service delivery, remote VDCs of Kavrepalanchok was facing such problem to develop essential infrastructure of energy development.

Hydropower is only appropriate technology to fulfill the energy demand of the rural, Hill, Terai, Himalayan and urban areas. The hydropower is one of the well known energy sources. This energy source is continuously renewable non-polluting efficient, widely distributed and available resource in Nepal. Operation system of hydropower if flexible and in process no fuel cost. As a whole we can say that hydropower technology is a very technology which suits to supply energy for isolated rural areas hill and mountains of the country. So, micro and small hydropower plants installation is one of the most appropriate methods of sub-station for other energy source, e.g. fuel, wood, animal dung, agriculture wastage, petroleum products and coal for specially hill area of Nepal. Number of community electrified VDCs in FY 2013/14 is 333 according to annual report of NEA.

There are few researches done in the field of micro hydropower in Kavrepalanchok both by government and private sector but they should not solve the electricity problem of Kavrepalanchok. For the hydropower development resource is not usually enough still the country facing problem of management and implementation of these resources.

The generation cost of large project should found comparatively higher than that of micro and small hydro project. Despite the generation cost of large scale project should be owner than the small one in accordance with the principle of economics in reality. The large capacity of electricity and ultimately, it has got to bear extra load of debt. The marginalized people are living in remote rural area which lack balance of regional development.

So, this study will be tried to analyze the socio-economic impact of micro hydro in Kavrepalanchok district, which is marginal and undeveloped Pahadhi district of Nepal.

1.3 Objective of the Study

The general objective of this study is to find out the socio-economic benefit of micro hydro power in Madan Kundari VDC, Kavrepalanchok District, Nepal.

The specific objectives of this study are as follows;

- to find out the household electricity consumption in project affected area;
- to examine the socio-economy impact of Chauri Ganga micro-hydropower project

1.4 Importance of the Study

Energy is backbone of all kinds' development in the world. It is most important and valuable in modern civilization. Thus development of all sector of an economy depends on energy. The utilization of energy especially electricity is centered in urban area and most of rural area have been passed by the existing energy development schemes in Nepal. Electricity can significantly diversify rural activities. Therefore electricity can raise living standard of people. Such as electricity helps to discover, develop, expand and promote new techniques and technologies in various sectors. Similarly, improve in extracurricular activities, which help to raise the living standard of the people. Also, electricity helps to improve overall sectors of the economy.

As electricity is significant in the development so the researcher have been conducted a research on a micro hydropower project. This research will have helpful and resourceful in the following ways. Similarly, research will be helped to know externalities (cost and benefit) for other project and programs and to implement such type of new project. So, socio-economic impacts of this project inform us the role of project in socio-economic uplift of community. Therefore the study has been significant at present, to control energy crisis in Nepal.

1.5 Limitation of the Study

This study has studied only one micro hydro power project in one VDC, so the conclusion derived from this study is applicable to other sector. This study has focused on socio-economic impact of micro hydro project to rural people, so present study is very specific. The study primarily focused the communities and social impacts causes by MHP at the local area.

1.6 Organization of the Study

This study will be organized in to five chapters. The first chapter deals with the introduction. It includes the general information of micro hydro, statement of problem, objective of the study, significance of the study, organization of the study. The second chapter presents the review of literature Review. The third chapters deal with the research methodology. It includes rational for the selection of study area, research design, nature and source of data, universe and sampling, data collection technique and tools, household survey, interviewed with key informants, observation, interview, data analysis .The fourth chapter presents the data presentation and analysis with profile of the study area. The last chapter of the study offers summary/finding, conclusion and suggestion. Appendices and reference have been kept at the end of this report.

CHAPTER – TWO

LITERATURE REVIEW

2.1Literature Review

Limited research has been conducted on socio-economic impact of micro hydro power projects; however these are many studies in other sector of hydropower project. Generally the studies on medium and large scale hydropower project have been conducted to identify various types of impacts created by the development of hydropower project. Besides this, many publications, reports thesis dissertations, articles on journals, newspapers which are related to the hydropower will be reviewed in this thesis. Those literatures which are closely related to this research will be also reviewed.

Micro-hydropower sector in Nepal has a long history dating back to the 1960s. The private sector companies mainly the manufacturers started providing services from 1970s. Electricity generation from micro-hydropower started after 1980s and was add-on activity at that period. Around 1990s micro-hydropower started getting recognized as a means of providing electricity in rural areas. Initial micro-hydro schemes were primarily addressing the need of processing, agricultural products and subsequently rural communities installed a large number of turbine mills. AEPC/ESCAP-2008

Micro hydro shall be understood as hydroelectric generating units with capacities ranging above 05 to 100 kW. Micro-hydro has the potential to be a major source of energy for rural areas. Water is plentiful in the rugged hills of Nepal and micro-hydro provides a more practical and cost effective alternative to the national grid. Micro hydro consists of following activities:

- Develop and promote the use of micro-hydro technology.
- Carry out surveys and feasibility studies for micro-hydro projects.

- Provide services to support the sustainable development of micro-hydro projects in Nepal.
- Conduct training for micro-hydro users and service providers.
- Work to establish local support structures for mini-grid electrification.
- Provide quality control services for micro-hydro equipment.

Nepal is the first richest country in water resource in Asia and the second richest in the world. Nepal has about 6000 large and small rivers. The total hydropower potential of these rivers is estimated about 83000MW of and which 45000 MW and 43000MW are technically and economically feasible. But only about 769MW hydropower is produced. The produced electricity is mostly used in urban than the remote rural areas, because of this condition the remote rural areas are directly affected, in which, they are not getting clean and affordable energy. Thus, in Nepal there are lots of possibilities of micro-hydropower project in remote rural areas; which is very much, environmental friendly and economically bearable. Recent Rural Energy policy of Nepal-2063

The electricity supplied by the national grid is not sufficient for electrifying the whole population. Only the 12% are getting service of electricity from the alternative source of energy, where the national transmission line is not assessable to reach in the geographically remote area, From the MPH; 23MW, wind energy; 20KW and Biogas; 11KW all together 35.03MW electricity is produced up to now (NPC, 2014).

Human development report 2014, ″The Rise of the South: Human progress in a Diverse World ″ examines the profound shift in global dynamic driven by the fast – rising new powers of the developing world and its long – term implication for human development. The report identifies more than 40 countries in the developing world that have done better than had been expected in human development terms in recent decades with their progress accelerating markedly over the past ten years. The report analyzes the

causes and consequences of these countries achievement and the challenges that they face today and in the coming decades.

Energy sources and supply in Nepal (Oct, 2006) by Karki, Nepal has vast potential hydro- resources; the economic potential for hydropower is estimated at 43000MW. Yet hydro- electricity accounts for only 1% of total energy supplies, firewood 65% and agricultural waste 15% are still the main sources of energy, while petroleum products 8% have replaced dung 8% as the third most important source of energy supply in terms of energy content.

By the end of approach paper to three year plan (2067/68-2069/70) capacity of hydropower connected to national grid are 705 MW among which electricity produced by NEA contributed to 473 MW and other production companies contributed 232 MW. Along with the thermal plant production the total electricity connected with national transmission line reached 753MW. 59 districts of the country are connected to national transmission line. In contrast to the target of producing 184 MW in last three year plan, only 64 MW was produced. Electricity line is expanded to more 900 VDCs benefiting extra 7 lakh families. Almost 67% of the national population is utilizing electricity among which 58% are getting benefited by national transmission line and 9% from other sources (NPC: thirteenth three year plan 2070/71-2072/73)

The national electrification rate in 2006 is around 45% with a very uneven region and urban/rural distribution. In urban areas, where less than 20% of the national population live the household electrification rate is close to 100%, the rural rate is around 38% being highest in the accessible low land region (The Terai) where electrification based on expansion of the national grid is made good progress and lowest in mountain communities that take from to horse to four days to reach by foot.

Faced with slow progress in rural electrification based on grid expansion by a natural or regional power utility, many countries in the developed world have turned to alternative modes of supply based on the decentralized identification and implementation of energy projects. Nepal is no expansion to this trend in fact; it is one of the international successes in decentralized energy supply.

NEA, (2014), ′Community Electrification′ As a part of the government policy to promote community participation in rural electrification, the business group carried out community based electrification in various parts of the country and handed over the facilities to the community for the operation. The government provided 90% of the capital cost of electrification, and remaining 10% of the capital cost was borne by the community. NEA is responsible for maintenance of HT line where as communities/users group is responsible for maintenance of LV distribution system. The public response to this initiative of NEA has been overwhelming. Altogether, about 360,000 households of 51 districts have been provided with electricity by the end of FY 2013/14 through 465 community groups.

Chauri Ganga Micro Hydropower, initially registered as chaurikhola 4th Micro Hydropower, was established by financial support from UNDP, Rural Energy Development (RED), DDC, contribution by local people. The installation and construction was accomplished by material and installation support from RED and labor contribution by local public. The generation and operation of the project is now being conducted by a committee consisting 13 members from local community. The energy was generated and used by local level. Total length from dam to hydropower is 10km.

Rural energy means energy that is environmental friendly and use for rural households, economic and social purpose such as; micro and mini hydro, solar energy, wind energy, biomass energy etc. Rural energy is also known as renewable energy.

Energy is essential to economic and social development and improved quality of life. Similarly renewable energy is a key element of sustainable rural development. (Sapkota, Bhabadatta 2012)Hydro-electricity is known as renewable, non-polluting and available energy resource within the country. Micro hydropower plants also known as 'micro hydro', 'MH and 'MHP' are installed in Nepal's remote hilly and mountainous areas. These are useful to provide electricity for lighting facility mainly. Agro-processing like grinding, hulling, operating radio, TV, computers and some other end users are its benefits. Electricity is one of the key determinants for economic growth of a nation. Although the benefits of rural electrification are immense, more than 33% of the people do not have access to electricity in Nepal. Micro-hydropower (MHP) scheme is considered the most feasible decentralized renewable energy option for providing reliable and affordable electricity to the remote and isolated areas of Nepal. The word electricity is derived from the Greek word 'electron' which means amber. According to Webster Electricity is a term referring to the large body of physical phenomena arising from stationary and moving charge particles.

According to Encyclopedia Britannica “Electricity is the phenomenon associated with positively and negatively charged particles of matter at rest in motion, individually or in great". Beginning several centuries before the birth of Christ the Greeks studied the effects and ability of amber to attract small objects after being rubbed and the attraction for one another of natural magnetic lodestones for long time these were considered to be one and it. It was not until the 16^{th} century that the English physician and physics William Gilbert (known as father of electricity) clearly distinguished between magnetic and electric effects in his book `The Magnet' [Mandible, 1960]. After 1800 the science of electricity developed rapidly with the invention of the first battery called voltaic pails by Alessandro Volta. The discovery of magnetic field was produced by an electric current by

Hans Christian in 1820, the almost simultaneous discovery of electromagnetic induction by Joseph Hennery and Michael Faraday made generator in 1831, theoretical compilation of electrical and magnetic observation and prediction of the existence of electromagnetic waves by James Clerk Maxwell [Encyclopedia Americana Vol. 10]. American scientist Thomas Alva Addition developed more - than thousand use of electricity like bulb. Addition opened company and built a power station at New York in (1881). This company supplied electricity in New York's 900 homes. This was the first time supply of electricity for commercial households lighting [Mva7:`elbm, Arnold 1960]. After that the earlier hydro electric development begin with the first commercial central power station which was placed in operation in 1882 at American city 'Appleton Wis' was composed of hydraulic turbines driving direct current generators from which the electric energy could be transmitted over wires [Encyclopedia Americana Vol. XIV, 1963].

The major energy sources of Nepal are forest organic matters, petroleum products, hydro-electricity, thermal plant, electricity and coal. Other alternative energy sources are wind, solar and biogas, which are gradually being used. However, Nepalese energy sector is dominated by traditional sources of energy such as fuel wood, agriculture residue and animal dung. The process of converting the solar energy into electricity and other kind of energy in order to meet the need of modern industry, transport, household and others in general has been found to be very costly. It is necessary to be able to gradually the first hydro-electric installation in Nepal was built at Pharping (500KW) in 1911 AD to supply electricity to Kathmandu, now the powerhouse is closed. Second hydro-power installation was built at Sundarijal Hydropower plant (640KW) in 1934, which is still in operation. There was electricity office named BijuliAdda to operate and maintain powerhouse transmission line and distribution to the people at that time. After that various diesel plants and Hydro power plants were constructed. As governmental department, Electricity

Department was established and BijuliAdda was organized under Electricity Department. In 1962 as autonomous body Nepal Electricity Corporation (NEC) was formed and BijuliAdda became NEC today NEC is called NEA. After that there was little further development until the 1960s. Then oil crisis of early 1970's rapidly accelerated for installation of hydroelectric projects. At the same time, the government became concerned with improving its administrative structure around the country and gives more priority to this sector. The Small Hydro Development Board was formed in *1975* to implement small hydro installation in remote areas, particularly at district head quarter SHDB. It was unable to fulfill its ambitious plan because of technical, financial and managerial problems and also due to the lack of overall condition and forward planning in this sector. Moreover, the need of energy has been emphasized and the programme related to this sector was started to.

