

# **Integrated Water Resources Management (IWRM): A Northeast Indian Perspective**

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## **IWRM and the Northeast**

Conceptually speaking Integrated Water Resources Management (IWRM) for a region is a process of developing and managing water resources in a sustainable way from a holistic perspective taking into consideration all the different uses of water from various sources for sustenance of the environment and socioeconomic benefit of the people of that region. Although IWRM principles or philosophy remains built-in in many project plans, one can rarely see the application of IWRM in reality in the context of the Northeastern region of India (NER). The annual cycles of heavy monsoon downpour and devastations of floods and erosion in the region have ingrained in the mindset of people perceptions that water is plentiful and water bring woes. The realization that water is, in fact, a valuable but finite resource that can be properly utilized to deliver social and economic benefits to people apart from augmenting the ecological services is relatively new. The renaming of the erstwhile ‘Department of Flood Control’ of the Government of Assam as the ‘Department of Water Resources’ is an indicator of the change in attitude of the decision makers.

Same was the case with the myriads of wetlands in the region, especially in Assam that were considered barren water bodies as good as wastelands having no utility for man. The extraordinary value of the biodiversity and the ecological and economic services of the wetlands have been recognized only recently. Similarly, the copious rainfall that the region receives in the premonsoon and monsoon months and the annual flooding have very often created the impression that the region is surplus in rainfall and water always and everywhere which is a reason why conservation of rain water and water in other natural or artificial water bodies have been thought to be unnecessary in the region. This perception is far from the truth. The variability of rainfall in the region is considerably high in space and time making some parts of the region water deficient and affecting peoples’ lives in general and agriculture in particular. Storage, preservation and sustainable utilization of rain, surface and ground waters are a must in these water-scarce regions.

In this essay a few water related issues that are of current concern to Northeast India are highlighted vis-à-vis their relevance to the implementation of IWRM in the region.

## **The Water Wealth of Northeast India**

The North Eastern Region (NER), comprising the eight Indian states of Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura, is endowed with bountiful water resources carried by its numerous rivers originating mainly from the Trans Himalayas, Middle Himalayas and the Sub-Himalayas on the north, Patkai-Purbachal hills on the north-east and east and Karbi-Jaintia-Meghalaya-Garo hills on the southern fringe. The Brahmaputra in the northern part and the Barak (Meghna) flowing through the southern margins along with their numerous tributaries are the two main river systems that have created a very dynamic and powerful hydrologic regime in the region. A third river, the Irrawaddy, flowing through Myanmar at the easternmost flanks of the region also drains a part of it mainly through some of its tributaries like the Chindwin. The Brahmaputra originates at the Tibetan plateau, passes through Arunachal Pradesh and Assam and merges with the Bay of Bengal in Bangladesh. The Barak has its origin at the Manipur-Nagaland border, passes through the southern part of Assam and outfalls in the Bay of Bengal after merging with the Brahmaputra by the name of the Meghna. The Irrawaddy has its source in Myanmar, passes entirely through Myanmar and empties in to the Bay of Bengal near Andaman and Nicobar islands. Thus all the three major rivers of the region and many of their tributaries are international in character with their courses lying in more than one country and their basins shared by several countries.

Individually the basins of the Brahmaputra, the Barak and the Irrawaddy occupy 68.42% (1, 74,528 km<sup>2</sup>), 16.36% (41,723 km<sup>2</sup>) and 7.27% (18,539 km<sup>2</sup>) of the region and together they account for 92.04% (234790 km<sup>2</sup>) of the region's geographical area. But the Brahmaputra and the Barak, the catchments of which jointly claim 84.78% (216251 km<sup>2</sup>) of NER, remain the most dominant hydrological systems having the greatest impact on the environment and lives of the people. The surface water resources available in the region amounts 652.8 billion cubic meters that gives it the highest (34%) share in the country's total surface water resources potential although the region represents only 8 percent of the total Indian landmass. The per capita and per hectare availability of water in this region is the highest in the country.

