NATIONAL WATER POLICY

Need for a National Water Policy

WATER IS a prime natural resource, a basic human need and a precious national asset. Planning, development and management of water resources need to be governed by national perspectives.

As per the latest assessment (1993), out of the total precipitation, including snowfall, of around 4000 bcm in the country, the availability from surface water and replenishable groundwater is put at 1869 bcm. Because of topographical and other constraints, about 60 per cent of this, i.e. 690 bcm from surface water and 432 bcm from ground water, can be put be beneficial use. Availability of water is highly uneven in both space and time. Precipitation in confined to only about three or four months in a year and varies from 100 mm in the western parts of Rajasthan to over 10000 mm at Cherrapunji in Meghalaya. Rivers and underground aquifers often cut across state boundaries. Water, as a resource is one and indivisible : rainfall, river waters, surface ponds and lakes and ground water are all part of one systems.

Water is part of a larger ecological systems. Realising the importance and scarcity attached to the fresh water, it has to be treated as an essential environment for sustaining all life forms.

Water is one of the scarce and precious national resources and needs 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.

Floods and droughts affect vast areas of the country, transcending state boundries. One sixth area of the country is drought-prone. Out of 40 mha of the flood prone area in the country, on an average, floods affect an area of around 7.5 mha per year. Approach to management of droughts and floods has to be coordianated and guided at the national level.

Planning and implementation of water resources projects involve a number of socio-econ omic aspects and issues such as environmental sustainability, appropriate resettlement and rehabilitation of project affected people and livestock, public health concerns of water impoundment, dam safety etc. Common approaches and guidelines are necessary on these matters. Moreover, certain problems and weaknesses have affected a large number of water resources projects all over the country. There have been substantial time and cost overruns on projects. Problems of water logging and soil salinity have emerged in some irrigation commands, leading to the degradation of agricultural land. Complex issues of equity and social justice in regard to water distribution are required to be addressed. The development, and over exploitation of groundwater resources in certain parts of the country have raised the concern and need for judicious and scientific resource management and conservation. All these concerns need to be addressed on the basis of common policies and strategies.

Growth process and the expansion of economic activities inevitably lead to increasing demands for water for diverse purpose : domestic, industrial, agricultural, hydro-power, thermal-power navigation, recreation etc. So far, the major consumptive use of water has been for irrigation. While the gross irrigation potential is estimated to have increased from 19.5 mha at the time of independence to about 95 million hectare by the end of the Year 1999-2000, further development of a substantial order is necessary if the food and fiber needs of our growing population are to be met with. The country's

population which is over 1027 million (2001AD) at present is expected reach a level of around 1390 million by 2025 A.D.

Production of foodgrains has increased from around 50 million tonnes in the fifties to about 208 million tonnes in the Year 1999-2000. This will have to be raised to around 350 million tonnes by the year 2025 AD. The drinking water needs of people and livestock have also to be met. Domestic and industrial water needs have largely been concentrated in or near major cities. However, the demand in rural areas is expected to increase sharply as the development programmes improve economic conditions of the rural masses. Demand for water for hydro and thermal power generation and for other industrial uses is also increasing substantially. As a result, water, which is already a scarce resource, will become even scarcer in future. This underscores the need for the utmost efficiency in water utilisation and public awareness of the importance of its conservation.

Another important aspect is water quality. Improvements in existing strategies, innovation of new techniques resting on a strong science and technology base are needed to eliminate the pollution of surface and ground water resources to improve water quality. Science and technology and training have to play important roles in water resources development and management in general.

National Water Policy was adopted in September, 1987. Since then a number of issues and challenges have emerged in the development and management of the water resources. Therefore, the National Water Policy (1987) has been reviewed and updated.

Information System

A well developed information system, for water related data in its entirety at the national/state level, is a prime requisite for resource planning. A standardised national information system should be established with a network of data banks and data bases, integrating and strengthening the existing Central and State level agencies and improving the quality of data and the processing capabilities.

Standard for coding, classification , processing of data and methods/procedures for its collection should be adopted. Advances in information technology must be introduced to create a modern information systems promoting free exchange of data among various agencies. Special efforts should be made to develop and continuously upgrade technological capability to collect, process and disseminate reliable data in the desired time frame.

Apart from the data regarding water availability and actual water use, the system should also include comprehensive and reliable projections of future demands of water for diverse purposes.

Water Resources Planning

Water resources available to the country should be brought within the category of utilisable resources to the maximum possible extent.

Non-conventional methods for utilisation of water such as through inter-basin transfers, artificial recharge of ground water and desalination of brackish or sea water as well as traditional water conservation practices like rainwater harvesting, including roof-top rainwater harvesting, need to be practiced to further increase the utilisable water resources. Promotion of frontier research and development, in a focused manner, for these techniques is necessary.

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 development projects and proposal 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.

Watershed management through extensive soil conservation, catchment-area treatment, preservation of forests and increasing the forest cover and the construction of check-dams should be promoted. Efforts shall be to conserve the water in the catchment.

Water should be made available to water short areas by transfer from the other areas including transfers from one river basin to another, based on a national perspective, after taking into account the requirements of the areas/basins.

Institutional Mechanism

With a view to give effect to the planning, development and management of the water resources on a hydrological unit basis, along with a multi-sectoral, multi-disciplinary and participatory approach as well as integrating quality, quantity and the environmental aspects, the existing institutions at various levels under the water resources sector will have to be appropriately reoriented/reorganised and even created, wherever necessary. As maintenance of water resources schemes is under non-plan budget, it is generally being neglected. The institutional arrangement should be such that this vital aspect is given importance equal or even more than that of new constructions.

Appropriate river basin organisations should be established for the planned development and management of a river basin as a whole or sub-basins, wherever necessary. Special multi-disciplinary units should be set up to prepare comprehensive plans taking into account not only the needs of irrigation but also harmonising various other water uses, so that the available water resources are determined and put to optimum use having regard to existing agreements or awards of Tribunals under the relevant laws. The scope and powers of the river basin organisations shall be decided by the basin states themselves.

Water Allocation Priorities

In the planning and operation of systems, water allocation priorities should be broadly as follows :

- Drinking water
- Irrigation
- Hydro-power
- Ecology
- Agro-industries and non-agricultural industries.
- Navigation and other uses.

However, the priorities could be modified or added if warranted by the area/region specific considerations.

Project Planning

Water resource development projects should as far as possible be planned and developed as multipurpose projects. Provision for drinking water should be a primary consideration.

The study of the likely impact of a project during construction and later on human lives, settlements, occupations, socio-economic, environment and other aspects shall form an essential component of project planning.

In the planning, implementation and operation of a project, the preservation of the quality of environment and the ecological balance should be a primary consideration. The adverse impact on the environment, if any, should be minimised and should be offset by adequate compensatory measures. The project should, nevertheless, be sustainable.

There should be an integrated and multi-disciplinary approach to the planning, formulation, clearance and implementation of projects, including catchment area treatment and management, environmental

and ecological aspects, the rehabilitation of affected people and command area development. The planning of projects in hilly areas should take into account the need to provide assured drinking water, possibilities of hydropower development and the proper approach to irrigation in such areas, in the context of physical features and constraints of the basin such as steep slopes, rapid run-off and the incidence of soil erosion. The economic evaluation of projects in such areas should also take these factors into account.

Special efforts should be made to investigate and formulate projects either in or for the benefit of, areas inhabited by tribal or other disadvantaged groups such as socially weak, scheduled castes and scheduled tribes. In the other areas also, project planning should pay special attention to the needs of scheduled castes and scheduled tribes and other weaker section of the society. The economic evaluation of projects benefitting such disadvantaged sections should also take these factors in account.

The drainage system should form an integral part of any irrigation project right from the planning stage.

Time and cost overruns and deficient realisation of benefits characterising most water related projects should be overcome by upgrading the quality of project preparation and management. The inadequate funding of projects should be obviated by an optimal allocation of resources on the basis of prioritisation, having regard to the early completion of on-going projects as well as the need to reduce regional imbalances.]

The involvement and participation of beneficiaries and other stakeholders should be encouraged right from the project planning stage itself.

Groundwater Development

There should be a periodical reassessment of the ground water potential on a scientific basis, taking into consideration the quality of the water available and economic viability of its extraction.

Exploitation of groundwater resources should be so regulated as not to exceed the recharging possibilities, as also to ensure social equity. The detrimental environmental consequences of over-exploitation of ground water need to be effectively prevented by the Central and state governments. Ground water recharge projects should be developed and implemented for improving both the quality and availability of ground water resources.

Integrated and coordinated development of surface water and ground water resources and their conjunctive use, should be envisaged right form the project planning stage and should form an integral part of the project implementation.

Over exploitation of groundwater should be avoided especially near the coasts to prevent ingress of seawaer into sweet water aquifers.

Drinking Water

Adequate safe drinking water facilities should be provided to the entire population both into urban and in rural areas. Irrigation and multipurpose projects should invariably include a drinking water components, wherever there is no alternative source of drinking water. Drinking water needs of human beings and animals should be the first charge on any available water.

Irrigation

Irrigation planning either in an individual project or in a basin as a whole should take into account the irritability of land, cost-effective irrigation options possible from all available sources of water and appropriate irrigation techniques for optimising water use efficiency. Irrigation intensity should be such as to extend the benefits of irrigation to as large a number of farm families as possible, keeping in view the need to maximise production.

There should be a close integration of water-use and land-use policies.

Water allocation in an irrigation system should be done with due regard to equity and social justice. Disparities in the availability of water between head-reach and tail end farms and between large and small farms should be obviated by adoption of a rotational water distribution system and supply of water on a volumetric basis subject to certain ceilings and rational pricing.

Concerted efforts should be made to ensure that the irrigation potential created is fully utilised. For this purpose, the command area development approach should be adopted in all irrigation projects.

Irrigation being the largest consumer of fresh water, the aim should be to get optimal productivity per unit of water. Scientific water management, farm practices and sprinkler and drip system of irrigation should be adopted wherever feasible.

Reclamation of water logged/saline affected land by scientific and cost-effective methods should form a part of command area development progamme.

Resettlement and rehabilitation

Optimal use of water resources necessitates construction of storages and the consequent resettlement and rehabilitation of population. A skeletal national policy in this regard needs to be formulated so that the project affected persons share the benefits through proper rehabilitation. States should accordingly evolve their own detailed resettlement and rehabilitation policies for the sector, taking into account the local conditions. Careful planning is necessary to ensure that the construction and rehabilitation activities proceed simultaneously and smoothly.

Financial and Physical Sustainability

Besides creating additional water resources facilities for various uses, adequate emphasis needs to be given to the physical and financial sustainability of existing facilities. There is, therefore a need to ensure that the water charges for various uses should be fixed in such a way that they cover at least the operation and maintenance charges of providing the service initially and a part of the capital costs subsequently. These rates should be linked directly to the quality of service provided. The subsidy on water rates to the disadvantaged and poorer section of the society should be well targeted and transport.

Participatory Approach to Water Resources Management

Management of the water resources for divers uses should incorporate a participatory approach; by involving not only the various governmental agencies but also the users and other stakeholders, in an effective and decisive manner, in various aspects of planning, design development and management of the water resources schemes. Necessary legal and institutional changes should be made at various levels for the purpose, duly ensuring appropriate role for women. Water User's Associations and the local bodies such as municipalities and gram panchayats should particularly be involved in the operation, maintenance progressively with a view to eventually transfer the management of such facilities to the user groups/local bodies.

Private Sector Participation

Private sector participation should be encouraged in planning, development and management of water resources projects for diverse uses, wherever feasible. Private sector participation may help in introducing innovative ideas, generating financial resources and introducing corporate management and improving service efficiency and accountability to users. Depending upon the specific situations, various combinations of private sector participation, in building, owning, operating, leasing and transferring of water resources facilities may be considered.

Water Quality

Both surface water and ground water should be regularly monitored for quality. A phased programme should be undertaken for improvements in water quality.

Effluents should be treated to acceptable levels and standard before discharging them into natural streams.

Minimum flow should be ensured in the perennial streams for maintaining ecology and social considerations.

Principle of 'polluter pays' should be followed in management of polluted water.

Necessary legislation is to be made for preservation of existing water bodies by preventing encroachment and deterioration of water quality.

Water Zoning

Economic development and activities including agricultural, industrial and urban development, should be planned with due regard to the constraints imposed by the configuration of water availability. There should be a water zoning of the country and the economic activities should be guided and regulated in accordance with such zoning.

Conservation of Water

Efficiency of utilisation in all the diverse uses of water should be optimised and an awareness of water as a scarce resources should be fostered. Conservation consciousness should be promoted through education, regulation, incentives and disincentives.

The resources should be conserved and the availability augmented by maximising retention, eliminating pollution and minimising losses. For this, measurers like selective linings in the conveyance systems, modernisation and rehabilitation of existing systems including tanks, recycling and re-use of treated effluents and adoption of traditional techniques like mulching or pitcher irrigation and new techniques like drip and sprinkler may be promoted, wherever feasible.

Flood Control and Management

There should be a master plan for flood control and management for each flood prone basin.

Adequate flood-cushion should be provided in water storage projects, wherever feasible to facilitate better flood management. In highly flood prone areas, flood control should be given overriding consideration in reservoir regulation policy even at the cost of sacrificing some irrigation or power benefits.

While physical flood protection works like embankments and dykes will continue to be necessary, increased emphasis should be laid on non-structural measures such as flood forecasting and warning, flood plain zoning and flood proofing for the minimisation of losses and to reduce the recurring expenditure on flood relief.

There should be strict regulation of settlements and economic activity in the flood plain zones along with flood proofing, to minimise the loss of life and property on account of floods.

The flood forecasting activities should be modernised, value added and extended to other uncovered areas. Inflow forecasting to reservoirs should be instituted for their effective regulation.

Land Erosion by Sea or River

The erosion of land, whether by the sea in coastal areas or by river waters inland should be minimised by suitable cost-effective measurers. The states and Union territories should also undertake all requisite

steps to ensure that indiscriminate occupation and exploitation of coastal strips of land are discouraged and the location of economic activities in areas adjacent to the sea is regulated.

Each coastal State should prepare a comprehensive coastal land management plan-keeping in view the environmental and ecological impacts, and regulate the developmental activities accordingly.

Drought-prone Area Development

Drought-prone areas should be made less vulnerable to drought-associated problems through soil-moisture conservation measures, water harvesting practices, minimisation of evaporation losses, development of the ground water potential including recharging and the transfer of surface water from surplus areas where feasible and appropriate. Pastures, forestry or other modes of development which are relatively less water demanding should be encouraged. In planning water resource development projects, the needs of drought-prone areas should be given priority.

Relief works undertaken for providing employment to drought-stricken population should preferably be for drought proofing.

Monitoring of Projects

A close monitoring of projects to identify bottlenecks and to adopt timely measurers to obviate time and cost overrun should form part of project planning and execution.

There should be a system to monitor and evaluate the performance and socio-economic impact of the project.

Water Sharing / Distribution amongst the States.

The Water sharing/distribution amongst the states should be guided by a national perspective with due regard to water resources availability and needs within the river basin. Necessary guidelines, including for water short states even outside the basin, need to be evolved for facilitating future agreements amongst the basin states.

