Water as a resource is indivisible. One cludburst may moisten the soil, fill a cistern, and wash out a bridge. Water drawn from a single well may be used for drinking and cooking, for watering stock, and for irrigating crops. Water put to one use may be used again and again for other purposes before it reaches the sea.

Until this century, nearly all water works were built for a single purpose, e.g., to provide power for a mill, to provide water for a town’s use, to provide means of transportation, to divert it for irrigation; to prevent floods or dispose of waste. These separate and unrelated ventures contributed nothing to one another’s effectiveness and quite often interfered with them. For example, it matters greatly to the downstream community what its upstream neighbours put into the water as it goes by them and the amount of it they take out may matter even more. Erosion is not merely the concern of the landowner whose topsoil disappears down the gullied hillside. The silt fills the reservoir of the neighbouring town and the runoff rushes down the bare land to flood farms and villages below.

Gradually it was realised that many of these disparate purposes were indeed compatible. For example, a dam could serve several purposes such as flood control, municipal and industrial water supply, irrigation, navigation, hydro-electric power generation,
fish and wildlife, recreation and water quality control. Moreover this approach was generally found to be more efficient and in many cases yielded greater benefits than the single facility.

The multipurpose concept has also led logically to the consideration of systems of channel works and facilities, i.e. to the drainage system or basin as the basis for planning. This basin concept reflects the understanding that overall optimal development must consider upstream and downstream effects, and the interdependence of water uses and facilities such as embankments, diversions, dams, etc. Water users are interdependent because they are connected to one another by the river channel network that forms the river basin.

But consideration of the interrelation of river works is not the full realisation of the river basin development concept. The river basin approach has gone even further to consider the entire natural resource base and economy of the basin, the needs and expectations of the people and their communities within the basin and their interaction with other basins.

The river basin approach provides three significant opportunities that do not exist otherwise; the opportunity to identify and develop potentials created elsewhere in a basin by the development of a single project of facility such as the obvious example of the multipurpose reservoir; the opportunity to identify and mitigate the negative impacts of projects or facilities upon other water uses and the environment of a basin; and the opportunity to enhance economic development by increasing the efficiency of water resources development. Multipurpose or multiobjective river basin development is thus intended to yield greater net benefits to all communities within a basin than any single community could develop in isolation.

**International River Basin**

When the waters of a river basin are shared by two or more nations unique problems are created. The ultimate and full
success of the river basin approach depends on the willingness of all who live in the basin to cooperate as members of the larger basin community. When nations independently seek the benefits of the development of international rivers, problems as great as maintaining peaceful relationships may arise. But clearly the international river basin also provides matchless opportunities for cooperation between peoples and nations for development of their potentials. The enormous advances in science and engineering in recent times have accentuated these opportunities by making possible many essential features of cooperative development that formerly could not have been accomplished at all. The management of international rivers is becoming not only a matter of distributing existing benefits and resources, but of increasing them greatly through cooperative action.

The possibilities of developing the water resources of the international river to the greater benefit of all parties can be instrumental in settling long standing disputes over river water. Of vastly more importance, however, is the stimulus that a successful venture of this nature can give to the solution of other issues troubling the relations of neighbouring countries. Since the river is such an elemental part of the life of the developing country, its cooperative development for the mutual benefit of riparian neighbours can become the foundation on which other structures aimed at promoting peace and harmony between them can be built.

Much of the land surface of the world is included in international river basins. On a global basis there are 214 rivers or lake basins that are shared by two or more countries, 57 in Africa, 40 in Asia, 48 in Europe, 33 in Northern and Central America and 36 in South America. Nine river and lake basins are shared by six or more countries—the Danube is shared by 12 countries, the Niger by 10, the Nile and Zaire by nine, the Rhine and Zambesi by eight, the Amazon by seven, and Lake Chad and the Mekong by six. Viewed another way there are at least 40 countries where at least 80 percent of the total area
falls within international river basins. In the last category are included Bangladesh, Nepal and Bhutan. The whole area of the latter two countries falls within international river basins.