Electricity, the most efficient and cleanest form of modern energy, is a critical component of economic development. An efficient provision of electricity can improve the socio-economic conditions and technological aspects of a nation that ultimately improves the living standard of the people. However, more than two billion people still lack access to electricity and rely on traditional biomass such as firewood, agricultural residues, charcoal, and animal dung for cooking, heating and lighting in their homes. Using these insufficient technologies, basic energy needs can hardly be met and contributes to maintaining the cycle of poverty in developing countries (Pokharel, 2007).

In Nepal, there is iota of possibilities to produce energy. Theoretically, hydro-power has a potential of 83000 MW hydropower, but among them only 43000MW can be produced from the prospective of economic and technical point of view. Up to now there is only 769 MW hydropower is produced and the produced hydropower is mostly used in urban areas than the remote rural areas. Because of this condition, the remote areas are

directly affected, in which, they are not getting clean and applicable energy. Thus, in Nepal, there is lots of possibilities of micro hydro project in remote rural areas; which is very much, environment friendly and economically bearable (Recent Rural Energy Policy of Nepal-2063). Only the 12% people are getting service of electricity from the alternative source of energy, where the national transmission line is not assessable to reach in the geographically remote areas. From the MHP 23 MW, Solar Power energy 12 MW, Wind energy 20 KW and Bio-gas 11 KW all together 35.03 MW electricity is produced up to now in Nepal (NPC,2014).

"Renewable is a key elements of sustainable development, providing clean, affordable, and reliable energy, a valuable resource in the world's energy portfolio." (G8 Renewable Energy Task Force 2001, final report). "His Majesty's Government shall provide grant through the Alternative Energy Promotion Center to the domestic private sector to generate and distribute electricity by building hydropower center of up to 100 kW capacities at the rural level. Moreover, such projects shall be included in the prioritized loan sector, and facilities shall be provided to such projects accordingly. Electricity shall be supplied from small hydropower projects in the mountainous rural area falling outside the access of the national power system. Provision shall be made to hand over the responsibility of operation and maintenance of such small hydropower projects to the local cooperative groups and these groups shall also be involved in the course of formulation and implementation of plans. (Hydropower development policy: 2001)

Micro hydropower plants also known as 'micro hydro', 'mh' and 'mhp' are installed in Nepal's remote hilly and mountainous areas. These are useful to provide electricity for lighting facility mainly. Agro-processing like grinding, hulling, operating radio, tv, computers and some other end users are its benefits. Nepal’s techno-

entrepreneurs have gained immense of expertise in this technology as they are in this trade for around 40 years. They have expertise to carry out all services for feasibility study, survey, design, manufacturing of turbines and other machines and equipment, installation, commissioning, and repair and maintenance required to micro hydropower plants. This technology has been successful to generate approximately 20 Mega Watt of electricity establishing 2500 mh plants of different size and capacity. Achievement in this technical expertise also have been appreciated abroad as services, materials and know how beyond the country have been extended.

Around 65 privately run firms/companies are there in this trade these days to render services to establish micro hydropower projects to generate of 5000 Kilo Watt of electricity annually in the country. The plants up to 1000 Kilo Watt capacity are to be known as micro hydropower as defined recently where as it was limited to 100 Kilo Watt in the past. The schemes of 5 Kilo Watt or less, now, have to be known as pico. Nepal Micro Hydropower Development Association was established, in 1992, by eight privately run micro hydropower development firms/companies to set as an umbrella organization of those dedicated to serve the nation with micro hydropower technology, skill and expertise. The Association is also to support formulating policies, plans and programmers to concerned agencies. Likewise, professional welfare is one of its objectives. (NMHDA)

The micro hydro is primarily used for lighting purposes in rural area. The average load factor of a typical micro hydro project is less than 30 percent. Biomass, fuel wood in particular is still the most dominant form of energy for rural households regardless of their access to MH electricity. Micro hydro plants in Nepal are playing important role for enhancing the rural livelihood. It reduces or replaces the use of kerosene. Micro hydro can also run agro processing units and some other small enterprises. The average

electricity consumption of Micro hydro users is only about 1.9[1] goes/month, which is roughly equivalent to 4 hours of daily use of three 60-watt bulbs.

Electricity provides luminance that is hundreds of times brighter and at the same time cheaper than kerosene- based lighting. People enjoy this consumer surplus because better illumination qualities can be obtained from micro hydro electricity at a far cheaper rate than kerosene fed electricity. This allows business activities in the rural communities to extend well beyond daylight hours, which has the potential for employment and income growth. The productive use of micro hydro electricity like agro processing, carpentry, communication centers etc. has given the opportunities of employment to the rural people resulting in a source of income. Similarly people can also engage themselves in operating and maintaining the micro hydro plants and enhancing their skill. It has also enabled women to be involved in productive activities in the evening, and increases their exposure to the outside world and education through electronic media such as TV powered by electricity.

The gender and social inclusion concept in micro hydro has prioritized women empowerment in this sector. Better lighting facility also increases study hours for school-going children and impact on results. Micro hydro plants have been a very good worth for promoting the Clean Delivery Mechanism (CDM) by reducing carbon emission. About 10 million kg of CO2 is saved every year by MH households in Nepal. Selling that carbon can also be listed as income generating way from micro hydro. Studies show that, household's benefit from MH exceeds its cost by about 3 times. Nepal's micro hydro projects are already registered in the CDM (AEPC-WB Survey, 2009).

Micro hydro is a type of hydroelectric power that typically produces up to 100 kW of electricity using the natural flow of water. These installations can provide power to an isolated home or small community, or are sometimes connected to electric power

networks. There are many of these installations around the world, particularly in developing nations as they can provide an economical source of energy without the purchase of fuel. Micro hydro systems complement photovoltaic solar energy systems because in many areas, water flow, and thus available hydro power, is highest in the winter when solar energy is at a minimum. Micro hydro is frequently accomplished with a peloton wheel for high head, low flow water supply. The installation is often just a small dammed pool, at the top of a waterfall, with several hundred feet of pipe leading to small generator housing.

A large section of the Nepalese population is deprived of electricity coverage despite huge hydropower potential, particularly in rural areas. About 63 percent of Nepalese households lack access to electricity and depend on oil-based or renewable energy alternatives. The disparity in access is stark, with almost 90 percent of the urban population connected, but less than 30 percent of the rural population. Nepal has about 83,000 MW of economically exploitable resources, but only 769 MW have been developed so far. This study has been designated to organize an evaluation system that measures the impact of micro-hydro installations on rural livelihoods and to establish a monitoring system for Alternative Energy Promotion Center (AEPC) to continually measure the results of the results of the renewable energy programs against the targets.(TWB) Hamal, (2001), Explain that rural and hill areas have undergone deforestation due to insufficiency of alternative energy, i.e. electricity and women over working in farm time-consuming and non-monitoring and highly backwardness. The author further explain that energy is required to fulfill day-today needs, which included cooking, heating, lighting and productive activities such as transportation, irrigation, cottage industries, etc. Energy shortage has been recognized as a major constraint in the economic development and it contributes to further deteriorate the environment, creating

a vicious cycle in rural life by the deforestations. Women are the main user of household energy. They are the main person responsible for collecting fuel wood or managing of other energy source such as doing crop residues etc. Deforestation has made of women work harder. The long and increasing foot trail distance to fetch and gather fuel materials.

UNDP (2005), explained on new and renewable energy source to study the situation of new and renewable sources in Nepal. In this context the research problem of this dissertation is to assess the socio-economic benefit of Kulekhani first hydropower which a view to prepare recommendation to augment the positive benefited and minimize negative benefits. This study is based on the survey covered in some district in the central and western development region areas namely hills and mountains. This study depicts the status of new and renewable energy source via small, micro, hydropower. Water turbines, biogas solar and wind power. The study has assessed the potentiality of this resource and also identified the area; which need further development. The study covers out with the conclusion that most hydropower installations are either operating under capacity or generating. In adequate electricity to meet local demand due to insufficient water resource during the dry season to generate electricity in full capacity and in some areas colder operation of the plan is often hampered by the formation of ice in the intake and frequent break down of the electro mechanical part. Thus the study concluded that the hydro projects run effectively only for about 9 months in a year. According to study the main establish effective linkage and co-operation between affiliated organizations and to monitor and evaluate programmed and preference the lack of adequate database related to micro-hydro project resource and the high cost of water turbines. It also suggests that the government should provide facilities to setup New and Renewable Energy Subsidy (NRES) and there should be provision of financial support thought subsidy in initial investment back financing on working capital, canalization of donor, resources to

promote healthy growth of (NRCES) technologies further their need to be the integration of cottage industries, ropeways and other income generating activities, as a means 01 improving load factors and viability of isolated hydro electricity.

WECS (1988), Carried out Rural Electrification Impact in Nepal, Volume I which is final report of the task force on rural electrification and impacts on Nepal. The main objective in this report was to investigate impact of rural circulation in trader to create a database for future forecasting and to provide police direction for future development. Rural areas Nepal served from a various generation sources were studied in this report. There included Nepal Electricity Authority grid sides and there are remote from the gird served by diesel, the Indian grid NEA. Investigations were made of small hydro and private micro hydro. The study gathered and analyzed demand date from NEA. Investigations were made of small hydro to determine operating characteristics. The major finding of this reports that is the impact of rural electrification have been minimal. But this is not meant that there is no future for rural electrification. Rather it means that development of rural grid must be under taken in a planned, reasonable ways so that systematic development of it in rural areas can be possible.

World Hydropower Atlas (2000), has categorized like wise large and small, is by far the most important of the renewable' for electrical power production. The World Hydropower Atlas 2000 published by the International Journal of Hydropower and Dams, reported that the world' technically feasible hydro potential is estimated at14 370 TWh=year, which equates to 100 per cent of today' global electricity demand. The economically feasible proper - tion of this is currently considered to be 8080 TWh=year.The hydropower potential exploited in 1999 was2650 TWh=year, providing 19 per cent of the planet's electricity from an installed capacity of 674 GW. Of new hydro capacity, 135 GW is expected to be commissioned in the period 2001– 2010. All other

renewable combine provided less than 2percent of global consumption. As illustrated in Fig. 1, North America and Europe have developed most of their economic potential, but huge resources remain in Asia, Africa and South America. Small hydro (<10 MW) currently contributes over 40 GW of world capacity. The global small hydro potential is believed to be in excess of 100 GW. China alone has developed more than 15 GW and plans to develop a further10 GW in the next decade.

Dongol, (1999), explains that power is the most important things for make country industrialization and in modern era industrialization of any country plays an important and role in economic development of Nepal. Exploitation, utilization, and utilization of energy resources have contributed so much to the development of industry, agriculture, transport etc. Per capital energy consumption is the basic factor; not only for the comparison of living standard of the people of Nepal but also for the measurement the role of economic growth of the country. Nature has been kind enough to favors Nepal with waterpower resources. The potentiality is quite Hugh and it plays a leading role in the economic development of Nepal. Actually Nepal started to utilize this resource from year 1911 but the study about the extent of the assets of waterpower potentiality was just recently during the years 1963-66. Though waterpower development of Nepal has considerably long history but due to several reasons only about 0.04 percent of the waterpower resources is utilized so far. Till this time other power resources like coal, gas, liquid fuel is not available. So only water power plays a positive role in economic development of Nepal. At present the country's hydroelectric power generating capacity is limited and very few areas. If we see the unbalanced nature of tiller development, the central region of the country is facing the problem of utilization of energy from the development power plants. Again industrially position area in the eastern and western region are not getting power is the main problem for industrialization of the country. For

to protect forest which are rapidly being depleted it became necessary of energy. To give irrigation facilities in hilly areas has become essential to utilize water resource as far as possible.

WECS, (2002) mentioned on socio-economic issues in energy development that energy is basic necessary for survival. It is necessary for development activities to promote education, health care, transportation and infrastructure for attaining a reasonable standard of living and it is also a critical factor for economic development and employment. Shortage of biomass fuels has forced urban households and industries to switch from biomass fuels to imported fossil fuels and other commercial form of energy. Deforestation and desertification are threatening to traditional energy supplies and agro-based rural economy. These shortages of biomass fuel in rural sector have energy sources are needed to promote rapid growth- of the rural economy. The aim of achieving rapid rural economic growth to meet the basic needs of rural families is also plagued by the lack of energy and other resources e.g. farm land, technology and capital for investment.

