

NEED FOR INTEGRATED WATER RESOURCES MANAGEMENT IN INDIA

S. Mahto,

Chairman,
Ganga Flood Control Commission,
Patna,

R. Srivastava,

Director (Reservoir Operation)
Central Water Commission
New Delhi

ABSTRACT:

Water is a prime natural resource, a basic human need and a precious national asset. Planning, development and management of water resources need to be governed by national perspectives. Water is a scarce and precious national resource to be planned, developed, conserved and managed as such, and on an integrated and environmentally sound basis, keeping in view the socio-economic aspects and needs of the States.

Water resources development and management will have to be planned for a hydrological unit such as drainage basin as a whole or for a sub-basin, multi-sectorally, taking into account surface and ground water for sustainable use incorporating quantity and quality aspects as well as environmental considerations. All individual developmental projects and proposals should be formulated and considered within the framework of such an overall plan keeping in view the existing agreements / awards for a basin or a sub-basin so that the best possible combination of options can be selected and sustained. Water resource development projects should as far as possible be planned and developed as multipurpose projects.

The main goal of IWRM at the river basin level is to achieve water security for all purposes, as well as manage risks while responding to, and mitigating disasters. The path towards water security requires trade-offs to maintain a proper balance between meeting various sectors' needs, and establishing adaptable governance mechanisms to cope with evolving environmental, economical and social circumstances.

IWRM addresses the "three E's": Economic efficiency, Environmental sustainability and social Equity, including poverty reduction. The three basic "pillars" of IWRM are the enabling environment of appropriate policies and laws, the institutional roles and framework, and the management instruments for these institutions to apply on a daily basis. IWRM addresses both the management of water as a resource, and the framework for provision of water services to all categories of users, and it addresses both water quantity and quality.

The paper attempts to highlight the importance of IWRM at river basin level, important conditions for IWRM, role of River Basin Organisations, interstate and international sharing of waters. The paper also lists the important steps India needs to take to achieve IWRM with focus on Development and Management aspects, Water Quality aspects, Environmental aspects, Rehabilitation and Resettlement, Project Planning & Prioritisation, Economic & Financial management, Inter-basin water transfer, Institutional Framework, Legal aspects, International dimensions and Research & Development needs in water resources sector.

Key Words: Integrated Water Resources Management, Institutional Mechanism, R&D Needs, Stakeholder Participation, Environmental and WQ Issues

Note: The views expressed in the paper are of the authors only and need not be of the respective organizations they belong to.

1.0 INTRODUCTION

Water is a prime natural resource, a basic human need and a precious national asset. Planning, development and management of water resources need to be governed by national perspectives. Water is a scarce and precious national resource to be planned, developed, conserved and managed as such, and on an integrated and environmentally sound basis, keeping in view the socio-economic aspects and needs of the States.

The concept of Integrated Water Resources Management (IWRM) emerged around the 1980s in response to increasing pressures on water resources from competition amongst various users for a limited resource, the recognition of ecosystem requirements, pollution and the risk of declining water availability due to climate change. IWRM addresses the “three E’s”: Economic efficiency, Environmental sustainability and social Equity, including poverty reduction. The three basic “pillars” of IWRM are the **enabling environment** of appropriate policies and laws, the **institutional roles** and framework, and the **management instruments** for these institutions to apply on a daily basis.

1.1 Definition of IWRM

IWRM is defined by the Global Water Partnership (GWP-2000) as ‘**A process which promotes the coordinated development and the management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems**’. It is a holistic approach that seeks to integrate the management of the physical environment within that of the broader socio-economic and political framework. The river basin approach seeks to focus on implementing IWRM principles on the basis of better coordination amongst operating and water management entities within a river basin, with a focus on allocating and delivering reliable water-dependent services in an equitable manner.

