Cry for Water

Tapping South Asia's Gold Mine

The Ganges-Brahmaputra-Meghna basin is awash in water, but lack of an integrated regional approach to developing and exploiting this resource is depriving South Asia of enormous agricultural and hydro-electric gains. **Dr. Yusuf A. Choudhury** writes

WATER resources development in South Asia has been a continuing endeavour for a very long time. Most countries in the region are spending considerable resources to make more water available to their growing population. But a lot remains to be done in terms of developing a holistic, regional approach for managing this vital resource.

Rapid growth of population and the economy has placed tremendous stress on the water supply in India, Bangladesh, Nepal, Bhutan, Pakistan, and Sri Lanka, threatening to cut short its availability, unless timely measures are taken to manage the system in an efficient and sustainable manner. The situation is made more complex by the fact that there are often extremes in water availability and demand in the same location at different times of the year, which upsets the water balance in each season. For example, the monsoon supply of water in the Ganges and Brahamaputra basins is far in excess of demand. But the basins also have supply shortages with concurrent peak demand (from irrigation) in the dry months.

When the total water resource potential of the region is considered, it is possible to foresee that there could be an abundant supply of water for meeting long-term demands of all countries if new developments could capture more of the seasonal run-off of major rivers to the sea. It is conceivable that through cooperative ventures more water could be made available to all the countries' water deficient areas when they are needed and at the same time the problem of excess seasonal deluge can be effectively managed. The efforts could also pay back through substantial amount of hydropower generation in a now power-starved region.

There is a growing recognition that water use decision in one part of a river basin can have significant negative impact on the wider catchment area, and in the whole of the river basin. In Bangladesh, it has become a very critical issue because a large tract of its south-west region is succumbing to salinity encroachment from the sea, besides experiencing a decline in agriculture, fisheries, and drinking water supply as a result of decrease in the flow of the Ganges during dry season.

The solution of the problem may lie in different measures such as creation of storage reservoirs for evening out the flows of the rivers during different times of the year and inter-basin water storage and transfer. These are, however, possible only if the three countries work cooperatively towards holistic development of the river basins of the Ganges, Brahmaputra and Borak/Megna. The adoption of an integrated river basin approach to water resources management is the only solution to mitigate the negative effects of isolated water development schemes and to maximize the returns from the entire system. Each country could gain from such a venture and resolve many of its outstanding water and power problems.

The Great Basin

THE combined Ganges-Brahmaputra River Basin consists of 1.8 million square kilometers of northern and northeastern India, Nepal, Bhutan, Bangladesh and Tibet. The Ganges Basin, which occupies over 60 percent of this area, comprises of the catchment area above its confluence with the Brahmaputra river in Bangladesh and a part of the delta complex formed by the Ganges, Brahmaputra, and Meghna rivers fed exclusively by the Ganges. Eighty percent of the basin lies in India, 13.9 percent in Nepal, 3.7 percent in Bangladesh, and 2.4 percent in China.

The Ganges River originates in the Himalayas in northwestern Uttar Pradesh of India and flows down 1,700 km through Uttar Pradesh, Bihar and West Bengal before bifurcating near the border of Bangladesh to form two distributaries. The Bhagirathi distributary flows south to the sea through the Hoogly estuary in India, and the Padma distributary flows eastward for 220 km before joining the Brahmaputra river coming from north-east in Bangladesh and then flows down to the sea. Above the bifurcation point, the river is joined by six major tributaries on its left bank (Ramganga, Gomati, Ghaghara, Gandak, Buri Gandak, and Kosi) and four on its right bank (Yamuna, Tons, Karamnasa, and Bhagirathi), all in India. The Ghagra, Gandak, Buri Gandak, and Kosi rivers, however, originate in Nepal.

The semi-arid upper Ganges basin lying in India has been systematically developed for over 500 years bringing the benefits of higher agricultural productivity and economic growth to the area. The lower Ganges, Brahmaputra and the Meghna basins, however, have remained undeveloped and faced multiple problems with increasing monsoon precipitation as one moves south-east with large discharge of silt-laden waters defying control and causing alternate flood and drought in these areas.