The main features of the energy sector are the imbalance between energy resource endowment and its current use. There is an excessive dependence on forest to meet energy needs while hydropower, which has vast potential, has remained virtually not so utilized. Biogas is not an important energy, which is technically limitation in hills and mountain even in Terai. Nepal's hill and mountain areas occupied under development infrastructure make life hard for rural population. Women generally hear the full responsibility of household chores and share work in the farm and also fuel collection for energy requirement. This increases workload for the women. This makes women's daily life more difficult. The report mainly concentrated on women who are responsible for reproduction and bring up all the time spent to the next generation and care on a daily

basis of all family members. Moreover they generally work hard but paid low wages and offer security low valuation of women's work, few legal rights, and also non-wages. Energy supply program should also include generating activities for rural people either men or women. Women are handicapped by their skills, materials and technology and extension services. Energy supplied could increase both productivity as well as decrease in hardship if men or women in such activities like shorter processing hour on agricultural sector and less physical work. It reduces time and hardship, i.e. cutting, grinding, stirring as a result more time has gone for productive work. So that energy helps women to improve income-generating activities. In conclusion; this report talks stainable development as the keyword for need oriented, self reliant and environmentally sound development and says that increased economic activities will require more energy input. Nepal relies excessively on the form of renewable energy, i.e. NV 00d obtained from forest and its role in balancing ecosystem has been decreasing. We have large amount of water resources, which could be exploited for hydropower, hydro-based energy (also all sector of energy) used in the domestic and industrial sector. It contributes development of the country as a whole.

Environmental impacts if they are not designed consciously to protect the environment ITDG. (1999) concludes that MHP can cause unacceptable negative or these impacts are not mitigated properly. The scale of MHP impacts is small enough to reasonably mitigate them without any significant adverse environmental impacts at affordable costs. Landslides or land erosion ranks highest among the possible negative impacts of MHP. The universal positive environmental impact from MHP is reduction of green house gas emission through substitution of kerosene used for lighting. MHP geared towards electric cooking can conserve forest as well as reduce green house gas emission. As already mentioned earlier MHP has positive gender impact. The involvement of

women in MHP promotion is still at the low profile. In this connection the participation of woman community organizations in MHP promotion is appreciable initiative. Efforts in this direction will be at the interest for the MHP promotion.

Pandey (2009), In Nepal, the installation of MHP has been supported by bilateral donors and banks who have not been effective in providing reliable and affordable energy to poor rural areas .In addition, due to poor planning and execution, most of the existing MHP plants were not functioning in many rural parts of the country. Also, there is a lack of data regarding rural energy supply and consumption patterns since energy planners overlook rural enterprises as less-productive members of the economy. Moreover, rural electrification follows a top down approach in Nepal. However, primarily rural energy sector has to be improved in order to improve the economic status of the country. Because more than 80% of the Nepalese people still live in rural parts of the country. Therefore, more attention should be given towards the rural household who are deprived of electricity especially, in mountainous region like “Sikles”. The objective of the current paper was to investigate the impact of decentralized small-scale renewable energy technologies in a rural community, Nepal. A case study was carried in order to assess the socio-economic conditions of a village impacted by the MHP plant using qualitative as well as quantitative.

Karki, (2004), Nepal’s rural electrification through the national grid is dwindling. This is because the extension of the national grid to rural areas is unrealistic both technically and economically due to the rugged mountainous terrain, and the sparse nature of human settlement. Also, rural electrifications often awarded as a political favor in Nepal, which ultimately put major portions of poor rural population in darkness if the areas are not within the interest of political leaders. Nepal is one of the poorest countries in the world with a per capita income of $447/year, where about 25% of the population

lives below the poverty line (NPC, 2010). Nepal's energy sector is small, inefficient, unreliable, poorly managed, and hugely dominated by traditional energy sources including firewood, agricultural residues, and animal dung. During the 2013/2014,79.9% of the country's energy demand had been met through traditional sources whereas commercial (petroleum, coal, and electricity) and renewable energy sources contributed 18.5 and 1.6%, respectively. The heavy reliance on traditional biomass for energy results in a poor quality of life, makes local resources scarce, reduces agricultural productivity since nutrient rich agricultural residues are transferred from the farm to the fireplace, and damages the fragile hill ecosystem.

Koirala, (2007), despite having limited access, the numbers of electricity consumers are growing annually in Nepal. During the year 2013/2014, the total number of customers reached 2,712,633 which represent a growth of 4.36% over a figure of last fiscal year (NEA, 2014). With the given economic condition of the country, the task of providing electricity to all through capital intensive large hydropower projects seems daunting to meet the existing power demand. Therefore, to meet the challenge of ever-increasing energy demand, small-scale renewable energy technologies have been adopted throughout the country. Rural areas are electrified using decentralized renewable energy technologies such as photo voltaic, wind, geothermal, and MHP, and are competitive with electricity delivered via the national grid. MHP has turned into one of the most promising indigenous technologies to satisfy rural electrification because of their simple design, simple manufacturing processes, low price per kilo watt, easy maintenance, and no dam has to be built. Additionally, many researchers have reported that HP not only provides lighting for rural communities but also helps to accelerate rural economic development if the power is integrated with agricultural production and other income generating businesses; plus less fuel wood is consumed. Overall, MHP can fulfill the technological,

environmental, economic and social sustainability criteria in remote and isolated areas in developing countries like Nepal.

Energy Trend in Nepal

Modern RE options that are considered technically proven and socially viable in Nepal include micro-hydro, solar photovoltaic systems, improved *ghatta,* biogas plants, solar thermal units and improved cook stoves. The government, along with bilateral agencies, non-governmental and private organizations is engaged in the promotion of RE through national and regional programs.

Solar Home System

The system of transforming the energy come from sun in to electric, heat and light energy by the help of collector is viable and feasible in the context of Nepal. At preset, there are about 30 manufacturers of solar system and the total installed capacity in the country is estimated at 10,000 sq meters of solar panels. About 14 companies have been involved in the installation and there are 42,500 solar home systems in 74 district except Bhaktapur district. The total installed capacity of solar home system in Nepal is 1,584.5 KW peak power. Among them Eastern Development Region carries 11,761 pants with 467.0 KWp, Central Development Region occupies 6,465 plants having 232.1 KWp and Western Development Region has 16,723 plants with 645.9 KWp. Similarly Mid-Western Development Region has 2,670 plants with 69.11 KWp and 3,470 plants having 116.1 KWp have been installed in Far-Western Region (CADEC, 2004: 18).

Analyzing above data, the trend of installing the solar home system is not dissatisfactory. Solar home system was introduced in 9992 but it had slow growth rate up to 1998, when below 5,000 pants had been cumulatively installed in Nepal at the mid of 1999. Incredibly at the end of 2003 there were 42,500 plants in total, which indicates that the growth rate of solar home system has been highly increased since 1999, (CADEC,

2004: 18). However, due to the high initial investment (required 31,500 – 33,000 per unit of 36 W module), the rural people of low-income level have deprived from it. Thus there are least solar home systems in Far Western Development Region while it is least developed region of Nepal. It is impossible to practice in cooperative way due to scattered settlement pattern and lack of cooperative sense in Nepal. Another system, the solar water heater technology has not yet been proud appropriate for Himalayan regions.

Biogas

Biogas is a byproduct of *"anaerobic digestions"* of organic wastes such as plants and crops residues, wood and bark residues and human and animal manure. It is an important and viable energy resources thus have expanded throughout the globe in the past two decades. Biogas at first was introduced in Nepal after the demonstration of it as modal in 1955, (Hora, 1991: 45). Latter on 250 biogas plants were installed during the fiscal year of 1975/76.

With the establishment of Biogas support program (BSP) in 1992 with the financial support from the Netherland Development Organization (SNV/Nepal), the pace of biogas development increased rapidly. Currently 49 biogas construction companies have been recognized for the installation of biogas plants. By the mid July of 2003, a total of 111,395 biogas plants have been installed in 65 districts having total installed capacity 776,146.9 cubic meters. Among them, 21,274 plants have been installed in Eastern Develop Region with 149,968.9 m^3 installed capacity, 32,826 plants have been installed in Central Development Region with 209786.7 m^3 installed capacity and 41,269 plants have been spread in Western Development Region with 283815.1 m^3. Likewise 8,855 plants have been penetrated in Mid-Western Development Region with total 66154.0 m^3-installed capacity and 7,171 plants having 56422.2 m^3 capacities are in Far-Western Develop Region, (CADEC, 2004: 19).

In Nepal 3,318 Biogas plants were installed in 1992/93 and reached the no. 37,354 cumulatively at the end of 1997/98, then due to the viability of this plant the installation trend was speeded swiftly and at the end of fiscal year 2001/02 the plants were installed in number of 95,055 in total, (CADEC, 2004: 19). It is reported that about 90 percent of the plants installed in Nepal have a provision of toilet connection and more than 50 percent households have already connected toilet to their plants.

Due to the well proven, design and quality control mechanism, recognition of local manufactures/installer, provision of all seasonal subsides; accessibility of masonry and technical work by local people and employment possibility the biogas program has been successfully increased in arithmetic series in Nepal. But biogas plants have not been installed parallel in numbers compared to their effective demands. It is due to less effectiveness of slurry utilization program, inadequate research and development and ineffective and inadequate monitoring and evaluation mechanism. Along these constraints, biogas is not viable in all places of Nepal due to geographically and climatologically uneven regions.

Turbine Mills

The development of hydro electricity turbines was initiated around the middle of 19^{th} century. Its subsequent improvement in efficiency and flexibility of utilization and finally coupling of turbines with electricity generation started enable the waterpower to produce electricity energy. It was famous all over Nepal and is still used widely where there is not accessibly of electricity handled agro-processing mills. It has no environmental impact and, effect on stream ecology is minor. Beneficially hydro electrical turbines system may serve other propose in addition to power such as water supply, flood control, irrigation and recreation.

In Nepal, there are 804 schemes of turbine mills on total and its installed capacity is 7106.9 KW as a whole. Among all, 92 plants with 1013.0 KW installed capacity have been installed in Eastern Development Region, likewise 197 plants have been operated in Central Development Region with 1749.7 KW total installed capacities. Similarly, 301 turbine mills have been installed in Western Development Region with 2573.5 KW installed capacity and Mid Western Development Region has 173 schemes with 1407.25 KW capacities. And Far Western Development Region owes only 36 schemes with 3161.1 KW installed capacity. Likely, 5 plants with 47 KW installed capacity are not region wise know, (CADEC, 2004 30).

Far Western Development Region is in poor status in turbine owing like other technology. Western Development Region is rich in turbine installation which region owes the developed status in Nepal. Though the turbine mills were notably operated in back years, most of them are not sustained ably because they are not used in multipurpose connection.

Improved Ghatta

Ghatta, a spinning device to crossing the cereals and grains using kinetic power of water started to operate from time immemorial. The devices used two hard stone slates knotting with a long modern churning stick are still seen operating at the bank of river mostly. These were operated traditionally and handled by local technology, later on; the technological investigation towards the local indigenous and traditional technology has progressively modernized the devices.In this process these traditional *Ghatta*were changed the figure to improved *Ghatta*joining or fixing iron churning stick stone/iron devices are fixedwith it according to the geographical location of plant installed area and speed and volume of water.

Presently in Nepal, total 872 schemes of improved *Ghattas*have been installed in total. Out of these schemes, 147 plants have been installed in Eastern Development Region. Similarly, 392 plants have been operated in Central Development Region which comparatively almost 3 times more than the plants of Eastern Development Region. Likewise 80,147 and 103 plants have been installed in Western, Mid-Western and Far-Western Development Region respectively where 3 plants have not regionally known, (CADEC, 2004: 21). These improved *Ghattas* have been used only for grinding purpose so its usefulness is comparatively less than MHP. Besides these, different books, reports, previous studies, articles, plans, policies, journals, other published and unpublished documents related to this research work will be studied.

2.2 Current Status of Electricity in Nepal

NEA's hydropower plants including small power stations generated a total of 2,308.37 GWh of electricity, against the generation of 2,305.17 GWh in the last year. The generation within the country has not been sufficient in eradicating load shedding; additional power had to be imported from India. The total energy imported from India was 2,581.80 GWh as compared to 2,175.04 GWh in the last year, an increase by 18.70%. The total power purchased from Independent Power Producers (IPPs) within Nepal was 2,167.76 GWh, an increase by 21.97% from the last year's fi gure of 1,777.24 GWh. The total energy available in NEA's system increased by 12.79 % to 7,057.93 GWh over the previous year's fi gure of 6,257.73 GWh. Out of the total available energy, NEA's own generation contributed 32.71% whereas those imported from India and local IPPs accounted for 36.58% and 30.71% respectively.

A total of 15 new projects developed by the Independent Power Producers (IPPs) with a combined installed capacity of 71.643 MW were commissioned in the FY 2017/18. This has increased the total number of IPP owned projects in operation to 75 with a combined installed capacity of 512.6954 MW. A total of 107 projects to be developed by IPPs, with a combined installed capacity of 2,356.313 MW are under construction after financial closure. Similarly, 74

IPP owned projects with a combined installed capacity of 1,658.817 MW are in the various stages of development.

