HYDROELECTRICITY POWER POTENTIALITY AND ITS DEVELOPMENT IN NEPAL

A Thesis

Submitted to the Central Department of Economics

Faculty of Humanities and Social Sciences of Tribhuvan University

in Partial Fulfillment of Requirements For the degree of

MASTER OF ARTS

In

ECONOMICS

Submitted by:

Prakash Panth

Roll No: 12 / 070

TU. Regd. No. 5-1-49-74-2005

Central Department of Economics

Kirtipur, Kathmandu

2017

LETTER OF RECOMMENDATION

Mr. Prakash Panth has written a dissertation entitled "Hydroelectricity Power Potentiality and its Development in Nepal" under my supervision on partial fulfillment of the requirement for the Degree of Master of Arts in Economics. I forward it with recommendation for approval.

…..……

Prof. Dr. Komal Dhital
Central Department of Economics
Tribhuvan
University, Kirtipur
Kathmandu, Nepal

APPROVAL LETTER

We certify that this dissertation entitled "HYDROELECTRICITY POTENTALITY AND ITS DEVELOPMENT IN NEPAL" submitted by Prakash Panth to the Central Department of Economics, Faculty of Humanities and Social Science, Tribhuvan University, in partial fulfillment of the requirements for the Degree of MASTER OF ARTS IN ECONOMICS has been found satisfactory in scope and quality. Therefore, we accept this as a part of degree.

Dissertation Committee

……

Prof. Dr. Ram Prasad Gyanwaly

(Head of Department)

……

Prof.Dr. Chakrapani Luitel

(External Examiner)

……

Prof. Dr. Komal Dhital

(Thesis Supervisor)

Date:- 2073- 11 – 03

2017-Feb-14

ACKNOWLEDGEMENT

I would like to express my deep sense of gratitude to my honorable supervisor Prof. Dr. Komal Dhital, Central Department of Economics, Tribhuvan University, for this generous encouragement and undertaking of the supervision of my entire research work. This form of the report is the outcome of is continuous encouragement, consistent guidance, helpful suggestions and comments. Similarly, I wish to extent my thanks for Prof. Dr. Ram Prasad Gyawali, The Head of Central Department of Economics for his Suggestion and encouragement and my respected teachers of the CEDECON, T. U. for providing me the invaluable information, suggestion and comments.

I am greatly thankful to my friend Mr. Rudra Mani Bhandari for providing his invaluable supports and suggestion generously for the complementation of this thesis. Also I am very much thankful to my friends Subak Shrestha, Niskash Subedi, Pankaj Pokhrel, Sammer Thapa Magar, Rupesh Chalise and all my colleagues for their kind suggestions. I would like to express heartily thanks to the staffs of Central Department of Economics, Central Library of T. U., NPC and Nepal Electricity Authority Office for their kind cooperation's during my visit for study

Lastly and most importantly, I am graceful to all the cheerful respondents who have helped me to come with this dissertation.

Prakash Panth

14-February-2017

ABSTRACT

A number of benefits that of minimization of the workloads and time of the fetching firewood, motivates house to help in many works like that industries, official work, agricultural work, and kitchen gardening and also marginalized community inclusive to the live hood programmed for the betterment etc. are major impacts of hydroelectricity development in Nepal. Further, it also economic impacts such as saving money for firewood, minimization of health services, women participation in economic work and slurry usefulness higher productivity of agricultural farms. The number of impacts goes on when environmentalists explain them. Present study reveals that the effect of hydropower is general in nature. It has made the work easier within the social construction of gender, but it has no effect to increase women participation in income generating activities outside the farm. After installation of hydropower plant women left to go to jungle to collect firewood or they are saving money by not buying firewood anymore. Social activities of women are mostly religious, which are also part of social construction. Beside these observations the study found that hydropower in Nepal is not able to benefit Dalits and minorities as they not included in the program significantly. The other weakness is that it is also not able to demonstrate the benefits of hydropower for lighting and thus it limited to industrial, cooking and slurry use for technical, official, agricultural, kitchen gardening and farms. However, hydropower programmed in general, has positive effect to reduce the workload and improve health situation of our life.

TABLE OF CONTENTS

CHAPTER IV

CHAPTER V

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS

BOOT	-	Built Own Operate and Transfer
CBS	-	Central Bureau of Statistics
DOED	-	Department of Electricity Development
EDC	-	Electricity Development Centre
EDF	-	Electricity Development Fund
EIA	-	Environmental Impact Assessment
FDI	-	Foreign Direct Investment
GDP	-	Gross Domestic Product
GJ	-	Giga Joule
GNP	-	Gross National Product
GON	-	Government of Nepal
GWH	-	Giga Watt Hour
HMGN	-	His Majesty Government of Nepal
IEE	-	Initial Environmental Examination
IL	-	International Leasing
FS	-	Finance Service
INPS	-	Integrated Nepal Power System
IPPS	-	Independent Power Producers System
KM	-	Kilometer
KV	-	Kilovolt
KW	-	Kilowatt
MOF	-	Ministry of Finance
MWH	-	Megawatt Hour
MVA	-	Megavolt Ampere
NEA	-	Nepal Electricity Authority
NPC	-	Nepal Planning Council
NPC	-	National Planning Commission
NRB	-	Nepal Rasta Bank
PPA	-	Power Purchasing Agreement
UK	-	United Kingdom
UNDP	-	United Nations Development Program
USSR	-	Union of Soviet Socialist Republic
WECS	-	Water Energy commission Secretarial
WRS	-	Water Resources Strategy

CHAPTER I
INTRODUCTION

1.1 General Background

Nepal has a huge hydropower potential. In fact, the perennial nature of Nepali rivers and the steep gradient of the country's topography provide ideal conditions for the development of some of the world's largest hydroelectric projects in Nepal. Current estimates are that Nepal has approximately 40,000 MW of economically feasible hydropower potential. However, the present situation is that Nepal has developed only approximately 829 MW of hydropower. Therefore, bulk of the economically feasible generation has not been realized yet. Besides, the multipurpose, secondary and tertiary benefits have not been realized from the development of its rivers.

Although bestowed with tremendous hydropower resources, only about 74% of Nepal's population has access to electricity(NEA 2016). Most of the power plants in Nepal are run-of-river type with energy available in excess of the in-country demand during the monsoon season and deficit during the dry seasons.

Nepal's electricity generation is dominated by hydropower, though in the entire scenario of energy use of the country, the electricity is a tiny fraction, only 1% energy need is fulfilled by electricity. The bulk of the energy need is dominated by fuel wood (68%), agricultural waste (15%), animal dung (8%) and imported fossil fuel (8%) (NEA 2015). The other fact is that only about 40% of Nepal's population has access to electricity. With this scenario and having immense potential of hydropower development, it is important for Nepal to increase its energy dependency on electricity with hydropower development. This contributes to deforestation, soil erosion and depletion, and increased flooding downstream in the Ganges plain. Shortage of wood also pushes farmers to burn animal dung, which is needed for agriculture. Not only this, the development of hydropower will help to achieve the millennium development goals with protecting environment, increasing literacy, improving health of children and women with better energy. Growing environmental degradation adds a sense of urgency.

The electricity demand in Nepal is increasing by about 7-9% per year. About 74 % of population in Nepal has access to electricity through the grid and off grid system. Nepal's Tenth Five Year Plan (2002– 2007) aims to extend the electrification within country and export to India for mutual benefit. The new Hydropower Policy 2001 seeks to promote private sector investment in the sector of hydropower development and aims to expand the electrification within the country and export.

The hydropower system in Nepal is dominated by run-of-river Projects. There is only one seasonal storage project in the system. There is shortage of power during winter and spill during wet season. The load factor is quite low as the majority of the consumption is dominated by household use. This imbalance has clearly shown the need for storage projects, and hence, cooperation between the two neighboring countries is essential for the best use of the hydro resource for mutual benefit.

The Nepal main natural resource is its abundant hydropower potential. The distinct topography of Nepal with its unique high hill and more than 6000 rivers and innumerable rivulets crisscrossing the country provides many opportunities for both large and small hydropower development (Warn hock 1989). According to the estimates from Rural Energy Development Programme (2007), Nepal is rich in hydro-resources, with one of the highest pre capital hydropower potential in the world. The available water resources in Nepal of which 72,000 MW is connected in small rivers course (Shah,2008).

One years have been passed in Nepal 1911, started producing hydro-electricity from Pharping Power Station. The east while Bijulie Adda has found its continuity in various forms of government agency and is presently the Nepal Electricity Authority (NEA). In this way, Generation Operation and Maintenance Business can be called to passes the heritage of a hundred years of operation and Maintenance of power station. The medium Power Plant Operation and Maintenance Development is responsible for Operation and maintenance of medium and small power station with installed capacity if below 30MW.

Topographically, Nepal is a mountainous country and climatically this country lies in monsoon region. The two factors have led to the occurrence of very reliable sources

of rivers along with their tremendous volume. From several sources water such as springs, lakes, glacier, etc. There are about 6,000 rivers in Nepal.

In the context of Nepal it can be more easily developed that the type of power. There is some technology problem, which however can be solved easily from technical assistance. But, hydroelectricity means not only development of energy resources but also protection of environment, economic development on one hand and solving soil erosion.

The government of Nepal has recently formulated and adopted a fresh water resources policy. There is a number of proposed hydropower project under consideration, national and bilateral debates are going on relating their priority and farming along with their measurement and cost benefits sharing. A part from these so, far as the giants of multipurpose projects are concerned. The environmental as well as seismic and others dangers, rehabilitation of displaced victims etc. are also matters of immediate concern.

Feasibility and delayed studies are being carried out for the development of hydroelectricity. The work to identify other necessary projects that would be able to meet the demand for electricity is also going on. To address the existing sessional imbalance of demand and supplied in the national electricity system, reservoir- based projects are failed necessary. During F/Y 2014/15, the total number of consumer grew by 12.85% to reach 2.32 million of the total consumer, domestic consumer accounted for 1.57%. The domestic and industrial consumer contributes 44.05% and 36.95% to the total revenue respectively. Rest of the consumer accounted for 3.49% of the total consumer but contributed only 19% of the total revenue.

Energy generation from NEA's hydropower plants remained almost stable during the FY 2014/15, despite the damage caused by “Jure landslide” and massive earthquake in Sunkoshi Power Plant (10.05 MW). NEA recorded 2,365.64 GWh of hydro electricity generation including small power plants against the target generation of 2,347.27 GWh. NEA slashed down thermal energy generation to 1.24 GWh against the target generation of 50.76 GWh due to incurring high cost of fuel consumption. The plants were operated only for short period to meet peak load demand. NEA increased power import from India by 27.97 % as compared to previous year to

minimize load shedding especially in dry season. Energy import from India was increased by upgrading conductor from Kushaha to Kataiya 132 KV second circuit, which was pending since last two years & additional import from Tanakpur from 20 MW to 35 MW as compared to previous year. Total energy import from India is recorded 1,369.89 GWh as compared to import of 1,070.47 GWh previous year. However, power purchase from IPPs within Nepal decreased to 1,268.93 GWh against the target purchase of 1,402.60 GWh.

The way forward Nepal Electricity Authority huge short fall to supply over demand cannot be removed out right and is bounded to remain for the next year 3-4year. For the intervening period following measures among other will pursed to restrict number of load shedding hour to 12-15 per day per consumer in the dry season. Demand side management such as promoting, the use of energy efficient lamps and electrical appliances will be implemented etc. NEA's will improve the quality of its service through the use of new technologies to meet the challenges of new environment of utility business. In particular following measures will be pursed

The allocation of budget according different plan periods, the simple effort of financing on power to different begun prior to planning led by the government. But there was not specific budget and target for it. It begin with the introduction of the First plan, the feasibility study of power production through various rivers were commenced systematically. The need of manpower proper institutionalization of power sector etc for the generation, transmission and distribution were studied. For the overall development of the power finds the well allocation in different plan.

Hydropower is one of the cleanest, renewable and environmentally bringing source of energy. Harnessing of water resources on large scale could provide significant contribution to the poverty reduction and employment generation. So, integrated water resources development plan are essential for the overall development of the country. The development of hydropower does not only bringing a social transformation of the local level but also create a resource pool. We have a lot of water resources and yet we are living in dark and we depend on fuel wood, animal drug and imported petroleum goods for our energy problem such as non-availability of market as well as difficult physical condition are cited on the reason.

1.2 Statement of the Problem

Nepal has the huge hydropower potential with very marginal utilization this is less developed countries. It is trying to raise the standard of living its people by developing different sectors such as agriculture, industry, transport, communication etc. Most of Nepalese people deprived of electrical energy and use traditional source of energy such as fuel wood, animal dung, agriculture waste, coal etc. it is the main cause of the deforestation to environmental degradation, natural calamities such as landslides, flood, soil erosion as well as ecological imbalance. So, the hydropower is one of the sources of clean, renewable and environment friendly sources of energy.

Without electricity new factories, industries and daily activities like business expansion is not possible. Revenue to the state is generated from industrial production which requires electric energy. Nepal has vast opportunity for energy production is not available most of the countries of the world. The generation of hydropower is environmentally friendly and resources required are available in Nepal. The main challenge's is now how to harness this vast potentiality.

But the problem of financing is acute in a poor and developing country like Nepal. It becomes much difficult when equity is poor (because of low saving) affordability is poor and willingness to pay is low. Sometimes this problem i.e. financing, also aggregates the sect oral crowding out effect. Therefore, utilization of financial resources renders from domestic to foreign sectors and from governmental to private sectors in the form of grant, loan etc. in this regard NEA's is playing leading role as a public enterprises. Therefore, the study of justifiable on the ground that it study, the resources and mobilization of financial sources. It is also assess financial structure of NEA's.

Despite huge potential of hydropower, its development could not take momentum as aspired by the general mass of Nepalese people due to some key impediments. Financial constraints, high tariff, unstable socio-political situations, indefinite cross border poor infrastructure, geographical condition etc. are the main challenges in the speedy development of hydropower in Nepal.

1.3 Objectives of the Study

The main objective of the study is to examine the status of the Hydropower Development in Nepalese economy at present. Besides following are the specific objectives:

1. To assess the plan wise hydroelectricity development in the Nepal.
2. To assess the potential of hydropower in Nepal.
3. To describe the present situation of hydroelectricity in Nepal

1.4 Signification of the Study

Hydropower occupies a very eminent place in the energy sector of Nepal. The utilization of energy is centered in urban area and most of rural areas have been by these power development schemes existing in Nepal. Nepal is blessed with many small and large rivers numbering almost 600 and favorable topography for hydrogen generation. In the hill and mountain region almost all houses are found to consume traditional source for cooking, heating and other necessary activities. Kerosene is used for lighting and cooking. The energy demand cannot be expected to the high in the intermediate in future. However, rural activities can be diversified living standard can be increased through the development of hydropower. Income of nation also increased through the electricity. Rural people can get job which help to increase their income. Students can also use to study electricity instead of other which help them in health.

1.5 Limitation of the Study

1. Limitation of the data and information: This study is mostly and mainly based on the secondary source of data and information.

