Disaster Risk Reduction through Integrated River Basin Management - A Policy Approach

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Abstract

The present paper deals with the disasters associated with mismanagement of water and provide policy approach for integrated surface water resources management considering river basin as a Hydrological Unit. Increasing demand for water globally has resulted in water crisis and established conditions for conflict over access at a range of levels from the river basin or aquifer level, through the sub-national level between regions of the country, down to local level between communities. Transboundary water resources disputes have become particularly significant in recent years. In India, out of 24 river basins, six basins namely; Sabarmati, East flowing rivers between Pennar and Kanyakumari, and West flowing river of Kutch and Saurashtra including Luni, Cauvery and East flowing rivers between Mahanadi and Pennar fall under the water scarcity category (1000 m^3/capita/annum) and many more are expected to come under this category by the year 2025 and 2050. The eutrophication of most of Indian major rivers and lakes has caused serious problems of drinking water, ecosystem needs, irrigation, water supply, etc. The destruction of wetlands is taking heavy toll on water quality because it serves as a sink in storing nutrients. The existing state of water (quality and quantity) environment has already led to 'conflicts on water' in various countries of the world. In India, conflicts on water had already started and there is a likelihood that it would be of serious concern in future, if the protection and wise management of most valuable of the world's renewable resources are not given top priority. The mismanagement of water in India had already created serious problems of floods affecting millions of people in Uttarakhand, Uttar Pradesh, Bihar, Assam, Orissa draughts covering 20 percent area of the total land area of the country affecting States like Jharkhand, high rainfall State Kerala, Himalayan States namely Manipur, Assam; advancement of desertification covering 20 percent of India's total land area in the States like Rajasthan, Gujarat, Maharashtra, Jammu & Kashmir, Orissa and Andhra Pradesh affecting critically the livelihoods and flood security of million in the country. The River Basin approach for management of water resources could not follow quick succession globally after the Tennessee Valley Authority (TVA) in the United

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States in 1934 and Indian Damodar Valley Authority (DVA) in 1948. Water being our common heritage, and the fact that we all share the responsibility of protecting it for future generations, a breakthrough for really sustainable water resources development and management is required. The ecosystem based-policy approach for the integrated management of water resources (River Basin approach) involving scientific, technical and engineering factors on the one hand and social, economical, environmental and legal factors on the other hand in various missions mode is need of the hour for disaster risk reduction and ensuring food, energy, water, land security in the country.

Keywords : *Disaster Risk Reduction, River Basin Management, River Basin approach.*

Introduction

Water is a key to sustainable development, crucial to social, economic and environmental dimensions. Water is life and essential for human health. Many people regard access to drinking water and sanitation to be a human right. There is no substitute for water, without it, humans and other living organisms die, farmers cannot grow food and business cannot operate.

Human consumption of freshwater threatens to push to the limits of capacity of nature to supply benefits to mankind. Increasing demands for water jeopardise flows in rivers and wetland ecosystems. In many areas, a failure to manage resources effectively has led to over obstruction of surface waters; some rivers are reduced to a mere trickle by the time they reach the sea; and lakes have dried out or significantly reduced in size, for example the Aral Sea in Central Asia. This in turn disrupts aquatic and other terrestrial ecosystems, the quantity and quality of water supplies, and the wider natural environment. Problems include vegetation loss and siltation, which lead to reduced capacity of rivers and increased risk of flooding. Poor land use practices (farming, deforestation and land drainage) have a major detrimental effect on the environment, and hence on its capacity to support and maintain hydrological process (Department of International Development, 2001).

Even so, this available fresh water would seem at first sight to be enough to supply all fundamental human survival needs, if divided by the total population of the Earth. Indeed – although the exact water volume necessary to fulfil human needs is still a matter of debate – it is estimated that theoretically there is sufficient fresh water on the planet to support about 20 billion people. Unfortunately it is not distributed evenly, as the large arid and semi-arid regions testify. And, thanks to seasonal weather pattern, this is sometimes not available when most needed, or arrives in excessive amounts, causing widescale flooding and loss of human life. To add to this problem, water is polluted when it is used in industry, agriculture and for domestic

purposes and thus the amount of water of acceptable quality available for human use is reduced still further. As a result of shortages, water of inferior quality is often used to meet demand. Conversely, the need for clean water makes heavy demands on total resources (Department of International Development, 2001).