During the FY 2017/18, a total of 45 new PPAs were signed with a combined installed capacity of 1,102.909 MW. This has increased the total number of PPA signed with the various IPPs to 256 with the combined installed capacity of 4,527.8254 MW. PPAs with grid-tied solar power projects have also started at the new flat rate approved by the NEA Board.

Two new 132 kV Transmission lines, KataiyaKushaha II and Raxaul-Parwanipur, were commissioned in the FY 2017/18 under the grant assistance of Ministry of External Affairs, Government of India. The commercial arrangement for drawing power of 50 MW from each of them through North Bihar Power Distribution Company Limited was made under India-Nepal PEC. Further, NEA proposed three new 132 kV transmission lines to be built between Nepal and the Indian State of Uttar Pradesh for the additional power exchange between Nepal and India in future.

Maximum power import from India in peak hours reached 521 MW in April/May, 2018, whereas the highest average power withdrawal recorded was 425 MW in January/February, 2018. The total quantum of energy transaction with a rise of 18.7 % reached to 2,581.78 GWh including 70 million units under the Mahakali Treaty. This corresponded to a payment of NRs. 19,371.76 million in the fiscal year 2017/18 against NRs 16,051.31 million for 2,175.04 GWh in the year 2016/17.

Energy mix for Nepal's nearly all ROR hydro based system has to be considered at least on the short term basis, until sufficient energy generating capacity is achieved to meet the all year demand. Imports from India as well as domestic grid connected solar generation have been considered. The 25 MW grid connected solar farm under construction in Devighat is a prime achievement in this regard. Similarly PPAs for private solar generation have also been initiated.

The completion of the Dhalkebar 220/132 kV substation has given an additional 100 MW of import capacity. Similarly the completion of the Kushaha-Kataiya second circuit and RaxaulParwanipur 132 kV Transmission Line will also add another 100 MW import possibility. With the completion of the above facilities, the importing capacity from India during the dry season will be more than 600 MW. Completion of Hydropower projects like Upper Tamakoshi and other IPP projects in the next year will see an addition of more than 600 MW to the system. Similarly with the completion of under construction generation and transmission projects, we can expect an addition of more than 1200 MW to the system within the next 2-3 years.

NEA has already signed PPAs with IPPs for more than 4500 MW. These are mostly ROR type projects with a few exceptions. PPA for one storage type project was signed with Tanahu Hydropower Company Limited. As a long term strategy to cater to the load demands at different time of the day as well as during the different seasons, we are focusing on Peaking Run-of-River (PROR) as well as Storage type projects to meet the generation mix defined in "National Energy Crisis Mitigation and Electricity Development Decade Concept/Action Plan, 2072". In this vein, we are developing Dudhkoshi (800 MW), Tamor (762 MW), Uttarganga (828 MW) and Andhikhola (180 MW) storage type projects and Upper Arun (725 MW) and Tamakoshi V (100 MW) PROR type projects. To attract private investment in Storage as well as PROR type projects, PPA rates for the same were also fixed.

Another important aspect that needs immediate attention to ensure that the power generated from the proposed plants be evacuated timely is the construction of a Transmission Line network. NEA is developing a 400kV transmission line backbone with support from the various donor agencies; such as the World Bank, Asian Development Bank, European Union, Exim Banks of India and China etc. Millenium Challenge

Corporation (MCC) funded by the US government has also initiated the development of 400 kV transmission line in the central part of Nepal. Moreover, one 400 kV cross border link with India from New Butwal (Nepal) to Gorakhpur (India) and one with China from Galchi (Nepal) to Kerung (China) have already been initiated and are expected to be completed within the next five years. More cross border lines are proposed with India to be initiated in the near future. These interconnections will enhance power wheeling possibility across the border and promote energy banking and export/ import opportunity. In line with Government Policy to make access of electricity to all within next five years and to cater 10 thousand megawatts of power by next ten years, NEA has initiated distribution capacity expansion in the rural areas and distribution system upgrading in the industrial corridor in the Terai and the main cities including Kathmandu. Without major augmentation and reinforcement of Distribution network within the next few years, the increase in demand with the increase in supply will not be met. Similarly for safety and reliability reasons as well as from the aesthetic point of view, the main distribution lines of Kathmandu are planned to have an underground system. NEA has started the procedure of adopting modern digital technology into its system to enhance its operational efficiency, reduce energy theft and enable itself to serve its customers in a better way. The implementation of Smart Grid and Smart Metering system will definitely increase efficiency and reduce losses. The integration of solar energy into its grid system through net metering is also planned to be expanded. Solar PPA signing with the new revised rates have already started. The online centralized bill payment system has been initiated and will be expanded to all the customers.

CHAPTER – THREE

RESEARCH METHODOLOGY

3.1 Rationale of the study area

Chauri Ganga Micro-Hydro project is situated in Madan KundariVDC of Kavrepalanchok district. Madan KundariVDC is culturally and historically famous in kotbhibrab . It is also very important for tourist area. There are a lot of scence and historical place which can attract the tourist. Chauri Ganga has a potentiality of small micro-hydro project because of its geographical status.Madan KundariVDCward no.3,4, 5, 6 and, 8, Braman, Tamang, Chhetri, Bhujel and Kami lives in the study area. The total population of the Madan KundariVDC is 800 (Primary Census 2011). The capacity of Chauri Ganga micro hydropower is 13KW and 160 household are benefited. The project was started in fiscal year 2055 and completed in fiscal years 2057.

3.2 Research Design

According to the nature of research problem and objectives, this study has applied the descriptive research designs. It has described to all field survey information and presented in basic statistic formula.

3.3 Nature and source of data

Both quantitative and qualitative data have been used. The primary data has been collected through field survey, KII, and focus group discussion. As a requirement of data analysis, secondary data also used which has been collected from library, online and existing literature and books.

3.3.01 Primary data

Primary data collected from the field survey. For this purpose the following tools applied in this research:

A. **Observation:** This researcher visited to the project site and observed. The project site influenced community, market, places and its surroundings.

B. **Interview**: interviews taken with educated as well as layman about the impacts of projects; interviews selected from the project catchments area as well as neighboring villages.

C. **Questionnaire**: A questionnaire developed prior to project visit. The questionnaire developed in such way that it covers demography, health and sanitation, agriculture and animal husbandry, sufficiency of agriculture product, income and expenditure pattern, human resource, women and children resource of fuel, kind of stove and forest and electricity. The project has occupied land of total 74 household who are considered as directly project affected families and they selected to fill up questionnaire.

3.3.02 Secondary data

Secondary data will be collected from different source of governmental and nongovernmental organization such as; MOEN, MOF, WEC, NPC, CBS, NEA, DOED, AEPC, CDRD, ICIMOD, VDC, Related bulletins, journals, published report, knows and official etc.

3.4 Universe and Sampling

The total population of study area is 160 households and selected 50 respondents house hold by random sampling among them.

3.5 Data collection techniques and tools

1. Household survey

For this purpose, followed the questionnaire design process and conducted a pre test program. After that finalized the questionnaire and outlined in the order line, which

was open and close ended questions. Researcher self involved in the household survey so that it is original and primary data along with field observation.

2. KII (6-8 experts interview)

Check list has been prepared based on the objectives and conducted a Key informant Interview (KII) with expert related of Micro-hydropower.

3. Observation checklist

For the field observation, check list also develop according to objectives and research questions. It was guided to field observation, and assisted to completion within timeline.

3.6 Data analysis process

According to field survey data, and research design, first of all computing to all the raw information in computer along with Microsoft word and excel sheet. Secondly verified to data error and corrected to remains data of field. Finally, quantitative data has been presented in simple statistic process where applied to Pie-Chart, table, Bar and trend line etc. Similarly, qualitative data has been explained based on the thematic base and interpreted as well.

3.7 Method of data collection

To analyze the collected data, categorization, ordering, ranking will be done to obtain required answer of research question. Data has been presented in simple statistical tools like table, figure etc. average; percentage, numbering etc. have use for simplifying data for comparison, for data analysis. According to attributes and features of data the required tables and figures have created and textually. This study declares on socio-economy impact of the Madan KundariVDC, Kavrepalanchok district.

3.8 Limitation of the study

This study will be studied only one micro hydro power project in one VDC, so the conclusion derived from this study will not be applicable to other sector. This study will be focused on socio-economic impact of micro hydro project to rural people, so present study will have very specific. Thus study primarily focused the communities and social impacts causes by MHP at the local area.

CHAPTER- FOUR

DATA PRESENTATION AND ANALYSIS

This section deals with the overall analysis of the field that the researcher had acquired through the field study. In the process of analysis, research highlights socio-economic impact of micro-hydro project. To justify the statement the researcher has analyzed both qualitative and quantitative data Micro-Hydro is the leading sector for the development of Nepal, It being a comparative advantage of Nepal has important role in Nepalese economy.

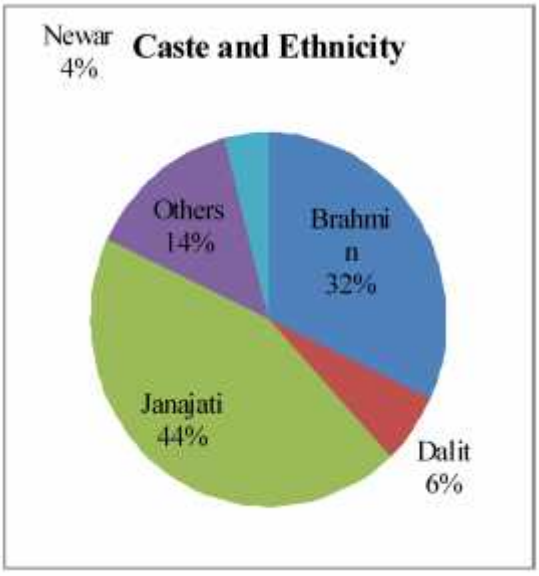
4.1 Demographic profile of respondent

4.1.1 Caste and Ethnicity of the respondent

The survey data tried to include the variety of caste and ethnicity of the study area. Among 50 respondents, the study included 22 Janajati, 16 Brahmin, 3 Dalit, 2 Newar and 7 other caste groups.

The majority of the population in the study area has followed by Brahmin, which can be replicated in the sample selection. The survey included equal number of male and female respondents, i.e, 25 male and 25 female respondents.

Figure 1: Caste and Ethnicity of Respondents



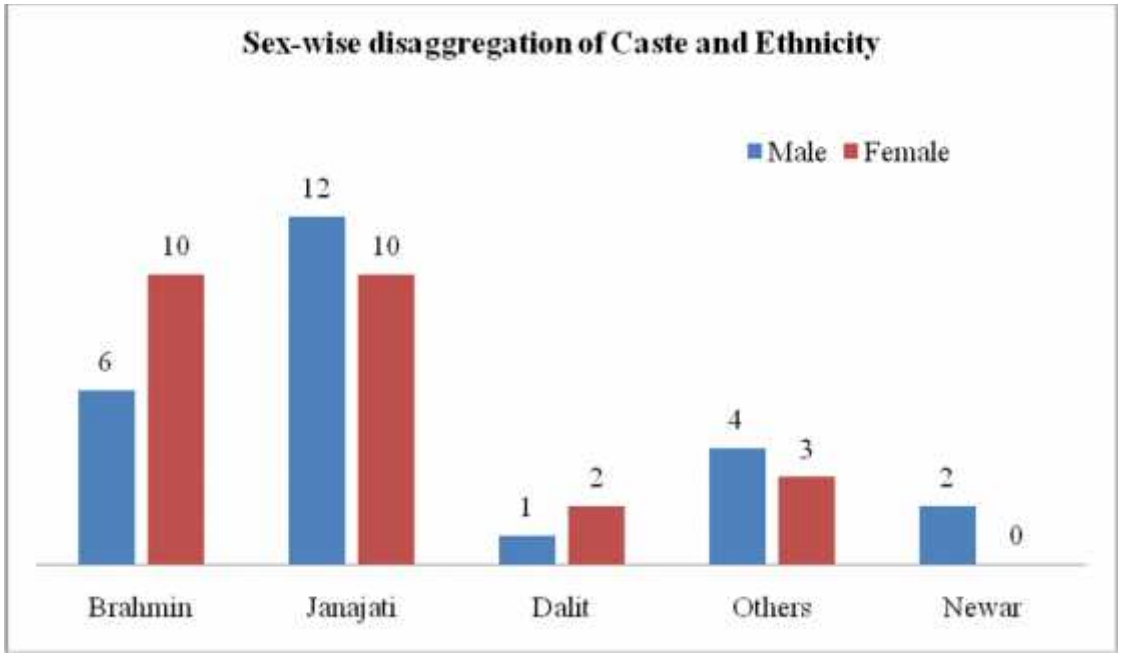
Source: Field Survey 2018

4.1.2. Sex-wise disaggregation of Caste and Ethnicity

The study has tried to segregate to respondent in sex-wise, which has assisted to analyze the gender based affect of hydropower and socio-economic status of respondents.

