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CONSTRUCTION OF BIG DAMS AND HYDROPOWER GENERATION IN HIMACHAL PRADESH: ENVIRONMENTAL IMPACTS AND SOCIAL IMPLICATIONS

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Abstract

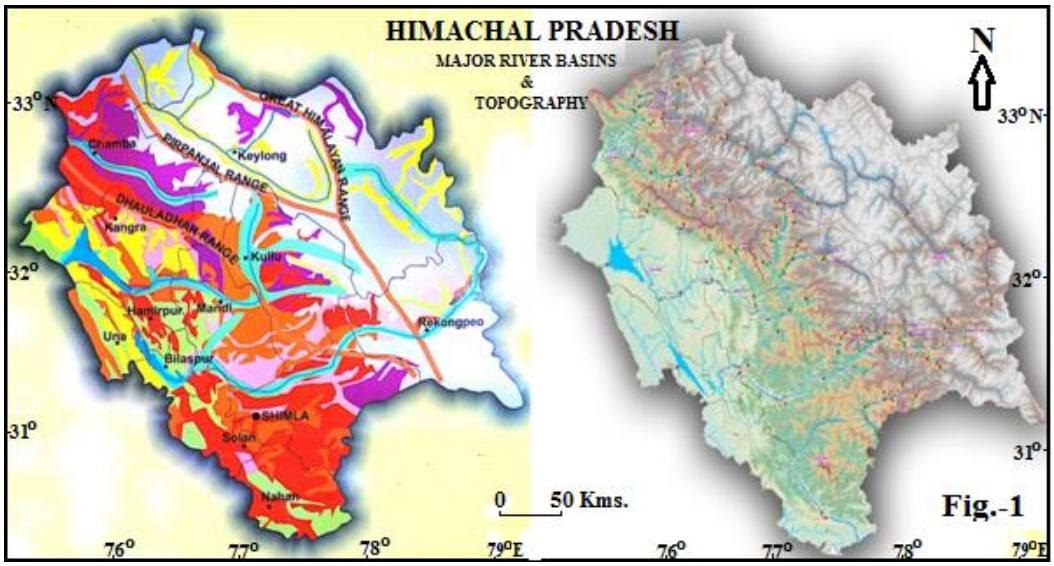
Topographically Himachal Pradesh is blessed with huge hydropower potential. The catchment areas of all the major rivers and their tributaries are both snow-fed and rain-fed, carrying abundant discharge of water throughout the year. Himachal Pradesh government in collaboration with the Central as well as few neighbouring State governments trying to tap this hydropower potential by constructing huge dams and establishing big hydel projects on all the major river basins. With the tremendous growth of this sector in the last few decades, Himachal Pradesh has been given the name of 'Power State' in the country. With enormous development of hydropower in the state, the pressure on the government agencies is not just to make hydro electric power, but to make clean power with good technology use which should be less damaging and more environmental friendly. To generate more and more revenues from the hydropower sector the government is changing its hydropower policy frequently during the last few years, making it friendlier to the private sector and ignoring to some extent the environmental and social issues. In view of all these factors this papers attempts to highlight the environmental implications of hydropower generation and the issue of Dam oustees in Himachal Pradesh.

Key Words: *Hydropower, Hydel Projects, Power State, Friendlier, Dam Oustees*

I INTRODUCTION

Himachal Pradesh is a part of the Indian Himalayas and lies between 30º 22' to 33º 12' N latitudes and 75º 47' to 79º 04' E longitudes. It is compact in shape and almost wholly mountainous [1] with altitude varying from 350 metres to 6975 metres. It has wide valleys, magnificent snow mountains, numerous beautiful lakes, mighty rivers and gushing streams. The landscape of Himachal Pradesh is sculptured by five major rivers – the Sutlej, the Beas, the Chenab, the Ravi and the Yamuna and their tributaries (See Fig.-1). These five rivers are parts of the Indus and the Ganga river system. A bulk of the state is drained by the Indus river system. Most of the rivers in the state are perennial rivers, which originate from glaciers and snow field. The flow of these rivers is further augmented by runoff from the catchment areas,

which got their maximum water supply from monsoonal rainfall. By virtue of its topographical and climatic setup, Himachal Pradesh possesses vast hydropower potential [2].



