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AN OVERVIEW OF HYDRO POWER PROJECTS IN HIMACHAL PRADESH

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ABSTRACT

Energy is the most fundamental sector for the progress of a nation. It is inevitable for survival and indispensable for developmental activities to promote education, health, transportation and infrastructure for attaining a reasonable standard of living and is also a critical factor for economic development and employment. Hydroelectricity exists as one option to meet the growing demand for energy and is discussed in this paper. Renewable electricity generation in 2017 was 24.5 percent and non-renewable electricity generation was 75.5 percent in the world. India currently has 5th rank in the world. In this paper, an attempt has been made to study the overview of hydropower project and analyze the present status of hydropower potential and it's harnessing in Himachal Pradesh. The study is based on secondary data. The result shows that highest installed capacities of hydropower highest assessed hydropower total potential (MW) found in Satluj basin. Finally, the study reveals that highest installed hydropower capacity (MW) in the year, 2014-15. Whereas medium installed hydropower capacity (MW) in the year 2012-13 and minimum installed hydropower capacity (MW) in the year 2008-09.Further study reveals that hydro power projects create more job opportunities in the state and our country.

KEYWORDS: *Hydroelectricity, Economic Development, Renewable Energy Sources*

INTRODUCTION

Power is one of the most important inputs for economic development. In addition to its widely recognized role as a catalyst to economic activity in different sectors of the economy, the power sector makes a direct and significant contribution to the economy in terms of revenue generation, employment opportunities and enhancing the quality of life.[1] The increasing global demand for energy combined with the ongoing quest for clean, renewable energy has been a topic of perceived interest amongst countries of developed and developing status worldwide. Several renewable energy sources like hydroelectric, wind, solar and biomass can be used for generation of electricity and for meeting our daily energy demands.[2] The increasing global demand for energy combined with the ongoing quest for clean, renewable energy has been a topic of perceived interest amongst countries of developed and developing status worldwide. Hydropower is a renewable, economic, non-polluting and environmentally friendly source of energy. It has been one of the sources of energy harnessed for centuries in different parts of the world. India has achieved remarkable progress in the field of power development since independence in 1947. The rate of growth of installed capacity, though impressive has not been able to keep pace with the increase in power demand and as a result, the country is presently facing peak power shortages of varying degree in various regions of the country.[3]

Hydropower Generating Agencies in Himachal Pradesh

Several agencies have been embarking on the generation of hydropower in the state. Bhakhra Bias Management Board (BBMB- 2711 MW), Satluj Jal Vidyut Nigam Limited (SJVNL-1500) and National Hydro Power Corporation (NHPC-1038 MW) respectively are the largest power producing organizations. Besides, NHPC Limited is surging ahead in developing hydropower in Himachal Pradesh, thereby changing the socio-economic conditions and augmenting the overall development of the region. NHPC Limited has already commissioned three projects, viz. Baira Siul (198 MW), Chamera Stage – I (540 MW) and Chamera Stage – II (300 MW). Three more projects, viz. Parbati Stage – II (800 MW), Parbati Stage – III (520 MW) and Chamera Stage – III (231 MW) are under active construction stage.

Table 1:Major Agencies Involved in Hydropower in Himachal Pradesh

Sr. No.	Organization		Remarks
1	Himachal Pradesh State Electricity Board	HPSEB	State Govt. Organization
2	Bhakra Beas Management Board	BBMB	Central Govt. Organization
3	National Hydropower Power Corporation	NHPC	Central Govt. Organization
4	Satluj Jal Vidyut Nigam Limited erstwhile Nathpa Jhakri Power Corp.-NJPC	SJVNL	A JV between Govt. of India and Govt. of HP
5	Himachal Pradesh Power Corp. Ltd.	HPPCL	State Govt. Organization
6	National Thermal Power Corp. Ltd.	NTPC Ltd.	Central Sector Organization
7	Jaiprakash Hydropower Ltd.	JHPL	A private entrepreneur
8	Ja Pee Karcham hydro corporation Ltd.	JPKHCL	A private entrepreneur
9	Malan Power Company Ltd.	MPCL	A private entrepreneur
10	Allain Duhangan Hydro Power Corp. Ltd.	ADHPCL	A private entrepreneur
11	GMR Bijoli Holi Hydro Power Ltd.	GMR BHHPL	A private entrepreneur
12	L&T Hydro Power Private Ltd.	L&T HPPL	A private entrepreneur
13	Reliance Power Ltd.	RPL	A private entrepreneur
14	Everest Power Private Ltd.	EPPL	A private entrepreneur
15	Pabbar Valley Power Corp.	PVC	A private entrepreneur
16	Beas Valley Power Corp.	BVPC	A private entrepreneur
17	Himachal Sorang Power Corp. Ltd.	HSPCL	A private entrepreneur
18	Nuziveedu Seeds Ltd.	NSL	A private entrepreneur
19	Lanco Green Power Private Ltd.	LANCO	A private entrepreneur
20	Dhamawari Power Corp. Ltd.	DPCL	A private entrepreneur
21	Allain Duhangan Hydropower Corp. Ltd.	ADHPL	A private entrepreneur
22	Tangu Romai Power Ltd.	TRPL	A private entrepreneur
23	IA Energy	IA E	A private entrepreneur

