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Prospects of Hydropower in Himahchal Pradesh (India): A Case Study of Shanan Power Project

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ABSTRACT

The present study has been conducted on Shanan project, Joginder Nagar. Natural resources are useful raw materials which we obtain directly from nature at free of cost. They occur naturally, which means that human cannot make natural resource. Instead, we use and modify natural resources in different ways that are useful for us. Western Himalaya is full of natural resources, like water, minerals, forests etc. Apart from others, water can be considered as an important one. It is a renewal source of energy which is used in hydro power projects to make electricity. In electricity generation, Shanan power house is the first hydro-electric power station of India. This power house project designed and created by British Engineer Colonel B.C.Batty with the ruler of Joginder Nagar, Raja Joginder Sen. This power project was given to Punjab in1926 on a 99 year lease, which is finished in March 2024. Currently this power project is under the control of Punjab State Electricity Board. The whole revenue of this project goes to Punjab Government. The capacity of this project has been increased to 110MW. It is the cheapest mode of Electricity generation. The cost of per unit is nearly Rs. 0.26 Paisa while cost of generation from thermals is more than Rs. 3 per unit. As per information from Superintending Engineer of Shanan Power project, this plant generates 50 Crore units per annum. As per estimate from the PSPCL at present the cost of the project will not be less than Rs.1600 Crore. Nowadays the project is in very bad condition because Punjab govt. is not maintaining the project properly. HP can run it in a better way and it can also explore the possibilities of tourism on International Level. So it is the time to take up the matter with the HP government as well as with the Indian government.

Keywords: *Electricity generation,* Hydropower, power *project, Natural* resources, *Western Himalaya.*

1. INTRODUCTION

Renewable energy resources are available in unlimited amount in nature since these can be renewed (i.e. regenerated in natural process) over relatively short period of time. Renewable energy sources are inexhaustible, i.e. they can be replaced after we use them and can produce energy again and again. These include, firewood (or fuel wood) obtained from forest, petro plants, plant biomass (as agricultural wastes like bagasse), animal dung, solar energy, wind energy, water energy (hydro-electrical, ocean wave and tidal energy), and geothermal energy etc. These can reproduce themselves in nature and can be harvested continuously through a sustained proper planning and management.

HYDRO-POWER

Water-energy is most conventional renewable source of energy. This Energy is obtained from water flow, water falling from a height. Hilly and highland areas are suitable for this purpose, where there is continuous flow of water in large amounts falling from high slopes. Dams are constructed over rivers. Rain water or river water stored in dams is made to fall from heights. The falling water flows through pipes inside the dam over turbine blades placed at the bottom of the dam. The moving blades then turn the generator to produce electricity. This is called hydroelectricity. The water discharged after the generation of electricity is used for irrigation.

Most hydroelectric power comes from the potential energy of dammed water driving a water turbine and generator. The power extracted from the water depends on twin factors- the volume of water and height between the source & the water's outflow. The difference between source and outflow is called the head. The amount of potential energy in water is proportional to the head. A large pipe (the "penstock") delivers water to the turbine. Power generated from water is termed as Hydroelectricity. Hydroelectricity means electricity generated by hydropower or by using gravitational force of falling or flowing water. This form of energy neither produces any direct waste matter nor is subjected to exhaustion. In order to have better understanding and deeper insight of the way hydroelectricity is generated a picture of hydroelectric dam is being given.

