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Groundwater exploitation linked to rise in India's carbon emissions: study

Billions of liters of groundwater pumped out contributes to carbon emissions in 2 ways - emissions released due to pumps and carbon dioxide released due to bicarbonate extraction

By **Dinesh C Sharma**

Last Updated: Thursday 15 November 2018



📷 The annual carbon dioxide emission from groundwater in India is between 2 to 7% of the total annual carbon dioxide emissions from India. Credit: Getty Images

Over-extraction of groundwater is a major environmental challenge in many parts of India. It is not only leading to rapid decline in groundwater reserves but also contributing to India's carbon emissions, a new study has warned.

Billions of liters of groundwater pumped out every year contributes to carbon emissions in two ways - emissions released due to the pumps used for extracting water and carbon dioxide released due to bicarbonate extraction. Most of the groundwater reserves or aquifers contain sand, gravel, clay, and calcite. Hydron ions react with calcite and create bicarbonate and calcium. When groundwater is

exposed to the atmosphere, carbon dioxide is released while calcite is precipitated.

Researchers at the Indian Institute of Technology, Gandhinagar, have assessed carbon emissions due to pumping as well as bicarbonate extraction using data related to energy requirement of pumping and chemistry of the groundwater. They have found that the total (pumping and bicarbonate) estimated annual carbon dioxide emission from groundwater in India is between 2 to 7 per cent of the total annual carbon dioxide emissions from India.

The total carbon emissions from the groundwater sector have been estimated to be between 32 to 131 million tonnes a year. The carbon dioxide emissions due to bicarbonate (about 0.72 million tons per year) are far less than by those due to groundwater pumping (31 to 131 million tons per year) in India, according to the study.

The estimates are based on data from the Central Ground Water Board (CGWB) and GRACE (Gravity Recovery and Climate Experiment) satellite mission of NASA. The data covered groundwater well parameters like specific yield, bicarbonate concentration and use of electric pumps. CGWB monitors groundwater tables at 24,000 locations across the country. The board also monitors groundwater quality in the pre-monsoon season when the concentrations of bicarbonate ions are maximum.

The distribution on pumps, which are predominantly used for irrigation, for each state at different depths was obtained from the census of minor irrigation. This helped in calculating energy required for groundwater pumping. Electric pumps cover about 70 per cent of the total available pumping energy sources in the country. However, the Gangetic plain region is dominated by diesel pumps.

The researchers also conducted a field survey of 500 farmers in Punjab. "We find that a low-cost intervention for irrigation scheduling based on soil moisture information can provide a sustainable solution by reducing groundwater pumping and carbon emissions," researchers said.

India is the world's largest groundwater user, withdrawing about 230 billion cubic meters of groundwater annually for irrigation. The total estimated groundwater depletion in India is in the range of 122 to 199 billion cubic meters. A large part of the country has over 60 per cent of the total area irrigated with groundwater. Most such areas are in the Indo-Gangetic Plain, northwestern, central, and western parts of India. Some regions (western India and Indo-Gangetic Plain) have more than 90 per cent of their area irrigated with groundwater.

“The environmental problem of groundwater depletion in India is much more serious than carbon dioxide emissions associated with it, and hence there is an urgent need for a regulation of groundwater use,” said Dr Vimal Mishra, a member of the research team, while speaking to *India Science Wire*.

“The warning about carbon emissions from groundwater extraction is an important reminder that every human activity has multiple impacts and can have unintended consequences,” commented Raghu Murtugudde, professor of atmospheric and oceanic science and earth system science at University of Maryland and currently a visiting professor at IIT Bombay. “We also need to keep a close eye on other factors like equal access for all stakeholders and increased fluoride and arsenic due to mining deeper for groundwater.”

The research team included Vimal Mishra and Akarsh Asoka (Indian Institute of Technology Gandhinagar); Kamal Vatta (Columbia International Project Trust, New Delhi) and Upmanu Lall (Columbia University, New York). The study has been published in journal *Earth's Future*. **(India Science Wire)**

NEXT STORY

Water

Will the inauguration of Ganga navigation destroy the river's ecology?

Down To Earth talks to riverine experts on what could happen to the river's flow, depth and wildlife

By **Rajat Ghai**

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 An old rusty ship anchored near the Vidyasagar Setu on the river Hooghly at Kolkata. Credit: Getty Images

As Narendra Modi inaugurated India's first multi-modal terminal on the Ganga river in Varanasi on November 12, the spotlight is back on how navigation of arguably India's greatest river would impact it.

Modi received India's first container vessel to move inland and the ship sailed from Kolkata to Varanasi on October 30, carrying cargo belonging to Pepsico (India).

The development marks the commencement of the Narendra Modi government's Jal Marg Vikas Project (JMVP) that aims to develop the stretch of the Ganga between Varanasi and Haldia for navigation of large vessels weighing up to 1,500-2,000 tonnes. It includes the construction of three multi-modal terminals (Varanasi in Uttar Pradesh, Sahibganj in Jharkhand and Haldia in West Bengal); two inter-modal terminals; five roll on-roll off terminal pairs; a new navigation lock at Farakka; assured depth dredging; integrated vessel repair and maintenance facility, differential global positioning system, river information system, river training and river conservancy works.

