COOPERATION AMONG CO-BASIN COUNTRIES - KEY TO EFFECTIVE MANAGEMENT OF THE GANGES WATER RESOURCES

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ABSTRACT

The Ganges is an international river with its basin encompassing parts of India, China, Nepal and Bangladesh.The flows of the Ganges are highly seasonal and heavily influenced by the monsoon rainfall. More than 80% of the total rainfall over the basin occur during only four monsoon months from June to September. Seasonal overabundance and scarcity of water are the two perennial impediments which have been frustrating the overall development efforts in the Ganges basin area.The area constituting the Ganges basin is one of the poorest in the world despite its rich natural endowments of land, water and people. The fate of the entire basin could have been changed dramatically through meaningful and effective cooperation amongst all the co-basin countries by harnessing, development and management of the water resources of this river. The desired development of this common resource however remained neglected. Basinwide development and management of water resources should be the major option for future development of the Ganges area. Conservation of waters would no doubt be the primary means for tackling the huge problems of alternative flooding and water scarcity during wet and dry seasons and meet the expanding water and power needs for sustaining a rapidly growing economy and population. Firm political commitment from the Governments of India, Nepal and Bangladesh for meaningful cooperation would be the essential prerequisite to launch a programme for effective development and management of water resources of the Ganges. A congenial atmosphere in the relations amongst the three countries shall therefore be crucial. With signing of the Ganges Water Sharing Treaty between India and Bangladesh in 1996 and the Mahakali Treaty between India and Nepal, a new climate of trust and confidence in the region has emerged. All concerned may, therefore, take advantage of this new climate. In the interest of all, the political and conceptual problems now need to be more purposefully addressed especially as the underlying commonality of interests in the Ganges is overwhelming.

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* The views and opinions expressed in this paper are the author's only.

THE GANGES RIVER AND ITS BASIN

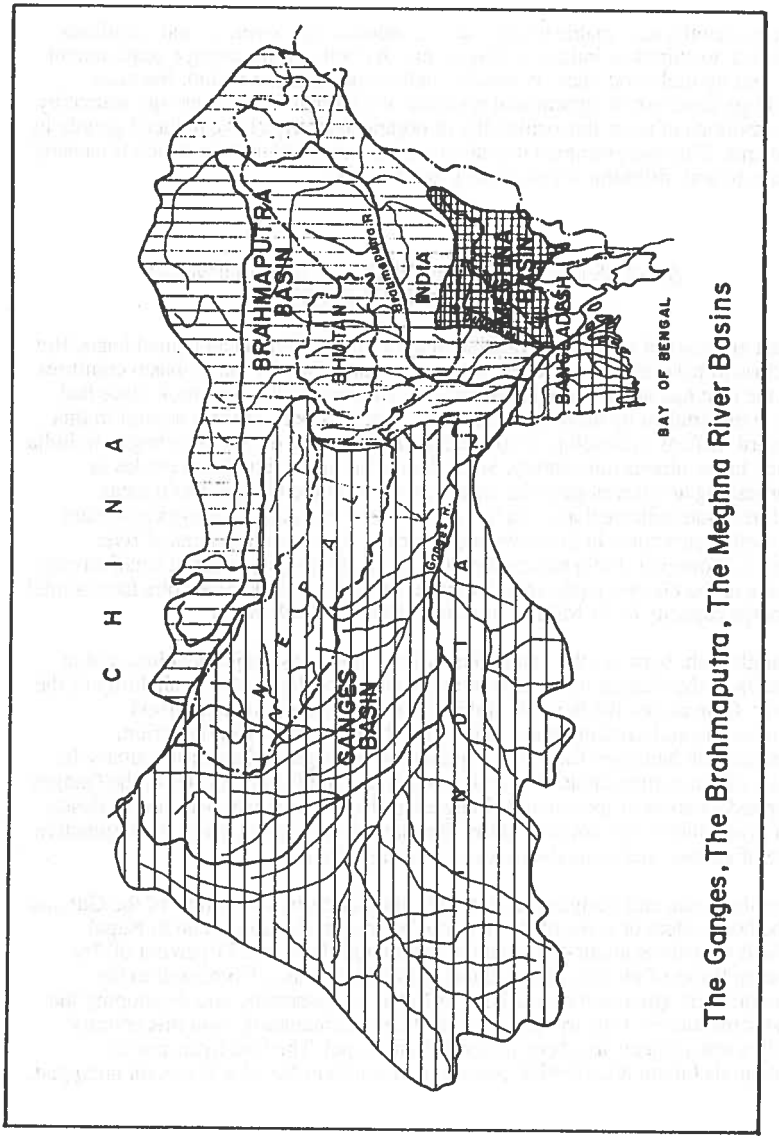
The Ganges is an international river. It ranks among the top ten large rivers of the world in terms of annual run-off. Rising in the Gangotri glacier at about 23,000 feet on the southern slopes of the Himalayas in India, the Ganges flows through the northeastern and eastern part of the south asian region. The Gangotri's melt water stream is a full fledged river even as it emerges from the sub-glacial tunnel at the glacier terminus, the holy Gaumukh (cow's mouth) of Hindu mythology. The Gangotri is considered to be the main source of the Ganges. The Yamuna, Ramganga, Gomti, Kosi, Karnali, Gandaki and Bagmati are important tributaries of the Ganges. The basin of the Ganges spreads over parts of China, India, Nepal and Bangladesh.

