International Journal of Agricultural Sciences ☞DOI:10.15740/HAS/IJAS/17.2/178-184
Volume 17 | Issue 2 | June, 2021 | 178-184 ■ ISSN : 0973-130X Visit us : *www.researchjournal.co.in*

RESEARCH PAPER

Hydropower potential in Assam: Assessment and analysis

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Abstract : Electricity is a must in every aspect of life. It has been identified as a fundamental human desire. It is the foundation of a country's socio-economic growth. The provision of low-cost electricity to rural India is critical to the country's overall growth. The service sector has made a significant contribution to our economy's development. The availability of a high-quality electricity supply is critical to the sector's long-term development. Energy consumption is rapidly increasing, as are greenhouse gas emissions from the energy industry. In terms of socio-economic indicators, Assam lags behind the rest of India. The vast hydroelectric potential of the area is due to the abundance of seasonal rivers and water bodies. However, it has been observed that hydropower development is hampered by a number of factors, including technical difficulties, political problems, a lack of adequately investigated projects, environmental concerns, power evacuation issues and many more. Exploitation of the huge hydro potential in Assam could be used for export to the power deficit regions of the country. Construction of infrastructure in remote hilly areas, communications, and energy supply, will benefit the country as a whole, resulting in a higher standard of living. The study's aim is to determine the current power situation in Assam in terms of hydropower and also highlighting the region's hydropower sector's potential opportunities and challenges.

Key Words : Hilly areas, Hydro power, Renewable energy

View Point Article : Panme, Florence Akangle and Sethi, Laxmi Narayan (2021). Hydropower potential in Assam: Assessment and analysis. *Internat. J. agric. Sci.*, **17** (2) : 178-184, **DOI:10.15740/HAS/IJAS/17.2/178-184.**

Article History : Received : 21.02.2021**; Accepted :** 13.03.2021

INTRODUCTION

Generation of energy has become a global necessity to meet the demand of increasing population and the increasing load demand. The depleting conventional energy for electricity has also contributed to the rise of demand for renewable energy. Renewable energy provides clean, cost effective, technically feasible and unending supply of power. Excessive reliance on fossil fuel resources such as coal, oil, and natural gas to meet human energy needs is not only unsustainable in the long term, but also has a negative effect on the atmosphere and biodiversity, with catastrophic consequences for natural resources. This is how non-conventional or renewable energy sources have intrigued the interest of planners, policymakers, economists, and environmental advocates around the world as a feasible means of achieving the aim of sustainable growth. For a long time, hydropower has been India's primary source of renewable energy. Hydropower accounted for about 40% of overall electricity production in the late 1970s. Despite the fact that hydropower production has steadily increased, its share of electricity generation has dropped to around 10%. (International Energy Agency, 2019). As Given by Central Electricity Authority, the Renewable Energy Generation will contribute about 20.1 % of the

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total energy requirement in 2021-22 and Hydro capacity addition of 300 MW has been achieved against the targets of 1190 MW for the year 2019-20. Due to a lack of proper infrastructure, connectivity, transportation, and knowledge, people living in the remote areas of India's North Eastern Region are still falling behind in economic growth and development. Assam, one of India's North Eastern states, has abundant water supplies and a diverse floral and faunal biodiversity, as well as significant hydropower potential that has yet to be realised. Existing energy generation capacity is not enough to meet the demand in the remote parts of the State. Unless positive steps are taken to energize the region, socio-economic development of the state will always be dormant. According to CEA, the installed capacity in North Eastern region comprised of 1,577.00 MW hydro energy. Assam alone has a capacity to produce 680 MW of hydro power. According to Ministry of New and Renewable Energy (MNRE), in Assam, the installed hydropower capacity as on 31st March, 2020 is 34.11 MW. Power is the most basic infrastructural need for the development of industries and the state's overall economy. Despite the fact that Assam has enormous power potential ranging from hydro to natural gas, as well as oil and coal resources, the state's development in this sector has not been commensurate with the opportunities. As a consequence, there is a significant difference between power supply and demand in the state.

Brief profile of study area:

Assam is a state in India's north-eastern region, situated to the south of the Eastern Himalayas. The Brahmaputra Valley in the north, the Barak Valley in the south, and the Karbi Anglong and Cachar Hills that separate the two regions with a total area of 30,285 square miles are the main geographical regions of Assam (78,440 km^2). Assam is the gateway to the North-Eastern States and the sentinel of north-east India. The Brahmaputra River is regarded as Assam's lifeline. The state also has a diverse range of flora and fauna.