Hydropower is a clean, environment friendly and a renewable source of energy [1]. The term renewable refers to the hydrologic cycle that circulates water back to our rivers, streams, and lakes every year. At hydro electric projects, this water is used as fuel to generate electricity. In contrast, fossil fuels like coal, natural gas, or oil must be extracted from the earth and burned to produce electricity. The term clean is also used because production of electricity with hydropower does not pollute the air, contribute to acid rain or ozone depletion because of carbon dioxide emissions, or (like nuclear power) leave highly toxic waste that is difficult to dispose of [3]. Each method of generating electricity has advantages and disadvantages, as well as significantly different effects on the environment [4].

The impact of hydroelectric power plant on the environment is varied and depends upon the size and type of the project. Although hydropower generation does not burn any fuel to produce power and hence does not emit greenhouse gases, there are definite negative effects that arise from the creation of reservoir and alteration of natural water flow. It is a fact that dams, inter-basin transfers and diversion of water for irrigation purposes have resulted in the fragmentation of 60% of the world's rivers [4].

1.1 Objectives of the Study

The main objectives of the present study are:

- To overview the hydropower policies of Himachal Pradesh.
- To assess the environmental impacts of dams and related hydropower plants in Himachal Pradesh.

- To highlight the social implications arises due to the construction of dams and related hydropower plants in Himachal Pradesh.

II DEVELOPMENT OF HYDROPOWER IN HIMACHAL PRADESH

Himachal Pradesh is situated in the lap of western Himalayas and topographically it is wholly mountainous state which is blessed with immense water resources. The bulk of water running in the rivers throughout the year attracted the government agencies to tap its hydropower potential. Owing to this factor the government of Himachal Pradesh is trying to achieve optimal harnessing of the available potential and to identify new Hydro power potential in the State [5]. The total power potential of various river basins in the state is estimated as 22,507.39 MW, which is available in five river basins.

Out of the five river basins the Satluj, the Beas and the Ravi basins contributes more than 72 per cent potential capacity out of the total assessed potential capacity of hydroelectric power generation in Himachal Pradesh [6]. The total hydropower harnessed under various sectors in Himachal Pradesh is 10350.97 MW (See Table-1).

Table-1 Status of Hydro Potential in Himachal Pradesh, 2016

Sr. No.	Sector		Commissioned		Under Construction		At Various Stages of Clearance & Investigation		Disputed/ Cancelled		Forgone		Grand Total	
			No. of Projects	Capacity in MW	No. of Projects	Capacity in MW	No. of Projects	Capacity in MW	No. of Projects	Capacity in MW	No. of Projects	Capacity in MW	No. of Projects	Capacity in MW
1.	Himurja	State	10	2.37	0	0.00	3	14.50	0	0.00	0	0.00	13	16.87
		Private	72	272.75	40	134.14	556	1187.98	0	0.00	0	0.00	668	1594.87
2.	HPSEBL		23	487.55	1	100.00	5	84.00	0	0.00	0	0.00	29	671.55
3.	HPPCL		1	65.00	4	791.00	17	2783	0	0.00	1	20.00	23	3659.00
4.	Central & Joint		12	7457.73	1	800.00	2	428	0	0.00	0	0.00	15	8685.73
5.	Yamuna Projects (Himachal Share)			131.57									0	131.57
	Ranjeet Sagar Dam (Himachal Share)			27.60									0	27.60
6.	Private		19	1906.40	24	735.60	51	4313.70	3	29.50	6	735.00	103	7720.20
Total			137	10350.97	70	2560.74	634	8811.18	3	29.50	7	755.00	851	22507.39

Source: *http://admis.hp.nic.in/doe/DOEAuth/welcome.aspx*

2.1 An Overview of the Hydropower Policy of Himachal Pradesh

To give boost to the hydropower sector, Himachal Pradesh had formulated its own Hydro-Power Policy in 2006. It seeks to safeguard the interest of the people of the State on one hand and to protect the delicate ecology and environment of the state on the other. Mandatory

provision of 1.5% of project cost has been kept in the state policy for the development of local area during the construction stage. Besides, a provision for 1% additional free power has been earmarked for development of local area in line with the National Hydro-Policy in post- commissioning scenario [7].

The State has embarked upon 100% clean electricity policy and accordingly since 2014-15, the Himachal Pradesh State Electricity Board Ltd. is meeting its 100% requirement from hydel sources, with a small quantum from nuclear and solar, mainly from Centre Govt. sources. State has shares in coal and gas based power plants of the National Thermal Power Corporation and this quantum is available over and above its annual requirement and hence these are either surrendered or traded, so that net requirement for consumption is met from clean sources, including renewable [8].