Eleven miles below Farakka (India), the Ganges enters Bangladesh and joins the Brahmaputra river near Aricha (Figure-1). The combined flow meets the Meghna river before they all empty into the Bay of Bengal. The total length of the Ganges from source to outfall is 1,570 miles (2530 km). The Ganges basin is one of the most densely populated areas of the world. In the Bangladesh portion of the basin, the population density is 1,917 per square mile (740 per sq. km). The estimated population of the Ganges basin is about 405 million including 346 million of India, 19 million of Nepal and about 40 million of Bangladesh. The total basin area of the Ganges is 433,938 square miles (1,123,899 sq. km).

The water resources of the Ganges have been playing an important role in the life and living of millions of people inhabiting the basin area. Over the centuries people from other regions have come to live in this area in view of the fertile alluvial soils in the plains, warm climate, good seasonal rainfall, numerous small and large rivers and easy agricultural production. The population of this area since then grew at a tremendous rate. The present population of the basin is likely to be doubled within next 30 to 35 years if the current growth rate is not effectively checked.

The flows of the Ganges are highly seasonal and heavily influenced by the monsoon rainfall. More than 80% of the total rainfall over the basin occur during only four monsoon months from June to September. The rainfall in other months is insignificant. As a result the rivers in the basin area swell to brims and often overflow during the monsoon months. On the other hand during dry months (Nov. - May) the flows in the rivers reduce dramatically. The basin area, therefore, faces two major hazards : floods during the monsoon and scarcity of water during the dry season. These hazards become more pronounced in the downstream regions particularly in Bangladesh which is the lowest riparian of the Ganges. Seasonal overabundance and scarcity of water are the two perennial impediments which have been frustrating the overall development efforts in the Ganges basin area.

Ironically, the Ganges basin area is among the poorest and most depressed in the world despite its rich natural endowments of land, water and people. A large number of people of the area live below poverty line. Land-man ratio and per capita food grain availability are steadily declining. It is a predominantly agricultural region and farming is central to the economy of all the national and federal units despite some industrial overlay. Agricultural yields are well below



The Ganges, The Brahmaputra, The Meghna River Basins

their potential and unable to generate the income, employment and surpluses needed to stimulate industrial investment. As bulk of the energy requirement is met by fuelwood, there is massive deforestation in the region. Because of large scale use of agricultural residues and animal waste as energy source by the millions of poor, the availability of organic fertilizers have reduced greatly in the area. This has prompted increased use of chemical fertilizer which is causing harm to soil, drinking water, fishery and livestock.

STATUS OF WATER RESOURCES DEVELOPMENT IN THE GANGES BASIN

Vast amounts of water are available in the Ganges basin on an annual basis. But efforts to harness these resources through joint efforts by the co-basin countries in the past had never been noteworthy. Whatever development took place had been undertaken by individual countries. India has been the major actor in this regard. Efforts to develop the surface water resources of the basin began in India back in the nineteenth century. Since then it has taken significant strides in harnessing and developing the water resources of the Ganges basin areas. Information indicate that India has now more than a dozen barrages and other diversion structures in the basin and diverting significant amounts of river flows. Moreover, India has constructed about 200 major, medium small storage dams in the Ganges basin area. Of these, 51 major storage reservoirs have a total storage capacity of 51 Million Acre-feet (MAF) (62908 mcm).

