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Assessment & Analysis of Hydro Power Potential in India

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***Abstract*-Electricity is a necessary demand for all faces of our life. It's been recognized as a basic human want. It's a backbone to the socio-economic development of a country. The offer of electricity at a cheap rate to rural India is important for its overall development. The service sector has created an important contribution to the expansion of our economy. The handiness of quality offer of electricity is incredibly crucial to the sustained growth of this section. Energy desires are rising speedily, as are greenhouse emissions from the energy sector. In a trial to scale back greenhouse emissions and reliance on fossil fuels, there's a growing interest in renewable energy like solar, wind and water power.**

Water, or hydropower, is often accustomed complement to the solar and wind sources, each of which is offered intermittently. Because water is held in reservoirs, hydropower may be used from time to time when these different sources of renewable energy aren't out there. Hydropower plays a vital role in the development of the country because it provides power at a cheaper rate being perpetual and renewable sources of energy. On the opposite hand, the hydropower generation affects the ecology. It affects the land use & flora and fauna of the actual field. This paper throws light on each positive and negative aspects of hydropower and assesses the potential of hydropower generation in the Asian country like India, primarily based upon the factual knowledge.

KEYWORDS: ***Hydropower, ecology, electricity, renewable, potential.***

I. INTRODUCTION

The world faces a large challenge in producing the energy desires of the growing population, in addition, keeping global climatic changes in restraint by reducing the greenhouse gas emissions. Hydropower is one of the choices for meeting this challenge. Hydropower is that the second most significant supply of energy in the world and accounts for 16.9% of the overall put in capability of 2,37,742.94 MW (CEA, 2014) within the world and still there remains a huge unexploited potential, particularly in developing countries. Consistent with the World Energy Council (WEC), two-thirds of the economically feasible hydropower generation potential remains undeveloped.

India has been a dominant player in terms of hydropower generation. This nation is the fifth largest producer of hydro electrical power.

The Hydroelectricity potential of 84,000 MW at 60% load factor is one among the biggest within the world. The current put in capability as on 30th April 2016 is 42,783.42 MW (see table-1) that is 14.35% of total utility electricity generation capability in the country. Additionally, 4,274 MW small hydropower units are put in as on 31st March 2016 and throughout the financial year 2014-15, the overall electricity generation in India was 129 billion kWh that calculate to 24,500 MW at 60% load factor.

Table-1. Installed Capacity of Hydropower in India(Source-Cea).

ALL INDIA INSTALLED CAPACITY OF HYDRO POWER ST (IN Mega Watt-MW)		
Region	Ownership/Sector	Hydro power Capacity
Northern Region	State	7502.55
	Private	2478
	Central	8266.22
	Sub Total	*18246.77*
Western Region	State	5480.50
	Private	447.00
	Central	1520.00
	Sub Total	*7447.50*
Southern Region	State	11558.03
	Private	0.00
	Central	0.00
	Sub Total	*11558.03*
Eastern Region	State	3168.92
	Private	195.00
	Central	925.20
	Sub Total	*4289.12*
North Eastern Regions	State	382.00
	Private	0.00
	Central	860.00
	Sub Total	*1242.00*
Islands	State	0.00
	Private	0.00
	Central	0.00
	Sub Total	*0.00*
All India	State	28092.00
	Private	3120.00
	Central	11571.42
	Sub Total	*42783.42*

Hydropower doesn't cause pollution as it burns no fuel, making it close to zero emissions. Therefore, Hydropower is comparatively cleaner as compared to different sources of energy and therefore the emission rate per unit of electricity generated from hydropower is negligible. Since hydropower generation doesn't need burning or combustion of any fuels, the price of operation doesn't seem to be prone to market value fluctuations.

Unlike alternative sources of energy, hydropower generation provides an abundance of distinctive edges which may be those emanating from the generation of electricity itself or from

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aspect edges related to hydropower reservoirs. Such advantages will embody a secure facility, irrigation, and control as well as accrued navigation and accrued recreational opportunities. There is scope for development of fisheries and tiny scale industries.

Besides various expected advantages from these projects, conjointly a mess of considerable social, economic and environmental impact potentials exist. At a similar time, hydropower generation has failed to keep step with the speedy increase in thermal power generation. As a result, there has been a homogenous decline within the proportion of hydropower generation inside the overall grid-connected generation within the country.

II. HYDROPOWER POTENTIAL IN INDIA

India is endued with the large quantity of hydro-electric potential and ranks 5th in terms of exploitable hydro-potential on the worldwide state of affairs. As per assessment created by CEA, India is endowed with economically exploitable hydropower potential to the tune of 1,48,700 MW of put in capability (see Table II).

The assessed potential is as under:

Table II. Potential of hydropower in India (Source-Wikipedia).

Basin/Rivers Probable	Capacity (Mega Watt-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*

In addition, 56 pumped storage projects have additionally been known with a most likely put in capability of 94,000 MW. Additionally, to the present, hydro-potential from small, mini & micro schemes has been calculable as 19,749MW (see Table-III) so, in totality, India is blessed with hydro-potential of concerning 2,62,450 MW.