For the last three years the Himachal Government has been making desperate attempts to revive the declining hydropower sector in the state. Falling revenues from the hydropower sector, the lack of interest of the private sector in taking up any new projects, the inability of existing projects to be completed on time, the rising cost of hydropower are some of the indicators that the government seriously needs to review its unrelenting and blind faith in hydropower development as the driver of the economy in the state. But instead of taking a hard and critical look at the root causes of this slow down [9], the government has taken several initiatives to encourage private sector participation in small hydroelectric power plants development. Attractive incentives for independent power producers, in the form of easy land acquisition procedures and speedy clearances have been ensured but still poor affected families are awaiting various legal clearances and compensations. What has been overlooked is that a large number of projects are sanctioned but what affects local livelihood of remotely located poor and tribal communities and fragile biodiversity ecosystems in numerous ways is overlooked by government. In several places, these rivers and streams support the traditional irrigation channels and watermills. In many villages the streams even supplying drinking water to the inhabitants have also been harnessed. In case of small hydroelectric projects even no environmental clearance from the Ministry of Environment and Forests is required. The critical clearances that are required at the state level include the techno-economic clearance and those from the Irrigation and Public Health Department, Fisheries Department and Public Works Department. But there are no procedures and

regulations in place at the state level to ensure a cost benefit analysis with an environment and social impact assessment of hydro projects [4].

On 17th August 2016, the Himachal Government's Power department issued a notification on amendments to the Hydropower Policy 2006 doing away with the requirement of separate NOCs from Public Works Department (PWD), Irrigation & Public Health Department (IPH), Revenue, Fisheries and Gram Panchayats. The intention is to fast track the clearance procedure with respect to hydropower projects. This is not the first time the government has made such a move. A similar notification was issued on 4th March 2014, post the setting up of a Committee on Speedy Development of Small Hydro Projects in 2013, which made a series of recommendations in order to deal with the delays in the execution of Hydropower Projects. Last year close to 15 groups and community representatives made a submission objecting to these amendments especially to the dilution of the NOC by the Gram Panchayat stating that it was in violation of the provisions of the Forest Rights Act which is yet to be implemented in the State. The government apart from diluting the NOC process has also from time to time made several major policy shifts to attract the private investors and incentivise the sector. One big move has been the reduction in the upfront premium to be paid by private producers from 35 Lakhs per MW to merely 1 Lakh. Despite this the sector has failed to attract investors [9].

III ENVIRONMENTAL AND SOCIAL IMPLICATIONS

The environmental and social implications of hydroelectric power plants are numerous and they varied from one project to the other. Although hydropower generation does not burn any fuel to produce power and hence does not emit greenhouse gases, however, there are definite negative effects that arise from the construction of dams and alteration of natural water flow in the rivers. It is a fact that dams, inter-basin transfers and diversion of water for irrigation purposes have resulted in the fragmentation of 60 per cent of the world's rivers [4]. There cannot be a totally environment friendly hydel project in the Himalayas. The result of blasting, excavating, tunnelling, cutting, dumping, tree-felling, diverting of rivers- all these are bound to have a severe and damaging effect on the environment and ecology of the area [10].

From human point of view, a large population is replaced, and the original land use pattern, socio-economic systems, agro-socio-forestry systems, and traditional ecological practices lead to an end. Traditional crops of the area, forests, vegetation and fauna including

micro-organisms show sudden disappearance. People displaced from a site adjust to new habitats, where their religion-cultural traditions, socio-economic web and occupation especially agriculture crumbles [11].

3.1 Environmental Implications

The environmental impacts associated with large scale dams often have significant negative impacts on the environment. Hydro power projects cause large-scale changes in the catchment area altering the ecosystem [12]. Any effect resulting from human activity is termed an "anthropogenic effect," and construction can create many of these effects [13]. Both the river and ecosystem of the surrounding land area has been altered with the construction of the dam. Following are the some of the important implications of dams and hydropower plants:

3.1.1 Impact of Hydropower Plants

Hydropower plants can be classified into two groups: *Reservoir Hydro Systems* and *Streaming* or *Run of the River* (RoR) Systems. Reservoir systems consist of a large dam that creates a sizeable lake behind it. The reservoir hydro systems have substantial ecological impact. Generally plants with smaller dams are considered less environmentally damaging than those with larger dams. The large manmade lakes behind the dams submerge a vast area with countless plants, animals, and people. The Bhakra, the Pong and the Kol Dams in Himachal Pradesh are well known examples of Reservoir system. In Streaming or Run of River hydro systems there are no dams and lakes, only diversion systems that direct a portion of a stream or river through the hydroelectric turbine. RoR systems are typically installed on smaller streams and rivers, and generate less power than large Reservoir systems. They are rapidly gaining popularity due to their ease of installation and small ecological footprint [4].