2. Limitation of the coverage: The coverage of the study is limited to analysis the financing trend of the government for power development in different plan and NEA's and the policy related with it.

3. So, some of the searching other department and library have been used to make the study more analytical.

CHAPTER II

REVIEW OF LITERATURE

2.1 Conceptual Review

The conceptual review of the study includes the theoretical concept about the hydropower development from the international perspectives. Some of the reviews made under this headings are as follow:

Nexant Sari (2003), in the report "Regionl Hydropower Resources, Summary and Analysis Selected SARI data" states that with 22.2% of the world's population and 3.85% of the global surface area, the energy region contribute a mere 1.98% of global GNP. The average GNP per capital of the region is US$ 440 which amount to 9% coupled with inadequate supply, presents a challenge throughout the region. Electricity storage have acted as a constraint on economic growth

The finding of the report are as follows:

1. The commercial energy mix of the region was 47% coal, 33% petroleum, 12% natural gas, 7% hydropower, 1% nuclear power and 0.2% other sources in 1998. Significant variation in energy mix is observed in the region.
2. Utilities in the region are mostly operated by the public sector in a commercially unviable manner. Revenues from energy sales do not reliable the cost of the delivery of services suffers as a result.
3. The estimated hydro-power potential of the SARI region some 98% of the potential lies in Bhutan, Nepal, and India.
4. Only the modest amount of the abundant hydro-power in the region has been developed. Sri Lanka and Bangladesh have developed a sustainable proportion of their abundant hydro-power resources not only to meet domestic power requirements, but also cater to the demands of the power markets as the neighboring countries.
5. The most important barrier is the lack of a deliberate policy the supports cooperation. Cooperation in hydro-power development is not a high-priority issues for the countries of the region. Insistence on the

idea of self-sufficiency, low per received benefits of the cooperation and absence of any established mechanism for cooperation can be considered the major factors responsible for the absence of a positive policy.

Based on the above findings, the recommendations by the report are as follows:

a. The region is likely to benefit greatly if the regional power market were created, but the complexity of the task is considerable. A gradual, step by step approach is the most pragmatic one, reducing the parties' risks while building mutual trust and confidence.
b. The sharing of information and technology could be first step. There is an example reserve of knowledge and expertise in the region, and this expertise could be made available to those interested through seminars, training programs and so on.
c. The second step would be to promote cooperation in power supply, with common or unilateral sharing of spare capacity.

Tshering-eta (2004), mentions that the decision by the Royal Government to Exploit its water resources for production of electricity has changed the economic scenario from Bhutan. The rapid attitudinal variations with swift flowing rivers have made Bhutan a natural heaven for hydropower production.

The paper highlights the role and importance of hydropower for social and economic development of Bhutan and covers aspects related to planning and policy initiatives being pursued by the hydropower sector to fulfill the national objectives.

Some of the major findings pf this paper are as follows:

1. Bhutan has an estimated hydropower potential of 30,000 MW, so for 23,760 MW has been identified and assessed to be technically feasible, only 1.6% of the potential is harness so for.
2. Bhutan electricity demand in the year 2003 was 105 MW, 664 GWH and 99.5% of the electricity was supplied from hydropower resources. About 40% of the Bhutanese population (in 40 towns and 822 villages) has electricity.

3. The surplus generation from hydropower plants is exported to India and fetches a substantial amount of revenue that helps to meet the budget deficit. About 300 MW power and 70% of the total hydroelectric energy generation was exported to India in 2003.
4. Hydropower provides safe, reliable, sufficient and affordable electricity for domestic consumption and industrial use.
5. The sustained techno-economic co-operation with India where Bhutan's export market lies is the key success factor for development of hydropower.

Based on the above findings the recommendations of this paper are as follows;

a. The sustainable development strategies incorporating the social and environment concerns of hydropower development will lead to successful implementation of hydropower projects.
b. Developments of legal and policy frameworks for restricting and reforming the power sector.

Royal Swedish of Science (2008), reports states that hydropower is a key energy resources. It presently constitutes the most important sources of renewable electrical power generation. In the most recent world energy assessments with data for 2005, hydropower stands for around 87% of the total electricity generation from renewable energy sources. With regard to the total electricity generation and the primary energy supply, it stands for about 16% and 2% respectively. The further stressed that hydropower is unique in providing a necessary development support for other renewable energy sources. The storage capacity of hydropower offers the operational flexibility needed for quickly responding to fluctuation electricity demands. This improves electricity grid stability and reliability as well as supports the development of intermittent renewable, such as wind and solar power.

On the basis of this study he recommended small, medium and micro hydropower of Nepal. He further stated that preferences should be given to mobilize domestic financial resources by encouraging private sector investment in hydropower project.

2.2 National Context

This heading includes the study of hydropower development in Nepal by various scholars based on the information of Nepal. Conclusions and recommendations prescribed by them are more useful in policy making and for accelerating the development of hydropower.

Adhikari Deepak (2006), focused on the exploitation of hydropower for the increasing demand of energy. He has argue that hydropower is a suitable source of energy with almost zero inputs costs. Its benefits are that it is non-polluting in the sense and it release heat or noxious gases. It has low operating and maintenance costs. Its technology oppresses reliable and flexible operation and hydropower stations have increased efficiencies along with life. He has focused that small hydropower has an and renewable source of energy with negligible environmental impacts micro-hydro system is becoming increasingly popular as in energy source in rural Nepal. He has suggested that the major strategies of power sector have been appropriately identified promoting private sector participation in power generation and distributed, integrating rural electrification with economic development programs and strengthening power infrastructure.

Hamal S. (2001) explains that rural and hill areas have under gone 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 explains that energy is required to fulfil day - today needs, which includes cooking, heating, lighting and productive activities such as transportation, irrigation, cottage industries, etc. Energy shortage has been recognized as major constraint in economic development and it contributes to further deteriorate the environment, creating a vicious cycle in rural life by deforestation women are the main user of household energy. They are the main persons responsible for collecting fuel wood or the managing of other energy sources such as doing crop residues etc. Deforestation has made the women's work harder. The increasing walking distance to fetch fuel materials has proven to be a work burden. Most of rural women are not yet exposed to the existing and as 'electricity' women are found to fetch and gather fuel materials.

Himal (2010), authored bu Shova Himal explains that rural and hills areas have gone under deforestation due to the insufficient 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 to day needs, which includes cooking, heating, lighting, and productive activities such as transportation, irrigation, cottage industry, etc. Energy storage 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 deforestation. Women are the main user of house hold energy. They are the main purpose responsible for collecting fuel wood or the managing of other energy sources such as doing crop residue etc. Deforestation has made the women's

Dhital. K (2004) in his article 'Hydropower Development in Nepal' states that Nepal is water rich country, but with little efforts towards harnessing water resources and developing hydropower. In recent years, economics growth rate is confined fairly below the normal target 4.3 percent during the tenth plan (2002-2007), growth has been inadequate to make crucial impact on poverty. Unless water resources is efficiently utilized to the millennium developments goal set by Nepal (UNDP,2003). The data are taken from the secondary source. The data are present in table and diagram and has been used analyzing information.

Some of the major finding of the article are as follows;

1. Hydropower is exportable commodity. India is the potential market for the electricity that Nepal produces. India's willingness to play for the Nepal's hydropower is one of the key factors for sustainable hydro-power development.
2. The primary challenges encountered by Nepal for hydropower development in the twenty first century is how to supply reliable, affordable and cheapest electricity to domestic production.
3. The access to electricity is to be taken as the key indicators to the progress of living standard. It enhance the capabilities of the people to reduce poverty. Thus hydro-power development should consider as one of the most important fact of economic developments.

He recommendations indicates that the process of electrification should be demand oriented rather than projects oriented.

Dhunge. K. (2002), in his article "Trends and Patterns of Energy Consumption in Nepal." Has explained that energy is not only used to meet the basic needs of households such as cooking, hearing, lighting but also in transportation, industries agriculture, services and commercial sectors. Unavailability of adequate energy to fulfill the need of these sectors will paralyze our economy. Nepal is rich in water resources and hydropower is only endogenous source of commercial energy. To meet the increasing demand for energy, Nepal has been spending large amount of foreign currency to import fossil fuel which is one of the cause of adverse balance of payment. So, Nepal should generate sustainable amount of hydroelectricity from its abundant water resources and sell to other countries that can generate foreign currency in order to solve the actual problems of balance of payments.

Nepal is dominated by traditional source of energy. It is accounted for 95, 94.9, 91.7, 86.4 percent of which fuel would only contributes 84.5, 64.8, 81.9 and 77.2 percent in 1984/85, 1989/90, 1995/96 and 2000/01 respectively. The share of commercial energy consumption was 5, 5.1, 8.3 and 13.6 during this periods. The per capital energy consumption is very low revealing the low level of economic growth.

Dhungel. K. (2009), in the article "Does Economic Growth in Nepal Cause Electricity Consumption" states that a primary objective of under developed countries is to reduced poverty. This objective is not meaningful unless it is tried to sustainable development to achieved desired level of economic growth. As the livelihood of the poor depends mainly on the nature resources, depletion in an unplanned manner will hit the livelihood of poor the hardest. Economic and social developments depend primarily on the use of energy. This implies that there is a strong and positive association between the growth rate of economy and growing energy consumption.

Excess use of energy, particularly fuels, for accelerating the economic growth rate of developing countries results is the excessive emission of carbon dioxide (CO_2) into the atmosphere. Furthermore, the energy requirement of developing countries is not only fulfilled by fossil fuel, but also by biomass which is another major source of pollutants.

The article examine the causal relationship between the per-capital electricity consumption and the per-capital real GDP during the period 1980-2006 in Nepal using co-integrate and vector error correction model.

The major findings of this article are as follow;

- Nepal has two possible option to reduce the use of fossil and biomass fuel.
  a) The development of immense water resources for generating electricity,
  b) The use of animal drug for generation bio gas.
- There is a unidirectional causality from per-capital real GDP to per-capital electricity consumption.
- Estimated of electricity income and price elasticity from the time series data (1980-1999) have shown that the income elasticity was highly responsive. Its shows that Nepal, for the long period of time does not have to arrange demand management. If further implies that more generation will create its own demand.

Bhatt (2008), mentioned the confusion and problem of hydropower development in Nepal. He did research with descriptive analysis and tabular form. The author has described that although with bestowed with ample hydro resource, we are facing actual power shortage and load shedding has become unpleasant word for Nepalese consumer. This means there is something wrong in our thinking, planning action and behavior. He has highlighted that we are not good at planning of resource of development as we do not have strategic plan for development of hydropower, neither we are good as the developer since most of those holding licenses are engaged in paper trading of license and nor good as consumer as our system loss is very high. Some of the problems highlighted by the author as given below:

- Electricity act 2049 has no insight of electricity market model and industry structure.
- Ministry of Water Resources issues license of hydropower development whereas the Ministry of Forest and Soil Conservation has it strength rules and provision for hydropower development that makes it almost impossible to develop hydropower.

- Still we not have a realistic view on development to meet internal demand in future. The transmission has the natural monopoly of the state. NEA neither responsible for managing transmission for all generation developer nor it is transmission planner.

Kafle (2005), in his article "Hydropower for Sustainable Development of Nepal" has explained that, Electricity is one of the basis inputs for the acceleration of economic growth of the country but generation of hydropower for supplying electricity to fulfill even to the domestic demand is delaying resulting to the adverse impact in the national economy. The enormous hydro-power potential of Nepal is the main alternative sustainable sources of energy that is environmentally friendly, socially responsible and economically viable. Development of hydropower contributes to the development of rural electrification meeting the domestic need, employment generation, stemming deforestation and expanding dome sting agriculture production and development of industry as well as business, there by contributing to sustain poverty reduction. The availability of electricity in affordable cost can be utilized as a vehicle of industry development and provide basis for competitive manufacturing industries, which in turn can lead to cheap manufactured export. In consideration for the storage of water on river valley performs multiple functions including supply of water for residential use, industrial production and irrigation as well as flood control and habitat maintenance contributing to environment protection and economic growth.

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

even to isolated pockets areas of the countries. The micro hydropower is also important from the consideration of national welfare in divers fields, such as conservation of forest, creation of self employment opportunities and also promotion of the tourist industry. Since electrification is related to productive the small and micro hydropower helps to increase the efficiency of rural power.

WECS (1995) examined the needs of energy in our lives cannot think of survive without energy. Energy is compulsion for the development purposes after the utilization of the energy properly and aptly then the status of education, condition of health, development of infrastructure, transportation facilities are gear up which leads a country on the prosperous way of development due to which living standard of people automatically sky up and it is vital for economic development and employment, it is also a critical factor for Shortage of biomass fuels has forced urban households and industries to switch from biomass fuel to imported fossils fuels and other commercial form of energy. Deforestation and desertification are threatening or traditional energy supplies and agro-base rural economy. These shortage of biomass fuel in rural sector have energy care and needed to promote rapid economic growth. To meet the basic need of rural families is also plagued by the lack and other resources example farmland technology and capital for investment.

WECS (2005), sets the objective to the generate hydropower to meet national energy requirement and to allow for export of surplus energy. This plan has presented the quantitative data in tabular form with the help of simplest statistical tool know percentage and ratio. It has taken target per capital electricity consumption of 160 KWh by 2017 and 400 KWh by 20227. The estimated budget of overall plan is Rs. 28,938 million for water sector and Rs. 51,136 million is allocated in hydropower structure and non-structural development. Private sector investment is continuously increasing. But at present, they contribute to only about 21% of total installed capacity. Most of the government sources is external (77%). The present resending of soft loan by government to NEA is a 10.25%. National water plan has presented the following action programs on hydroelectricity.

1. The focus of the hydroelectricity power program during the first five years on identifying and developing cost-effective small and medium

hydropower projects that are capable to meeting domestic needs, including ground water pumping for irrigation at affordable prices.

2. In ten years substantial benefit will be realized by maximizing hydropower development for different markets including energy intensive industries, transport sector and power exports.
3. By the end of 25 years, the country will have total hydropower capacity about 4000 MW excluding exports and more than 75% of all household will be provided with integrated Nepal Power System (INPS) electricity.

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

1. The residential sector consumed about Rs. 331 million Giga Joule (GJ) energy in FY 2004/05. The share of electricity consumption was 0.64% in FY 2004/05.
2. The industrial sector consumed about Rs. 2.5 Million GJ energy in FY 2004/05. The share of electricity in industrial energy consumption was 22% in FY 2004/05.
3. The commercial sector consumed about Rs. 5.3 million GJ Energy in FY 2004/2005. The share of electricity in commercial sector was 7% in FY 2004/2005.
4. The transportation sector consumed about Rs. 13.8 million GJ energy in FY 2004/05. The share of electricity in transportation sector was 0.15% in FY 2004/05.
5. The agriculture sector consumed about Rs. 3 million GJ energy in FY 2004/05. The share of electricity in agriculture sector was 6% in FY 2004/05.

