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IRRIGATION, AGRICULTURE SHIFT RAINFALL TO NORTHWESTERN INDIA, IIT-B FINDS

Relevant for: Indian Economy | Topic: Different types of Irrigation & Irrigation systems storage

The shortcoming: Till now, the models used widely for land-surface modelling have not been designed for Indian conditions. | Photo Credit: RITU RAJ KONWAR

For the first time, researchers from the Indian Institute of Technology (IIT) Bombay have found that even a change in irrigation policy has the potential to shift monsoon rainfall and intensify extreme rainfall in India through its feedback to atmosphere. They have further found the reason behind the shift in the summer monsoon rainfall towards northwestern India and intensification of extreme rainfall over central India during the month of September.

It became possible to understand what causes the monsoon to shift and the role of irrigation as the researchers developed a module of land-surface model that takes into account the actual soil irrigation and agriculture pattern seen in India.

During the month of September, agriculture lands are highly irrigated and the crops are matured. As a result, there is maximum evapotranspiration taking place leading to highest contribution of moisture from the land to the atmosphere. “Till now, the models that have been used widely for land-surface modelling were not designed for Indian conditions,” says Subimal Ghosh from the Department of Civil Engineering at IIT Bombay and corresponding author of a paper published in *Geophysical Research Letters.*

“The models used so far considered that irrigation starts only when soil moisture is very low (permanent wilting point) and stops when it reaches slightly below saturated soil moisture state (field capacity)”

But the reality is otherwise — there is uncontrolled irrigation in India. And nearly 50% of crop area is covered by paddy where the fields are kept in submerged conditions. As a result, the contribution of moisture from the land to the atmosphere is very different from what is followed in the West, which is what the models used so far took into account.

“So we collaborated with Pacific Northwest National Laboratory to develop a land-surface model that takes into account the Indian conditions,” says Prof. Ghosh.

Several studies have already shown that irrigation contributes moisture to the Indian summer monsoon. But the IIT Bombay team along with researchers from Pacific Northwest National Laboratory and Oak Ridge National Laboratory have shown that whenever there is a change in the irrigation management, there is a change in the moisture feedback to the atmosphere.

The researchers considered three scenarios — no irrigation, irrigation that is based on soil moisture deficit h, and finally uncontrolled irrigation as seen in India.

The researchers found that as a result of excess irrigation over northern India, the summer monsoon rainfall in September shifts towards the northwestern part of the country. There is also intensification of extreme rainfall over central India during September.

Land-surface processes including irrigation affect the heat fluxes — temperature related and evapotranspiration. Modified heat fluxes along with changes in atmosphere moisture content

and distribution result in a shift in rainfall towards northwestern part of the country and increased extreme rainfall over central India during September.

The study has not looked at how irrigation and agriculture influence monsoon in southern India.

“Rainfall increasing the moisture content in soil is well known and can be visualised. But soil moisture contributing to the atmosphere cannot be visualised easily and is therefore neglected,” points out Prof. Ghosh.

“Our analysis underlines why the soil to atmosphere feedback cannot be neglected. Each of the component — atmosphere and hydrology — have to be coupled together to understand the system in full.”

“Any land-surface model used for India should take into account Indian irrigation and agriculture system. Otherwise, we will not add value and will come up with incorrect results,” he says.

“We need more detailed irrigation data for southern India to perform much better analysis of land-surface feedback of human-natural systems,” he says.

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