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AN OVERVIEW OF IMPACTS OF HYDROPOWER PROJECTS IN THE HIMALAYAN REGION - REVIEW ON REPORTS OF ENVIRONMENT AND LEGAL COMMITTEES

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ABSTRACT

Hydropower projects have been significantly considered as one of the alternatives of generating electricity from fossil fuels and it contributes to cut down carbon emissions. It is time to pause 'green tagging' the hydroelectricity projects in the Himalayan region as it is exceeding the controversial impacts in those surroundings by being a major contributor to the environmental hazards as well as a factor affecting the livelihood of the local community. These projects have been a part of Indian measures to promote a green economy since 1897 by being less polluting and as an institution of renewable resource energy, but the present stage seems to be compromising the detrimental impacts like inducing landslides, floods, loss of habitat, change of river flow and also affecting the local communities by loss of livelihood, agricultural land, livestock and emigration for survival purposes. The rapid need to combat the climate change by controlling the greenhouse gas emissions and the need to provide sufficient energy resource for the dense population has led to the immense increase in the number of hydropower projects in the Indian Himalayan region. The article addresses the existing drawbacks of the hydropower projects and how it has become a hitch rather than being a betterment to the environment along with the role of judiciary and policies with significant report references. Exhausting the nature would always be reflected in one way or the other and it is time to pitch out ideas of alternatives by significantly considering the impact on environment of potential future projects.

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Key words: *Hydro power projects, Himalayan region, Environmental hazards, green economy, loss of livelihood.*

INTRODUCTION

Due to rapid increase in population, industrialization and urbanization the required rate of power supply to meet the needs of the population is also increasing. The global energy requirement is anticipated to double in the upcoming decades. This places the world nations in a position to seek alternatives to fossil fuel energy and sustainable generation of electricity. One of the most efficient renewable resources of energy is hydropower energy which generates electricity from the natural flow of water. They involve high capital investment and takes longer construction period.[3] Hydro electricity generation is considered less polluting than fossil fuel-based electricity generation. But is it that exceptional to ignore the environment hazards caused by it, is debatable. Increasing the rate of hydropower structure involve both green economy as well as it imposes wide range of impacts on the environment life loss of habitat, triggering disasters like landslide, floods etc. and alteration of river flow and effects on livelihood of communities of the project area.

Several environmental organizations have strongly opposed the construction of hydropower dams in ecologically fragile areas and it raises concern over the inefficient impact assessment and improper rehabilitations of the affected people. This article covers the basic knowledge on hydropower dams especially in the region of Himalayas along with the detrimental effects on environment. It also deals with the lacunae in regulation of these projects and exposes the role of the Indian policies governing the construction and management of hydropower projects along with legal precedents.

HYDRO ELECTRIC POWER PROJECTS (HEP):

Hydro power is the process of extracting electricity from the flow of water. The use of water for producing electricity paves its way back in history, where it was used to light a lamp in Northumberland, England in 1878. Then used for minimal amount of private and commercial

[3] BartleA. 2002.Hydropowerpotentialanddevelopmentactivities. Energy Policy 30(14):1231–1239.http://dx.doi.org/10.1016/S0301-4215(02)00084-8.

purpose In Wisconsin, USA. As decades passed by there were hundreds of hydropower projects around the world.

For example, 99 percentage of Norway's electricity is extracted from hydropower projects as it is considered cost-effective.[4] By 1900's the construction small hydro power projects also peaked. Within 1980 and 1990 several projects were halted on the basis of environmental and social impact reasons and their capacity building process were stagnated.[5] The 1st hydro power plant was installed at Sidra pong, Darjeeling with capacity of 130 kilo watts in the year 1897 and it is also the 1st one to be installed in Asia.[6] India is the 7th largest nation to produce hydropower electricity[7], China being the world's leading producer. As of 2024 the total installed generation of electricity from hydropower is 46,850 MW.[8]

MECHANISM OF HYDRO POWER PLANT:

Hydro power or Hydroelectric power, is a source of renewable energy which generates electricity from power of a dam or diversion of a river body structure to alter the natural flow of water. for working of a hydropower to produce electricity, it relies constantly on a recharging system of water cycle. It works on kinetic energy of downstream flowing water and that kinetic energy is converted into electricity by using generators and turbines[9]. This electricity is passed on to electrical grid to supply power for residential and commercial purposes. The energy extracted depends on the strong flow of water as well as the elevated structure known as the head. The higher the head and greater the flow, the more the electricity can be generated from the dam or reservoir.

