Study shows the impact of unplanned development on river basins and catchment areas

A team of ecologists from Bengaluru studied the Kali river basin to determine interlinkages between water biodiversity, hydrology, ecology and the land cover.

by TV Padma

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A novel approach by Indian scientists to assess the water and ecological footprints in Kali river basin in the Western Ghats of peninsular India has revealed declining native vegetation in the basin. This is affecting the region's water sustainability.

The method, developed by ecologists at the Indian Institute of Science, Bengaluru, was for the first time used to study a river in Karnataka and assesses the inter-linkages between biodiversity, hydrology, ecology and the land cover/land use dynamics in river basins.

The Kali basin in the area is home to a tiger reserve, a hornbill reserve and wild elephants, while the Kali river estuary is home to 37 species of fish, as well as bivalves or molluscs. The river also has six major dams, built between 1980 and 2000.

“The catchment, dominated by native vegetation, meets the demands of various sectors such as water, irrigation, electricity, compared to the sub-catchment area that which was badly impacted due to mismanagement and where there is scarcity of water, which, in turn, has affected the livelihood of people in the area,” lead scientist TV Ramachandra, professor, energy and wetlands group, Centre for Ecological Sciences, Indian Institute of Science, told *Mongabay-India*.

The study shows that streams in the river sub-catchment areas turn perennial – that is, carry water all the year round – when at least 55% or more of the river catchment is covered with native vegetation, whereas there is water sustenance for only six to eight months in catchment areas dominated by monoculture plantations. Streams carry water for less than four months and turn seasonal when the catchment area is degraded, with less than 30% vegetation cover. The team’s assessment of land use dynamics, using remote sensing data from 1973 to 2016, shows a decline in evergreen forest cover from 61.8% to 37.5% in the Kali river basin.

The Kali river running through Dandeli. Photo credit: Pixabay.

The scientists' computation of eco-hydrological indices shows that the sub-catchments in the Western Ghats with more forest cover, comprising native species, have a better eco-hydrological index as against the plains. This highlights "the vital ecological function of a catchment in sustaining the hydrologic regime when covered with the vegetation of native species," their report in the *Yale Journal of Biology and Medicine* says.

Results of the study also demonstrated that inter-annual water budgeting across sub-basins indicated the mountains or 'Ghats' and coastal areas to the west to be more sustainable with perennial rivers compared to the plains in the east which showed water deficit, indicating water stress.

'Development' goes south

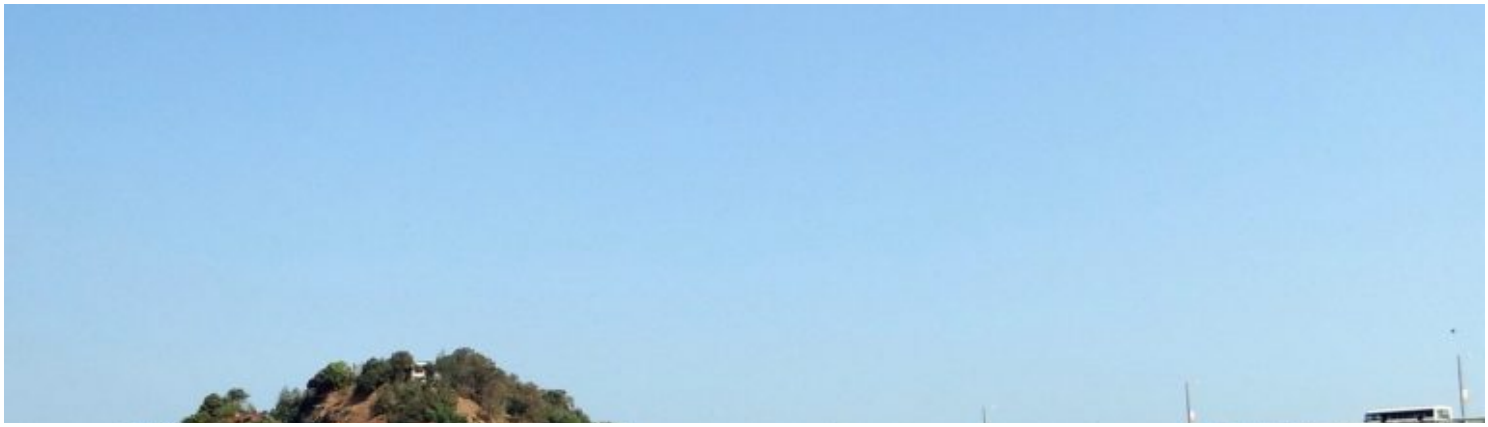
The study also shows the "impacts of unplanned senseless developmental projects coupled with the large-scale forest fragmentation", Ramachandra said.