Bangladesh, born in 1971, could not embark upon any major development of waters of the Ganges in the face of uncertainties of dry season availability of the river from across the borders. But in its frantic effort to increase food production and drinking water supply for the millions of its population, Bangladesh had gone for heavy exploitation of its ground water resources. In view of the current crisis of arsenic contamination of groundwater in the Ganges dependent areas of the country, Bangladesh has realised that over- dependence on groundwater has not been wise. Emphasis is now being given to conjunctive use of surface and groundwaters in the Gangetic area.

Besides India and Bangladesh, Nepal is another co-basin country of the Ganges. The headwaters of some of the major tributaries of the Ganges lie in Nepal which contribute about 40 percent of the annual flows and 71 percent of dry season flows of the Ganges available at Farakka (India). Compared to the magnificent opportunities available in Nepal for harnessing and developing the water resources of the tributaries of the Ganges emanating from this country, only a few projects had been undertaken in Nepal. The vast hydropower potentials (about 80,000 MW according to some) in Nepal still remain untapped.

THE ISSUE OF SHARING THE DRY SEASON FLOWS OF THE GANGES

Although the annual flow of the Ganges is 446 MAF (550132 mcm), the dry season (January through May) availability at Farakka, amounts to only 21 MAF

(25903 mcm). Because of extreme low flow in the Ganges during dry seasons when there is very little rainfall, there arises upstream-downstream conflict over the use of water of this river.

The issue of sharing the Ganges waters between Bangladesh and India arose when India Commissioned a 7,300 ft. (2225 m) long Barrage across the Ganges at Farakka only 11 miles upstream of the Bangladesh border. The stated purpose of the barrage was to divert dry season Ganges flows into the Bhagirathi-Hooghly river in the state of West Bengal for improving navigability of the port of Calcutta. The Governments of Bangladesh and India had discussed for more than 20 years to resolve the Ganges sharing issue but could not arrive at a long-term Agreement during those years.

Although the two countries did agree on short-term arrangements for sharing the dry season Ganges flows for five years (1978-82) under an Agreement signed in 1977 ; for two years (1983-84) under a Memorandum of Understanding (MOU) signed in 1982 and for three years (1986-88) under another MOU signed in 1985, the Ganges issue has irritated the relations between India and Bangladesh quite often.

In 1996, new Governments came to office both in India and Bangladesh. Intense and bold efforts by both the new Governments ultimately resulted in the signing of a thirty year Treaty between Bangladesh and India on sharing of the Ganges waters at Farakka on December 12, 1996.

According to the Treaty of 1996 the sharing will be for thirty years and the quantum of waters agreed to be released by India to Bangladesh will be at Farakka (in India). The sharing between India and Bangladesh of the Ganges waters at Farakka will be in 10-day periods from January 1 to May 31 every year and shall be with reference to the following formula :

Availability at Farakka	Share of India	Share of Bangladesh
70,000 cusec or less	50%	50%
70,000-75,000 cusec	Balance of flow	35,000 cusec
75,000 cusec or more	40,000 cusec	Balance of flow

Note : *Cusec means cubic feet per second and 35.3147 cusec equals to 1 cubic metre per second (m^3/s)*

Subject to the condition that India and Bangladesh each shall receive guaranteed 35,000 cusec (991 m^3/s) of water in alternate three 10-day periods during the period March 11 to May 10.

For the period of this Treaty, in the absence of mutual agreement or adjustments following reviews, India shall release downstream of Farakka Barrage, water at a rate not less than 90% of Bangladesh share according to the formula mentioned above, until such time as mutually agreed flows are decided upon.

The sharing of Ganges waters between Bangladesh and India under the 1996 Treaty commenced from January 1, 1997. A Joint Committee set-up by the two Governments as per provisions of the Treaty has successfully implemented the arrangements for sharing contained in the Treaty during the dry seasons of 1997 and 1998. The Joint Committee has formulated detailed procedures and guidelines for sharing the Ganges flows at Farakka in India and monitoring at Hardinge Bridge in Bangladesh which the Joint Observation Teams posted at the two sites are following strictly. No major difficulty in implementing the sharing arrangements has arisen as yet.

The Ganges Treaty has now opened opportunities for Bangladesh to undertake projects like the long-awaited Ganges Barrage project for restoration of the Ganges dependent area of Bangladesh because of its critical situation. This area, mostly located in the Southwest of the country was once generously watered by the Ganges and a diverse range of eco-systems evolved as a result. Past reductions of fresh water flows into the area has caused widespread degradation of the environment, primarily due to salinity ingress from the Bay of Bengal which together with the pressures of a growing population, has had detrimental impact on social and economic development. Health, nutrition and the well-being of the population, particularly amongst women, have been put significantly at risk. Bangladesh is now trying its utmost to make best use of the opportunities derived from the Treaty, so that the dry season flows of the Ganges secured by Bangladesh under the Treaty as its share can be used to nurture the region that has suffered so much social and environmental damages since their diminution.