## **IWRM and Flood Management in NER**

The Brahmaputra and Barak (Meghna) basins, particularly in Assam, have earned notoriety for the awesome hazards of annual flood and erosion that create mayhem every year, bringing misery to the people and shattering the fragile agro-economic base of the region. With 40 % of its land surface susceptible to flood damage, Assam's Brahmaputra valley represents one of the most acutely hazard-prone regions in the country, having a total flood prone area of 3.2 million ha. Floods in Assam are caused by a combination of natural and anthropogenic factors. The unique geo-environmental setting of the basin vis-à-vis the eastern Himalayas, the highly potent monsoon regime, weak geological formation, active seismicity, accelerated erosion, rapid channel aggradation, massive deforestation, intense landuse pressure and high population growth, especially in the floodplain belt, and ad hoc temporary flood control measures are some of the dominant factors that cause and/or intensify floods in Assam. The

scenario is further exacerbated by a myriad of social, environmental and economic factors that make populations increasingly vulnerable.

The state has experienced major floods in the years 1954, 1962, 1966, 1972, 1977, 1984, 1986, 1988, 1998 and 2004. In the aftermath of the Great Earthquake of 1950, the damage due to and intensity and frequency of floods increased progressively (Goswami and Das 2002). The floods of 1988, 1998 and 2004 were the worst in recent history.

Breaching of embankments has been a major cause of intensification of the flood hazard in recent times. The undesirable consequence of embankments, especially in aiding channel aggradation and overbank flooding is clearly visible in Assam. Structural measures, mainly embankments, have been used so far as the sole answer to tackling floods. Out of a total of 15,675 km. of embankments built in the entire country, Assam alone has as much as 5,027 km., about 32% of the country's total.

In the case of Assam, one of the main aims of promoting and implementing IWRM must be to provide a viable long-term solution to the chronic flood problem. A judicious combination of structural and non-structural measures aimed at reducing vulnerability and risks of the people and places to the hazards of flooding and erosion must be a component of IWRM systems. So far the entire emphasis has been put on structural measures such as embankments, spurs, dykes, porcupines, bamboo cribs, permeable screens etc. Of late multipurpose storage reservoirs seem to have caught the imagination of the planners as a single window solution to moderate flood peaks as well as to generate power. Non-structural measures such as flood plain zoning watershed management, soil conservation, afforestation, real-time flood forecasting, reduction of susceptibility to flood hazards and damage, enhancing coping capability of the affected people to floods etc. are yet to be encouraged and adopted in reality. Catchment treatment plans that include massive afforestation both in upstream highlands and downstream flood plains are needed to stabilize the channels of the tributaries of the rivers and reduce silt load in the flow.

### **IWRM and the Hydropower Blueprint for the Northeast**

Out of the total of 84,044 MW of the country's total hydropower potential the NER carries a potential of 31,857 MW (37.9% of the country) of which about 3% has so far been tapped for human use (Brahmaputra Board, 2000). The Ministry of Power, Government of India has identified 185 sites as suitable for starting water resources development projects mainly for the purpose of generation of hydropower in Northeast India (CEA, MoP). These projects, covering most of the major rivers in the region are sought to be implemented in phases in the coming five decades in addition to 49 projects that are already operational or under construction or granted clearance or at various stages of clearance or under investigation. The MoP is contemplating to achieve a target of generating a colossal 99,256 MW of hydropower from these projects by the end of the year 2050.

The region's peak demand of power by the end of the ninth plan (2001-02) was expected to be 1,809 MW which was to be met by a targeted generation of 2,419 MW. The planned addition to hydropower generation is 19,098 MW by the year 2010 which is more than six times the projected peak demand of power in 2,010 (3200 MW). While the peak demand of power is expected to increase to 8,200 MW and 10,700 MW in 2040 and 2050 respectively, the total installed capacity of hydropower is sought to be raised to 59,256 MW and 99,256 MW by that time, the figures being more than seven and ten times the projected peak power demand of the region in the same time frame (Goswami and Das 2003).