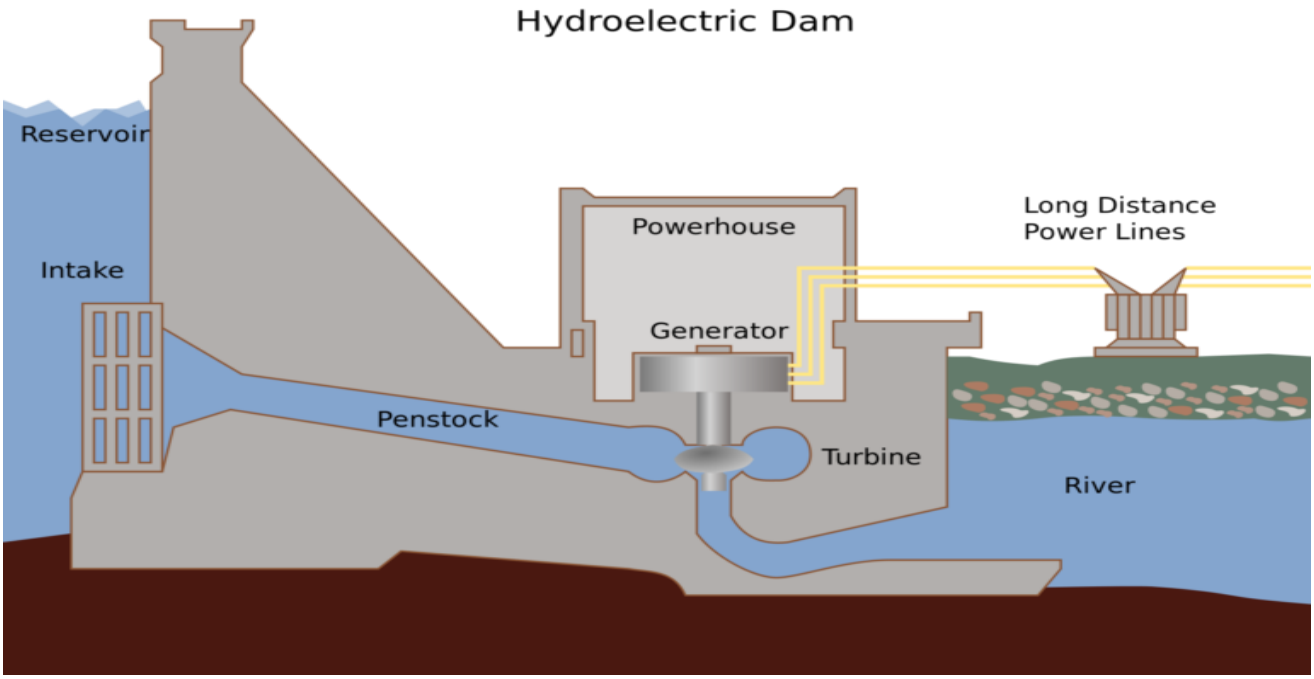

Figure 1 Schematic diagram of Hydro-power project

Image Source:-https://www.mechanicalbooster.com/2017/12/hydropower-plant.html

Hydro-power is a clean, non-polluting source of energy. It can be transmitted to long distance through wires and cables. But, this form of energy cannot be stored for future. Thus markets are to be fixed before generation of this form of energy. One fourth of the world's electricity is produced by hydro-power. Many developed nation harness their water resources for water energy. In South America, about 75 % of the total electricity consumption comes from water. China, Brazil and Canada are the leading countries in production of hydro-power.

HYDROELECTRICITY - A NATION CONCERN

Hydroelectricity is the most widely used form of renewable energy, accounting for 16.6 percent of global electricity consumption, and 4200 terawatt-hours of electricity production as per reported in 2019 hydropower status report. It is produced in 150 countries, with the Asia-Pacific region generating 33 percent of global hydropower. China is the largest hydroelectricity producer, with 920 terawatt-hours of production in 2013, representing around 17 percent of domestic electricity use. Three Gorges Dam in China, Itaipu Dam in Brazil, and Guri Dam in Venezuela generate more than 10 GWs hydroelectricity. The cost of hydroelectricity is relatively low, making it a competitive source of renewable electricity. India has a potential of 1, 48,701 MW of which less than one fifth is being tapped. It ranks fifth in terms of exploitable hydro-potential on global scenario. The basin wise assessed potential is shown in table 1.

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Table 1. The basin wise assessed potential

Basin/Rivers	Capacity (MW)
Indus Basin	33,832
Ganga Basin	20,711
Central Indian River system	4,152
Western Flowing Rivers of southern India	9,430
Eastern Flowing Rivers of southern India	14,511
Brahmaputra Basin	66,065
Total	1,48,701
Data Source :- http://www.nhpcindia.com	

In addition, 56 number of pumped storage projects have also been identified with probable installed capacity of 94,000 MW. In addition to this, hydro-potential from small, mini & micro schemes has been estimated as 6,782 MW from 1,512 sites. Thus, in totality India is endowed with hydro-potential of about 2, 50, 000 MW.

Classification of Hydroelectric Power Projects

There is no uniformly accepted range of sizes of hydropower stations. However for academic purposes and based on current trend of classification brief description of large, small, micro and mini hydropower capacities is detailed as under;

Large: Facilities from over 25MW to more than 10 GW are generally considered large hydroelectric facilities. In other words power stations which are not mini, micro and small and are larger than all of these are termed as large. Earlier, the power generated from these power projects did not come under the ambit of renewable energy. Only the projects that generate power less than 25 MW were considered renewable as installation of large power projects have environmental hazards and additional risks in hilly terrains, like in Himachal Pradesh. Large Hydropower Projects have been controversial due to their impact on local ecology and population, which invariably gets displaced.