On an average, the Ganges Basin receives 120 cm of precipitation per year and the Brahmaputra basin about 212 cm. Eighty five percent of this annual precipitation occur during the monsoon period June-October. There is also a great deal of variation in the rainfall over different parts of the region. On the whole, the area deluged by rain four months of the year suffers from acute water shortage during the remaining eight.

Over 535 million people live in the Ganges, Brahmaputra, and Meghna (GBM) basin, the largest concentration of world's poorest - a figure likely to double by 2045. Bangladesh accounts for only 7.4 percent of this vast drainage basin but over 1.1 million cubic meters of run-off and 2.4 million tons of sediments are annually funneled into the sea through it. The headwaters of 54 rivers, counting for 95 percent of Bangladesh's run-off, originate in or beyond India.

The groundwater resources of the Ganges basin are also substantial but increasing utilization in India, Bangladesh and Nepalese Terai region are pushing it towards full utilization. Groundwater constitutes part of a single hydrological resource, feeding rivers during the lean season and replenished by them at other times. Excess pumping in eastern India, thus, depletes surface flows in Bangladesh.

Land use pattern in the Ganges basin shows substantial agricultural use. About 62 percent of the basin area in India, 75 percent in Bangladesh and 16 percent in Nepal are devoted to agriculture. The extent of cultivation in the Indian part of the Ganges basin is very high (over 80%) and the ratio of gross to net sown area is as high as 180. The development of surface water irrigation schemes has received high priority in India ever since its independence in 1947 and today virtually every river in the Indian part of the Ganges system has diversion for irrigation and storage reservoirs, particularly on the right bank tributaries.

Development of irrigation in Bangladesh during the period it was a part of Pakistan was through a few large public surface water schemes. Since the country's independence in 1971, however, private sector led groundwater irrigation has expanded with a current coverage of about 90 percent of the irrigated area. In Nepal, privately managed surface water irrigation is predominant and groundwater irrigation is minor, concentrated mainly in the Terai region.

Potential Unutilized

Surface water resources of the Ganges basin are huge in terms of total annual volumes. However, as indicated before, more than 80 percent of the total runoff in a year normally occurs during the four-month period of June to October. In the absence of large surface reservoirs, a major portion of the annual flow is lost to the sea. But there is a substantial drop in the flows of the basin rivers in the dry season, which is further aggravated by the need for diversion of water for irrigation during this time. As a result, water shortages in the lower reaches of the Ganges during the eight non-monsoon months are endemic.

Data Inadequacy: At present, it is difficult to quantify the water resources availability within the basins with accuracy for a number of reasons. Hydrological records of river flows in Nepal are not available at its border with India. Detailed data on river flows and stream diversions on the Indian part of the basin are not available due to restrictions imposed by the Indian government. Moreover, whatever data is available are year-round statistical aggregates that render them impossible for inferring lean season flows. Also, there are differences between the available data at different gauging points in the system.

Aggregate Known Potentials: The estimated average annual run-offs in the Ganges and Brahmaputra basins are 502 BCM and 537 BCM, respectively. The largest contribution to the Ganges flows are provided by its left bank tributaries with catchments in the Himalayas, such as Ghaghara (98.4 BCM), Kosi (68.3 BCM), and Gandak (51.7 BCM). The right-bank tributaries, that drain about 51 percent of the basin above Farakka, together contribute about 123 BCM or approximately 30 percent of the total basin run off.

Low flows in the Ganges occur between November and May, peaking between January-April. In the upper portion of the basin the low flows have been further reduced by irrigation diversion from the main river and its tributaries. In some of the lower basin areas the reduction have been partly compensated by return flows from surface irrigation. Large expansion of groundwater usage has also reduced the dry season flows. There are no reliable measures, however, of the effect of each type of development on the hydrological regime of the basin as a whole.

The estimated basins' potentials, on the basis of available data (outdated in many cases) are somewhat indicative of the substantial opportunity for development in this area. Particularly, the potential for hydropower is enormous, the current utilization being slightly over 2 percent. Available data show that although irrigation potential has been almost fully utilized in India, the full irrigation potential of the basins remains greatly underutilized in relation to the aggregate annual run-off.