[4]"Hydropower,"*available at*: https://www.irena.org/Energy-Transition/Technology/Hydropower (last visited January 28, 2025).
[5]"Blog: Hydropower growth and development through the decades,"*available at*: https://www.hydropower.org/blog/blog-hydropower-growth-and-development-through-the-decades (last visited January 28, 2025).
[6]"Sidrapong Hydel Power Station," 2015*available at*: https://web.archive.org/web/20150407011251/http://www.wbpower.nic.in/sidra.htm (last visited January 28, 2025).
[7]"List of Hydro Power Plants in India 2022," *Jagranjosh.com*, 2022*available at*: https://www.jagranjosh.com/general-knowledge/list-of-hydro-power-plants-in-india-1501159366-1 (last visited January 28, 2025).
[8]"Power Sector at a Glance ALL INDIA | Government of India | Ministry of Power,"*available at*: https://powermin.gov.in/en/content/power-sector-glance-all-india (last visited January 28, 2025).
[9]"How Hydropower Works," *Energy.govavailable at*: https://www.energy.gov/eere/water/how-hydropower-works (last visited January 28, 2025).

Hydro power plants consist of two variations. One is with reservoir and dams used to store water and released at one point of time to collect electricity from the suddenly released force of water. These large reservoir type projects can store water for longer and shorter period of time depending upon the requirement of the state.

The other type of hydropower plant is without a reservoir which is called run of the river system or pumped storage system, where electricity is extracted from the natural flow of water but only a limited amount of electricity can be obtained. It functions without disturbing the flow of water and it is environmentally encouraged.

Types Of Hydroelectric Power Plants:[10]

- Pelton Turbines – It is an impulse turbine which is generally used for more than 250m of water head.
- Francis – It is a reaction turbine which is used between 2.5m to 450m of water head.
- Propeller – It is used for 1.5m to 30m range of water head.
- Kaplan – This propeller type of plant has adjustable blades which is used for water heads varying from 1.5m to 70m.
- Tubular – It is generally used for low and medium height type projects which ranges less than 15m of water head.

Major components of a Hydroelectric Power Plant:[11]

- Dam or a Barrage
- Head race tunnels or Channels
- Surge shaft or Surge chambers
- Pressure shaft or Penstock
- Underground surface power house
- Tailrace Channel or Tailrace tunnel

THE HIMALAYAS – WATER TOWERS OF ASIA:

[10]"Policy on Hydro Power Development | Government of India | Ministry of Power,"*available at*: https://powermin.gov.in/en/content/policy-hydro-power-development (last visited February 12, 2025).
[11]*Ibid.*

The potential use of water resources to meet one of the nation's biggest economically essential commodity of electricity supply, plays a vital role in renewable source of energy and a sustainable option. Especially in India the northern and north eastern states closely fitted next to the Himalayan region gives India the opportunity to utilize and exhaust its territorial water resources for the purpose of hydropower plants.

The topographic conditions of the Himalayas in the northern India are a perfect circumstance for installation of large as well as small hydroelectric power projects in that region. The Himalayan region has immense coverage of glacier as area over 33,000 sq km, where about 5000 to 6000 glaciers are present in the Indian region of Himalayas. It is called the water towers of Asia as it provides around 86,000,000 cubic meters of water every year.[12] The perennial rivers from the Himalayan glaciers are a significant source for hydro power generation. Major investments on large and small hydro power projects are executed. Any drastic change in the river patterns due to climate change would have profound impacts on the potential of the hydropower projects and in turn it would raise concerns over the investment. Therefore, the Himalayas play a pivotal role in the development of the nation.

