

ड्राफ्ट

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**Draft Guidelines for
Integrated Water Resources Development and
Management**

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ABBREVIATIONS

AIBP	Accelerated Irrigation Benefit Programme
BIS	Bureau of Indian Standards
CGWB	Central Ground Water Board
CPCB	Central Pollution Control Board
CWC	Central Water Commission
DPR	Detailed Project Report
EIA	Environmental Impact Assessment
FO	Farmers' Organisation
GBM	Ganga Brahmaputra Meghna
GWP	Global Water Partnership
HRD	Human Resources Development
IMD	Indian Meteorological Department
IRAP	Integrated Rural Area Programme
IWRM	Integrate Water Resources Management
IWT	Inland Water Transport
LULC	Land Use Land Cover
MOU	Memorandum of Understanding
NGO	Non-Governmental Organisation
NWRC	National Water Resources Council
O&M	Operation and Management
PAP	Project Affected Person
PIM	Participatory Irrigation Management
RBO	River Basin Organisation
R&R	Rehabilitation and Resettlement
TAC	Technical Approval Committee
WALMI	Water and Land Management Institute
WMO	World Meteorological Organisation
WUA	Water Users' Association

1.0 INTRODUCTION

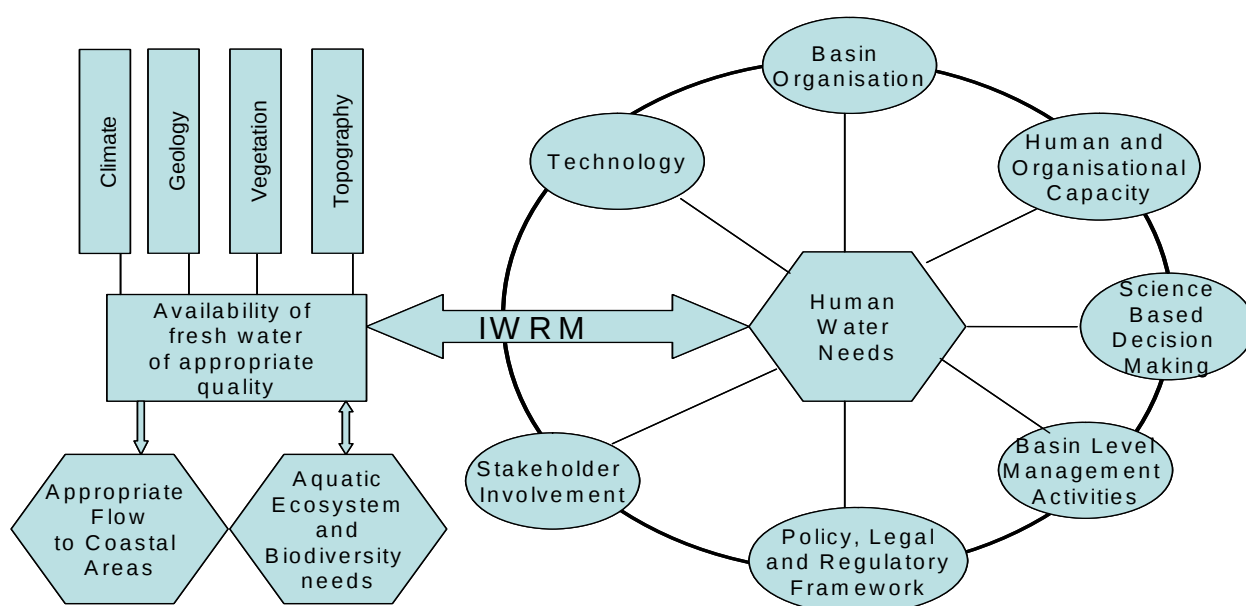
1.1 Background and Concept of IWRM

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. 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. In doing so, the basin (river, lake or groundwater) must be recognized as the basic unit for planning and management, and a firm societal commitment and proper public participation must be pursued. India has not yet reached the level of Water Resources Development as has already been achieved by many developed countries, therefore, there is a need for India to undertake developmental measures alongwith management measures

A central 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.

Well-developed, well-tested, scientifically robust, socially acceptable and economically viable approaches to implement IWRM at the river basin level are still not widely available. IWRM strives for effective and reliable delivery of water services by coordinating and balancing the various water-using sectors – this is an important part of sustainable water management.