But what does all this entail for the river, its waters and the creatures that inhabit them?

A number of river experts that *Down To Earth* spoke to agree that the government's claims that inland water transport would be cheap are exaggerated. "Inland water transport is not so cheap. Not when we have options like the railways. It is true that roadways can be costly. But one must remember that roads also provide last mile connectivity. In case of inland waterways, the expense incurred to transport goods to the moored vessel will ensure that the end amount will be almost equal to transporting goods by road all the way," says Shripad Dharmadhikary, a researcher at Pune-based non-profit Manthan Adhyayan Kendra. "Certainly, inland waterway transportation is not going to be cheap as we are being made to believe," says the "Waterman of India", Rajendra Singh.

The most contentious issue is dredging of the river and its costs. "To allow ocean-going vessels to traverse a river, it should have a depth of 2 to 3 metres and a width of 45-60 metres. Even a river as mighty as the Ganga does not have those parameters. It will have to be dredged continuously," says Dharmadhikary.

"I have just come back from a tour of the lower Ganges in Uttar Pradesh's Ghazipur district. The authorities had done dredging of the channel before the monsoon. We saw that it has caused a lot of erosion," says Rajendra Singh.

Besides erosion, dredging will effectively destroy the river's aquatic life and the fisher communities that depend on them. "Dredging increases water turbidity and this affects fish. It also affects benthic organisms," says Dharmadhikary. Benthic organisms are creatures that live in and on the bottom of the river floor. They include worms, clams, crabs, lobsters, sponges, and other tiny organisms that live in the bottom sediments.

He adds that most ships moving on the Ganga will be carrying freight of mostly coal and crude oil. "Spillage of these substances could cause more damage. Two years ago, the Union Ministry of Environment, Forest and Climate Change had commissioned a research to study the effects of transporting coal between Farakka and Haldia. There is a thermal power plant at Farakka that regularly needs coal and ships travel upriver from Haldia. The study found that the coal transportation had severely affected fish stocks and in turn, the livelihoods of fisherfolk," says Dharmadhikary.

The passage of huge ships on the river would also cause a lot of noise pollution. This, in turn, will affect fish and other wildlife, most notably the Ganges dolphin, one of the Ganga's most famous residents. "We all know that dolphins, especially river species, find their way through echolocation. Noise generated by passing vessels would disturb their delicate SONAR and in turn, affect them in ways that we cannot fathom," says Dharmadhikary.

The JMVP also envisions the construction of barrages and locks on the Ganga. "That could reduce water flow in various stretches of the river and make life difficult for wildlife," says Singh.

Another species that could be affected is the Gharial (*Gavialis gangeticus*), the fish-eating crocodilian native to the Ganga. "The Varanasi-Haldia stretch has a negligible population of gharials. But Ganga tributaries like the Gandak and Ghagra do have them. The government has declared the Gandak to be National Waterway Number 37. Big vessels could disturb gharials, dredging would destroy mid-channel islands or sand bars, vital to the animal for basking and regulating its body temperature. If ships begin to ply the Gandak, it will be catastrophic for the gharial," warns Samir Sinha, scientist at Delhi-based non-profit, Wildlife Trust of India.

"Inland navigation has not been properly studied in India. For the JMVP, the Environmental Impact Assessment was not scrutinised by independent, international quarters. The government gave the go-ahead to its own project. No environmental clearance was given. Even if the clearance is given, there are a number of binding conditions which must be abided by. Nothing has happened in this case," says Dharmadhikary.

But then, isn't inland, riverine navigation common in other parts of the world? The Amazon, Yangtze and Mississippi are some of the great global rivers which are regularly traversed by vessels. Even smaller western rivers like the Clyde and Thames in the UK and the Elbe in Germany have ocean-going vessels plying them. Can't the Ganga experiment be like them?

"It is not that navigation on these rivers does not harm their ecosystems. But the damage is lesser. Also, most such rivers have enough water of their own to enable navigation. In India though, most rivers are monsoon-fed and are at their full only during the rains. One can do inland navigation in India, but it should be homogenised to the depth and flow of the river in question," says Dharmadhikary.

"Our rivers with a mere 20-30 days of annual rainy days against 150-200 days in the west are neither comparable nor similarly manageable. Nor is our biodiversity and its fragility the same," says Manoj Mishra of the Yamuna Jiye Abhiyaan. "The silt load in western rivers is nothing comparable to the Ganga or our other Himalayan rivers. Clearly, the commercial navigation plan as envisaged, cannot provide any returns without massive and regular dredging, which is akin to disemboweling. It is an invitation to disaster as regards the biological integrity of the Ganga," he adds.

People such as Singh are going to protest against the project. "On November 25, 26 and 27, there is going to be a *Dharma Sansad* in Varanasi. After that, many of us from civil society will embark on a *Sadbhavna Yatra* from Varanasi to Gangasagar at the mouth of the Ganga in West Bengal. This will last till Makar Sankranti or January 14 next year," he said.

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