Fig. A : Location of study site ***(Source: www.google.com)***

Current scenario of energy distribution in Assam:

In Assam, the industrial and domestic sectors account for the majority of electricity consumption. The Assam Power Distribution Company Limited (APDCL) is responsible for supplying electricity to all Assam consumers. The company has made every effort to boost the state's power supply situation, and now supplies 95 % to 100 % of power during off-peak hours and 90 to 95 % during peak (evening) hours. It is undeniable that demand for electricity has risen dramatically in the state over the last three to four years. Just 16 % of rural households were electrified until several years ago, but that number has now risen to about 50 %; nevertheless, as part of the National Electricity Policy, measures have been taken to electrify every household of Assam by the year 2019. As a result, there has been a significant rise in power demand in both rural and urban areas in recent years. Assam has been experiencing an average peak demand for power of 1400 MW this year, owing to increased growth and better economic activities in recent years. The present status of power scenario as given by Assam Government is given in the Table 1.

Table 1: Present status of distribution of power in Assam

No. of Distribution Circles	19
No. of Distribution Divisions	45
No. of Distribution Sub-Divisions	157
No. of Consumers Catered	Approx. 33 Lakhs
Present demand of the state	1400 (during peak)

Hydro Power Generation in Assam:

According to the Central Electricity Authority's re-assessment studies of the country's hydroelectric potential, the economically exploitable hydropower potential in terms of installed capacity is 148701 MW, with 145320 MW of capacity emerging from schemes with outputs greater than 25 MW. As of 31.03.2020, hydroelectric schemes in operation account for just 28.15 % (40913.6 MW) of total installed capacity, while those under construction account for 7.84 % (11393.5 MW). As a result, the majority of the capacity (64.01 %) has yet to be achieved. The state of Assam has a range of hilly areas with lots of hydro potential and there are a number of small streams that can be used to generate distributed power by installing small hydro power or pico

hydro power projects. Assam's hilly regions are mostly divided between the two hill districts: Karbi Anglong and North Cachar Hills. The Assam Power Generation Corporation Limited (APGCL), a subsidiary of the Assam State Electricity Board (ASEB), and the Assam Energy Development Agency (AEDA), are in control of preliminary investigation and survey, which is used to prepare Detailed Project Reports for hydro project installation and execution. According to Energy Statistics, Assam's projected renewable power capacity through Small Hydro Power Plants is 202 MW in 2020. Assam Power Generation Corporation Ltd. (APGCL) is primarily concerned with maximizing energy production in order to satisfy the state's energy demand. APGCL has a total installed capacity of 379.7 MW, and peak generation of about 250 MW. According to Nath (2015), Karbi Anglong has the largest small hydro potential, reported to be about 83 MW, followed by the N.C. Hills district with a capacity of 29 MW.

The government of Assam has implemented a policy on small hydropower growth, with a potential of 541 MW in the region. In addition, the State Government established a joint venture with IL and FS called Assam Power Projects Development Company Ltd to promote SHPs (APPDCL). After conducting a pre-feasibility review, assessment, and other protocols, APPDCL prepares a DPR. Following that, bids for project construction are sought. So far, 7 SHP have been awarded for production through competitive bidding. The 2.25 MW Champawati Project is producing electricity, whereas the 4.7 MW Bardikarai Project is closed due to forest clearance rejection; the detailed status is as follows:

According to re-assessment studies conducted by the Central Electricity Authority, the whole of North Eastern Region's hydro potential in terms of installed capacity is estimated to be 58971 MW (58356 MW-above 25 MW capacity). So far, 1727 MW (above 25 MW capacity) has been harnessed, with projects totalling 2300 MW (above 25 MW capacity) currently under development. Hydropower generation in the North Eastern Region in 2019-20 (as of 31.03.2020) was 4828 MU, which is around 30% less than the goal of 6852 MU. The following is a list of the North-Eastern Region's identified hydro-electric potential (greater than 25 MW) and its current state of development:

Among all the North-Eastern states Assam has harnessed maximum hydro potentiality 55.14 per cent following Sikkim 15.6 per cent and Meghalaya 11.78 per cent. Some of the major Hydro Electric Projects being planned in Assam are:

The Brahmaputra basin encompasses 651 334 km^2, and the river receives 22 tributaries in Tibet and 33 tributaries in India along its 4696 km range (Handique and Dutta, 2012). The Central Electricity Authority (CEA) has estimated 65,400 MW of hydroelectric potential in the Brahmaputra basin among the country's various river basins, of which 4,274 MW has been built