Various components involving IWRM and their interaction with each other are represented in the figure below.



1.2 Definition of IWRM

The term ‘Integrated Water Resources Development and Management’, as used in these Guidelines, is referred to in the context of implementing IWRM for the provision of water services at the river basin level. 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.

1.3 IWRM in the context of National Water Policy

The National Water Policy also emphasises on the need of planning the Water Resources in an integrated manner on the lines of IWRM.

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. It is one of the most crucial elements in developmental planning. As the country has entered the 21st century, efforts to develop, conserve, utilise and manage this important resource in a sustainable manner, have to be guided by the national perspective. **(Para 1.4 of National Water Policy-2002)**

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. **(Para 3.3 of National Water Policy-2002)**

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. Within a country or a river basin, different areas have diverse water problems and challenges. Each country and river basin must chart its own vision and plans based on its unique situation. Constructing infrastructure that can meet the demands of multiple sectors while ensuring water for irrigation and functioning of ecosystem as well as preventing negative impacts of floods can be given as examples of an integrated approach. 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. Part of an IWRM approach is to characterize the present situation and use this and other information to anticipate future changes.

2.2 Important Conditions

The conditions listed below are important, but are not a set of necessary prerequisites for implementing IWRM. It aims to create sustainable water security within the present constraints and through improving conditions incrementally 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 spiral.

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. The services, expected benefits and effects of each project should be clearly presented in line with various agreements and the appropriate balance of related sectors. 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. Stakeholder involvement can be defined appropriately for local conditions and improved gradually, for example by setting up a committee, public hearings and workshops in the process of applying IWRM at the river basin level. Stakeholder's participation and its improvement requires assistance from various people representing different sectors. Those who are most likely to be affected should be involved. The identification of key stakeholders can be facilitated through interviews and meetings.

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. Local communities have a wealth of historical hydrological knowledge and information. Thus, relevant stakeholders can collaborate in the sharing of reliable information, mutual satisfaction of their needs, and to promote collaborative efforts to resolve basin issues.

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. Regional training priorities are best expressed in terms of problems of water functions that need to be addressed locally but regional synergies are possible. Development of a community's ability to function in participatory processes is also an important part of capacity development. Consensus-building should be based on dialogue amongst stakeholders. Jargon free terminology should be used to facilitate comprehension by important stakeholders outside the water sector. Thus, each stakeholder group would have a comprehensive vision of basin issues.

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. The development of legal and regulatory frameworks provides the best method for proactively addressing potential issues in implementing projects. 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. In the early stages this can be adequately achieved through water resources agencies, but with good coordination and linkages to other relevant agencies, including those at the national level. Ideally, one agency should be responsible for facilitating this process. This most often requires a paradigm shift in mindset, behaviour, and organisational design: from 'development, implementation, control and coordination of the process' towards facilitation of the IWRM process. This is achieved by persuading the organisations and agencies involved in the basin to contribute to IWRM objectives and by convincing decision-makers – in terms they understand – of the validity of their approach so as to gain recognition and the necessary resources.

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.

Funding and Cost recovery: Funds can be raised through tariffs, transfers, central government support, or in the case of the less wealthy countries, through external aid. Sustainable cost recovery should be promoted. It is essential to make the most of available resources, choose the most appropriate projects and carry them out at the lowest possible cost.

Management and development: Many developing countries have struggled to balance management and development of the resource. Long-term management should be considered when conceiving and implementing development of the resources and infra-structure in accordance with those factors relating to finance and stability.

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. In many basins, however, it may be necessary to embark on developing a water resources management plan with available data and information. Maintaining and accruing sound knowledge of the natural resources in the basin and ensure that it is strongly supported by scientific knowledge and views. 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. In this regard, relevant national guidelines (IMD, CWC, BIS, CGWB, CPCB and coastal data) and international guidelines including that of WMO may be referred. CWC guideline on 'Preparation of River Basin Master Plan' provides a comprehensive list of various data required for preparation of Master Plan of river basins.

2.2.8 Comprehensive Monitoring and Evaluation of the River Basin

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. Regular evaluation is necessary. 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.