The Inter-State Water Disputes Act of 1956 may be suitably reviewed and amended for timely adjudication of water disputes referred to the Tribunal.

Performance Improvement

There is an urgent need of paradigm shift in the emphasis in the management of water resources sector. From the present emphasis on the creation and expansion of water resources infrastructures for diverse uses, there is now a need to give greater emphasis on the improvement of the performance of the existing water resources facilities. Therefore, allocation of funds under the water resources sector should be re-prioritised to ensure that the needs for development as well as operation and maintenance of the facilities are met.

Maintenance and Modernisation

Structures and systems created through massive investments should be properly maintained in good health. Appropriate annual provision should be made for this purpose in the budgets.

There should be a regular monitoring of structures and systems and necessary rehabilitation and modernisation programmes should be undertaken.

Formation of Water Users' Association with authority and responsibility should be encouraged to facilitate the management including maintenance of irrigation system in a time bound manner.

Safety of Structures

There should be proper organizational arrangements at the national and state levels for ensuring the safety of storage dams and other water-related structures consisting of specialists in investigation, design, construction, hydrology, geology, etc. A dam safety legislation may be enacted to ensure proper inspection, maintenance and surveillance of existing dams and also to ensure proper planning, investigation, design and construction for safety of new dams. The guidelines on the subject should be periodically updated and reformulated. There should be a system of continuous surveillance and regular visits by experts.

Science and Technology

For effective and economical management of our water resources, the frontiers of knowledge need to be pushed forward in several directions by intensifying research efforts in various areas, including the following.

- hydrometeorology;
- snow and lake hydrology;
- surface and ground water hydrology;
- river morphology and hydraulics;
- assessment of water resources;
- water harvesting and ground water recharge;
- water quality;
- water conservation;
- evaporation and seepage losses;
- recycling and re-use;
- better water management practices and improvements in operational technology;
- crops and cropping systems;
- soils and material research;
- new construction materials and technology (with particular reference to roller compacted concrete, fiber reinforced concrete
- new methodologies in tunnelling technologies, instrumentation;
- advanced numerical analysis in structures and back analysis;
- seismology and seismic design of structures;
- the safety and longevity of water related structures; economical designs for waterr e s o u r c e s projects;
- risk analysis and disaster management;
- use of remote sensing techniques in development and management;
- use of static ground water resource as a crisis management measure;
- sedimentation of reservoirs;

- use of sea water resources;
- prevention of salinity ingress;
- prevention of water logging and soil salinity.
- reclamation of water logged and saline lands;
- environmental impact;
- regional equity.

Training

A perspective plan for standardised training should be an integral part of water resource development. It should cover training in information systems, sectorial planning, project planning and formulation, project management, operation of projects and their physical structures and systems and the management of the water distribution systems. The training should extend to all the categories of personnel involved in these activities as also the farmers.

Reproduced from National Water Policy,

Government of India,

Ministry of Water Resources,

April 2002.

Reproduced from
The Indian Journal of Public Administration
Vol. XLIX No. 3 - July-September, 2003

WATER : SOME CRUCIAL QUESTIONS

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The right to water is a part of the right to life, and the right to life is not a property right. Can this be reconciled with the perception of water as a commodity? If water is a commodity in some uses, can we define property rights in respect of water? So water markets have a role to play? Is the privatisation of water the answer to our problems? This article discusses the question of recognition of the primacy of water as basic need and right over water as commodity. It contains stimulating views on water being regarded as tradable commodity, water markets, globalisation, privatisation, corporatisation and public-private partnership in water management.

Introduction

During the last 10 years or so, water has become an important subject. There is a sense of acute pressure on the available (finite) supply because of increasing demand arising from the growth of population, the pace of urbanisation and the processes of economic 'development'. There are predictions of severe scarcity, or even a crisis, and warnings of conflicts and of 'water wars'. Anxieties of that kind were heard at the Second World Water Forum at The Hague (March 2000), and at the Third World Water Forum at Kyoto in March 2003.

There are two kinds of responses to such apprehensions. One is to argue from perceptions of inadequate supply to increased 'production' (as in the case of consumer or industrial goods) and to propose a number of large supply-side projects. That is the engineer's and the bureaucrat's response. The other, that of the 'liberal' economist, is the advocacy of water markets ("define water rights and allow trading"): the argument is that if market forces were given free play, with the state playing only facilitatory and regulating roles, and if policy changes are made to enable 'private sector participation', supply will match demand, prices will be right and conflicts will get resolved by the market. Both these responses implicitly or explicitly regard water as a commodity like any other (or as an 'economic good', slightly modified to 'economic and social good'), and subject to the same forces and laws of supply and demand. There is a convergence of these two approaches, because (it is argued) supply-side solutions need investments; these need resources; these are of magnitudes that the governments of developing countries cannot easily muster; those governments are also plagued by plagued by planning and managerial weaknesses; and therefore private sector investments are the answer, and government policy should facilitate this. That convergence finds support in the ideological predilections of Wester governments, of international financial institutions and of economic 'reformers' or 'liberalisers' in the developing countries themselves. Further, it appears that the corporate world, particularly the handful of big international water corporations, have begun to sense profits in increasingly scarce water, which some see as the next big business prospect after oil.

The advocacy of 'private sector participation' which had been heard at. The Hague was much stronger at Kyoto, though it is now fashionable to talk of 'Public-Private Partnership' (PPP, sometimes expanded to PPPP or 'Public-Private Partnership for the Poor'). However, there was also strong resistance to that ideology. There were two broad groupings at Kyoto.

One group consisted of governments (of 'developed' countries and others of the same persuasion); institutions such as the World Bank, ADB, and the UN family in general; international 'water' institutions such as the World Water Council, Global Water Partnership, etc., and the corporate. That group argued for water being regarded as a tradable commodity, water markets, globalisation, privatisation, corporatisation, PPP, and so on.

The other was a loose group of NGOs, social activists, civil rights people, left-wing intellectuals, and so on. Their concerns varied widely, but they tended to come together on certain beliefs and predilections : e.g., treating water as a basic or human right, a common pool resource and not a tradable commodity; a

feeling that the profit motive was irreconcilable with that view; a deep suspicion of the corporates; and a strong sympathy with the community and civil society as against the state.

Cutting across that divide were two other concerns; (i) environmental and ecological concerns, the movement against dams, etc.,and (ii) movements for the rights of the poor and the disadvantaged, for the protection of the people, particularly aboriginal, tribal communities, from displacement, from the loss of rights of access to their natural resource base, etc.

There was indeed some common ground. Everyone was agreed that water was getting scarcer, that water a basic need and therefore a basic right, that the natural environment must be protected, that people likely to be affected by a project should be consulted right from the start and should participate in its planning and execution, and so on. However, beyond that point, there was a clear division between those who argued for big projects, for private investment, for water markets, etc., and those who argues for local, community-level action and civil society initiatives, and were very worried about the loss of control over natural resources first to the domestic corporate sector and then to the foreign or multi-national companies.

That is the global scene. In India, the temporal and spatial variability of rainfall; the prevalence of arid zones and drought-prone areas on the one hand and proneness to floods on the other; inter-state conflicts; and the over-exploitation of groundwater in some areas, have played an important part in influencing planning policy-formulation. The official response to those problems is exemplified in the Government of India's response to the Report of the World Commission on Dams (2000) stating that it proposed to add 200 BCM of storage in the next 25 years; and more recently, in its announcement of a massive 'river-linking' project. Such projects find considerable support in the country. However, there are also serious doubts and concerns about that kind of approach. There are movements against big projects, movements on behalf of affected communities, and movements for local initiatives.

Against that background, the following questions arise :

1. Will there be a water crisis? Is a crisis avoidable?
2. Do we need large Water Resource Development (WRD) projects?
   What is the overall balance of costs and benefits on such projects?
   Are they avoidable? Is the river-linking plan a good idea?
3. Are there alternatives ? How significant/major/minor are they?
4. Is water a commodity? Do water markets have a role to play? Is the privatisation of water the answer to our problems?

The following paragraphs will discuss these questions in a broad and summary fashion. The intention is to provide a perspective and clarify issues rather than present detailed analysis.

Is a Crisis Inevitable ?

Is a crisis inevitable ? The brief answer to that question is : "Yes, if we go on as before. No, if we take certain steps". That needs elaboration with reference to estimates of the availability to water for use, and projections of water needs for diverse uses.

Over the years, there have been many estimates of the water resources available to India. The most recent are those given in the report of the high-level National Commission for Integrated Water Resources Development Plan (hereafter NCIWRDP) set up by the Ministry of Water Resources. In that Report (September 1999) the following figures are given (in km^3)[2].

Table 1. Availability of Water

(Figure in cubic km)

Precipitation over the Indian landmass	4000
Available surface water resources	1953
Available groundwater resources	432
Usable surface water resources	690
Usable groundwater resources	396
Total usable water resources	1086
Present quantum of use	around 600

There are some problems here relating to the separation between surface water and groundwater, as also to the concepts of 'available' and 'usable' water resources; and there are wide variations, both temporal and spatial, in the availability of water in the country, limiting the significance of national aggregates and averages. Subject to those caveats, we may take not of the above figures of availability.

As against these, different studies have given their projections of future water requirements on the basis of various assumptions, norms and 'scenarios':

- The Working Group (WG) of the NCIWRDP and NCIWRDP itself : 973 to 1,180 BCM in 2050.

- India Water Vision (IWV) of India Water Partnership : 1,027 BCM in 2025.

- Study by Kanchan Chopra and Biswanath Golder of the Institute of Economic Growth (K C / B G) : 920.92 BAU, = 'business as usual' or ' scenario' of no significant change; HG=high growth scenario; SS=sustainable development scenario).

The demand fidures mentioned above are close enough to the 'usable' availability figure of approximately 1,100 BCM to warrant concern, whether we view it as a difficult situation or a cirsis. However, we need to take a closer look at both demand and supply sides of picture.

Taking demand first, the NCIWRDP's projections of future water requirements for various purpose are given in Table 2.

Table 2. Water Requirements for Different Uses

St No.	Uses	Year 1997-98	Year 2010 Low	Year 2010 High	%	Year 2025 Low	Year 2025 High	%	Year 2050 Low	Year 2050 High	%
1.	Irrigation	524	543	557	78	561	611	72	628	807	68
2.	Domestic	30	42	43	6	55	62	7	90	111	7
3.	Industries	30	37	37	5	67	67	8	81	81	6
4.	Power	9	18	19	3	31	33	4	63	70	6
5.	Inland Navigation	0	7	7	1	10	10	1	15	15	
6.	Flood Control	0	0	0	0	0	0	0	0	0	0
7.	Environment (i) Afforestation	0	0	0	0	0	0	0	0	0	0
8.	Environment (ii) Ecology	0	5	5	1	10	10	1	20	20	2
9.	Evaporation losses	36	42	42	6	50	50	6	76	76	7
	TOTAL	**629**	**694**	**710**	**100**	**784**	**843**	**100**	**973**	**1180**	**100**

SOURCE : Government of India, Report of the National Commission for Integrated Water Resources Development Plan, Vo. I, 1999.

'Demand' projections are generally based on current patterns of water use with some adjustments for improvements in efficiency and resource conservation, and prevailing notions of 'development'. It is taken for granted that with a growing population, an increasing pace of urbanisation and the processes of 'development', the demand for water must necessarily go up very sharply, and that the needed supplies must somehow be found. That is not self-evident. If in fact water is a scarce because of increasing populations, and if a crisis is looming on the horizon, that consciousness of scarcity and impending crisis should surely guide our planning. The approach, common in the case of other consumer or industrial goods of projecting demand and providing the supply through productions, is inappropriate in the case of water. Here we need to start from the recognition of finite availability and learn no live with it. With that kind of reversal of approach, the 'demand' projections may undergo drastic changes.

In so far as rural and urban water supply is concerned, it must be noted that the existing 'average' supply is not equitably distributed: there is minimal consumption by the poorer sections, fairly heavy use by the middle classes, and profligate use by the affluent. Instead of improving the norms for supply from the current figures to an average of 200 litre per capita per day (lpcd) for urban areas and 150 lpcd for rural areas as proposed by the NCIWRDP, it would be more appropriate to maintain or even reduce current norms and *enforce economies on the middle and upper classes, whether rural or urban.* Doubtless the latter would be an extremely difficult undertaking. However, this needs to be attempted, rather than forthwith seeking supply-side solutions.

Again, the demand projections will surely change if irrigation efficiency improves from the current level of 35-40 per cent to say 65 or 70 per cent instead of the 60 per cent assumed by the NCIWRDP, and earlier than the year 2050; and that cannot be dismissed as utterly impossible. Further, we cannot be content with a yield of four tonne per hectare from irrigated agriculture; attempts need to be made to raise this to six or seven tonne. In industrial use of water, multiple recycling, and re-use needs to be insisted upon, allowing no more than 10 per cent make-up water. Strenuous efforts need to be made to promote improvements in efficiency and technological innovations in every kind of water-use to maximise what we get out of each drop of water. Apart from minimising waste, it needs to be recognised that domestic and municipal water is also a source from which water for some uses needs to be extracted. If we do all this, the demand picture will not remain the same.

Turning to the supply side, large-dam projects are not the only answer; there are other possibilities. We must shake, ourselves free of the usual engineering conventions of defining 'available water resources' in terms of flows in rivers, and 'usable water resources' in terms of what is stored behind a dam. What is available in nature is rainfall, not just river-flows; and while storing river waters behind a dam doubtless converts 'available' water into 'usable' water, so does *in situ* rainwater harvesting (i.e. catching the raindrop as it falls') and local watershed development. These are also part of the supply-side answers to the demand. Fortunately, many successful examples of such initiatives are available. If these examples could be replicated in thousands across the country (wherever feasible), they could be far more significant components in national water planning than we can now imagine. A veritable transformation of the water scene may result.

If we combine those two approaches, namely : on the demand side, the practice of the utmost economy and efficiency in water-use and of resource-conservation; and on the supply side, efforts to augment the availability of 'usable' water through extensive recourse to local water-harvesting and watershed development, we may be able to avert a crisis, though the situation will undoubtedly be difficult and will call for careful management.

Are Big Projects Avoidable ?

Here again, let us start with a brief answer and then proceed to elaborate it : "No, but they are minimisable; they should be treated as projects of the last resort and chosen only if they are the best options in a given situation."

But why should they be 'minimised' or treated as the last option rather then the first choice? The reasons can be succinctly stated : they have serious impacts and consequences, environmental, social and human, not all of which can be remedied or compensated for, or even foreseen fully; environmental impact assessments and cost-benefit analyses are highly flawed as the basis of project decisions; the balance between total costs and total benefits (financial, economic, ecological, social and human; direct and indirect; immediate and distant; primary and secondary/tertiary; quantifiable and non-quantifiable) is difficult to ascertain; the costs will be definitely incurred and may turn out to be higher than foreseen, whereas the benefits and uncertain and may fall short of expectations; the financing of such projects presents formidable budgetary and debt-service problems; and so on. (We may ignore the phenomenon of 'time and cost over-runs' on such projects; the extent of corruption often associated with large public investments; and the vicious circle of poor revenues arising form low water rates; leading to poor operation and maintenance and to poor service, and therefore to poor revenue collections and resistance to increase in tariffs. These are either managerial or 'political economy' problems not necessarily attributable to the projects.)

