SAVING INDIA'S RIVERS AND RIVERINE ECOSYSTEMS

written by Jagdish Krishnaswamy December 10, 2015

The Prime Minister in a speech some months ago very rightly remarked that "future generations will not forgive us for t manner in which we have treated our water". It would be really nice if this concern was also extended to the plight of In remaining free-flowing streams and rivers. The dominant paradigm is that rivers which flow freely all the way to their e and deltas do not serve any purpose and one often hears politicians and bureaucrats stating that so much water is going into the Arabian Sea. The ecosystem functions, ecosystem services and livelihoods that rivers and streams provide to communities is rarely mentioned.

No one doubts that rivers may have be to tapped and hydrology modified for human use. Many of the gains in agricultu hydropower generation in India are from dams, barrages and reservoirs. However it is now time to look at the costs of fu large-scale transformations on the last remaining free-flowing stretches of rivers and streams and question our entire a to water management in the country. The growing evidence from negative impacts of barrages and dams on downstrear ecosystems, ecosystem services and livelihoods including impacts on productivity of estuaries and deltas should be care assessed by all stakeholders before planning any new transformations.

> *India is facing uncertainty and variability from changing climate and so is the competition and conflict access to water among sectors and states.*

All over India, from small headwater streams in forested mountains to large rivers, projects for hydropower generation, abstraction of water for industry, towns and cities, and even large-scale inter-basin water diversions are ongoing and pl

Source: Frits Ahlefeldt

Add to that the polluted state of our major rivers, and we can imagine the magnitude of the problem.

Some of these projects will, by design, introduce an artificial diurnal cycle into stream flow with pulses of water release the power generation cycle that is a multiple of any natural diurnal fluctuations. The small hydropower projects (SHP) v categorised as "green energy" also often result in diversion of water through pipes and canals, leaving the original strea up to one km or even a few km. The impacts on native aquatic biodiversity, riparian ecosystems and some local livelihoc be substantial. And when several streams are tapped, the cumulative impact can be irreversible and can cause extinctio endemic species in the river basin.

> *The National Water Policy has mandated that ecological and environmental flows should be maintaine rivers, but we do not have rigorous scientific guidelines for assessing flow regimes for specific riverine ecosystems and ecosystem services.*

India is facing uncertainty and variability from changing climate and so is the competition and conflict over access to w among sectors and states. The Indian monsoon has been declining since the 1950s, and extreme rain events are increas some parts of the country. The spatial and temporal uncertainty in the rainfall regime is best illustrated by what we saw

country this year: drought in some parts, floods in others and areas with crop failure subsequently undergoing intense r floods. There is broad agreement that our rainfall regime is changing in complex ways. Furthermore the failure of clima models to simulate observed trends is worrying, casting doubt on their future projections.

These trends need to be considered when large-scale inter-basin transfers are being implemented or planned. These int transfers are based on the assumption that "surplus" water in some basins (in the wet season) can be diverted to other "deficient" basins. The role of peak monsoonal flows in sustaining downstream ecosystems and livelihoods, especially t fisheries in deltas, estuaries and shallow marine ecosystems, is ignored. These ecosystems depend on sediment, nutrien freshwater flows to maintain the unique salinity and biogeochemistry regime that underpins their productivity.

> *The whole engineering-dominated discourse on "utilisation" of river waters vis-à-vis ecological and environmental functions and ecosystem benefits of free-flowing rivers from headwater to estuaries is be questioned.*

In most cases, water scarcity problems have been addressed by supply augmentation either through creating additional storage or diversion from neighbouring basins.

In the context of the Western Ghats, numerous inter-basin transfer projects have been proposed by state and central governments including the National River Linking Project (NRLP) to divert 'supposed' surplus water from the west-flow to the scarce basins of east-flowing rivers to meet drinking water, irrigation and energy demands. However, the notion o 'surplus' and its estimation in a river basin is often based on limited data, flawed methodologies of environmental flow requirements, non-utilisable river flows and recurrent floods which discharge into the Arabian Sea. The whole engineer dominated discourse on "utilisation" of river waters vis-à-vis ecological and environmental functions and ecosystem be free-flowing rivers from headwater to estuaries is being questioned.