Table 2 : Status of Hydro electric projects of APCGL

Project name	Location	Capacity (MW)	Status
Karbi Langpi Hydro Electric Project (KLHEP)	Karbi Anglong district	100	Running
Myntriang Small Hydro Eletric Project (MSHEP)	Karbi Anglong district	13.5	Running
Lower Kopili Hydro Electric Project	Dima Hasao district	120	Ongoing
Karbi Langpi Middle-II H.P.P	Karbi Anglong district	24	Upcoming
Borpani Middle-I SHEP	Karbi Anglong district	22.5	Upcoming
Borpani Middle-II SHEP	Karbi Anglong district	24	Upcoming

Table 3: Small Hydro Power Plants status of APDCL

Sr. No.	Name of project	District	Capacity (MW)	Tariff (Rs./KWh)	Remarks
1.	Champawati	Barpeta	2.25	3.20	Generating Electricity
2.	Pahumara	Barpeta	2	2.91	Forest clearance applied for
3.	Desang	Dibrugarh	9	2.88	Work in Progress
4.	Rupohi	Baksa	0.4	3.13	Upcoming
5.	Kalanga	KarbiAnglong	6	2.98	Forest clearance applied for
6.	Bardikorai	Sonitpur	4.7	2.73	Project closed due to rejection of Forest Clearance
7.	Dronpara	Kamrup	1.6	3.18	Upcoming

(Source: Assam Electricity Regulatory Commission, Annual Report 2019-20)

Table 4 : Hydro power potential (above 25 MW) In the North Eastern Region

Region/ State	Identified potential as per Re-assessment Study (MW)		Hydro electric schemes developed (Above 25 MW)	Hydro Energy schemes under Construction (Above 25 MW)
	Total	(Above 25 MW)		
Meghalaya	2394	2298	322	000
Tripura	15	0	0	0
Manipur	1784	1761	105	0
Assam	680	650	350	0
Nagaland	1574	1452	75	0
Ar. Pradesh	50,328	50,064	815	2300
Mizoram	2196	2131	60	0
Total (NER)	58,971	58,356	1727	2300

(Source: CEA Annual Report 2019-20)

Table 5 : Major Hydropower plant status in Assam

Kopili Hydro Electric Plant	Installed Capacity (MW)	Generation in Million Units		
Power stations		Design	MoU (Very good)	Actual
Kopili Power Station	200 (4*50)	1186.14	980	717
Khandong Power Station	50(2*25)	277.65	220	190
Kopili Stage - II	25(1*25	86.30	100	104
Total	275	1550.09	1300	1011

(Source: NEEPCO Annual Reports, 2019-2020)

and 3,553 MW is still under development. Despite the fact that the state has a promising source of energy, there is widespread interest in the potential social and environmental impacts of these hydropower projects in the region.

Hydropower technology:

The power produced by the movement of water is known as hydroelectric power. A consistent flow rate and head are needed to generate hydroelectric power. Water descending from suitable height gains energy as it advances into the turbine, which is converted to electricity by the generator attached to the spinning turbine as they hit. When a natural water supply is unavailable, the water is normally drawn from a flowing river or stream, but it may also be drawn from a reservoir through a pipeline or a channel. The water hitting the turbine causes the shaft to spin, which is converted to electrical energy by the generator.

Hydro power plant classification:

Hydroelectric power plants can be categorised using the following criteria: a. Classification based on the extent of available water flow regulation; b. Classification based on the availability of water head; c. Classification based on the type of load supplied; and d. Classification based on installed capacity

Benefits of hydropower projects:

Renewable energy source:

Hydroelectricity is a renewable energy source because it generates electricity from the earth's water. The never-ending water cycle adds to the infinite capacity for energy production. The sun evaporates water from the earth's atmosphere, forms clouds, and then falls down as precipitation on the ground. The generator converts water energy into hydro electricity during the generation of hydro energy.

Clean energy source:

Hydropower is a renewable energy source that does not require the use of fossil fuels to produce electricity. Energy processing has no negative effects on the atmosphere and produces no waste.

Flexible in nature:

Hydropower plants, unlike other renewable energy sources that are produced under particular circumstances, can be scaled to meet energy demands. Hydropower generation is considered dynamic in nature because it is not affected by weather conditions.

Reliability:

Hydropower is one of the world's most efficient fuel sources. Solar energy is just 30-35 percent efficient,

Table 5 : Hydro power classification according to various configuration	
Based on the extent of available water flow regulation	Non-ponded run-off river power plants.
	Ponded run-off river power plants.
	Power plants based on reservoirs.
Based on the availability of water head	Low head (<30 m)
	Medium head (30 – 300 m)
	High head (>300 m)
Based on the type of load supplied	Base load
	Peak load
	Pumped storage plants for the peak load
Based on installed capacity	Large/Very large >100MW
	Medium 25 - 100MW
	Small 1 - 25 MW
	Mini 100kW - 1 MW
	Micro 5 - 100kW
	Pico < 5kW

while wind energy is 25-45 per cent efficient, coal power is 33-40 per cent efficient, and hydropower is up to 90% efficient. Hydroelectric power is not dependent on external factors such as environment or oil/fuel rates, however it does rely on the amount of water flowing through it. Hydropower is a fully fossil-free energy source. Hydroelectricity is used as a base burden fuel source by countries with high hydropower reserves.