The reasons for being wary of large WRD projects and choosing them only if the are the unique possibility or the best option in a given case are clear enough'. However, their avoidability would depend on the availability of other options.

Are there Alternatives ? How Significant are they?

It has already been argued that extensive local rainwater-harvesting and community -led watershed development may minimise the need for big projects, and that this can form a significant part of national planning if undertaken in large numbers all over the country (wherever feasible). However, two questions arise:

1. On a national scale how much will this add to the available ('usable') water ? No clear answer is available to this question, but there is a number of 140 BCM shown as 'additional runoff capture'. in the Chopra/Goldar study referred to earlier. All that one can say is that given the large gap between precipitation (4000 BCM) and 'available' water resources (1953 BCM), and that between the latter and 'usable' surface water resources (690BCM), there seems to be scope for adding significantly to the last number through local action.

2. What will be the hydrological consequences of extensive rainwater, harvesting in all catchments? Will this reduce runoff and therefore river-flows? Again, no answer are available. This needs new research. However, one's guess here again is that given he gaps mentioned above, river-flows may not be significantly affected by interceptions in the upper catchments, though some reduction of downstream run-off in t he immediate vicinity may occur.

Is Water a Commodity ?

Given the multiple dimensions of water, the answer to the question has to be "Yes and No". In economic uses (commercial irrigation, industry) it is a commodity, but as a means of life support (water for drinking, bathing, washing and cooking) it is not. The right to water is a part of the right to life, and the right to life is not a property right. (It does not follow that drinking water should be free. The state has a duty to ensure that no one is denied this basic needed, but there is no reason why the non-poor should not pay for the service.) It must be added that if water is a commodity in some used and a basic life-support need and therefore a fundamental right in other uses, the latter aspect must always take precedence over the former.

Is Privatisations the Route to Follow ?

The advocacy of 'privatisation' in relation to water is part of the prevailing economic philosophy. In the case of consumer or industrial goods- say, soap, steel, fertiliser, machinery the argument is that it is

not the business of the state to produce or market these thing, that they should be left to the play of market forces (subject to regulation), and that if there are state-owned enterprises producing these things they should be 'privatised', i.e. their ownership should be transferred to private hands. By analogy, the same argument is extended to water. However, there are some difficulties with that analogy.

First, in the case of consumer or industrial goods, if the price is too high, or if the supply fails for commercial reasons, we can at a pinch do without them or look for substitutes; we cannot do without water and there are no substitutes for it. We cannot reduce our intake of water (for drinking, cooking and washing) below a certain level. The supply cannot be allowed to fail. And rationing by price has only a partial application to water because the pricing out of any individuals or groups is unacceptable. While the pricing of water has to be generally based on certain obvious considerations (viz. it must sustain the supply, discourage wasteful use and promote economy and conservation), no one should be denied this basis need merely because he or she cannot afford the price. How are we to resolve this conundrum ? It is clear that the analogy with consumer and industrial goods is imperfect.

Secondly, soap or steel or fertiliser can indeed be wholly left to the market; there is no obligation on the part of the state to provide these commodities, though it may have to regulated the market. However, if water is basic need and therefore a basic right, the state dose have a responsibility to ensure that no one is denied it. Even if the supply is entrusted to a private agency, the responsibility of the state does not disappear in the event of a failure on the part of the private agency the responsibility will revert to the state.

Thirdly, water is a vital and scarce natural resources of the community and the country, and a finite resource. It has to be protected from pollution, contamination and depletion, and conserved for future generations.

It follows that the privatisation argument cannot forth with be transferred from consumer or industrial goods to water. Keeping that in mind, let us consider what privatisation can mean in relation to water.

1. It can mean the transfer of the water supply function in a rural or urban area from the local municipality or corporation or any other agency of the state to a private agency. The state can earmark a certain quantum of water from a specified source and ask a private party to distribute it in a certain area. The private body is then an agent or a contractor or a licensee or a concessionaire. It may invest in purification systems, storages, pipelines, pumping systems, quality control, etc., collect charges from the consumers for the service, and pay certain charges to the state. What this means is that a service that was being performed by a state agency will in future be performed by a private agency. (Under these circumstances the question of 'ownership' of water, i.e. whether that ownership stands transferred to the private agency, need not arise).

2. Alternatively; privatisation can mean the entrustment of a 'water resources development' (WRD) project to a private body, or the authorisation of such a body to undertake a WRD project, i.e. build dams, reservoirs, canal systems etc., on a river, or install plant and equipment for the extraction of water from a river or river-bed or lake or aquifer. This may involve serious questions of control over natural resources, resources-conservation and stainability, equity and social justice, and so on.

A simplistic proposition might to say that the privatisation of a service is acceptable subject to regulation, but that we must be wary of privatising the resources itself. However, such a distinction is difficult to maintain. The privatisation of the water supply service may sooner or later lead to the transfer of control over the resource. A private agency is unlikely to undertake the responsibility for water supply to a certain area without some degree of control over the source of supply (a stretch of the river or a lake or an aquifer or whatever). Even if it is not formally given the ownership of the water source, the transfer of control structures (a dam ora borewell or pumping station) to it (or the building of such structures) gives it a position of power which cannot easily to undone, and which can have serious implications.

There are difficulties even with the privatisation of a water supply service. The prime motive-the raison d'tre- of the private corporate sector is profit. The 'accountability' of the management is primarily to the shareholder, not to the customer or to the community. If considerations of profitability come into conflict with other considerations, profitability will prevail. How can such an approach be brought into the sphere of abusive life support resources ? Can profitability really be allowed to prevail over 'other consideration' when these includes the protection and conservation of the resources, ecological sustainability, assurance of basic need, social justice and equity? Can these considerations be adequately taken care of through regulation?

These difficulties get compounded when privatisation goes beyond the provision of a service. The doctrinaire call for 'privatisation' includes allowing the corporate private sector to build and operate dams across rivers for hydroelectric power and/or for irrigation. Assuming that the private sector is interested in investing in such capital-intensive, long-gestation, modest-return projects, how are the environmental and social impacts (which have presented serious difficulties to the state in past project) going to be handled by the private entrepreneur and manager? Supply may match demand but resources conservation may receive scant consideration; resettlement and rehabilitation aspects are likely to be given grudging attention only to the extent that resistance by those affected and public opinion compel such attention; and it is naive to imagine that market forces will obviate conflicts or provide a magical route to their resolution. (That does not mean that one is arguing for a dominant role for the state; but merely that the alternative to the state is not necessarily the corporate sector.)

One important question that will need consideration in this context is whether allowing the domestic private sector to exploit national natural resources, particularly water, will make it difficult to deny a similar right to foreign investors in terms of the WTO regime and the principle of 'national treatment' of foreign investors, and if so, whether there is a danger of our losing the fear as exaggerated. For his part, the author has serious apprehensions about the implications (for equity, social justice and environmental protection and sustainbility) of the induction of the corporate sector into water services and water resources development. The concerns expressed by Rajendra Singh and Vandana Shiva in this regard need urgent and careful consideration. In particular, their caution about the erosion of community rights, about the disempowerment of the people, and about the danger of the loss of control over our natural resources first to the domestic corporate sector and then to foreign and trans-national corporations, have to be taken very seriously indeed.

Reproduced from
The Indian Journal of Public Administration
Vol. XLIX No. 3, July-September 2003

INTEGRATED WATER RESOURCES DEVELOPMENT

(A) Legal and Institutional Framework

Legal Issues

In the present political climate, it may not be feasible to amend the Constitution to include 'water' in the union or concurrent list. The Union may pass laws to more effectively deal with inter-state rivers, for which it has powers under the Constitution. There is also need for the Union to put in the place centre-state consultative mechanisms of effective kind through which the centre and the states agree on a number of issues relating to water.

There is an urgent need for enactment of a law on inter-state rivers (in the place of the River Boards Act) to be called the Inter-State Rivers & River Valley (Integrated and Participatory Management) Act, which inter-alia may provide for the constitution of River Basin Organisations and for their powers and functions. The act may also provide for data collection and studies to be made by the Union for possible inter-state inter-basin transfers, so that the work of NWDA has statutory backing and the organisation would be able to obtain information and cooperation for its studies.

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 inter-state water dispute 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 RBO's . 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.

In order to ensure that awards of inter-state water tribunals are given within a reasonable period of time as also the effectiveness of such awards, immediate steps should be taken to amend the ISWD Act on the lines suggested by the Inter-State Council, with the following additions :

- Provision may be made for efforts for settlement at the river basin level, as and when RBO's are formed.
- When any matter is referred back to the tribunal for clarification under Section 5(3) of the ISWD Act, the tribunal should give its final verdict within a period of six months and the Central Government shall notify and publish the award/decision of the tribunal within three months.
- The tribunals should hear the views not merely of the contestant states but all other stakeholder, who may impled themselves in response to a public notice and who, in the judgement of the tribunal, have a stake in the dispute.

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 groundwater 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 groundwater that would have to be enacted.

The following legal and institutional mechanisms are suggested for immediate regulation of groundwater in 'dark' and 'over-exploited' areas :

- The overall guidelines of regulation may be prescribed by the Groundwater Authority concerned, based on local studies and surveys
- Panchayat should get approval of the Gram Sabha (village community) as a whole on groundwater management; where villages are large, the Sabha could be formed for smaller areas
- The use of groundwater for irrigation would similarly require approval of the Gram Sabha. This would ensure that the village community determines whether the groundwater should be used and if so, in what quantity, based on the technical information and the advice received from the state groundwater officers.
- The sale of groundwater needs to be prohibited in 'dark' and 'over-exploited' areas for the simple reason that it converts a scarce natural good into 'commodity' and dealing must meet the requirements of public interest, which it does not do.
- The village community may be inspired and enable to undertake groundwater recharging operations and conserve the utilisation of water in the village area.
- The central and state groundwater officials may be required to extend full cooperation, rendering technical service and advice to the village communities.

The draft Rivers and River Valleys Statistics Bill circulated earlier has several weaknesses. There does not seem to be need for a separate law for this purpose. Suitable provisions in the proposed Act on Inter-State Rivers as well as the Environment Protection Rules and notifications (as regard groundwater) would enable collection of required data.

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 inter-state rivers. For this purpose, more specific laws, mechanisms and inter-state agreements have to be worked out on the analogy of the European conventions and agreements. It is suggested that the restructured CWC should take the initiative to catalyse discussions in this regard, so that laws and conventions and necessary institutional mechanisms could 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 legitimising a top-down hierarchical relationship, the new social contract has to legitimise relationship of co-equals 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 department so that the institutional base of village level associations can be strengthened. In particular, WUAs/FOs require an independent resources base and an enabling organizational 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 recognised in law and under them. Without this, the overriding principle of accountability and transparency cannot be established. Both are needed to make PIM strong and functional.

To cover various issues like access to water to be recognised as a basic right, of the community over common resources, environment, water rights and many other related aspects a comprehensive National

Water Code, that is, not one single law but an integrated set of water laws, may be needed. Such codes have been framed in a few countries and have been found to be extremely useful. It is suggested that a National Water Code may be got prepared with the assistance of the Law Commission.

Institutional Aspects

The need to form user's bodies (Water Users' Associations, Farmers' Organisations) at the ground level for watershed development and management, for operation and maintenance of field canals and for groundwater use and regulation as the case may be is reiterated.

For the suggested functioning of WUAs and Fos, several characteristics and conditions seem to be relevant as detailed in the Report. These have to be ensured.

There is need to evolve a legally and institutionally enforceable system, which will ensure susceptibility and provide 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 interest 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 framework of regulation have to be devised by each state and incorporated in the irrigation law. A uniform composition for all states is not advisable.

For all inter-state 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 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, with maximum autonomy, in order to deal with policy and reforms, centre-state and inter-state issue, planning and project finalisation, international aspects other than those that have to be retained with the Ministry; legal, economic and financial issues, water productivity, conservation and management, environmental aspects and rehabilitation, people's participation and communication, coordination and facilitation of inter-disciplinary research, HRD and training and a National Information/Data System.

CWC may consist of six full time members, that is, three more members than at present, one for HRD and administration, one for economic and social aspects and other for environmental matters. The Commission may have three ex-officio members, namely, chairman CGWB, Director-General, NWDA and Director-General, IMD. The Central Ground Water Board will be a separate organisation linked to the restructured CWC with the Chairman as an ex-officio member of CWC.

In our view, the Chairman, CWC should actually function as a Secretary to government in the Ministry in respect of certain responsibilities. We suggest that the entire question of restructuring of the CWC may be got studied in detail, by appointing competent consultants. The study may cover CGWB and the inter-relationship and linkages between groundwater and surface water organisations at the central and state levels.

For efficient irrigation management, certain organisational and procedural changes necessary in the state irrigation departments were suggested to all the states in 1992. The changes are designed to ensure that the integration assumed a clear functional identity, with horizontal broadening and the integration of multidisciplinary status acting at the field level as support services to farmer's organisations. The restructured CWC, by taking this up as a priority item, should persuade the states to adopt the changes.

On the lines of restructured CWC, State Commission may be modelled in due course.

NWRC is a high level centre-state political body which meets at long 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.

(B) Economic and Financial Management

Financial Aspects

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 Ninth Plan, so that appropriate lessons may be drawn and remedial measures taken in each case, at least in the Tenth Plan.

Detailed micro-level studies are needed to evaluate the longevity and viability of minor irrigation schemes. Since substantial institutional funding is involved, NABARD should take the initiative to finance such independent studies.

The entire treatable area should be covered by integrated local watershed programme by the end of the Thirteenth Plan with both government's and people's initiatives.

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. The experience of operationalisation of initiatives taken by State of A.P. Kanataka, MP, Maharashtra and Orissa have to be evaluated and appropriate lessons drawn from it.

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 applied and managed.

All the means for augmenting government's resources 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 released of pressure on government funds.

Urgent steps are needed to prevent more damage and for proper up-keep and maintenance of existing irrigation systems on the lines suggested in the Report.

The following measures are needed for immediate adoption to instill a measure of financial discipline in the system.

Major Projects

- As was the case in the early years of the plan period, assistance to large projects may be project wise form 200 AD, instead of being part of the overall plan assistance. The 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.
- The procedures for release of AIBP funds require change and 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 in the next two years (1999-2001) for all the ongoing projects.

A Monitoring Committee may be constituted for the 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 state 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 meaningful 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 will be dealt with as a separate scheme.

- A Completion Report should be prepared for each project phase. To ensure this, an amount of Rupees one to two crore may be retained in final bill for reimbursement under project financing. The amount may be released only if the Completion Report is itself completed.

- Since establishment costs are soaring and in the extend period of projects rise to unconscionable levels, a ceiling on establishment costs (including work-charged) should be enforced. The ceiling should be 20 per cent of the cost and every effort should be made to keep it around 12 to 15 per cent. Expenditure above 20 per cent should not be reimbursed.