Pandey (2009), he say about “Rural Entrepreneurship through Electricity” in Nepal hydro Budget Speech 2009-10 has found the some important conclusion described as follow, with a view to end load shedding forever and extent the service in the villages where the electricity has not yet reached, the consumption of ongoing electricity projects will be expedited to accomplish on time. Emphasis has to be given to feasibility study of new projects extension and repair of transmission line. On the basis of the objectives laid by Water Resources Strategy, 2002 and current evaluation of hydro-electricity development, progress has to be formulating to develop at least 25,000 MW capacities within forth coming two decades for this necessary institution and policy has to be formulated. Nepal’s has allocated Rs. 14 million in the electricity sector.

National electricity crises Reconciliation Work Plan with necessary amendments has to be carried out with high priority. In order to encourage private and foreign investment, appropriate policy has to be formulated for long- run energy development regulatory commission has to be formed for the effective regulation of the production and transmission of electricity.

WECS (2010), explained energy consuming sectors as per the economic sector of the country. They are residential, commercial, transport, industrial and agriculture sector. For energy accumulating, others have been induced as energy consuming entity which does not fall in the above five sectors, are included in others like street light, temples, mosques, church etc. the total energy consumption in the same year was 401 million GJ. The sectorial energy consumption for the year 2008/09 has changed only marginally as compared to the previous year. However, the sectorial energy consumption for the year 2008/09 has increased by about 9% as compared to the FY 2004/05. In 2008/09 the residential accounts for the major share of energy consumption (89.1%) followed by transport (5.2%), industry (3.3%), commercial (1.35) and then the agriculture and others.

1. The residential sector consumed about Rs. 356.7 Million GJ energy I FY2008/09. The share of electricity consumption was 1% in FY 2008/09.

2. The industrial sector consumed about Rs. 13.4 Million GJ energy I FY2008/09. The share of electricity in industrial energy consumption was 1% in FY 2008/09.
3. The commercial sector consumed about Rs. 5.2 Million GJ energy I FY2008/09. The share of electricity in commercial sector consumption was 1% in FY 2008/09.
4. Thetransportation sector consumed about Rs. 29.8 Million GJ energy I FY2008/09. The share of electricity in transportation sector consumption was 1% in FY 2008/09.
5. The agricultural sector consumed about Rs. 3.6 Million GJ energy I FY2008/09. The share of electricity in agricultural sector consumption was 1% in FY 2008/09.

Regmi, (2012) analyzed the present condition of Nepalese energy system. The summary conclusions of her finding are there should be need of proper utilization of natural resources like water to achieve the goal of development. By proper harvesting of rest water resource by generating aptly trained man power and investment on water resources dependency on foreign country could be vanished. One of the alternative ways to increase the energy power not only by the formation of new hydro projects but also maintaining and optimizing the existing hydropower plants, which may become panacea to control the wave of problem and has been grossly overlooked for these reasons. The development of hydropower in Nepal has always been dictated by many constraints and conditions. Projects are selected by planning procedure which is deliberately designed to produce a 'no option' situation in decision making. It is too late to understand the government that private sector is not capable to develop sufficient hydropower projects to satisfy the demand, so, public sector must play a sustainable role for important of hydropower project.

Nepal is rich in water resources, Nepal has more than 6,000 rivers and rivulets with an overall annual run of 225 Billion cubic meters following to the south. The annual average run off with in the Nepalese territory is estimated at 174 Billion cubic meters. Nepal's total hydropower potential in term of installed capacity and annual energy of identified 122 projects are 43,000 MW and 180,000 GWH respectively. Hydropower utilization is currently about 1.5% of the proven potential. The total installed

hydroelectricity generation is about 759 MW in 2013. Out of this total generation of electricity 705 MW are hooked to national grid and remaining are in isolates system comprising 40 small/mini hydro plants, about 2,000 micro hydro and about 12,000 peptic set serving remote areas of the country (WECS 2006). Out of the total population, 48.5 percent was expected to have access to electricity services by the end of Tenth Year Plan. Prior of the Tenth Year Plan, electricity was available to 58 municipalities and 1,600 VDCs in the country. A total of 2,100 VDCs were expected to have access to electricity services at least partially.

Presently, the NEA system is a supply deficit one. This is being evident from load shedding being implemented for last seven years. Even in the FY 2007/08 the peak power supply demand in wet season and dry season were 640 Wm/542 MW and 720 MW/ 308MW respectively, resulting into load shedding per day was about 98 hour per a weak (WECS,2010). In 2015/16 load shedding per day was about 14 hours. According to the report NEA, 2010 energy demand was 4367.13 GWH and supply energy was 3689.14 GWH and rest 677.860 GWH was managed by load shedding. This kind of load shedding due to supply deficit is to continue till at least 2017/18. When among others, Upper Tamakoshi (456 MW) is expected to be commissioned. In the dry months shrinking of snow-fed river further increase power deficit.

CHAPTER III

RESEARCH METHODOLOGY

3.1 Nature of Research Design

This study is descriptive type of research because it is a fact finding investigation with adequate interpretation in the context of social research. It is more specific than exploratory study as it aims to identify the various socio-economic characteristics of the commodity.

3.2 Source of Data Collection

This study is absolutely based on secondary data most of the data and information related to hydropower and other energy have been collected from secondary sources. The secondary sources have included the previous studies carried out on the issue of hydropower, various institution, organization books, Nepal Electricity Authority (NEA), Water and Energy Commission Secretariat (WECS), Central Bureau of Statics (CBS), National Planning Commission (NPC), Ministry of Finance (MOF), Nepal Rasta Bank (NRB), Central Library of T.U. and other journals relevant to the study area.

3.3 Methods of Analysis and Interpretation of Data

Thecollected data from various relevant sources are processed according as the requirement of the chapter. The available data from various documents are collected, classified and tabulated to meet the need of the study. Simple statistical tools like pie chart, bar diagram, line chart are used to show the consumption, sale, revenue, available energy, peak demand, target and achievement, present status, potential of electricity as required in analysis. Other different data presenting techniques statistical tool with ratio, percentage are used for analysis. The qualitative data is analysis widely as required and revelent.

CHAPTER IV

PLANWISE DEVELOPMENT OF HYDROPOWER IN NEPAL

4.1 Before Starting Five Year Plan

The history of hydropower development in Nepal is not old as it's more than 100 years. Pharping hydropower house is the first power house installed in Nepal which is the one of the oldest hydropower in Asia. This station was developed on 1911 AD, during the Prime Minister of Chandra Samsher Rana's timeto meet the energy requirement of the member of the ruling class. It's financed by British Government. The capacity of hydro power was 500 KW and 12KW cable was installed to transmit 11KW of purpose the power house has been closed now and water from this reservoir is now use for water supply to Lalitpur Municipality and adjoining area. In order to meet the growing demand of electricityanother power plant was established at Sundarijal at the time of Juddha Samser Rana in 1936,the installed of that power plant was 900 KW. Now It's working with the capacity of 640 KW. Morang Electricity Supply Company located at Latang in Morang District was the third power house established in the country with the capacity of 677KW. It was the first project outside the Kathmandu valley and started distributing the electricity in 1939. Before 1956 utilization of water resource for electricity generation was negligible. Table 4.1 shows the electricity installations that were in operation in country before the introduction of First Plan.

Table no 4.1 Electrical Installation before 1956(First Five Year Plan)

S.N	Name of the plant	Power supply in KW	Agency	Cost
1	Pharping Hydel Plant	500	British	Nrs 0.713 million
2	Sundarijal Hydel Plant	900	British	Nrs. 3,67,984
3	Morang Hydroelectricity Company	677	-	-
4	Birgunj Electricity Company	255	-	-
	Total	2332		

Source: NPC, HMG

The table 4.1shows the total production of electricity before the implementation of First Five Year Plan. Out of the total 2,332, the share of Pharping Hydro Plan, Sundarijal hydro plant, Morang Hydroelectricity Company and Birgunj Electricity Company were 21.72%, 39.02%, and 9.77% respectively.

Until 1955 there had been hardly any policy for the development of the country. There was no hydropower and energy development policy in Nepal. Some Rana rules d adopted ad-hoc policy in regard to hydropower development in the country. Hence, some hydropower projecrs took shepe during Rana Regime, the notable on being the hydropower plants of Pharping and Sundarijal.

4.2 After Starting Five Year Plan

Nepal has got specific direction on power development after planning economic since 1956. It was proposed to increase the generating capacity of hydropower in different plan periods.

(I) The first Five Year Plan (1956-1961)

The First Five Year Pan introduced a policy to study the feasibility of small and medium size of hydro project. When Rana rules collapsed in 1950, the process of national development started. It target to increase generation capacity of 20,000 KW at a cost of Rs. 80 Million (9% of the plan). In this plan, achievement to its target for power generation was 8.5 percent. Electricity was generated entirely from the diesel plants. Therefore, achievement in hydropower sector was totally failed. The power plants installed and commissioned during the first plan are listed in the table No. 4.2

Table No.4.2: The Power Plant installed and commissioned during First FiveYear Plan

S.N	Name of the project	Power Supply in KW	Donor Country	Cost (in lakh)
1	Trishuli Hydro project	9,000	India	225
2	Panauti Hydro Project	2400	USSR	20
3	PokharaHydro Project	500	India	40
4	Thadokhola Hydro Project	400	UK	15
	Total	12300		

Sources: First Plan, NPC, HMG

During this plan period additional supply of 700KW of power was added to the system mainly by Teku (500KW) and Bhaktapur (200KW) diesel power plant in Kathmandu valley.

Nepal made agreement for the first time with USSR and India to get aid for the consumption of the most important hydroelectricity project like Panauti (Rosi Khola) and Trishuli respectively.

Similarly, agreement was also made with India for the construction of hydroelectricity project in Pokhara with the capacity of 500KW.

Agreement was also done with UK for the consumption of hydroelectric project in Chisapani with capacity of 400 KW. This was only the achievement of this plan period. Similarly, during this plan period Kathmandu – Hetauda –Birgunj transmission line and Karnali and Kali Rivers preliminary survey were completed.

(II) The Second Three Year Plan (1962-1965)

The plan put demand emphasis on the establishment and expansion of transmission lines and diesel plants on temporary basis to meet the demand, until the hydropower plants in some big towns like Kathmandu, Birgunj, Hetauda, Nepalgunj and biratnagar etc were completed. The target of the second plan was 22,000 KW of additional power generation both from hydropower and diesel. The monetary allocation of this was 91 million rupees (15% of the plan). In order to produce more power to meet the increasing requirements of industrial and agriculture development and efficiency manage the distribution of power, separate organization under the name of Electricity Corporation was established in 1964, as government enterprises. This plan also did not specifically maintain about the energy policy of the government (Bhattari, 2005).

Table No 4.3: Major Targeted Hydropower project of the Second Plan

S.N	Name of the Project	Power Supply in KW	Location
1	Trishuli Hydro Project	9,000	Trishuli
2	Panauti Hydro Project	2,400	Panauti
3	Pokhara Hydro Project	500	Pokhara
4	Thadakhola hydro Project	350	Chisapani
	Total	12,250	

Sources: HMG of Nepal, NPC and the second plan

In the second plan period Panauti Project with a capacity of 2400KW, Patan diesel plant with a capacity of 1470 KW and Birgunj Diesel Plant with a capacity of 560 KW were brought into operation. In additional to this construction on the Kathmandu – Birgunj transmission line was started and the Sunkosi and Karnali Project surveys were contributed. Mainly achievement of the second plan was limited to Panauti Project having capacity of 2,400 KW.

(III) The Third Five Year Plan (1966-1970)

The Third Plan had given top priority to hydropower generation alone with development of transport and communication. It was proposed to increase the generated power by 60,000 KW and 260million rupees (15% of the plan) were allocated for this purpose. The policies were formulated to improve the administration of depart of electricity corporation, with the objective maintaining co-ordination in the activity of the this two organization and establishing Central Power Authority in order to preparea long term master plan for the production and distribution of power completing the projects initiated in the first and second plan period (Bhattari, 2005).

Table No 4.4 Major hydropower Projects Targeted on the Third Plan

S.N	Name of Project	Power Supply in KW	Agency
1	Trishuli Hydro Project	18,000	India
2	Gandaki Hydro Project	10,000	India
3	Koshi HydrooProject	7,500	-
4	One project from Marshyangdi or Kali or Kulekhani	18,000	ADB
	Total	53,000	

Sources: Third Plan, NPC, HMG

In the Third Five Year Plan, the total supply of power has been increased by the 19,960 KW, primarily from Trishuli project (12,000 KW), from Pokhara hydro project (500 KW), from Hetauda diesel plant (4,470 KW) and from Patan and Biratnagar diesel plant (2,990 KW) respectively. Therefore total achievement of electricity generation to its target was 55.44 percent.

Table No. 4.5 Achievement of Third Five Year Plan

S.N	Name of the project	Power Supply in KW
1	Trishuli Hydro Project	12,000
2	Pokhara Hydro Project	1,000
	Total	13,000

Sources: Fourth Plan, NPC, HMG

(IV)The Fourth Five Year Plan (1970-1975)

In the Fourth Five Year Plan, the government accorded second must priority on electricity development. A total of Rs. 225.3 million was allocated which accounted for 9 percent of total budget to the development ofelectricity. It has set a target of generation a total of 40,300 KW from large hydro project, 500 KW from small micro plant and 4,000 KW from dieselplants(NPC 1970). The table 4.6 shows the target for generation of hydropower in the plan period.

Table No.4.6 Target for Fourth Plan

S.N	Name of the project	Power Supply in KW	Agency	Cost in million
1	Trishuli Hydro Project (additional)	9,000	World Bank	-
2	Sunkoshi Hydro Projects	10,000	JICKA	57.5
3	Gandaki Hydro Projects	10,000	India	-
4	Koshi HydroProjects	68,000	-	-
5	Kulikhani Hydro Projects	32,000	Japan & Nepal	245
6	Micro hydro Plants (including Dhankuta)	500	-	-
	Total	68,300		

Sources:Fourth Plan, NPC, HMG

The table no.4.6 shows the target generating 40,000 KW electricity from different hydro plants and diesel plants.

The achievement of electricity generation was 26,040 KW during the Fourth Five Year Plan, which is shown in the table 4.7

Table No.4.7:The Targeted and Achievement of Fourth Plan

S.N	Name of the projects	Target in KW	Achievement in KW
1	Trishuli Hydro Projects	9,000	9,00
2	Sunkoshi Hydro Projects	10,000	10,000
3	Gandaki Hydro Projects	10,000	Running
4	Koshi Hydro Projects	6,800	6,800
5	Kulekhani Hydro Projects	32,000	Running
6	Micro Hydro Plants	500	240
	Total	68,300	26.040

Sources: Fifth Plan, NPC,HMG

Table 4.7 shows the Fourth Plan Planned to generate 40,300 KW hydroelectricity from different hydro projects namely Trishuli hydro projects, Sunkoshi hydro projects, Gandaki hydro projects, koshi hydro projects, Kulikhani hydro projects and Micro hydro plants (Dhankuta) under the capacity of 9,000 KW, 10,000 KW, 6,800KW, 32,000 KW, and 500 KW respectively. Total hydroelectricity 26,040 KW was achived in Fourt Plan from Trishuli hydro projects (9,000 KW), Sunkoshi hydro projects (10,000 KW), koshi hydro projects (6,800 KW), Kulekhani hydro projects (32,000 KW) and Micro hydro plants (240 KW). The achievements of the Fourth Plan in hydroelectricity was near 71.74%. Feasibility study of Kankai projects and beginning of Devighat and Kulekhani hydro projects were other achievement of the Fourth Plan. During the plan period 12 new districts were electrified and 152.2 KW transmission line were constructed.