Source: Power Scenario in Himachal Pradesh. [4]

REVIEW OF LITERATURE

The following existing Literature has been reviewed

Engwall (2002)[5] in his study on **"No project is an island: linking projects to history and context"** has compared the traditional project perspective in project management research with an extended perspective in time and organizational context. The paper illustrates how the structures and procedures employed in a project have to be understood in relation to previous and simultaneous courses of activity to future plans and to standard operating procedures, traditions, and the norms of its surroundings. Author has to analyze how project practices evolve through history over the prior present and future projects as well as its organizational scope. Also analyzed how project practices relate to long-term institutions as well as simultaneous activities in its environment.

Author has suggested that future research on project management needs to extend its temporal scope.

Kishor Nand et al. (2005)[6] conducted a study on "**A review on hydropower plant models and control"** They have broadly categorized the research on the basis of hydro plant model development and its controller design under different sections. Due to diversification in layout/configuration of the hydroplant a number of models were developed to suit the requirement of performance. It was noted that a number of contributions exist for simple linear zed first-order model of the plant. Similarly, different control approaches have been tested and implemented to study the behavior of the plant.

Shivarudraswamy et al (2007)[7] wrote a paper on **"Role of Mini and Micro Hydel Power Projects in Supplying Power to the Rural Area-a Case Study"** and highlight the role of the micro hydropower project in respect to benefits for the consumer. The cost of energy per year is calculated and the comparisons were made with the electricity board supply. It is evident that in the Indian context, distribution generation though small, mini, micro and Pico hydel project do hold the solution to the power crisis. This also aids in promoting economic development and social welfare by ensuring greater participation of people. The study found that a micro-hydroelectric power plant (MHP) had a significant impact on the consumption of firewood in rural households. It was revealed that children have lesser propensity to go for wood collection once their homes have been connected to the MHP. Similarly, modem electric lights in the households allow more time for students to conduct their study during night time. The study concluded the MHP has a positive impact on the socio-economic conditions of the rural communities.

Jahidul et al (2011)[8] focused on the potential of the micro-hydropower plant in Bangladesh. Author has pointed out the current power crisis of Bangladesh and also discussed on the current energy scenario in Bangladesh. In order to achieve this goal, it has been needed to explore green energy. The study explored the potential of micro hydropower plant as a source of renewable energy in order to tackle the power crisis of Bangladesh with an in-depth analysis of Bamerchara micro-hydropower unit as a model. Thus the study shows that how the establishment of the widespread micro-hydropower plant can help overcome the current power crisis. The study reveals that existing potential sites and outlined new sites by performing hydrology studies, topographic studies, head calculations, turbine selection and so forth.

Partridge Ian (2013)[9] in his paper **"Renewable Electricity Generation in India"** tested the using learning rate analysis, based on large samples of wind and small hydro projects in India and projects likely changes in these costs through 2020. It was the first study of learning rates for renewable generation technologies in India and only the second in any developing country. It has provided valuable input to the development of Indian energy policy and will be relevant to policymakers in other developing countries. The Perils of the Learning Model for Modeling Endogenous Technological Change by taking account of these issues. It has possible both to improve the models used for making cost projections and to examine the potential impact of remaining forecasting problems.