3.1.2 Impact of River Diversion

Large-scale execution of hydro power projects has wreaked havoc on Himachal Pradesh environment and the state is on the verge of ecological disaster as flow of major rivers is being diverted into tunnels leaving its original bed dry [5]. Often downstream flows are reduced considerably or even completely stopped during certain periods of time with sudden intervals of high flows. Such drastic variability in water flow impacts the structure of aquatic ecosystems often leading to a loss of biodiversity. Also, under normal conditions, increased sediment transport from low to intermediate flows provides a warning to aquatic organisms that high flows may follow. Abrupt changes from low to high flows obliterate this cue,

making it difficult for organisms to respond to impending environmental changes. A decrease in fish populations has been observed in dewatered reaches below diversions. After long periods of little to no flow some species may not be able to recover and go extinct [4].

3.1.3 Impact of Dams

The environmental consequences of large dams are numerous, varied and negative. These include direct impacts to the biological, chemical and physical properties of rivers and riparian or stream-side environments [14]. Environmental impacts of dams have largely been negative. Worldwide, at least 4,00,000 square kilometres have been flooded by reservoirs. Once the barrier is put in place, the free flow of water stops and water will begin to accumulate behind the dam in the new reservoir. This land may have been used for other things such as agriculture, forestry, and even residences, but it is now unusable. The loss of habitat may not seem severe but if this area was home to a threatened or endangered species, the dam construction could further threaten that species risk of extinction [4]. Following are the most common negative impacts associated with dams.

3.1.3.1 Problem of Deforestation

Deforestation is the removal of stands of trees for the purpose of construction of road. Felling of thousand of trees took place when construction of hydel project started. Road construction for the transit of commercial vehicles involved in the construction of hydro facilities and the associated infrastructure construction leads to deforestation which has adverse impact on the environment of the region [13]. Dam has also resulted in the clearance as well as submergence of vegetation [14] (See Fig.-2).

Fig.-2 Effect of quarrying operations on land and flora during Kol-Dam construction phase in 2011 9 *Chand H., Verma K.S. and Kashyap R., Environment Management Plan for*

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3.1.3.2 Problem of Muck Disposal

Muck disposal is another serious problem associated with construction of hydropower plants. Muck is the term used for any by-product from the construction activities, such as waste rock material generated during tunnel excavation to soil and/or excess building materials. There are numerous examples of disposed muck contaminating and polluting river systems. Unfortunately, the impact may not always be observed at the construction site but further downstream where the suspended load of sediment is deposited [13]. (See Fig.-3).

Fig.-3 Muck Dumping along the Sainj River by Parvati Hydropower Project *(http://hillpost.in/2014/04/ beas-a-dying-free-flow-himalayan-river-photo-essay/98678/)*

3.1.3.3 Problem of Sedimentation

Large dams with reservoirs significantly alter the timing, amount and pattern of river flow. This changes erosion patterns and the quantity and type of sediments transported by the river. Sedimentation rate is primarily related to the ratio of the size of the river to the flux of sediments. The reservoir that has been rapidly filling up with water immediately begins filling up with sediment as well. The trapping of sediments behind the dam is a major problem. Every year it is estimated that 0.5 to 1% of reservoir storage capacity is lost due to sedimentation. The engineering problem with sedimentation is that less power is generated as the reservoir's capacity shrinks [4]. The rate of reservoir sedimentation depends mainly on the size of a reservoir relative to the amount of sediment flowing into it: a small reservoir on an extremely muddy river will rapidly lose capacity; a large reservoir on a very clear river may take centuries to lose an appreciable amount of storage. The amount of sediment carried

into a reservoir is at its highest during floods [17]. With the construction of Kol Dam, the Bhakra Dam will get a fresh lease of life. Its life span will increase by about 20 years as the silt and stone sediments will be trapped in the Kol Dam upstream of Bhakra Dam [18] (See Fig.-4).