(V) The Fifth Five Year Plan (1975-1980)

In the fifth plan policies were formulated to fulfill the short term and long term demand with in the country and to export excess power to India and expand village electrification to promote agriculture development, village industries and production activities. It also formulated a policy to fix the tariff on the base of the actual costs of

projects, to limit the electricity services and activities in government sector and to handover the operation and distribution of electricity gradually to other electricity entities making them capable in business activities. Similarly, as in plans, no specific power policy was formulated for the development of other energy sector.

Table No 4.8: Program of Electricity Development in the Fifth plan

S.N	Name of the project	Position of the project	Target in KW
	Small hydro project		
1	Jhurpa small hydro project	Running	345
	Big and Medium hydro projects		
1	Kankai hydro projects	Running	32,000
2	Devighat hydro project	Running	14,000
3	Kulekhani hydro project	Running	60,000
4	Shikharbas hydro projects	New	2,400
5	Sarada Babai hydro projects	New	49,000
	Total		1,57,745

Sources: HMG of Nepal and the Fifth Plan.

In this plan period, it was established that diesel plant of Biratnagar and Pokhara and Supplied 1500KW electricity respectively. The small hydro projects (3 projects) generating electricity of 445 KW to 545 KW in the Fifth Plan period. The jhurupa small hydro project situated in Surkhet district was to be constructed during the period, which was carried from Fourth Plan.

Table No. 4.9 Transmission Line in Fifth Plan

S.N	Name of the projects	Transmission line
1	Hetauda – Gandak	132 KV(started in Fourth plan)
2	Gandak – Butwel	132 KV
3	Bhairawa – Pokhara	66KV
4	Butwal – Tansen	33 KV

Sources: Fifth Plan, NPC, HMG

For the distribution of electricity in the Fifth Plan the target was to develop transmission line in different parts of country were as shown in above.

In this plan target of electricity generation and consumption of transmission line was high, but achievement was very low in both. Total achievement of electricity was just 18.712 MW. Due achievement was 16.22 MW from different hydro projects and 2.492 MW from diesel plants. The field of transmission line only 182 KM was finished. In this plan period the achievement in electricity production was 31.75 percent of total target. Similarly, in transmission line 50.13 percent was achievement as that of target (NPC, 1980).

Table No. 4.10: Achievement of Fifth Plan

S.N	Name of the project	Achievement in KW
1	Large hydro project	15,000
2	Small hydro project	1,220
	Total	16,220

Sources: Sixth Plan, NPC, HMG.

(VI) The Sixth Five Year Plan (1980-1985)

The Sixth Plan laid emphasis on the development of small hydro project in the mountain and remote area. In order to find out alternative source of cheaper energy, research and survey activities were initiated. The plan also laid emphasis on narrow down of regional imbalance in power distribution. Private sector were enough to invest in power sector including alternative energy sector. The development of multipurpose project was expected to increase foreign exchange earnings by exporting surplus power to neighboring countries, in addition to irrigation and other benefits (NPC 1980). This plan has set a target to generate 1,24,000 KW from large hydro projects and 5,829 KW from small hydro project. In this way, a total of 1,29,000 KW from hydro and 5,829 KW from diesel plant was available and hence makes total power production of 1,44,829 KW (NPC, 1080). Total production of electricity during Sixth Five Year Plan was 75,217KW,which is mentioned in the table 3.11.

Table No. 4.11 Target of Sixth five Year Plan

S.N	Name of the project	Power Supply in KW	Donor country
1	Kulekhani (i) hydro project	60,000	Japan & Nepal
2	Devighat hydro project	14,000	-
3	Marsangdi hydro project	50,000	ADB & HMG
4	Small hydro project	5,829	-
	Total	1,29,829	

Sources: Sixth Five Year Plan

Table No 4.12 Achievement of Hydropower Generation in Sixth Plan

S.N	Name of the project	Production in KW
1	Kulekhani (i) hydro plant	60,000
2	Devighat hydro project	14,000
3	Small hydro project	1,217
	Total	75,217

Source: Sixth Plant NPC, HMG,

(VII) The Seventh Five Year Plan (1985-1990)

The objectives of the power development of the Seventh Five Year plan were basically same. Its objectives were also generate power from water resources of the country so as to meet the growing needs of various sectors of the economy, to develop small hydro power projects in rural areas and to conserve the long ever decreasing forest area as well as reduce the use of imported fuels. Policies were adopted to initiate to meet the long term and medium term power supply with preparation of inventory of hydropower project and to make project attractive from economic point of view.

During the Seventh Plan period, construction of Kulekhani Hydro-electricity projects, phase ii (32MW) Marsyangdi Hydro project (66 MW) and Andhikhola hydro projects (5.1 MW) were presently under construction and which were carried over from the Sixth Plan were to be completed. The projects planned for completion during the Seventh Plan were sixteen whose estimated energy production was 3.549 MW

(NPC<1992). The power projects planned for completed during the Seventh Five Year Plan period are presented in the table 4.13

Table No. 4.13 Power Projects Planned in the Seventh Five Year Plan

S.N	Name of the project	Power Supply in KW	Agency
1	Taplejung	125	Private (Shivani hydropower Company)
2	Khadbari	250	-
3	Terahthum	100	Private (Reliable hydropower Company)
4	Bhojpur	260	Private (Eastern Hydropower)
5	Namche	484	-
6	Salleri	200	-
7	Okhaldhunga	125	Private (Green Venture)
8	Ramechhap	75	Private (Garjang Upatyaka Hydropower)
9	Manang	80	Private (Distribution Consumer Services West)
10	Chame	50	Private
11	Tatopani	1,000	ADB & GoN
12	Chourjhari	150	Private
13	Syarpudaha	200	Private (Distribution Consumer Service West)
14	Bajura	200	Private (Distribution Consumer Service West)
15	Bajhang	200	Private (Distribution Consumer Service West)
16	Dharchula	50	Private (Distribution Consumer Service West)
	Total	3,549	

Sources: Seventh Five Year Plan, NPC, HMG

The table 4.13 shows the construction of hydropower plants of total of 3,549 capacities targeted to be completed during the Seventh Five Year Plan period. Important projects with a share in contribution to the capacity were 1,000 KW from

Tatopani, 484 KW from Namche, 250 KW from Khadbari, 200 KW from Bajura Power projects.

The progress in the electricity sectors and alternative sources of energy during the Seventh Five Year Plan (1985-1990) and the Interim Period (1991-1992) is given in the table 4.14. The total production of hydropower during the Seventh Plan and Interim Period were 108.55 KW and 66.900 KW respectively.

Table No. 4.14 Progress during the Seventh Plan and the Interim Period

S.N	Item	Seventh Plan	Interim Period
1	Electricity Generation (KW)		
	Hydropower	1,03,055	6,690
	Medium and Large projects	1,01,000	5,100
	Small projects	2055	1,590
	Fuel operated	-	26,000
2	Transmission Line (KM)	1,226	197
	132KV	723	-
	33KV	503	197
	Alternative source of energy		
	Small hydropower (KW)	1,145	239

Sources: Eighth Plan, NPC, HMG,

(VIII) The Eighth Five Year Plan (1992-1997)

In the Eight plan, comprehensive policies for hydropower and energy development were formulated. Hydro- projects of different level and capacities were implemented to meet the medium and long term needs (NPC 1992). A policy was formulated to encourage the sale or joint venture of one or more private national investors as well as to encourage the joint venture with the government and a single or more national or foreign investors. Like the previous plan, hydroelectricity was given high emphasis in the Eight Five Year Plan. The target of this plan was goes to gradually electrifying the rural areas where majority of the people live. Electrification work was proposed to be undertaken in about 1,200 villagers of 21 districts (NPC 1992). The programsin electricity sector include in the Eight Plan had been classified in following categories.

Construction of New Hydroelectricity Projects

All the construction work of Jhimruk hydro- electric project with an installed capacity of 12.5 MW under the construction in Pyuthan was to be completed, construction of the Kaligandaki 'A' hydroelectric projects with an installed capacity of 144 MW was proposed to be started. In addition to this, work relating to the first phase of the Arun III hydroelectric project was to be installed in order to generate power from the Arun River. A total of 29.7 MW of additional hydropower was to be generated during this plan period with the respective contribution of 12.2 MW and 0.5 MW by refurbishing Trishuli-Devighat hydropower stations, completing the Jhimruk hydroelectric projects and by various other small electric projects.

Strengthening of the Existing Hydropower Stations

The existing generating capacity of the Trishuli and Devighat hydropower station in Nuwakot district were to be increased as per the policy of increasing the existing generating capacity. The generating capacity of the Trishuli and Devighat hydroproject station were to be increased during this plan period by carrying out improvement and consolidation measures. These measures were to be increased of about 12.2 MW of power generation capacity.

Construction-Extension and Strengthening of Electric transmission Lines

Construction of 42 km long Duhabi Katiya 132 KV transmission line had to be completed. Similarly, construction of 200 km long 132 KV transmission line between Banke (Kohalpur) and Kanchanpur (Mahendranagar) of the remaining portion of the central gried was be constructed during the Eight Plan period. In addition to this 132KV and 66 KV transmission line passing through high electricity consumption areas especially of the central grid ie. Biratnagar – Kathmandu Valley and HEtaude – Bharatpur _ Birgunj and Butwal – Bharatpur sections were to be strengthened.

In the process of development, construction and study of hydropower projects in the Eight Five Year Plan period, medium projects such as Puwa (6 MW), chilime (10 MW) and Modi (14 MW) were initiated. Out of these, Arun III could not be implemented because the donor agencies with drawn from the projet while arrangement was in the final stage (NPC 1992).

Rural Electrification

Electrification from the Central Grid

Electrification work was to be undertaken in about 1200 villages in Illam, Jhapa, Sunsari, Morang, Dhausa, Pahottari, Saraha, Rauthat, Chitwan, Nawalparasi, Rupandehi, Kapilvastu, Kaski, Gulmi, Arghakhanchi, dang, Banke, Bardia and Surkhet districts having high population densities. This program was to be benefited about 9,50,000 people of those areas.

Electrification by Small Hydroelectric Projects in isolates

Small hydro-electric projects were to be constructed in order to meet the rural electricity demand in the hills and Himalayan region. Electricity capacity under this programme was to be increased by 3,260 KW during the plan period from the continuing and proposed projects, construction of the Namche (600 KW), Achham (400 KW) and Tatopani Second Phase (1,000 KW) projects from the seventh plan were to be completed. In addition to these, the Khotang (500 KW), Kalikot (600 KW) and Dolpa (160 KW) projects were to be constructed.

Table No. 4.15 Achievement in the Eighth Five Year Plan

Details	FY 1991/92	FY 1996/97	Increment in figure (%)
1. Total installed capacity			
a. Hydropower stations	2,38,563	2,52,418	13,855 (5.8%)
2. Length of Transmission			
132 KV single circuit	1178	1191	13 (.09%)
132 KV double circuit	-	43	43
66 KV single circuit	64	179	115 (179.7%)
66 KV double circuit	153	158	5 (3.20%)
33 KV single circuit	1096	1349	253 (23.1%)

Sources: Ninth Five Year Plan, NPC, HMG,

(IX) The Ninth Five Year Plan (1997-2002)

In the Ninth Plan enunciated long term policy with a view to raising the share of electricity in total energy consumption from about 1 percent to 3.5 percent in the next 20 years. The plan also laid emphasis on development of multipurpose project like Koshi 4,700 MW, karnali 10,800 MW and Mahakali 4,680 MW (about 22,000 MW) for domestic use and as well as for export. It adopted the policy of controlling the power leakage. The major policies mentioned in the plan included institutional reforms to attraction private sector in power generation and indigenous talent and involvement line. The nine plan has set the following objectives in the hydropower development.

1. To develop hydropower in a least way so as to meet the energy demand from agriculture, industry, transportation, domestic, commercial and other sector.
2. To supply electricity at affordable price internally and to export electricity at competitive price by developing reliable and quality hydropower.
3. To maintain regional as well as rural-urban balance in power supply.
4. To develop hydropower with minimum adverse impact on environment.

In the Ninth Five Year Plan, the target was to increase hydropower to 546 MW from the existing 253 MW linked with the central grid. Out of this, 4 projects (172 MW) were to be, implemented from public sector and 4 projects (121MW) were to be implemented from private sectors. The total capacity of thermal power stations was to increase 60 MW from the existing 47 MW. Transmission line was targeted to expand 3,926 KM from existing 2,902 KM. Similarly, 6,067 KM of distribution line was also target to add. A total of 8,28,000 people be benefited by electricity power in the end of the Ninth Plan. Feasibility studies started in the Eighth Plan were also been completed and feasibility studies of 12 other projects were to be started and completed in the Ninth Five Year Plan.

Power Generation and Supply

From the various hydropower projects 295 MW additional electricity's was targeted to generate from large and medium projects and 660 MW from small hydro projects.

Table No. 4.16: Power Generation in Ninth Plan by Large, Medium, and Small hydro projects;

S.N	Name of the project	Capacity (MW)	Sector	Agency
1	Indrawati III	5	Private	IPP/GoN
2	Puwa Khola	6	Private	NEA
3	Modikhola	14	Private	NEA/South Korea
4	Chilime	20	Private	NEA/ Company
5	U.Bhotekoshi	36	Private	IPP/ America
6	Khimti I	60	Private	IPP/Norwegian
7	Kali Gandaki 'A'	144	Public	NEA/ADB/OECF
8	Tanakpur	8	Public	-
9	Kalikot	0.5	Public	-
10	Dolpa	0.16	Public	-
	Total	293.66		

Sources: Ninth Plan, NPC, HMG,

Target and Achievement of Ninth Plan

Table No. 4.17: Physical Target of Electricity Development in the Ninth Plan

Details	Total	1997/98	1998/99	1999/2000	2000/01	2001/02
1. Electricity generation and supply system						
a. Large and Medium Hydropower projects (MW)	293	-	6	104	183	-
b. Small hydropower projects	660	160	500	-	-	-

2.Consumption and extension transmission line	1024	-	-	286	267	471
3.Rural electrification (KW)	6067	1220	597	1620	1650	980
4.Survey, feasibility study and detailed engineering design no.	31	7	5	8	7	4

Sources: Ninth Plan, NPC, HMG,

Table No. 4.18: Target and Achievement of the Ninth Plan

S.N	Area	Unit	Target	Achievement	Achievement %
1	Hydropower installed capacity	MW	538	527.5	98.04
2	Transmission line (132.66 & 33 KV)	KM	3926	4324	110.13
3	Capacity sub-station at higher level (132 KV & 66KV)	MVA	832	881	105.89
4	Distribution line (11 KV & 400/230 volt)	KM	6067	8400	138.45
5	No of consumer	000	828	878	106.4
6	Benefited people	%	20	40	200

Sources: Tenth Plan, NPC, HMG.