Many scholars now argue that the water surplus assessments conducted as part of NRLP have ignored a whole range of ecological, environmental and social issues. The methods used to estimate the environmental flow requirements (EFRe stream utilisation (water demands) of stream flow to arrive at the surplus followed the guidelines proposed in the India Policy, 2002 and draft Revised India Water Policy, 2012. These methods applied for estimating EFReq are scientifically o and application of new methods for understanding environmental flow 'regimes' (EFReg) could classify these large stor diversion projects either environmentally damaging or socially unjust/inequitable. Traditional methods of estimating E used either historical or modelled minimum discharge in the river as essential flows for environmental benefits, and typ some percentage of the total annual discharge or twice/thrice the minimum discharge (measured/modelled) in the strea average year. In India, the concept of impacts of river flow regimes on specific components of aquatic biodiversity and e services downstream is a very recent area of research enquiry and even the concepts and methods are largely hydrologic

statistically driven rather than comprehensive approaches encompassing taxa-specific biology, aquatic ecology, ecosyst services and livelihood dependencies.

> *We first found out from our independent measurements that the claim of the authorities that a discharg m3/s that was supposedly maintained in the Son downstream of the dam was not correct. It was a fract that!*

The role of flow 'regimes' and 'flow variability' in maintaining ecologically and socially beneficial habitat is very recent. example, tropical estuarine areas free from major developmental projects have been known for their extremely product fisheries. All along the Indian west coast, the estuarine banks are densely populated with hamlets dependent on fisheri including shellfish. There are hardly any rigorous studies to ascertain the importance of unaltered hydrologic regimes a economic returns from fisheries to in stream and downstream communities. Even rarer are studies which assess the neg impacts of altered flow regimes due to hydroelectric projects or diversions in any of the several rivers from the Western

Freshwater, estuarine and deltaic ecosystems and their biodiversity and ecosystem services are the most threatened in I to dams and upstream diversion for agriculture and industry, overexploitation of groundwater and pollution of surface addition, growing urbanisation and the need to supply water to villages and towns is likely to place even greater deman limited supplies of unpolluted water that emerges from forested highlands and wetlands. The plan to interlink rivers is raising concerns about impacts on biodiversity and ecosystem services, apart from its sustainability under the current c and future climate change.

The National Water Policy has mandated that ecological and environmental flows should be maintained in rivers, but w have rigorous scientific guidelines for assessing flow regimes for specific riverine ecosystems and ecosystem services. W have a management and policy framework that imposes efficiency on competing water use in industry, cities and agricu enable allocation of water for maintaining ecological and environmental flows.

Ideally, multi-stakeholder and inter-disciplinary approaches are needed to estimate ecological and environmental flows selected river ecosystems and design an adaptive management plan that reconciles ecological flows with other competi and also privileges sustainable use of precious unpolluted water for drinking water, reduces water use in agriculture, pr recycling and reuse by industry and in urban areas. Furthermore this assessment must take into account ongoing and p future trends in climate.

Saga of the Son

There is legitimate concern about projects on the last remaining free-flowing streams and rivers, but what about the riv are already regulated and managed (the majority of rivers in most parts of India) in particular ways? Can we manage the enhance biodiversity and ecosystem services?

To illustrate the challenges of maintaining ecological flows, I will cite our experience from the Son River, a tributary of t Ganga that originates from the highlands in central India. The Son River had river dolphins, gharial crocodilians, freshv turtles, otters and a thriving fishery that sustained communities of fisher folk.

The Son was also prized for the quality of its sand. The first major change and barrier was the Indrapuri barrage in Biha completed in 1968, which reduced the Son to a trickle in the dry season downstream. Dolphins were probably the first c this barrier and discontinuity of flow. However the Son upstream of this barrage was still a thriving riverine ecosystem. stretch of the river and part of its two main tributaries, Banas and Gopad, was declared the Son Gharial Sanctuary in 19 Son Gharial Sanctuary is home to a number of endangered species, with the flagship species being the gharial (Gavialis gangeticus), narrow-headed softshell turtle (Chitra indica) and Indian skimmer (Rynchops albicollis). All three species a specialists and their breeding ecology and reproductive success are closely linked to the seasonality of flow regimes and availability of undisturbed nesting sites like large, high sand deposits and emergent sandbar habitats.

But in the last ten years, this 200 km riverine biodiversity hotspot was transformed. The Bansagar Dam (whose waters a shared between MP, UP and Bihar) was completed in 2006 after decades of planning and construction. As the gates were the reservoir started filling, the stretch of the Son River downstream of Bansagar and upstream of Indrapuri was subject changes in flow regime and sediment dynamics. As the reservoir filled up, the river downstream was choked of dry seas and sediment. Subsequently once the reservoir was filled up, a new regime of flows subject to releases of water from the irrigation and for hydropower generation started. Sand mining of the exposed riverbed in the dry season proliferated an mafias defied state authorities. Successful *gharial* nesting was restricted to only one site along the entire stretch.