Methodology

The assessment of the State of water environment globally and in Indian scenarios have been made. The factors responsible for mismanagement or poor management of water and its impacts on accelerating natural disasters like floods, droughts, advancement of desertification/degradation of land, climatic variability, etc. have been assessed. The legal regime governing management and development of water resources in Indian context have been examined and accordingly policy and programmes based on ecosystem approach have been proposed/advocated for ensuring integrated river basin management to minimise disaster risks.

Results

Global Scenario

Of all the earth's water reserves, 97 percent is saltwater and thus of no use to human beings as drinking water; two percent is locked up in glaciers and the polar caps as freshwater, and only one percent freshwater is accessible. It would be wrong, however, to say without qualification that the world is suffering from a water shortage. The total volume of this one percent that is available in the hydrological cycle is estimated to be 500 000 cubic kilometers - theoretically more than enough for the whole of humanity. The major problems that do exist stem from a huge imbalance in the regional distribution of these water reserves and the fact that an expanding world population is demanding ever more of this vital yet finite resource (Federal Ministry for the Environment, 2002).

Freshwater is a finite and precious resource that is essential for sustaining life, as are the natural systems that provide and maintain its supply. As demand increase, this resources is becoming increasingly scarce. Global freshwater consumption rose six fold between 1900 and 2000, more than twice the rate of population growth and the rate of consumption is still accelerating. Demand for water resources is increasing both because of population growth (particularly in developing countries) and because of rising demand per person due to such causes as irrigation development, industrialisation and increasing use by individuals as incomes rise. A potential crisis is looming where available resources can no longer meet needs (Department of International Development, 2001). The Stockholm Environment Institute has estimated

that, allowing for predicted population growth and assuming moderate projections of development and climate change the proportion of the world's population living in countries of significant water stress will increase from approximately 34 percent in 1995 to 63 percent in 2025. Those living in poor countries in Asia and Africa, with low and unreliable rainfall and high level of utilisation of the total water resources, will be most at risk of water stress impacting severely on their lives and livelihoods (Department of International Development, 2001). The world now has less than half the amount of water available per capita than it had 50 years ago. In 1950, world reserves (after accounting for agriculture, industrial and domestic uses) amounted to 16,800 cubic meters per person. Today, global reserves have dropped to 7,300 cubic metres and are expected to fall to 4,800 cubic metres in just 25 years (Sadeq, 1999). The water resources in developing countries of Himalayan region viz. Afganistan, Bangladesh, Bhutan, Burma, China, India, Nepal and Pakistan; of the Andean region of the south America: of the Altas countain of Moracco and the mountain regions of Ethiopia, Tanzania, Ruanda, and Burundi as well as of the mountain areas of the Pacific Island region are under threat of safe drinking water supply and sanitation. The exhausted river, falling water table, and shrinking lakes, all testify to worldwide human abuse of water resources (Ahmad, 1990 & 1999).

In the Middle East, it is now water, not oil, which is the real threat to regional peace. With Environmental and Political factors dramatically affecting the flow of the Nile, Jordan, Tigris, and Euphrates, the need for water could lead to unexpected and potentially explosive new alliances – between Iraq & Syria, for instance both threatened by Turkey's control of the Tigris-Euphrates. Israel's determination to hold on the West Bank, Golan Height and South Lebanon, for instance, is partly to preserve access to water resources (Ahmad, 1989).

Throughout human history, water resources have been a source of conflict. As demand for water rises, the potential for conflicts may increase. Many international Commentators argue the water will be an increasing cause of dispute (some suggest even war) in the years ahead. Increasing demands for water may establish conditions for conflict over access at a range of levels from the river basin or aquifer level; through the sub-national level between regions of the country, down to local level of lists between communities. Transboundary water resources disputes have become particularly significant in recent year. The exploitation of fresh water reserves for human use increased six-fold between 1950 and 1995, growing twice as fast as the population. Roughly two-thirds of the world's population will suffer from a shortage of water by 2025. This also entails a growing risk of armed conflict across the water (Department of International Development, 2001).

Presently, more than 1.3 billion people live without electricity, 768 million people lack potable water, 2.8 billion live in areas of high water stress and 2.5 billion people without sanitation. Water security is an important issue in 21st century.

In nut shell, the mismanagement or poor management of water is main factor for disasters like floods, droughts, climatic variability, advancement of desertification, landslides, etc. Many of the impact of natural disasters on socio-economic development occur through water. Water-related hazards accounts for 90 percent of all natural hazards and their frequency and intensity is generally rising. Some 373 natural disasters killed over 2,96,800 people in 2010, affecting nearly 208 million others and costing nearly US$ 110 billions (UN Secretary General Report, 2010).