Only 2 months back in May 2019, Union Cabinet brought all hydro projects of more than 25 MW capacities under the renewables category.

Small: In India, hydro power projects with a capacity of up to 25 megawatt (MW) fall under the category of small hydro power (SHP) stations. This may be stretched to 30 MW in the United States. Small-scale hydroelectricity production grew by 28% during 2005-08, raising the total world small-hydro capacity to 85 GW. Over 70% of this was in China (65 GW), followed by Japan (3.5 GW), the United States (3 GW), and India (2 GW). Small hydro plants may be connected to conventional electrical distribution networks as a source of low-cost renewable energy.

Alternatively, small hydro projects may be built in isolated areas that would be uneconomical to serve from a network, or in areas where there is no national electrical distribution network. Since small hydro projects usually have minimal reservoirs and civil construction work, they are seen as having a relatively low environmental impact compared to large hydro. This decreased environmental impact depends strongly on the balance between stream flow and power production. The estimated potential for power generation in the country from such plants is about 20,000 MW. Most of the potential is in Himalayan States as river-based projects and in other States on irrigation canals.

Micro: It is a term used for hydroelectric power installations that typically produce up to 100 KW of power. These installations can provide power to an isolated home or small community, or are sometimes connected to electric power networks. There are many of these installations around the world, particularly in developing nations as they can provide an economical source of energy without purchase of fuel. Micro hydro systems complement photovoltaic solar energy systems because in many areas, water flow, and thus available hydro power, is highest in the winter when solar energy is at its minimum.

Mini: Less than 5 KW of hydroelectric power is generated in it. It is useful in small, remote communities that require only a small amount of electricity. For example, it may cater to the needs to power one or two fluorescent light bulbs

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and a TV or radio for a few homes. Even smaller turbines of 200-300W may power a single home in a hill state like Himachal Pradesh with a drop of only 1 m (3 ft). Pico-hydro setups typically are run-of-the-river which means that dams are not used, but pipes divert some of the flow, drop this down a gradient, And through the turbine before returning it to the stream.

Hydro Power Scenario in Himachal Pradesh

Himachal Pradesh is naturally suited for hydropower generation and accounts for around 25.9% of India's total hydropower potential. The State undertook structural reforms in 2010 wherein the erstwhile Himachal Pradesh State Electricity Board (HPSEB) was unbundled into Himachal Pradesh Power Transmission Corporation Ltd. and Himachal Pradesh State Electricity Board Limited.

As of October 2017, Himachal Pradesh had a total installed power generation capacity of 4,011.78 MW. Hydro power accounted for 2,910.48 MW of total installed power generation capacity, followed by renewable power (836.44 MW) and thermal power (235.91 MW).

As per estimates, the state has the potential to generate 27,436 MW of hydro power through the construction of various hydel projects including major, medium, small and mini/micro hydroelectric projects on the river basins. The largest potential for electricity generation lies on the river Satluj (13,332 MW), followed by Beas (5,995 MW), Chenab (4,032 MW) and Ravi (3,237 MW).

Hydropower generation is all set to pick up pace in Himachal Pradesh with significant changes in the hydro policy announced recently by the state government. The changes made in the new policy are expected to revive the stalled projects Small Hydro Power (SHP) and attract developers to invest in new projects. The major changes include mandatory purchase by Himachal Pradesh State Electricity Board Limited (HPSEBL) of the entire power generated from projects with a capacity of up to 10 MW, commissioned after the notification issued in May 2018. Deferring the 12% free power for the first 12 years in the case of already allotted projects is another positive highlight of the policy. It also offers rationalization of royalty rates for the allotment of new projects. Projects of up to 10 MW for captive use of power for existing or new industrial units within the state will be allocated without competitive bidding. Further, no wheeling charges/open access charges will be applicable for hydropower plants up to 25 MW capacities, thereby enabling them to sell power on competitive rates outside the state as well.

State has the largest capacity hydropower station (1500 MW), the largest unit size (250 MW), the largest underground power house cavern and the longest tunnel in operation in the country at Nathpa Jhakri. State also has third highest head hydropower station (Bhava-887m) in operation.