There have been long standing conflicts over the development of some of these international rivers, such as the Colorado (United States and Mexico), Euphrates (Syria and Iraq), Ganges (India and Bangladesh), Indus (India and Pakistan), Jordan (Israel and Jordan) and the Paranala Plata (Brazil, Paraguay and Argentina). With increasing population and need for further economic development, pressures for further water resource development will increase. For example, the Ganges Basin alone may have to support some 500 million people by the year 2000.

Many successful international efforts to regulate and develop international rivers have been undertaken in the past and are now underway. In addition to the Indus and Mekong rivers, multilateral and bilateral treaties have created legal rights and improved development opportunities on many other important river systems. To name only a few: in North America, all boundary waters between the United States and Mexico, and between the United States and Canada; in Europe, the Danube, Rhine, Moselle and Oder; in Africa, the Nile; in the Near East, the Tigris-Euphrates; and in South America, the Uruguay.

A number of programmes involving international cooperation among groups of nations to develop international river basins are going forward. In Africa the Senegal River Basin is being developed through an interstate committee of the four riparian countries, Guinea, Mali, Mauritania and Senegal. The riparian countries of the Niger River Basin are working together for the development of this river. Several other river basins are being investigated in a like manner in Africa and Latin America.

But no such cooperative effort has yet been initiated in this Himalayan region to which India, Bangladesh, Nepal and Bhutan belong. Although all of them stand to benefit greatly
from the cooperative development of their common rivers and the basins they share, the immense potential wealth of their river basins is still waiting to be developed. Nearly 300 million people live in the valleys and flood-plains and the delta area of this region. Their very existence and livelihood are closely geared to the waters of its great international rivers.

The Himalayan River Basins

In South Asia, the Himalaya exercises a dominant influence on the meteorological conditions of this region as well as its physical geography. On account of its high altitude and location in the path of the monsoons, the Himalaya causes precipitation of most of the cloud moisture, either as snow or rain. It creates a vast resource for water in the form of ice, snow fields and glaciers giving rise to many large rivers and innumerable streams that form major valley systems south and west of the range such as the Brahmaputra, the Ganges and the Indus.

The Indus and the Brahmaputra rise from the north slopes of Himalaya near Lake Manas-Sorovar and the Ganges from the southern slopes of the mountains in the Garhwal region. These Himalayan rivers are a source of life-giving water for over 350 million people in the northwestern, northern and eastern parts of the subcontinent. The basins of the Ganges and Brahmaputra rivers total about 665,000 sq. miles. These two rivers flow southward from the Himalaya and join to form a vast delta in the Bay of Bengal. The Indus flows northwestward from Tibet and Kashmir through India and Pakistan to the Arabian sea. The Indus system carries an annual average flow of 183 million acre-feet (maf), the Ganges 317 maf, and the Brahmaputra 492 maf. These may be compared to 5,114 maf of the Amazon; 1914 maf of the Congo, 752 maf of the Yangtze; 481 maf of the Mississippi; 405 maf of the Mekong; 229 maf of the Danube, 65 maf of the Nile, and 57 maf of the Rhine.
The Ganges basin is shared by Nepal who occupies the headwaters, and India, and Bangladesh who occupy the delta. The Brahmaputra basin is shared by China, Bhutan, India, and Bangladesh. The Indus basin and river system is shared by India and Pakistan and includes the main stem of the Indus and five major tributaries. The three eastern rivers - the Beas, Sutlej and Ravi - flow through India into Pakistan to join the Indus. The three western rivers - the Chenab, Jhelum and Indus - flow out of Kashmir and Jammu into Pakistan.

The Indus Basin

Disputes between the Sind and Punjab States of British India over the allocation of water from the Indus basin began long before partition. When India was partitioned the boundary line went through the Punjab leaving the upper reaches of the Beas, Sutlej and Ravi in India with the lower reaches in Pakistan. A serious dispute arose between India and Pakistan over the water of the Indus. The dispute was solved by the creation and execution of the Indus development Plan, a remarkable exhibition of engineering imagination and international cooperation.

The Indus Basin is some 200 miles wide and 800 miles long. About 50 million people live in the basin, largely on land irrigated from the river. At the time of partition about 5 million acres were irrigated in India and 20 million acres in Pakistan. Approximately 72 million acre-feet annually were being used for irrigation out of 120 million acre-feet estimated as the potential average quantity of water available for the purpose. After protracted negotiations by the World Bank with the two governments, the waters of the three eastern rivers were allocated to India and the waters for the other three to Pakistan.