2.0 IWRM – AN EVOLUTIONARY PROCESS AT RIVER BASIN LEVEL

2.1 Embarking on IWRM in a Basin

A country’s need for water resource management varies according to its characteristics – its geography, climate, size, population, political and cultural systems, level of development, and the nature of its water resource problems. Each country and river basin must chart its own vision and plans based on its unique situation. Basin activities, such as development or land use, that may impact water resources and the hydrological characteristics in the basin must also be considered, while taking into account the social and cultural implications of the river for the population residing in the basin.

2.2 Important Conditions

IWRM aims to create sustainable water security within the present constraints in each basin. Water managers should seek and recognize which conditions are essential to effective management, which cannot be readily instituted, and which can be developed wholly or partially over time to progressively move up the process.

2.2.1 Basin Management Plan and Clear Vision

IWRM at the river basin level is a continuous process working towards a basin development plan. A clear vision should specify the area as well as the level of safety to ensure project execution. Periodic reviews of progress are important to consider changes in national objectives and other plans managed by sectors not directly related to water issues.

2.2.2 Participation and Coordination Mechanisms, Fostering Information Sharing and Exchange

Identify and involve stakeholders: Sustainable basin management, from planning to implementation and operations, requires well-coordinated mechanisms and frameworks for participation of different stakeholders, sectors and levels of administration. Participants who may be adversely impacted and/or socially marginalized may be stimulated to participate within a consensus-building strategy.

Sustained relationship with stakeholders: Sustained relationships among stakeholders assure successful IWRM. Initial sharing of general basin-wide data and information, and further sharing of more specific information regarding proposed projects, programmes and policies, will assist basin partners to more readily develop trust and respect for one another.

2.2.3 Capacity Development

Water Resource Management requires a minimal level of capacity at all levels, including that of decentralized local governments. Functional community-level capacity builds resilience to hazards, and facilitates the use of knowledge and technologies, innovation and education, thereby creating a culture of safety and resilience at all levels. Local capacity development and training priorities should be expressed as a regional agenda, to enable many partners along the research-to-development continuum, and to form collaborations where consortia, alliances, networks, and individual organisations may all find their place to both fund and benefit from it.

2.2.4 Well-defined Flexible and Enforceable Legal Frameworks and Regulation

To apply IWRM, it is necessary to assemble and review the full range of existing laws and regulations that apply to water-related activities and determine how existing legislation adapts or can be better adapted to accommodate sustainability and integration with regard to water resources management. Water legislation can clarify the entitlement and responsibilities of stakeholders and ensure sustainable use of the resource by presenting a balanced approach between resource development for socio-economic purposes, and the protection of water quality, ecosystems and other public welfare benefits.

2.2.5 Water Allocation Plans

Water is a shared resource among various sectors – including water supply & sanitation, irrigation, industrial sectors, and hydropower generation – that relate individually to specific economic, social or environmental activities and that depend in whole or in part on water to fulfill their needs and roles. Water resources development coordinated among the various sectors and users is facilitated by the preparation of a master plan reflecting individual sector plans, and offering the most effective and efficient utilization of a basin's resource. Sectoral water allocation to the co-basin States should be periodically reviewed and revisited.

2.2.6 Adequate Investment, Financial Stability and Sustainable Cost-recovery

Implementation of IWRM needs to be financially sustainable. Aside from the development and planning functions, adequate funding is required to improve managerial capacity and support research for technical and best practice advancement and for raising public awareness of water resources management issues through media and education. Various combinations of government grants, public resources, user charges and taxes, donor funds, and a basin environmental trust fund can be considered as funding options. Many international financing institutions and other major donors have roles to play in encouraging and advocating greater transparency and public participation in regional planning and decision-making on developments, and in commitments to inform the public of their potential impacts.

2.2.7 Good Knowledge of Natural Resources Present in the Basin

Adequate knowledge and information on the water resources inventory and human resources of the basin is desirable. Further scientific studies, audits and investigations can be targeted at key areas for greatest improvement in resource management. Water Resource managers should therefore include scientists among their resources and strengthen linkages with them throughout their activities.

A well defined water related data collection network including its quantity and quality are key to planning, development and management of water resources.