Gopala Krishnan (2015)[10] study pointed out that electricity is a critical infrastructure for social economic development in the past, present and future in the country. Some relevant aspects of the global situation have also been discussed. In the study evaluates the development of the hydropower sector and the relevant policies of the Central Government related to the hydropower sector. The author explained India was able to use all the exploitative hydroelectric power in the region including the Himalayas in co-operation with its neighboring countries there is the potential to play the main role in energy security. In order to achieve this goal, India is well prepared to focus on the development of hydro

energy enough to meet challenging sites mostly in the Himalayas. He suggested that there should be renewable energy projects to meet the future demand of power in the country by which the object of power to all can be achieved.

Faria (2017)[11] studied the impact of Brazil social economic variable on 56 hydropower projects made in Brazil between 1991 and 2010. Average income life expectancy level, level of education, piped water, public electricity, Teenage pregnancy, and HIV cases were selected as socioeconomic variables affected by hydropower project. In his research paper minimum and a maximum value of the research method for creating a human development, index has been used. It explains the large hydropower project affected socio-economic development in Brazil. The first set describes how large hydropower's plants are built, affected the local GDP and public revenue of Brazil. The second set describes how hydropower plant socio economic variable of Brazil. It is research concluded that the short-term hydropower does not affect the socialeconomic development but in the long-term it makes the investment route to other factories. That's why to increase investment in the future and increase fluvial can help in improving the status of socio-economic development.

Akova et al. (2018)[12] identified that the environmental impact of small hydropower project plant in spisske Byster Slovakia. The paper highlighted that the importance of assessing the impact of construction on the environmental in phases. The main objective of this paper was to analysis and evaluation the environment impact of small hydropower project by use of the matrix impact. The study concluded that Environmental assessments based on the technical description of the project as well as prediction and evaluation. Environmental requirements for construction the negative impact on the environment is minimized in the preparatory phase of the project by analyzing and assessing the impact of the construction on the environment, thus avoiding an increase in costs due to unforeseen impacts during the construction phase.

OBJECTIVES OF THE STUDY

- To study the overview of hydropower projects in Himachal Pradesh.
- To analyze the growth of hydropower projects in Himachal Pradesh.

RESEARCH METHODOLOGY

The present study is an empirical study just to examine the Status of Hydro Power Projects in Himachal Pradesh. The study area will be featured by changes due to this Hydro Power Projects. The study will be conducted on the basis of Secondary data. A secondary data is one where data is collected from the publications. The present study will be based on the relevant information from the secondary data. This type of data will be collected from the publications, office records, newspapers, magazines, existing literature, internet, and other scholarly work.

Current Status of Hydro Electric Plants in India

With a population of well over a billion people a fast-growing economy, India electricity demand is expected to double over the next decade. India currently has 5th rank in the world for potential hydropower capacity, 197 hydropower plants above 25 MW and 9 Pumped storage stations. Nearly 4800 large dams have been built in the country. Hydro generating unit sizes have increased from 22 MW (from the independence) to 250 MW till today. At the time of independence the installed capacity of hydroelectric power was only 508MW and then the number of units operating was only 51. Indian government invests in large amount for the development of hydroelectric power. Soon after the

independence in the year 1948, the construction of Bhakra and Hirakund dam started. The construction of Bhakra dam completed in 1963 and the construction of the Hirakud dam completed in 1957. In 1955 the construction of Nagarjuna dam started on the river Krishna and the construction was completed in 1967. Another large gravity dam is Indra Sagar dam on Narmada River. The construction of the dam was started in 1984 and it was commissioned in 2005. With the passage of time, many large dams are built across the nation. Hydroelectric power stations are built across these dams and thus they help in the production of large hydroelectric power.[13] Hydropower in India has mainly three sectors, depending upon the entity that is generating the power. These entities are the Central Government, respective State Governments and the private companies. Table 1 shows the sectorwise installed capacity of hydropower in India.

Table 2: All India Installed Capacity of Hydropower (MW) Sector-Wise as on 31.09.2018

Sr. No.	Sector	Installed Capacity (MW)
1.	Private Sector	3,394.00
2.	Central Sector	12,151.42
3.	State Utilities/board	29,942.00
	Total	**45487.42**

Source: Central Electricity Authority

Table no.2 shows the sectorwise installed capacity of hydropower in India. In the table, hydropower has been classified three categories namely private sector, central sector, and state utilities/board. Where maximum installed capacity found 29,858 MW instate utilities and followed by 12,041.42 MW in the central sector and 3,394 MW in the private sector. It was shown that the highest installed capacity of hydropower is found 29,858 MW in-state utilities.