The agreement freed each country from dependence on the continued flow of vital water from the other country, and enabled both to use their water freely according to their own plans. Pakistan was compensated for the loss of the water of the eastern rivers that formerly entered Pakistan but was allocated to India under the
plan by the construction of a series of canals to take water from the western rivers to the eastern lands. India in return paid for a part of the new replacement link canals as compensation for the additional water from the eastern rivers. The World Bank advanced loans for a substantial part of the construction cost and brought together a consortium of countries to provide the other money needed. India agreed not to diminish the supply of water to Pakistan during a 10 years transition period.

Under the Bank's aegies a consortium was formed of Australia, Canada, the Federal Republic of Germany, New Zealand, the United Kingdom and the United States. These nations along with India, Pakistan and the World Bank signed an agreement establishing the "The Indus Basin Development Fund" providing the equivalent of 894 million dollars in commitments for the construction of the necessary works in Pakistan. The Governments of India and Pakistan, joined by the Bank, signed an international water treaty on September 19, 1960 setting out the agreement between them for the development of the Indus Basin. In the treaty the Bank undertook responsibilities that were key to the successful negotiation of the agreement and execution of the project; it was to receive and hold the contributions and pay them out under its normal procedures for work done. It was also to supervise the technical work of the project. The project was completed ahead of schedule.

The Ganges and Brahmaputra Basins

Every year, uncontrolled flooding in the Ganges and Brahmaputra river basins results in loss of life, damages to crops, dwellings and other properties, contamination of water supplies, the spreading of water-borne diseases and disrupting of orderly social and economic processes. Despite the erection of barriers and marginal embankments to protect against flooding, major floods continue to cause extensive damages and prevent full utilisation of the land. The attempts to clear and maintain river channels to assure the passage of floods without obstruction and the pro-
tection of river banks and flood embankments by revetments and other river training works have proven to be expensive and only marginally effective.

At the same time the waters of these great river basins are the key to the survival and quality of life of the people. About 80 percent of the annual rainfall occurs in the six-month monsoon season. At the end of the monsoon the valleys and delta of these rivers are quickly transformed from an apparent inland sea to a dry and parched land. Traditionally cultivation of only one crop a year has been possible. As population increases the per capita farm size must inevitably decrease since there is little or no new land to be converted to agriculture. This disastrous trend can only be offset by increased water supplies for modern irrigation. Modern irrigation systems during the dry season make two and even three crops possible. Each crop, when water control is combined with other elements of modern agriculture can yield far more than the traditional one.

The entire water regime of these two great river basins appears to be deteriorating due to deforestation of the Himalayan slopes and many areas of formerly forested valley lands. This slow process of deforestation and exposure of the soil to chemical change and erosion may have vast consequences throughout the basin: increased frequency of flooding, increased flood magnitude, increased sedimentation and diminished drainage capacity, and decreased agricultural potential and productivity.

The partition of India also led to a dispute over the waters of the Ganges and other rivers between India and the present Bangladesh. Negotiations over the use of the waters of the rivers started in 1951 and continue today. An interim agreement on the sharing of the waters of the Ganges at Farakka between India and Bangladesh was executed in November 1977 for a period of 5 years with arrangements for studies on augmentation of the dry season flow of this river to meet the needs of the two countries. When this first agreement expired a new Memorandum of Understanding between the two countries was signed in October,
1982 to continue the sharing with some modifications for a further period of 18 months and to study each others proposals for the augmentation of the Ganges dry season flow. This Memorandum of Understanding has expired in May 1984 without any agreement to continue the sharing of the Ganges waters, nor is there any resolution of the question of the augmentation of the flow of the river.