Table 2. Status of 5 MW Power project

Status of 746 SHP projects of up to 5 MW capacity

Description	No.	Capacity (MW)
Projects commissioned	83	310.50
Projects under construction	33	110.24
Projects at different stages of clearances	162	425.21
S&I in progress	287	548.54
TEC accorded but implementation agreement to be signed	27	46.80
DPR with HIMURJA	0	0.00
DPR with Directorate of Energy	154	299.00
Total	**746**	**1,740.24**

Source: Himachal Pradesh Energy Development Agency (HIMURJA)

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Table 3. Status of 25 MW Power project

Status of projects of up to 25 MW		
Description	**No.**	**Capacity (MW)**
Projects commissioned (private sector)	15	180.90
Projects under construction (private sector)	18	268.90
Projects commissioned (state)	19	155.55
Projects under construction (state)	Nil	
Projects at various stages of obtaining clearances (private)	41	555.50
Projects at various stages of obtaining clearances (state)	7	92.00

Source: Directorate of Energy, Himachal Pradesh

Background of Hydro Power Development in HP

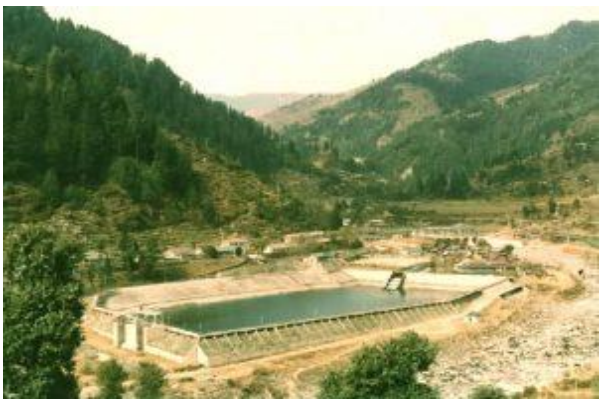
Himachal Pradesh has been pioneer state for hydropower development. Two small/mini hydro schemes Jubbal (50 kW) and Bhura Singh/ Chamba (170 kW) were in operation in Pre-Independent India. Unit-1&2 35 kW each & Unit-3 (100 kW) of Chamba were installed in 1904 & 1938 in erstwhile east Punjab. Shimla Hydroelectric Project on Nauti Khad, a tributary of Sutlej was constructed in 1913. Uhl-I/ Shanan Power Project (4×12=48 MW) installed in 1932 in erstwhile Punjab also came in Himachal Pradesh during 1966 after reorganization of states. Its units have been up-rated to 15 MW each and an extension unit of 50 MW has also been installed in 1982. However, Shanan has been given on lease to Government of Punjab by govt of HP.

A STUDY OF SHANAN POWER PROJECT

The Shanan Project is the most picturesque project in the beautiful surroundings of Himalayan ranges. It is the first hydro-electric power station of India in Megawatt capacity situated 2 km from Jogindernagar in Himachal Pradesh, India. It takes advantage of two small rivulets at an altitude of about 6000 ft., in Barot valley. Barot is at an elevation of 1829 m (6001 ft.) while Shanon power house is at an elevation of 1283 m (4212 ft.). The water conductor system consists of a diversion dam at Barot, a tunnel and penstocks. The three penstocks include the two original penstocks of 1.397 m diameter and the third added for increased capacity in 1982 which is 1.83 m diameter. The water from the power house discharges into Neri Khad in the River Beas catchment area.

Historical Perspective

The idea of harnessing a power potential of 4X12 MW (48 MW) initially was envisaged by Col. Batty, the then Chief Engineer of British Government and his team, in 1922. The power house had been constructed under a 99-year lease deed executed between Joginder Sen, ruler of Mandi state and Col B C Batty in 1925. This 48 MW Stage -I Project was constructed at the initial cost of Rs. 2,53,43,709/- and commissioned in 1932 and was officially opened by His Excellency, The Viceroy of India at Shalimar Receiving Station, Lahore on 10th March, 1933. During reorganization of States of Punjab, Haryana and Himachal Pradesh which took place in 1966, as per provision contained in Punjab re-organization Act, 1966, Shanan Power House situated at Jogindernagar (Mandi) in the State of Himachal Pradesh was allocated to Punjab State by The Government of India. The Shanan Power House used to meet the energy requirements of the himachal, Punjab and Delhi.



Data Source :- Punjab State Power Corporation Ltd.