There is no denying the fact that generating power from the utilizable water resources of the Northeast for augmenting development efforts for the country as well as the region is a legitimate pursuit. But at the same time the ecological and social costs of such large projects in an environmentally and socio-politically vulnerable region like the Northeast need to be assessed properly before going all out to change the landscape of the region forever with so many dams that nobody is sure whether we really need or not. So far, the objectives of planning and executing mega-dam projects in the region have not been convincingly integrated with social, cultural and ecological benefits to the stakeholder people which is contrary to any IWRM approach.

An integrated plan of water use needs reliable and accurate knowledge of different aspects of the water regime of a region such as hydrology, meteorology, climatology, geomorphology, geology, eco-hydrology and socio-economy. There is a big question mark about whether we really have adequate information and knowledge-base and a sound understanding of the dynamic and tectonically unstable geo-hydrological regimes of the Himalayan Rivers of the NE region. The glaring paucity of reliable hydro-meteorological and geo-environmental data of required quality and length are a factor that hinders all kinds of research on water resources and also raises questions regarding the acceptability of the technical soundness of the feasibility reports of these large-hydro projects.

Participation of the people in decision making in developing and managing the water sources is a fundamental aspect of IWRM, which is yet to take effect in the NER. The lack of a sound water governance systems is apparent from the fact that stakeholder in both upstream and down-stream areas of these projects are not properly consulted denying them any opportunities for participatory decision making regarding the use of the waters that they have a natural right over. There are serious complaints from stakeholder groups and people that public hearings (mandatory in the process of getting a project approval) are often made a mockery of. The hearings are conducted in a farcical manner without prior information to the stakeholders so as to get a designed approval in favour of the projects. More than the desirability or the viability of the project, the issue here is the people's right to information and environmental justice to be a part of decision the making process. Interested readers may refer to the following two publications for more information on how existing norms and laws have been violated and public rights to information have been denied in the context of a number of hydropower projects in the northeastern region.

1. *Ecologist Asia: Special issue on large dams in northeast India- Rivers, forests, people and power. Vol. 11. No. 1. Jan-Mar 2003.*
2. *Large Dams for Hydropower in Northeast India-A Dossier: Kalpvriksh and South Asia Network on Dams, Rivers and People, 2005.*

## **IWRM and the IRLP in NER**

Aimed at resolving the water crises in central, southern and western parts of the country by transferring excess water from the water surplus river basins to the water deficient basins, the Indian River Linking Project (IRLP) mooted by the Government of India in the year 2003 has faced opposition from experts, environmental groups and the common people alike on several grounds. IRLP, especially its Himalayan component that involves proposed transfer of water from the Brahmaputra basin has been a subject of vigorous discourses, debates and controversy in the Northeast. One of the major apprehensions expressed by people at large is that the plan to transfer water from the Brahmaputra basin in NER through the Manas-Sonkosh-Tista-Ganga link along the Assam-Bhutan-North Bengal border margin of foothills is fraught with the possibility of disastrous consequences for ecosystems, rivers and people. Apart from rendering the entire region tectonically more vulnerable, construction and the link canals may, many believe, induce more of landslides and soil erosion, exacerbate floods and jeopardize the life-livelihood-landuse systems of the many ethnic groups living in those areas. One of the main arguments of the critiques of the IRLP is that the project has been launched without having any authentic estimation of water resources in the Brahmaputra basin and that the perception of surplus and deficiency is a myth. As stated earlier in the context of the hydropower projects, reliable quantitative assessment of water resources in the basin/sub-basins of the Brahmaputra and the Barak and their tributaries is a prerequisite to all integrated water resources development and management schemes including the IRLP

## **IWRM and Wetland Resources of NER**

The valleys of the Brahmaputra and the Barak in Assam are the seats of numerous wetlands of different sizes and shape most of them originating from abandoned river courses and located close to the parent rivers. There are about 5,213 nos. of wetlands in Assam occupying nearly 10,123 sq. km area (13 percent of the total geographical area of the state) and distributed in 23 districts of Assam. Most of these wetlands are significantly rich in biotic resources and diversity and support the sustenance of many riparian communities. Two of them viz. the Deepor Beel<sup>1</sup> in the vicinity of Guwahati city and the Loktok in Manipur are wetlands of international importance designated as Ramsar Sites. Many of these wetlands are dying a slow death due to development pressure viz. annexation to agricultural fields, land filling for building housing colonies, water contamination from industries, factories and pesticides used in the cultivation of crops etc.