The technology applied extensively for irrigation in this region depends on surface water diversion, which is neither adequate nor reliable round the year. Storage dams in the Himalayas were not extensively undertaken in the past due to shortage of technical capability, high investment requirement, and lack of political will. Other aspects of water such as navigation, flood control, drainage, hydroelectric development and drinking water supply have only received limited support and remain undeveloped to a large extent.

The potential of hydroelectric power from the rivers in Nepal is enormous. Till now only half of one percent of this potential has been harnessed. This latent potential, if fully developed, could power the whole of Nepal, northeastern India, and Bangladesh with clean energy.

Uncoordinated Development

India takes more than 95 percent of the surface water used for irrigation in the Ganges basin. Virtually every river in the Indian part of the system contains diversions for irrigation, and a number of storage reservoirs have been constructed for this purpose on the Right Bank tributaries of the Ganges. The total diversion capacity on the various basin rivers above Farakka in India is estimated at 6,500 cubic meter per second. There are, in addition, a large number of smaller diversion structures on the smaller rivers on which no substantive data is available. The estimated diversion, however, is greater than the total low flows in these rivers.

Analysis at the Farakka point show that there has been a definite trend towards decline of dry season surface water flows. There are indications that essentially all the low flows in the river system above Farakka Barrage are being intercepted and diverted for irrigation. This implies that the water reaching the lower basin and arriving at Farakka Barrage during the low flow season are mainly effluent flow from the groundwater system to the rivers. Since groundwater abstraction is increasing rapidly both in India and Bangladesh, the overall effect of all these will be disastrous on the river systems leading to irreparable environmental damage in the future.

Diversion of water from the Ganges at Farakka has already produced a series of adverse effects in Bangladesh. The Gorai, the main distributary of the Padma, dried up on 29 March, 1976. As a result, fisheries and navigation received a serious setback and the salinity front on the delta moved about 150km inland. So far, India has created about 33 BCM of live storage on rivers in its part of the Ganges basin through medium and major reservoirs to supply its agricultural needs. About 88 percent of this storage are above Farakka and the balance is on the Bhagirathi drainage system. Present on-going projects in India will create additional live storage of about 14.7 BCM, and 6.5 BCM more are in the plans.

Some preliminary studies have been conducted for storage projects in Nepal, but the progress is slow because agreement with India over cost sharing and energy pricing have not been reached. The most recent Mahakhali Treaty between India and Nepal (February 1996) provides for water sharing and joint power development in the Mahakhali basin through an integrated development of the Mahakhali River, the Sarada Barrage, Tanakpur Barrage, and the new Pancheswar Dam.

There are critical shortages of water supply in the Khatmandu Valley both for drinking and commercial purposes, and at present the demand is somehow being managed with conjunctive use of surface and groundwater. Overexploitation of groundwater has led to virtual mining – raising fear of soil subsidence. Currently, irrigation infrastructure has been developed over a command area of 1.06 million hectares of which some 854.000 hectare is under surface irrigation and 206,000 hectares under groundwater irrigation.

Bangladesh's priority, as a lower riparian, is to optimize dry season flow of the Ganges below Farakka and to moderate the monsoon discharge of the Ganges and Brahmaputra. On its own, there is nothing much it can do to increase the Ganges flow in the dry season without major diversion from the Brahmaputra or storage dams in the upper reaches of the river. It is, therefore, actively considering a barrage on the Ganges just below the Harding Bridge for storing water to augment dry season scarcity and restore flow of its major tributary in the south-west region, the Gorai.

Political Constraints?

The most important constraints to integrated basin development are the persistent suspicion between the three countries and the lack of political will to tackle the problems squarely. Financial constraints are also cited as probable cause, but that is something that can be circumvented if the former can be dispelled. Another major obstacle has been that India has all along insisted to address the issue on bilateral basis with each of the riparian rather than jointly with all.