CHALLENGES OF INSTALLATION OF HYDROPOWER PROJECTS IN THIS FRAGILE ECOSYSTEM:

Melting of glaciers a threat to hydropower dams:

Due to the increase in demand for electricity, several hydro power projects are constructed near the upstream of Himalayan glacial lakes which becomes uncertain to predict the economic viability of the project on facing a glacier melt.[13] Melting of glaciers as an impact of global warming triggers floods and washes away the hydropower dams built near the glacier lakes. In February 7 2021, the Raunthi glacier rockslide resulted in the flooding of river

[12]Prakash Rao, G.Areendran and Rajneesh Sareen, "Potential Impacts of Climate Change in the Uttarakhand Himalayas" *ICIMOD - International Centre for Integrated Mountain Development*.
[13]Rivika Bisht, "Himalayan hydropower projects built near glacial lakes pose risk to environment" *Down To Earth*, 2016*available at*: https://www.downtoearth.org.in/environment/himalayan-hydropower-projects-built-near-glacial-lakes-pose-risk-to-environment-55011 (last visited February 12, 2025).

Rishi Ganga River where more than 200 people were mortified and it also demolished the Rishi Ganga and Tapovan hydropower dam infrastructures.[14]

Climate change and erratic weather conditions

Extreme weather conditions associated with climate change can significantly impact the hydropower projects.

Floods, droughts, sediments of excessive rainfall, landslide risks, willcause fluctuations in the availability of water, disrupts the electricity generation and damages the infrastructure.[15]

Expensive cost incurred in construction

Though the cost of generated hydropower electricity is low, the cost of an average investment for installation of a hydropower plants as of 2022, costs about 2881 USD per Kilowatt. It varies depending on the size, quality, output, labour costs, raw materials etc.[16]

Distribution of electricity is limited

The construction of Hydropower projects may be of a state initiative or a private company's construction. The allotment of a private company's percentage of their generated electricity to the residents of the region is very low. Thus, the state undergoes a major environmental risk without proper compensation to meet the challenges of its nation.

INCIDENTS ON SOCIAL AND ENVIRONMENTAL EFFECTS ON HYDROPOWER PROJECTS TRIGGERED BY SUSCEPTIBILITY OF HIMALAYAN REGION:

- In 2023 Uttarakhand's Joshimath town encountered around 800 buildings developed cracks due to subsidence.
- The flooding of the Assi Ganga river of 2012 damaged the Assi Ganga hydroelectric projects.

[14]"NTPC's 520 MW Hydropower Project Damaged in Glacier Burst and Floods - Mercom India," *Mercomindia.comavailable at*: https://mercomindia.com/ntpc-hydropower-project-damaged-floods (last visited February 11, 2025).
[15]"Executive summary – Climate Impacts on South and Southeast Asian Hydropower – Analysis," *IEAavailable at*: https://www.iea.org/reports/climate-impacts-on-south-and-southeast-asian-hydropower/executive-summary (last visited February 11, 2025).
[16]"Hydropower installation cost worldwide 2022," *Statistaavailable at*: https://www.statista.com/statistics/799341/global-hydropower-installation-cost/ (last visited February 11, 2025).

- The Kedarnath floods of 2013 severely damaged the Phata-Byung, Singoli-Bhatwari, and Vishnuprayag HEPs.
- In 2021 in the Rishi Ganga glacier melt avalanche the Vishnu - Tapovan HEP was damaged and led to the death of 200 people and estimated a loss around 1500 crore.
- In December 2022 the Urni landslide in Kinnaur district of Himachal Pradesh affected the construction of KarchamWangtoo HEP. These landslide dams result in a landslide lake outburst, secondary landslides, formation of flood terraces in the downstream region and affects the local communities.
- A glacial lake outburst in Lhonak lake, Sikkim resulted in the breach of a mega hydropower project, Chungthang dam which is also called the Teesta III Dam.
- In July 2022 the flashfloods of Malana village of Himachal Pradesh's Parvati valley damaged a 100MW Malana II HEP and led to the death of 5 local residents.

EFFECTS OF HYDROPOWER PROJECT IN HIMALAYAS:

Social Impacts of Hydropower Projects

- Transboundary water issues
- Ineffective Environmental Impact Assessment
- Changes in standard of living
- Cracks in houses due to blasting activities
- Improper employment generation
- Health problems occurring due to air and water pollution on construction of Hydropower projects
- Lack of proper rehabilitation of people from construction site to another place
- Disruption of customs, cultural activities

Environmental Impacts of Hydropower Projects

- Emission of greenhouse gases
- Air pollution
- Noise pollution
- Effect on water quality

- Changes in water flow pattern or diversion of natural flow of river
- Impacts of large transmission lines
- Effect on wildlife ecosystem
- Excessive drilling and blasting for tunnels
- Soil erosion
- Effect on forest land
- Impacts on marine life
- Impact on other installed projects