- The scope of a project should not be allowed to change, except after prior mid-project appraisal and specific approval. If there is change of storage/capacity of main canal/potential over 10 per cent of what was envisaged at the time of approval of the project, a project should be considered to have changed in 'scope'.

Medium Project

- 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. If may be laid down that in all such cases, the state proposing its 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 objectives within the prescribed period, they should be sorted out mutually or through the Basin Organisations.

- The principles regarding commencement, completion and establishment was suggested for major projects shall apply to medium projects also it is the state authorities and audit to ensure them.

Measurers should be taken to increase revenue from water rates substantially to such increases to be accepted, utility and efficiency of the system should be increased through savings of working expenses through modernisation, better water managements organisational reforms, improved infrastructure and reorientation in O & M cost plus curtailing overstaffing, providing better communications and establishing participants management.

With the background of the past proposals, especially the detailed ones made in Vaidyanathan Committee, the following general principles are recommended regarding increase in water rates :

- The water rates should cover the entire annual O & M cost plus one per cent of the gross value of the produce/ha in respect of cereal crops and in higher percentage in case of cash crops. These rates should be levied as single pass variable tariff for the present. However, the logic of charging a basic flow rate alongwith a variable part is quite logical and should be followed up with the state Government.

- Some states have supplementary levies like betterment charges, maintenance charges, etc. The states may consider continuing these additional charges.

- There should be rationalisation of basic principles of fixing the water taxes in all the sates. The revised water pricing structure should be such that this rates are substantially lower for those who accept group volumetric supply than for individual farmers. Also, the WUAs should be allowed to collect little over and above the prescribed water rates to encourage them improving the systems under their charge.

- Though area, crop and season based tariffs are in force in various states. At present they require inter-se rationalisation to reflect varying degrees of water consumption by various crops and their economic values. Looking to the extremely low existing rates and the policy of subsidising water which has been continuing since several decades, it is not practicable to enhanced at one-go the water rates. Subsidies in the rates in the form of lower percentage applicable to gross value of the product will have, therefore, to be continued for sometime and gradually phased out.

- Realistic O & M costs/ha should be worked out by each state on water representative systems by allotting adequate funds. These figures should be used for fixing of rates. However, in working out the cost, the ceiling rate and establishment charges should be followed.

- There should be two distinct components of irrigation water charges for O & M and other related to the value of the product. The O & M components should be fully utilised for the operation and maintenance of the respective portions of the systems. The second part should be used to modernise 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 procedure 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 optimised per unit of water or least indicate the intention. Thus the rates should be so rationalised 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 per cent or above and (b) less than 75 per cent. Considering a minimum reliability of 50 per cent the water rates for the latter should be two-third of the full rates fixed for the former. The objective should be to achieve volumetric measurement ultimately through gradually and this should be kept in mind at every stage. The change should encourage user groups 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 scheme. As this water will be easily measurable, the tariff should be fixed on volumetric basis. The schemes can be categorised according to lift ranges and rates be fixed for different categories.

In the case of supplies for industrial purpose, the principle of user pays, polluter pay's has to be applied and water charges fixed accordingly, adopting a premium for security, in water scarce regions. In the case do 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 as suggested in this Report, with suitable local modifications, incorporated as guidelines for the Pricing Authority.

Project Planning Priortisation

There is need to make change in approaches to project planning, particularly in respect of allocation of water among various uses, dependability and carry over related issues, conjunctive use, water lifts, project and viability criteria. INCID & CWC have issued guidelines in reagrd to conjunctive use. The extent of their implementation and effectiveness has to be studied for improving the techniques.

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 state/s) 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 as suggested in the Report.

Planning Commission and Ministry of Water Resources should insist on each state to priorities major projects on the basis of guidelines and revised system of points recommended in the Report by using an Excel based Programme developed by the Working Group and accepted by the commission. Release of plan funds for a project should be contingent on such prioritisation.

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. Prioritisation cannot be a one time exercise since there is a continuing addition to the stock of possible projects. The exercise should be done before further into identifiable sub-systems for implementation. Phasing should be supported by specific financial outlays for better monitoring and financial discipline.

Imternational Dimensions

Though India is not a signatory to the UN Convention on the Non-Navigational Uses of International Watercourses, we could draw upon the principles enunciated therein usefully for the purpose of evolving an Interpretative matrix not spelt out in our bilateral treaties.

The optimised and integrated development of South Asian and trans-Himalayan river water calls for operation amongst the countries and India should work for such cooperation.

Augmentation of the lean season flows of the Ganga can be secured by local rain water harvesting, conservation and demand management over a period of time. But additionality can only come through storing the monsoon flows, especially in the Nepal Himalaya or through transfer from the Brahmaputra system. The Sapta Kosi High Dam offers the best prospect of augmentation and this possibility will need to be kept in mind when the design and operational parameters of the project are decided. A lesser quantum of augmentation may be possible from other major storages and through ground water recharge, and through exploitation of deep aquifers if their techno-economic parameters are established to be favourable.

Calcutta Port studies should be undertaken with respect to its long term flushing requirements in relation to alternatives such as new ports and inter-modal transport with a strong island water navigation component.

Augmentation of Teesta and Ganga flows could also come through possible storages on the Dharla, Dudhkumar, Sankosh and Manas in Bhutan.

The Brahmaputra river, which is virtually untapped is an obvious potential source for transferring supplies for supplementation elsewhere. Various potential alignments for water transfer from the Brahmaputra have been proposed, come limited to Bangladesh, but others extending into India either through Bangladesh or through the Siliguri neck. Obviously, careful techno-economic planning and environmental care will be necessary and optimization and integrated development of the system will require bilateral and regional cooperation.

The problem of several other common rivers in the Cachar-Tripura sector can be subsumed in the Tipaimukh benefit area if the dam on the Barak and the associated irrigation barrage at Fulertal is taken up. The studies agreed upon in the JRC should be continued for other projects.

The reported project proposals in the Upper Brahmaputra basin in Tibet (China) for power generation and diversion for irrigation, though futuristic, need to be noted.

There is scope for Indo-Myanmarese cooperation in jointly developing the hydro potential of the Chindwin to mutual benefit.

India should fully utilise the permissible pondage/storage in the Western rivers, viz., the Indus, Chenab and Jhelum for hydro-electric development and for achieving the prescribed irrigated cropped area at the earliest.

The satisfactory disposal of saline waters from the IGNP command requires detailed study. One of the solutions would lie in negotiating with Pakistan, for an outlet to its Left Bank Outfall Drain or other systems in Sind on the basis of a suitable quid pro quo.

India would find it useful to negotiate additional inland water transit routes through Bangladesh including some inter-modal routes.

Unless storage are built upstream in Nepal to augment the lean season flow, no navigation in the Gandak will be feasible. Therefore, of all the available options, the Kosi navigation link appears the most viable/

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 boundries. There has to be agreements on construction of anti-erosion and flood protections works along common or successive rivers so that one countries solution does not cause problems to the other.

The GBM and Indus basins are endowed with a huge hydro potential which has only been harnessed to a very limited extent. This power can be trade across frontier through power exchanges as hitherto or, more meaningfully, through an interconnected grid. It would probably be cheaper to transmit Northeast power to the Indian heartland via Bangladesh, making sales to that country en-route. Bangladesh itself seems poised to make large gas discoveries in which case an integrated energy grid could be contemplated and Bangladesh gas traded for Indian hydropower.

Asian Development bank has funded studies regarding two sets of power links between Bangladesh and India and the linking of Indian regional grids and formation of a national grid. These developments requires to be well planned instead of being taken up in a piecemeal and ad hoc fashion and some machinery for forward regional planning and joint consultation would be necessary.

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 concert action in South Asia is the extent to which emission trading can be used to generate funds for clean Himalayan hydropower and in negotiating the find print so that the terms are right.

Foreign and Indian investors have shown interest in engaging in hydro development in this country and in Nepal. This would raise several issues and calls for the evolution of a clear policy framework. The effects of regulation of major dams to be built through private investment in Nepal and Bhutan and their safety would need to be examined at an early stage of negotiations in order to prevent adverse effects, if any, in India. Expertise has to be developed with regard to financial and techno-economical aspects as well as in negotiating skill.

Transparency, public awareness and stakeholder participation are the pathways to future water 'resource development'. This will be more so in respect of trans-boundary projects as also to combat the rise of hydro-polities. Political will is sure to be strengthened by genuinely consensual approaches.

There is utility in strengthening certain existing mechanisms such as the JRC by giving is a permanent secretariat and some funds. There would certainly appear to be a strong case for designating certain bodies like, the National Water Development Agency (NWDA) in India, the Water Resources Planning Organisation (WARPO) in Bangladesh and the Standing Committee of the National Water Council or the clearing house of information. National basin plans for long term water resources planning and development could be exchanged through a regional forum in order to facilitate regional optimization reflecting the highest common denominator of the national plans.

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 recognised 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 end, Track II 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.

The time frame within which projects on the international rivers will materialize is uncertain and will in any event take up to two to three decade. Our planning should, therefore, proceed on the basis of varied scenarios. It would be also useful to study appropriate management structures for joint venture setting up, say, a Rs. 1,000 crore revolving fund to extend supplier's credit for Indian equipment and material to support water resources development in Nepal/Bhutan and elsewhere.

Studies should be initiated for a South Asian power grid and wider energy grid for hydropower, coal, nuclear power, oil and gas. There is need to restore the GBM river system as a unified inland-cum-coastal waterway and encourage public and private carriers to develop and operate barge and coastal fleets with inter-modal/transhipment linkages. This will require a legal framework and agreed documents, customs procedures, bonded warehousing etc.

Water Quality and Environmental Aspects

Water projects have both beneficial and detrimental effects. The Project authority should weight 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 as part of a project.

Integrated watershed projects help in water and soil conservation and thus enable restoration of degraded areas.

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. Thee following should receive total attention. The following should form, the core R & R plan :

- The R & R plan should be prepared alongwith the project but implemented well ahead of the project completion. There should be perfect timing so that all PAP's are settled well before the reservoir is filled in R & R should be taken at the obligation we have to the people, 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 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 department/agencies.
- A part from periodic assessment of the R & R plan, there should be an assessment made five-seven 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 land for land, homesteads for all including the landless, cash compensation, training for vacations, 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 and reduce local tension between the locals and 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.

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 established biological, physical, chemical water quality criteria for users. Action is to be taken to minimise 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.

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 receiving water 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.

Water quality monitoring is done by Central Pollution Control Board, State Pollution Control Boards. CWC and CGWB. Although they are engaged in the same task, they are working in isolation and without interaction as well as coordination on a continuity basis. There is need to set up a mechanism for effectively coordinating the work of water quality monitoring by these organisations. This would help to decide upon corrective / remedial measures.

To restore and maintain water quality and ensure environmental susceptibility, 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, groundwater protection, monitoring and surveillance of water resources and water receiving wastes, The actions needed are not beyond the present status of our knowledge of science and engineering and of social sciences.

A number of programmes have been initiated to restore water quality and sustain our rivers, lakes and wetlands. Experience gained in the implementation of Ganga Action (GAP) - I should be utilised in the further phase of GAP as well as in the National River Conservation Plan. The National Lake Conservation Programme and the Wetland Conservation Programme need to be expanded with additional outlays.

Reproduced from
The Indian Journal of Public Administration
Vol. XLIX No. 3 - July-September, 2003

WATER RESOURCES MANAGEMENT - ISSUES AND STRATEGIES

S. Prakash

India's finite and fragile water resources are stressed and depleting while sectorial demands are growing rapidly. Fragmentation of water management at the sectoral, national, regional and international levels with very little coordination amongst them has added another dimension to the issue. Deterioration of surface and groundwater quality due to inadequate pollution control and waste treatment along with rapid urbanisation, industrialisation and intensification of water usage has been causing pollution of rivers, lakes and wet lands. In the past, water has been developed rather than managed. The essence of all water resources management efforts should therefore be to satisfy the water needs of communities in terms of both quantity and quality.

Introduction

Water is the key to all human energy and activity and is elixir of life. According to our scriptures all life forms emanate from water. 'Water' is essential for sustenance of life and, therefore, a matter of deep concern. On a global basis, though covering over 70 per cent of the earth's surface, only 2.7 per cent of this valuable resources is fresh water. Out of which only one per cent is usable as the rest is either frozen in glaciers or ice caps, or else is lost through streams and rivers to the sea.

Fortunately, the water cycle allows the one per cent water available to us to be replenished, however, to sustain and improve the quality of life, it is necessary to invest in systems to make it potable to meet necessary health and safety standards before use.

In the operation of the annual hydrological cycle, it has been estimated that 400,000 cubic kilometer (km^3) of water are taken up by way of evaporation of which 340,000 km^3 are taken from the sea and about 60,000 km^3 from the land. The amount returned to earth after precipitation as rain, hail or snow, is estimated as 340,000 km^3 over the land. It follows, therefore, that 40,000 km^3 which are received on the land surface find their way to sea and evaporate in the next cycle. This is what can be termed as world's renewable fresh water supply.

The world has ultimately to move to the sustainable development based on renewable resources. For India, water, apart from meeting domestic and industrial requirements has to support irrigated agriculture not only for self-sufficiency in food requirements but also export of agro-products. Water can contribute in no small measure, to hydropower generation which is vital element in the nation's power generation matrix due to its flexibility of operation, peaking capabilities and comparatively lower cost. It can play role in sustenance of ecology, preservation of environment and maintenance of social equilibrium.

Water in the New Millenium

In respect of water world faces following challenges in the 21st Century :

Water scarcity due to population growth, finite fresh water resources and/or its uneven distribution; and development constraints due to technological, economic and environmental factors. All these have severe consequences for food security, deforestation and desertification in many parts of the globe.

Lack of universal and affordable access to clean drinking water, sewerage and sanitation, particularly to women, children and disadvantaged populations especially in water scarcity regions.

Deterioration of surface and groundwater, water quality due to inadequate pollution control and waste treatment resulting from rapid urbanisation, industrialisation and intensification of water usage causing pollution of rivers, lakes, wet lands. More and more money is spent on health care and to combat water-borne diseases.

Increasing competitive demand and disputes on shared water resources and inter-sectoral water allocation which can threaten peace and security.

Decline of financial resources in the water sector is bound to slow down the development process of this vital infrastructure and affect the levels of service. The strategies have to be evolved to encourage much needed private sector investments and its involvement for bridging the gap.

Inadequate awareness among the public and decision-makers in understanding the full extent of the water crisis, and to find lasting solutions.

Fragmentation of water management at the sectoral, national, regional and international levels with very little coordination amongst them.

The Approach

India's finite and fragile water resources are stressed and depleting while sectoral demands are growing rapidly. Water resources assessment, identification of available suppliers, projections of future use and the presentations of development options and their potential impacts should form the basis of sustainable management and development. This would aim at :

- Satisfying the water needs of communities in terms of both quantity and quality.
- Protecting the communities against floods and droughts.
- Developing or maintaining good environmental and ecological conditions including those affecting human health.