In much of the 1970's, 1980's and 1990's, the relationships between India and Bangladesh, and Nepal and India, have been mired by conflicts over water rights and basin development controversy. In 1974, the Prime Ministers of India and Bangladesh recognized the necessity of augmenting the dry season flows of the Ganges to meet the needs of the two countries. Both countries, however, proposed quite different approaches to this and till date remain at odds with each other on this issue.

India's solution for augmenting the flow of the Ganges is to divert water from the Brahmaputra basin. It proposes construction of a barrage on the Brahmaputra at Joghighopa in India with a 324 km long link canal, which would cross through Bangladesh and then re-enter India and connect with the Ganges upstream of Farakka. The scheme also envisages construction of three storage dams with live storage of about 52 BCM on the Brahmaputra river system in India upstream of the barrage.

Bangladesh does not agree to this mainly because it has a serious problem with giving up land for the canal and considers that diverting the Brahmaputra water will interfere with its own long term plans for development of this river. It proposes, instead, development of vast surface water storage reservoirs in Nepal, and additional storage dams in India, through participation of all the three countries.

The relation between Nepal and India on joint basin development has been rocky because of the Nepalese feeling that India has all along been able to extract more out of any agreement than Nepal. They cite the design and construction of the Kosi and Gandak projects in the 1950's in a manner that gave Nepal little benefit. More recently, political relationships between these two countries have mellowed and an agreement was reached in December 1990 on a range of large, medium, and small multipurpose hydro and flood management projects.

Even so, several constraints remain. One of them is that the Nepalese opinion is still divided on the merits of mega projects. Since the power from large hydro projects would have to be sold to India mostly, it would make the country overly reliant on India. Also, sensitized by the feeling of losing out on earlier deals with India, Nepalese negotiators are anxious to establish cost-benefit parameters even before project profiles have been established.

Conflict Resolution

It is important to get the three countries thinking uniformly about the benefits that could be reaped from the joint development of the GBM basins. The Nepalese have to be assured that India's actions will be more transparent in respect of all new water resources development. In turn, they would have to build a national consensus on the strategies, priorities and methods of water resource development, especially with respect to mega and medium projects in their own hinterland. At present, three mega projects are under discussion between Nepal and India, e.g. the Karnali High Dam project, the Pancheswar project, and the Sapta Kosi High Dam project, and that may provide the opportunities for further exploration.

Opinion in India and Bangladesh too is beginning to change in favour of more accommodative policies that better serve the national interests. The conclusion of the Ganges Water Sharing Accord between the two countries in 1996 has opened the door for fruitful negotiations for other aspects of GBM basin development. The assistance of international donors in furthering the process now will be quite timely.

A New Initiative

The principal objectives of a new initiative on basin wide management of water in the Ganges and Brahmaputra could be:

To facilitate the opening of meaningful dialogues between India, Bangladesh, and Nepal for developing the potentials of the three basins without compromising any of their critical interests.

To secure an acknowledgment by the three countries of the need to optimize the potential of the Ganges, Brahmaputra, and the Meghna-Borak basins for meeting each country's immediate and long-term water, power and environmental needs.

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The Ganges-Brahmaputra Basin: The Wealth Over the Ground

***The combined Ganges-Brahmaputra River Basin consists of 1.8 million square kilometers of northern and northeastern India, Nepal, Bhutan, Bangladesh and Tibet.**

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***The effective water holding capacity of potential dam sites on the river Ganges in Nepal alone is 77 billion cubic meters. This constitutes almost 68 percent of the total flow of July, August and September (the peak wet months).**

***The potential for hydropower in the Ganges-Brahmaputra basin is enormous, but the current rate of utilization is slightly over 2 percent.**

***The latent potential of hydroelectric power from the rivers in Nepal, if fully developed, could power the whole of Nepal, northeastern India, and Bangladesh with clean energy.**

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Delay Exacts a High Price

FAILURE to manage the GBM basin rivers as a single ecological unit results in heavy costs for the people who live there. There are tremendous losses due to flood, landslides, desertification, and other calamities in addition to the forfeited benefits of renewable hydroelectric power and better irrigation. The rugged Himalayan terrain and enormous capital requirements for developing the rivers make it difficult for Nepal to take advantage of its natural water endowment. Cooperation of India and Bangladesh could help to finance and develop large-scale hydroelectric projects whose benefits could be shared by all three.

