Extreme rainfall events pose a challenge to reservoir operations

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Extreme rainfall events pose a challenge to reservoir operations

We need to improve prediction skill of extreme rainfall events at longer lead, which can be valuable for the reservoir operation to avoid downstream flooding, say Vimal Mishra (right) and Saran Aadhar.

Modelling studies by IIT Ghandhinagar team has found that if high emission continues, then by the end of the century the mean annual air temperature is projected to increase up to 6.25 degree C, while rainfall in the catchments is likely to rise by 13-18%. There is a need to improve prediction skill of extreme rainfall events at longer lead, which can be valuable for the reservoir operation to avoid downstream flooding and also to optimize hydropower production.

The catchments of top seven large reservoirs that produce hydropower in India are likely to experience “substantial warming” leading to increased mean annual rainfall in near future (2020-2030), mid and end (2070-2099) of the century due to global warming. Based on modelling, a team of researchers from Indian Institute of Technology (IIT) Ghandhinagar found the mean increase in rainfall in the catchments is projected to be 6-11% while the mean annual air temperature

is projected to rise more than 2.5 degree C by the end of century if the emissions are low.

In the case of high emission scenario, the mean annual air temperature is projected to increase up to 6.25 degree C by the end of century, while rainfall in the catchments is likely to rise by 13-18%, the **study published** in *Scientific Reports* says.

The impact assessment of climate warming on hydropower production was carried out on seven large reservoirs — Nathpa Jhakri, Bhakra Nangal, Srisailam, Nagarjuna Sagar, Hirakud, Sardar Sarovar, and Indira Sagar. Of the seven reservoirs, Nathpa Jhakri, Bhakra Nangal are located on Satluj River, and snowmelt is one major source of water, which is likely to change under the future climate. The other five are primarily located in the monsoon-dominated climate region in central-south India.

Due to projected increase in rainfall, all the reservoirs are expected to experience increased mean annual stream flow — from about 26% for Hirakud to about 45% for Nagarjuna Sagar. Reduced snow cover and snow depth will result in less snow-melt generated flow to Nathpa Jhakri and Bhakra Nangal reservoirs, leading to reduced stream flow during summer.

"If the projected increase in rainfall occurs predominantly in the form of extreme events it is likely to pose enormous challenge to reservoir operations," says Prof. Vimal Mishra from the institute's Department of Civil Engineering and senior author of the paper. "Almost all of the additional flow into the reservoir has to be released. This might not add to hydropower generation as the focus will be on flood or disaster mitigation than power generation."

According to him, increased number of multi-day extreme rainfall events that can bring a significant amount of seasonal rainfall in a few days is expected to pose a challenge to reservoir operation. Increasing the capacity of reservoirs through desilting might help but having in place a better strategy to operate reservoirs will be ideal.

"For that we need a more reliable and credible monsoon forecast at different timescales (seasonal, weekly and daily). We need to improve prediction skill of extreme rainfall events at longer lead, which can be valuable for the reservoir operation to avoid downstream flooding and also to optimise hydropower production," Prof. Mishra says.

It's not clear how the daily forecast made by India Meteorological Department (IMD) is used for reservoir operations. "There is a need for all stakeholders to look at how reservoir operations should change in response to increased heavy rainfall

events," he says. "Tropical cyclone forecast which is given well in advance allows people to be evacuated in time. This is lacking in the case of extreme rainfall events."

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