In the past, water has been developed rather than managed. Comprehensive management on a river basin basis, for both surface and groundwater, with respect to quality and quantity aspects of water is called for. Development has been on a piecemeal basis with desperate investments made by different sectoral users. Cooperation between states sharing river basin has been limited. Management of water has been through a top down approach with government monopoly. There are two broad issues which need addressing :

- Finding solutions for competing inter-sectoral demand.
- Allocation, planning and managing water on a river basin basis, including riparian states sharing the same river basin. Inter-state mechanisms must be found for handling geographic disparities in water use and availability between different states sharing the same river basins.

Both the issues require addressing not only of water quantity, but also issues related to the environment. In addressing these issues, a comprehensive approach is required, recognising river basins as a hydrological unit and the integral nature of surface and groundwater resources. These issues were addressed at a number of recent conferences on water and environment notably at the one held in Dubling in January 1992 and the United Nations Conference on Environment and Development (UNCED), and Rio-De-Janeiro 1992.

The general conclusion of the conference per se made it clear that water is a key to sustainable development and calls for broad approach integrating all interests of the society, objectives and constraints, covering all sectors of economy. The Dubin principles and also Agenda 21 envisage that :

Water is to be considered as an economic good, needing a price reflecting its scarcity, based on willingness to pay, while ensuring that everyone has a right of access to the resources at an affordable price.

National Water Policy

The most comprehensive water policy statement issued at the Union Government level is The National Water Policy (NWP), adopted by the National Water Resources Council (NWRC) in 1987. Salient directives envisaged in NWP are summarised below:

- Water allocation priorities to be broadly as below :
  - Drinking water
  - Irrigation
  - Hydropower
  - Navigation
  - Industrial and other uses
- Consideration of drainage basin as a planning unit.
- Conjuctive use of surface and groundwater.
- Re-cycling and re-use of wastewater to form an integral part of water resources development.
- Water rates to be such as to convey the scarcity value of resources to the users and to foster the motivation for economy in water use.
- Periodic assessment of groundwater potential.
- Development of national information systems on water resources.
- It is good step in the direction of evolving a national consensus. But it has largely remained unimplemented.

The NWP was a good first step in the direction of evolving a national consensus. But it has largely remained unimplemented. Meanwhile, several new issues and concerns like those relating to displacement and rehabilitation have emerged. The revised NWP 2002 has addressed these and other emerging issues with a national perspective. However, one may advise that the policy should also be accompanied by a blue print for action.

Scenario in India

Spatial and Temporal Variations

Rainfall for most parts of India is limited to about three-four months of the monsoon season (from mid-June to September end). The coastal regions on the east coast of the peninsula receive rainfall during winter from north-east winds. In addition to the monsoon rainfall there is very large variation in the precipitation. Cherrapunji in the eastern part of Meghalaya receives 11,000 mm of rainfall while western Rajasthan receives only 100 mm annually.

Water Resources of India

Annual precipitation including snowfall	4000 km^3
Runoff/surface water	1869 km^3
Utilisable surface water	690.3 km^3
Groundwater	431.4 km^3

Total utilisable (surface and ground) water	1121.7 km^3
Per capita availability of utilisable water (1998)	1156 mm^3
Per capita availability of utilisable water (2025)	806 mm^3 (Projected)
Per capita availability of utilisable water (2050)	684 mm^3 (Projected)

Groundwater

Usable ground occurs in aquifers. Quantum of water which can be extracted economically, however, is generally reckoned as groundwater potential. This implies that water extracted in any year should be returned to the aquifers in the form of recharge from the succeeding precipitation or recharge, so that over a cycle of two, three or five years the groundwater table does not go down progressively. When there is over-exploitation of groundwater, the water tables go down causing the water quality to deteriorate. Such over-exploitation has occurred at several places in our country. It has induced saline waters of the sea into coastal areas.

Surface Water

In its various reports, the Central Pollution Control Board has outlined the need and urgency to put a stop to pollution of the rivers by discharge of domestic and industrial wastes. The very sources of water supply are threatened. Even in the capital of India the water purification plants have to be shut down as a result of release of contaminants from upstream. Practically all the rivers of our country are increasingly getting polluted. The Ministry of Environment and Forest has taken up the task of purification of the rivers in a phased manner by involving the states concerned. This, however, requires sustained efforts at all levels including the people.

Effective Management

It can be said that in India water has been developed rather than managed. Focus has been on the supply side and not on the demand side and its effective management. Considerable capital costs can be saved on projects by proper management of the demand. The demand management gives rise to improved line of supply. In domestic water supply it is seen that unaccounted for water in almost all the cities in India is over 40 per cent. The situation in Delhi is no better. Many times the importance of quality of water is lost sight of. The supply of safe and potable water to the community is essential for prevention and control of water-borne and water related diseases. It should be mandatory for authority to incorporate schemes for effective control of quality of water as well as for undertaking systematic leak detection surveys and adopting necessary strategies for keeping the unaccounted for water within the limits.

Water Pricing and Water Conservation

Time has come for every one to realise that water when received in the form of rainfall is a nature's gift. It is not so, when water is supplied to the consumers as lot of public money is spent on its purification and treatment, and supply. Huge investments are needed for operation and maintenance of water supply systems. Water thus has a 'cost' and has to be treated as an 'economic good'.

The principal objectives of pricing to be meaningful, the following guidelines may be observed for conservation of this precious resource :

To provide revenue to recover all expenditure in order to make the water utility self-supporting.

To provide funds for future expansions so that dependence on outside capital is minimised.

To distribute costs equitably amongst water users.

To avoid undue discrimination to subsidise particular users as a principal of redistribution and to ensure that even the poorest members of the community are not deprived of access to safe water.

To subsidise a minimum level of service on public health grounds.

To control excessive growth in demand to defer or to abandon system expansion with a view to minimising costs.

To discourage wastage and extravagant use of water and to encourage user economy by designing the tariff with multi-tier system incorporation incentives for low consumption.

In Indian cities including Delhi 'pricing policy' and tariff structure has not received the emphasis which it deserves, though consensus is that water rates need to be periodically revised to cover full O & M costs and also a part of capital costs. There are enough studies to indicate that a well designed tariff structure has given place to conservation of water besides providing as boost to the revenues.

Water Conservation, Recycling and Reuse

These are keywords and often go hand in hand when considering management of waste water. Technologies are available for purification of waste water to make it suitable for use and reuse in the industry especially for processing, cooling and even in manufacture.

The demand for water use in the industrial sector is going to increase many folds. The effect of recycling and reuse of waste water is going to have cascading impact on down stream users both in terms of quantity and quality of water. The reuse of waste water within the industry will help in minimising the fresh water requirement and at the same time bring down the cost of production and reduce discharging of wastes which often are hazardous and harmful to the environment.

Rain Water Harvesting and Groundwater Recharge

The Central Ground Water Board (CGWB) has brought out in its publications that there is continuous decline in the groundwater levels in several parts of the country. The water quality consequently, over the years has become unacceptable and unfit for human consumption. In the coastal areas there has been ingress of salinity in groundwater thus making it unfit for use. In south Delhi and area of Gurgaon water levels have gone down very steeply so much so that existing bore wells have failed there by necessitating lowering of 'well assemblies'.

Besides, the chemical analysis of water has revealed increase of various parameters like Fluorides and Nitrate. The administration itself is to blame for neglect on these issues. In India, rainwater harvesting and groundwater recharge has not yet made the impact. The water authorities often do not ensure 'satisfaction level' to the consumers in terms of assured supply and supply at fixed hours. The water pressure are also not adequate in the water system leading to low level of public satisfaction. The consumers thus are forced to provide underground tanks with boosting arrangements individually leading to huge private arrangements. This practice leads to uneconomical use of electric power and the economic wealth of country.

Reproduced from
The Indian Journal of Public Administration
Vol. XLIX No. 3 - July-September, 2003

HARNESSING RAIN WATER : NEED OF HOUR

Gursharan Singh Kainth

In most parts of India rains are the major source of water, yet this water is allowed to flow in large measures as run-off to the seas. With an all-round scarcity of water, it is a paradox that rainwater is not conserved and harnessed, when it is available. On the other hand it causes soil erosion and water logging that affect the soil fertility. The article analyses this problem and calls for a judicious approach towards harvesting rainwater by making reservoirs and inter-basin links and adopting techniques for recharging of groundwater.

Although the concept of water harvesting is very old yet it came into prominence only in the drought year of 1987. It means harvesting rainwater from rooftops and open areas in urban areas and rural check-dams and soak pits, naturally or artificially, allowing the run-off to percolate into the ground and recharging soils. This simple process would help soil retain moisture and top green as well. Water percolation has, in fact brought back dry seasonal rivers to life in Rajasthan and Karnataka, which have major success stories. The ocean water, which is saline and unfit for human consumption in its native form, constitutes 97 per cent of the total water availability on the earth. About two per cent is frozen and trapped in icecaps and glaciers. It is only less than one per cent of the total available water, consisting of surface and groundwater, which is fit for human consumption. Because of an easy access to the groundwater, people have been exploiting the hidden treasure of agroundwater indiscriminately leading to fall in water level, which can only be maintained by recharging artificially through rainwater harvesting.

A large part of the country receives, on an average, rainfall less than 1100 mm per annum. With the exception of Jammu and Kashmir in the extreme north and Tamil Nadu in the south, 80 to 90 per cent of the rainfall over the country occurs mostly during south-west monsoon. It is rightly said that Indian agriculture is a gamble of the mansoon. The success of agriculture depends primarily upon the timely onset, proper volume and distribution of rains during the monsoon season. South-west monsoon reaches Kerala coast by the end of May, advances along the Konkan coast in early June and extends over the entire country by the end of July. The rains continue up to the end of September, when the south-west monsoon recedes. During November and December, north-east monsoon is the main contributor to the volume of rainfall over the south-eastern portion of the peninsula. Paradoxically, areas (Cherapunji) receiving the highest volume of rainfall not only suffer from soil moisture stress but also face drinking water facilities. This is because rainwater is not conserved and harvested when available. With undulating terrain and low moisture retention capacity of the soft soil, the most of the rainwater is lost as surface runoff, causing erosion and adding to water-logging of the low lying areas. As much as three-fourth of the precipitation goes waste as runoff and ultimately reaches oceans depending upon the amount and intensity of rainfall, soil characteristics, topographical gradient and sub-surface lithology, etc. After the rain ceases, very little moisture is left in the profile to support plant growth and grain production. It is the need of the hour that we tap this runoff having a large scope. The government has so far taken half-hearted and languid interest in arresting the rainfall *in situ* (at the site of its occurrence) and has consequently neglected the time-tested practices. Even if five per cent of annual rainfall were harvested properly, that would produce substantial quantum of water to the tune of 900 million litres. Presently due to inadequate planning, excess rainfall (runoff) has been getting discharged into the oceans after coursing its way through the drains and rivers. Therefore, it is possible to prevent this wastage of water by storing it during the rainy season for use during the dry seasons or allowing it to seep underground as a measure of maintaining adequate levels of ground water. This water can subsequently be recharged or pumped up for irrigation or drinking water purposes.

Rain water can be harnessed through proper soil and water conservation measures. The technologies available are levelling and terracing, contour bunding, contour stonewall, contour trenching, providing permanent/temporary check dams, construction of percolation ponds/nala bundies/gully control structures, vegetative barriers, micro-catchments, diversion of water to land areas (water spreading) and the *in situ*

moisture conservation measures. Village panchayats should be involved in this process. These structures, which can improve the availability by a factor of 20 to 40 per cent of the total precipitation, must therefore be promoted with priority by a timebound programme. By these activities the runoff water with silt soil is obstructed and stored to recharge the groundwater. Hence groundwater availability is increased which can be used for irrigation. Furthermore, the roof (rain) water from the buildings can also be collected and recharged through recharge pits after filtration. This water can be used later for different purposes including recharging ground water through simple filtration devices. Studies have shown that groundwater recharge from a house with a 100 sq. m rooftop will be 55 thousand litres in a year.

Rainfall of one inch per hour over an area of 12 acre will create a flow of one cusec. Alternatively, rainfall of one inch per hour over an area of one sq km (after taking into account a runoff coefficient of 0.6) will generate a volume of 150 cubic m or 12.5 acre ft. In the case of towns (built-up areas) where the area of each house is measured in yard (as per building bye-laws or otherwise), a small pit should be constructed together with an injection well. The flow from the rooftop should be directed towards the pit which helps in decanting the water. The decanting water should be directed to flow down into the injection well, which is nothing but a borehole of eight inches diameter consisting of perforated PVC pipe. The water passing through the borehole will be immediately absorbed into the ground. The Central Ground Water Board has prepared a drawing of this arrangement and made this mode of water harvesting compulsory through a gazette notification.

The eco-friendly Supreme Court of India has always acted as a saviour of the environment. Several significant judgements pronounced by Supreme court have gone a long way in protecting the environment. One such very significant judgement given during the year 2001 relates to the rooftop rainwater harvesting. As per judgement of the Supreme Court, the plot owners of eight maria (200 yards) or more have to make a provision for rooftop rainwater harvesting structures in their premises. The mandatory provision of rooftop rainwater harvesting structures should also required to be extended to the old buildings, whether in residential or industrial areas. The industries should voluntarily come forward and adopt such structures. The rainwater so harvested can be stored on surface or sub-surface, but the sub-surface reservoir is the most hygienic environment. There are several types of structures, which can be constructed for rooftop rainwater harvesting depending upon the field conditions. The structures are a recharge pit, a recharge trench, a vertical shaft, a lateral shaft with injection wells, etc. The old structures like a dug well, a hand pump, a tubewell and pits, etc. can also be used as rainwater harvesting structures. But such structures should be constructed under the guidance of expert hydrogeologist otherwise another set of groundwater problems can emerge instead of water conservation. If the harvested water is injected into the finer sediment zones like clay layer, water-logging problem will occur in the area and cause damage to the foundation and whole of the building. It is of paramount importance to ensure that the harvested water is injected or in-filtered under gravity into the sand or coarse sediments layer and below the water lable.

Had we build dams across all the rivers whose water in mamonth quantity is wastefully flown into the sea annually the situation of water scarcity would have never arrived. There was a freak rainfall in the Yumuna basin in February-March 2002 and nearly 90 thousand cuses of water just passed over the Tajewala headwork to flow to sea ultimately. This is the real loss. Conservation of rainwater for cities outflow and hillocks is not even 0.002 per cent of loss of water through undamed rivers. Heartening to note, Ministry or Power and Irrigation, Government of India has prepared a blueprint for developing hydropower of 50 thousand MW by 2017 and if it comes into existence the dams so constructed will also achieve rainwater harvesting. With the green revolution, confining only to irrigated areas, showing signs of fatigue, attention is being focused on rainfed areas to provide impetus for future agriculture growth. Ministry of Agriculture has accorded very high priority to the holistic and sustainable development of management approach. Tenth Five Year Plan (2002-07) has a target of treating 15 million hectare of rainfed land under various watershed development programmes.

Reproduced from
The Indian Journal of Public Administration
Vol. XLIX No. 3 - July-September, 2003

ROLE OF FORESTS IN WATER MANAGEMENT

M. Kamal Naidu

Infiltration is also an important factor in hydrological cycle as reported by soil conservation Research Institute, Dehradun. This depends on the noncapillary porosity of the topsoil. A well developed forest floor with deep litter accumulation and thick humus layer may have an infiltration capacity of 5" - 6" per hour, high enough for entry of even very heavy rainfall; while a destroyed forest floor allows only a few tenth of an inch infiltration per hour.