Fig.-4 The Gobind Sagar Lake (HP) is so full of silt that its bed level has raised by at least 5 feet *(http://myboardmyblog.blogspot.in/2011/04/gobind-sagar-submerged-temples.html)*

3.1.3.4 Problem of Downstream Erosion

Trapping of sediments at the dam also has downstream impacts by reducing the flux of sediments downstream which can lead to the gradual loss of soil fertility in floodplain soils. Clean water stripped of its sediment load is now flowing downstream of the dam. This clean water has more force and velocity then water carrying a high sediment load and thus erosion of the riverbed and banks becomes problematic. Since this is unnatural and a form of "forced erosion" it occurs at a much faster rate than natural river process erosion to which the local ecosystem would be able to adapt [4]. (See Fig.-5).

Fig.-5 Broken flood protection wall along the Sutlej River downstream of Karcham Wangtoo dam, Photo taken on Nov 10 2010

(http://www.sandrp.in/hydropower/Violations_of_Environment_Norms_by_Four_Big_Himachal_HEPs-Feb_2011.pdf)

3.1.3.5 Greenhouse Gas Emission from Dams

For all their ecological faults, hydropower dams are usually thought of as a source of green, carbon-neutral energy. But it turns out that the reservoirs behind dams release a significant amount of greenhouse gases that, until now, have gone unaccounted for in global carbon budgets [17]. Freshwater reservoirs can emit substantial amounts of the greenhouse gases-methane and carbon dioxide as organic matter submerged in a reservoir decays under anaerobic and aerobic conditions, respectively [4]. The biggest effect is from methane, which is responsible for about 80 per cent of the climate-change potential of greenhouse gases released from reservoirs. Global methane emissions from reservoirs are similar in magnitude to those from rice paddies or biomass burning [19]. Studies indicate that GHG emissions from hydropower reservoirs in boreal and temperate region are low relative to the emissions from fossil fuel power plants, but higher relative to life cycle emissions from wind and solar power [4].

3.1.3.6 Evaporation from Dams

Reservoirs have large open surfaces that facilitate water loss by evaporation, and much more water is lost in the same period of time from reservoirs than was originally lost from the river that flowed in its place. Even though the loss mainly depends on the climate of the area, it can

also depend on the size, shape and depth of the reservoir, with reservoirs having smaller surfaces or larger depths losing less water. This added evaporation can affect the microclimate of the area as it reduces fluctuations in the extremes temperature and may change the ecosystems that exist there, since organisms suited to the two extremes of temperatures, or which need the fluctuation as part of their breeding cycles cannot survive [19].

3.1.3.7 Risk of Landslides

Indiscriminate construction of Roads and Hydro Electric Power projects weakens the slopes [20] and increased the risk of landslides in this geologically sensitive mountainous region [4]. The inhabitants of tribal district of Kinnaur have repeatedly been facing road blockages at Urni dhank on NH 22 due to landslides [21]. The most prominent example of these landslides is that of Pangi village near Reckong Peo town, where the road construction for the Kashang-I dam site, led to massive landslide and caused severe damage to the project power house construction site.[22] (See Fig.-6). Heavy blasting for the excavation of tunnels has also created cracks in the houses of the affected people. This phenomenon has been seen almost everywhere in the state where hydropower projects are under construction (See Fig.-7).

Fig.-6 Remnants of houses damaged by the landslide at Pangi village near Reckong Peo town *(http://www.epw.in/journal/2015/18/ reports-states-web-exclusives/kinnaurs-curse.html)*

Fig.-7 Cracks developed in the houses of the native people *(Katoch, Anup et al, 'Impact of Nathpa Jhakri Hydroelectric Power Project on the Environment and Livelihood in Kinnaur and Shimla Districts of Himachal Pradesh, 2014, CSK HPKV Palampur H.P.)*

3.1.3.8 Impact of Dams on Fisheries

Hydropower production alters the range and rhythm of the water level in waterways as well as the flow rates, compared to their natural state. The changes affect the fishing industry and the ecology of the waterways. Power plant dams prevent fish from natural migration. Damming and regulation weaken and decrease the number of fish reproduction areas and change the nutritional conditions [23]. A survey of 125 dams by the World Commission on Dams (WCD) reported that blocking the passage of migratory fish species has been identified as a major reason for freshwater species extinction in North America. Lower catch is a common side effect of dams and has been reported worldwide. There have been cases where fishery production below a dam has decreased due to controlled discharge of the sediments [4]. Cases have also been reported for non-releasing of water to downstream by some dams in Himachal Pradesh. Due to this negligence, the fishes which survive for few days in some water holes ultimately died after drying of the river bed (See Fig.-8 & 9).