Economic Impacts of Hydropower Projects

- Construction, installation and maintenance cost
- Unit generation cost
- Investments of public and private sectors over demand of electricity
- Effect on tourism
- Effect on local industry
- Impact on commercial activities
- Resettlement and rehabilitation cost of the affected people

REPORTS OF ENVIRONMENT AND LEGAL EXPERT COMMITTEES ON ENVIRONMENTAL IMPACTS OF HYDROPOWER PROJECTS:

1. Ravi Chopra committee 2013:

Supreme court passed a Suo moto order while disposing the petition on Srinagar Hydroelectric project (HEP), where it ordered the Ministry of Environment and Forest and Government of Uttarakhand to refuse from providing anymore permits to HEP construction in that state as it was presumed to be reason for the 2013 Uttarakhand floods. In this regard the Union Ministry of Environment and Forests appointed a committee headed by Dr Ravi Chopra. The committee submitted the report on 'Assessment of Environmental Degradation and Impact of Hydroelectric Projects During the June 2013 Disaster in Uttarakhand' on April 2014. The 17-member expert

committee recommended that at least 23 of the 24 hydropower projects in the Alaknanda and Bhagirathi basin must be dropped in order to safeguard the environment as it stated that it would cause an 'irreversible impact' on the ecology of that region. Following this report 6 of the private project holders pleaded to retain their projects on the ground that the projects were already cleared for construction before the disaster.

The committee also recommended to frame a National Himalayan Policy to study the impacts of HEPs in terms of deforestation, tunneling, blasting, reservoir formation on the hydrogeology.[17]

2. Vinod Tare Committee 2015:

Succeeding the report of the Chopra committee, the Ministry of Environment, Forest and climate change set up another committee headed by Vinod Tare of IIT- Kanpur, to examine the case on the HEP involvement of Kedar Nath tragedy. The committee stated in its report that six of the proposed hydropower projects would adversely raise severe ecological concern if the installation is executed. But based on this report the MoEF&CC pleaded to the supreme court to resume the other proposed projects. This report was criticized as IIT Kanpur did not have any mandate to submit such a report and that report was declared inconsistent and unprofessional.[18]

3. B.P. Das Committee 2020:

On failure of the Vinoda Tare committee, the MoEF&CC set up another committee led by Dr.B.P.Das, former chief engineer and former Vice Chairman of the MoEF&CC expert appraisal committee on River Valley Projects. He was a member of the initial committee but opted for a dissenting opinion, abiding by the conflict of interests of the project developer. The B.P. Das expert panel recommended an approval of 28 projects in Uttarakhand despite the environmental concerns raised in the Himalayan region.

4. T.V. Somanathan Committee 2024:

Reviewing the controversial approvals of the B.P. Das committee the supreme court of India appointed another High-level committee headed by the Cabinet Secretary T.V. Somanathan. The

[17]SANDRP, "Report of Expert Committee on Uttarakhand Flood Disaster & Role of HEPs: Welcome recommendations:" *SANDRP*, 2014*available at*: https://sandrp.in/2014/04/29/report-of-expert-committee-on-uttarakhand-flood-disaster-role-of-heps-welcome-recommendations/ (last visited February 12, 2025).
[18]*Ibid.*

Somanathan panel in its report on November 8 2024 submitted that only 5 of the total proposed projects of the B.P. Das committee can be approved due to the concerns raised by the environmentalists and local stakeholders about the impacts on the seismic zones and landslides prone zones of the Himalayan region of Uttarakhand. The five projects approved by the panel are, Urgam II (7.5 MW), Jhalakoti (12.5 MW), Bhyunsar Ganga (24.3 MW), Devasri (252 MW), BowalaNandprayag (300 MG)[19]. Ravi Chopra, the veteran environmentalist criticized the panel's findings as lack of knowledge of environmental experts on the factors of environmental impact assessment of the projects. He criticized the locations of the approved projects as they were proposed on para glacial zones.