The measurement of runoff and soil loss in India and abroad indicated that under a well managed agriculture it varies from 50-200 tonne/ha/year depending on climate, soil, topography, etc., while in a well stocked forest it is not more than 1.0 tonne/ha.

In Switzerland where a shower lasted for 45 minutes amounting to 30 mm resulted in 60 per cent runoff on poorly forested area and was only 16 percent on a good forested area ; and this was followed by landslides in nonforested areas and no landslides in the forested areas.

Experts say runoff in India could be reduced to 80 Mham by soil management and afforestation of watersheds, and thus also increase the lean season discharge despite the uneven distribution of precipitation in time and space. A mountain stream near Dobri village in Garhwal district of Uttar Pradesh supplied water at 360 litres per minute to Pauri, the district HQ in 1966. By 1977 its capacity was reduced to 100 litres, and by 1982 to 50 litres due to severe deforestation in the catchment areas, which reduced the ecological balance by reducing the seepage and hydrological cycle.

Warren in 1941 expressed that forests modify the local micro-climate to a considerable degree by reducing temperature, raising humidity and making conditions more favourable for obtaining rainfall. There are indications that presence of forests may locally affect the incidence and distribution of rainfall, and increase the same, but effects on a regional and continental scale are yet to be demonstrated.

Blandford (1889) reported for 14 meterological stations of Central Provinces during 1876-85 when it was forested the rainfall had increased by 173 mm or 12 per cent as compared to the period 1867-75 when it was deforested.

Voelkar Commission (1894) reported Ooty having 374 rainy days with 4,120 mm rain during the rainy months for four years of 1870-74 when it was made treeless. This rainy period increased to 416 days (that is an increase of 107 days) with 4,420 mm (300 mm increase) after restoration of tree cover during 1886-90.

Schlich (1896) reported, based on his 10 years study of Prussian forest, that there was increased rainfall in forested areas as compared to non-forest areas at different elevations as follows :

Sea-level to 100 m elevation	1.25 per cent increase
650 m-760 m elevation	19 per cent increase
700 m-900 m elevation	43 per cent increase

Ranganathan quoted Nicholson in 1949 about deforestation in Chhota Nagpur and the decline of rains : "About 50 years ago when the district was well wooded, afternoon showers known as 'instability rains' were fairly frequent during the hot weather and at the time several tea gardens were opened up. During the last half-a-century the forest have been destroyed. There is no evidence to show that the monsson rainfall has been effected thereby, but so serious have been the decrease in the instability rains that the tea gardens can no longer survive and they are dying out. While today, these areas are rainless and have

slowly become devoid of these gardens due to heavy deforestation and denudation.

Russian Scientist Molchonov reported an increased rainfall by 10 per cent in forested areas as against non-forested areas.

Thus a wise forest and range management makes important contribution towards the control of floods and sedimentation problems by way of :

1. Reducing peak discharge and sediment load; and
2. Prevention of increase in runoff and siltation rates.

Forest, thus, enables water management objectives fully in catchment areas and play an important role in preventing floods by various means, thus :

1. Consumption of large quantities of water by evaporation and transpiration;
2. Withholding rain water from reaching the ground surface by interception;
3. Increasing infiltration capacity of soils;
4. Increasing underground runoff and decreasing surface runoff;
5. Reducing erosion and thus siltation of lakes, rivers and reservoirs; and
6. Improving soil characteristics for building underground water reservoirs.

The soil moisture storage capacity of a good forested land is roughly 3,333 cum. It has been estimated that total forest area soils can store 25 Mham. An earth dam of this capacity of water storage would cost Rs. 25,000 crore at a conservative estimate of Rs. 10 per cu m of storage. As against this Bhakra Dam can store only 1.13 Mham.

In this connection a well-known hydraulic engineer H.J. Morgan remarked : 'Dams are good, but if we could raise the underground water table of the Tennessee Valley only six inches, that would mean 26 m acre feet of water, which is four times as much as the Norris Reservoir, where nature does the storing."

Schemes for Re-charging Ground Water

The Hyderabad Urban Development Authority (HUDA) commenced a "Greening Hyderabad" project with a view to improve the humidity level and conserve rainfall over 5,100 ha in 1994 and completed it around the water tanks, in wastelands, as roadside plantations and agro-forestry. As a part of the planting the biggest ever plantation exercise was undertaken in response to the call given by the Chief Minister by planting one lakh seedlings on a single day with over 95 per cent survival on, August 26, 1997 at 14 locations in and around Hyderabad city. These are besides the extensive plantations raised over 17 lakh ha under Joint Forest Management in 7080 villages by the Forest Department in the state.

Reproduced from
The Indian Journal of Public Administration
Vol. XLIX No. 3 - July-September, 2003

ECOLOGICAL IMPACTS OF WATER RESOURCES PROJECTS

R.S. Goel

Water resource projects may submerge forests, reduce downstream flows in rivers and at times lead to loss of bio-diversity. It may be noted that the loss of forest area due to submergence is less than five per cent of the total forest area lost in the country in the last five decades. The loss of biomass through submergence is, far smaller than the biomass through submergence is, far smaller than the biomass generated on account of the irrigation. Notably, it has been observed that a forest far superior to the original, sans the original bio-diversity, comes up after the creation of the reservoir. Adverse effects like water logging and salinity are being prevented through conjunctive use of groundwater, prevention of canal water leakage, reduction of seepage losses from water carrying bodies, implementation of adequate drainage and adoption of efficient irrigation methods along with water conservation.

Reservoirs may create new conditions for the growth of organisms, and ultimately, as adjustments are made, foster new eco-systems. Varieties of new organisms thrive on this new eco-lake system. Additional water is made available for the dry period of the year, when the environment tends to harsh and makes the area inhospitable, it supports the growth of life around. Water resources projects provide a dependable source of drinking water. People from the irrigated areas enjoy better health and sanitation facilities, thus reducing the incidences of diseases. General decline in incidences of diseases has been reported from different irrigation commands. The very availability of water leads to improvement in the level of sanitation. The improved economic status also makes people health conscious and capable of availing of requisite health care.

Substantial increase in the numbers of tigers, panthers, elephants and cheetahs have been observed in the famous Jim Corbett National Park with the availability of green fodder, clean water throughout the year and improved climatic conditions, after construction of the Ramganga Multipurpose Dam Project. It is also observed that rare species of birds flock there after the reservoir construction. Similar phenomenon of an increase in birds and wildlife has also been observed around the Rihand and Matatila reservoirs, which were previously barren lands. Some of the best tourist places of India like Ukai tourist resort, Periyar wild life sanctuary, Shalimar garden, Brindavan garden, Pinjore garden, Kalindi-Kunk, Matatila garden, Dhyaneshwar Udyan and the Ramganga Udhyan are the bye products of river valley projects.

The controversies concerning the rehabilitation of persons displaced by dams have muddied the entire debate on the utility of water resources projects and caused much harm to the national economy and well-being of the population at large. As per the broad assessment made by Central Water Commission through the review of data of 2784 dams, the total affected persons may range between six to seven million. The exaggerated claims by the opponents of large dams blow up this figure up to 70 million by taking the average of the recent few mega dams and multiplying the same by 4291 (total number of dams over 15 m height). It has to be borne in mind that most of the high dams (by definition every dam having height of more than 15 m is classified as high dam mainly for safety concerns) did not displace persons, first due to very thin population in the submergence in earlier dams during construction, secondly very few dams having the height greater than 50 m would have the submergence impacts on the upstream habitation. Even though, the national policy for rehabilitation and resettlement of project affected persons is still to be enacted, liberal provisions and comprehensive plans for implementation are being kept in recent water resources projects so as to ensure that the Project Affected Persons (PAPs) are rehabilitated properly with adequate civic amenities so that their economic conditions improves after rehabilitation.

Large dams help in conversion of wasteland into agricultural land and making the area greener. Indira Gandhi canal has not only transformed Western Rajasthan into vast green area but also checked the

spread of Thar Desert in the adjoining areas of Punjab and Haryana. Bhakra Dam is a shining example, which has changed backward area of erstwhile-undivided Punjab into the granary of India with improved environment.

Scientific Public Awareness

It must be noted that future demands of water can be met only by exploiting almost all the 1,222 bcm of utilisable water. It would thus be essential to utilise the entire 690 bcm of the utilisable flows for which storages of the order of 400 bcm will have to be created. Water demands forecasts show that Rajasthan, Maharashtra, Gujarat, Haryana, Karnataka and Tamil Nadu could face heavy water supply shorfalls. The water shortages would be far more serious in the water short basins like the Cauvery, Pennar, Sabarmati, Mahi, and Krishna etc. To meet the bulging water requirements, it would be necessary to ensure substantial augmentation of water supplies; requiring sufficient raising of water storage capacities, thus necessitating completion of new large water storage projects.

About 80 per cent of the surface water of the rivers goes to the sea unutilised, while the country reels under the flood-drought-flood syndrome. The socio-economic development in India is dependant on sustainable conservation of water wealth. We have to act very fast in a decisive manner to accelerate the water resources development due to fast emerging crisis of water for urban use, production of food and power on account of bulging population in India.

Supreme Court Majority Judgement for Narmada Projects has highlighted that against the utilisable storage 690 Km of surface water resources out of 1869 km; so far storage capacity of all dams in India is only 174 km, which is incidentally less than the capacity of Kariba Dam in Zambia/Zimbabwe with capacity of 180.6km and only 12 Km more than the Aswan High Dam of Egypt. We must realise the basic fact that the medium and small water projects as well as water harvesting schemes cannot substitute the need of large water storages but can at best complement the larger projects. This, too, depends upon the hydrological, geological, topographical and regional limitations.

It is essential to make the people aware of the status and issues in water sector, both through the process of creating public awareness through mass programmes and through sharing of information. The environmental aspects and process of planning and operation of water resources projects should also be fairly understood by the experts of different disciplines. Participation of people is a must in the management of water. People have to be made an integral art of the water management system. The community is to be made not only water conscious, but also be integrated to participate in the planning and management of such projects and pollution prevention programmes.

Civil society organisations can act as multi-disciplinary fora for national and regional debates, analysis and framing of action plans on water related matters by utilising their infrastructure, organisations expertise, library, publication and documentation services. These societies can serve as rich sources in generating technically sound options with well-defined limitations and assumptions in India specific situations.

Reproduced from
The Indian Journal of Public Administration
Vol. XLIX No. 3 - July-September, 2003

HYDROPOWER-THE BEST USE OF WATER

Yogendra Prasad

Hydropower industry is closely linked to both water management and renewable energy production and thus has an important role in sustainable development in a world where billions of people still lack access to safe drinking water and adequate energy supplies. As hydropower doesn't consume the water it uses to generate power it leaves this vital resources available for other used. Moreover, the revenue generated can fund other infrastructural projects for providing drinking water supply system, irrigation system etc.

During the phases of hydropower development, the option of building dams and reservoirs is often criticised as they profoundly modify the ecosystem where they are created. But this is the option through which unequal distribution of water that occurs in the unmanaged environment can be adjusted. Rejecting the option of a dam is in fact rejecting the opportunity to rectify severe inequalities which are also unsustainable in the long run. Dam thus have an important role to play an integrated approaches, when negative social an environmental impacts can be successfully mitigated or avoided. Dams thus associated with hydropower have an important role in socio-economic and economic development and hence essential to the well being of many millions of people.

The hydropower has several advantages over other forms of commercial power. Besides being inexhaustible, it is pollution free and non-inflationary in character. Moreover, it helps in infrastructural development of the remote and hilly areas. There are several technical merits of hydropower which are required for extending peaking support and for lending reliability and stability to the power system as a whole. And above all, in this age of ozone depletion and global warming, we have to look up to hydropower as the energy source of the future. World over the recent concern has been on the increasing amount of Co_2 in the earth's atmosphere due to excessive burning of fossil fuels and to curb this emission we must switch over from fossil fuel based energy to the clean hydropower.

Indian Hydropower Scenario

As per assessment made by Central Electrical Authority, India is endowed with economically exploitable hydropower potential to the tune of 84,044 MW at 60 percent load factor correspondent to 1,48,701 MW of installed capacity. Over and above, 56 number of pumped storage projects have also been identified with installed hydro-potential of 94,000 MW.

Basin/Rivers	**Probable Installed Capacity (MW)**
Indus Basin	33,832
Ganga Basin	20,711
Central Indian River System	4,152
Western Flowing Rivers of Southern India	9,430
Eastern Flowing Rivers of Southern India	14,511
Brahmaputra Basin	66,065
Total	1,48,701

In addition to this hydro-potential from small, mini and micro schemes has been estimated as 6,782 MW. Thus, in totally India is endowed with hydro-potential of about 2,50,000 MW. However, exploitation of hydro-potential has not been upto mark due to various constraints confronting the sector as well as due to shift in priority for capacity addition in short term, based on exhaustible conventional sources.

Till 2002-03, hydro-potential to the tune of 26,910.23 MW only has been developed which comes to only

about 10 per cent of viable potential, leaving gigantic opportunities for developers to exploit. The key issues which led to this low hydro share are time and cost overruns resulting into long gestation periods, financial problems, environmental issues, geological surprises, rehabilitation and resettlement, water sharing disputes among states and detrimental law and order situation in many states. Attributed to some of these issues, hydroelectric power development suffered serious setbacks which resulted in decrease of hydro thermal mix to 26.74 against an optimal mix of 40:60 as on date. Building a good number of hydro projects and pumped storage schemes is a better management of water resource as well as a technical requirement of Indian grid.

Recent Trends in Hydroelectric Sector

Government of India launched "Policy on Hydro Power Development" during 1998 under which impetus is given to development of hydropower in the country. This was a welcome step towards effective utilisation of our water resources in the direction of hydropower development. There has been growing concern for meeting out the energy demands of the country and as for now the energy planners have decisively judged development of vast unharnessed hydro potential in the country as national priority. Government has taken strong initiative towards starting new mega hydroelectric projects and completing the ongoing projects well in time. Some of the major hydro projects like Nathpa Jhakri project (1500 MW), Parbati Stage-II (800 MW) and Chamera - II (300 MW) in Himachal Pradesh, Tehri (Stage-I, 1000 MW) project in Uttaranchal, Indirasagar project (1000 MW) and Omkareshwar (520 MW) in Madhya Pradesh, Teesta Stage - V (510 MW) in Sikkim, Purulia Pumped Storage (900MW) in West Bengal and Subansiri Lower (2000 MW) in Arunachal Pradesh are all in different construction stages and will start generation within coming few years.