2.2.8 Comprehensive Monitoring and Evaluation of the River Basin

Regular Monitoring and evaluation are essential for ensuring that the current management of water resources is properly implemented and to identify the needs for adjusting management strategies. Effective monitoring requires accessible data, analytical tools and adequate information. The basic factors which can be used to assess basin condition include:

- a) The health or condition of the natural resources of the basin.
- b) Changes in the basin.
- c) The negative phenomena that are occurring or likely to occur and in which parts of the basin.
- d) The key parameters to respond to global/local changes.
- e) Indicators to link the assessment findings to the goals.
- f) Financial operations.
- g) Economic benefits.
- h) Internal indicators such as accountability, consultation on the costs of data collection, and budget limitations.
- i) Such assessment should not only be done internally but in an open and transparent manner, with the findings widely publicized.

2.3 Role of River Basin Organisations

River Basin Organisations provide an appropriate institutional mechanism to facilitate implementation. A major role of Basin Organisations is basin-wide planning to cater to all users' needs for water resources and to provide protection from water-related hazards. Their role involves wide public and stakeholder participation in decision-making, group involvement and empowerment at all levels. Basin Organisations are successful when they are structured to provide partnership and consultation processes among the members, involving high-level decision-makers and expertise in all aspects of integrated natural resource planning, implementation and management.

2.4 Interstate Issues

Potential conflicting interests in interstate river basins can be addressed through mutual trust and understanding between the States, appropriate legal and institutional frameworks, joint approaches to planning and management, and sharing of the ecological and socio-economic benefits, and related costs. The overall water management process at the basin level is relatively easier. More options, including multi-purpose uses and joint projects, appear when issues and relations between riparian States and related sectors are treated together.

3.0 IMPORTANT STEPS FOR INDIA TOWARDS IWRM

3.1 Water Availability and Requirements

- The re-assessment of water resources of various basins using modern technology is undertaken under National Water Mission. Initially, two basins namely Godavari and Brahmani & Baitarni basins have been selected as pilot basins for assessing the water resources potential using a complete water balance approach.
- Impact on climate processes e.g. meteorological cycles, day/night temperature variations etc consequently influencing rainfall and runoff, evapo-transpiration, crop water requirements etc observed through General Circulation Models (GCM) / Global Climate Models need to be suitably addressed through appropriate mechanism in each River Basin.

3.2 Development and Management Issues: Sectoral

3.2.1 Domestic Use

- Ideally, water supply and liquid waste management schemes should be integrated and for this it is necessary that water supply programmes are not taken up without simultaneous approval.
- The assigned target of 100% coverage in water supply can be achieved only if impediments like inadequacy of funds are removed and an autonomous system with economic viability is encouraged.

- To reduce the gap between demand and supply, water conservation measures be accorded highest priority, specially in areas facing water quality and scarcity problems, such as proper maintenance of systems with emphasis of recycling/ reuse of treated waste water.
- Tariff rates in the urban areas have to be so revised as to cover not only the O&M costs but also part of the capital cost, debt service plus some reserve fund. Water for meeting the minimum requirements of the urban poor may be supplied at least at a nominal charge, so that they also realize the importance of treated water supply. The affluent sections of society should be charged at higher rates based on metered quantity.
- Public Awareness needs to be created for reducing water consumption. Women's participation is to be encouraged to the maximum as they are major users.
- Water-efficient delivery systems in domestic use need to be promoted for conserving this precious natural resource.