Bangladesh occupies only the delta portion of these two major river basins. Over 90 percent of these basins lie outside Bangladesh but the two rivers provide about 80 percent of the river flow in the country. Water resources development in the delta portion of a basin is greatly dependent on the course of upland development. In the monsoon season Bangladesh must accommodate the concentrated flood flows of both the Brahmaputra and Ganges rivers within a complex drainage system controlled largely by tides in the Bay of Bengal. Maintenance of that drainage system is a difficult task since the inflow of choking sediments and the streamflow required to carry them and prevent their deposition is beyond the control of Bangladesh. In the dry season the river flows decrease to a fraction of the monsoon season volumes.

Bangladesh has been accelerating the development of its own meagre water resources but it has become increasingly clear that even over the medium term, continued expansion and orderly development will depend critically on the streamflows of the major rivers. The flow of the Ganges below Farakka into Bangladesh has continued to decline alarmingly and is no longer a reliable resource on which to base development. The Brahmaputra river flow will thus be the key source of water for future growth of agricultural production in Bangladesh, and efforts to plan the development and use of all the water resources of Bangladesh including these river flows are presently underway. But planning by each co-basin state individually is an inefficient approach to water resources development in a river basin. To reap the potentials and increased benefits of the basin approach requires that the nations who share these great rivers join together to cooperate in their development.
The inability of the two countries to agree on solutions to the problems of the Ganges has been due in part to the different proposals of India and Bangladesh. Bangladesh is of the view that annually there is enough water in the Ganges basin and that storage of the huge monsoon flow could augment the dry season flow of the river to adequately meet all the needs of the two countries. On the other hand, India is of the opinion that the additional water available from storage in Nepal and India is required by India and no part of it can be spared at Farakka. Thus India proposes that water from the Brahmaputra should be transferred to the Ganges. India has proposed excavation of link canal from the Brahmaputra near Dhubri to the Ganges at Farakka through Bangladesh. Bangladesh has not agreed to this proposal since Bangladesh cannot forego the dry season flow of the Brahmaputra. And further, the scheme proposed by India will, in the opinion of Bangladesh, have far reaching adverse effects on Bangladesh. The negotiations between the two countries are thus virtually deadlocked. The two alternative technical solutions are related to the Ganges. The discussion must shift to a scientific consideration of the problems and potentials of the whole Ganges river basin as a basis for eventual political decision and agreement.

THE ROLE OF THE SOUTH ASIAN REGIONAL COOPERATION

The South Asian Regional Cooperation consisting of Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka can play a useful role in fostering mutual cooperation in river basin development in the region. It has already identified a number of specific areas of cooperation and has begun work in those fields. Water development is vital area in which regional cooperation can bring lasting benefits for the people of the region.

The first step in co-operative river basin development in the Ganges and the Brahmaputra river basins might be the establishment of Joint Committees of the co-basin states, comprising Nepal, India and Bangladesh for the Ganges and China, India, Bangladesh and Bhutan for the Brahmaputra. The Committee would esestablish institutes or centers where the full range of technical spe-
cialists appropriate to river basin planning including scientists, engineers, sociologists, legal scholars, economists, hydrologists, etc., would work together on joint programmes of research, training, investigation, monitoring, and basin planning. The staff would be drawn from each of the co-basin states. The main work of the Committees through the established Institutes or Centres would be to:

(a) Collect and exchange information on the physical aspects of the river basins; establish and improve data collection networks and techniques including remote sensing by satellite; carry out scientific studies of physical processes including for example the geology, ecology and hydrology of the basins and sub-basins.

(b) Carry out study and investigation programmes to identify major water management needs and problems and carry out technical evaluations of alternative solutions. The latter studies could include field and laboratory investigations, surveys, research and testing.

(c) Develop multidisciplinary training and research programmes in modern scientific methods and approaches to all aspects of river basin, water management and development, that is expressly tailored to the social, political, economic and physical framework of this region.

Great river development programmes take a long time to plan and execute, but, once completed, they may endure for centuries. Hundreds of millions of people living in the Ganges and Brahmaputra basins depend on water for their present livelihood. They need security from the ravages of flood and drought. They need access to inexpensive power for new industries and operation of a greatly expanded modern irrigation system. To fail to take steps now to deal effectively with these needs would be a great failure on the part of the leaders of the different countries of this region. The countries must decide now to start a joint and cooperative endeavour to develop the water wealth of these international river basins for the optimum use of their international river basins for the optimum economic well being of their people.