Development of region:

Hydroelectric facilities link electricity, expressways, industry, and trade networks, boosting the economy, increasing access to health and education, and raising the standard of living. Power is an invention that has been well-known and actively sought for more than a century, and hydropower generation has huge potential and is accessible from anywhere.

Cost effective:

A couple of people are needed since the majority of the tasks are computer operated. Hydroelectric power plants have low usable costs because of this. Furthermore, as the hydroelectric power plant matures, the cost of power produced from it has decreased. For a long period of time, the plant's investment is recouped.

Constraints for hydropower generation in Assam:

Since hydropower facilities operate in both electric power and water systems, they are susceptible to a range of limitations. Each system imposes its own set of conditions on hydropower facilities. As electricity generators, hydropower facilities face the same limitations as conventional power generators, such as system size, maintenance needs, reserve capacity, and power distribution. Hydropower facilities face environmental and regulatory restrictions as hydrological reservoirs, such as spillage constraints, reservoir level constraints, seasonal water releases, water reliability issues, and downstream effects. Assam's area is diverse in terms of community blocks, non renewable resource livelihoods, and specific socio-cultural, agro-ecological, and land-holding structures (such as various types of community control over forests in various parts of the region). Major part of the region are hilly, therefore, there is very little land suitable for permanent cultivation. The effects of dams on common-use resources (such as pasture lands), which are critical to local communities' livelihoods, are also a significant missing link in project impact assessments (Qinglong *et al.,* 2007, Subrahmanyam, 2013). In Assam, shifting agriculture (jhum) is a dominant traditional land use that is important for people's livelihoods, agricultural biodiversity, and food security. Outsiders migrate and settle in the region changing the demography of the region, affecting the social, economic, and political situation, as well as putting a strain on the state's limited resources, such as land. Several areas that have been subjected to hydropower schemes are sacred to indigenous peoples and are spiritually and culturally significant. The destruction of sacred landscapes has been a major source of dissatisfaction among the people (Sharma and Pandey, 2013). Access to the region is not very easy and along with the presence of remote areas, lack of infrastructure, as well as restoration of project-affected communities and forest clearing, have all been cited as issues with hydropower production. Dam protection and security is a matter of utmost importance, lack of which may cause grave environmental catastrophe and loss of human life and property. Therefore careful scrutiny, inspection, operation and maintenance of systems are necessary to ensure for safe functioning. Despite the fact that a series of dams is being built in the Lohit river basin, no cumulative effect analysis has yet been completed. Since the project is located on the border of Arunachal Pradesh and Assam, the project's main downstream effect will be in the Assam valley, and no attempt has been made to research the project's possible downstream impact. (Subrahmanyam, 2013). The construction of infrastructure, ensuring adequate investigations to mitigate geological surprises, land acquisition, restoration and

relocation of project-affected communities, clearance of forest and other environmental features, and potential law and order issues are the next collection of major problems in hydropower production (as exist in many parts of the Northeast) (Rao, 2006). On the hydro scheme, there is also a need to offload indirect cost components. There is an immediate need to change the government's current policy of charging the entire protection expenditure on the project cost from design to commissioning. The key operational limitations for hydropower are equipment capacities, such as the minimum and maximum power that can be generated, as well as maintenance requirements. Some turbines have a minimum amount of power that must be generated in order for the turbine to function, as well as a maximum power capacity depending on the turbine's rating. Turbine capacity is often limited during scheduled or forced outages of the facility due to maintenance requirements. Turbines often have optimal operating ranges; operating outside of these ranges increases wear and tear, reduces equipment lifespan, and can have a detrimental effect on efficiency (Escalar, 2006).

Future perspective of hydro power generation in Assam:

Despite the Government of India's obvious attempts to promote large-scale hydropower production in India, including a few that have brought in a new set of greater private entrepreneurs, problems remain due to some inherent contradictory policies and issues. Several major issues afflicting the hydropower sector have been established, but overcoming these obstacles will necessitate collaboration among ministries at the federal level and between states and the federal government. More and more pumped storage systems, involving specific solutions based on site possibilities, would increase hydropower generation capability. The states should make consistent policies and regulations. Any disparity in the policies and benefits provided by different states would stymie the growth of several project sites in various states. State agencies should undertake large-scale hydro projects that require greater risks due to geographical uncertainty, etc., whereas private entrepreneurs should be provided comparatively safer projects with lower risks and smaller capital investments.