Table III. State wise small hydropower potential (Source- Wikipedia).

S.NO	States/Union territories	Small hydro potential (Mega Watt-MW)	S.NO	States /Union territories	Small hydro potential (Mega Watt-MW)
1	Andhra Pradesh	978	16	Manipur	109
2	Arunachal Pradesh	1341	17	Meghalaya	230
3	Assam	239	18	Mizoram	169
4	Bihar	223	19	Nagaland	197
5	Chhattisgarh	1107	20	Orissa	295
6	Goa	7	21	Punjab	441
7	Gujarat	202	22	Rajasthan	57
8	Haryana	110	23	Sikkim	267
9	Himachal Pradesh	2398	24	Tamil Nadu	660
10	Jammu & Kashmir	1431	25	Tripura	47
11	Jharkhand	209	26	Uttar Pradesh	461
12	Karnataka	4141	27	Uttrakhand	1708
13	Kerala	704	28	West Bengal	396
14	Madhya Pradesh	820	29	Andamaan&Nicobar	8
15	Maharashtra	794		TOTAL	19749

III. MECHANISM OF HYDRO POWER GENERATION

A dam is constructed wherever there's a natural supply of water and it's accustomed to hold the water and make pressure, so the water will turn out additional wattage. The water flows from a height through the penstocks to the turbines that have blades. The falling water has enough Kinetic energy, that once they knock with the blades of the turbines, they begin spinning which implies that the Kinetic energy is reborn into mechanical energy. The turbines use the potential and kinetic energy of falling water to convert into work. The shafts of the turbines convert the mechanical energy into electrical energy.

IV. HYDRO POWER PROJECT BENEFITS

A. *Renewable*

It's a renewable style of energy. It's a clean fuel supply. Its accessibility is infinite. The generation depends on the Rain cycle, that is driven by the sun, making it a renewable power supply, creating it an additional reliable and reasonable supply than fossil fuels that are quickly being depleted. It's eco-friendly.

B. *Flexibility*

Hydropower is a versatile source of electricity since stations can be ramped up and down terribly quickly to adapt to dynamical energy demands. Hydro turbines have a start-up time of the order of a couple of minutes. It takes around 1 to 2 minutes to bring a unit from still start-ups to full load; this is abundant shorter than for gas turbines or steam plants. Power generation can be attenuated quickly once there's a surplus power generation. Due to the limited capacity of hydropower, it serves during peak loads. They supply essential backup power throughout major electricity outages or disruptions.

C. *Contribution to development*

Hydroelectric installations bring electricity, highways, business and commerce to communities, thus developing the economy, increasing access to health and education, and raising the standard of life. Electricity is a technology that has been better-known and well-tried for over a century. It offers a colossal potential and is obtainable wherever development is most crucial.

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D. Cost of generation of electricity

For the operation of a hydroelectric power plant, only a few individuals are needed since most of the operations are machine-controlled, so operative prices of hydroelectric power plants are low. Furthermore, as the hydroelectric power plant gets older, the pricing of generation of electricity from it becomes cheaper since initial opportunity cost endowed within the plant is recovered over the long period of operations.

E. Irrigation and water park

Water from the dams can also be used for the irrigation of farm lands, therefore, producing the agricultural outputs throughout the year even in the areas wherever there's scanty or no precipitation. In the locality of the dams, the water from the reservoir can be used to develop public recreational facilities like water parks for water sports and gardens.

V. DISADVANTAGES OF HYDRO POWER PLANT

A. ENVIRONMENTAL CONCERNS

A. Wildlife Impacts

A dam that makes a reservoir (or a dam that diverts water to a run-of-river hydropower plant) obstructs fish migration. Also operating a hydroelectric power plant may also lead to change the temperature and the flow of the river. These changes may hurt native plants and animals within the stream and ashore.

B. Global Warming Emissions

Global warming emissions are produced during the course of installation and disassembly of the hydroelectric plants. Recent analysis also suggests that emissions throughout the facility's operation can also be vital. Such emissions vary greatly betting on the scale of the reservoir and also the nature of the land that was flooded by the reservoir.

C. Water Related Diseases

Changes in water quality, weed growth and the increase in areas of stagnant water lead to the proliferation of insects or different vectors of water-related human and farm animal diseases. There's a risk of introduction of newest pathogens and illness vectors. The health care facilities, particularly within the relocated space and the adequacy of planned measures to cut back the unfold of water-related diseases are needed.

D. Environmental Flows

Alteration of the natural flow of watercourse affects the social, economic, cultural, and recreational values of the native communities. Modification in water levels will stop the spawning of fish by exposing or sinking the favored nesting areas in shallow waters. Nutrient delivery to offshore areas could be disrupted by upstream damming activities that would have serious implications for the biogeochemistry and protoctist ecology of the downstream areas.