A rail line was laid between Pathankot and Jogindernagar to transport heavy machinery from different parts of the world to Shanan complex. To deliver construction material to hill top for making water reservoir at Barot, a funicular haulage trolley way system, one of its kinds in the country, was created there. There are four stations in the eight kilometers long track from Shanan to Barot. The ropeway trolley, starts from Shanan — located at a height of 4,300 ft above sea level goes up to a point known as 18-Number and onward to the second phase of the haulage rail line, which terminates at Winch Camp located amidst green forest at a height of 8,000 ft above sea level. From Winch Camp, a

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serpentine 3 km-long rail line was laid up to a place known as Head Gear. The fourth station is Kathyadu. Its marvelous setting made it a tourist resort. The route through which the trolley passes is very beautiful with eye catching views. On reaching Winch Camp, one can see the amazing view of dhauladhar range with snow covered peaks.

CONSTRUCTION

Construction of Uhl stage-I Shanan Power Project was completed in 1932. Col. Batty had drawn up plans to construct five units of hydropower projects by utilizing the water of Uhl River, but died before his dream came true. Later, the Himachal Pradesh government constructed the Uhl Stage II (66 MW) Bassi power house. Later more surveys were conducted to enhance the installed capacity of the project to 100 MW. The construction of third stage of the project, Uhl Stage III (100 MW), was inaugurated at Chullah near the Machhyal Lake and is currently under progress.

Initially the Shanan Power project was set up with capacity of (4*12)48 MW but later the Punjab government enhanced its capacity to (4*15) 60 MW. The extension of the Stage-I of this Project was proposed by constructing an additional unit of 50 MW in 1982. This extension work consisted of a new extended reservoir at Brot, laying of new penstock for 50 MW and construction of new power house building. Finally this project with extended unit of 50 MW supplied by M/s BHEL, was commissioned. The generation cost at this project is the cheapest in the country. Information revealed that power worth Rs 250 Crore (approx.) is generated from this power house and hence this project is one of the economic power projects of PSPCL.

Table 3. Salient Features Of Shanan Power House

Sr. No.	Description	Shanan 1st Stage	Shanan Extension
1.	Rating of each unit	15 MW	50 MW
2.	No. of units at PH	4 Nos.	1 No.
3.	Manufacturer of Turbine	GANZ MAVAG, Hungary	GANZ MAVAG, Hungary
4.	Turbine out put	21800 HP	70000 HP
5.	Type of Turbine	Pelton wheel	Pelton wheel
6.	Generation voltage	11,000V	11,000V
7.	Max Net Head	548 M	548 M
8.	Min. Net Head	446 M	481.6 M

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9.	Generator Type	Horizontal Shaft	Vertical shaft
10.	Speed of Turbine in RPM	428.5	375

Data Source :- Punjab State Power Corporation Ltd.

Current Scenario

Though located in Joginder Nagar in Himachal Pradesh, Shanan Power House, generates 110MW of electricity. The project is under the control of Punjab State Power Corporation Limited (PSPCL) and the entire revenue generated from the project goes to Punjab Government, not even the lease amount is paid to HP Government.
While HP Government has announced not to renew or extend the lease period and wants the project to handed over to the state. Meanwhile the Punjab Government is in no mood to do so. Punjab State Power Corporation Limited (PSPCL) that currently runs the project has staked claim over it on the grounds that the 99-year lease does not hold as it had built 100MW Bassi hydro project for Himachal Pradesh in lieu of Shanan but Himachal Pradesh State Electricity Board Limited (HPSEBL) made it clear that the PSPCL is not aware of the actual facts, Bassi hydroelectric project was constructed by Himachal Pradesh government at its own cost. With the 99-year lease agreement of the Shanan Power Project ended in 2024, the Punjab Electricity Board has stopped taking interest in the maintenance of this heritage power project.

Rail track of Shanan Power project has now been closed for three years now. In 2016, on the historic Pathankot-Jogindernagar-Shanan rail road, the debris had fallen due to hill crackling during the rainy season it has not been removed yet. About 200 meters of this rail route has disappeared from the debris of the fall, but the government who otherwise receives crores as railway budget has no idea. The track was used to bring heavy machinery to the site till three years ago but as the lease agreement is ended, the Punjab State Power Corporation Limited (PSPCL) does not seem to be interested any more. Far from developing this line, its proper maintenance is also not being done.