Indian Scenario

The river systems of India can be classified physiographically into four groups viz. Himalayan rivers, Deccan rivers, Coastal rivers, and Rivers of the inland drainage basin. The main Himalayan River Systems are those of Indus and Granga-Brahmaputra-Meghna systems which receive very heavy rainfall in monsoon. The flows in the summer months are due to melting of snow and glaciers and, therefore, these rivers have continuous flow throughout the year. The important river systems in the Deccan are the west flowing rivers of Narmada and Tapi and the east flowing rivers of Brahmani, Baitarni, Mahanadi, Godavari, Krishna, Pennar and Cauvery. The Deccan rivers are rainfed and some of them are non-perennial. While only a handful of such rivers drain into the sea near the deltas of east coast, there are as many as 600 such rivers on the west coast. The west coast rivers are short in length and have limited catchment areas. A few rivers in Rajasthan do not drain into the sea. They drain into salt lakes or get lost in sands with no outlet to sea (Ministry of Water Resources, 1999).

India has sufficient water resources on the average in comparison to many other countries in the world. It has been assessed that out of the total precipitation of around 400 million ha. metre (M.ha.m) in the country, the surface water availability is around 185 M.ha.m. Out of this only about 69 M.ha.m. can be put to beneficial use because of topographical and other constraints. The country has been divided into 24 river basins comprising 3287260 km^2 catchment area. At present 13 water surplus basins are available where less than 105 ha of net sown area per million cubic metres of water potential exists. The availability of surface water in various regions in the country is uneven. The Ganga-Brahmaputra-Meghna system covers a land areas of 33 percent and accounts for 60 percent of India's water resources, while the catchment of river flowing west is 3 percent and they account 11 percent of India's water resources. Therefore, 71 percent of India's water resources are available to 36 percent of the area while the remaining 64 percent has only 29 percent water resources.

The countries having 1000 m^3 water availability per capita and per annum are considered under very low category scarcity conditions. Based upon this criterion, already six basins viz. Sabarmati, east flowing rivers between Pennar and Kanyakumari, Pennar, west flowing rivers of Kutch and Saurashtra including Luni, Cauvery and east flowing rivers between Mahanadi and Pennar fall into this category. More and more basins will become water scarce by 2025 and 2050 with the population increase (Indian Water Resources Society, 1997). The per capita water availability in India was 5150 m^3/capita/annum during 1947 which reduced to 2200 m^3/capita/annum in 1998 and it is predicted that by the year 2017, it will go down to 1600m^3/capita/annum resulting in serious water crisis leading to disasters.

Since the industrial revolution, water pollution problems have become first regional, then continental, and now global. The major factors associated with the accelerated pace of fresh water pollution leading to greater challenge of water resources development and management are:

– Urbanisation (17.29% in 1951, 23.33% in 1981, 25.72% in 1991 and 35% in 2014) and the consequent increase in population.

– Intensification of agriculture and growth in industries.

– Deforestation (507 km^2 during 1993 and 1995 i.e. 25350 ha/annum and 367 km^2 in two years i.e. between 2009 and 2011) leading to siltation of water bodies and diminishing of perennial water springs.

– Alteration in land use as well as discharge of domestic, industrial and municipal wastes – 57 million tonnes/annum industrial and hazardous wastes – 6.23 million tonnes/annum plastic wastes – 10,000 tonnes/day, e-wates – 11017 tonnes/annum in Mumbai, 9730 tonnes/annum in Delhi, 4648 tonnes/annum in Bengaluru and 4132 tonnes/annum in Chennai.

– Conversion of water bodies into hydroelectric dam without environmental management programme.

– Accidental water pollution (burst pipes and tanks, major leaks, fires and oil spills).

– Destruction of wetlands resulting loss of capability of storing and degrading many pollutants such as phosphorus and heavy metals.

– Loss of pesticides, fertilisers, and manure from agricultural fields during run-off.

– Encroachment in lake catchment area.

– Mining and industrial development.

– Invasion by exotic weeds.

– Primary energy consumption leading to increased atmospheric emissions of sulphur and nitrogen oxides, the main cause of acid rain.

These human-induced activities have caused challenges to the technologists, scientists and water managers worldwide to now adopt integrated approach for river basin management for reduction of disaster risks (Ahmad, 1999). Some of the disasters occurred due to mismanagement of water in India are as follows.

