Guidelines for
Integrated Water Resources Development and Management

Government of India
Ministry of Water Resources, River Development and Ganga Rejuvenation
Central Water Commission
Basin Planning and Management Organization
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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' Organization
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 Organization
NWRC	National Water Resources Council
O&M	Operation and Management
PAP	Project Affected Person
PIM	Participatory Irrigation Management
RBO	River Basin Organization
R&R	Rehabilitation and Resettlement
TAC	Technical Approval Committee
WALMI	Water and Land Management Institute
WMO	World Meteorological Organization
WUA	Water Users' Association

1.0 INTRODUCTION

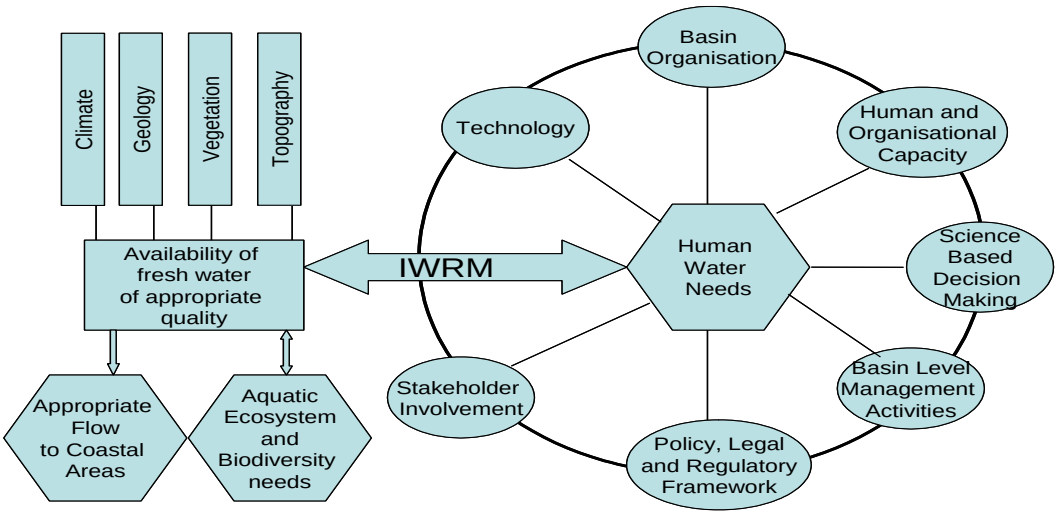
1.1 Background

The guidelines on 'Integrated Water Resources Development and Management' were prepared in BPMO, CWC under strategy V.4 of National Water Mission in March 2010 and were circulated within CWC for comments. The suggestions received from various organisations / directorates of CWC during the meeting on 10.3.2010 were incorporated and the guidelines were submitted to Commissioner (PP), MoWR on 31st March 2010 for concurrence, so that the interaction with various States on the guidelines might be held. The guidelines were, then, circulated to all States and Union Territories for their views and observations. Some States and organizations submitted their views and the same were suitably incorporated in the guidelines. Thereafter, the draft guidelines were discussed and deliberated upon with various stakeholders including State Govt during a workshop on IWRM organized by World Bank in New Delhi in Feb, 2015 along with various international experts.

1.2 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"**: E**conomic efficiency, **E**nvironmental sustainability and social **E**quity, 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 basin/sub basin 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 along with management measures

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



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.

1.3 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.

1.4 National Water Policy (2012) on IWRM

The National Water Policy-2012, in several provisions, has enumerated the integrated perspective of water resources planning, development and management. One of the basic principles of the policy is that planning, development and management of water resources need to be governed by common integrated perspective considering local, regional, State and national context, having an environmentally sound basis, keeping in view the human, social and economic needs.

The Policy under para 2.3 states that there is a need for comprehensive legislation for optimum development of inter- State rivers and river valleys to facilitate inter-State coordination ensuring scientific planning of land and water resources taking basin/sub-basin as unit with unified perspectives of water in all its forms (including precipitation, soil moisture, ground and surface water) and ensuring holistic and balanced development of both the catchment and the command areas. Such legislation needs, inter alia, to deal with and enable establishment of basin authorities, comprising party States, with appropriate powers to plan, manage and regulate utilization of water resource in the basins.