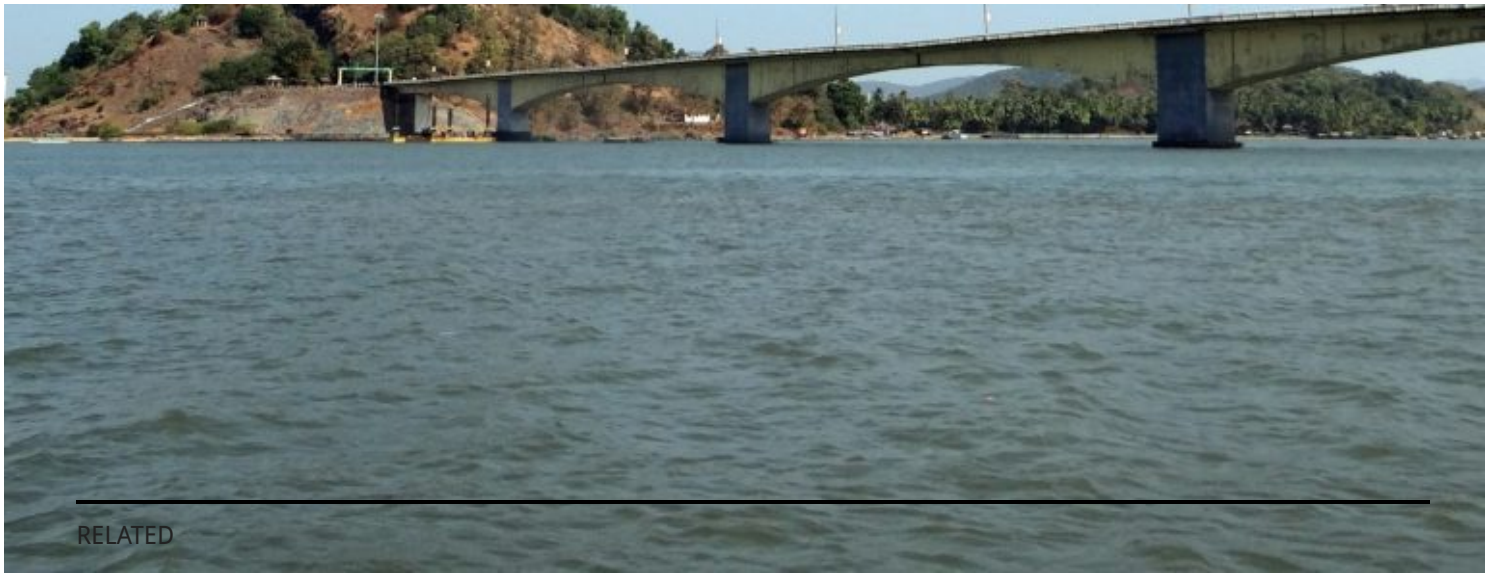
According to the study, unplanned developmental activities have altered the catchment integrity, which, in turn, has threatened regional water security due to the conversion of perennial streams to seasonal ones. Perennial streams are present in sub-catchment areas dominated by native vegetation, while catchment area dominated by human activities and monoculture plantations have only seasonal streams.