Keep water managers updated on the latest technology. Local and central water managers should be updated on the use of current and emerging technologies and models such as:

- i) Satellite monitoring systems being developed internationally, which aim to provide information for adaptation and mitigation for climate change, reducing damage from disasters caused by nature and human beings, improving water resource management through better understanding of the water cycle, and using satellite imageries for Land Use Land Cover (LULC) information.
- ii) Improvements in rainfall prediction methods connected with run-off models and information technologies. These would be useful in reducing damage in the basins affected by frequent flooding.
- iii) The evolving role of communication technologies such as mobile phones and internet, which can be powerful tools for transmitting data.
- iv) Remote control of water storage and delivery systems in the basin. This can enable optimized water supplies in basins affected by water scarcity.
- v) Developments in scientific models to augment and interpret data in data sparse environments.

2.2.9 Political Will and Commitment

Political-will at all levels can help unite all stakeholders and move the process forward. It is needed especially if the resulting plan or arrangement would create or require changes in legal and institutional structures, or if controversies and conflicts among stakeholders exist. Generally a high level of political commitment exists in varying degrees outside of the water sector, but water managers should understand that decision makers at these levels drive comprehensive water management over time. Political will is a potential engine of public awareness. However, there is a feedback process, as strong political will is also often motivated by public pressure to address high-profile issues. Water managers should focus on promoting correct understanding of the importance of water and the necessity for IWRM when dealing with the public, press, governments and politicians.

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. Attention should be paid to gender and minority issues, effective demand and bulk water management, agreements on commitments within a basin relating to the quantity, quality, and efficiency of resource management and mechanisms for monitoring those agreements, and adequate human and financial resources. 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.

The application of IWRM by Basin Organisations varies according to each river basin's specific conditions and requirements. Many river basins have set up coordinating bodies to facilitate river basin management. These may take the form of informal committees or authorities with important mandates and authorization. Decentralization and participation of the private sector has opened the way, in some countries, for the adoption of institutional mechanisms based on the concept of integrated management of river basins, through the transfer of responsibilities for the management of the resources from the ministries of the central government to local governments, to autonomous public corporations or to the private sector .

2.4 Interstate Issues

Potential conflicting interests in interstate river basins can be overcome 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. Any River Basin Organisation (RBO) may face a wide array of challenges depending on its unique situation. Nevertheless, the overall water management process at the basin level is easier. More options, including multi-purpose uses and joint projects, appear when issues and relations between riparian States and related sectors are treated together. Top-down basin-wide approaches based on constructive ambiguity principles are often essential to foster trust and trigger action for cooperation due to the political nature of allocation of interstate water resources.

A fully integrated approach to manage water in a basin may not be immediately possible. However, this does not prevent embarking on IWRM at the basin level whether the process is well developed or not. Various water-related sectors or users should be considered in a well coordinated manner, highlighting the interactions among them, their activities and associated infrastructure.

3.0 Important Steps for India towards IWRM

Water conservation in every sphere and increase in efficiency of water use in every activity should be overriding considerations in water resources development and management. The methods and means of water resources management need to be sustainable over time both from the point of view of development needs and environmental sustainability.

3.1 Water Availability and Requirements

- The work of refining the assessment of water resources of various basins using modern technology and collect reliable data pertaining to observed flows, utilization from surface and ground water resources for irrigation and from other uses from surface as well as ground water resources need to be undertaken. There is also a need to develop uniform guidelines for assessing water resources potential and assessing water requirements for various uses.
- 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 will have 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 to bring traffic generating activity back to the rivers.
- The norms adopted for satisfying the basic human needs of communities (both urban and rural) may be reviewed after every 10 years.
- 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. The latter has a direct impact on the generation of funds for maintenance and development.
- To reduce the gap between demand and supply, water conservation measures be accorded highest priority, specially in areas facing water quality and scarcity problems, with emphasis of recycling/ reuse of treated waste water.
- Poor maintenance of the systems by the utilities results in leakage of costly treated waters. The discipline of maintenance should be instilled in the utilities and they should be held accountable for it. The importance of maintenance should also be impressed upon consumers, since considerable leakage and waste take place in households also.
- Improved low cost technologies have to be developed and adopted to save cost of construction and maintenance.