Highlighting the importance of integrated water resources management, the policy under para 12.4 states that Integrated Water Resources Management (IWRM) taking river basin / sub-basin as a unit should be the main principle for planning, development and management of water resources. The departments / organizations at Centre / State Governments levels should be restructured and made multi-disciplinary accordingly.

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 floods and droughts can be given as examples of an integrated approach. Basin activities such as development, land use and climate change, that may impact water resources and the hydrometeorlogical 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

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. Various water-related sectors or users should be considered in a well coordinated manner, highlighting the interactions among them, their activities and associated infrastructure.

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 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 and hydrological conditions are important to consider changes in national objectives and other plans managed by sectors not directly related to water issues.

The River Basin Master Plan shall, *inter-alia*, include

i. all the results of the analysis of the River Basin Characteristics
ii. a comprehensive review of the impact of anthropogenic interventions on the status of surface water and ground water, including an estimation of pollution, point as well as diffused, in water uses
iii. identification of protected areas, social and cultural flow needs and duration
iv. environmental needs
v. ground water and protected aquifers, if any

vi. a summary survey of existing pricing policies and an economic analysis
vii. a fair assessment of the effects of existing legislations
viii. an economic analysis for optimal allocation and the notional cost of deviation from optimal

2.2.2 Participation and Coordination Mechanisms, Fostering Information Sharing and Exchange

i. ***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 require assistance from various people representing different sectors. The identification of key stakeholders can be facilitated through interviews and meetings.

ii. ***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, appreciate the mutual requirements, 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 organizations 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, in light of current practices of existing law and if required, any repeal/suggestion/improvements of existing law, 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 processes for 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. Apart 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 to inform the public of their potential impacts.

***2.2.6.1 Funding and Cost recovery*:** Funds can be raised through tariffs, transfers, central government support or 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.

***2.2.6.2 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 to 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 practices in water resources is properly implemented and to identify the needs for adjusting management strategies. Effective monitoring requires accessible data, analytical tools and adequate information. For this regular evaluation of the strategies and their outcomes 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 of 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 the water sector. 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

RBOs are basin/sub basin level multi-disciplinary organizations comprising of various co-basin State governments and central government so as to promote integrated water resources development and management in the basin/sub-basin.

River Basin Organisations (RBOs) support the integrated and physical and technical management of water resources, and, if developed adequately, can respond to the growing competition for water among various State governments and among agricultural, industrial, domestic, and in-stream uses within the basins. RBOs can help recognize the environmental impacts of water uses and water development at the basin scale and can effectively take appropriate adaptation measure to climate change.

Without integrated river basin management through the RBOs, there would be interstate disputes and limited collaboration between departments related to water (irrigation, agriculture, industries and environment). Water related data and information would remain fragmented, consequently reducing the possibilities to conserve water. Given the limited possibilities to increase water supply or decrease demand, water resources would continue to move to those uses where the value of water is highest (e,g to industry rather than to irrigated agriculture) and water would continue to be allocated in an ad-hoc, suboptimal manner (from a social and environmental point of view). Broadly defined, RBOs offer a mechanism to achieve such integrated management by providing the framework for water allocation following efficiency and equity principles and also for resolution of disputes between various stake holders.

Majority of the current river basin management organizations are for specific functions, such as flood planning or water resources construction, water allocation, water pollution mitigation, etc. The adopted approach is demand oriented and focuses on resolving specific problems in the river basin.

The main functions of RBOs are given in the table below:

Function	Definition
Integration	Ensuring that the management of surface water, ground water, water quantity and quality and the environment are managed in an integrated way
Participation	Facilitating the participation of the community in river basin planning, and consideration of issues, policies, strategies and plans.
Plan	Formulation of medium to long term plans for managing and developing water resources in the basin
Construct facilities	Activities executed for the design and construction of hydraulic infrastructure
Maintain facilities	Activities executed to maintain the serviceability of the hydraulic infrastructure in the basin
Allocate water	Mechanisms and criteria by which water is apportioned among different use sectors, including the environment
Distribute water	Activities executed to ensure that allocated water reaches its point of use
Monitor and enforce water quality	Activities executed to monitor water pollution and salinity levels and ensure that they remain at or below accepted standards
Preparedness against water disasters	Flood and drought warning, prevention of floods, and development of emergency works, drought preparedness and coping mechanisms
Resolve conflicts	Provision of space or mechanisms for negotiation and litigation
Protect ecosystem	Priorities and actions to protect ecosystems, including awareness campaigns
Coordinate	Harmonization of policies and actions undertaken in the basin by state and non-state actors relevant to land and water management.