In the absence of international agreements on watershed management, Bangladesh faces continued water shortage during the dry season and flooding during the monsoon. These floods are further aggravated by local flood mitigation projects upstream that are designed solely to pass monsoon run-off quickly downstream.

Floods are endemic to India also, and their damage runs between three billion and fifty billion rupees annually, not counting human distress, other indirect adverse effects, and ecological degradation. In Nepal, the uncontrolled flows of rivers and their tributaries wash away whatever topsoil there is from the denuded fragile hillside and much of the hills cannot regenerate forests and even vegetation. The country may be on the way to an irreversible ecological disaster. The human distress is deferred by the large-scale migration of the Nepalese hill people to the valleys and plains of the already crowded Tarai. Large-scale migration is taking place to India also.

Water Is Not the Problem

The problem, as one can see, is not one of water scarcity in the GBM basins. In terms of average water availability, the basins are water-rich. But most of the water is wasted to the sea in the monsoons. If the monsoon flows are not captured behind dams and regulated and managed to meet the demands of Nepal, India, and Bangladesh, the flood and drought will continue their toll.

The effective water holding capacity of potential dam sites on the river Ganges in Nepal alone is 77 billion cubic meters. This constitutes almost 68 percent of the total flow of July, August and September (the peak wet months). Overall, a series of dams in Nepal could increase the dry season (December-May) flow by about 4,950 m3/sec., which is more than 170 percent of the average dry season natural flow.

Similarly, storage projects with a total effective capacity of 45 billion cubic meters have been identified in the upper reaches of the Brahmaputra (Dihang, Subansiri). They could substantially regulate the flows at downstream reaches, moderating floods and increasing dry season flows. Many potential sources for hydropower are located in the upstream reaches of the Terai, which could be harnessed by building storage reservoirs.

Another major water resource development could be improving at least one major river (possibly the Kosi) for navigation to the sea. This will be important for India if Bihar is to be connected with the sea through an inland waterway. Nepal has time and again expressed deep interest in securing a navigation outlet to the sea, via India and Bangladesh, through possible canal linkages of some major rivers. Regulated releases from Himalayan storage could augment lean season flows of these rivers, and with suitable river training work or irrigation-cum-navigation canals or link canals, it is possible to create waterways connecting the main stem of the Ganges to point in or near Nepal.

India too is anxious to improve inland waterways. The stretch of the Ganges from Haldia-Calcutta to Patna-Alahabad has been declared a national waterway. If feeder routes are established up the Kosi and Gandak it would be advantageous to extend them up to the Nepalese border. The use of water for navigation, when the supply is low, conflicts to some extent with its use for irrigation, particularly in India. Under any circumstances, however, Nepal's water needs are limited by availability of irrigable land and enormous surpluses would be available if flow regulation dams were to be built.

Lack of development of a common approach for harnessing the power of the Ganges, Brahmaputra and Borak/Meghna rivers is costing India and Bangladesh - both with acute shortage of power, and Nepal considerable losses in terms of lost opportunity. Integrated surface water development by Nepal, India, and Bangladesh could provide them with over 700,000 mw of clean and sustainable electric power.

Power shortfalls in India have ranged from 6 percent to 16 percent annually since 1975. Official estimates forecast a growth in electrical demand of 13 percent annually, but over the past decade India has only succeeded in expanding its total generation capacity by 10 percent annually.

A growing share of the power is being consumed by agriculture and it is necessary for the government to expand power supply to this sector significantly to meet the growing population and food security need. The momentum of growth is such that failure to meet the demand for power will sacrifice much in terms of foregone benefits.

In short, the GBM basins provide unique opportunity for sustainable development of their immense water resources. Only 2.3 percent of the region's hydroelectric potential has so far been developed. Agriculture in the region is still primitive with poor yields and, currently, only about 26 percent of the cultivable area are irrigated. Potable drinking water has been provided to only 10 percent of the population. Assured and adequate water for modern irrigation could easily support 200-300 percent cropping intensity over the entire region.