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