Floods

Floods affect vast areas of the country, transcending state boundaries. Out of 45 million ha of flood-prone area in the country, on an average, floods affect an area of around 7.5 million ha per year (Ministry of Water Resources, 2002). The Ganga basin is worst affected due to flood i.e. about 50 percent of the total flood-prone area in the country. The recurring floods cause huge loss to life and property every year viz. the States of Uttar Pradesh and Bihar had lost Rs. 110 crore and Rs. 24 crore respectively due to crops, houses and public utilities damages. In 2008, the floods coupled with burst of Kosi embankment resulted in inundation of 1000 villages in 5 districts of Bihar involving 3 million people. According to the UNDP Assessment, the valuation of houses damaged stands around Rs. 880 crore. Enormous amounts of goods were lost, including food grains and domestic items estimated to be worth Rs. 400 crore and 155 crore respectively (United Nations Development Programmes, 2009).

The heavy floods in 2014 have led to huge loss of lives and properties in the States of Assam, Orissa, Uttar Pradesh, Uttarakhand and Bhihar. The floods of Mahanadi in Orissa have affected about 10 lakh people in 1553 villages in 23 districts and death toll to 34 people. In Assam, the floods due to Brahmaputra and its tributaries have affected about 3 lakh people in 1066 villages in 15 districts covering 90,867 hectares of cropland. In Uttarakhand, heavy floods caused death of about 27 people and huge loss of properties. In Uttar Pradesh, floods due to Ganga and its tributaries namely Rapti, Ghaghra, Saryu, Gandak, etc. have affected 1500 villages in 9 districts, loss of lives of 89 people and huge loss of crops and properties. In Bihar, floods have affected about 11 lakh people in 13 districts.

The Central Water Commission had assessed floods damages in India which indicates maximum damage to crops, house and public utilities to the tune of Rs. 8864.54 crore in 2000 (Central Water Commission, 2010).

The epidemics in the aftermath of floods events are also responsible for considerable loss of human lives. For instance, the floods of July-August 2007 led to an outbreak

of cholera in four districts of Orissa, killing more than 100 people (SAARC Disaster Management Centre, 2008).

Droughts

The South-west monsoon contributes more than 75 percent rainfall in India. The failure of such monsoon and mismanagement of water after monsoon resulted in droughts and advancement of deserts including climatic variability. Presently, 68 percent area is vulnerable to droughts due to India's unique physiographical features.

According to the World Bank report of 2008, about 20 percent of India's flat land area is drought-prone. As per the Ministry of Agriculture, 14 states declared drought like situation in 338 districts with Himachal Pradesh, Assam, Jharkhand, Manipur and Meghalaya declaring all the districts as drought-prone in the year 2009. The Government of Kerala also declared drought in 14 districts in 2010 due to acute water shortage and drying up of water resources.

Desertification

Twenty-five percent of India's total land is undergoing desertification while 32 percent is facing degradation that has affected its productivity critically affecting the livelihoods and food security of millions across the country. The states suffering from land degradation/desertification are Rajasthan, Gujarat, Maharashtra, Orissa, Andhra Pradesh, Jammu & Kashmir.

The mismanagement of water resources is main reason for above disasters which is increasing alarmingly every year. The economic, social and environmental impacts of such disasters are escalating due to poor water management resulting in serious impediments to the economy of the country.

Discussions

The modern history of river basin management can be traced back to two events. The first was the creation of the Tennessee Valley Authority (TVA) in the United States in 1934. The second event was the creation of Damodar Valley Corporation (DVC) in July, 1948 for development and management of the basin as a whole. Further river basin management schemes in India followed in quick succession but elsewhere in the developing world the adoption of the river basin planning approach has not been adopted, with most countries concentrating on single large scale, high prestige projects.

Global Scenario

The present State of the water environment which led to disasters in both developed and developing countries have attracted attention of all classes of people globally. The UNEP has been involved in a number of international water projects, stressing its programme of Environmentally Sound Management of Inland Waters (EMINWA). To date UNEP has cooperated with riparian countries in EMINWA efforts in a variety of regions, including the Zambezi River Basin and Lake Chad Basin of Africa, the Mekong River Basin of Southeast Asia, the Aral Sea Basin of South Central Asia, the San Juan River Basin of Central America, the lake Titicaca Basin of South America, and in the Xinjiang Autonomous Region of north-west China. EMINWA projects are ongoing or planned for the Caspian Sea Basin of Eastern Europe, the Nile River Basin of Africa, and within the Human Autonomous Region of south-west China.