Hence, it has presented to caste wise sex distribution of respondent of study area. The details of sex wise distribution has showed in figure no.2.

Figure 2: Sex-wise disaggregation of Caste and Ethnicity



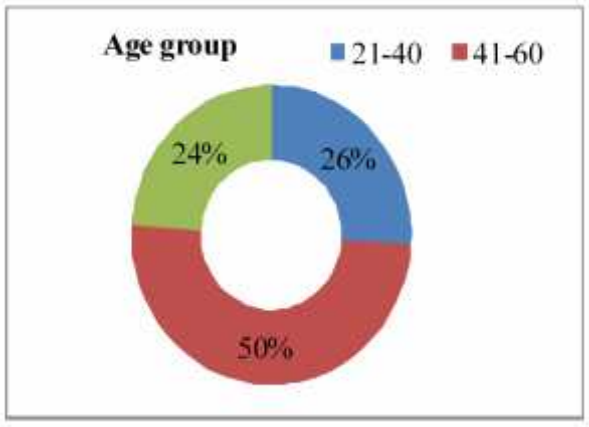
Source: Field Survey 2018

Above figure no.2 shows that no one represent female respondent from Newar caste, but dalit have a less number of male respondent than female. Except Brahmin and Newar caste, rests of the caste have near about equal participant from male and female. Although, it's satisfactory of represent in totality from the community and also not gives major priority to gender analysis in this study.

4.1.3 Age Group

Figure 3: Age group of Respondent

The study included samples from different age groups. The age group is taken in an interval of 20 years for easy calculation. Since the study evaluated the socio economic condition before and



after project, the sample size is selected from the age 26 years to 75 years are group. It is seen that the 50% of the sample size is from the age group 41-60 whereas there is almost equal number of respondents from age group 21-40 and 61-80.

4.1.4 Education status of respondent

The education status of the respondent does not very much. The population of the area is not highly educated. They range from illiterate to higher secondary level. The education of the respondent is directly related to their age. The people with more age is less educated or with very less education whereas the younger the generation, higher the educational status is.

Table 1: Distribution of Education

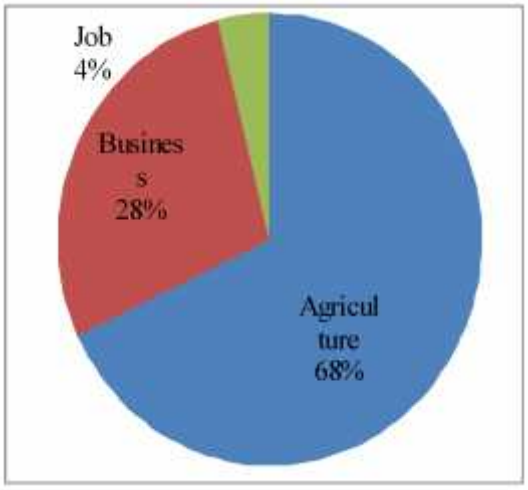
	Age group		
Education	21-40	41-60	61-80
illiterate	0	15	11
up to class 5	0	7	0
up to class 10	3	2	1
SLC	8	1	0
+2	2	0	0

Source: Field Survey

According to table no.1 shows that most of the respondents are illiterate, which belong to 41-60 and above age group. Very less number represent from 21-40 age group who are literate and achieve higher education too. Therefore, it can assume how the economic condition of the respondent is. Because education also determine the social status and it explores the more opportunities for employment. As well as if they have a low education, it is a challenge to relate with income generating activities based on the electricity. The study has focused to identify the socio-economic status therefore education also be a indicator as a variable of the change.

4.1.5 Occupation of the respondent

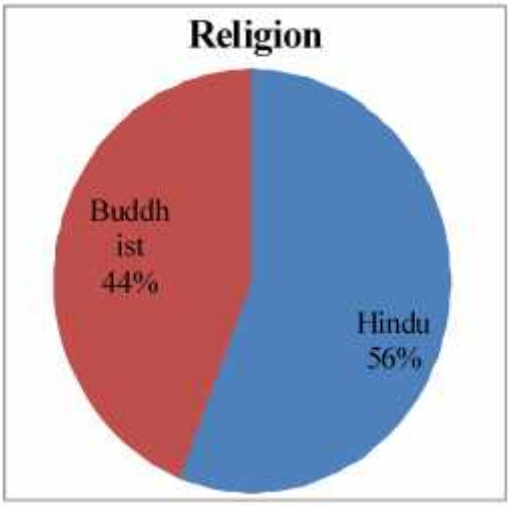
Figure 4: Occupation of the respondent



The occupation of the respondent is categorized into three categories; agriculture, business and job. Most of the respondents are involved in agriculture as their main occupation. 34 out of 50 are involved in farming whereas14 are involved in different types of business. 2 of the respondents are involved in teaching job. Some of the respondents are adopting more than two occupations at a time. it is seen that the respondents with low educational status are mostly engaged in farming, whereas with high educational status are engaged in job.

4.1.6 Religion of the respondents

Figure 5: Religion of the respondents



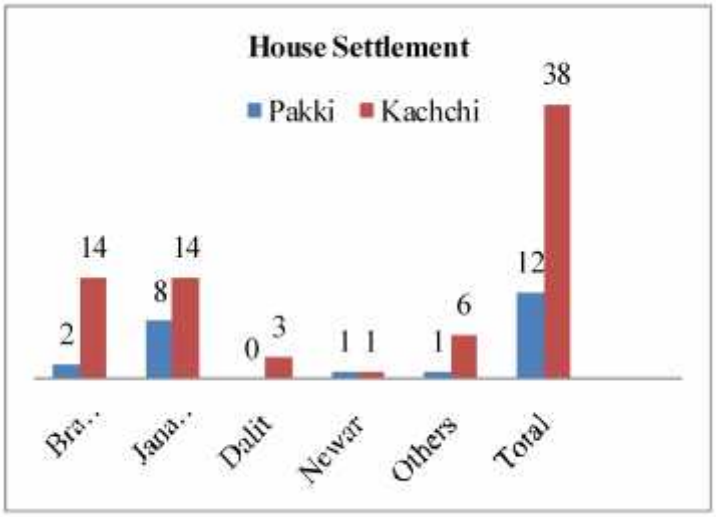
The religion of the respondents consists of Hindu and Buddhist religion. 22 of the total respondents follow Buddhism whereas 28 of them are Hindus. The major festival they celebrate is also directly related to their religion. Buddhists celebrate Lhochar and Buddha Jayanti as their major festival whereas Hindus celebrate Dashain, Tihar, Janai Purnima, Teej as their major festival.

4.2 Socio- Economic Profile of respondent

This section deals with economic profile of respondents in various indicators and variables. Which are explained and describe based on the following thematic area. These are development indicator too and represent of the project affect area.

4.2.1 House Settlement

Figure 6: House settlement status of Respondents

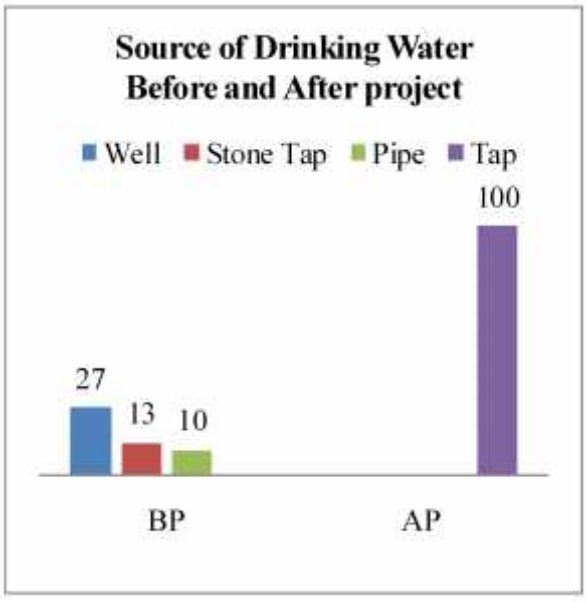


Most of the houses of the settlement area is Kachchi, i.e, made up of mud and stone with stone roof. Out of 50 houses of sample respondents, 38 are of Kachchi nature. Only 12 houses are of Pakki nature, i.e., made up of tile or tin roof. This shows the living standard of the people of the area. They also have cattle sheds attached to their houses.

4.2.2 Health and Sanitation

4.2.2.1 Drinking Water

Figure 7: Source of Drinking water

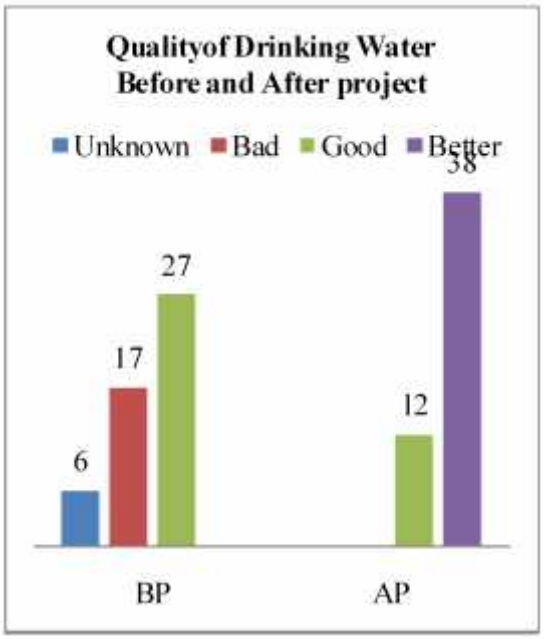


The research evaluated the source of drinking water of the project area after and before project implementation. Before the implementation of the hydro-power project, most of the people were using water from well, stone tap, and very few were using water from pipe line. But after the project implementation, every sample household is using tap water. Before project, 17 respondents responded that the quality of water they were drinking was bad, whereas 27 respondents responded that the water quality was good. 6 were unknown about the quality status of water. But after

project implementation, all the respondents responded that the quality of water is either good or better.

In addition, study has explored the quality of drinking water condition after and before intervention of hydropower. According to figure no. 8 shows that 6 respondents have not unknown about quality of water, very high number respondents 27 said good of water quality before intervention. Similarly, only 12 respondents said good and 38 said better of water quality after intervention of hydropower.

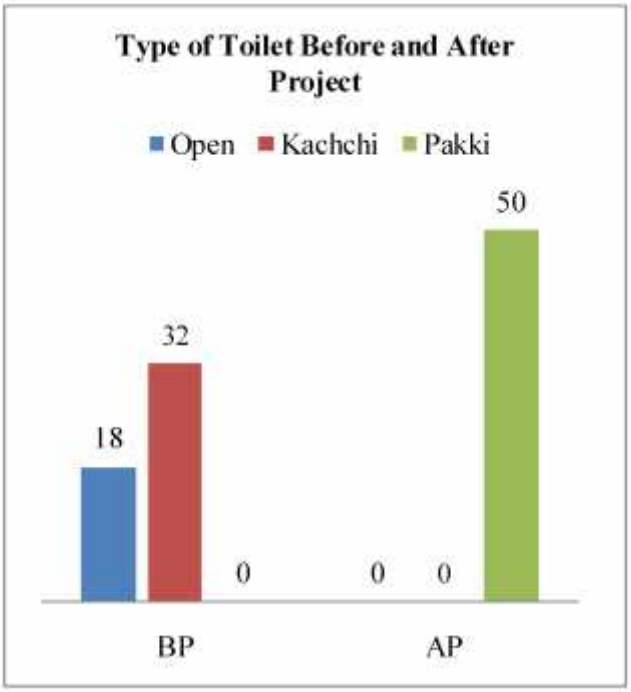
Figure 8: Quality of drinking water



4.2.2.2 Use of Toilet

Sanitation is one of the indicators of living standard of the people. Before the project started, there were 32 kachchi toilets in the household of the respondents whereas rest had open toilet and none of the household have pakki toilets. After the project implementation, all 50 households have pakki toilets. This shows the change in lifestyle of the people of the area along with the improvement in knowledge about sanitation and behavior change.