3.2.2 Irrigation

- Integrated and coordinated development of surface water and groundwater resources and their conjunctive use should be envisaged right from the project planning stage.
- Considerable saving in water can be achieved by adoption of sprinkler, drip /micro-sprinkler irrigation systems in water scarce areas, having conditions conducive to their application. For better water application efficiency, proper design of field application methods as well as new methods, like drip and sprinkler need, to be used.
- There is a need for:
 - instilling discipline in equitable distribution through WUAs participation.
 - fixing of water rates on volumetric supply and recovery of water charges through WUAs.
- The gap between potential created and its utilization, should be reduced to the minimum. Use of satellite imageries should also be made for assessment of irrigated areas.
- There is need to undertake State / Basin-wise assessment of waterlogged and salt affected areas irrigated command. In order that the area under water-logging does not increase, precautionary measures have to be taken. In areas affected by water-logging, remedial and ameliorative measures have to be undertaken.
- The efficiency of existing systems needs to be enhanced and water, so saved, should be utilized to increase irrigation intensive farming practices improved with modern inputs and technologies. Operation and maintenance have to be substantially improved through participatory management.
- Heavy subsidies in electricity consumed for agriculture have tended to encourage wasteful use of energy and also wasteful use of water. This has also encouraged farmers to overdraw water from deep aquifers, thus causing water quality deterioration in many areas. It is therefore, necessary to gradually reduce the subsidy on power for agriculture.
- After each modernization project is completed, a performance review should be carried out to assess the benefits and costs. For new projects to be taken up under this programme, technologies and reforms should be included as components of the projects.
- Re-use is an important method of managing drainage water. The options for re-use of drainage water would include direct use for irrigation, blending with canal water, cyclic or rotational use, saline agriculture, forestry system and solar evaporators, aquaculture and use of saline water through salt tolerant crops.

3.2.3 Flood Control and Management

- Dams have played a vital role in moderating the inflow flood peaks and also absorbing the floods. Adequate flood-cushion should be provided in water storage projects, wherever feasible, to facilitate better flood management.

- In addition to structural measures, non structural measures also need to be simultaneously taken e.g. efficient management of flood plains, flood-plain zoning, flood proofing including disaster preparedness & response planning, flood forecasting & warning, and other non-structural measure such as disaster relief, flood fighting including public health measures, and flood insurance.
- The performance review of selected embankments may be carried out and based on the findings, planning, designs and management of embankments may be reviewed for obtaining better results. It is essential to associate the beneficiaries in the upkeep and surveillance of embankments during the monsoon season for prevention of possible breaching.
- The network of flood forecasting and warning at the Central level needs to be extended to remaining flood prone areas.

3.2.4 *Hydropower*

- There is an urgent need to evolve suitable strategies for accelerating the pace of hydropower development.
- Unlike other water uses, the planning for power cannot usually be restricted to the demand within a basin alone. The demand for a region or the nation, as a whole, is important rather than demand in a basin.

3.2.5 *Industrial Use*

- Tariff rates have to be prescribed such that the industry feels compelled to look into technological interventions leading to reduced use per unit production. For effecting maximum conservation, production processes have to be improved, to have lesser generation of effluent water.
- Waste utilisation technologies / clean production technologies with emphasis on waste minimization, recycling and reuse have to be encouraged for adoption.

3.2.6 *Ecological and Other Uses*

- Appropriate minimum flow in the river should be maintained to maintain water quality, river regime, maintenance of riverine eco-system, or other public necessities such as bathing, recreation etc. The norms for minimum flow may depend on the type of river, availability of water in various seasons, development of structures on the river etc.
- The water quality and maintenance of aesthetics around river or water body is very important for development of recreational activities. The effects of the development and management of water resources on the environment, available to aquatic life need to be carefully considered in planning.

3.3 *Water Quality Aspects*

- There is need to establish and operate cost - effective water quality monitoring systems. Adverse effects of all activities on water quality are to be prevented. It is essential to establish biological, physical, chemical water quality criteria for users. Action is to be taken to minimize soil runoff and sedimentation. Proper disposal of sewage is to be ensured.
- Application of 'polluter pays' principle is needed to prevent water pollution. Treatment facilities for domestic sewage and industrial effluents are to be improved and standards for discharge of effluents and for the receiving water are to be established.
- To restore and maintain water quality and ensure environmental sustainability, action is needed on a wide front under water resources protection and conservation, water use efficiency, water quality management, drainage and control of water logging and salinity, prevention and control of water pollution, development and application of clean technology, and ground water protection.