Beyond functional cooperation there is integrated approach to river basin management focusing on the river basin as a whole and try to resolve the existing hydrologic, ecologic and socioeconomic problems through holistic policies. The integrated approach is widely endorsed

and promoted by international organizations as well as by NGOs and scientists though there are few examples of truly integrated RBOs.

The type of RBO for a Basin is a function of the political and institutional situation and overall objective of the organization. Much of this will be assigned in its charter assigned by government. Common types of RBO include: (i) consultative bodies including stakeholders from government and civil society who advise government on river basin management needs. Implementation is done by others. (ii) Planning and regulatory bodies which oversee development of policies and plans for the basin. The RBO would oversee water entitlements and annual water allocations; delivery of major water diversions from the river; monitor water conditions. It may own, oversee, and operate water regulatory structures. It would provide a service as a bulk water (wholesale) water supplier for which it might recover costs but usually not supply water to end users. (iii) A large multi-purpose organization that as well as undertaking the services of model (ii) it would undertake revenue raising services such as hydropower operation, or irrigation water supply. In deciding these models it is relevant to consider separation of roles between different organizations in order to minimize conflict of interest. For example an RBO that also supplies water to one sector such as irrigation on a fee for service basis may have a conflict with supplying water to other users in water scarce seasons.

Depending upon the RBO model and its power and autonomy, the RBO secretariat that provides administrative and technical support could be supplied by the government water agency, or, where the RBO is a more autonomous body (types ii and iii), it would have its own secretariat.

3.0 Important Directions for 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

i. The work of refining the assessment of water resources of various basins using modern technology and to collect reliable data pertaining to observed flows, utilization from surface and ground water resources for various uses need to be undertaken at periodic intervals. There is also a need to develop uniform guidelines for assessing water resources potential and assessing water requirements for various uses.

ii. Impact of change in climate processes e.g. meteorological cycles, day/night temperature variations etc. influencing rainfall and runoff, evapo-transpiration, crop water requirements etc. observed through General Circulation Models (GCM) / Global Climate Models will have to be suitably downscaled to work upon the likely problems and their best possible solutions in each River Basin.

iii. Activities should also be focused on improvement of ground water estimation methodology and estimation of ground water withdrawals, based on a total hydrologic system balance. Problems of non accounting or double counting of interactions and withdrawal of resources are to be properly dealt with.

3.2 Water Rights and Priorities

i. Every individual has a right to a minimum quantity of potable water for essential health and hygiene and within easy reach of the household i.e., on the immediate public access road of the household.

ii. The minimum quantity of potable water shall be prescribed by the appropriate authority after expert examination and public consultation. However, the minimum quantity of potable water shall not generally be less than 25 litres per capita per day. The minimum quantity may however be geographically referenced State-wise and region-wise to take into account the climatological factors.

iii. Safe Water for drinking and sanitation should be considered as pre-emptive need, followed by high priority allocation for other basic domestic needs (including needs of animals), achieving food security, supporting sustainable agriculture and minimum eco-system needs. Available water, after meeting the above needs, should be allocated in a manner to promote its conservation and efficient use.

3.3 Policy, Legal and Institutional Framework

i. There is a need to evolve a National Framework Law as an umbrella statement of general principles governing the exercise of legislative and/or executive (or devolved) powers by the Centre, the States and the local governing bodies.

ii. There is a need for comprehensive legislation for optimum development of inter-State rivers and river valleys to facilitate inter-State coordination ensuring scientific planning of land and water resources taking basin/sub-basin as unit with unified perspectives of water in all its forms (including precipitation, soil moisture, ground and surface water) and ensuring holistic and balanced development of both the catchment and the command areas.

iii. Integrated Water Resources Management (IWRM) taking river basin / sub-basin as a unit should be the main principle for planning, development and management of water resources. The River Basin Authorities / organizations need to be established and the departments / organizations at Centre / State Governments levels should be restructured and made multi-disciplinary accordingly.