Fig.-8 Dry bed of Satluj River about 10 kms. downstream from the dam site of Nathpa Jakhri Project, Photo taken on Nov 10 2010 *(http://www.sandrp.in/hydropower/Violations_of_Environment_ Norms_ by_ Four_Big_ Himachal_HEPs-Feb_2011.pdf)*

Fig.-9 Dead Fish downstream the Gaj II Project *(http://www.indiawaterportal .org/articles/small-projects-big-impacts-micro-and-mini-hydel-projects-himachal-pradesh)*

3.1.3.9 Reservoir Triggered Earthquakes

The phenomenon of dam-triggered earthquakes is known as reservoir-induced seismicity (RIS).The dam, designed keeping in mind the possible seismic activity, performed quite well with only nominal damage to the dam. Until recently, the most powerful earthquake

attributed to dam activity happened in western India in 1967. Three years after builders completed the Koyna Dam, a 6.5 magnitude earthquake hit the area, killing 180 people [24], injuring 1,500 and rendering thousands homeless besides damaging the dam itself and putting the powerhouse out of action, and thus paralysing the Bombay industry. Prior to this earthquake, the area used to be considered aseismic. However, after the construction of dam and filling up of reservoir in 1962, the seismic activity increased significantly. This earthquake lead to the revision Indian seismic zone map wherein the area around Koyna was brought in zone IV from zone I, and seismic zone of Bombay was upgraded from zone I to zone II [25]. Himachal Pradesh is prone to severe earthquake hazard and fall in zone IV and zone V. In future, if any earthquake with magnitude 8.0 or more will happen, these hydropower projects will definitely have devastating impact on life and property of the people living downstream.

3.2 Social Implications

Hydroelectric projects cause displacement of people, damage to land use system, local ecology including flora and fauna, surface and ground water resources. The acquisition of private land along with setting up of the project will result in changes of socio-economic aspects and lifestyle of the local people [26]. Following are some of the important social implications of dams and hydropower plants:

3.2.1 Issues of Dam Oustees

An area to be flooded for use as reservoir has to be cleared of human population. To mitigate relocation damage, such as loss of home and livelihood, governments need to protect both the populations that are being displaced and the ones that accept them. These efforts must be made in conjunction with affected peoples who live downstream [27]. In February 2008 it was estimated that 40-80 million people worldwide had been physically displaced as a direct result of dam construction [7]. According to the South Asia Network on Dams, Rivers and People (SANDRP) and other sources, in India, 5,500 minor and major dams built since independence have together displaced an estimated 55 million people and submerged 44,00,000 hectares of land [28] . Indigenous, tribal, and peasant communities have been particularly hard hit [29] Nearly 47% of people displaced by these dams are tribals [28] These legions of dam refugees have, in the great majority of cases, been economically, culturally and psychologically devastated. Those displaced by reservoirs are only the most visible victims of large dams [29]. In the following paragraphs the problems of dam oustees

have been outlined particularly for the Bhakra, the Pong and the Kol dams in Himachal Pradesh.

3.2.1.1 Case of Bhakra Dam Oustees

The Bhakra Dam was the first multi-purpose project of free India, which was termed as the *Temple of Resurgent India* by Pandit Jawahar Lal Nehru, the first Prime Minister of India and dedicated it to the Nation on the 22nd of October in 1963 [27].The Bhakra Dam led to the displacement of 36000 people and submerged Bilaspur, a town with population of 4000 people [29]. The contribution of this ambitious project, in the name of country, especially North India, through electricity and irrigation is enormous. However, during this process nearly ten thousand families were uprooted from 256 villages [30]. Some of the displaced people were rehabilitated in Sarsa, Hisar and Fatehbad districts of Haryana. Several others were settled in Ropar (Punjab) and Bilaspur, Nalagrah and Una in Himachal Pradesh. Apart from this, some of the displaced have also been resettled along the forested slopes on both sides of the reservoir from Bhakra to Slaapad and Lathyaani [31]. The 50 years long story of the suffering and anguish of Bhakra oustees is not yet over. There is still a question of full resettlement of oustees. What is significant is that even today; the oustees have not fully settled and continue to battle it out in their own way [32]. The proper settlement of Bhakra dam oustees has not been done by the governments at the Centre and in the state. Majority of the people were forced to settle in the forest and sanctuary areas and, to date, have not been given ownership rights [31] (See Fig.-10).