3.4 Environmental Aspects

- The project authority should weigh all alternatives before going in for a project so as to cause the least social and environmental disturbance. A catchment treatment programme for arresting the degradation of the catchment areas and restoring ecological balance needs to be planned and monitored as part of a project.
- To mitigate the adverse impacts of submergence of forest area, a compensatory afforestation plan, bio-diversity conservation programme and wildlife conservation plan to rehabilitate / protect the wildlife species is needed. Adequate Fishery Management Plans with provision of hatchery and fish ladder etc, for sustainable u/s aquaculture should be provided

3.5 Rehabilitation and Resettlement

- For Rehabilitation and Resettlement of PAPs, the National Policy on Rehabilitation and Resettlement (NPRR), 2007 issued by Ministry of Rural Development, may be referred.
- The R&R plan should be prepared along with the project but implemented well ahead of the project completion. There should be perfect timing so that all PAPs are settled well before the reservoir is filled in R&R should be taken as the obligation towards the affected persons, who have to suffer on account of the project and should be dealt with as such with human compassion and sensitivity.
- Tribals must be given special attention. They should as far as possible be settled in habitats, closer to the ones left behind by them and without breaking their group identity. Support to the landless, unemployed should be extended, through appropriate means, to enable them to rehabilitate themselves.

3.6 Economic and Financial Management

- It is essential that a detailed review and evaluation of the ongoing projects is done during the Twelfth Plan, so that appropriate lessons may be drawn and remedial measures taken in each case, at least in the Thirteenth Plan. Detailed studies are needed to evaluate the longevity and viability of minor irrigation schemes. .
- For field level works in the case of major projects, minor irrigation works, repairs of tanks and other works in rural areas, as much funds as possible should be generated through community involvement. For main works of the major projects, government funds would continue to be the principal source and they have to be better supplied and managed.
- All the means for augmenting government's resource have to be encouraged to the maximum extent possible. To the extent they are successful, many neglected activities can be better looked after and there will be release of pressure on government funds.
- The subsidy on water rates to the disadvantaged and poorer sections of the society should be well targeted and transparent.
- The WUAs should be allowed to collect a little over and above the prescribed water rates to encourage them improving the system under their charge.
- In the case of supplies for industrial purposes, the principle of 'user pays, polluter pays' has to be applied and water charges fixed accordingly, adopting a premium for security, in water scarce regions. In the case of domestic supply, a certain fixed quantity per connection may be fixed, in addition to the public taps, and charges increased progressively for larger use. The principle of seasonal water rates could also be tried.

3.7 Inter-basin Transfers

- Inter-basin transfer of water is a large and complex programme of water management. Therefore, studies have to be done with the help of computer simulation models and systems analysis capable of handling large data. Social and environmental impact studies as well as studies on economic viability have also to be undertaken on an elaborate scale.

3.8 Institutional Framework

- The need to form users' bodies (Water Users Associations, Farmers Organisation) at the ground level for watershed development and management, for operation and maintenance of field canals and for ground water use and regulation.
- There is need to evolve a legally and institutionally enforceable system, which ensures sustainability and provides the parameters within which water markets could operate.
- For all interstate rivers, there is need to set up the RBO, a body in which the concerned State Governments, local governments and water users would have representation and which would provide a forum for mutual discussions and agreement.

3.9 Legal Issues

- There is an urgent need for enactment of a law on interstate rivers, which inter-alia may provide for the constitution of River Basin Organisations and for their powers and functions.
- There is need for institutional arrangements with the requisite legal backing for making the States to come together for holding serious discussions on sharing of waters including diversion to non-basin States, ultimately paving way for reaching an agreement on the basis of mutual needs. One such arrangement would be River Basin Organisations of the respective basins. Efforts for seeking mutual agreement on interstate water disputes should first be made at the river basin level, through the mechanism of the River Basin Organisation (RBO). The method of conciliation can be tried by the RBOs. However, if the dispute cannot be resolved within a reasonable time by these means, it may be referred for adjudication by a tribunal or to NWRC.
- The following changes are essential in the existing statutes and the rules framed under them :
 - Irrigation Acts should be enabling laws, so that PIM initiatives become possible.
 - Within the areas of operation, WUA or FO has to be given powers that today are vested in State Irrigation Departments so that the institutional base of village level associations can be strengthened.
 - The farmer's right to water (that is, the agreed quantum) has to be recognized by law and under rules framed for that.