> *High quality water from ecosystems must be at a premium and industry must not be able to get it cheap has been the case all along.*

Meanwhile, the water of tributaries downstream has been allocated for a series of thermal power plants, cement factori townships, one of which has already tapped the Gopad tributary.

I was part of a small team consisting of myself, wildlife biologist Ravi Chellam, and dedicated aquatic ecologists Tarun I Suyash Katdare, who had to advise the MP authorities on how much water to release from Bansagar Dam to maintain "e flows" in the Son Gharial Sanctuary. Bihar's share of the Bansagar water flows through the Son Gharial Sanctuary. We fi out from our independent measurements that the claim of the authorities that a discharge of 50 m3/s that was suppose maintained in the Son downstream of the dam was not correct. It was a fraction of that! We also discovered that the Go Banas tributaries were now the lifeline of the Son in the dry season.

Our basic idea was to try to relate quantitatively release of water from Bansagar Dam to maintenance of desired water l breeding and nesting sites of the endangered *gharial*. Using this, we would propose a reservoir release regime that woul damaging.

However, as we worked with a very sincere forest officer and a dedicated team of ecologists on the ground, we experienc hand the complexities of maintaining ecological flows downstream of reservoirs.

On 20 February 2015, the Bansagar Dam authorities informed that they would release water from the Bansagar Dam for state at a discharge rate of 170 m3/s from 2pm. This raised water levels in the sanctuary by over 50 cm over a couple of event that would usually not happen at this time of the year, inundating basking and nesting sites of the gharial.

We protested and requested them to reduce the rate of discharge, and finally it was reduced to 125 m3/s after four days. release regime did connect isolated pools and *gharials* were able to move from one site to another along the river, and e excavated trial nests, but it was a short-lived connectivity, as the dam gates were shut on 9 March 2015, and no successf emerged in any new site. Such movements can also leave *gharials* stranded in less protected sites once the dam gates ar and water levels recede.

On 6 April 2015, the dam authorities informed us of their plan to release water again due to demands from UP and Bihar. We requested him to defer any releases till we discuss the matter with the Forest Department, particularly since skimmer nesting had commenced on emergent sandbars and islands in the Son Gharial Sanctuary. Following Forest Department intervention, Bansagar Dam authorities provided assurances that no water

would be released in this period. They furthered offered to make available, on demand, up to 3 m3/s of water for mainta river flow in the sanctuary. However, the sudden opening of a smaller dam on the Gopad River tributary that caters to th thermal plant resulted in the drowning of the first clutch of skimmer nests and abandonment of nesting sites in the one important nesting sites in the fourth week of April 2015. While the increase in water levels was relatively small (< 15 cm to the submergence of a large part of the emergent sandbar that was used as the skimmer nesting site, and the subsequ disruption of their first nesting effort.

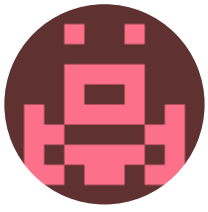
Finally, on 8-9 June 2015, the Bansagar Dam authorities were ordered by their superiors to start releases and this raised levels by 78 cm, and this release of water from Bansagar Dam resulted in the total loss of skimmer nests at four breedin Even mounds created by the sanctuary management, as an emergency measure, a day earlier could not prevent the inur nesting sites. However the gharials fared better as the 2015 season produced 3 nests in the only breeding site, and 85-9(hatchlings emerged between late-May and early-June. But skimmers had a bad year, despite their attempts to nest for a time in the same season.

This is just to illustrate the complexities of managing reservoirs for ecological flows all over India. In the future, we will think of innovative and creative ways of restoring sediment deposition to riverine ecosystems, which will be a big challe

Conclusion

Ecological and environmental flow regimes should become an integral part of any future project design, rather than an afterthought. Ultimately, ecological flows, water stress and conflicts over competing demands on scarce water resource resolved only by promoting recycling, reducing water use and wastage of water in all sectors: agriculture, industry and i and towns. Furthermore, high quality water from ecosystems must be at a premium and industry must not be able to ge cheaply as has been the case all along.

In conclusion, I would like to dedicate this piece to the memory of Professor Ramaswamy Iyer, former Union Secretary, Resources, Government of India, who passed away on 9 September 2015. He was the architect of the first National Wate and wrote on sustainable water management with insight and foresight. He belonged to the dwindling tribe of bureaucr scholars, and he will be missed by all of us who are concerned with saving India's rivers and their ecosystems.



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