Fig-10 View of Bhakra Dam

(https://www.google.co.in/search?q=Bhakra+Dam&espv=2&tbm=isch&imgil = mLaMKsx017AOWM%253A%253B838uu7CGN-)

3.2.1.2 Case of Pong Dam Oustees

The construction of the water reservoir in a village near Pong began in 1961. The Pong dam project was conceived as part of larger project then known as the Rajasthan canal project (RCP), later it was rechristened as Indira Gandhi Nahar Pariyojna. Total length of the canal is 649 kilometres, which takes water from the reservoirs to the desert land of Rajasthan. The process of the land acquisition started in early 1960s. Total 75,000 acres spread over 94 villages in Nurpur, Dehra and Gopipur tehsil of Kangra district was acquired for building a dam over Beas river [33]. Out of the 339 tikkas(a tikka is a revenue estate and a village consists of more than one tikka) submerged by the Pong reservoir, 223 were submerged fully and 116 were submerged partially. The area that got submerged was the "Heart of Kangra", officially known as the " Haldoon Valley" (meaning the granary of Kangra). This part of Kangra was a green valley with fertile soil, abundant water and other resources. It produced enough to feed the entire district, leaving some surplus for export as well. The reservoir produced displacement on a massive scale. It affected about 30,000 families, a population of about 150,000. Most people displaced in this valley were small farmers and others dependent mainly on land [34]. After more than fifty years some displaced families have yet not been rehabilitated by the Rajashtan government because of the encroachment done by the local people on the land allotted to the them or some other reasons. Now, the Government of Himachal Pradesh has taken up the issue with the Rajasthan and committed to allotment of 'murabbas' (land) to all 827 left out Pong Dam oustees in Rajasthan [35] (See Fig.-11).

Fig.-11 View of Pong Dam

(https://www.google.co.in/search?q=pong+dam+images&espv=2&tbm=isch&imgil=r611yMIclpeP7M%253A%253BiX5aKeXjciNFlM%253Bhttp%25253A%25252F%25252Findia)

3.2.1.3 Case of Kol Dam Oustees

The foundation stone for the dam was laid on 5th June, 2000 by Prime Minister Atal Bihari Vajpayee. On 14th January, 2004, main construction on the dam began [36]. The dam construction resulted in loss of natural resources as it lead to the acquisition of 1068 hectares forest & 442 hectares of private land & thus ultimate loss of flora & fauna due to habitat destruction. Acquisition of land by dam has also resulted in the loss of trees which was maximum 80.60 per cent in Kasol followed by Kyan, Harnora and Jamthal i.e. 52.84, 44.04 and 38.93 per cent respectively. It was minimum (37.45 per cent) in Ropa [25]. Total 1125 families uprooted from the construction of Kol Dam from the four districts of Bilaspur, Mandi, Solan and Shimla [37]. While giving the plots to the oustees, it was agreed that freehold plots registered in the name of the owner will be given but now people are apprehensive as the plots are not registered in their names and it may happen that these are given on a 99 years lease which is not acceptable to the displaced people [38]. After long struggle by the left out displaced families, the Himachal government has promised to give free plots to such families at Sunni in Mandi district [39] (See Fig.-12).

Fig.-12 View of Kol Dam reservoir after completion of project during 2014 *(Chand H., Verma K.S. and Kashyap R., Environment Management Plan for Hydropower Project: A*

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3.2.2 Compensation and Rehabilitation Issues

On compensation and rehabilitation issues the resentment of the displaced people is genuine. A comprehensive program to disburse resettlement compensation funds for lost property, crops, and income sources is needed for dam oustees. Compensation rates and a payment procedure need to be widely publicised, and the objections and revisions suggested by affected persons should be noted. Land surveys, checking of entitlements to land, and payment of compensation has to be done in a transparent manner and well before a project starts. Affected persons have to be informed how their land and other properties were valued and the rates of compensation. Compensation calculations and the manner in which compensation is paid have to be closely monitored by a competent authority. Appeal boards have to be established to settle disputed claims. Representatives of affected persons, as well as local knowledgeable persons**,** should be the members of such bodies. Delays and partial payments should be minimized. If sufficient funds are not available for compensation payment, the proposed project implementation should be delayed until sufficient funds are available [38]. The government of Himachal Pradesh published Relief & Rehabilitation Plan in the Gazette on 23rd Feb., 2015 which reveal that the adversely affected families due to construction of hydropower plants will be compensated and providing quality of life to the people of the area through better infrastructure, sustainable income and better skills and to ensure the right of individual and society particularly those belonging to the weaker section of the society [40].