The UN, has also taken a number of initiatives and declared the years 1981 to 1990 as the International Drinking Water Supply and Sanitation Decade. The 1992 International Conference on Water and the Environment in Dublin was the first to lay down principles for action at local, regional and international level. In 1997, a special session of the UN General Assembly launched an International freshwater initiatives and in the spring of 1998, a strategy on freshwater was adopted at the Commission on Sustainable Development (CSD) Conference. In its millemium session in the year 2000, the UN announced its aim to cut by half the proportion of people without access to clean drinking water by 2015 and to put an end to non-sustainable use of water resource. In December, 2001, an innovative meeting took place in Bonn, focusing on water as key to sustainable development. The water issue was further discussed in 2003 at Kyoto, Japan and thereafter series of meetings in various parts of the world.

Agenda 21 was adopted in 1992 at the UN conference on Environment and Development in Rio-de-Janerio. In 40 chapters, it describes all major policy areas for environmentally sound and sustainable development. Chapter 17 and 18 are particularly relevant for water resource management.

Chapter 17 deals with protection of the oceans and all kinds of seas including coastal regions and the protection and efficient utilisation and development of their living resources.

Chapter 18 lays down objectives for the protection of fresh water resources in terms of quantity and quality. The chapter describes seven different programme areas:

– Integrated planning and management of water resources,

– Assessing water supply,

– Protecting water resources, water quality and aquatic ecosystems,

– Drinking water supply and sanitation,

– Water and sustainable urban development,

– Water for sustainable food production and rural development,

– Impacts of climate change on water resources.

The Nile basin provides a current example of an International initiatives of a regional partnership under which the countries of the Nile basin are engaging in co-operation on the Sustainable Development and management of the waters of the Nile. The Nile Basin Initiatives was launched in Dar-es-Salaam in February, 1999. The member countries are Burundi, Democratic Republic of Congo, Egypt, Ethiopia, Kenya, Ruwanda, Sudan, Tanzania and Uganda. The Nile Basin Initiatives has established a strategic Action Programme to promote the shared vision to achieve sustainable socio-economic development through the equitable utilisation of, and benefit from the common Nile Basin water resources.

Indian Scenario

The Constitution of India lays down the legislative and functional jurisdiction of the Union, State and local Governments regarding 'water' under the scheme of the constitution. 'Water' is basically a State subject and the Union comes in only in cases of inter-state river waters.

India is a Union of States and the constitutional provisions in respect of allocation of responsibilities between the States and the Centre fall into three categories namely; the Union List (List-I), the State list (List-II), and the Concurrent list (List-III). Article 246 of the Constitution deals with subject matter of laws to be made by the Parliament and the Legislature of the State. As most of the rivers in the country are interstate, the regulation and development of water is a matter included in Entry 17 of List-II i.e. State list. This entry is subject to the provisions of entry 56 of list-I i.e. Union list.

Article 262 provides:

- Parliament may be law provide for the adjudication of any dispute or complaint with respect to the use, distribution or control of the waters of, or in, any inter-state river or river valley.
- Notwithstanding any things in this constitution, parliament may, by law provide that neither the Supreme Court nor any other court shall exercise jurisdiction in respect of any such dispute or complaint as is referred to in clause (1).

River Boards Act, 1956

Under entry 56 of the List-I of the Constitution, the River Board Act, 1956 was enacted for the establishment of River Boards for the regulation and development of Inter-state River and River Valleys. Central Government has however not been able to constitute any River Board under this act so far for the integrated planning, development and management of water resources of the river basin as a whole. The Government, however constituted the Betwa River Board, Banasagar Control Board, Tungabhadra Board, Brahmaputra Board, Narmada Control Authority (NCA) and Upper Yamuna River Board outside the River Boards Act, 1956 for specific purposes for the planning, management, regulation of water resources in specific river basins.

Interstate Water Disputes (ISWD) Act, 1956

Under Article 262 of the Constitution, Parliament has enacted Interstate Water Disputes Act, 1956 for adjudication of disputes relating to waters of inter-state rivers and river valleys. Section 11 of the ISWD Act, 1956 also precludes all the Courts including Supreme Court from having jurisdiction in respect of any water dispute which may be referred to Tribunal under this Act.

The Union of India has made various institutional arrangements for development and management of water viz. National Water Resources Council (NWRC), National Water Board, Negotiated Settlements, Standing Committee on Inter-State issues. The Government of India has also initiated the Basin approach for the management of the water resources through Commissions, Boards and Authorities as follows:

Krishna-Godavari Commission: The Krishna-Godavari Commission was constituted in 1961 for ensuring coordinated planning and integrated operation of all projects in the basin.