iv. Appropriate institutional arrangements for each river basin should be developed to collect and collate all data on regular basis with regard to rainfall, river flows, area irrigated by crops and by source, utilizations for various uses by both surface and ground water and to publish water accounts on ten daily basis every year for each river basin with appropriate water budgets and water accounts based on the hydrologic balances. In addition, water budgeting and water accounting should be carried out for each aquifers.

v. Appropriate institutional arrangements for each river basin should also be developed for monitoring water quality in both surface and ground waters.

vi. State Governments need to expedite the Enactment and Implementation of the Bills for Ground Water Legislation and legislation for Participatory Irrigation Management.

vii. The regulation of groundwater shall be in consonance with the principles of non-discrimination and equity, principle of subsidiary and shall conform to the constitutional provisions for decentralisation of powers and functions.

viii. 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.

ix. 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.

x. 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.

xi. The extraction of groundwater in any manner in any area shall be regulated through community based institutions with due regard to the hydro-geological and ecological characteristics and features of the aquifer as a whole. Such users and community based

institutions will be empowered to take information based decisions based on aquifer information and extraction data shared with them.

xii. For the above, the appropriate Government and local Authority shall keep all groundwater related information, such as, groundwater levels, water quality, local aquifer maps and groundwater utilization, in public domain.

xiii. 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.

3.4 Project Planning, Implementation and Prioritization

i. River basin or sub-basin shall be developed with unified perspectives of water and ensuring holistic and balanced development of both the catchment and the command areas, following the principle of integrated water resources management.

ii. Optimal utilisation of waters within a river basin shall be ensured, with due regard to the reasonable present and future needs for life and livelihoods, appropriate economic activity, social justice and equity, and ecological sustainability.

iii. 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.

iv. There is a need to lay down improved procedures of benefit cost analysis after considering all relevant aspects, such as technical, financial, economic, social and environmental.

v. Considering the heavy economic loss due to delay in implementation of projects, all clearances, including environmental and investment clearances, be made time bound.

vi. 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.

vii. 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.

viii. 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.

ix. A project should be considered as having commenced, only after the issue of formal administrative and technical approval by the Government and after clearance by the Technical Advisory Committee. All expenditure incurred prior to this should be shown against investigation and preparation.

x. 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.

xi. Efforts should be made to constitute Joint Corporations (Centre and States) for selected projects with an MOU and arrive at an Agreement for joint management.

xii. For speedy completion of projects, efforts need to be made for substantial changes in the contractual procedures.

xiii. 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 onetime exercise since there is a continuing addition to the stock of possible projects. The exercise should be done before each Five Year Plan.

xiv. 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.

xv. 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 State Government's commitment.

xvi. 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.

xvii. 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 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.

xviii. 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.

3.5 Sectoral Issues

3.5.1 Domestic Use

i. Ideally, water supply and waste water management schemes should be integrated and for this it is necessary that water supply programmes are not taken up without simultaneous taking up of waste water management schemes.

ii. Urban and rural domestic water supply should preferably be from surface water in conjunction with groundwater and rainwater. Where alternate supplies are available, a source with better reliability and quality needs to be assigned to domestic water supply. Exchange of sources between uses, giving preference to domestic water supply should be possible. Also, reuse of urban water effluents from kitchens and bathrooms, after proper treatment, to flush toilets and other uses should be encouraged.

iii. The artificial difference in quantities of water supplies for urban and rural sectors needs to be rationalized as flushing is not dependent upon the nature of habitation. Hence, water supply quantity may be seen more as a human development index and made uniform in rural and urban areas.

iv. The appropriate Government and local Authority shall ensure that urban water supply and sewage treatment schemes are integrated and executed simultaneously with provision of sewerage charges included in the Water supply bills.

v. The problem of drinking water in tribal areas are more acute, therefore, to provide accelerated coverage of drinking water to all habitats in tribal areas, an appropriate mechanism should be devised.

vi. The norms adopted for satisfying the basic human needs of communities (both urban and rural) may be reviewed periodically.

vii. 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.

viii. To reduce the gap between demand and supply, water conservation measures be accorded highest priority, especially in areas facing water quality and scarcity problems, with emphasis on recycling/ reuse of treated waste water.

ix. 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.

x. Improved low cost technologies have to be developed and adopted to save cost of construction and maintenance.

xi. Public Awareness needs to be created for reducing water consumption. Women's participation is to be encouraged to the maximum as they are the one who are the primary and major users at domestic level.

xii. 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.

xiii. Provided that implementation of rainwater harvesting should include scientific monitoring of parameters like hydrogeology, groundwater contamination, pollution and spring discharges.

xiv. Water resources projects and services shall be managed with community participation. For improved service delivery on sustainable basis, the State Governments / urban local bodies may associate private sector in public private partnership mode with penalties for failure, under regulatory control on prices charged and service standards with full accountability to democratically elected local bodies.