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<sup>1</sup> In Assamese *Beel* means a freshwater wetland.

Although these wetlands play a crucial hydrological role in storing and moderating flood flows in the rainy season and sustain water needs of thousands of people, there is no study available on the water regime and hydrology of these wetlands or economic valuation of their resources and services. Lack of baseline data and knowledge about our age-old wetlands is a constraint in the way of integrated planning for the conservation and utilization of the water and other resources of these wetlands.

## **IWRM and Rainfall Regime of the NER**

Meteorologically the eight northeastern states are grouped under the Northeast India (NEI) Homogeneous Rainfall Region. With a mean annual rainfall of 2070 mm and mean summer monsoon rainfall of 1420 mm (69% of annual mean), the NEI is the wettest of all the five homogeneous rainfall regions of India. NEI also receives the highest pre-monsoon and second highest post-monsoon rainfall of magnitudes of 429 mm (21% of annual mean) and 178 mm (8.6% of annual mean) respectively. The rainfall characteristics of NEI are distinctly different from those of other regions of India as well as the All India rainfall in several important aspects viz. variability and trends in annual and seasonal precipitation and conformity to the El Nino Southern Oscillation (ENSO) events.

The rainfall regime of the region is characterized with high spatial and temporal variability. While temporal variability is determined largely by fluctuations in the monsoon and premonsoon circulations, spatial variability is controlled overwhelmingly by the physiography of the region. Rainfall in large chunks of this hilly region is generated and distributed orographically which enhances the contrasts in rainfall distribution that usually remain eclipsed by the seeming abundance of rain and water, but actually have far reaching consequences for local climates, agriculture and environment ([Das and Goswami, 2003](#)).

Annual rainfall in the NER varies from as high as 11,000 mm–13,000 mm in the Cherrapunjee-Mawsynram area in the southern Khasi hills to as low as 800-1200 mm in the rain shadow area in the south-central part of the Brahmaputra valley. The southern part of Nagaon district in central Assam valley is a well known rainshadow zone where rainfall is very low due to obstructions by the Meghalaya-Karbi plateau on the way of the surging southwest monsoon winds that produce copious rainfall by orographic mechanism on the southern hillslopes of Meghalaya leaving the leeward side relatively dry. The rainshadow belt is found to extend from there through the north Cachar hills up to the Manipur plains. Average annual and summer monsoon rainfall in the rainshadow zone is 1/8<sup>th</sup> and 1/9<sup>th</sup> of that in Cherrapunjee and 1/10<sup>th</sup> and 1/11<sup>th</sup> of that in Mawsynram. It is therefore important to prepare plans to conserve and harvest rainwater properly using a judicious mixture of traditional methods and modern techniques in the central-south zone of Assam and other rain-deficient areas in the region to fulfill soaring demands of agriculture and domestic needs.

It has also been observed that the summer monsoon rainfall of South Assam meteorological subdivision (consisting of Nagaland, Manipur, Mizoram and Tripura) has decreased considerably over the last century at a statistically significant (at 1% level)

rate of about 10 mm per decade (Das, 2004). The concerned authorities will do better to draw up plans to handle situations of wider disparity in rainfall and water availability for agriculture, irrigation and other purposes in these states. Rainwater harvesting, has so far been largely ignored in the region (with the only exception of Mizoram) mainly due to the existing perception that the region has enough of rainfall and surface and ground water everywhere. However, the prevailing agro-meteorological ground situation negates this myth and necessitates promotion of rainwater harvesting along with rejuvenation of all other traditional water harvesting systems in the region.