India's "skewed strategies", oriented mainly towards societal benefits with little regard for environmental consequences, have led to large-scale degradation of the landscape, the study says, adding: "Large-scale alterations of the landscape structure have led to erosion in the ecosystem supportive capacity that plays a major role in sustaining the hydrological regime. Insights of eco-hydrological footprint in the catchment would aid in formulating policies to sustain the hydrologic regime and natural resources."

The findings of the study reveal the need for integrated watershed management on a priority basis in India to address water scarcity issues due to climate changes. This is especially crucial given that 156 districts in Karnataka were reeling under drought in 2018, said Ramachandra. Prudent catchment management strategies can also help maintain aquatic and terrestrial biodiversity and sustain water resources.

According to the scientists, the water scarcity has hit livelihoods of the local people. Villagers in the vicinity of native vegetation earn $2,164 (Rs 1,54,000) per acre per year compared to the villages in the vicinity of monoculture plantations, who make only $449 (Rs 32,000) per acre per year. The research sounds a note of caution against trying to achieve higher gross domestic product at the cost of water and health. In addition to water scarcity, there is an alarming absence of pollinators and lack of organic carbon and nutrients in the soil. "This demands large-scale afforestation with native species in order to sustain water in India," advised Ramachandra.





A bridge on the Kali river. Photo credit: Sarangib/Pixabay.

Underlining the "novel" approach in studying a river in Karnataka for the first time, Ramachandra says, "It is worth replicating this model to major rivers (in India). Now we are replicatingthis approach to other river basins in Karnataka. Then we plan to scale up to the Western Ghats rivers, as the Western Ghats ensures water security, and hence food security, to dependent populations in peninsular India."

Similar studies in the north

The IISc study is not alone in its cautionary note. A study by scientists at the Indian Institute of Technology, Kanpur, led by Rajiv Sinha, professor, department of earth sciences, on the upper Ganges basin also records the impacts of unbridled development activities along the river. Their 2017 report in the *Journal of Hydrology: Regional Studies* revealed the effect of dams, barrages and hydropower projects on natural water flow in the upper Ganga region.

"The dams and barrages disrupt the longitudinal connectivity of the river as well as the flow pattern," the study report says. The study showed unnatural high flows during the dry period and significantly less-than-normal flows during the wet period. "This indicates that although the bare minimum eco-geomorphological conditions are

being fulfilled, these river stretches are highly impacted and vulnerable to future damage," the report adds. It surmises that while hydropower generation is considered necessary to fulfil India's energy demands, conventional hydropower projects "tend to violate the basic integrity of a river… It is imperative, therefore, that existing and future hydropower projects are planned, designed and/or modified in such a way that suitable provisions are made for uninterrupted and adequate river flows."

Similarly, studies led by Jagdish Krishnaswamy, a senior fellow at the Suri Sehgal Centre for Biodiversity and Conservation at the Ashoka Trust for Research in Ecology and The Environment, Bengaluru, show a decline in soil water infiltration at the surface of degraded forests as result of human impact over decades and centuries in the Western Ghats.

"Plantations of exotic trees, for example, *Acacia auriculiformis* have not ameliorated the soil hydrology, and their soil water infiltration still remain quite low when compared to the less disturbed forest permeability," said Krishnaswamy, adding that restoration efforts by stakeholders across the board, preferably using native or non-invasive species, are needed to address this concern.

Research by Krishnaswamy's team shows that groundwater recharge during the wet season in the coastal basins in the Western Ghats under natural forests, acacia plantations and degraded forests was estimated to be 50%, 46% and 35% respectively and in the Malnaad it was 61%, 55% and 36% respectively.

The researchers attribute the higher level of groundwater recharge in the first instance to the presence of natural forests. There is also a 10%-36% difference between natural and degraded forests' ability to buffer high-rainfall events. These events are predicted to increase due to global warming.