3.5.2 Irrigation

i. 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.

ii. 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.

iii. Demand management shall be given priority, especially through;

(a) Evolving an agricultural system which economizes on water use and maximizes value from water, and

(b) Bringing in maximum efficiency in use of water and avoiding wastages.

iv. The water used for irrigation should be free from various toxic elements such as arsenic, fluorides and other bio-accumulators etc, so that such elements do not end up in the food chain.

v. 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.

vi. In planning of water saving projects, detailed water balance studies should be made to ensure that the water savings are real and do not affect downstream users depending on lost water such as ground water recharge etc. Real water savings may be achieved by reducing non-beneficial evapo-transpiration and losses of water to polluted water bodies/saline ground water.

vii. Awareness should be raised among Agricultural Water users in a command area on economical use of precious water, land planning, integrated farming, crop diversification, harvesting, storage in scientific method and its marketing etc.

viii. There is a need to provide training to farmers in Crop Alignment including diversification as per water availability to increase the productivity for each unit of water

ix. There is a need to provide training and skill development of farmers in enhancing effective rainfall for crop production through various agronomic and mechanical measures like adoption of Resource Conservation Technologies, such as land Leveling, Terracing and contour farming, Mulching, Fertigation, water harvesting etc.

x. Planning and execution of all components of irrigation projects including command area development works shall be carried out in a pari-passu manner with concurrent monitoring of projects with a view to prevent time and cost over-runs.

xi. Project planning and management of water resources shall be on the basis of regional agro-climatic considerations taking into account possible future scenario (including climate change) after maximizing water use efficiency and benefits from the locally available water resources.

xii. 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 so that appropriate lessons may be drawn and remedial measures taken in subsequent Plans. Benchmarking for the projects should be given maximum importance for increasing the performance of existing and future projects.

xiii. There is a need for:

(a) instilling discipline in equitable distribution through WUAs participation.

(b) 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.

(c) operation of canals / distribution network on demand based rather than supply based distribution.

(d) fixing of water rates on volumetric supply and recovery of water charges through WUAs.

xiv. 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. The figures of the irrigation/water resources department and land use statistics should also be reconciled.

xv. 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.

xvi. 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.

xvii. 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.

xviii. There is a 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.

xix. 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.

xx. Till a system of demand based supply of irrigation is achieved, State Governments should make efforts in introducing Warabandi system of rotational water supply.

xxi. 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.

xxii. 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.

xxiii. 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.

xxiv. Detailed studies are needed to evaluate the longevity and viability of minor irrigation schemes.

xxv. 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.

3.5.3 Flood Control and Management

i. 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. The rule curves should accordingly be devised for operation of reservoirs so as to get optimum benefits and such rule curves should be modified periodically taking the current flow data and considering the impact of climate change in the flow pattern.

ii. In addition to structural measures, non structural measures also need to be simultaneously taken e.g. efficient management of flood plains, flood risk mapping, flood-plain zoning, flood proofing including disaster preparedness & response planning, inflow forecast, flood forecasting & warning, and other non-structural measure such as disaster relief, flood fighting including public health measures, awareness raising 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.

iii. Embankments/spurs do provide reasonable protection. The performance review of selected embankments/spurs may be carried out and based on the findings, planning, designs and management of embankments/spurs may be reviewed for obtaining better results. The embankments/spurs or any other such structures may also be examined through model study before execution. It is essential to associate the beneficiaries in the upkeep and surveillance of embankments/spurs during the monsoon season for prevention of possible breaching.

iv. The appropriate Government and local Authority shall expand flood forecasting extensively across the country and modernize flood forecasting using real time data acquisition system linked to forecasting models.

v. Operating procedures for reservoirs shall be evolved and implemented in such a manner to have flood cushion and to reduce trapping of sediment during flood season on the basis of sound decision support system.

vi. Need for river mouths dredging for removal of the deposited silt as a part of flood management may be assessed periodically and implemented.

vii. There should be proper coordination between the co-basin states during release of water from upstream states so as to manage flood effectively for the benefit of the inhabitants of the entire basin.

viii. Possibility and feasibility to divert and store the flood water for later use may be explored.