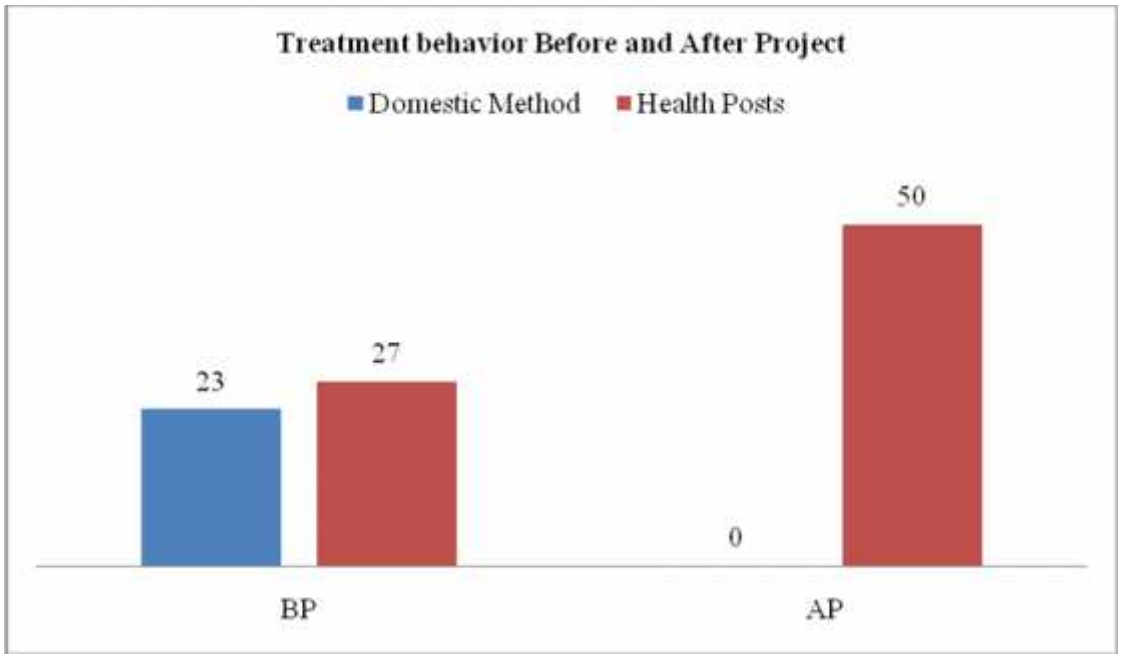
Figure 9: Type of Toilet



4.2.2.3 General Treatment

Before the project started, people of the PAFs used to follow both domestic method and go to health post for treatment. But mostly they follow domestic method which includes use of herbs and belief in witch doctor (Dhami-Jhakri). But after the implementation of the project, all of the respondents responded that they go to health posts for general treatment. After the project implementation, the increase in health posts and private health centers also enhanced the habit of treatment in health posts.

Figure 10: Treatment behavior



Source: Field survey 2018

4.2.3 Agriculture

4.2.3.1 Land Holding

Most of the land plots of PAFs are cultivatable. Out of some plots of land are situated in the bay of Chauri Khola River where the project is situated. The land is classified into three categories such as Khet, Bari and Pakho Bari (Non - Cultivatable land) The Total area of Khet with irrigation facility were 169.4 Ropani before the projected started, however, 15 ropani has turned to uncultivable (Banjho) after project

implementation. The total area of Bari without irrigation facility before project implementation is 531.6 ropani which remain static after project implementation. The total area of Pakhobari (uncultivable land) is 328.4 before implementation which decreased to 284.4 ropani after project implementation. The sources of irrigation for 31 household were khola or river whereas rest of the 19 household depends upon the rain water for irrigation.

Table 2: Land Holding by Caste group and its Kinds

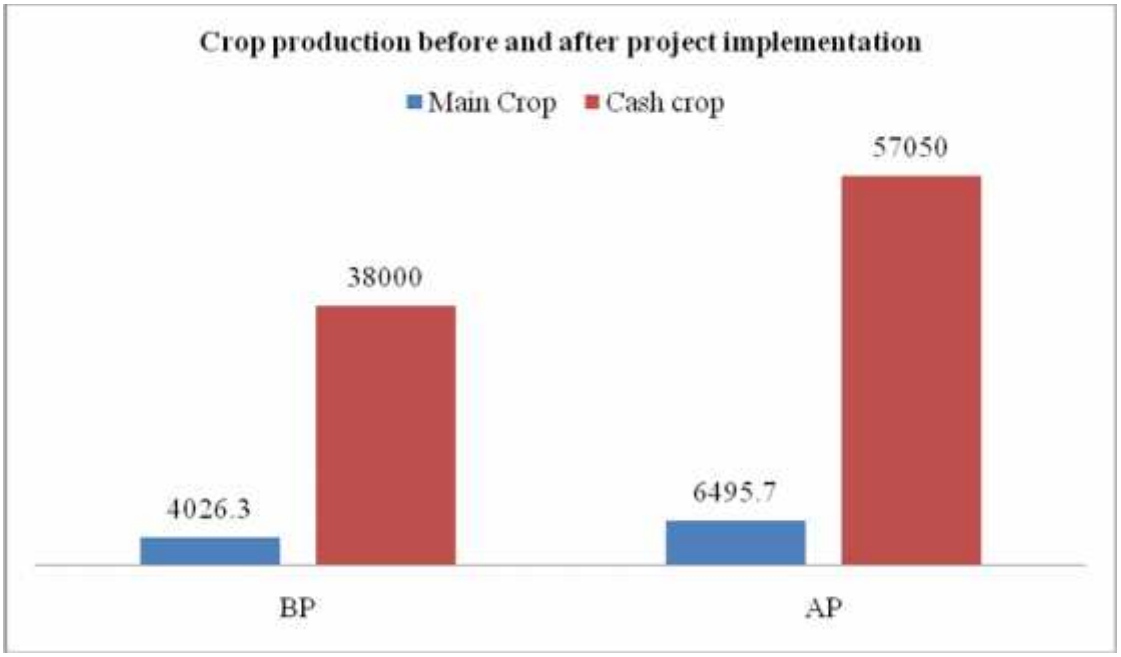
Caste Group	Kinds of Land *(inRopani)*							
	Khet		Bari		Pakho Bari		Ground total	
	BP	AP	BP	AP	BP	AP	BP	AP
Brahmin	55.3	49.3	184.5	180.5	123	83	362.8	312.8
Janajati	92.5	83.5	244	245	134.6	147.6	471.1	476.1
Dalit	0	0	25	28.5	22.3	22.3	47.3	50.8
Newar	3.5	3.5	15.6	15.6	11	3	30.1	22.1
Others	18.5	18.5	62.5	62.5	37.5	28.5	118.5	109.5
Total	169.8	154.8	531.6	532.1	328.4	284.4	1029.8	971.3

Source: Field Survey 2018

4.2.3.2 Production

The production has significantly increased after the project implementation. Before project implementation, 4026.3 Muri of crop were produced by the household of sample respondents whereas it increased to 6495.7 Muri after project implementation. The production of cash crop(oil seed) was 38000 per year before project implementation which is significantly increased to 57050 per year after project implementation. None of the respondents used chemical fertilizer and advanced seed before project implementation whereas all household used both chemical fertilizer and advanced seed after project implementation. The use of such fertilizers and seeds were also the reason for increase in the production.

Figure 11: Crop Production status

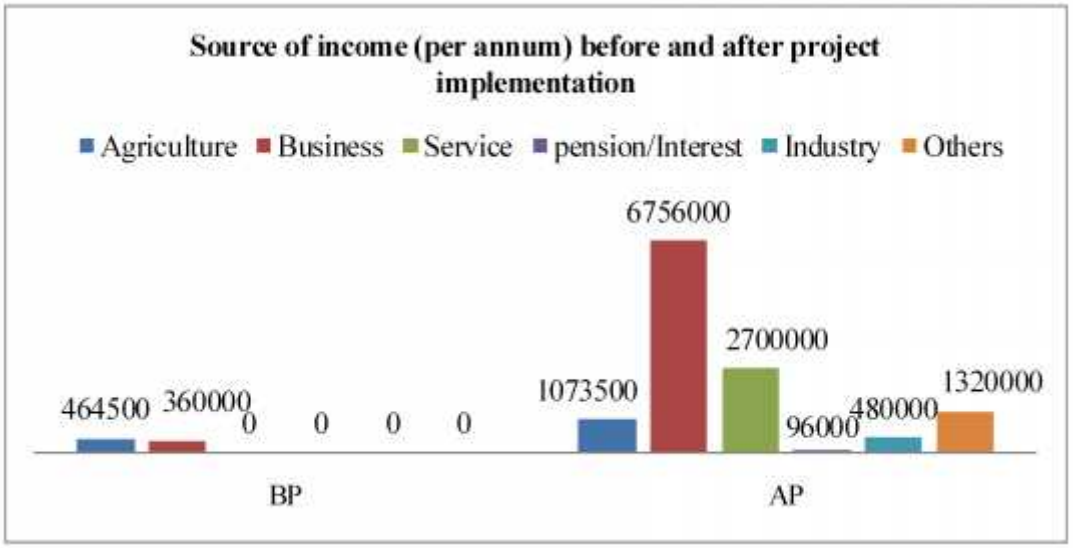


Source: Field Survey 2018

4.2.3 Source of income

The income level of the respondents increased drastically after project implementation. The income from agriculture increased with the increase in production of agriculture product. With the development of market in the area, the business also boomed in the area and the income from business drastically increased to more than 1800%. The income from service increased from 0 to 2700000 per annum with the increase in the opportunity of service. Similarly, income from interest/pension, industry and others increased from 0 to 96000, 480000 and 1320000 per annum respectively after project implementation.

Figure 12: Source of Income of respondents



Source: Field survey 2018

4.2.4 Expenditure

The expenditure of the respondents also increased drastically after the implementation of the project. The per annum expenditure on clothing, education, health, festival and other expenses also increased heavily with the increase in income. The increase in expenses can be the effect of the inflation over the years but it also showed the change in lifestyle of the population with the pace of development and increase in income.

Figure 13: Expenditure status

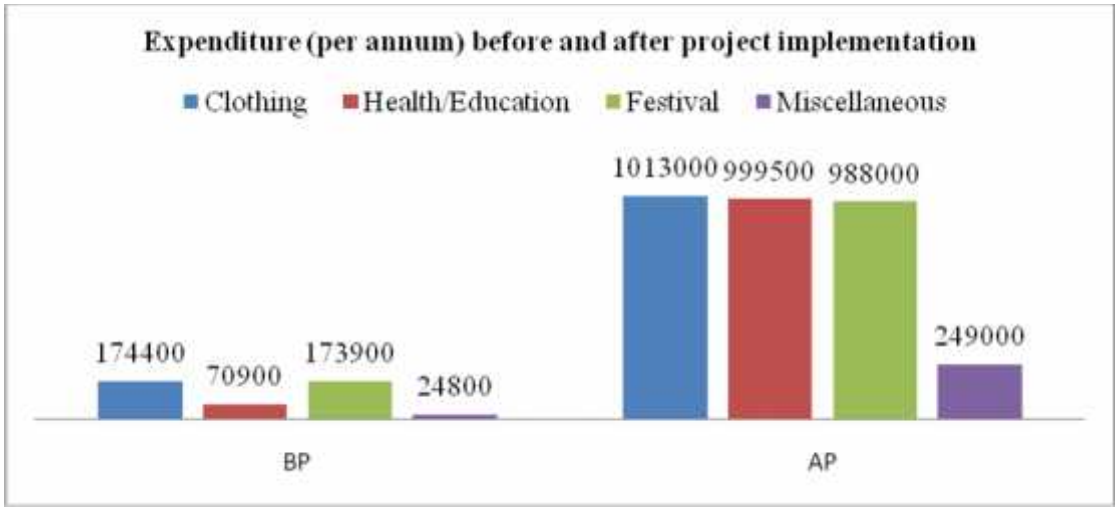


Table 3: Income and Expenditure

	Before project	After Project	Proportionate increase
Income	824500	12425500	1507%
Expenditure	444000	3249500	732%

Source: Field Survey 2018

The above table shows the proportionate increase in income and expenditure after the project implementation. The table shows that the proportionate increase in income is greater than the proportionate increase in expenditure. This shows the increase in saving and uplift of lifestyle of the people living in the area after project implementation.