(X) The Tenth Five Year Plan (2002-2007)

The Tenth Plan emphasis on the construction of small, medium and large reservoir type of hydro projects. The plan intends to promote integrated development of water resources involving private and public sector and domestic and foreign investments. The plan also lays emphasis rural electrification, control of unauthorized leakage of

electricity and private sectors involvement in generation, transmission and distribution. In the power sectors private sectors are given full freedom for the investment. As a result private sector joint venture companies have to constructed to some hydro project under the Built Own Operate and Transfer (BOOT) system. Implementation of the concept would help in economic development industrialization, flood control, environmental protection and creating employment opportunities besides benefiting the downstream nation in profit sharing. The Tenth Plan had set the following objectives in hydropower sector to reduce the poverty of Nepalese people in sustainable manner.

1. To produce electricity at low cost by harnessing the existing water resources.
2. To expedite rural electrification so that it could contribute to the rural economy.
3. To develop hydroelectricity as an exportable item.

The quantity target of the plan was as follows;

- Hydropower projects constructed to supply 842 MW electricity out of which 70 MW could be exported.
- Additional 10 percent people supplied electricity through national grid for which power supplied to 26,000 villages development communities (VDC's) through national grid and additional five percent people supplier power through alternative source of energy.
- Per capital electricity consumption rose to 100 kilo/hour.

In the Tenth Plan period, the target was to increase 315 MW of hydropower by public sectors. Of the total population, 48.5 percent was expected to have access to electricity service by the end of the Tenth Plan. Prior to the Tenth Plan, electricity was available to 58 municipalities and 1600 VDCs in the country. Out of 315 MW, 101 MW was to be produced by public sector and 214 MW by private sector. In this plan period some projects were to be started for export hydropower and to supply the demanded electricity after the Tenth Plan Period. The projects which were to be started construction work were Arun III (402 MW), Upper Karnali (300 MW), Upper Tamakoshi (250 MW) and West Seti (750 MW). Transmission line was targeted to expand 430 km. Out of this 302 km transmission line was to be constructed by public sector and 129 km transmission line was targeted to constructed by private sector. In

the tenth Plan there was to supply electricity of additional 1,000 VDCs and additional 7,05,000 consumers were to be benefited.

The plan laid emphasis on the studies of reservoir projects during plan period. Survey and studies commissioned on various project with a total capacity of 13,376 MW of which 12,239 MW had planned to produce from the public sector and 1,137 Mw from the private sector. Studies had been commissioned with bilateral co-operation on Pancheshower Multipurpose Projects (6,480 MW), Sunkoshi- Kamala diversion (1,300 MW) during the plan period.

From the various hydropower projects 101 MW additional electricity was targeted to generate from public sector and 214 MW private sector as shown in below.

Physical target and Achievement of electricity development during the tenth five Year Plan Period is shown in the table 4.19

Table No. 4.19: Physical Target and Achievement of the Tenth five Year Plan

S.N	Areas	Unit	Target	Achievement	Percentage
1	Hydropower installed capacity	MW	315	40	12.69
2	Transmission line (132-66KV)	KM	430	47	10.93
3	Capacity sub-station at higher level (132-66 KV)	MVA	426	332	77.93
4	Transmission line 11KV	KM	865	123	14.21
5	Capacity Sub-station	MVA	101	112	110.89
6	Distribution line (11 KV)	KM	14,197	8,371	58.96
7	Supply electricity in VDCs	Number	2,100	21,000	80.77
8	No of consumers	000	417	417	59.06
9	Benefited people	%	10	8.5	85

Sources: Three Year Interim Plan, NPC, HMG.

(XI) The Three Year Interim Plan (2007-2010)

The main objectives of hydroelectricity in the three Year Interim Plan is to create an environmental quality and easily accessible electricity services for the major of the people of the rule area of the country, considering hydropower as an important base for the comprehensive economic develop of the country. The Interim Plan has set the main objectives of the hydroelectricity sector are expand electricity to rural area by providing quality services at low cost,to adopt hydro-electric as the foundation of overall economic development and develop it as on an exportable item. The following main policies will be adopted to attain these objectives.

1. Domestic and foreign investment will be encouraged for development of hydroelectricity.
2. An electricity regulation agency will be strengthening for institutional improvement of electricity sectors, and management of production, transmission and distribution.
3. Clear, simple and transport procedure will be adopted to increase the participation of private sector, community and local persons in production, consumption and export of hydroelectricity.
4. Rural electrification will be expanded with priority.
5. Policy will be adopted to provide electricity easily and at low cost to agriculture and other productive sectors.
6. The tendency to just obtain license for small hydroelectricity production and distribution, without carrying out production and distribution works will be discourage.
7. Domestic investment will be encouraged in hydroelectricity production to a certain capacity.
8. Water resources strategy as well as other provisions in national water plan will be gradually implemented.
9. Initiative will be taken to integrate micro and small hydroelectricity with the national grid.

The qualitative targets of the Three Year Interim Plan (2007-2010)

1. Hydropower projects will be constructed to supply additional 105 MW electricity's and the consumption work will be started of additional 2,115 MW electricity.
2. Additional 10 percent of the people will be supplied electricity through the national grid for which power will be supplied additional 500 VDCs.
3. Per capital electricity consumption will be expanded to 100 kilowatt hour.

The programme in electricity sector include in the three Year Interim Plan period have been classified in the following categories.

Electricity Production and Supply;

Hydropower projects with a total capacity of 105 MW shall be developed under the public and private sectors within the plan period to meet the domestic electricity demand. For this, the public sector will contributes 85 MW and that the contribution of the private sector will be 20 MW. During the plan period, Middle Marsyangdi hydropower plants of 70 MW and Kulekhani III hydropower plant of 20 MW will make important contribution to the public sector. The private Dhalkebar- Vittamod (30 km) transmission line will be constructed during the plan period other two transmission line Butwaal- Sunauli (25 km) and Duhabi- Jogbani (15 km) will be started to construct. In addition to this hetauda- Bardghat (220 km) transmission line will be commenced during the plan period.in the Three Year Interim Plan Period, constructionof some new sub-station completed. For this 337 MVA of capacity transmission sun-station will be increased of different kilovolt.

Electricity, Distribution, Expansion and Electrification Programme

In order to cover large parts of the rural areas, construction of transmission and distribution lines of 652 km of 33 KV capacities, 3,163 km of 11 KV capacities 5,978 km of 400/230 volts and construction of 33/11 KV distribution sub-station of a total of 113 MVA capacities shall be completed during the plan period. This will help electricity services to a 5000 VDCs providing electricity to a total of 450,000 householders. The national transmission grid will be expand to an additional Electrification Programmed, Transmission and Distribution lines of 130 km of 33 KV,

1,154 km of 11 KV and 2,345 km of 400/200 Volts shall be completed. This will help expand electricity services to an additional 135,000 householders (NPC, 2007).

Special Efforts for the Shortage of Supply of Electricity (Load Shedding)

In the Three Year Interim Plan Period load shedding will be completely wipe through the following programmes.

In the First Year FY 2007/08 40 to 50 MW, electricity will be imported from India. This will reduce the time of load shedding. From selected three cross border transmission line, dhalkebar- Bhittamod transmission line will be started to construct in 2007/08 and completed in 2008/09. This will help to increase the business of electricity.

In the second year FY 2008/09, Middle Marsyangdi hydropower project will be completed and additional 70 MW, electricity will be connected in national grid which will be also decrease load shedding. After that importing electricity from India load shedding will be decrease.

The hydropower projects that will be constructed in the Interim Plan Period will be completed in FY 2010/2011 and FY 2013/14 about 600 MW, electricity will be connected in national grid.

Table No. 4.20: Hydropower Projects Proposed to be During Interim Plan Period

S.N	Name of the project	Installed capacity (MW)	Completion year	Agency
1	Chameliya	30	2010/11	China
2	Upper Tamakoshi	309	2013/14	ADB/GoN
3	Upper Seti	122	2013/14	-
4	Upper Trishuli 'A'	60	2013/14	China
5	Upper Trishuli 'B'	40	2013/14	China
6	Rahughat	27	2013/14	IVRCL, India
7	Kaweli 'A'	30	2013/14	Arun Kabeli Power
8	Mailing	5	Private Sector	-

9	Lower Indrewati	4.5	Private Sector	-
10	Upper Modi	14	Private Sector	NEA/Korean Water Resources Corporation
11	Darem Khola	5	Private Sector	-
12	Lower Nyadi	4.5	Private Sector	-
13	Moodi i	10	Private Sector	South Korea
14	Phawakhola	2.079	Private Sector	-
15	Arun III	102	Private Sector	NEA from home loan
16	Upper Karnali	300	Private Sector	-
17	West Seti	750	Private Sector	China
	Total	2,115.079		

Sources: Three Year Interim plan, NPC, HMG.

Table No. 4.21: Transmission Line to be Initiated Interim Plan Period

S.N	Name of the project	Length
1	Kabeli Corridor 132 KV	129
2	Hetauda-Bardaghat 220 KV	143
3	Middle Marsyangdi- Damauli 132 KV	43
4	Butwal-Kohalpor 132KV	208
5	Butwal-Sunauli 400 KV	25
6	Duhabi-Jogbani 400 KV	14
7	Upper Modi- Modi 132 KV	10
8	Mofi- Lekhnath 132 KV	7
9	Mailing-Grang 66 KV	3
	Total	583

Sources: Three Year Interim Plan, NPC, HMG.

Table No. 4.22: Transmission Line to be completed in the Interim Plan Period

S.N	Name of the project	Length (KM)
1	Kulekhani III- Hetauda 132 KV	0.5
2	Thankot-Chapagaun 132KV	27
3	Dhalkebar-Bhittamod 132 KV	30
4	KKhimti- Dhalkebar 220 KV	75
5	Middle Marsyangdi-Marsyangdi	42
	Total	174.5

Sources: Three Year Interim Plan, NPC, GON.

(XII) Three Year Plan (2010-2013)

Despite the fact that various promotional and motivational measures have been adopted to involve the private sector and communities in the generation and distribution of hydropower under the Electricity Act (1992), and various policies and periodic plan, progress in hydropower has been far from satisfactory. By the end of the Three Year Plan in the FY 2012/13, the installed capacity of the power generation centers connected in to the national grid was only 705 MW, out of which the NEA contributed 473 MW and the Private sector 232 MW. The national grid coverage 59 districts. The Year Plan target for increasing capacity was 184 MW, the actual additional was only 21 MW. While progress in expanding capacity was discouraging that in increasing distribution lines was satisfactory, nine hundred additional VDCs and 7,00,000 additional customers benefited from electricity. Nearly 50 percent per capital power consumption has reached 108 KWh. By 2011, nearly 67 percent of population had access to electricity.

The supply of power does not meet the demand for it, however, due to a host of problems such as the lack of transmission line certain parts of the nation, the poor management of distribution, the fact that the nation's run of river system base power production approach means that plants do not run of at their installed capacities during the dry season, the inability of the private sector to generate power within the time from committed and the fact that not even the government sector operates any new huge capacity generation projects. The supply of power does not meet the demand for it, however, due to a host of problems such as the lack of transmission

line in certain parts of the nation, the poor management of distribution, the fact that the nation's run of river-system base-power-production approach means that plants do not run of at their installed capacities during the dry season, the inability of the private sectors to generate power within the time from committed and the fact that not even the government sectors operates any new huge capacities generation projects.

- **Objectives of the plan**

To increase the existing access to reliable and good quality electricity services by encouring hydropower production.

- **Strategies of the plan**
    1. Increase the existing capacity for electricity production increasing public, private, community and cooperative investment through the creation of an investment friendly environment.
    2. Expand and strength electricity transmission and distribution regimes.
    3. Promote foreign investment in an assistance for the development of extensive and multipurpose hydropower projects that fulfill domestic needs and generate electricity to export.

- **Operating Policies of the Plan**
    1. Projects will be implemented through both private and government investment transmission line will be constructed and power for domestic consumption generated.
    2. Government and national private capital will be mobilized to construct and operate small and medium projects.
    3. To increase private investment by Nepali citizens, power purchases rate will be revised and incentives and tax concession materials will be given to those projects which will be completed during the Three Year Plan Period.
    4. The efficiency of the power generation; distribution and utilization system will be increased.
    5. The private sector will encouraged to construct transmission line through public private partnership.

6. Electricity leakage will be controlled by adopting legal provisions and technical measures.
7. Action will be taken to construct underground and power-induced accidents.
8. Rural electrification will be expanded as called by policy.
9. Detailed reports on the purposed Pancheshor and Saptakoshi hydropower projects will be prepared.
10. It will be mandatory for big hydropower projects to consider the effects of climate change.
11. The water sheds of big river will be projected.

Expected Outcomes of the Plan

By the end of Three Year Plan, completed hydropower projects will have added 668 MW of power generating capacity and projects with a total capacity of 584 MW will have been started. In additional, 400 km of new transmission line will have been constructed; power leakage will have decreased to 21 percent. Per capital consumption will have increased to 140 KWh, the proportion of the population using electricity from the national grid have reached 65%and electricity will be available in 3,000 VDCs.

(XIII) The Thirteenth Three Year Plan (2013-2016)

The supply of power does not meet the demand for it, however, due to a host of problems such as the lack of transmission line certain parts of the nation, the poor management of distribution, the fact that the nation's run of river system base power production approach means that plants do not run of at their installed capacities during the dry season, the inability of the private sector to generate power within the time from committed and the fact that not even the government sector operates any new huge capacity generation projects. The supply of power does not meet the demand for it, however, due to a host of problems such as the lack of transmission line in certain parts of the nation, the poor management of distribution, the fact that the nation's run of river-system base-power-production approach means that plants do not run of at their installed capacities during the dry season, the inability of the private

sectors to generate power within the time from committed and the fact that not even the government sectors operates any new huge capacities generation projects.

By the end of this plan 67% people are using electricity from the national grid. The total installed capacity of electricity in the country is 758 MW. In which NEA has produced 475 MW and other 232 MW from private sector. 59 district were connected by national grid.

- **Objectives of the plan**

To increase the existing access to reliable and good quality electricity services by encouring hydropower production.

- **Strategies of the plan**
    1. Increase the existing capacity for electricity production increasing public, private, community and cooperative investment through the creation of an investment friendly environment.
    2. Expand and strength electricity transmission and distribution regimes.
    3. Promote foreign investment in an assistance for the development of extensive and multipurpose hydropower projects that fulfill domestic needs and generate electricity to export.