3.10 International Dimensions

- The optimized and integrated development of international rivers calls for cooperation amongst the countries. In an increasingly global economy, to attain the goals of poverty alleviation and sustainable economic growth, the regional integration and cooperation are necessary.
- Cross border water monitoring and establishment of common regional standards is very useful. The threat of global warming and climate change has engendered new concerns. The point to study and appropriate action in South Asia is the extent to which emissions trading can be used to generate funds for clean Himalayan hydro power and in negotiating the fine print so that the terms are rightly defined and expressed.

3.11 Water Resources Development and Management at Local Level

- Renovation and modernization of tanks and other local water resources are to be considered as priority task. The programme needs to be planned and implemented on a watershed basis, taking into account the comparative techno-economic feasibility of renovating existing tanks vis-à-vis construction of supplementary tanks, upstream and downstream.
- At every stage, from the very beginning, people concerned must be involved in working out the project plan. A data base needs to be established and constantly updated at the district level.

3.12 Research and Developmental Needs

- It is necessary to build systematically a data and information system, scientific in approach and comprehensive in coverage, simultaneously with a system of data exchange and information dissemination in order to address our concerns in the water sector effectively through research and development.
- Desalination of saline and sea water is a relatively high cost alternative, normally employed as the last resort. However, in arid areas near the sea coast, it may be competitive with tanker supply and may prove viable. Continuous improvements in membrane technology are bringing down the costs and research needs to be stepped up in this area.
- Research is needed to provide guidance to the farmers, to obtain maximum production per unit of water for different crops suited to their climatic and soil conditions
- For domestic water supply, research needs to be directed towards supply of safe water at minimum cost. Evaluation of latest technologies for sedimentation, treatment and purification is needed. For sanitation, the evolving techniques using smaller quantity of water need to be evaluated and improved. For sewage treatment, research effort should be directed towards defining the design parameters for low cost energy intensive techniques, like oxidation and duckweed ponds. Recycling of treated wastes for industrial use and irrigation has to be promoted subject to requirements of safety.
- There are several fields where further research is needed for technological innovations such as in sedimentation studies, river morphology, forest hydrology, designs and model studies for specific structures, construction technologies, new materials etc.
- A regular personnel training policy needs to be evolved by each government and organisation. This policy needs to provide for adequate training, with emphasis on acquisition of knowledge in the early career, on acquisition of skills in the middle period and on managerial aspects in the later period.
- There is a need for much larger horizontal mobility, within a specialization, amongst cadres and specialists. Similarly, exchange between academic institutes and line department personnel would be beneficial. Such a move could go a long way in changing the prevailing attitudes about coordination, management, administration and policy making to a healthy and superior level.

4.0 CONCLUSIONS

After independence, the development of Water Resources was project-centric on 'as is where is' basis. The approach worked well for quite some time as the pressure on water resources was not so much. With the three fold increase in population and many fold increase in industrial activities, the pressure on the quantity and quality of water resources is very much visible. The demand-supply gap, flood-drought-flood syndrome, deteriorating water quality and environmental impacts in most parts of the country are testimony to this. The integrated approach involving RBO like setup has been successfully applied in many river basins of the country. Tennessee Valley Authority, Mekong Basin and Murray Darling Basins are worth emulating examples of IWRM approach with appropriate Institutional Mechanism. In India too, Damodar Valley Corporation (DVC) partly follows the integrated approach by integrating the operation of various reservoirs in Damodar basin for power generation and irrigation in West Bengal through Durgapur Barrage. As, most of the easy storage sites have already been identified and executed, the future lies in Integrated Water Resources Management for sustainable development of water resources alongwith preservation of ecosystems.