- 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.
- Wherever feasible, artificial recharge and rain water harvesting have to be encouraged. Instead of looking only for new and distant sources of water supply or tapping fast depleting ground water, local bodies should lay emphasis on water harvesting also.
- As efforts by government alone will not be able to solve the problems of 100% coverage, public/ private and community initiative in developing household or colony wise systems, like withdrawal from dug wells should be encouraged.
- In rural areas, where piped water scheme is operational or is proposed to be developed, appropriate model may be adopted, in which local governments and users' committees participate in the development and maintenance of water supply systems.
- 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 and should form an integral part for optimum utilisation of water resources. Conjunctive use planning can also be implemented in existing commands by way of including it in the scheme for modernisation and improvement of existing commands.
- Over-exploitation of groundwater should be avoided, especially near the coast to prevent ingress of sea water into sweet water aquifers, while implementing the conjunctive use planning in the new projects / existing commands.
- 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.
 - instilling discipline in adopting advisable and designed cropping pattern through intervention of Agriculture Extension Services of State Agriculture Deptt, and cooperative federations for bringing synergy between market forces and farmers and optimal use of water.
 - operation of canals / distribution network on demand based rather than supply based distribution.

- 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. Appropriate guidelines may be laid down for reporting the figures of potential created and the utilization achieved so that there is uniformity in the figures reported from all States. The figures of the departments and land use statistics should be reconciled.
- There is need for periodical reappraisal of ultimate irrigation potential, created irrigation potential and actual utilisation in irrigation, in order to take measures to accelerate the utilisation of the potential created and make improvements in utilisation.
- There is need to undertake State / Basin-wise assessment of waterlogged and salt affected areas irrigated command. The status of protected and reclaimed land should be reviewed in every five year plan.
- 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.
- There is need for a paradigm shift in emphasis towards improving the performance of existing irrigated agriculture. Marginal changes in irrigation practices may not be enough to increase productivity. If growth in irrigated agriculture is to be achieved, efficiency of the 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.
- Every State Government should make whole-hearted efforts in introducing Warabandi system including night irrigation.
- After each modernization project is completed, a performance review should be carried out to assess the benefits and costs. Such a review should be made for all modernization projects which have so far been completed. For new projects to be taken up under this programme, technologies and reforms should be included as components of the projects.
- Canal automation is a new technology, which is being introduced in some projects in our country. The performances require to be watched carefully and the modifications, if any, to be incorporated in the future canal automation project identified.
- 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.
- Removal of silt from the reservoirs has been engaging attention since long. A cost effective method of removal of silt has yet to be devised. Desilting of reservoir is project

specific. However research efforts are required for development of economic technologies for this purpose.

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 highly flood prone areas, flood moderation should be given overriding consideration in reservoir regulation policy even at the cost of sacrificing some irrigation or power benefits.
- 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. Although, it is feasible in most cases to provide a certain degree of protection against floods in terms of reduced frequency and flood damages, there are no universal solutions which can provide complete protection against floods.
- Embankments do provide reasonable protection. 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. In north-eastern region and Jammu and Kashmir where there is large hydro potential but the transmission costs to consuming centers are high, energy intensive industries could be located close to the hydropower project sites. This would attract private participation and accelerate hydro-power development.
- The other measures may be classified broadly in two parts; the first as a short term strategy and the second as a long term strategy. The short term measures include - full financial support to public sector on-going schemes, through survey and investigations and preparation of DPRs strictly in accordance with norms, effective monitoring, sorting out implementation problems where necessary, completion of renovation, modernization and uprating of old plants and small hydro development. The long term strategies include expediting the hydro potential review in consonance with environmental concerns, resolution of interstate disputes, promotion of joint ventures, tariff rationalization, R&R policy etc.
- 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. Therefore, the planning should attempt to generate hydroelectric power wherever feasible. The excess power, if any, can always be used elsewhere through regional grids.

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.
- Instead of allowing location of hazardous industries and insisting on Zero effluent condition in semi-arid and arid areas, industrial zoning be done in a manner that in such areas water intensive industries are not permitted especially those releasing toxic effluents. Hazardous waste treatment and disposal need to be so planned and sited as to protect people and environment from adverse impacts.
- Selection and zoning of industries associated with potential risks especially those releasing toxic waste, need a thorough analysis and planning before they are set up in any water basin. The concerned State Government and other local bodies should have a coordinated approach in selecting and locating industries of a specific nature with respect to their water requirement and facilities for wastewater disposal. A policy for zoning the river basins according to the types of industries, quantity of water consumed, and effluent discharge need to be laid down.

3.2.6 Navigation

- Development of inland water transport needs basic infrastructure like the fairway, terminals and navigational aids. State Government should undertake the development.
- Water front development programme and rebates for investments are necessary to bring traffic generating activity back to the rivers.