Table No. 4.23: Physical Target of Electricity in Thirteen Plan

S.N	Name of the projects	Capacity (In MW)
1	Upper Tamakoshi Hydro Project	456
2	Buddhi Gandaki Hydro Project	600
3	Narshimghad Hydeo Project	410
4	Pashim Seti Hydro Project	750
5	Tanahau Hydro Project	140
	Total	2,356

Sources: NPC 13th plan, GON

Table No. 4.24: Study of the Hydro Project

S.N	Name of the project	Capacity (In MW)
1	Sunkoshi II Hydro Project	1,100
2	Sunkoshi III Hydro Project	530
3	Aadhi Khola Hydro Project	180
4	Uttar Ganga Hydro Project	300
5	Dudkoshi Hydro Project	300
6	Kali gandaki Hydro Project	660
7	Naumure Hydro Project	240
8	Upper Arun Hydro Project	335
9	Karnali Chisapani Hydro Project	10,800
10	Arun IV	300
11	Simbua Khola Hydro Project	53
12	Dudkoshi IV Hydro Project	49
13	Beni-kali Gandaki Hydro Project	50
14	Shankhuwa Khola Hydro Project	30
	Total	14,927

Sources: NEA, NPC 13th Plan

Table No.4.25: Hydro-power Projects Under-Construction

S.N	Name of the project	Capacity (In MW)
1	Kulikhani III Hydro Project	14
2	Chamelia Hydeo Project	30
3	Upper Trishuli Third ‘A’ Hydro Project	32
4	Upper Modhi Hydro Project	40
5	Budhi Ganga Hydro Project	42
6	Tamakoshi V Hydro Project	20
	Total	256

Sources: NEA, NPC 13th Plan

4.3 Hydroelectricity power potential in Nepal

Nepal is water rich country. The geographical construction of Nepal with great variation of altitudes from higher Himalayan to the low land of the Terai over a relatively narrow with combined with abundant snow melt and monsoon water after tremendous energy potential for generating hydropower. Nepal's theoretical hydro potential has been estimated at about 83,000 MW and its technical and economically feasible potential of about 45,000 MW and 42,000 MW respectively. Table 3.23 shows that summaries of the theoretical, technical and economical hydropower potential classified within the major river system in Nepal, feasible potential estimated by the Water and Energy Commission (WEC). The Karnali and Mahakali river system represent approximately 43 percent of Nepal theoretical hydropower potential and 55 percent of the technical/economical potential.

Table No. 4.26: Hydropower Potential in Nepal

In Thousand MW

S.N	River Basin	Theoretical Potential	Technical Potential	Economical Potential
1	Saptakoshi	22.35	11.40	10.860
2	Saptagandaki	20.65	6.66	5.270
3	Karnali & Mahakali	36.18	26.57	25.125
4	Southern Rivers	4.11	0.98	0.87
		83.29	45.61	42.13

Sources: WECS, 1992/93

Table No. 4.23 shows that Nepal has 83.29 thousand MW of hydropower potential. Of this total potential, 50.5% (42.13) thousand MW is economically viable. The highest potential possessed by Karnali and Mahakali river from theoretical, technical and economic perspectives. Southern rivers posses low potential because they don't flow from the Himalayan region like others major rivers. There are many projects in number including large, medium and small in Technical and Economical viable sector respectively.

4.4 Nepal Electricity Regulation Commission Bill (2007/08)

Nepal government has been submitted a bill on electricity regulatory body to the parliament (constituent Assembly) for facilitating electricity production, transmission, distribution, trading and management in a transparent way. Its other objectives are to balance supply and demand, to set electricity market and to protect consumer rights. But till now, no action is being taken to in act the bill by the parliament yet. With the establishment of this regulatory body, electricity market is expected to develop in a competitive environment where stakeholder's rights are protected and electricity is made accessible, affordable and acceptable.

4.5 Ten Years Hydropower Development Plan 2009

Government of Nepal formed a task force under the convener ship of Mr. Somnath Poudel in December 2008. The task given was to formulate programmes for developing 10,000 MW in 10 years to provide relief to the consumers, concerned industries and business against the ongoing energy crises in the country. The task force has already submitted the draft report which is yet to be discussed among the concerned stakeholders and ratified by the government. Never the less, it has clearly pointed out the great importance of developing hydropower and the systematic way and means to materialize it in the country. It has also adequate presented the scary scenario of load shedding in the years to come and need of high level mechanism under the top leadership to resolve the crises. GoN has again come up with the plan of development of 25,000 MW in 20 years in the plan and programmers of thegovernment in July 2009 under the convener ship of the security, WECS. There is huge potential of hydropower resources in the country and if the government can facilitate the development of hydropower. On priority basis through private public partnership, Nepal can export the surplus power after meeting the domestic energy need of the consumers-households and industries in the country (WECS, 2009).

4.6 Physical Achievement in Hydro-Electricity Development

Nepal has travelled the 100 years journey of power development since the installation of Pharping Hydro Plant in 1911 AD: it was one of the largest hydropower projects in South Asia during that time. Although, Nepal has completed the 13th development

plan,but the power development in Nepal is still infant stage. Following table shows the physical achievement of hydro-electricity in Nepal.

Table No. 4.27: Achievement in Hydro-Electricity Development in Different Plan Period

S.N	Total planned Target (MW)	Total Achievement (in MW)	Achievement %	Share of hydropower (in %)
1	20	0.75	3.75	-
2	22	7.50	34.09	73.33
3	36	19.96	55.44	100
4	40.30	28.50	70.72	91.37
5	58.85	18.71	31.79	86.75
6	144.92	87.62	60.45	87.81
7	106.63	103.06	96.65	99.90
8	29.70	28.50	95.96	100
9	306.66	137.66	44.89	90.56
10	315	181.279	57.73	N.A*
Interim	105	77	73.36	-

Sources: Bhattari (2005), Interim Plan Statistical Pocket Book CBS (2009)

N.A*=Not Available

CHAPTERV

PRESENT STATUS OF HYDROPOWER DEVELOPMENT IN NEPAL

5.1 Hydropower Potential of Nepal

In the global context the total annual energy potential has been calculated theoretically to correspond roughly to 80,000 TWH. Of the estimated probable potential, technically and economically useable energy has been accessed as 10,000 TWH. About 48% of this total belongs to the developing countries (WECS 2006). Out of the total hydropower potential 2,494 million KW, Nepal accounts for 3.34 percent (83.29 million KW). This is the highest amount of SAARC nations. Regarding utilization, however, Nepal's performance is lowest amount the SAARC countries. Only 0.75 percent of theoretical potential and 1.5 percent of economical potential is utilized. The rate of utilization is highest in Sri Lanka (84.75%) follower by India (33.16%0 and Pakistan (24.07%) (Bhattari, 2005).

Not only among many development countries but also in the global scenario too, Nepal has dominance in water resources. The geography has blessed Nepal hydropower potential has been estimated at about 83,000 MW and its technically and economically feasible potential of about 45,000 MW and 42,000 MW respectively. The mountains topography of the country provides the possibility of a series of high dams, which can hold huge quantities of water for multipurpose. This storage has the potential to augment dry season flow by about 5400 m3/sec (Bhatt 2008).

Table No. 5.1: Theoretical Hydropower Potential

River Basin	Potential in MW		Total MW
	Major river course having catchments areas above 1000 km^2 (Major Rivers)	Major river course having catchments areas above 1000 km^2 (Small Rivers)	
Saptakoshi	18750	3600	22,350
Saptagandaki	17950	2700	20,650
Karnali and	32680	3500	36,180

Mahakali			
Southern River	3070	10040	4,110
Country Total	72450	10840	83,290

Sources: Shrestha (1966).

Table No.5.2: Technical Hydropower Potential

River Basin	Number of projects sites	Technical Potential Capacity in MW
Saptakoshi	53	11,400
Saptagandaki	18	6,660
Karnali	30	25,410
Karnali and Mahakali	4	1,160
Southern River	9	980
Country Total	114	45,610

Sources: Shrestha (1966).

Table No. 5.3: Economical Hydropower Potential

River Basin	Number of projects sites	Technical Potential Capacity in MW
Saptakoshi	40	10,860
Saptagandaki	12	5,270
Karnali	7	24,000
Karnali and Mahakali	2	1,125
Southern River	5	878
Country Total	66	42,133

Sources: Shrestha (1966).

5.2 Total Energy Available and Peak Demand

By the end of FY 2014/15, total installed capacity generated is found to be 759 MW from hydro resources. Out of the total installed capacity (NEA and IPP) generate 705 MW is connected nation grid and the remaining electricity generated by other micro hydropower is not connected with national grid. The available energy is less than the demand and available electricity has shown in the table 5.4

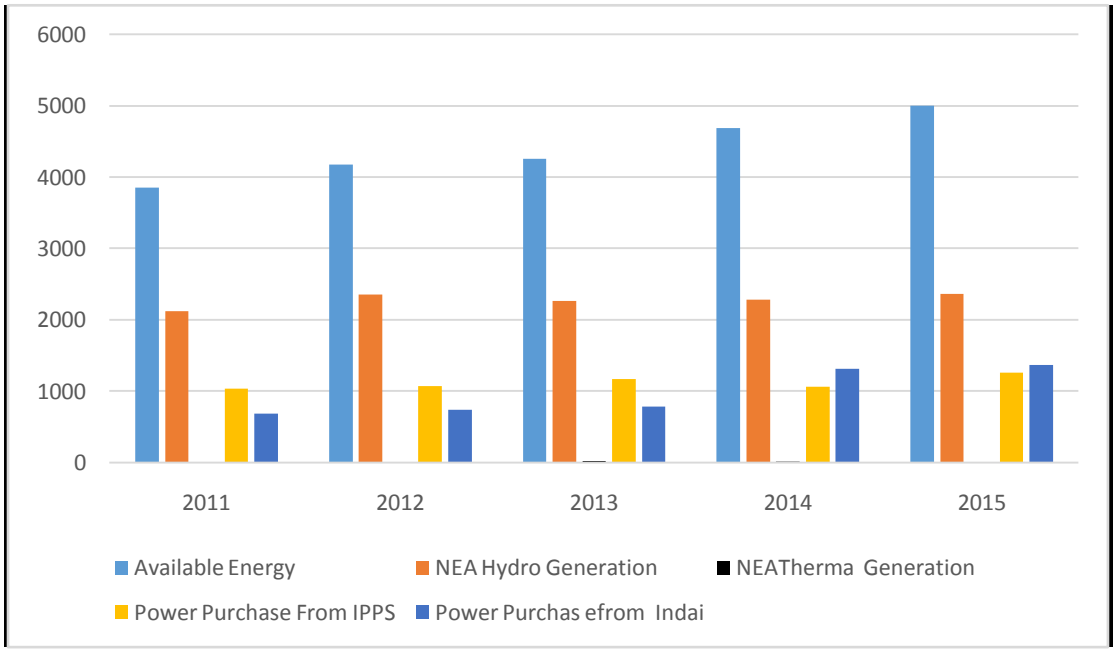
Table No. 5.4: Electricity Available and Peak Demand

Particulars	2011	2012	2013	2014	2015
Peak demand (MW)	946.10	1,026.65	1,094.62	1,200.98	1,291.80
NEA Hydro Generation	2,122.08	2357.43	2,273.43	2,288.23	2,365.04
NEA Thermal Generation	3.40	1.56	18.82	9.65	1.24
NEA Total Generation (GWH)	2,125.48	2,358.99	2291.96	2,297.88	2,366.88
Power Purchases from India	694.05	746.07	7922.52	1,318.75	1,369.89
Power Purcheses from IPPS	1,038.84	1,073.57	1175.97	1,070.47	1,268.93
Power PurchaseTotal	1,732.89	1,819.64	1,968.49	2,389.21	2,638.8
Available Energy	3,858.37	4178.63	4,260.45	4,687.09	5,005.69

Source: NEA 2014/15

Note: Peak demand is for all areas covered by integrated system including supply by India.

Figure 5.1 Total Energy Available and Peak Demand



The table 4.4 and figure 5.1 shows the availability of total energy available and peak demand in different time period. The demand is for all areas covered by integrated system in including supply to India. The electricity peak demand are increasing every year. The peak demand were 946.10 MW in 2011 and it was 1,291.86 MW in 2015. Similarly, total available energy in 2011 was 3,858.37 GWH and it was 5,005.69 in 2015.

5.3 Growth of Electricity Consumer

The number of consumers receiving electricity service is growing every year. By end of FY 2011/12 the number of consumer had reached by 29,56,292 and in FY 2015/15 it reached to28,68,012. The consumers of electricity are increasing day by day. Butthe production is not increased as number of consumer increased. As a result, we have facing load shedding problem. Table 4.5 shows situation number of consumer in different years according as the sectors involved consumer are divided in various sector such as domestic, commercial, non-commercial, water supply and transportation sector, irrigation, temple, street light, temporary supply, community wholesale consumer in our nation and bulk supply consumer outside country.

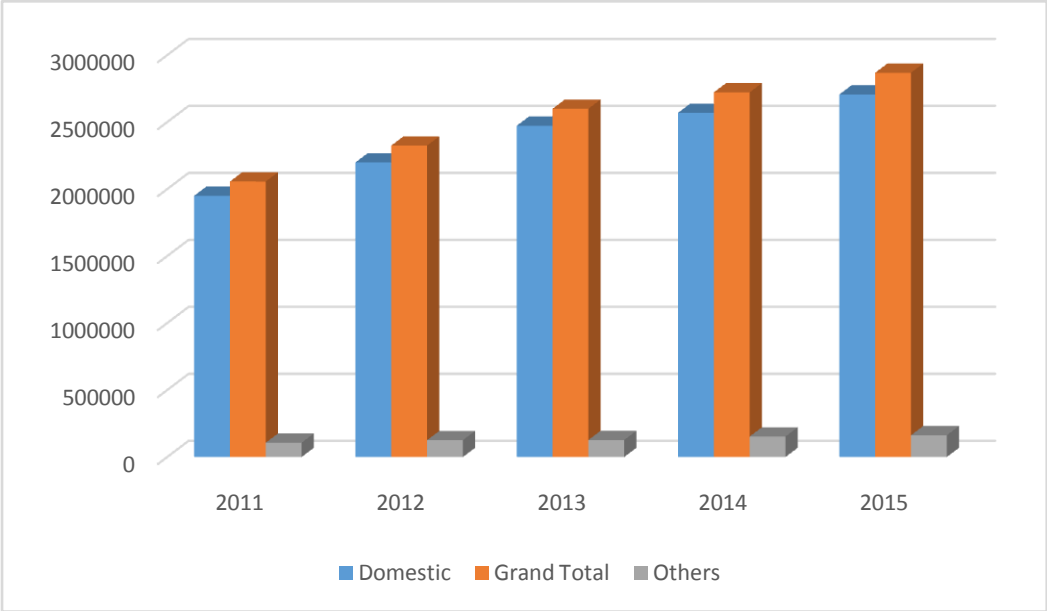
According to the given table we can say that domestic consumers are greater with respect to other sector and its consumer are increasing continuously. In 2011 domestic sectors consumer are 1,949,530 and it increased to 27,05,732 in 2015.