AUGMENTATION OF DRY SEASON FLOWS OF THE GANGES

The present dry season availability of the Ganges at Farakka is not enough to meet the requirements of both Bangladesh and India. The dry season flows of the Ganges being received by Bangladesh now are only half of those which formerly entered the country before commissioning of the Farakka Barrage. Bangladesh needs more waters in the Ganges during dry seasons to support the socio-economic development for present and future generations. As such there is an urgency for initiating a process of cooperation amongst the co-basin countries for augmenting the dry season flows of the Ganges. In Article-VIII of the 1996 Treaty, both Bangladesh and India have recognised the need to cooperate with each other in finding a long-term solution to the problem of augmentation of dry season Ganges flows.

Plenty of water is available in the Ganges during the monsoon and there is ample scope to harness from the monsoon flows. A portion of the monsoon floods of the Ganges which cause widespread damages in the co-basin countries could be conserved in the upstream storage sites, particularly in Nepal to mitigate flood intensities downstream. This in turn would enable significant augmentation of the dry season flows of the Ganges satisfying the reasonable water needs of all the co-basin countries.

FUTURE NEED

The area constituting the Ganges basin is one of the poorest in the world. But this should not have been the case in view of the basin's rich endowments. In fact the fate of the entire basin could have been changed dramatically through meaningful and effective cooperation amongst all the co-basin countries for harnessing, development and management of the water resources of this river and its tributaries. The desired development of this common resource however remained neglected with inadequate appreciation of the fact that every year lost meant the loss of a productive multiplier through the creation of wealth and employment that would otherwise have been at work. According to many, a number of social, political and historical inhibitions had been at work obstructing meaningful regional cooperation for development and management of common water resources of the Ganges.

In the Ganges basin area today, humanity faces two overriding realities relating to fresh water. First, the use of water has increased dramatically during the past century and will continue to do so as the number of human beings using and relying upon it continues to multiply at an alarming rate. This implies the complexity of issues related to ensuring food scarcity, providing adequate and safe drinking water and sanitation services, stimulating the economy, and preserving the environment. Satisfying these needs would no doubt be a challenging task.

It needs to be realised that water would be the most important vector of development that would shape the future of millions of people living in the Ganges basin area. Their future would depend on collective and individual choices and action. At the brink of a new century, taking a long view would be an appropriate exercise for all concerned in this region. The vision should address water sector transcending issues such as seasonal water scarcity and its overall effect on life and living of the people and environment ; flooding and the cost to society in terms of public health and the loss of economic assets; water pollution and the links to public health, the loss of essential environmental functions. This vision would help development and management of the water resources of the Ganges in the next millennium.

DEVELOPMENT AND MANAGEMENT OF WATER RESOURCES IN THE GANGES BASIN

Basinwide development and management of water resources should be the major option for future development of the Ganges area. Conservation of waters would no doubt be the only way for tackling the huge problems of alternative flooding and water scarcity during wet and dry seasons and meet the expanding water and power needs for sustaining a rapidly growing economy and population. Side by side, conjunctive use of surface and groundwater and its equitable distribution, controlled flooding through scientific catchment management and water management would be the other important elements which would play crucial roles. Again, development of waterway transportation could make a significant contribution to the economic integration of the region with investments in various navigation improvement programmes.

The option and measures envisaged above would undoubtedly need large projects with major investments. Moreover, the way towards formulation, implementation, operation and maintenance of the projects envisioned, would not be devoid of complications. Firm political commitment from the Governments of India, Nepal and Bangladesh to undertake effective joint actions would be the essential prerequisite to launch a programme for integrated development and management of water resources of the Ganges. A congenial atmosphere in the relations amongst the three countries shall therefore be crucial. With signing of the Ganges Water Sharing Treaty between India and Bangladesh in 1996 and the Mahakali Treaty between India and Nepal, a new climate of trust and confidence in the region has emerged. All concerned may, therefore, take advantage of this new climate.