Sone River Commission: The Sone River Commission was constituted in 1980 for preparing a comprehensive Sone river basin plan for optimum utilisation of its water for various uses. The commission has since been wound up in 1988.

Ganga Flood Control Board (GFCB) **and** ***Ganga Flood Control Commission (GFCC):*** The Ganga Flood Control Board was set up in 1972 by a Government of India Resolution. The GFCC has completed the master plans of 23 river systems of Ganga sub-basin. The problems of erosion and drainage caused due to Ganga flood are dealt by GFCC in the States of Bihar, Haryana, Himachal Pradesh, Madhya Pradesh, Rajasthan, Uttar Pradesh, West Bengal and NCT Delhi.

Brahmaputra Board : The Brahmaputra Board was set up in 1980 to prepare a master plan for control of floods in the Brahmaputra Valley giving due regard to the

overall development and utilisation of the water resources of the valley for irrigation, hydropower, navigation and other beneficial purposes.

Upper Yamuna Basin: The Yamuna water dispute was resolved by signing a memorandum of understanding (MOU) on 12.5.1994 by the Chief Ministers of the co-basin states of Haryana, Uttar Pradesh, Rajasthan, Himachal Pradesh, and NCT of Delhi. The agreement takes care of the irrigation and consumptive drinking water needs of all co-basin states and has opened up of development of water resources in the upper yamuna river basin.

Bhakara-Beas Management Board (BBMB): Bhakara-Beas Management Board was constituted through an executive order in accordance with the section 79 of the Punjab Reorganisation Act 1966 to regulate the supply of the waters of rivers Sutlej, Ravi and Beas to the States of Punjab, Haryana, Rajasthan and NCT of Delhi and to distribute power from the Bhakra-Nangal and Beas projects to the States of Punjab, Haryana, Himachal Pradesh, Jammu & Kashmir, Union Territory of Chandigarh and Delhi.

Narmada Control Authority: The Narmada Control Authority has been set up as per the final orders and decisions of the Narmada Water Disputes Tribunal (NWDT) as machinery for implementation of its directions and decisions. The Authority started functioning from 20th December, 1980. The role of the Authority comprises overall coordination and direction of the implementation of all the projects including the engineering works, the environmental protection measures and the rehabilitation programmes and to ensure faithful compliance of the terms and conditions stipulated by the Central Government at the time of clearance of the aforesaid projects. With Union Water Resources Secretary as ex-officio Chairman of the NCA, the decisions of the Authority are final and binding on all the party States. However, a Review Committee consisting of Union Minister of Water Resources as Chairman, Union Minister of Environment and Forests and Chief Ministers of Gujarat, Madhya Pradesh, Maharashtra and Rajasthan as Members may *suo-moto* or on the application of any party State can review any decision taken by the Authority. The Secretary, Ministry of Water Resources, Government of India, shall act as convenor to the Committee.

Besides above, several other organisations like Betwa River Board for Rajghat dam across Betwa, the Bansagar Board for Bansagar dam across Sone, the Mahi Control Board for Mahi Bajajsagar project across Mahi and the Narmada Control Authority for Sardar Sarovar Project (SSP) across Narmada are examples of the river basin organisations set up mainly for achieving efficient, economic and early execution of important inter-state water resources development projects.

Why River Basin Development in India?

The mismanagement or poor management of Water Resources has led to serious problems of floods affecting millions of people in Uttarakhand, Uttar Pradesh, Bihar, Assam, Orissa. Draughts covering 20 percent area of the total land area of the country are affecting States like Jharkhand, high rainfall State Kerala, Himalayan States namely; Manipur, Assam. Besides we witness advancement of desertification covering 20 percent of India's total land area in the States like Rajasthan, Gujarat, Maharashtra, Jammu & Kashmir, Orissa and Andhra Pradesh affecting critically the livelihoods and flood security of millions in the country.

India's population is now above 1.2 billion and is expected to reach around 1.4 billion by 2025 and 1.6 billion in 2050. The per capita land is 0.13 ha and hence large percentage of income in poor families goes in meeting food requirement. The food security challenge and livelihoods are of utmost importance. The nutrition security is also a dream for 300 millions of people. The Planning Commission, Government of India estimated that despite significant progress in the 1970s and the 1980s, nearly 30 percent of the people remained below poverty line in 2004-07. Presently 27 crore people are below poverty line. The share of landless and wage-dependent households in this group is growing. There are presently more than 300 million unemployed and severely underemployed persons in the country.