3.2.7 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.
- Outdoor activities are generally associated with the presence or proximity of water, particularly reservoirs. 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 agricultural 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. Communities are to be educated about the pollution-related impacts of fertilizers and chemicals on water quality.

- Deteriorating water quality, both surface as well as ground water, is a major concern. Effective monitoring of variations in Water Quality, on seasonal / monthly scales as well as long-term scale, is essential to include varying scenarios in the basin at different stages for proper redressal of the problem.
- 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. Mandatory EIA of all major water resources development projects, use of risk assessment and risk management in reaching decisions, identification and application of best environmental practices are needed to avoid pollution.
- 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. The actions needed are not beyond the present status of our knowledge of science and engineering.

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.
- Integrated watershed projects help in water and soil conservation and thus enable restoration of degraded areas.
- 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 shall be provided. To sustain the riverine ecology in d/s of project, release of adequate minimum flow shall be ensured in the river d/s of project.
- Green belt development around the periphery of reservoir to check air and noise pollution is needed, to protect the slip zones / landslides around the rim of reservoir, biological and engineering treatment shall be ensured.
- Monitoring and Evaluation of environmental safeguards during the construction phase and in post operation phase as stipulated in EIA clearance, is essential.

3.5 Rehabilitation and Resettlement

- Much of the criticism against major developmental projects including water projects emanate from poor R&R, and therefore, R&R of PAPs should receive total attention.
- 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.
- The R&R plan should receive sufficient funds and be implemented by a functional authority. It should be vested with powers to deal with the affairs of the State / Basin, to the extent, it is concerned.
- Special care should be taken that the minimum extent of land required alone is proposed for acquisition.
- The project advisory steering committee must be broad based to include representatives of the PAPs, NGOs and representatives drawn from the concerned departments / agencies.
- Apart from periodic assessment of the R&R plan, there should be an assessment made 5-7 years after its full implementation, to see how the PAPs have done for themselves. If further support/ interventions are required, they must be provided.
- A complete survey of the affected zone and people, their occupations etc. should be taken in this respect, wherever tribals are involved.
- Compensation packages should be well laid down to take care of all categories of displaced persons. They would include land for land, homestead for all including the landless, cash compensation, training for vocations, employment and so on. As far as possible, cash compensation is not to be considered for tribals as they are tied to land in their way of life and are not careful in handling money.
- 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.
- The resettled sites should be well developed with all infrastructure so as to provide the resettled a better way of life.
- Support to the landless, unemployed should be extended, through appropriate means, to enable them to rehabilitate themselves.
- There should be active involvement of the displaced in the R&R activities and flexibility to the extent required should be built into the plan.
- NGOs should be involved to the maximum extent possible, in the formulation, implementation and follow up of the R&R plan. They are based locally and will be able to build up the confidence of the resettled PAPs.

- Infrastructure, training material etc. should be improved and updated to increase the efficiency of the institutions and persons involved in the sector so as to effectively deal with environmental issues.

3.6 Project Planning and Prioritisation

- There is need to make changes in approaches to project planning, particularly in respect of allocation of water among various uses, dependability and carry over related issues, conjunctive use of water, lift projects and viability criteria.
- Planning Commission may lay down improved procedures of benefit cost analysis after considering all relevant aspects, such as technical, financial, economic, social and environmental.
- It is necessary that participation of members from the Ministries in the TAC is effective so that delay in giving mandatory clearances is avoided.
- Processes for detailed appraisal, establishment of techno-economic viability, regular monitoring of physical and financial progress as well as of resettlement and rehabilitation and funding in accordance with project programming schedule, which are followed in the case of externally aided projects, should be adopted for all other projects.
- Efforts should be made to constitute Joint Corporations (Centre and States) for selected projects with a MOU and arrive at an Agreement for joint management.
- For speedy completion of projects, efforts need to be made for substantial changes in the contractual procedures.
- Guidelines have to be applied at the level of the State Governments which is the most relevant level for making decision about the implementation of important projects. Prioritization cannot be a one time exercise since there is a continuing addition to the stock of possible projects. The exercise should be done before each Five Year Plan.
- Prioritized major projects could be phased further into identifiable sub-systems for implementation. Phasing should be supported by specific financial outlays for better monitoring and financial discipline.