Development and management of water resources would involve various components and wide ranging issues. Some of the major components and important issues are described below :

WATER CONSERVATION

Although there is scarcity of surface water in the basin area during dry season, plenty is available in the rivers during the monsoon (the proportion of lowest and highest flows is about 1:70 for the Ganges in Bangladesh). Portions of monsoon flows of the Ganges which cause widespread flood damage can be conserved in the upstream storage sites available in Nepal and India to mitigate flood intensities downstream. This in turn would enable significant augmentation of the dry season flows of these rivers satisfying the reasonable water needs of the co-basin countries. In addition, generation of large amounts of hydropower from the storage dams could ease the energy crisis in the region and create more job opportunities by facilitating rapid industrialization in different parts of the region. More hydro-power would reduce the tremendous pressure on fuelwood in the region as an energy source and the forest resources and thereby environment shall be saved. The upstream storages would also help improvement of navigation in the region, check salinity intrusion in the lower deltaic areas and control pollution by increasing fresh water supplies during dry seasons. The potentials of the reservoir sites in the Gandaki, Mahakali, Kosi, Karnali basins in Nepal and remaining sites in the Ganges basin in India offer bright prospects for water conservation.

According to a Bangladesh-Nepal Joint Study on Flood Control (1989), there are about 30 potential storage reservoir sites in Nepal in the Ganges basin. The study highlighted the following regarding the potential Nepalese storage reservoirs :

- all the five reservoirs identified in the Sapt Kosi basin, after full development could have potential to store 50.4 percent of the total monsoon flow for dry season use.

- the nine reservoirs identified in Gandak basin could similarly store 54.7 percent of the total monsoon flow for dry season use.

- the reservoirs identified in Karnali basin are capable of total regulation of monsoon flow.
- the two reservoirs in the border river Mahakali together will be able to hold 43.2 percent of the monsoon flow.
- reservoirs on southern smaller rivers are capable to store the monsoon flow of their catchments from 60 to 100 percent.

The Bangladesh-Nepal Joint Study Report stated as follows ,

> "In general, however, it could be said that among thirty identified sites for reservoir creation, the more effective sites in terms of flow regulation will be Sapta-Kosi, Tamur-1, Sun Kosi-II, Burhi Gandaki, Marsyangdi, Seti-I (central), Kali Gandaki-I and II, Andhi-Khola, Mainachuli, Bagmati, Bhalubang, Naumuri, Pancheswar and all the reservoirs in the Karnali basin. The dry season (December-May) flow augmentation potential of these reservoirs taken together is in the vicinity of 4,950 cumec (174,800 cusec). This constitutues more than 170 percent of average dry season natural flow".

These reservoirs when created would provide benefit for irrigation navigation and hydro-electricity generation and other consumptive and non-consumptive use. According to the Joint Report, the total hydro-power installation potential at different capacity factors is in the order of 36,600 MW.

The proposed water conservation projects shall definitely be large projects and would have their implications. There may be valid arguments in favour of small dams, water harvesting techniques, micro and mini hydel schemes or run-of-the river hydropower generation, all of which would reduce or avoid human displacement and encroachment on or damages to wildlife habitats. These are well intentioned but not alternatives to storage dams for the most part of the region and, where they are feasible, are additional to rather than substitutes for dams. It needs to be appreciated that the condition in the Ganges basin is different where it may not be possible to abandon or limit the conservation and harnessing its water resources in an increasingly water short situation during dry season. Large water storage projects are, therefore, difficult to be ruled out. Moreover, one should appreciate that the proposed storages are nothing but rain water harvesting projects - but of course on a mega scale. However, there is need to assess the environmental, ecological, human and social implications and impacts of such projects. In case of those projects which would be found acceptable, adequate machinery and procedures will have to be devised in each case to ensure the proper formulation and full implementation of remedial and ameliorative measures ; and in each case there will have to be the fullest measure of consultation with and participation by the people concerned.

FLOOD MANAGEMENT AND FLOOD FORECASTING

The aforementioned storage reservoirs would no doubt reduce flood intensities in the Ganges river in the downstream reaches. But that might not be enough.

Besides the main Ganges there are many other tributaries, distributaries and smaller rivers in the basin which cause localised flood havocs. For mitigation of floods caused by such rivers appropriate flood management strategies are to be chalked out and practiced. Watershed management through extensive soil conservation, catchment area treatment, preservation of forests and increasing the forest area and the construction of check dams would have to be promoted to reduce the intensity of floods. The possibilities of flood by-pass or diversions shall need to be investigated more intensively through joint efforts. Uncontrolled and indiscriminate development of flood plains under the false sense of security due to pressure of population has been responsible for increasing flood damages in some areas of the basin despite substantial investments in flood sector in the past. The concept of flood plain zoning would therefore, need to be more vigorously practiced in a concerted manner by all the co-basin countries to avoid dangerous, undesirable and unwise use of flood plains.