Conclusion:

According to the present research, Assam has the capacity to construct hydro power plants. Not only large dams, but also small hydro power plants will meet the area's power needs, while avoiding the constraints of traditional non-renewable energy sources, and redirecting the questionable large dam projects that are expected to be dangerous for these difficult terrains. There are certain constraints to tapping this vast reservoir of hydro assets, such as poor road connectivity, remote locations, lack of local involvement, and lack of access to release information, to name a few.

REFERENCES

Abdullah, A H D, Karlina, N., Rahmatiya, W., Mudaim, S., Patimah and Fajrin, A.R. (2017). Physical and mechanical properties of five Indonesian bamboos. IOP Conf. Series: Earth and Environmental Science 60, pp1-5.

Attri, M., Sharma, S. and Bharghaw, N. (2017). 'Assessment and Analysis of Hydro Power Potential in India. Internat. J. Engg. Res. & Technol., **6** (5) : 312-315.

Al Amin, R. and Talukder, S.H. (2014). Introducing Pico Hydro From Daily Used Water And Rain Water. *Internat. J. Engg. Res. & Applications,* **4**, Issue 1(Version 2) : 382-385

Bhoi, A. (2014). 'Potential of Hydro Power Plant in India and its Impact on Environment', IJET Journals.

Das, Partha J. (2013). 'The hydropower – climate change Nexus: Myths, Science, and Risk for North East India'.

Escaler, X., Egusquiza, E., Farhat, M., Avellan, F. and Coussirat, M. (2006). Detection of Cavitation in Hydraulic Turbines. *Mechanical Systems & Signal Processing,* **20** (4) : 983– 1007.

Handique and Dutta (2012). Power and North East: The Hydro Power Scenario of North East. *Internat. J. Science & Res.* , pp 602-609

Kadier, A., Kalila, M.S., Pudukudya, M., Hasana, H.A., Mohamed, A. and Hamid, A.A. (2018). 'Pico hydropower (PHP) development in Malaysia: Potential, present status, barriers and future perspectives'. *Renewable & Sustainable Energy Reviews-Elsevier*, **81** : 2796– 2805.

Lahimer , A.A., Alghoul , M.A., Sopian, K., Amin, N., Asim, N. and Fadhel, M.I. (2012). 'Research and development aspects of pico-hydro power'. *Renewable & Sustainable Energy Reviews* 16 : 5861–5878. journal homepage: www.elsevier.com/locate/rser

Nath, D.R. (2015). 'Small Hydro Power and its Potentiality in Assam. *Internat. J. Engg. Trends & Technol. (IJETT)*, **23** (8) : 391-395.

Saini, R.P. (2011). 'Small Hydro Power Generation'. Course on Integrating Renewable Energy Sources into Emerging Electric Power Systems.

Sharma, G. and Pandey, Trilochan (2013). 'Water Resource Based Developments in Sikkim: Exploration of Conflicts in the East and West Districts'

Smart Hydro Power (2018). Hybrid power plant with solar panels and river turbine as optimal solution for decentralized electrification in colombia. Retrieved date of access January 13th , 2018, from http://www.smart-hydro.de/hybrid-power-plant-with-solar-panels-and-river-turbineas-optimal-solution-for-decentralized-electrification-in-colombia/

Subrahmanyam, D.S. (2013). 'Status of Electric power generation in India with special emphasis on Hydropower expansion. *Internat. J. Renewable Energy & Environ. Engg.*; ISSN 2348-0157, Vol. **01**, No. 01.

Sustainable Development Goal, Power (Electricity) Department Government of Assam, 2016.

TKÁÈ, Š. (2017). *The power of water within micro urban structures*. Beau Bassin: LAP Lambert Academic Publishing. ISBN: 978-620-2-07422-3, pp 144

WEBLIOGRAPHY

www.aerc.gov.in/AERC_Annual_Report_2019-20.pdf

www.asmenvis.nic.in/Database/Energy_858.aspx?format=Print

www.cea.nic.in/old/reports/annual/annualreports/annual_report-2020.pdf

www.google.com

www.iea.org/reports/india-2020

www.neepco.co.in/sites/default/files/reports/Annual_Report_2019_20_FINAL_0.pdf

www.niti.gov.in/writereaddata/files/Arup%20hazarika%20assam.pdf

www.power.assam.gov.in/frontimpotentdata/apply-power-sanction