3.5.4 Hydropower

i. 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 centre is high, energy intensive industries could be located close to the hydropower project sites. This would attract private participation and accelerate hydro-power development and also help in development of the region.

ii. 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.

iii. 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.

iv. All water resources projects, including hydro power projects, should be planned to the extent feasible as multi-purpose projects with provision of storage to derive maximum benefit from available topology and water resources.

3.5.5 Industrial Use

i. Actual quantity of water utilized by the major industry should be monitored by government agencies. Major water using industries and businesses consuming water more than one Million Cubic Meter in a year shall file annual 'Water returns' containing information, such as, water utilization per unit produce, effluent discharge details, rain water harvested, water reuse details and freshwater consumption.

ii. Waste utilisation technologies/ clean production technologies with emphasis on waste minimization. Recycling and reuse of water, after treatments to specified standards, should be incentivised through a properly planned tariff system. .

iii. 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. Even if allowed, such industries may be allowed to either withdraw only the makeup water or have an obligation to return treated effluent to a specified standard back to the hydrologic system.

iv. Private sector participation would be practicable in projects mainly intended for supply for industrial use and urban water supply. The responsibility of the state as public trustee shall remain even if some of the functions of the state in relation to water are entrusted to any public or private agency.

v. Hazardous waste treatment and disposal need to be so planned and executed so as to protect people and environment from adverse impacts.

vi. 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 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.

3.5.6 Navigation

i. Development of inland water transport needs basic infrastructure like the fairway, terminals and navigational aids. State Government should undertake the development.

ii. Water front development programme and rebates for investments are necessary to bring traffic generating activity back to the rivers.

3.5.7 Ecological and Other Uses

i. The appropriate Government shall take all measures to protect the ecological integrity necessary to sustain ecosystems dependent on waters. A portion of river flows shall be kept aside to meet ecological needs ensuring that the low and high flow releases are

proportional to the natural flow regime, including base flow contribution in the low flow season through regulated ground water use.

ii. 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.

iii. Riparian rights of the inhabitants along the river sides should be preserved as prevailed from the ancient times.

3.6 Ground Water Aspects

i. The critical importance of the nexus between groundwater and the agricultural policy, urban infrastructure and energy consumption has to be stressed, since without integrated vision and action at these interfaces, the major challenge of groundwater-resource sustainability cannot be effectively addressed. The approach for groundwater management needs to be multidisciplinary and strongly participatory.

ii. Ground water quality protection should follow a strategy comprising the systematic assessment of groundwater-pollution hazard (based on mapping of a aquifer-pollution vulnerability and subsurface contaminant loads) and definition of a 'groundwater protection plan'.

iii. An interdisciplinary framework for planning groundwater management may consist of the (a) Encouraging Local institutional arrangements with an empowered government agency facilitating community awareness and participation and, where appropriate, self regulation (b) Financing and implementation of demand-side and supply-side measures.

iv. Aquifers should be identified and mapped at micro level to quantify the available ground water resources and make plans appropriate to the scale of demands and aquifer characteristic.

v. Artificial recharge of ground water is one of the most efficient ground water management tools for ensuring sustainability of ground water resources and should therefore be resorted to wherever possible/feasible. It is essential to ensure the quality of recharge to prevent possible contamination/pollution of aquifer. The appropriate Government shall demarcate groundwater recharge zones by identifying critical natural recharge areas of an aquifer and those areas that require special attention with regard to the recharge of groundwater and including areas that are affected by contaminants and saline water ingress. The groundwater recharge zones shall be accorded the highest priority in terms of groundwater protection and regulation and the appropriate government shall take all possible measures to conserve and protect such groundwater recharge zones