Hydropower Generation in Himachal Pradesh

Himachal Pradesh is known to its snow-fed rivers and rivulets flowing in almost all parts of the Himachal Pradesh. Himachal Pradesh has been blessed with vast hydroelectric potential in its five river basins namely Satluj, Ravi, Beas, Yamuna, and Chenab. The total power potential of various river basins in the state is estimated as 27,436 MW which is available in five river basins. The basin wise potential are Satluj (13,332) MW, Beas (5,995MW), Chenab (4,032MW), Ravi (3,237MW) and Yamuna (840MW). The basin wise details of the hydropower potential in HP have been given table no. 3. Out of the total harnessable potential of about 24,000 MW potential to the tune of 21,500 MW already stands allotted under various sectors. The total power potential of five river basins in the state (2018-19) is estimated to be about 23,063.63 MW. The basin wise details of the hydropower potential in HP have been given table no.3.

Table 3:Assessed Hydro Power Total Potential (MW) in Himachal Pradesh 2018-19

S. No.	Basin	Hydro Power Potential (MW)
1	Satluj Basin	13,332
2	Ravi Basin	3,237
3	Beas Basin	5,995
4	Chenab Basin	4032
5	Yamuna Basin	840
	Total	**27,436**

Source: www.ibef.org.[15]

Classification on the basis of the assessed hydropower total potential (MW) in Himachal Pradesh has been shown in table no. 3. It is observed from the table that maximum assessed hydropower total potential (MW) found in Satluj basin i.e. 13,332 and followed by 5,995 MW in Beas basin, 4,032 MW in Chenab basin, 3237 MW in Ravi basin and 840

hydropower total potential (MW) found in Yamuna basin. Finally, the study shows that the highest assessed hydropower total potential (MW) found in Satluj basin.

Table 4:Basin-wise Hydropower Installed in Himachal Pradesh 2018-19

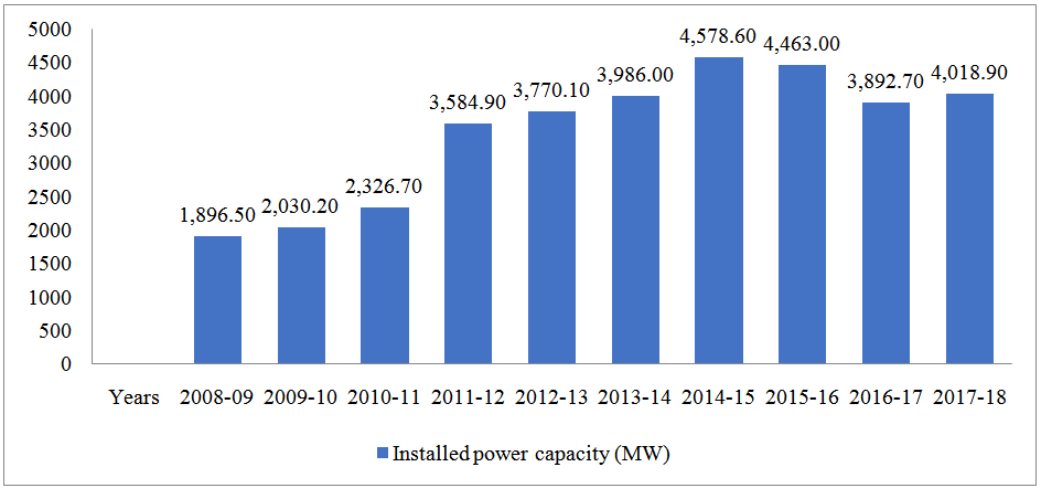
S. No.	Basin	Installed Capacity (MW)
1	Satluj Basin	10,124.45
2	Ravi Basin	2,895.29
3	Beas Basin	5,564.08
4	Chenab Basin	3,701.64
5	Yamuna Basin	778.17
	Total	**23,063.63**

Sources: Himachal Pradesh Power Corporation ltd.[16]

Table no. 4 shows that the basin-wise hydropower installed capacity in Himachal Pradesh. The table depicts that maximum hydropower installed capacity found 10124.45MW in Satluj basin and followed by 5564.08 MW in Beas basin, 3701 MW in Chenab basin, 2895.29 MW in Ravi basin and 778.17 hydropower installed capacity (MW) found in Yamuna basin. Finally, the study shows that the highest installed capacities of hydropower are found in Satluj basin.