3.7 Economic and Financial Management

- Since a number of major projects are continuing over the plan period, the costs are increasing and the benefits are delayed, 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. .
- Private sector participation would be practicable in projects mainly intended for supply for industrial use and urban water supply and for these components in other major projects.

- 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.
- Urgent steps are needed to prevent more damage and for proper up-keep and maintenance of existing irrigation systems.
- The following measures are needed for immediate adoption to instil a measure of financial discipline in the system:

3.7.1 Major Projects

- The assistance for large projects may be deducted from the central assistance to a State and kept as a separate pool/ fund. Within a large project, funding could be earmarked for phases and sub-systems also.
- For Central Assistance, it is necessary to assess minimum number of years to complete the project/ phase and provide funds for that period in a non-lapsable manner.
- Revised estimates may be got prepared for all the ongoing projects. A Monitoring Committee may be constituted for this purpose. Thereafter, the estimates so revised may be got revised every year of the plan period.
- In the case of new projects, the project cost should cover escalation over the proposed construction period and the project should indicate both the basic cost and the estimated completion cost. The cash flow assumed in the Project Report should be got certified by the State finance and planning departments, to indicate the stage government's commitment.
- In the absence of clear understanding as to when a project should be considered as having commenced and completed, it is necessary to lay down the criteria regarding these for all to adopt.
- A project should be considered as having commenced, only after the issue of formal administrative and technical approval by the government, after clearance by the Technical Advisory Committee. All expenditure incurred prior to this should be shown against investigation and preparation.
- Major projects should be broken into identifiable and meaning full phases/ sub systems/ components 'completion' should be considered for each such phase/ component. The irrigation component should be considered to have been completed, if 90 per cent of the physical progress is achieved and the status continues for one year and if at least 80 per cent of the estimated potential is created. The balance may be dealt with as separate scheme.
- Measures should be taken to increase revenue from water rates. For such increases to be accepted, utility and efficiency of the system should be increased through savings of working expenses through modernization, better water management, organisational reforms, improved infrastructure and reorientation in O&M costs by curtailing overstaffing, providing better communications and establishing participatory management.

3.7.2 Medium Projects

- The CWC should concentrate on large projects and monitor them more closely. The approval and implementation of medium projects may be left to the States. It may be laid down that in all such cases, the State proposing the project shall notify it in the Gazette and to the concerned States with full details of the parameters laid down by the CWC. If there are objections, within the prescribed period, they should be sorted out mutually or through the Basin Organisations.
- The principles regarding commencement, completion and establishment costs for major projects shall apply to medium projects also and it is for the State authorities and audit to ensure them.
- Measures should be taken to increase revenue from water rates. For such increases to be accepted, utility and efficiency of the system should be increased through savings of working expenses through modernization, better water management, organisational reforms, improved infrastructure and reorientation in O&M costs by curtailing overstaffing, providing better communications and establishing participatory management.
- The subsidy on water rates to the disadvantaged and poorer sections of the society should be well targeted and transparent.
- The water rates should cover the entire annual O&M cost plus a part (say 1%)of the gross value of the produce/ ha in respect of cereal crops and higher percentage in case of cash crops. These rates should be levied as single part variable tariff for the present. However, the logic of charging a basic fixed rate along with a variable part is quite logical and should be followed up with the State Govts.
- There should be rationalization of basic principles of fixing the water tariffs in all the States. The revised water pricing structure should be such that the rates are substantially lower for those who accept group volumetric supply than for individual farmers. Also, 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.
- Realistic O&M costs/ ha should be worked out by each State on pilot representative systems by allotting adequate funds. These figures should be used for fixing of rates. However, in working out the cost, the ceiling rates on establishment charges should be followed.
- There should be two distinct components of irrigation water charges; one for O&M and other related to the value of the product. The O&M component should be fully utilized for the operation and maintenance of the respective portions of the system. The second part should be used to modernize the system with supplementation from budget allocations. Each State will have to decide the natural proportion of the two components based on its figures of O&M and the productivity of the crops. The financial procedures should be modified to make this possible, so that the farmers are encouraged to pay the enhanced rates. The rate structure should differentiate between the seasons and also the crops in such a way that production or benefits are optimized per unit of water or at least indicate the intention. Thus the rates should be so rationalized that the water intensive crops are charged proportionately more as compared to less water consuming crops.