B. SOCIAL CONCERNS

A. Displacement and Compensation

The low worth of land in the remote craggy areas leads to low compensation for land to the affected. The character of the compensative land given is non-fertile. There's non-availability of irrigation sources. Cash-based compensation doesn't mirror the 'true' cost of the quality. Attempts for the compensation for the loss of common property resources are terribly rare. The compensation is insufficient. The worthiness and class of exchanged land provided is lesser than the previous one.

B. Resettlement and Rehabilitation

There is a lack of employment opportunities for displaced communities. The access to the natural resources, health, and education facilities becomes an issue within the new place. The rehabilitation packages are lesser and there's delay in payment. Also, there are certain processes associated with the displacement which is a lack of deceptive data and inadequate warning systems. There's loss of livelihoods. There's lack of observation or redressal mechanisms.

The inflow of migrant employees from alternative elements of the country for construction will impact the community lifetime of the locals. Hourly, daily and seasonal amendments within the watercourse flow, thanks to the development of dams, impacts the locals massively.

C. Safety

The most well-known weakness is that of safety. With Brobdingnagian amounts of water controlled back by the dam, there's continuously the potential of terroristic acts, accidents or major flooding downstream caused by faulty construction or natural disasters, evoking natural concern within the population living within the encompassing and presumably affected areas. Throughout times of war, dams are major targets for destruction. As a result of they will not solely disrupt power, moreover, they additionally produce an oversized variety of casualties when the water is suddenly discharged from the broken reservoir.

For example, during the Second war, a nation's Royal Air Force used specially designed "Bouncing Bombs" that primarily skipped across the water and sank at the sting of the dams, inflicting the foremost quantity of harm to them. (CWGC 2005). This plan of action was used on the Moehne and Edersee dams in Germany, releasing the voluminous amount of water into the Rhine depression.

VI. DISCUSSION

The slogan of every country is sustainable development. The event ought to be in such a way that we have a tendency to gain the utmost output from the resources with marginal impact on the surroundings. Sustainable development is a method for meeting human development goals while sustaining the flexibility of natural systems to continue to offer the natural resources and ecosystem services upon which the economy and society rely. To scale back the impact of hydropower some small steps can be taken-

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1. A locality should be chosen where the population is a smaller amount so there's less need of displacement.
2. When fish is going down in a stream or a river, they may get into the headrace channel or tunnel and there is a risk of dying once passing through the rotary engine. Fish ladders are provided for the security of fishes which are marginally booming. In addition to the fish ladder systems, newly developed Divergent types of kits like strobe lights for repelling fish, mercury lights for attracting fish, sound generating devices and electrical steerage systems can be used which will keep fish far away from passing the trash rack.
3. One issue dams do is entice sediments that are filled with nutrients. This starves massive volumes downstream that rely upon that sediments for richer soil on the banks. Adding a periodic dredging mechanism into the dam's operations and flushing the silt downstream would cut back this impact. For the security purpose, the condition of the dams ought to be monitored in accordance with the security scrutiny programs approved by the dam authority.
4. Instead of reservoir-based hydro plants, run-off river plants can be established. It'll scale back the impacts caused by the dam construction. Also, small hydro plants can be established rather than large hydro plant as small hydro plants have less adverse impacts on the surroundings as compared to the large hydro plants.
5. The hydropower plants can be operated in *TANDEM OPERATION*. In this, the outfall of one project becomes the inlet of the another project. This will not just cut back the price of the dam construction but additionally, the impact owing to the development of a dam on the setting. This additionally reduces the price of desilting chambers and other facilities required for individual plant's operation and maintenance.
   For example, in India, Rampur hydro Power station(412MW) works in TANDEM with Nathpa Jhakri Power station(1500MW).
6. Noises and vibrations inside a hydroelectric plant come back from the trash rack cleaner, the trash conveyor, the generator, the gear case, the turbine, & the transformer. This type of impact will be unacceptable once homes are situated almost about the powerhouse or when the plant is constructed in a protected natural site. In these cases, a careful style can permit the action of excellent levels of noise reduction and therefore powerfully mitigate the acoustic impact of the plant. Some of the foremost *diffuser techniques* are the following:
   i. Small tolerances geared manufacturing.
   ii. Sound insulating blankets over the turbine casing.
   iii. Acoustic insulation of the building.
   iv.

VII. CONCLUSION

With the growing want for additional electricity owing to the rise in population and also the increasing development of Indian states, a "clean" and "cheap" energy resource is required. Measures are being enforced and policies are being initiated by the central government for the betterment of the energy sector of India. Being having a tropical climate, major a part of India rely on hydroelectric power. Since it a green and clean renewable energy, its development will meet the longer term demand for electricity. The hydro plant can also be created on small streams so that many locations of India that are off from the grid connectivity can implement this source of energy for the essential needs. It helps in irrigation and cultivation. It conjointly becomes a storage to the social requirements throughout the summer season. Thus, Indian government ought to develop additional schemes and policies toward the development. Besides constructing new hydro plants, the present plants ought to be renovated and modernized with the latest technologies for maximum efficiency from the available resources.

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