### **IWRM and Water Quality in NER**

Although the NER is not a highly industrialized region, problem of contamination of surface water originating from industrial sources such as paper mills, oil-refineries, oil fields, coal mines, other smaller factories etc. exist at local scales. But of late contamination of ground water sources with fluoride and arsenic and consequent health hazards have emerged as one of the most critical problems especially in the southern part of Nagaon and Karbi-Anglong districts of Assam. Children and young people have been affected more with body deformations and skin diseases. Till now no effective measures have been taken to provide health security and safe drinking water to the people of these areas nor have any programs been launched for effective remediation of these problems. The civil society also has a major role to play in terms of empowering these distressed people to live a life of dignity. Keeping in mind that these are the areas that get relatively low rainfall and are dry, an integrated strategy for supplying safe drinking water and sufficient water for agriculture and other purposes can only address the problems holistically.

### **IWRM as a development paradigm in NER**

While it is true that the present utilisation of the colossal water resource potential of the Brahmaputra river system is dismally poor, the policies and practices for the utilisation of these resources in the future need to have a broader outlook and a changed paradigm and philosophy of development akin to IWRM principles. As against the ad hoc, piece meal, short-term structural measures that are being adopted now, an integrated basin management approach, based on the principles of soil and water conservation as well as sustainable development, needs to be adopted sooner than later.

It is high time for us to go beyond the confines of techno-centric management to broader notions of resource utilisation and disaster management involving wisdom as well as participation of local people at smaller scales. Proper assessment and reduction of vulnerability, empowering local populations and strengthening existing institutions are essential for achieving the goals of sustainable development through IWRM. For the Brahmaputra and the Barak rivers with their diverse backgrounds of natural and human heritage, such a plan will contribute immensely towards ensuring food, health and ecological security.

As a long-term strategy of IWRM including hazard management, a judicious mix of structural and non-structural measures with a greater emphasis on the latter should

form the core of a watershed based regional plan. The water resources of the northeast region must be planned zonally to ensure optimal resource utilisation, hazard management and welfare maximization.

Establishment of a Northeast Hydrometeorological Information System (NE-HIS) for generation, dissemination and networking of hydro-meteorological data across state, national and international boundaries can play a key role in real-time decision making especially during the time of emergencies (e.g. flooding) in the region and for safely operating the hydropower and other river projects. Regional cooperation is essential between 'downstream' countries like India and Bangladesh with 'headwater' countries like China and Bhutan for developing flood management and irrigation projects and getting sufficient flow in the lean season. The Brahmaputra and the Barak rivers being international rivers of immense size, huge resource base and high hazard potential, only effective cooperation and coordination among the basin countries (China, Bhutan, India, Bangladesh) can assure successful planning, management and utilization of the water resources of these region.

Agriculture, the mainstay of most of the basin dwellers, suffers the most as a result of gross under-utilisation of existing water resources and the impact of ravaging flood and erosion hazards. In view of the extensive flood damage to paddy crops, there seems to be an urgent need to adjust the crop calendar by increasing the emphasis on winter (rabi) crops. However, development of sustainable, localised irrigation facilities that safeguard environmental and social concerns is a prerequisite for any such change.

One can also point to the fact that opportunities and facilities for education and training in IWRM for different target groups are poor in the region. Courses available in engineering and technological institutions meet the needs of specific groups with cut-off qualification. Water education at a non-formal or semi-formal level for the lay people (such as stake holders of different projects) is almost non-existent. The awareness programmes of NGOs of the region have been confined to more on conservation of forests and wildlife than on other aspects of environment. Promotion of IWRM as a basic educational component at all levels from schools to universities and encouraging research in IWRM at doctoral and post doctoral levels will go a long way in achieving popularization and practice of IWRM as a means of securing sustainable development in the region.

Although IWRM may not prove to be a panacea for all the problems and issues concerning the water resources of the NE region, it is the most suitable approach to ensure long-term solutions to the problems and achieve the goals of sustainable development for the region.

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CEA (Central Electricity Authority): <http://www.cea.nic.in>

MoP (Ministry of Power): <http://powermin.nic.in>

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