Flood forecasting and Warning plays and shall continue to play a very important role in saving lives and properties from flood damages. Meaningful cooperation and co-ordination amongst the co-basin countries can improve the flood forecasting and warning system in the Ganges basin. There exists limited cooperation on Flood Forecasting amongst the countries of the region on bilateral basis. These cooperations need to be further strengthened, expanded and made multilateral. To that end, the co-basin countries may decide expeditiously all aspects of data requirements for effective and early flood forecasting and warning in the river basin and ensure free flow of data relevant to flood forecasting on a real time basis.

WATER QUALITY

Another priority concern for water management in the Ganges basin should be water quality. With the increase of population, more and more often the use of water will be limited by its quality rather than the quantity available. Poisoning of water by arsenic and other toxic chemicals and related chronic effects are the most recent public health concerns to arise over water quality. Strict water quality measures would need to be undertaken to avoid or reduce contamination of water that results in the degradation of drinking water quality and quantity, contamination of food resources and increasing incidence of infectious diseases and in the substantial biological impoverishment and impairment of basic ecological functions and services.

FREE FLOW OF DATA AND INFORMATION

The success of integrated water resources management in the Ganges basin will depend greatly on free flow of relevant data and information amongst the co-basin countries. Mistrust, fear, misperception and myth had so long impeded free flow of data amongst the countries concerned. In the brink of a new century, such mistrust and fear need to be removed totally for the sake of a better future of millions of people. The co-basin countries, through mutual

agreement, would need to establish a system of free flow of all water related data and information amongst them as early as possible. In today's world, with revolutionary advancement in global communication, establishment of such a system would not take much time if the political will is there. With regard to data management and long-term data needs the following initiatives require to be envisaged :

- mapping of all governmental and non governmental agencies, Institutions, Research Centres and etc. connected with water resources development, management and use in the Ganges basin area ;
- analysis of technological and institutional bottlenecks in basic data acquisition and dissemination mechanisms ;
- evaluation of options for rehabilitation, harmonization and standardization, and integration of data collection, processing and exchange mechanisms on basin scale ;

EFFECTIVE COOPERATION

The management of water resources of a river basin like that of the Ganges is a matter of regional concern because it is a transboundary resource. In the past, isolated and unilateral actions for development and utilization of waters of the Ganges in one co-basin country have caused adverse impacts in another country. This has resulted in irritations in the relations between the concerned countries. When one country is adversely impacted because of another's action in the same basin, it becomes the collective obligation of all the co-basin countries to take corrective measures in a concerted manner. The development, sharing and management of the Ganges water resources must not be a zero-sum game. The key to future development of the Ganges basin area is effective cooperation amongst the co-basin countries. Such cooperation should necessarily be multilateral as the number of co-basin countries of the Ganges is more than two.

So long whatever negotiations or actions regarding development, sharing and management of waters of the Ganges and its tributaries have taken place had been purely on bilateral basis between India and Bangladesh; between India and Nepal; and between Nepal and Bangladesh. This principal of bilateralism has already created confusion and even mistrust amongst the co-basin countries. Enough time has already been wasted. It is time now that all concerned breaks this myth of Bilateralism. For the sake of teeming millions of the basin area, all the co-basin countries should act in unison. Without effective cooperation from all, the desired objectives of water conservation, flood management, water quality management, free flow of data and information in the Ganges basin area would remain only illusions. All concerned should, therefore, make sincere efforts to create the required atmosphere of mutual trust and confidence to commence the journey towards such cooperation.

CONCLUSION

Water of the Ganges is too precious a resource to waste when there are millions of people dependent on it. The waters of this basin can really be turned into wealth. What is needed, is the will and commitment of the Governments and people of all the co-basin countries. Effective cooperation will be the key to future development and management of the Ganges water resources. This however would require a different mindset and a long-term view of the political and social leaders of the Gangetic region. In the interest of all, the political and conceptual problems now need to be more purposefully addressed especially as the underlying commonality of interests in the Ganges is overwhelming. Waters of the Ganges must be seen as a potential source, not of conflict but of peace and prosperity in the region.

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