He quoted the disasters of Dhauliganga flood of February 2021 and Teesta River disaster of October 2023 as evidence of drawback of installation of HEP in a fragile location.[20]

5. Himdhara report on impacts of Hydro power projects in Himachal Pradesh 2019:[21]

The Himdhara Collective, an Environment research and Action collective released a report called "The Hidden Cost of Hydropower: Environmental Hazards and risks of tunneling, excavation and construction in Run of the River Hydropower Projects in Himachal Pradesh". The purpose of the document is to provide evidence to establish that there are severe risks and hazards associated with hydropower construction, especially in Himalayan regions like Himachal Pradesh. The report places attention to four major impacts of construction of Hydropower projects:

- Geological impacts - triggering of landslides/slope failures leading to damage of roads, farms houses
- Hydrogeological impacts - drying of springs and underground water sources
- Muck Dumping - along rivers leading to increasing siltation, in forests and pastures
- Safety negligence leading to accidents

[19]www.projectstoday.com, "India's #1 Projects Tracking Platform" *Projects Todayavailable at*: https://www.projectstoday.com (last visited February 12, 2025).
[20]"Supreme Court Approves 5 Controversial Hydroelectric Projects on the Ganga | Dehradun News - Times of India,"*available at*: https://timesofindia.indiatimes.com/city/dehradun/supreme-court-approves-5-controversial-hydroelectric-projects-on-the-ganga/articleshow/115873646.cms (last visited February 12, 2025).
[21]A Dossier, "The Hidden Cost of Hydropower: Environmental Hazards and risks of tunneling, excavation and construction in Run of the River Hydropower Projects in Himachal Pradesh" (Himdhara, Environment Research and Action Collective, 2019).

The report brought into light that most of the available studies were biased and in favour of the hydropower producers. The report pinpointed the institutional failures of the Central water Commission, the Central electricity Commission, the MoEF&CC, the State directorate of Energy and State Disaster Management Authority who have failed to ensure their regulatory roles. The report focused on the failure of the parliamentary standing committee on energy policy when it gave 'renewable resource' status to all projects above 25MW. The subsidies provided to the hydropower sector on the basis of green tagging the HEPs, blinds the impacts and non-compliances of those projects.

The report recommended public consent mechanisms, independent audit of social and environmental norms, scientific assessment of long-term implications, and to pause the hydropower projects overall.

National Mission on Sustaining Himalayan Ecosystem (NMSHE):[22]

The National Mission for Sustaining the Himalayan Ecosystem (NMSHE) is one among the eight missions declared under the National Action Plan on Climate Change (NAPCC). The NMSHE attempts to contribute to the sustainable development by understanding the climate change and requirements of the Himalayan Ecosystem. The mission covers eleven states and two union territories. The NMSHE facilitates policy formulation and programmes to sustain ecological resilience to safeguard the Himalayan region. The intention of NMSHE can only be achieved with the cooperation of Ministry of Science and Technology, Indian Himalayan states, the central planning commission, the Ministry of Environment Forest and Climate change. Sufficient transfer of information among South Asian nations sharing the Himalayan ecosystem is necessary. Efforts of climatologists, ecologists, legal experts are crucial. The scientists with the help of NMSHE were able to educate the farmers to ensure sustainable and climate suitable agriculture in Leh region.

The mission involves the efforts of addressing the following goals,

- Conservation and protection of bio diversity
- Calculating the consequences of Himalayan glacier melts

[22]"NMSHE MISSION DOCUMENT," (Department of Science and Technology).https://dst.gov.in/sites/default/files/NMSHE_Mission_document.pdf

- Conservation and protection of wildlife
- Protection and recognition of traditional knowledge
- Protection of livelihood of Himalayan community
- Addressing the consequences of climate change and safeguarding the Himalayan Ecosystem

SUGGESTIONS AND CONCLUSION:

The rapid increase in urge to meet the electricity needs and the failure of environmental governance on behalf of the MoEF&CC over prioritizing economic condition over environmental conditions is an open reason for repeated ill effects of Hydropower plants in the Himalayan region. Implementation of proper action plan and long-term vision of managing resources and consideration of susceptibility of Himalayan ecosystem must be adopted. Opting for small hydro power projects and run of the river projects with lesser impacts over social and environmental aspects must be promoted. Public participation and valuing the opinion of local residents over commitment of any new projects is crucial. The state authorities must adequately evaluate the reasonable grounds for requirement of a hydropower project before engaging in installation and must not resent over a negligent move of ignoring the environmental impacts of Hydropower projects as it would result in humongous damage in future if not executed properly. The prominent Himalayan region deserves its peace, therefore human intervention and their needs must not ruin it.