

Significance and Challenges of Hydropower Energy

Why in news?

Recent droughts in Colombia and Ecuador have severely hampered energy supplied by hydropower.

What is the significance of hydropower energy?

Hydropower functions by harnessing the movement of water flowing through a turbine, which generates electricity as it spins.

- **Renewable source**- It's a renewable form of energy, relying on the water cycle, which is driven by the sun, ensuring sustainability.
- **Clean energy**-Hydropower uses water as its fuel, making it a clean energy source that doesn't produce air pollution or toxic byproducts.
- **Energy independence**- It allows for domestic energy production, reducing dependence on imported fuels and enhancing energy security.
- **Flexibility**-Hydropower plants can quickly adjust their output to match demand, providing essential backup power during electricity outages.
- **Scalability**- Hydropower projects can range from small-scale systems suitable for powering individual homes or communities to large-scale projects that provide electricity for entire regions or countries.
- **Multipurpose use**- Hydropower projects often involve the construction of dams and reservoirs, which can serve multiple purposes such as water storage for irrigation, flood control and recreational activities like boating and fishing.
- **Combat weather change**- Hydropower plants are built to respond to changes in the weather such as storing water in the rainy season to use when it becomes dry.
- **Cost-effective**- It provides low-cost electricity and has a long lifespan, which can offset initial construction costs.
- **Supports other renewables**- Hydropower can be used in conjunction with other renewable sources, like wind and solar, to provide stable energy supply.
- **Eco-friendly**- Hydropower is a key element in creating secure and clean electricity supply systems and reaching global net-zero targets.
- **Expansion potential**- Hydropower is expected to expand because it provides cheap power at a large scale.
- **Renewable leadership**- While wind and solar energy are on the rise, the International Energy Agency acknowledges that hydropower will remain the world's largest source of renewable electricity generation through the 2030s.

To limit global temperature increases to 1.5°C, hydropower capacity needs to

double by 2050.

What are the challenges faces by hydropower energy?

- **Global decline-** Hydropower, despite being the *world's largest renewable electricity source*, experienced a historic 8.5% drop in global output in the first half of 2023.
- **Climate change vulnerability-** Climate change poses a significant threat to hydropower infrastructure, as altered precipitation patterns, increased temperatures, and more frequent extreme weather events can affect water availability and hydrological cycles.

A study from 2022 indicates that over a quarter of hydropower dams are located in areas at risk of water scarcity by 2050.

- **Drought impact-** A drought fuelled by the [El Nino](#) weather phenomenon has reduced reservoir water levels in hydropower plants, which Ecuador and Colombia rely on for most of their electricity.
 - **Ecuador-** The country declared a state of emergency and instituted power cuts.
 - **Colombia-** The water has been rationed in the capital and the country has halted electricity exports to Ecuador.
- **Impact on China-** China, which is the largest producer of hydroelectric power, saw significant power shortages due to droughts, leading to electricity rationing.
- **Over reliance-** Countries with a high dependence on hydropower, like those in *Africa* (around 80% of energy), are especially vulnerable to the impacts of climate change, which can cause severe droughts and affect electricity generation.
- **Limited alternatives-** Many of the over-reliance countries *lack sufficient capacity* for alternative power generation and have limited infrastructure to import power.
- **Environmental impacts-** Constructing dams and reservoirs alters the natural environment as it can disrupt ecosystems, impact wildlife migration, and change water quality.
- **Water allocation-** Water is a finite resource, and competing demands for water use, including agriculture, industry, and ecosystem needs, can create conflicts over water rights and allocation.
- **Social disruptions-** Large scale hydropower projects often involve the resettlement of communities living in the project area, leading to loss of livelihoods and cultural heritage.
- **Cultural impact-** Indigenous peoples may have spiritual or cultural connections to the affected rivers and lands where the dam would be built, leading to conflicts over land and resource rights.
- **Geological hazard-** Hydropower infrastructure is vulnerable to geological hazards such as landslides, earthquakes, and volcanic eruptions, which can damage dams, tunnels, and other structures, leading to safety risks and operational disruptions.
- **Joshimath slide-** A sanctioned hydropower project in *Dhauliganga-Alaknanda basin* punctured an aquifer in 2009 that resulted in Joshimath slide.
- **High cost-** While hydropower is considered cheap, building large-scale hydroelectric

plants is expensive and resource-intensive.

What lies ahead?

- The *International Hydropower Association* (IHA) promotes a combination of water, wind, and sun to achieve sustainable energy goals.
- *Ghana* and *Kenya* are successfully moving from high reliance on hydropower towards a more “robust portfolio of technologies”.
- There’s significant potential in placing *floating solar panels* on reservoirs in hydropower plants, it is already explored by countries like China and Brazil.
- There is a need to move away from mega dams toward medium-scale plants, it can help mitigate climate risks associated with overdependence on large infrastructure projects.

Reference

[Indian Express- Role of hydropower in a world facing drought](#)