- On the basis of previous hydrological records, the existing surface irrigation projects should be classified into those with performance reliability of (a) 75% or above and (b) less than 75%. Considering a minimum reliability of 50%, the water rates for the latter should be two-thirds of the full rates fixed for the former. The objective should be to achieve volumetric measurement ultimately, though gradually, and this should be kept in mind at every stage. The change should encourage user group formation and give adequate incentive to group consumers, who can be supplied water on volumetric basis, over individual consumers who have to be charged on crop area basis.
- The pricing for water of lift irrigation schemes should be worked out on the basis of the capital and O&M costs of these schemes. As this water will be easily measurable, the tariff should be fixed on volumetric basis. The schemes can be categorized according to lift ranges and rates fixed for different categories.
- 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.
- The details of rates have to be worked out and operationalised in each State perhaps separately for regions in large States or even for projects. It is felt that a uniform formula for the entire country would have no practical value. Water Pricing Authority may be constituted in each State by statute, on the analogy of the energy pricing authorities with suitable local modifications.

3.8 Inter-basin Transfers

- The approach to inter-basin transfer is that optimal utilization of land and water should first be aimed at, in basins with possible surpluses. After meeting such essential requirements, if there is surplus water available in the basin, its transfer to other basins may be considered.
- 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. Computer simulation models are urgently required even for intelligent and coordinated operation of a number of storages already built or under construction in these basins. Social and environmental impact studies as well as studies on economic viability have also to be undertaken on an elaborate scale.

3.9 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.
- Above the field level and below the State level, water districts may be formed, as has been successfully done in many countries. The water district management should comprise of representatives of all types of water users and the local governments. Agriculture and drinking water supply interests would have special representation and they should also be

empowered to take decisions. The composition of the water district bodies and the setting of hydrological boundaries for each water district and the frame work of regulation have to be devised by each State / Basin and incorporated in the irrigation law. A uniform composition for all States is not advisable.

- 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. RBO may consist of a general council and Standing Committee. It shall be the function of RBOs to collect data and disseminate them in local languages formulate integrative plans and consider the proposals from constituent States on various issues including project proposals in the basin and monitor implementation of large projects.
- The CWC should be restructured into a statutory high powered inter disciplinary commission, in order to deal with policy and reforms, centre-State and interstate issues planning and project finalization, international aspects other than those that have to be retained with the Ministry.
- NWRC is a high level Centre-State political body which meets at regular intervals. It may take steps to constitute committees, groups and even appoint eminent persons as mediators/facilitators so as to have sustained, serious discussions and negotiations to arrive at solutions. The Chairman of RBOs as and when constituted may also be the members of the Council.

3.10 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.
- So far as the major and medium rivers and streams are concerned, the State may continue to have the right of regulation, collection, retention and distribution of water. However, small rivers and minor streams could be managed by the village communities and the laws should enable this.
- It is necessary to introduce participatory process in the ground water management in which the role of the State could be that of a facilitator or empowerer and the prescribing regulator, and the role of the community organisation as an implementing regulatory agency of the scarce resource. This is to be provided for in the law on ground water that should be enacted.
- The general laws on environment protection and pollution control are in themselves not adequate to arrest and reverse the trend of deteriorating water quality of interstate rivers. For

this purpose, more specific laws, mechanisms and interstate agreements have to be worked out.

- The old irrigation acts are based on a concept of a social contract which is not appropriate in the present times. Instead of legitimizing a top down hierarchical relationship, the new social contract has to legitimize relationship of coequals or partnership between the irrigation bureaucracy and the water users. The State Irrigation Acts should be farmer friendly.
- 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. In particular, WUAs / FOs require an independent resource base and an enabling organisational structure, which represents various interest groups and makes water user organisations accountable to farmers.
 - The farmer's right to water (that is, the agreed quantum) has to be recognized by law and under rules framed for that. Without this, the overriding principle of accountability and transparency cannot be established. Both are needed to make PIM strong and functional.