4.3 Women Empowerment

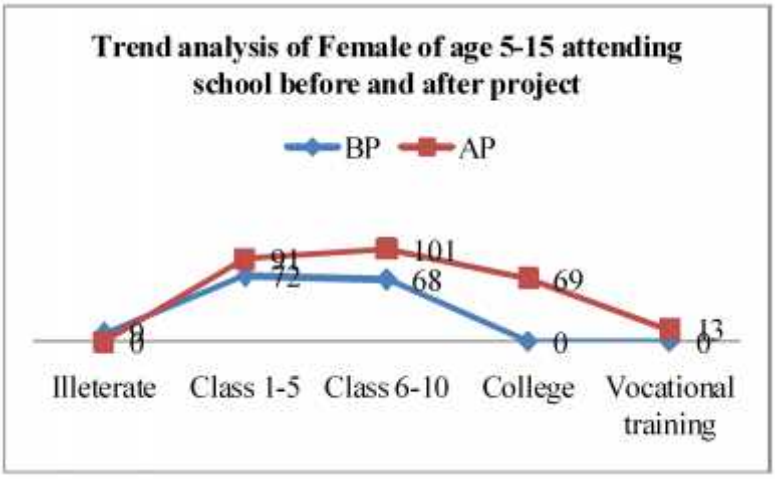
4.3.1 Female literacy rate

The survey found out the total number 149 female of age 5-15, i.e., school going age in the respondent's household before project whereas the female of age 5-15in the respondent's household after project is 261. It is seen that 9 of the female of such age group before project implementation was illiterate whereas none of such age group had attended college. After project implementation, it was found that none of the female of the age group is illiterate and 69 of them are attending college. 13 female has received vocational training after the project implementation. The literacy rate among female is increasing which can be seen in the trend analysis figure given below:

4.3.2 Participation

The survey evaluated the engagement of youth in various aspects of socio-economic development. The research shows that the involvement of youth in the various aspects of social development has increased after the project implementation. The participation of female in such development has also been increased over number of years. Before project implementation, there was just 1 male jobholder, which is increased to 12 (5 male and 7 female) after project implementation. Similarly, number of youth engaged in business before project implementation is 2 (1 male and 1 female) which

Figure 14: Attending in school



increased to 28 after project implementation (19 male and 9 female). The population actively engaged in politics is also increased from 8 male to 9 (5 male and 4 female); significantly increasing the number of female in political activities. Youth in abroad for study or employment and lead of organization/institution/group were not present before project implementation. But it has increased to 18 (14 male and 4 female) and 8 (2male and 6 female) after project implementation.

Table 4: Participation Status

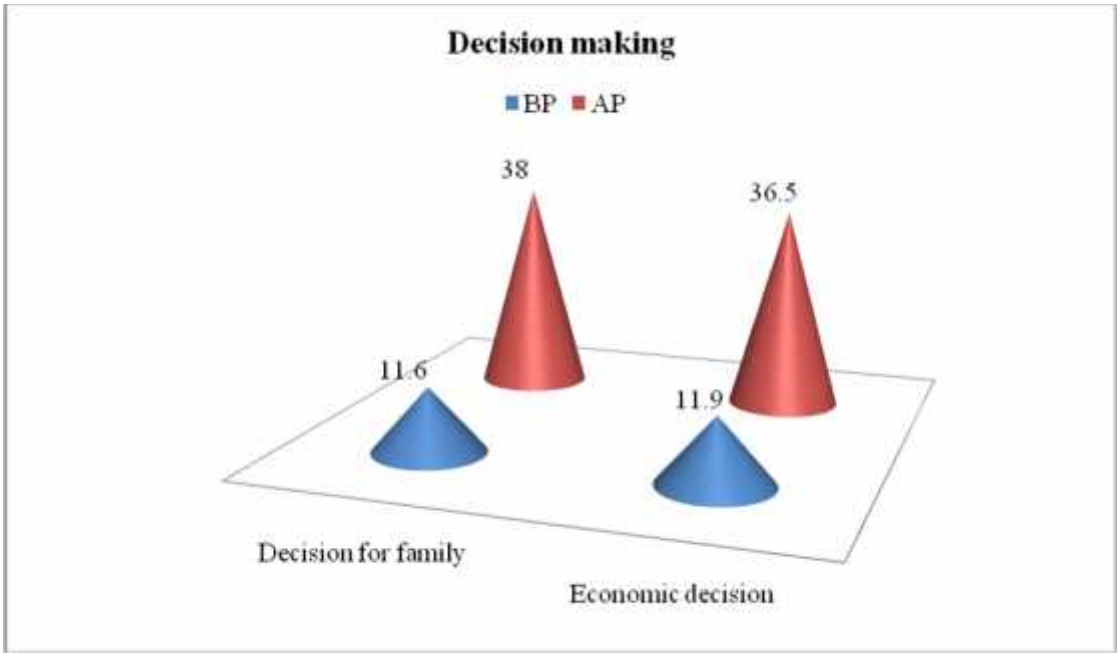
	Job holder		Engage in Business		Actively participating in politics		Abroad for study or employment		Lead organization/group/institution	
	BP	AP	BP	AP	BP	AP	BP	AP	BP	AP
Male	1	5	1	19	8	5	0	14	0	2
Female	0	7	1	9	0	4	0	4	0	6
Total	1	12	2	28	8	9	0	18	0	8

4.3.3 Decision making

The participation of the women in the decision making process of the family and the economic activities has also been increased significantly after project implementation. Before project implementation, women contributed only less than 12% in average of the total decision making for family and economic decision making process. But after project implementation and engagement of women in various economic and social activities, the average decision making authority of the women has significantly increased. In average,

women's contribution in decision making for whole family is 38% whereas decision making for economic activities is 36.5%.

Figure 15: Decision Making



4.3.4Health and Consciousness

4.3.4.1 Treatment and institutional delivery

The health consciousness for women health has been significantly increased over the years. There were significant numbers of household before project implementation who do not have access to health institutes for general treatment, checkup for pregnant women and children and for child birth. They depend upon herbs and other methods available at house and depend upon unskilled delivery persons for child birth or give birth to child by themselves. But the health consciousness has been significantly improved after project implementation as none of the women of sample household depend upon household medicine and they go for institutional delivery for child birth. Every woman has access to health institution after the project implementation.

Table 5: Treatment status

	General treatment		Checkup for pregnant women and children		Place for delivery	
	BP	**AP**	**BP**	**AP**	**BP**	**AP**
House	32	0	24	0	29	0
Health Institute	18	50	26	50	21	50

4.3.4.2Knowledge about Family Health and Radio/TV/News program

The surveys showed that the knowledge about family health and radio/TV/news program related to health were very little before project implementation. All of the respondents responded that they have less knowledge on the topics. But with the increase in health consciousness, education, income and overall social development, the knowledge on family health and radio/T/news program is significantly increased and all the respondents now have enough knowledge on the topics.

4.4 Education of children

The number of school going children before project implementation is 160 whereas the number is 158 after project implementation. So, there is not very difference in number of school going children of age 5-15 in the families of the respondents. But there is difference in their reading habits and sanitation habits. The average study time at home before project implementation is 3 hours per day whereas their average study time at home after project implementation is 3.16 per day. There is not very difference in the daily study hours of the children after the project. But the children had learned sanitation habits. The children, before project implementation, sometimes used to maintain their own sanitation. But now, they mostly maintain their own sanitation and their sanitation habits have improved a lot.

4.5 Use of electricity

The research studied about the use of electricity to the community people. the electricity is generally used for three purposes; domestic purpose, commercial purpose and industrial purpose. For domestic purpose, every household has access to electricity and they use electricity for lighting, heating and cooking. For commercial purpose, they use it for photocopy, printing, cooking, lighting, heating, ironing and for industrial purpose, they are using for operating furniture industry and mill.

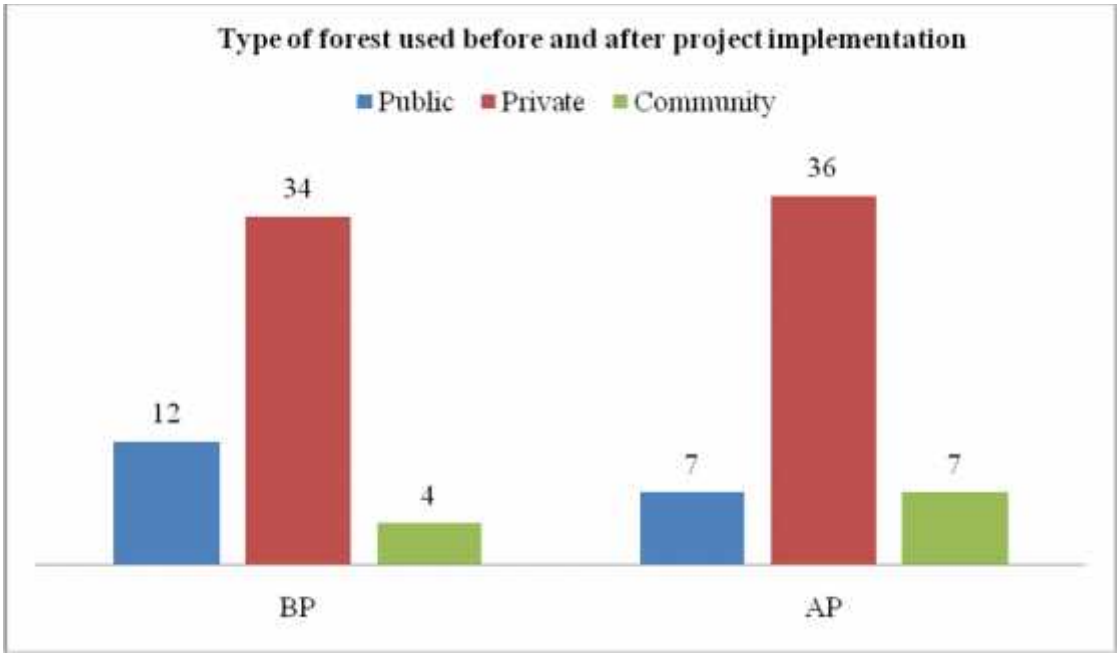
4.6 Source of energy

The study showed that kerosene was the major source of energy used by every household before the project implementation. But after project implementation, each household has access to electricity. Hence, after project implementation, the major source of energy for every household is electricity. Before project implementation, all household used traditional stove for cooking. But after project implementation, only 16 out of 50 household are using traditional stove whereas rest of the household are using heater or bio-stove.

4.7 Forest

Forest is still one of the major part of daily life for the people of the area. They collect grass for their livestock, collect materials for building and repair of houses, collect firewood and timber, etc from the forest. The research shows that there is not very significant change in the type of forest by the respondents before and after the project. It is seen that majority of the respondents, i.e., 34 of them were using private forest before project implementation whereas the number of private forest users increased to 36. 4 were using community forest before project implementation which increased to 7. 12 were using public forest before project implementation which reduced to 7 after project implementation.

Figure 16: Uses of Forest



4.8 Use of other facilities

The research studies the use of modern facilities such as radio, TB/deck, emergency light, iron/fan and charger before and after project implementation. It is seen that only two houses had radio and one household had solar charger before project implementation whereas all households have such facilities after project implementation.

Table 6: Use of other facilities

	Radio		TV/Deck		Emergency light		iron/fan		Charger	
	BP	AP	BP	AP	BP	AP	BP	AP	BP	AP
Yes	2	50	0	50	0	50	0	50	1	50
No	48	0	50	0	50	0	50	0	49	0

CHAPTER- V

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary

Energy is a basic requirement for development. The development of all the productive sector of an economy depends on development of the energy sector. In general there are two types of energy sources viz. traditional and commercial. Electrification creates various opportunities of development activities in rural area. Traditional source of energy are not sufficient to meet the energy demanded. The use of fossil fuel is also costly and it negatively pressurizes on the balance of payment in the economy. Over pressure on forest creates various problems. This study attempts to appease the importance of electricity in economic development. It also discusses about hydropower potentiality and its present status in Nepal and impacts of CGMHP on socio-economic condition of people in the area around the project.

Nepal has great potentiality of hydropower. The theoretical potentiality of hydropower is estimated to be 83.290 MW on the basis of hydrology and topography the technical hydropower potential is accounted 45,520 MW and the economically exploitable capacity of the kingdom, however, is 42,133 MW. The hydropower development in Nepal has long history starting from the local water mill known as Ghatta. The first hydropower plant of Nepal was Pharping hydro project (500 kw) which was in operation since 1911 A.D and start construction from 1907 A.D. The government has been lunching the development program in accordance with economic plan. Every plan has given to priority to hydropower development for national development.

Before introducing of the development plans, only 2,07 KW hydropower was generated in Nepal. Then first five year plan failed to generate power, 2,400 kw: 13000

kw 16.040 kw 16220 kw, 77.577 kw, 90,172 kw, 25,500 kw and 274,514 kw hydropower were generated during the second three year. Third forth, fifth, sixth, seventh. Eight Ninth and Tenth five year plans period from large as well as small scale projects respectively.

75 hydro projects exist up to the end of FY 2016/17. NEA's hydropower plants including small power stations generated a total of 2,308.37 GWh of electricity. Out of the total available energy, NEA's own generation contributed 32.71% whereas those imported from India and local IPPs accounted for 36.58% and 30.71% respectively.Kaligandaki 'A' (144 mw) is the largest hydropower project among all hydropower projects.

The total number of consumers increased from 3.26 million to 3.55 million including community and bulk buyers during FY2017/18. Domestic and Industrial consumer category contributed 43.50 % and 37.53 % to the gross electricity sales revenue respectively. Rest of the consumer category accounted for the remaining 18.72% of the gross sales revenue. The total population with access to grid electricity has reached about 70% from 65 % in the last fiscal year. The total energy available in NEA's system increased by 12.79 % to 7,057.93 GWh over the previous year's figure of 6,257.73 GWh.