3.7 Demand Management, Water Pricing and Participatory Management

i. An Independent statutory Water Regulatory Authority shall be established by every State for ensuring equitable access to water for all and its fair pricing, for drinking and other uses such as sanitation, agricultural and industrial. The decisions of the Water Regulatory Authority shall be subject to judicial review.

ii. The principle of differential pricing for water for drinking and sanitation; and for ensuring food security and supporting livelihood for the poor may be adopted. The

appropriate Government might provide minimum quantity of water for drinking and sanitation free of cost or at a subsidized price to eligible households, being part of pre-emptive need. The available water, after meeting the pre-emptive needs, shall increasingly be subjected to allocation and pricing on economic principles so that water is not wasted in unnecessary uses and could be utilized more gainfully and water infrastructure projects are made financially viable.

iii. Water charges should be determined on volumetric basis in order to meet equity, efficiency and economic principles. Such charges should be reviewed periodically. Hence, low cost measurement structures should be installed in the canals.

iv. Free of cost water supply to forest dwelling STs and other Traditional Forest Dwellers for drinking water and farming needs may be considered as they help in maintaining forested watersheds.

v. Water Users Associations (WUAs) should be given statutory powers to collect and retain a portion of water charges, manage the volumetric quantum of water allotted to them and maintain the distribution system in their jurisdiction. WUAs should be given the freedom to fix rates subject to floor rates determined by WRAs. Women should be encouraged for involvement in WUA and also in decision making activities in management of canals and command areas. The irrigation system should be planned, developed and managed in consultation with prospective water user groups. Government should progressively transfer management of irrigation command areas to WUAs and support and build their capacity for management.

vi. Urban and rural water supply as well as supply for all the sectors shall be 100% metered and priced on volumetric basis. Provided that supply of minimum water to Below Poverty Line populations may be subsidised by the appropriate government.

vii. Water accounts and water audit reports indicating leakages and pilferages, shall be published to sensitize communities for reduction of non-revenue water uses taking into due consideration the associated social issues.

viii. Tariff rates 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.

ix. 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.

x. Pricing of water for industry shall include efficiency costs and capital charges.

xi. 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.

xii. 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. 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.

xiii. 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.

xiv. 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.

3.8 Environmental Aspects

i. There is a need to assess and identify the environmental assets and social/cultural values in the river system and support them through interventions/efforts commensurate with their significance.

ii. The environmental protection plan, including cumulative environment impact assessment, for an area shall form part of the Master river basin management Plan

iii. Environmental needs of Himalayan regions, aquatic eco-system, wet lands and embanked flood plains need to be recognized and taken into consideration while planning

iv. The project authority should weigh all alternatives before going in for a project so as to cause the least social and environmental disturbance.

v. 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.

vi. Integrated watershed projects help in water and soil conservation and thus enable restoration of degraded areas. Therefore, integrated watershed development activities with groundwater perspectives need to be taken in a comprehensive manner to increase soil moisture, reduce sediment yield and increase overall land and water productivity. To the extent possible, existing programs like MGNREGA may be used by farmers to harvest rain water using farm ponds and other soil and water conservation measures.

vii. 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 should be fully implemented as approved.

viii. 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.

ix. 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.

x. Monitoring and Evaluation of environmental safeguards during the construction phase and in post operation phase as stipulated in EIA clearance, is essential.

3.9 Rehabilitation and Resettlement

i. Much of the criticism against major developmental projects including water projects emanate from poor R&R, and therefore, R&R of PAPs should receive due attention and should be done in accordance with the provision of the relevant policies/Acts in force .

ii. 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. 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 human compassion and sensitivity.

iii. The R&R plan should receive sufficient funds and should be implemented by an independent authority. It should be vested with powers to deal with the affairs of the State / Basin, to the extent possible. Implementation of R&R should also be monitored and evaluated by an independent agency.

iv. Special care should be taken that the minimum extent of land required alone is proposed for acquisition.

v. The project advisory steering committee must be broad based to include representatives of the PAPs, NGOs and representatives drawn from the concerned departments / agencies.

vi. 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.

vii. A complete survey of the affected zone and people, their occupations etc. should be taken in this respect, wherever tribals are involved.

viii. 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.

ix. 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.

x. 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.

xi. The resettled sites should be well developed with all infrastructure so as to provide the resettled a better way of life.

xii. Support to the landless, unemployed should be extended, through appropriate means, to enable them to rehabilitate themselves.

xiii. 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.

xiv. 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.

xv. 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 R&R and environmental issues.