Table No. 5.5 Growth of Electricity Consumer

Particulars	2011	2012	2013	2014	2015
Domestic	19,49,530	21,98,680	24,72,260	25,68,870	27,05,732
Non-commercial	12,520	14,055	15,179	16,454	16,942
Commercial	10,802	13,297	1,309	14,714	16,056
Industry	33,030	36,409	37,498	40,158	42,409
Water Supply	688	860	834	1,142	1,272
Irrigation	42,494	53,165	51,520	71,438	76,275
Street light	2,374	2,590	2,878	2,874	2,810
Temporary supply	634	619	768	741	749
Transport	42	44	51	42	46
Temple	3,181	3,529	1,207	4,088	4,243
Community sales	995	1,161	1,207	1,350	1,476
Total (Internal Sales)	20,56,290	23,24,409	15,99,148	27,21,871	28,68,010
Bulk Supply (India)	2	5	4	2	2
Grand Total	20,56,292	23,24,414	25,99,152	27,21,873	28,68,012

Sources: NEA 2014/15

Figure 5.2: Growth of Electricity Consumer

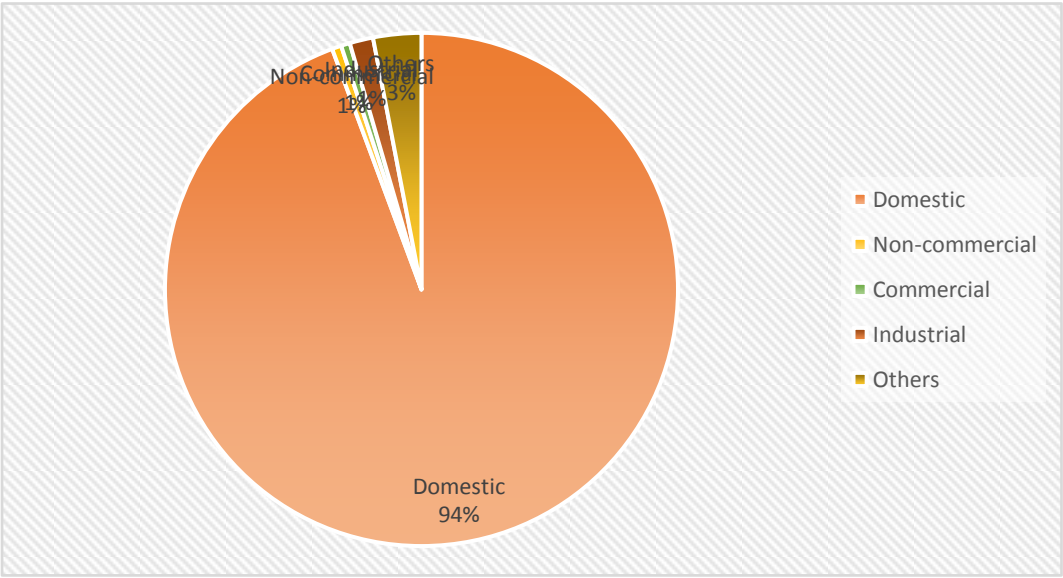


Sources: NEA 2014/15

The figure 5.2 shows the domestic consumers and grand total in different time period. The electricity domestic consumer are increasing every year. The electricity domestic consumer were 19,49,530in 2011 and it increased to 27,05,732 in 2015. Similarly, grand total were 2,056.292 in 2011 and it is increased to 28,68,012 in 2015.

5.4 Electricity Consumption Scenario

Fig No. 5.3 Electricity Consumption Scenario



Sources: NEA 2014/15

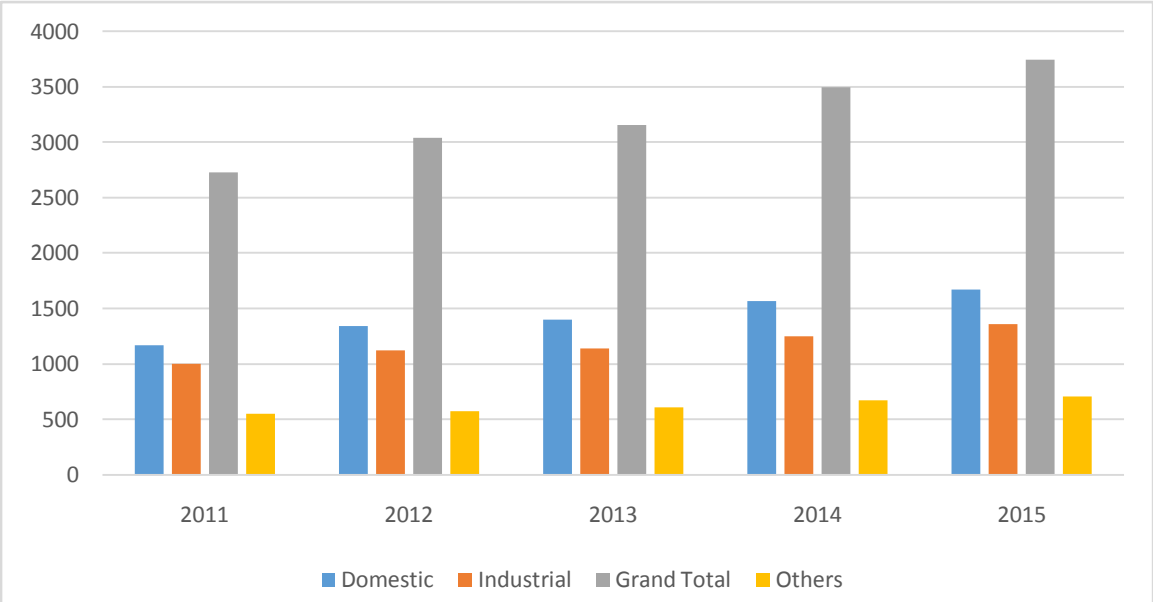
5.5 Electricity Sales

Table No. 5.6 shows electricity for 2011 to 2015 more electricity sales are in domestic sector. A mainly electricity sales is in increasing pattern according as number of year increase.

Table No. 5.6 Electricity Sales (IN GWH)

Particulars	2011	2012	2013	2014	2015
Domestic	1,169.87	1,342.67	1401.64	1,571.39	1,676.38
Non-commercial	109.49	115.68	115.21	126.64	130.59
Commercial	204.03	240.74	256.82	285.42	302.10
Industry	1,001.73	1,123.94	1141.07	1,251.69	1,359.34
Water Supply and Irrigation	82.80	64.59	72.55	82.52	84.26
Street light	76.21	72.06	76.24	76.44	78.06
Temporary supply	1.00	1.20	1.47	1.34	1.51
Transport	5,54	6.72	6.26	6.22	6.55
Temple	3.46	3.95	4.11	5.18	4.90
Community sales	51.95	69.02	77.04	86.08	96.85
Total (Internal Sales)	1,696.52	3,040.57	3152.41	3,492.91	3,740.54
Bulk Supply (India)	31.10	4.14	3.60	3.04	3.31
Grand Total	2,727.62	3,044.69	3156.01	3,496.31	3,743.75

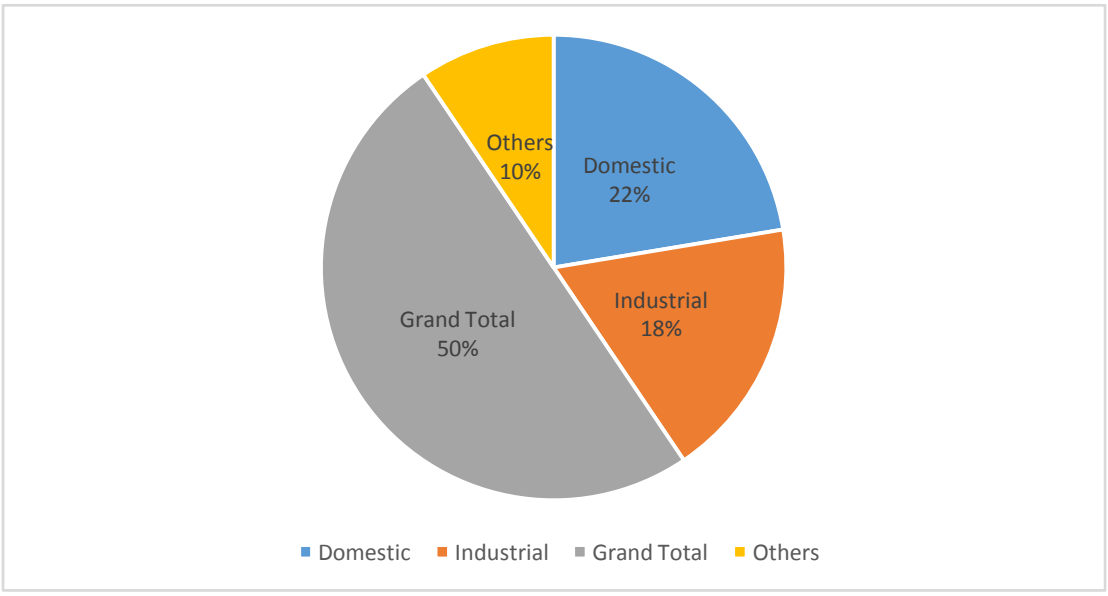
Sources: NEA 2014/15



Sources: NEA 2014/15

The above shows the domestic, industrial, grand total and others in different time period. This shows that the sale of electricity is increasing day by day. The domestic electricity sale were 1,169.87 in 2011 and it reached to 1,676.38 in year 2015. Industrial sector were 1,001.73 in 2011 and in 2015 it were 1,359.34. grand total also increased which was 2,727.62 in 2011 and in 2015 it were 3,743.75.

Figure 5.5 Electricity Sale Scenario



Sources: NEA 2015

5.6 Revenue from Electricity

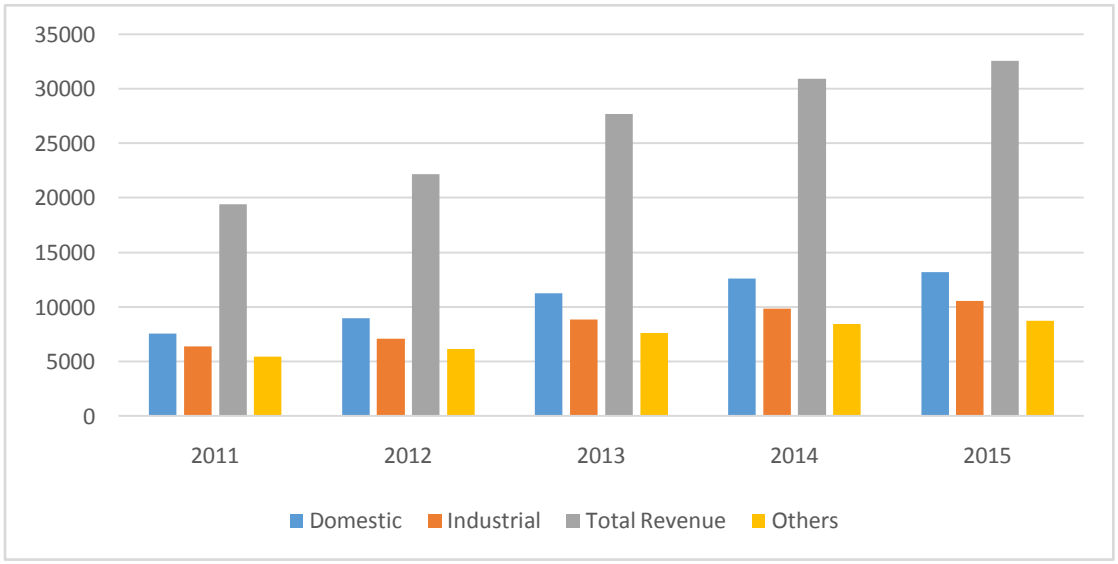
Table No 5.7 shows the revenue from electricity from 2011 to 2015. Revenue sector shows more revenue from domestic sector than other sector.

Table No. 5.7 Revenue from Electricity (in million)

Particulars	2011	2012	2013	2014	2015
Domestic	7,602.34	8,967.77	11,247.77	12,622.11	13,226.66
Non-commercial	1,020.51	1,091.52	1,355.17	1,486.63	1,542.30
Commercial	1,910.28	2,259.52	2,994.00	3,359.69	3,579.93
Industry	6,378.25	7,107.37	8,885.21	9,844.18	10,575.66
Water Supply and Irrigation	250.60	294.82	389.34	418.20	447.68
Street light	433.42	464.22	582.69	601.84	609.65
Temporary supply	13.98	16.18	24.48	25.07	26.01
Transport	27.78	31.70	39.53	39.31	41.67
Temple	26.51	21.38	23.66	26.34	27.64
Community sales	189.28	244.97	301.38	334.94	380.62
Total (Internal Sales)	17,547.35	20,494.43	25,843.23	28,756.31	30,457.82
Bulk Supply (India)	215.42	23.97	32.22	30.90	25.64
Grass Revenue	18,068.37	20,518.40	25,875.45	28,787.21	30,483.46
Net Income from Others Services	1,382.94	1,695.42	1,868.37	2,156.90	2,085.41
Total Revenue	19,451.31	22,213.82	27,743.82	30,944.11	32,568.87

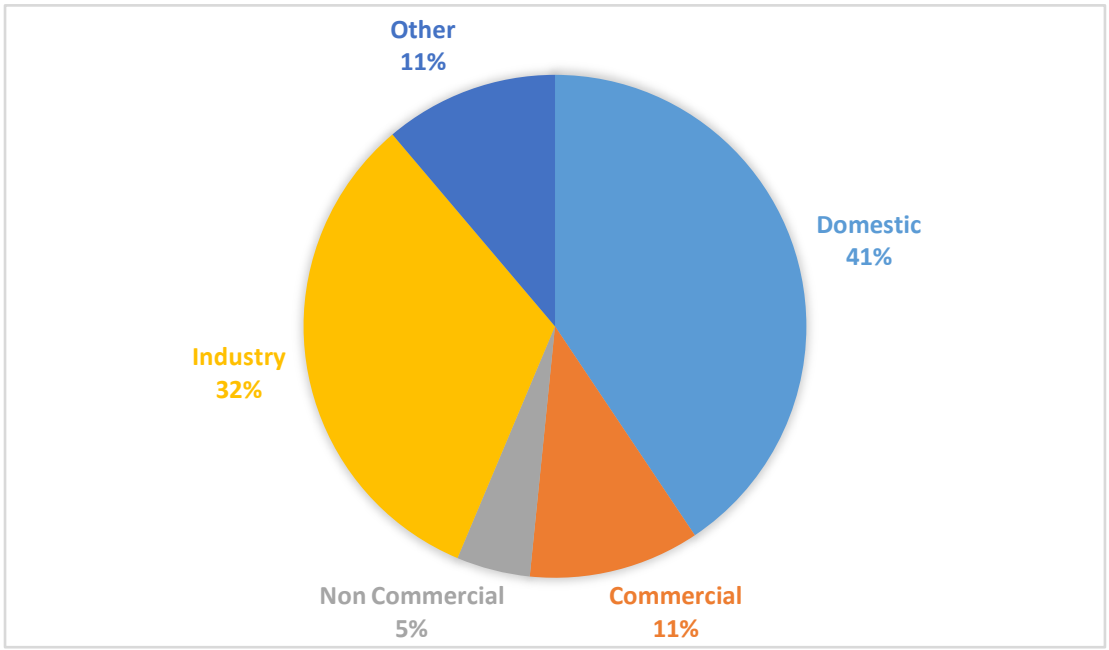
Sources: NEA 2014/15

Figure No. 5.6 Revenue from Electricity (in million)



Sources: NEA 2014/15

Figure No.5.7 Revenue from Electricity Scenario



Sources: NEA 2014/15

5.7 Load Shedding in Nepal

Before some day we are suffering from 12 to 18 hour load shedding in a weak. It is affecting social life as well as economic life of the people. It effects the investors who have invested their properly in the industries and after then the consumers and the finally the economic as whole. On the other hand it has also created the unemployment in the state as most of the industries are going to be closed due to the load shedding of Nepal from which day by day large number of workers are being deprecated from their job. Besides this it has made life very miserable in the country as in this era of modern science and technology. This will finally effect the people of Nepal as there may arise the problems of starvation, shelter problem and other facilities as the land is limited and cannot give the support beyond its capacity. Although, the government of Nepal focused on to removing the problem of load shedding. The government of Nepal has bringing some electricity from to remove load shedding from the country. Due to the unstable politics directly affects, on the development of hydropower sector. Development of hydropower are pending on every plan. Electricity cannot be developed according to the target. Due to this reason country is facing daily 12–16 hour load shedding in dry season every year.