The Chauri Ganga micro hydropower project is run off river type of project with 13kw capacity located in Kavrepalanchok district of set zone it is middle power project of the mid development region. This project was initiated in 2056 BS and completed 2057 BS. It has influenced various aspects of socio-economic aspects of human being residing in the surrounding areas of the project. The project has used the mitigation measures to reduce negative impacts on environment, physical biological and socio-economic aspects.

The study area lies in the Madan KundariVDC, Kavrepalanchok district. The study area is situated in mountain area. The adverse impact on aquatic life has resulted mainly from the lack of water in the stream.

The CGMHP has directly as well as indirectly influenced 560 people of 75 house-holds and consumers of community forest of 40 families (PAFs), who lost land, have been benefited by the project. PAFs consist of 161 people: Five caste group such as Bhujel, Kami, Tamang, Braman,Newar is found residing in the area. The study covered only 50 samples among the PAFs.Hindu and Buddist are in the major religious groups were the study covered 56% of Hindu and 44% of Buddhist population.

The agriculture and livestock husbandry are the main occupation of the area which is gradually being displaced by business. The study compares the socio economic status of the people of the area before and after the implementation of the hydropower project. We can see the significant change in lifestyle of the people after the project implementation. People started getting qualitative water from tap and all of them are using toilets after project implementation. Earlier, they used to have water from unhygienic source such as well and stone tap and most of them did not have toilets. They have adopted treatment in health centers rather than relying on domestic method and witch doctors.

Significant change can also be seen in economic standard of the people. The income level has significantly been increased. The opportunities of income generation have also increased to wider dimension. Previously, agriculture and animal husbandry were the only option for economic activities. But, now the diversified opportunities can be seen such as business, industry, job, foreign employment, etc. This leads to change in expenditure habits and behaviors of the people. The surplus or the saving amount is also increasing which indicates the economic prosperity of the people of the area.

The change in social perspective about women is also taking place. The importance of education and especially girl's education is being promoted and more girls are sending to school. Along with this, other opportunities for empowerment and

advancement are also being open for girls and women. The number of girls and women conducting business or taking job or going abroad for education or employment is in increasing trend. The decision making authority and the political participation of women is also increasing. The trend of institutional delivery and ANC/PNC checkups at health centers is significantly increased and the knowledge about family health, sanitation, etc is increased. Electricity has provided them opportunity to gain knowledge about health, sanitation, empowerment, etc through different means of communication.

The lifestyle of the people is also changing with the change in the economic status. As there is much area for income generation and the availability of modern equipments in the market, and the availability of electricity, the community people are being attracted to such utilities such as radio, TV, emergency light, charger, iron, fan, etc.

The project has provided permanent as well as temporary job opportunities to the people of surrounding areas. Some freely available natural goods have become economic goods, wage rate, market price of imported construction materials and local products have increased.

5.2 Conclusion

The demand for electricity is higher in comparison to the generated capacity. During this decade, hydropower projects are being installed rapidly within our country. 1,749 to 859 GWH power has been generated from 58 larges as well as small scale projects up to the end of FY 2006/07. Out of the total investment, the contribution of the private sector emerges to be significant due to the liberal as well as privatization policies of Nepal Government.

The Chauri Ganga micro hydropower project (13 kw) is supplying electric power through its own capacity. Besides its impact can be noticed in the Kavrepanchok district, particularly.The study area is dominated by Brahman followed by Tamang Community

about various impacts on the life style of local people of the project area and its surrounding.

The socio-cultural norms and values have changed due to the concentration of large influx of people from divers place background. The level of awareness has increased in people. Opportunity knowledge, skill etc. are available in the area and their economic status has become better than before people are attracted towards service foreign employment and business instead of traditional occupations such as agriculture livestock husbandry etc.

Women of the study area are still backward. But their status is improving smoothing with time. Now they are aware of sanitation health, nutrition, child care and family planning. Their role in economic decision and overall decision about family is increasing day by day.

The consumption of the electricity is increased in the project area. There is a significant replacement of kerosene and other source of energy to electricity. Various business and industries have been established in the area and a significant rise in income can be observed after the access to electricity. In conclusion the installation of microhydropower projects like Chauri Gangamicro hydro projectis rather than significant from various angles in the present context of Nepal.

As for the impacts ofenvironmentChauri GangaMicro Hydro projects concerned, they are almost ignorable. Likewise it does not affect the human settlement as much as the large projects do. Obviously it helps to raise the living standard of people living in the surroundings area of the project. It helps to fulfill the demand of electricity in the rural area.

5.3 Recommendations

- Government should emphasize the development of infrastructures in remote, hilly and mountainous districts which support the development of hydropower.
- Detail survey and estimation should be conducted the identity and install Chauri Ganga micro hydro project which can which can be invested by foreign Donor Agencies
- The multipurpose hydropower project should be installed to promote industries especially cottage and small scale industries and irrigation facilities.
- Strong financial agencies should be established to facilitate the investment on the development of microhy dropower project.
- The environmental friendly, technically feasible and economically profitable hydropower plants like Chauri Ganga micro hydro project should be installed.
- Priority should be given for the development of small hydropower project because it helps to reduce regional imbalance of development, meet the local and national demand for electricity and implement, large scale project as export oriented project.
- The private sector should be encouraged to develop hydropower specially Micro-hydropower project like –Chauri Ganga Micro Hydro project
- Efficient plants and equipments like that Chauri Ganga micro hydro project should be sued in hydropower project, which many help to generate high power at low cost.
- Electricity duty should be reduced to encourage small and cottage industries in rural areas e.g. saw mill, herbal product industry. Cold storage, cheese and ice cream factory etc.

- Participatory approach should be adopted to involve local people in the developmental activities as far as possible.
- In every opportunity preference should be given to the local people.
- A portion of project's revenue should be invested to launch various programs for raising the living standard of the people.
- The compensation should be paid on time through the easy procedure for PAFs.
- Income generation programs should be launched by project in the study area.
- Local people should be also ready and conscious to help the up coming projects and program and grab advantages.

In short it is recommended that mitigation measures must be closely monitored and upcoming hydropower project should avoid the short comings of the Chauri Ganga micro hydro project. This is the lesson we must learn from the Chauri Gangamicrohydropower project to develop other hydropower project to develop other small hydropower projects throughout the hilly areas of our country.

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ANNEX: 1

QUESTIONNAIRE

The study of socio-economic impact of Chauri Ganga micro hydro power

1) General Information:

a) Name of Respondent

b)Age……c)Sex…….

d) Zone : ……. District: …….. VDC: …….

Word No: …….. Village: Tole:

e) Total population of the family

Male……Female……..

f) Family's information.

Table: 1

S.N.	Name	Relation with Head of HH	Sex	Age	Education	Occupation	
						Main	Secondary
1							
2							
3							
4							
5							
6							
7							

g) Spoken language ----------mother tongue.

No. speaker of mother tongue----------male----------female

h) Religion ----------major religious festival ----------

i) Status of house and land, house only land only/both.

i. House: Pakki/Kachchi

ii. Shed/cell: No. Kind:

2. Health and sanitation

Table 2

	BP	AP
Source of Drinking Water	Piped/well/tape	Piped/well/tape
Quality of drinking water	Better/good/bad unknown	Better/god/bad unknown
Kind of Toilet	Open/kachchi/pakki	Open/kachchi/pakki
Institution to treat	Domestic/witch doctor health post/center activist.	Domestic/witch doctor health post/center activist.

3. Land Holding

Table 3 In Ropani

Kind	Irrigation		Non-irrigation		Worked by	
	BP	AP	BP	AP	Own family	Next family
Khet						
Bari						
Pakhobari						
Grand Total						
AP H.H.						

4) Agriculture and animal husbandry

a) Source of Irrigation: BP ……..AP…….

B) Production of cereal and cash crops.

Table 4

		Production per Ropani		Total Production	
	crop	BP	AP	BP	AP
cereal	Paddy				
	Maize				
	Wheat				
	Millet				
cash	Oil seed				
	Other				

Status of livestock

D. market for vegetable, food and cash crops, chemical fertilizer and use of advanced, improved seed.

Table 6

Crop and Vegetable	Market		Chemical fertilizer		Advanced seed		Problem	
	BP	AP	BP	AP	BP	AP	BP	AP
Food crop								
Cash crop								
Vegetable								

5. Sufficiency of agricultural production (BP and AP)

a) If you save your production, what and how much do you save? How do you utilize it?

b) If agricultural production is insufficient for your family to now months to fulfill of a year and what are the source it? Sources to fulfill insufficiently of food pension/ labor wage/ service/ portering.

6. Annual income and expenditure of your family?

Table 7

Source of income	Bp	AP	Remark	Expenditure	BP	AP	Remarks
Agriculture				Pattern			
Business				Clothing			
Services				Health/education			
Pension/interst							
Industry				Festival			
Other				Miscellaneous			

7. Human resource management

a) How many time period of a year is required for agriculture?

For paddy farming . . . to for maize farming . . . to . . . . for. Wheat / oil seed farming . . . to . . . other farming . . . to . . .

b) What do you do in the rest ment's of a year?

c) Except agriculture, what sorts of work do your family member (15-59 years)? If do and why and where?

d) Is your family's youths migrated for employment? If migrated, where and how much they earn monthly/annually?

c) Female-education of PAFs

	Total female(5-15years)	Illiterate	Literate and 1-5 class	5-10 class	College	Trained/skilled
BP						
AP						

d) Women- Empowerment (Participation on Employment, political Leadership, Decision Making and other sectors).

Table (In female No.)

	BP	AP
Job-holder		
Engage on Business		
Actively Participated on Politics		
Live in abroad for study of employment		
Leading of organization/institution/group		
Decision about whole family (percent)		
Economic-decision (percent)		

c) Health and Consciousness

Table

	BP	AP
Institution general treating	House/health inst.	House/Health Inst.
Check up for pregnant women and child	House/health inst.	House/Health Inst.
Place for delivery	House/Health Inst. or activist	House/Health Inst. or activist
Knowing about family-health	No/Little/enough	No/Little/enough
Knowing about Radio/TV-news/programme	No/Little/Enough	No/Little/Enough

1) Schooling – age children of your family (5-15 years)

	BP	AP	Remarks
No. of children who go to school			
Daily time to study in home			
OwnSanitation done by themselves	No/some time/mostly	NO/Some time/mostly	

If, they do not go to school, what do they do? Why?

8. Source of Fuel, Kind of Stove and Forest

Fuel	BP	Solar	Bio-Gas	Kerosene	Electricity	Other
	AP	Solar	Bio-Gas	Kerosene	Electricity	Other
Stove	BP	Traditional	Bio Stove	Bio Stove	Heater	Other
	AP	Traditional	Bio Stove	Bio Stove	Heater	Other
Forest	BP	Public	Community	Lease-hold	Private	Other
	AP	Public	Community	Lease-hold	Private	Other

9) Electricity

a) For what purposes do you use electricity? Domestic use: Lighting/ Heating/Cooking Commercial Use Industrial Use

b) Electronic Goods and use of fuel

Electronic Good	Bp	Ap	Use of fuel	BP	AP
Radio/Tape					
TV/Deck					
Emergency Light					
Iron/Fan					
Charger/Fridge					

10) Miscellaneous

a)What did you get advantages and disadvantages during the construction period as well as after the completion of the Chauri Ganga micro hydro project .

b) Did your family-member employ in the project's construction? From what, how much did you earn?

c) What are the good and bad aspects of this project?

d) What sort of project/projects is fruitful of your family?

e) What did the projects employees behave you?

f) Are your ready to help any this type of project?

g) Finally, have you any comment?

KII Question

Name: ……..

Position: ……

1. Has the project caused deforestation? If yes, what is the rate of deforestation?
2. What are the changes in the environment that people have experienced, after the launch of program?

3. Is there the irrigation program in the community? If yes, has the project effect the irrigation program?
   Has the government provided electricity (from same hydropower of from different?) to the community?
   a. If no, then – if there any plan of connecting electricity supplied by the community?
4. If yes, then- is there the plan for sustainable use of the Chauri Ganga micro hydropower?
   Is community getting the electricity in cheap price than that of national line?

5. What are the benefits of the project in comparison to the investment?

6. What is the rate of community participation after the project has been launched?

7. Are women Participated or involved in management and decision making?

8. Has the project benefited female, male, dalit and poor people?

   If yes, what are the benefits gained or experienced by them?

9. What are the changes that occurred in development at infrastructure of the community after the launch of the project?

10. Any industries established/expanded technically after launching of hydropower?

11. If yes, what benefit community people are gaining from that industry (for ex, price cheaper than before, qualitative produces, time saving, etc)?

12. What are the economical status change, that occurred in community after the project was launched?