3.10 Water Quality Aspects

i. There is a need to assess and identify the water quality issues and its social/cultural values in the river system and support them through interventions/efforts commensurate with their significance.

ii. Subject to the provisions of the Environment (Protection) Act 1986 and Water (Control and Prevention of Pollution) Act 1974, the approach to the prevention and control of pollution and contamination of water sources shall include: (i) minimizing the generation of waste in all water uses; (ii) reducing non-point source of pollution; (iii) recovering, to the extent possible, water for some uses from waste; and (iv) ensuring that nothing that does not meet certain stringent quality standards, to be prescribed, is allowed to enter water sources.

iii. There is need to establish and operate cost - effective water quality monitoring systems on seasonal / monthly scales as well as long-term scale, in varying scenarios in the basin at different stages. 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.

iv. 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 properly implemented and monitored.

v. 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.

vi. 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.

vii. The appropriate Government and local Authority shall take all possible measures to protect and improve the quality of groundwater, includes measures for prevention of pollution and for remediation from groundwater contamination. It shall also ensure planning and implementation of necessary safeguards to protect the quality of groundwater while giving licenses for mining and industrial activities.

3.11 Inter-basin Transfers

i. 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.

ii. Water balance study of the source basin should be undertaken including existing and planning water uses, downstream and interstate requirement, environment needs to decide availability of supply water. Likely impact of climate change may also be considered.

iii. 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.

3.12 Interstate Issues

i. 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. 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-wise 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.

3.13 International Dimensions

i. The optimized and integrated development of international rivers calls for cooperation amongst the co-basin countries. In an increasingly global economy, to attain the goals of poverty alleviation and sustainable economic growth, the regional integration and cooperation are necessary.

ii. Since water does not recognize 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.

iii. 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.

iv. Flood moderation and forecasting is a matter of common concern and there is need for improving hydrological and silt data 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.

v. 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.

vi. 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. 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.

vii. 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.

3.14 Water Resources Development and Management at Local Level

i. In a basin, there is a place for the whole range of structures - large to small, the latter has a particularly important role in many regions of the country.

ii. 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.

iii. 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.

iv. 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.

v. 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. Operation and maintenance of local water harvesting schemes may be transferred to local water users.

vi. 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 local materials.

vii. 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 not be added on an ad-hoc basis.

3.15 Information and Knowledge Management

i. 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 all concerns in the water sector effectively through research and development.

ii. Monitoring of surface water and groundwater quantity and quality should be undertaken to support water resources management. Monitoring systems and databases, data standards and protocols should follow national standards.

iii. Data should be shared between departments and levels of government freely other than for the costs of data transfer and made accessible to the public consistent with national security requirements.

iv. Decision support system including integrated modeling should be used to develop river basin and watershed management plans and to support the development of government policy.

3.16 Research and Developmental Needs

i. Considerable work has been done regarding surface water availability, but as the studies themselves indicate, further refinement is warranted. Surface water availability studies need to be refirmed through the modelling of the hydrological cycle using modern technology like Remote Sensing and GIS. 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 from different uses.

ii. 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.

iii. 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 particularly through the use of standardized water footprints.

iv. Research and Development should be closely linked with the needs of the water resources managers and users. Research is needed to provide guidance to the farmers in particular, 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.

v. 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.

vi. 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.

vii. Research is also needed to assess the impact of large scale interbasin transfers on donor and recipient basins with respect eco-system, sociology and economics.

viii. 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.

ix. 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.

x. 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 etc. needs to be evaluated.

xi. There are several fields where further research is needed for technological innovations such as in environmental flows, sedimentation studies, river morphology, forest hydrology, designs and model studies for specific structures, construction technologies, new materials etc.

xii. The methodology for determination of nationally standardized water foot prints for every activity/product should be developed, tried and promoted according to the results.

xiii. 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 of high practical utility.

xiv. There is need to update technology, design practices, planning & management practices, preparation of annual water balances and accounts for the project sites and basins. Benchmarking and performance evaluation of the projects should be given due importance for increasing the performance of existing and future projects.

xv. 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.

xvi. 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.

xvii. 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.

xviii. 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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