Image source: - jogindernagar.com

Haulage way trolley, once the major attraction and vital part of 110 MW Shanan Hydropower Project, is in pathetic condition. Such are the condition of the ropeway system that it will be no more than scrap when it will be handed over to Himachal Predesh. Grass has grown in the track that is lying unused, as the trolley was closed 20 years back because of fault in machines. Punjab govt. is not paying any heed to this heritage link, but earning crores of money from the project. The ropeway has enough potential to attract tourists and if the project is not freed from clutches of Punjab soon, it will be a scrap site. Higher officials of Shanan Project from Patiala used to visit Barot every year, but did not pay any attention towards this closed ropeway. Engineers working on the project claimed that budget was asked for repair and maintenance work many times, but it was never granted.

Image source: - jogindernagar.com

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As per article reported by Divya Himachal in 2015, it was found that Punjab is earning extra handsome income from Shanan Hydropower project even by giving building on rent to private operators. The Shanan Project management has given a building on rent to a private school. Notably, the building was constructed to open a middle school for the kids of its employees and wards of people affected from the project. But with the passage of time the school was closed and building was rented over to a private school runner. It is only known to higher officials that the land given on lease or building constructed on it could be given further on rent to private operators or not, but for a laymen it is a clear violation of lease rules

Future Prospects

The Shanan Project is not merely a way of generating electricity but it is a saga erupted from the mountains of Himachal and a way to boost tourism in the area. By observing the passage of time, the insult of this asset by the Punjab govt is apparent. Pain is inflicted on whole of Himachal when Punjab shows apathetic attitude towards Shanan Hydro Power Project, which served the nation for a century. Even though, many politicians from state have undertaken the responsibility to raise the issue of Shanan Power Project to the centre but, simultaneously it is also the test of state government to conserve the heritage power project. Many aspects of Shanan project also reveals our cultural heritage and progressive thinking that became witness of development of hill state before independence. Cooperating with the British government a century ago while sensing the need for electricity supply is not only a deed but, it reflects the worry for the future of its citizens. Many other milestones were also achieved through Shanan project and it brought expansion of rail network up to Jogindernagar too. The deteriorating condition of the project is not only displaying the negligence of PSPCL but also damaging the tourism prospects in the area.

The matter might escalates into a big dispute between the two neighbouring states, as the Himachal Pradesh Government has stated that it will not renew or extend the lease. Chief Minister of Himachal Pradesh written to the Union Power Minister and Chief Minister of Punjab stating that his Government will not renew or extend the lease and wants the project to be handed over to the state. Punjab, however, is reluctant to give up the project and may seek legal recourse to retain it moved to the Supreme Court over this issue.

A day before the conclusion of the 99-year lease agreement the Central Government intervened by issuing an order to maintain the status quo on the project. The measure was implemented to ensure the continuous operation of the project.

Inter-State River Water Disputes

Inter-State Water Disputes Act, 1956: In case a particular state or states approach the Centre for the constitution of the Tribunal, the Central Government should try to resolve the matter by consultation among the aggrieved states. In case, if it does not works, then it may constitute the tribunal. The ISWD Act, 1956 was amended in 2002 to include the major recommendations of the Sarkaria Commission. The amendments mandated a one year time to set up the water disputes tribunal and also a three year time frame to give a decision.

As this project deals with the geopolitical issues, the two state governments need to handle the issue in the most professional manner possible and the central government intervention is required in order to save this heritage project. If there is no significant conclusion after the talks, in such a situation, Himachal Pradesh stand should be not only to reclaim the project but rather receive it in its original state in order to preserve the heritage of this project. Status quo as per the lease deed with the British government in 1925 should be ensured in the guidelines of its ownership transfer. An amount should be estimated for the conservation of building and machinery and complete restoration should be made before transfer of the project to Himachal.

Also the prospect of the developing the surrounding area and the project area of Shanan Power Project into a popular tourist destination can be explored by the govt of the day as we already know the potential of clubbing tourism aspects associated with similar projects in India and the world, a popular example of the same can be the Niagara Falls in Canada.

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CONCLUSION

The decision of the Government of Himachal Pradesh to harness and effectively utilize the other renewable sources of energy has been promoted by the fact that Speedy exploitation of these natural resources in the State will provide cheap, renewable and reliable power to the people of the Pradesh specially those living in the remote hinterlands. In Himachal Pradesh, electricity is generated mainly from Hydroelectric Projects which help in reduction of emission of "Greenhouse Gases". So state has further taken commendable stride in generating hydro-power. It has also succeeded in formulating a comprehensive 'Hydro power Policy'. The revenues generated by the hydro-projects will be the major contributor in the state exchequer in coming years. With the Shanan Power Project coming into its helm, the state govt can further pursue its aim of becoming the renewable energy production gaint. In this sense it can be said to be 'power state'.

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