3.11 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.
- Since water does not recognise borders, regional cooperation at the scale of the whole basin is essential for water related developments as development in one country may have consequences in another country.
- Cross border water monitoring and establishment of common regional standards as in many other matters, would be 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.
- Flood moderation and forecasting is a matter of common concern and there is need for improving hydrological and silt data and transmission in real time. Likewise, flood embankments need to be tied together across national boundaries. There has to be agreement on construction of anti-erosion and flood protection works along common or successive rivers so that one country's solution does not cause problems to the other.
- There is a need for a joint water resources development programme at basin scale, owned and managed by the riparian countries themselves, in close cooperation with the technical institutions, investment institutions and civil society.
- Transparency, public awareness and stakeholder participation are the pathways to future water resources development. This will be more so in respect of trans-boundary projects as

also to combat the rise of hydro-politics. Political will is sure to be strengthened by genuinely consensual approaches.

- Capacity building for regional water resources development is also necessary. The emphasis should be on maximizing local manpower, material and equipment, then going to the regional level and only thereafter going international in order to save heavy foreign exchange outgoes and to build national and regional self-reliance.
- In the matter of capacity building, the role of universities, research institutions and NGOs has to be adequately recognized and promoted. It is essential that the scientific as well as the techno-socio-economic aspects of various issues are not allowed to be obscured by parochial and emotional considerations. Towards this the efforts should be mounted and sustained by nurturing and strengthening suitable institutions which can also play a role in the creation of public awareness about issues relating to international water resources.

3.12 Water Resources Development and Management at Local Level

- In a basin, there is a place for the whole range of structures - large to small, the latter has a particularly important role in rain-fed regions of the country.
- 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.
- There is need for optimum use of local sources of water even in canal-irrigated areas, in the interests of efficiency of water use, extension of irrigated land, prevention of water-logging and increased productivity.
- Due importance should be given to local water planning, with the ultimate aim of making each rural area manage its own water needs as far as possible through water harvests, conservation measures and watershed development.
- 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.
- State Governments should establish technical bodies at the local level for constant interactive relationships between the programmes and the people on technical matters and for use of low-cost and local materials.
- The Government of India should bring together all the area programmes of different Ministries as well as the rural employment and development programmes into one 'Integrated Rural Area Programme' (IRAP). For each eco-system-arid, semi-arid, dry-sub-humid, hill, wastelands, wetlands, heavy rainfall regions, irrigated plains - different, location- specific programmes may be drawn up locally under this overall programme. All the existing programmes may be merged in this and need not continue on parallel lines. New Schemes should also not be added on an ad-hoc basis.

3.13 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.
- Considerable work has been done regarding surface water availability, but as the studies themselves indicate, further refinement is warranted through the modelling of the hydrological cycle using modern technology like Remote Sensing and GIS environment. One issue that may be mentioned is further analysis of contribution from snowmelt and glaciers, which is particularly important in the Himalayan rivers. Another important component to be studied is assessment of the return flows.
- 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.
- Estimation of water demand and its implications on water quantity and quality are extremely important. Related to it is the management of water demand, through technology, policy and specifications. For planning purposes, more refinement in the assessment of water demand is needed.
- 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. Crop planning itself has an important bearing on water demand and of course on farmer's income.
- 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.
- Research is needed on the actual observed impact of existing high dams and other irrigation systems on environment with respect to river regime, ground water, flora and fauna, human health, quality of life etc.
- Research is also needed to assess the impact of large scale interbasin transfers on donor and donee basins with respect of biology, sociology and economics.
- The subject of climate change and its impact on water has been mentioned under issues to be taken into account while determining the development policy, but in view of the uncertainty of the subject, considerable research is required. This also raises the issue as to how uncertainty has to be handled in decision making. The subject needs considerable research.
- More research effort needs to be directed towards environmental, legal, socio-economic aspects of irrigation and water resources development and management in general. The impact on income, employment and acquisition of household goods needs to be evaluated.

- 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.
- If the results of the research work are not properly documented, they do not become available to other potential users, who may be facing similar problems. It is extremely important that all research results are properly documented and published. The completion reports of important projects would record problems faced and solved and will be highly educative.
- Effective networking and coordination of research work done in different institutions is essential to maximize their benefit and avoid duplication of effort. Intercommunication between research workers active in the same field and in different disciplines enhances progress of the work and evolution of new policies and systems.
- Most of the big States have got institutions for research such as Irrigation Research institutes and WALMIs. These need to be made autonomous organisations in order to ensure the continuity of the persons and to give them flexibility in their functions.
- 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. Water professionals, at senior levels, could be given a choice to either branch into senior management and policy making responsibilities or continue in their specialized fields striving for professional excellence and towards becoming a role model to the younger generation. 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.

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