3.2.3 Boomtown Effect

The set of socio-cultural impacts collectively summarized under the term “Boomtown effects” [41]. Boomtowns are typically characterized as "overnight expansions" in both population and money [42]. The sudden inflow of large armies of construction workers and related groups within small, often traditional and remote local communities’ causes social/health/economic and cultural problems at the local community level. This occurs not only in large dams but even in the case of small and medium size. Over the last 15-20 years, the previously known socially destabilizing effects of boomtowns have been compounded by circumstances that made labour-camp settlements into a spreading source for the scourge of contagious diseases like-AIDS. Further, a frequent planning error in labour-recruitment for

many dams (an error that enlarges boomtowns, increases project costs, and decreases the options to reduce adverse impacts on local communities) is the under-employment and under-training of the area population for professions needed in dam and auxiliary constructions. Local labour is substituted by over-importation of massive labour from outside areas, causing unnecessary social and financial complications and also surreptitiously reducing the long term social sustainability of dams [43].

3.2.4 Human Health Risks

In tropical areas, reservoirs provide a perfect breeding ground for parasitic organisms, especially as mosquitoes. Larger reservoirs have a higher potential for breeding such parasites and spread disease to surrounding populations. Indirectly, infected water is used for irrigation and thus infects crops. If large numbers of people are relocated to areas near the reservoir during the reservoir construction, the increased density of people will make the spread of infectious disease more likely [24].

IV CONCLUSION

Himachal Pradesh is lying in the lap of western Himalayas which is considered as a delicate and ecologically fragile mountain ecosystem. The state is experiencing serious ecological disorder viz. excessive exploitation of river courses for construction of dams and hydropower generation, erratic river courses, rapid siltation of river beds, soil erosion, hydrological disorders etc. All these environmental and social problems emerged owing to so called economic development and anthropogenic transformation of the river basins.

All possible efforts are being made by the government of Himachal Pradesh to tap every bit of hydropower potential available in all river basins to strengthen its coffer. Therefore, the state government framed its hydropower policy and makes amendments according to needs and requirements from time to time, however, instead of attributing losses to the real causes – its inability to study the environmental impacts of mindless construction in the fragile Himalayas, its failure to monitor the project authorities and its lack of foresight on the vagaries of the power sector itself – is using the current scenario to cut corners on people's democratic rights and doling out public resources to the private sector companies in the name of the hydropower development.

The environmental and social implications of large dams and big hydropower projects are numerous and varied, and includes direct impacts to the biological, chemical and physical properties of rivers and riparian or stream-side environments. The dams have definite

negative effects that arise from the construction of dams and alteration of natural water flow in the rivers. There cannot be a totally environment friendly hydel project in the Himalayas. The result of blasting, excavating, tunnelling, cutting, muck dumping, tree-felling, diverting of rivers- all these are bound to have a severe and damaging effects on the environment and ecology of the area.

From human point of view, the impacts of dams are extensive with significant implications for the people displaced or living downstream who rely directly or indirectly for their livelihoods. People displaced from a site adjust to new habitats, where their religion-cultural traditions, socio-economic web and occupation especially agriculture crumbles. Relief and rehabilitation is another issue on which the affected and displaced people never satisfied and the problems of resettlement never came to an end. It is strange that the dilemma of rehabilitation is still alive even after the completion of more than 50 years of Bhakra and Pong dams.

No doubt the hydropower generation at large scale proves a boon to the daunting economy of the state but it is not beneficial to the fragile ecology of this mountainous state. Govt. must ensure credible environmental and social impact assessment of all activities including all dams and all hydropower projects of above 1 MW capacity, such assessments should also include how the projects can increase the disaster potential of the area, how they will affect the adaptation capacity of the local people in the context of climate change and how the projects themselves would be affected in changing climatic scenario at present.

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