Agriculture in India is mainly dependent on irrigation. The net sown area in the country has almost stabilised at about 145 million ha while the gross cropped area is about 175 million ha. Taking into account areas sown more than once, it is unlikely that net sown area will increase in the future. The only way to increase the gross cropped area is to expand irrigation facilities and to facilitate intensive agriculture in a sustainable manner, avoiding e.g. over irrigation, salinisation and flooding. The gross irrigation is estimated to have increased from 22.6 million ha in the year 1951 to about 108 million ha which means, about 77 percent of the ultimate irrigation potential has since been created. Further development is must to meet food security challenge of growing population. The food grain production which was about 210 million tonnes in the year 1999-2000 may have to be raised to about 350 million tonnes by 2025. The demand of water for irrigated agriculture will also go up from 630 km^3 in the year 2000 to 770 km^3 in the year 2025. The demand of drinking water supply would increase to 52 km^3 in 2025 from 33 km^3 in year 2000 and the demand of industrial water is expected to go up from 30 km^3 in year 2000 to 120 km^3 in 2025. The per capita water availability was 5177m^3 in 1951 has come down to 1820 m^3 in 2001 and is now projected to 1314 m^3 in 2025 and 1140 m^3 in 2050.

At the energy front India has made rapid progress in terms of the installed generating capacity, from a mere 1362 MW at the time of independence to about 237742 MW by

February, 2014. Though this growth appear to be impressive but in December, 2013, there was a deficit of 5547 MW of peaking power in the country. The percentage of installed thermal, hydel and nuclear power stations capacities are around 73, 24 and 3 respectively. The hydro-electricity has still vast untapped potential.

The River Basin approach for management of water resources could not follow quick succession globally after the Tennessee Valley Authority (TVA) in the United States in 1934 and Indian Damodar Valley Authority (DVA) in 1948. Water being our common heritage, and the reality that we all share the responsibility of protecting it for future generations, a breakthrough for really sustainable water resources development and management is imperative. The ecosystem-based policy approach for the integrated management of water resources (River Basin approach) involving scientific, technical and engineering factors on the one hand and social, economical, environmental and legal factors on the other hand in various mission modes is need of the hour for tackling disasters like floods, droughts, erosion, landslides, climatic variability, advancement of desertification, land degradation and to meet the food, energy, drinking water, irrigation, ecosystems security challenges of today and tomorrow, Integrated Management of Water Resources (IMWR) deserves due attention for ensuring environmentally sustainable development in the country.

Recommendations

Following recommendations based on ecosystem approach deserve due consideration globally for the integrated river basin management to prevent disasters like floods, droughts, desertification's, climatic variability, etc.:

1. The water should be made a Union/Concurrent subject in the Constitution. It should be considered as a National asset and accordingly comprehensive National Policies and Strategies for integrated Water Resources Management that link water to National Development goals should be framed.

2. The multi-disciplinary River Basin Authority exclusively funded by Central Government should be established under River Boards Act, 1956 under entry 56 of List-I to promote integrated development of water resources especially inter-state rivers, and river valleys. The water management must be organized to maintain or restore the ecological balance (terrestrial and aquatic ecosystems) and guarantee water supplies on a sustained basis in terms of quality and quantity. The Centre, State and Local bodies (Panchayats, Corporations, Municipalities, Traditional Industries, etc.) should play an important role.

3. Multidisciplinary River Basin Authorities in each States for Integrated Intra Water Resources Management (IIWRM) and Sustainable Development. The

policy and programmes for Resettlement and Rehabilitation (R&R) of displaced persons and Environmental Management should be an integral part in the Authority.

4. The River Basin authorities of the States should formulate programmes under various Missions through people participation to ensure livelihoods to the basin population and at the same time for ensuring Natural Resources Management and sustainable development in the basin. These missions could be as follows:

   a. *Water Mission* (construction of multi-purpose water resources projects, water harvesting, rehabilitation of degraded rivers, rivulets lakes, ponds, water quality surveillance).

   b. *Aquaculture Mission* (based on technical feasibility and economic viability, capacity building, marketing, etc.).

   c. *Livestock Mission* (value chain development in dairying, goatery, piggery, poultry, duckery, capacity/institutions building, entrepreneurship development, etc.).

   d. *Forestry Mission* (protection and management of forests, plantation in both urban and rural areas, rehabilitation of degraded forests, incentive to forest growers and owners of sacred groove in North-East).