CHAPTER VI

FINDINGS,CONCLUSION AND RECOMMENDATION

6.1 Finding

- In fiscal year 2014/15, total number of consumer reached 28,68,000 an increase of 5.72% of the previous fiscal year 2013/14 figure. In comparison to the previous year, less increase in consumer number in last fiscal year due to insufficient availability of energy meters. However it is expected to increase sustainability once the energy meters are available.
- Similarly in fiscal year 2014/15 a total of 3743.75 GWH of energy was sold earning a gross revenue of Rs. 30483.460 million, an increase of 9.66% and 11.28% over the previous year sales and revenue respectively. Industrial and commercial consumer categories combined together represent only 2.045 of the total number of consumer but shared 45.84% of total sale. Similarly, the domestic consumer category represents 94.29% of total consumer and contributed 43.98% to the total sale.
- The annual peak power demand of the Integrated Nepal Power System (INPS) in fiscal year 2014/15 was 1,291.80 MW, with 585 MW load shedding. Out of the power actually supplied, 357.65 MW was contributed by NEA hydro, 124.71 MW by IPP hydro and the rest 224.43 MW was imported from India compared to the preceding fiscal year figure of 1201 MW, the annual peak power demand of the INPS registered a growth rate of 7.56%.
- A total of 6 new projects developed by the Independent Power Producers (IPPs) with their combined capacity of 42.118 MW were commissioned in FY 2014/15. Projects that were commissioned are: Upper Puwa Khola-1 (3 MW), Jiri Khola (2.2 MW), Mai Khola (22 MW), Upper Hugdi Khola (5 MW), Andi Khola ater upgrading (9.4 MW) and Belkhu (0.518 KW). With these 6 projects, the total number of IPP-owned projects that are in operation has reached 44 with their combined installed capacity of 292.818 MW. Similarly, 83 projects of

IPPs with their combined capacity of 1521.28 MW are under construction. Likewise, 33 projects of IPPs with their combined capacity of 542.532 MW are in other stages of development.

- During FY 2014/15, 23 new PPAs with their combined capacity of 442.406 MW were concluded. With this, the total number of PPAs concluded so far till FY 2014/15 has reached 160 with their combined capacity of 2356.63 MW.
- The Power in the quantum from 15 to 35 MW was imported under a short term PPA with Power Trading Corporation of India (PTC) Ltd. from Tanakpur point at 132 kV level in the Fiscal Year 2014/15. Besides, a long term Power Sale Agreement (PSA) has already been signed with PTC India for the import of 150 MW power for 25 years through 400 kV Dhalkebar-Mujaffarpur transmission line.
- Hydro power projects are advantageous from many perspectives. It is renewable, multipurpose fuel, no raw materials cost and from environmental perspective too. Hydropower development in Nepal has been facing different problems such as government procedural complications, political instability, insufficient infrastructure most of the rivers are of type, unnecessary condition imposed by multilateral and bilateral countries while providing financial assistance too.
- Hydropower projects are capital intensive and the government is unable to arrange adequate financial resources to finance such project, ignoring more priority sector like health education and infrastructure development.so on one hand foreign aid has played an important role in public financing of investment in the electricity sectors, on the other hand investment of private sector investment has increased but attraction of private sector is still lower than the expectation.

Now, it’s time to scratch the new way for hydropower development by accumulating scattered money within the country for investment as well as proper utilization of foreign assistance and encouraging private sector by removing different hurdles existed in the hydropower development sectors.

6.2 Conclusion

Nepal a country with rich biodiversity, cultural heritage, majestic Himalayans and immense water. It's economically viable capacity is estimated to be 42,000 MW. The availability of electricity contributes significantly to the overall development of the country on one hand, and its consumption reflects the economic condition of the nation on the other. Therefore, it has become highly important to harness the abundant water resources to generate electricity for the development of the kingdom.

Total energy sales including sale to India was 3,743.75 GWH in the fiscal year2014/15. This is grow by 7.08% in the sale figure of fiscal year 2013/14. Sale to India, however declined to 3.21 GWH from 3.4 GWH in fiscal year 2013/14.NEAs system loss decreased by 0.81% from the audited loss figure of 24.64% in fiscal year 2013/14 to 24.44% in fiscal year 2014/15. We are committed to intensity our effects to bring down the system loss to a technical acceptable level. For this support from the political parties, civil societies and general public will also be solicited. The total number of consumer at the end of fiscal year 2014/15 grew by 5.75% and reached 2.87 million at the end of the fiscal year 2014/15. Out of the total number of consumer domestic, industrial and other remaining consumer categories accounted to 94.34%, 1.48% and 4.18% respectively. However, in term of scale the corresponding share are 44.78%, 36.31% and 18.92% of the total sale.

The major contribution of the hydropower development in Nepal are not only the financial and technology constraint but it face the problem like local communities creates problem, poor infrastructure, insurgency, lack of skilled manpower, licensing difficulties, inadequate of storage project conservation and environmental problem. In Nepal policy deficiencies and slow making process in the electricity sector has resulted in the increased project cost and has reduced the involvement of private sector and entrepreneur. In spite of its high possibilities hydropower has no contribute enough in GDP of Nepal, neither has it generated huge amount of revenue in national economy. Thus, restricting and improvement at all policy level is required to overcome various hardness and then only hydropower development will possible in Nepal.

The primary challenge encourage by Nepal for hydropower development in the 24th century is how to supply reliable, affordable and cheaper electricity to the domestic population. Rural electrification is essential for the economic prosperity and advancement. The access to electricity is to be taken as the key indicator to the progress of living standard. It enhance the capabilities of the people to reduce the poverty. Nepal is currently facing an actual power shortage which has negative impact in economic growth. This is the right time to move forward for the development of this sector by all involved stakeholders; viz, investor, financier, government, the local public, potential parties; eg .The combined effort gives momentum for further developing the hydropower sector.

6.3 Recommendations

The major recommendations are as follows:

- Being a low income country with a low electrification ratio limited financial resources in the public sector. Nepal needs to attract more domestic and foreign investment in hydropower development to meet demand.
- Concerned Authority should provide easy facilitation from national parks and wild life conservation department for the purposed project in the Buffer Zone and protected areas.
- Government and NEA should also be invested in the transmission line attention should be given to Power Purchase Agreement (PPA). In the absence of PPA, only issuing license produce electricity and also PPA procedure should be simplified.
- The benefit from the project should be distributed among the local people. So that they may be compensated and feel the project are their own property.
- Preference should be given to mobilize domestic financial resources by encouraging private sector investment in hydropower projects. Government should provide loan at confessional rate to encourage local people for the promotion of small and micro hydro projects.
- Hydropower development must be declared as first priority of Nepal. There should be forming the powerful high commission to determine

and definite the core and priority agenda of the nation for its development and also should be eliminated the existing problems.

- To optimize hydropower development it is vital to pursue a basin-wise development policy. So that, the project infrastructures such as road and transmission line are shared by all projects with in the basin. Such policy is absent in Nepal project development is undertaken hazard and isolated modes makes them expensive.
- It is complained that is it is clumsy and time consuming to get the license for generation of electricity. It is also complicated and time consuming to make the IEE and EIA process. Therefore, it is necessary to reduce EIA and IEE approval procedure. There are many rules, laws and regulation which must be changed relaxed and simplicity so as to accelerate the development of this sector. The government policies must be consistent and should not be changed frequently.
- NEA should be given more authority and autonomy to work more electricity. NEA should strength its financial condition and reduces electricity loss, which is 25 percent with efficient distribution system.
- There is need for national consensus among major political parties on the issues of water resources utilization. A clear national policy on hydropower.
- The existing legal as well as institutional problem hindering Foreign Direct Investment (FDI) in hydropower sector should be resolved. Various problems associated with FDI such as; lack of investment guarantee heavy and dual taxation on earning, lack of provision of re-investment of earning, lack of promotion of private sector partnership for investment should be addressed properly and in time.
- The multipurpose hydropower project should be developed to promote heavy industries, small and cottage industries and irrigation facilities of the nation in order to increase the employment level of country.
- Foreign loan should be accepted and invested in such hydro projects where adequate return would be generated to repay back the loan.
- Hydropower research and development should be given top priority.

- Government should promote the use of electricity vehicles which have been recently introduced in Nepal by waiving customs duties on the imports of petrol and control environmental pollution.
- Licensing application process of hydropower development should be fast and encouraging instead of being tedious and requiring the potential investors to run one after another window

REFERENCES

Adhikari Deepak (2006), "Hydropower Development in Nepal" Economic review Occasional Paper, Number 18 Nepal Rasta Bank.

Bhatt S (2008), "Confusion and Problems of Hydropower Development of Nepal" Vidhyut, NEA, Kathmandu.

Budget speech 2073/74, "Government of Nepal, MOF 2073 Jesth 15"

Dhital K (2004),"Hydropower Development in Nepal" The Nepalese Economy, Hira Book Enterprises and CEDON T.U. Kirtipur.

Dhungel K R (2002),"Trends and Pattern of Energy Consumption in Nepal"' Economic Journal of Nepal, Volume 25, November 3, CEDECON, TU, Kirtipur, Kathmandu.

Dhungel K R (2009), "does Economic Growth in Nepal Cause Electricity Consumption"Economics Journal of Nepal, TU Kirtipur, Kathmandu.

Himal S (2001), "Energy and Rural Women" WECS Bulletin, Vol 6 Kathmandu Nepal.

Himal (2010)," Energy and Rural Women" WECS Bulletin, Vol 6 Kathmandu Nepal.

Jha H.B (1995), "sustainable Development of Hydropower in Nepal" Centre for Ecomomic and Technical Studies, Nepal.

Kafle K.N. (2005), "Hydropower for Sustainable Development of Nepal" Vidhyut alf yearly magazine NEA Kathmandu.

Ministry of finance (2010), Economic Survey, GON, MOF, Singh Durbar, Kathmandu, Nepal.

Ministry of finance (2011), Economic Survey, GON, MOF, Singh Durbar, Kathmandu, Nepal.

Ministry of finance (2012), Economic Survey, GON, MOF, Singh Durbar, Kathmandu, Nepal.

Ministry of finance (2013), Economic Survey, GON, MOF, Singh Durbar, Kathmandu, Nepal.

Ministry of finance (2014), Economic Survey, GON, MOF, Singh Durbar, Kathmandu, Nepal.

Ministry of finance (2015), Economic Survey, GON, MOF, Singh Durbar, Kathmandu, Nepal.

NPC (1956), The First Plan (1956-1961),NPC, GON, Singh Durbar, Kathmandu.

NPC (1962), The Second Plan (1962-1965),NPC, GON, Singh Durbar, Kathmandu.

NPC (1965), The Third Plan (1965-1970),NPC, HMG, Singh Durbar, Kathmandu.

NPC (1970) The fourth Plan (1970-1975),NPC, HMG, Singh Durbar, Kathmandu.

NPC (1975), The Fifth Plan (1975-1980),NPC, HMG, Singh Durbar, Kathmandu.

NPC (1980), The Sixth Plan (1980-1985),NPC, HMG, Singh Durbar, Kathmandu.

NPC (1985), The Seventh Plan (1985-1990),NPC, HMG, Singh Durbar, Kathmandu.

NPC (1992), The Eighth Plan (1992-1997),NPC, HMG, Singh Durbar, Kathmandu.

NPC (1997), The Ninth Plan (1997-2002),NPC, HMG, Singh Durbar, Kathmandu.

NPC (2002), The tenth Plan (2002-2007),NPC, HMG, Singh Durbar, Kathmandu.

NPC (2007), The Three Year Plan (2007-2010),NPC, HMG, Singh Durbar, Kathmandu.

NPC 2010), The Three Year Plan (2010-2013),NPC, HMG, Singh Durbar, Kathmandu.

NPC (2013), The Three Year Plan (2013-2016),NPC, HMG, Singh Durbar, Kathmandu.

NEA (2011), Fiscal Year (2011/12), A Year In Review, NEA, Durbar Marg, Kathmandu.

NEA (2012), Fiscal Year (2012/13), A Year In Review, NEA, Durbar Marg, Kathmandu.

NEA (2013), Fiscal Year (2013/14), A Year In Review, NEA, Durbar Marg, Kathmandu.

NEA (2014), Fiscal Year (2014/15), A Year In Review, NEA, Durbar Marg, Kathmandu.

Nexant Sari (2003), Regional Hydropower Resources Summary and Analysis Selected SARI Data , Sari Energy Vol, III November, 2003.

Pandey A (2004), Hydroelectricity Development in Nepal, on MA Thesis Submitted to CEDECON, Kathmandu.

Regmi S, (2012) "The Hydropower in Nepal" Japan Tokyo University.

"Royal Swedish of Science (2008)".

Shrestha Hariman, (1966) "*Water, Energy and Environment*" vol 7.

Thering-eta (2004) "Government to Exploit its Water Resources for Production of Electricity" Bhutan.

WECS (1995) "Socio-Economic Issues in Energy Development" Nepal.

WECS (2005) "Water Resources Strategy Nepal" Singh Durbar Kathmandu.

WECS (2006) "Water Resources Strategy Nepal" Singh Durbar Kathmandu.

WECS (2010) "Water Resources Strategy Nepal" Singh Durbar Kathmandu.

World Bank (1988), "Nepal Power Sector Review", World Bank, Washington, D.C.

http//:www.nea.org.np

http//:www.nepalhydro.com.np

http//:www.wec.gov.np