Special emphasis is laid on development of North Eastern India which is blessed with Bhrahmputra river system where it has a total drainage area of about 2.65 lakh sq.km. It covers the North Eastern states of Arunachal Pradesh, Assam, Meghalaya, Manipur, Tripura, Mizoram, Nagaland, Sikkim and a substantial part of West Bengal. As per the assessment studies, Bhrahmaputra basin is having hydroelectric potential of 66,065 MW of installed capacity. Out of this. NE states along with Sikkim have a potential of 63,257 MW of installed capacity out of which less than two per cent hydro potential has been developed so far. For this underdeveloped part of India, lot of work needs to be done for social and economic development and hydropower could be an excellent option for achieving these objectives as development of hydro projects not only generate clean energy but also provide services such as flood mitigation, water supply, irrigation, improved water quality, navigation and recreation.

Recently the Prime Minister of India during May 2003 launched 50,000 MW Hydroelectric initiative". Under this programme pre-feasibility reports for 162 new hydroelectric projects across 16 states with proposed capacity of over 50,000 MW are to be implemented by the end of 12th Five Year Plan (year 2017). Out of the total 50,000 MW initiative 33,294 MW has been identified in the North Eastern region of the country. Once we achieve this capacity addition programme, the whole outlook of this region will change as more and more economic activity will start in the region and the area will get huge relief from the frequent floods that has been endangering the lives of the people for centuries now.

What needs to be done further

Having realised the importance of hydropower development in the country, the present initiatives by the government and other agencies working in this field must be further continued for accelerated hydro-development, some of these initiatives could be

Reproduced from
The Indian Journal of Public Administration
Vol. XLIX No. 3 - July-September, 2003

WATER RELATED DISASTERS AND THEIR IMPACT

Satendra and A.D. Kaushik

Being a vast country with unique geo-climatic conditions as well as a large population, the Indian sub-continent is exposed to major natural hazards particularly water related, which often turn into disasters causing significant disruption of socio-economic life of communities leading to mounting loss of life and property year after year.

Disaster is defined by United Nations as "the occurrence of sudden and major misfortunes which disrupts the basic fabric and normal functioning of society." The disaster is the product of hazards like floods, cyclones, landslides, earthquakes, etc., and these are not rare, while the vulnerability varies from region to region. Indian sub-continent is amongst the world's most disasterprone areas with 57 per cent area being vulnerable to earthquake; 28 per cent area is vulnerable to drought; eight per cent area is vulnerable to cyclones; and 12 per cent area is vulnerable to floods (while 37% area was affected in 1998.)

One million houses get damaged annually including other human and social losses. A natural hazard pertains, "to a natural phenomenon which occurs in proximity and pose a threat to people, structure and economic assets caused by bilogical, geological, seismic, hydrological and meteorological conditions or processes in the natural environment."

In the 1970s and the 80s, droughts and famines were the biggest killers in India, the situation stands altered today. It is probably a combination of factors like better resources management and food security measures that have vastly reduced the deaths caused by droughts and famines. Floods, droughts, cyclones, earthquakes, landslides, avalanches and cloud bursts are some of the major natural disasters and dominate (98%) reported injuries repeatedly and increasingly in the last ten years. Among all the disasters affecting the country, floods are more frequent and often the most devastating. Floods are more frequent in the Ganga-Brahmaputra-Meghna basin, which carry 60 percent of the nation's total river flow. Almost 85 per cent of the somewhat copious annual average rainfall of 1200 mm is concentrated over a short monsoon season of four months. In the country, the pattern of rainfall in 35 meterological sub-divisions varies consirably from a high of 10,000 mm in Cherrapunji to 200-300 mm in Jaisalmer. This factor combined with the inflow of water in the northern rivers from Nepal, results in some areas invariably getting flooded each year, while others reel under the impact of severe droughts.

The melting snows from about 1500 glaciers feed several rivers, which sustain life of the plains and are the sources of our economic development. During last two decades, the unwanted human activities, i.e., extensive blasting operations and deforesting carried out for constructing roads, building and dams, etc. have led to increased soil erosion and landslides in Himalayas. In due course, landslides, ground subsidence and avalanches occurred and a good deal of silt and other materials are carried down, causing floods, in the rivers of the plains. This flood disaster causes enormous environmental damage.

High man-land ratio, lack of employment opportunities, poverty and food shortages combined with natural disasters like flood and drought, etc., contribute to the migration of people particularly from the Himalayas in search of livelihood and for increasing their economic status. Even out migration has its implications on fragile environment and leads to decline of natural resources and rural productivity because women, children and old people left behind cannot maintain their agriculture and natural resources properly.

Relentless degradation of the Himalayas leads to the loss of fuelwood and fodder supplies, massive soil erosion, landslides, debris deposition, sedimentation in rivers, dams and reservoirs. The phenomenon has increased flood frequency, which leads to loss of agriculture, land, buildings and even large number

of human lives. Out of five macro-flood zones of India, three zones fall under the Himalayan region. The upper catchments and piedmont zones, the Ganga river valley and the Brahmaputra valley and its tributary catchments are closely related with the Himalayan conditions. The floods in the piedmont zones of the Himalayas are obviously owing to the high rainfall intensity or even snow melting in the upper catchments. The man-induced erosion activities further aggravate the situation to a great extent. Almost the entire Ganga-Brahmaputra basin is a low-lying flood plain with high population density and cropping intensity (150%). About 64 per cent of the total land areas are agricultural where intensive cultivation is practiced. In India, the cost of increasing flood damage and destruction of reservoirs and irrigation systems by sediment from misused slopes have averaged US $ 250 million a year in compensation and damage prevention measures.

Management of Water Resources

As water related disasters, i.e., floods and droughts are the most devastating in nature, their mitigation and prevention demand top priority. An effective management of these disasters needs a strategic and holistic approach. Management of our water resource is the only solution to mitigate; prevent and manage these disasters.

In our country, the total water resources have been estimated at 167 mhm. Of these, only about 66 mhm (40%) is used for irrigation while the rest runs off into the sea. The conservation and utilisation of this huge quantity of water, which flows into the sea, needs a strategic water management policy and system.

Management or conservation of natural resources means the rational utilisation of environment to provide the highest sustainable quality of living for mankind. Management of resources is essential for the survival of man. In fact, life depends on air, water, soil, rocks, forests and water bodies, the ultimate purpose of conservation is to maintain all these in a healthy operating condition. Management of resources has, therefore, economic, social and scientific value particularly by way of mitigation of disasters for mankind.

Certain management practices have been developed and adopted from the earliest times of human civilisation. Religious sanctions prevented the destruction of forests, groves, sacred rocks, and mountains. Early civilisations developed good techniques of terracing to prevent soil erosion on hill-sides and for making more effective use of water for irrigation. As civilisation progressed and developed, human experiences led to increasingly sound land use practices and protection of wild animals and forests. The agricultural landscapes in India, Japan and China-especially in the hilly areas-reflect the great skill in conservation of water and soil resources. Irrigated land in the Nile Valley, Alluvial soils in the Great Plains of India and the lava soils in Maharashtra have been kept fertile and productive over thousand of years by the sustained and skilled efforts of men.

The recent history of management of resources has been marked by a great expansion of government role in protecting the environment and by a growing public interest in conservation. The principal resources that need conservation and suitable management are soil, water, forest, wildlife (birds, fish, and animals), power resources, metalic and non-metallic minerals, recreational resources, and the life of the people.

Though all the natural resources mentioned above have their own significance and need a strategic conservation policy, the water, the base of life on the planet needs a special attention as far as its management is concerned.

The need for water management in our country can be appreciated on the basis of variable and seasonal rainfall distribution among various regions, fluctuating water flow in the catchments areas in the Indian rivers particularly in rain-fed rivers, various kinds of terrain in north (soft alluvium) and the south (hard alluvium) and extension and linking of river basins over several states.

At present, the rivers in dispute are the Narmada, Krishna, Godavari and Kaveri. The dispute over the use

of water of Kaveri involves mainly Karnataka and Tamil Nadu states. The inter-state disputes over water sharing hamper the optimum utilisation of river waters.

The natural disasters like floods and droughts in India are the two sides of the same coin. Both are the direct consequences of the erratic nature of the monsoon rainfall. The unusual monsoon pattern, i.e., intense and heavy rainfall cloud bursts, cyclones (mainly in coastal areas) cause landslides blocking stream flows and inadequate drainage systems, sometimes create severe flooding in some parts of the country and drought conditions in others at the same time. In 1987, severe floods occurred in Assam, Bihar and West Bengal while most of the other states faced drought conditions.

Floods

The low-lying plains and river valleys in the country suffer recurrent floods cause by persistent downpours, about one-third of earth is classified as flood prone which is ravaged by devastating floods every year. The Ganga and the Brahmaputra account for about 60 per cent of flooding. The states where flood occur more frequently are Uttar Pradesh, Bihar, West Bengal, Assam, Orissa and Andra Pradesh. In recent years, even the states like Gujarat, Rajasthan, Haryana, Punjab and Kerala have witnessed severe floods.

The task of water management in flood-prone areas needs investigations, data collection and validation and analysis with the help of analytical tools to facilitate quantitative modeling through use of data stored in the information system. This information system prescribes some form of diversion and storage. The National Commission on Floods in 1980 had suggested the flood protection measures. These include the construction of embankments, drainage channels, town protection works, and raising the level of low-lying areas. The various reservoir projects have also helped in reducing the fury of floods. More notable among these are the Hirakud Dam on Mahanadi, the Damodar system, and the Bhakra Dam on Satluj. Largescale afforestation in catchment areas is also an effective measure of controlling floods.

Reproduced from
The Indian Journal of Public Administration
Vol. XLIX No. 3 - July-September, 2003

WOMEN IN SUSTAINABLE WATERSHED DEVELOPMENT

D. Mukhopadhyay

Irrigated agriculture in India has reached its limit and further increase in food production must come from dryland farming, specially watershed development and management through community participation. One of the main situations in which participation among the rural people emerges is the existence of common problems, which forces the people to come together to take decisions regarding common action. For instance, soil erosion, paucity of fodder and fuelwood, scarcity of water for drinking and domestic use, loss of vegetation, etc., are the commonly perceived problems of rural women which should result in high level of their participation in watershed management programmes. Community mobilisation could also be viewed as an important mechanism through which the responsibilities of common property resource management could be transferred back effectively to the people so that more productive, sustainable and equitable development is possible.

Introduction

'Watershed' indicates a geo-hydrological unit comprising of all land and water within the confines of a drainage divide. The size of watershed is expressed through terms such as micro-watershed, sub-watershed, watershed catchment, and river basin in order of increasing size. A watershed has been identified as the ideal geophysical unit for planning and executing development programmes aimed at achieving the rational utilisation of all natural resources for sustained optimum production of bio-mass with the least damage to the environment. Watershed management is an integrated approach to the development of an area with the ultimate objective of improving the quality of life of the people who live within it.

Integrated watershed development involves all categories of land, low-cost technology and active participation of people. It aims at preventing land degradation, increase in land productivity and simultaneously maintaining the ecological balance between land, water, plant and animal kingdom in the area. Thus watershed management approach can be considered a holistic one in developing the degraded areas and preventing further spread of problem through optimisation of integrated use of land, water and vegetation.

The watershed approach had conventionally aimed at treating degraded lands with the helps of low cost and locally accessed technologies such as in-situ soil and moisture conservation measures, afforestation, etc., and through a participatory approach that seeks to secure close involvement of the user communities. The broad objective was the promotion of the overall economic development and improvement of the socio-economic conditions of the resource poor sections of people inhabiting the progarmme areas.

Objectives

The objectives of Watershed Development Projects are :

i) Developing waterlands/ degraded lands, drought-prone and desert areas on watershed basis, keeping in view the capability of land, site-conditions and local needs.

ii) Promoting the overall economic development and improving the socio-economic condition of the resource poor and disadvantaged sections inhabiting the programme areas.

iii) Mitigating the adverse effects of extreme climatic conditions such as drought and desertification on crops, human and livestock population.

iv) Restoring ecological balance by harnessing, conserving and developing natural resources, i.e., land, water, vegetative cover.

v) Encouraging village community for :

(a) Sustained community action for the operation and maintenance of assets created and further development of the potential of the natural resources in the watershed.

(b) Simple, easy and affordable technological solutions and institutional arrangements that make use of, and build upon, local technical knowledge and available materials.

vi) Employment generation, poverty alleviation, women empowerment and development of human and other economic resources of the village.

Justification

Frequent failure of rainfall especially since 1980s has resulted into highly fluctuating productivity in dryland regions making it difficult to sustain the increasing population on the farming-system alone. The immediate solution of tapping groundwater has also reached alarming levels of depletion in many parts of the dryland regions. Increasing human and livestock population along with he uncertain crop yield have reduced the availability of the common property resources. Frequent crop failure and politically volatile situations in many predominately dryland regions have jeopardised the cooperative support system for credit, input supply and marketing of milk and other farm produce. Conservation of rain-water and checking of soil erosion, therefore, become the central themes for development of dryland farming. Formulation of Integrated Watershed Development (WSD) programems especially since the mid-1880s is a manifestation of such realisation.

Panchayat and watershed

The Zilla Parishads and other Panchayati Raj Institutions (PRIs) have very important role to play in Watershed Development Programmes. Wherever the DRDA has been made responsible for implementation of the watershed programmes, the Chief Executive Officer of the Zilla Parishad shall be a member of the DWDC. The PRIs shall have the right to monitor and review the implementation of the programme and provide guidance for improvements in the administrative arrangements and procedures with a view to ensure convergence of other programmes of Ministry of Rural Development such as JGSY, SGSY, IAY, CRSP, Rural Drinking Water Supply, etc.

At the village level, the Gram Panchayat shall be fully involved in the implementation of the programme, specially community organisation and training programmes. It may use its administrative authority and financial resources to support and encourage the formation of Self-Help Group (SHGs)/ User Groups (UGs), operation and maintenance of the assets created during project period and the common property resources such as pasture lands, fisheries tanks, plantations or village common lands, etc. The Gram Panchayat may also ensure that funds from other developmental programmes of Ministry of Rural Development are used to supplement and complement the Watershed Development Programmes. The gram Panchayat shall be empowered to review and discuss the progress of watershed development programme in its meetings. The watershed action plan should have the approval of Gram Sabha and it should be a part of annual action plan of Gram Sabha.

The projects at the field level shall be implemented by the Watershed Committees under the overall supervision and guidance of Project Implementation Agencies (PIAs). The PIA shall normally be assigned 10-12 watershed projects covering an area ranging from 5000-6000 hectare. The PIAs will motivate the Gram Panchayats to pass necessary resolutions to make public contributions, conduct Participatory Rural Appraisal (PRA) exercises, prepare the development plans for the watershed, undertake community organisation and training for the village communities, provide technical guidance and supervision of watershed development activities, inspect and authenticate project accounts, undertake action research to adapt low-cost technologies and/or validate and build upon indigenous technical knowledge.

The PIA shall constitute SHGs in the watershed area with the help of WDT. These groups shall be homogenous groups having common identity who are dependent on the watershed area such as agricultural labourers, landless persons, women, shepherds, scheduled castes/scheduled tribes persons. Around 50 per cent of villagers, i.e., who are directly or indirectly dependent on the watershed, should generally be enrolled as members of at least one SHGs. Separate SHGs should be organised for women, scheduled castes, scheduled tribes, etc.