   e. *Agriculture and Horticulture Mission* (cropping pattern for irrigated agriculture, nursery for horticulture, improved seeds for agriculture, extension services, marketing and storage infrastructure for agriculture and horticulture produces at Panchayat level).

   f. *Tourism Mission* (potential tourists sites/places already existing and identification of new sites, infrastructure development, institution and capacity building and linking of tourism with water sports, forestry, horticulture, agriculture, game farming, game fishing, etc.).

   g. *Energy Mission* (with focus on geo-thermal, solar, wind, biomass, hydel, tidal resources in Ganges delta and Sundarbans, Gulf of Kutch and Khambhat).

   h. *Apiculture Mission* (oriented towards value chain development, capacity and institution building, entrepreneurship development, etc.).

   i. *Sericulture, Weaving and Artisan Mission* (capacity and institution building, extension services, marketing, etc.).

j. *Health Mission* (focus on Sanitation and Hygiene).

k. *Vocational Training Mission* (opening of ITIs in rural areas).

5. Interstate rivers disputes should be resolved timely so that translation of disputes into conflict over shared water resources could be avoided. The Tribunal constituted under the Inter-State Water Disputes Act, 1956 should be multi-disciplinary, headed by a judge. The time line should be fixed for final order, clarifications and supplementary orders. Appeals to the Apex Court should also be prescribed under the Statute.

6. The following dimensions of the water protection area should be given due emphasis :

Catchment zone-I. Any pollution of the bank area and the water in the catchment zone is to be avoided. The catchment zone belongs the waterbody of standing waters and its bank areas, the storage body and take-out construction of reservoirs. Considering terrain exposition and morphological, geological and local conditions, the catchment zone, as a rule, to be determined at 100 to 200 m around the waterbody measured in the projection from the highest storage line.

Narrow protective zone-II. The narrow protection zone encircles the catchment zone and has to be so dimensioned that the catchment zone is protected against all threats that may result from utilisations or pollution within the broader protective zone. In an inclined terrain it is to be extended to all areas that drain directly into the catchment zone, in a shallow terrain, it can be upto 500 m. wide. All impairing utilisations in this zone that may have negative effect upon the catchment area should be prohibited.

Broader protective zone-III

- The measurement of development e.g. mining, drilling, soils development etc. are to be coordinated with the interest of water management.
- Special places for the storage of residues are to be determined that shall have no possibility of pollution of the water.
- The handling of oil and petroleum products should be carried out scientifically.
- Enterprises, which utilise, store or produce poisons according to the law on poisons have to take special precautions with respect to water treatment and safeguarding populations against catastrophe.
- The waste products of agricultural production and processing plants are to be utilised in agriculture itself.

- Nitrogen, manure and minerals washout should be controlled.
- If colonies get waste water canalisation, the waste water is to be let out of the drinking water catchment area or to be brought to sufficient waste water treatment.
- Soil cultivation is principally to be carried out at right angles to the slope.
- A slope with an unfavourable relief, necessary erosion mindering measures are to be implemented.
- Slopes with an inclination between 12 to 18 percent are preferably to be utilised as permanent grass land or forest.
- Slopes with an inclination over 18 percent are to be utilised by forestry. The plantation has to be carried out to develop special forests with protective function.

7. International community to strengthen its commitments and efforts to enable developing countries to manage water sustainably and to ensure equitable sharing of benefits from internationally shared water resources. The UN system should have to play an important role in coordination and strengthening of activities on water issues.

Conclusions

The problems associated with integrated surface water resources management considering river basin as a Hydrological Unit are a great global challenge. The existing state of water environment had already given way to 'conflicts on water' on one hand and disasters like floods, droughts, landslides on the other hand in various countries of the world mainly in North Africa, Middle east, Western Americas, South-east Asia. In India, the mismanagement of water is main reason for conflicts between various states and disasters like floods, landslides, droughts, climatic variability, advancement of desertification, etc. jeopardising livelihoods and posing food security challenge of millions on one hand and major economic, social and environmental impacts on the other hand. In India, conflicts on water will be of serious concern in future, if the protection and wise management of most valuable of the world's renewable resources are not given top priority. The integrated management of water resources (River Basin approach) involving scientific, technical and engineering factors on the one hand and social, economical, environmental and legal factors on the other hand is need of the hour. Water being our common heritage, and the fact that we all share the responsibility of protecting it for future generations, a breakthrough for really sustainable water resources development and management is required.

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