Table 5: Year Wise Installed Hydropower Capacity (MW) in Himachal Pradesh

Sr. No.	Years	Installed Power Capacity (MW)
1	2008-09	1,896.5
2	2009-10	2,030.2
3	2010-11	2,326.7
4	2011-12	3,584.9
5	2012-13	3,770.1
6	2013-14	3,986.0
7	2014-15	4,578.6
8	2015-16	4,463.0
9	2016-17	3,892.7
10	2017-18	4,018.9



Source: www.ibef.org17

Figure 1: Year Wise Installed Hydropower Capacity (MW) in Himachal Pradesh

Table no. 5 shows the year-wise installed hydropower capacity (MW) in Himachal Pradesh. The study reveals that highest installed hydropower capacity (MW) in the year, 2014-15, 2015-16 and 2017-18 i.e. 4578.6, 4463.0 and 4018.9.

While, in other side average hydropower capacity (MW) installed in the following year, 2013-14, 2016-17, 2012-13 and 2011-12 i.e. 3986.0, 3892.7,3770.1 and 3584.9. Minimum hydropower capacity (MW) installed in the following year 2010-11, 2009-10 and 2008-09 i.e.2326.7, 2030.0 and 1896.5. Further, the table shows that highest installed hydropower capacity (MW) in the year, 2014-15. Whereas medium installed hydropower capacity (MW) in the year 2012-13 and minimum installed hydropower capacity (MW) in the year 2008-09.

Table 6: Power Harnessed Under Various Sectors

Sector	Capacity (Mw)
HPSEBL	487.55
HPPCL	165.00
CENTRAL/JOINT	7,457.73
HIMURJA (STATE)	2.37
HIMURJA (PRIVATE)	291.45
PRIVATE above 5 MW	1955.90
HP SHARE	159.17
Total	**10,519.17**

Sources: Economic survey 2017-18.

The State has been accelerating the pace of hydropower development through the active involvement of both the public and private sectors. Power harnessed under various sector in Himachal Pradesh has been shown in table no. 5. A table shows that maximum power harnessed under Central/Joint i.e. 74,57.73 (MW) and followed by 1955.90,487.55, 291.45,165, 159.17 and 2.37 (MW) power harnessed under Private, HPSEBL, HIMURJA(Private), HPPCL, HP SHARE, and HIMURJA (State) sector respectively.

CONCLUSIONS

Hydro-power was considered as one of the most desirable sources of electrical energy due to its environmentally friendly nature and extensive potential available throughout the world. Hydropower presently is the biggest source of renewable energy in the world and play a predominant role in the worldwide production of electricity. Himachal Pradesh has many hydropower stations which generate power in amount. Himachal has made a commendable stride in generating hydro-power. The revenues generated by the hydro-projects will be the major contributor in the state exchequer in coming years. Having the capacity to generate the HEP from the river and its tributaries, a large number of hydropower projects are undergoing in the whole state. Hydropower development was the main source the growth of economic conditions of the state. The maximum installed capacity found 29858 MW in-state utilities and followed by 12041.42 MW in the central sector and 3394 MW in the private sector. The study also shows that highest installed capacities of hydropower highest assessed hydropower total potential (MW) found in Satluj basin. Further, the study reveals that highest installed hydropower capacity (MW) in the year, 2014-15. Whereas medium installed hydropower capacity (MW) in the year 2012-13 and minimum installed hydropower capacity (MW) in the year 2008-09. The study concludes that the maximum power harnessed under Central/Joint i.e.7457.73 (MW) and followed by 1955.90, 487.55, 291.45, 165, 159.17 and 2.37(MW) power harnessed under Private, Hpsebl, Himurja (Private), HPPCL, HP Share and Himurja (State) sector respectively. The Himachal Pradesh has been marked as the power state with a good potential to produce electric energy. The pressure is not just to make electric power, but to make clean power with good technology use which is less damaging and more environmentally friendly.

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