The PIA shall also constitute UGs in the watershed area with the help of WDT. These groups shall be homogenous groups, who may be most affected by each work and shall include the persons having land holding within the watershed areas. Each UG shall consist of the persons who are likely to derive direct benefits from a particular watershed work or activity.

The aim of watershed development projects are :

- To conserve the basic natural resources like soil, water and vegetation.
- To impart stability to crop yields through improved management and farming practices.
- To develop alternative land use systems, through horticulture, forestry, pasture development and animal husbandry.
- To train, educate and provide experience to the beneficiaries of the watershed and strengthened village institutions.
- To provide income generating activities to women.
- To check environmental degradation and to restore ecological balance.
- To arrest distress migration from rural areas to the urban areas.

The main components of watershed management are :

1. Soil, Water Conservation
2. Water Harvesting
3. Crop Management
4. Alternate Land Use System
5. Integrated Farming System

Limitations of Watershed programme

In the past, watershed programmes did not have the desired effect although physical activities have been carried out, because, the beneficiaries were not aware of the importance, method and usefulness of the activities. Conservation measures include protective measures, productive measures, community works, conservation structures, etc. The soil and water conservation technologies have been evolved over a long period of time, tested and tried in various agro-climate conditions and modified to be location specific and need based. In practice, what is needed for one watershed may not be required for the other. Also it may serve different purposes from soil moisture conservation to flood control and from prevention of sheet erosion to prevention of massive landslide, in different watersheds.

Participation is widely recognised as being essential to making watershed development sustainable. However, sustainability in watershed development is often perceived to be something narrow. Sustainability of watersheds entails enhancing the capacity of households and communities to manage resources including fostering innovation to develop appropriate biological and social technologies. Watershed development is an opportunity to initiate the communities to think beyond the present and their field boundaries, and to help them act collectively.

Women in Watershed

Role of women is often invisible but they are real traditional decision making power group in the rural areas. Therefore, the goal should be for the women to be self-reliant and solve their problems with minimum outside intervention. Women should be chosen as trainees for capacity building for micro planning, need assessment, objective setting, problem analysis, project design, and finally monitoring and evaluation of watershed area development and management. As women are responsible for collecting fuel wood and fodder the environmental training for women will increase their knowledge and their negative practice can be checked and new insight on environment can be created. Watershed development approaches should aim at enhanced empowerment of women through skill formation and value addition to their time. Knowledge base enhancement must be given priority for women so that they can pursue the social goal of sustainability, productivity and equality. Knowledge is power and therefore providing knowledge is a way to providing power, to empower the women.

Since rural women are involved in using water in agriculture, household purposes, drinking, horticulture, live-stock rearing, they should actively participate in the decision-making and programme implementation of watershed development programmes in the rainfall areas. Awareness generation, provision of technical knowledge, change in attitude and involvement of women are essential for sustainable watershed management in rural areas.

Women are mostly not represented in any development programme. In a watershed, since water is a limited resource, its protection, distribution, etc., is decided by farmers as per their needs. It is possible that women may like some part of it to be reserved for their family consumption but decision taken are such that all water is diverted for irrigation and women end up walking long distances to fetch drinking water. Unless women participate actively in the watershed management their interests cannot be protected.

It is essential to familiarise women with new technologies so they understand and get benefits. To do this, we also need to demystify the technologies. Women in rural areas generally have a low awareness of technology. Sometimes they may have experienced its effects, but would not have consciously related the effects to technology. Equipped with knowledge and self-confidence, women together can manage resources and lead an active and meaningful life as equal partners in the development process.

In the village, institutes like *gramin* bank, women's group, youth group, credit union, dairy cooperative and agricultural cooperatives have been organised by the people themselves. They are represented on the village watershed committee. Many of these groups have saved substantial sums of money and make loans to their own members.

Enabling a women to participate requires following :

- She must overcome her shyness.
- Be able to talk confidently in the village meetings.
- Should know her needs and desires and set them as her objectives.
- Develop a sense of achievement and acquire abilities.
- Develop a strong will to achieve her objectives.

While initiating a programme of watershed management the foremost task would be to win the confidence of the people. There should be an environment of mutual trust. Entire planning process should be based on participatory approach so that farmer's needs are taken care of. Decisions taken jointly by the beneficiaries in a watershed area are more important. Success of watershed projects in Sukhomajri and Banga (Haryana), Anola and Tejpur (UP), Chavela (AP), and Mitimari (Karnataka), is due to community action and women's participation.

Warabandi is a system followed for equitable distribution and efficient utilisation of irrigation water. Special efforts are made to provide water to the needy farmers who are usually at the tail end. Water is made available to each farmer in the command of an outlet for a specific period in proportion to the size of his holding and according to a turn schedule prepared in advance. In the system quantity of ware allocated to each farmer is thus fixed and farmers therefore, are forced to use water more efficiently.

There is now an increasing involvement of voluntary organisations and other agencies in watershed development. Some of them have been successful in achieving the results through active participation of local communities. These agencies have not only been instrumental in promoting participation of farmers; they have also promoted and enhanced the individual farmer's capacities to think, organise and decide on the action plans. They have also involved women volunteers and motivators in the watershed projects.

The first stage of watershed management involves appraisal of natural and social resources through participatory methods. The second stage is the formation of village institutions for implementation of natural resource management. The village institutions train volunteers from the village to do extension work. They contact and organise meetings with local farmers and women and serve as a link between farmers and the institutions. They divide their work and responsibilities so that one person becomes responsible for any one activity, viz., soil and water conservation, dryland farming, credit and other commercial activities.

Willingness to bear a portion of the costs is and indication of communities recognising the benefits from watershed projects. It is easier to persuade communities to share costs if they are also given opportunities to make project decisions. It is a common practice to make individuals and communities share the costs of investments to instill a sense of ownership under the belief that they are likely to maintain things that they pay for.

Limitation of the Water Policy

Water resource management, water security, means that "people and communities have reliable and adequate access to water to meet their different needs, present as well as in future, are able to take advantage of the different opportunities that water resources present, are protected from water-related hazards and have fair recourse where conflicts over water arise". Such water security ensures equity and sustainability. But the recent national water policy document lacks substance, direction of seriousness in addressing the real issues pertaining to water. It is a sad reflection of the status of water resources in the country. It narrates only the issues of problem areas. But it is silent on the more important aspects of how to go about tackling the problems. Moreover, it does not provide any new insights or approaches.

The latest initiative in Andhra Pradesh is the introduction of Water, Land and Trees Act of 2001 and attempt to integrate the land, water and plant resources for a sustainable resource management.

As pointed out by Upadhyay, despite the government's repeated assertions in recent years on the need for a decentralised, people-oriented and demand driven water management, these have not bee converted into implementable solutions. While policy initiatives exist with regard to Water User Associations. Watershed Associations, and legal strategies are a much-needed prerequisite in order to evolve satisfactory working relationship between local bodies, institutions and networks of formal and informal village groups engaged in water management.

An effective strategy for operationalising participation in watershed development needs to include social organisations, joint decision-making and cost sharing. Sufficient conditions are created through joint decision-making in which the communities gain control over the projects that affect them. Cost sharing by communities further instills sense of ownership and helps in targeting limited resources to activities valued. By communities and regions.

Reproduced from
The Indian Journal of Public Administration
Vol. XLIX No. 3 - July-September, 2003

WATER RESOURCES MANAGEMENT : CHALLENGES OF THE 21ST CENTURY

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The present trends of water scarcity indicate that it is going to be critical problem in the 21st Century. This article presents a comprehensive survey of the existing scenario of the water resources management and water related issues facing the country. The first and for most is the need for resource conservation, efficiency in water uses, minimisation of losses and recycling of used water. Agriculture being the largest consumer of water, the article suggests adoption of water-conserving cropping patterns, water harvesting and water pricing policies to discourage waste. The core strategy of watershed management lies in a combination of protection, regeneration and production. It concludes that to address the problem fully and severly both the Central and state government must seek and enlist the involvement of communities at all levels.

WATER is one of the important priceless gifts of nature and an essential need for sustanence of life and civilisations in the word. Most of the wars in the world have, historically been fought for territory and land. This may change in the present century. It is believed that, perhaps, the wars of the 21st Century will be fought not land but for water.

In its totality the availability of water globally is practically fixed. The variations are in its dispersal and areal availability. Of the total quantity of water available on the earth, 97.3 percent is contained in the seas. Of the remaining 2.7 per cent most of it is locked up as ice and snow, in the polar regions and on mountain tops. Only one part of water in 10,000 is available above ground, apart from sea water which is not usable as such. What is available is present in rivers, streams, lakes, ponds and other water sheets. It is the hydrological cycle, which determines the renewal and repleshishment of water all over the globe.

The world's total water, budget is 14,000 cu km of which only about 3,000 cu km is used. About three-fourths of water is utilised for irrigation and the rest for other uses. In India total annual precipitation is 400 millions hectare meters (mhm) but surface water availability is only about 178 mhm. Of this, just about half can be put to beneficial uses because of topographical and other constraints, if surface and ground water is put together the potential of use can be raised to nearly two-third. Water availability in the country is uneven in both space and time. Most of the rainfall is recorded during mansoons (about 80% between June and September) and a substantial part of this water flows to the sea as run off. The annual run-off of the river systems in India is 1645 billion cum, of which, nearly two-thirds is contributed by the Himalayan river systems. We are able to use only a part of the total available water and this is where the situation needs to improve.

India has 16 per cent of the world's population but only 2.45 per cent of land area and four per cent of water resources. According to the Tata Energy Research Institute, the annual per capita availability of water in India was Research Institute, the annual per capita availability of water in India was 6,008 cum when the country achieved Independence in 1947. In 50 years after Independence this availability had fallen by 67 per cent. It was about 2,266 cum in 1997 and is now only around 1,800 cum. It is estimated to fall further to the abysmal level of 750 cum in the next 50 years. Thus, we are already at the stage of water stress, and moving steadily to the likely state of water scarcity.

Water Quality Management

Water quality management is an inseparable component for proper use of water resources. Many benefits flow if water quality is assured. First, there are health benefits-for the consumers. The cost of treatment of water by sown-stream municipalities is reduced the risk of contamination of ground water is less.

Both surface and ground water has to be regularly monitored for quality. Rivers are at preset polluted by all kinds of effluents and water in most of the large rivers has become unfit for use. A National River Conservation Programme has been initiated but it is applicable to a selected number of rivers and lakes. This programme needs to be extended to cover all important rivers and water sheets. It would be also necessary to have stringent laws as well as enforcement so that pollution of water can be minimised and eliminated. Regular monitoring of water quality is most essential so that no risks are created for people from municipal, river sheet or well water.

Problems of Large Dams

The question of building large water storages for expanding irrigation facilities and generation of power is one that is full of complexity as well as controversy. There are differing views and differing perceptions. The environmentalists are apprehensive of large dams. They are of the view that large dams cause massive human dislocations, soil erosion, increase the incidence of water borne diseases, give rise to sedimentation, soil erosion, stratification and proliferation of acquatic-weeds. Many such negativities are identified and emphasised. The other side of the coin is represented by technologists, engineers and development planners. The truth may lie somewhere in between. The issue cannot be approached integrally either from the exclusive point of environmental 'extremism' or from that of the 'hubris, of technology which has a 'fix' available for every problem. A touch-me-not policy would be quite misplaced. The water potential of the country must be harnessed but this must be done in environmental-friendly and people friendly ways. There is no contradiction between these two objectives if the twin objectives of development and environmental security are converged in complementary modes.

Legal Framework and Institution Building

Water, in its natural state, is a unique commodity the characteristics of which seem to defy the usual concepts of ownership. It is now generally agreed that the state, as guardian and promoter of public good, should have a clear responsibility of ensuring efficient and equitable use of this critical resource. Increased competition amongst water users leads to a wide variety of disputes of which there are many examples to be observed in our own country today. The governments, therefore, have to intervene to prevent such conflicts from arising or to settle them in judicious ways.

The legal framework has to be strengthened in terms of laws, institutions, and enforcement machinery so that water, as a priceless resource is used for the good of the people in the most equitable manner and also most efficiently.

For efficient management of water as a crucial resource appropriate river basin organisations are necessary. Similarly, there have to be effective and empowered institutional arrangement for sorting out inter-estate water problems and settling of disputes that often arise as regards sharing of water. At the lower end, water users associations have to be strengthened and empowered so that there is full participation in equitable distribution and use of water for different purposes.

Privatisation

The NWP states that private sector participation should be encouraged in planning development and management of water resources for diverse uses wherever feasible. The private sector participation could be in the form of building, owning, operating, leasing and transfer of water resources facilities. The issue of privatisation has caused widespread and genuine apprehension in the country. Water is a merit good. Its access has to be ensured for all. As such this resource should be in the public domain. Some specific functions like constructions of projects or treatment plants or energy producing units can be entrusted to private entrepreneurs but, as a resource, water in its totality, being a human right, must be fully within the preview of the Central and the state governments. The apprehensions of people in respect of privatisation need to be dispelled.

Data and Access to Information

The problems of water availability and flow data as well as ground water estimates are difficult and fraught with complexity. While we have adequate data on rainfall and water flows in major rivers and streams, it is still inadequate. Small rivers, tributaries and streams are not covered. Our information about run-off and infiltration is also said to be lacking accuracy. The need is to put on ground a well-developed water information system at the Central, state and decentralised levels-with, facilities for networking of date banks and for exchange of information in one-time as well as series modes. The use of modern information technology as also of Remote Sensing and GIS technique would be necessary for developing a reliable and accessible information base. Such base should include mechanisms for reliable projections for future availability as well as demand of water for different purposes.

Science an Technology Inputs

Frontier scientific knowledge and technologies should be utilised for improving water resources management. These for example, include areas like hydrometerology, snow and lake hydrology; river morphology; water resources assessment; water quality assurance; water harvesting; ground water recharge; water conservation; reducing conveyance seepage; and evaporation losses; better agronomic uses of water; energy saving, structural design material uses, etc. While using science and technology inputs there is need to build on such traditional knowledge, which has been found to be beneficial and economic for centuries.

Water Pricing

It is unfortunate that water is being often treated as a free-riding resource in many ways. In urban areas, in most cities and towns water supply is not fully or adequately metered. Similarly, in rural areas, water for irrigation is supplied in a way where there is no relationship between the price charged and the quantity utilised. Then again, there is hardly any regulation of extracting ground water. Many industrial units are treating ground water as some kind of a free resource. This is a situation that possibly can not submit. Water need to be properly priced so that its consumption is regulated and its waste avoided. If any subsidies have to be provided to specific consumer categories like, for example, the urban poor, slum dwellers and small and marginal farmers, then that should be a charge on government expenditure but should not impact the correct water tariff setting. Time has come when in all the states of the country. Water Tariff Authorities must be set up for regulating the uses and prices of water.

Human Resource Development

A critical input for economic sustainability and efficient utilisation of water resources is trained and motivated manpower. Water resources planning requires high quality knowledge in several areas which can be related to different fields-technical, engineering Agriculture environmental, economic organisational, financial or related to social sciences. The issue of providing the required trained and competent manpower in all these fields and disciplines has not received trained and competent manpower in all these fields and disciplines has not received the attention it deserves. This is an aspect that needs to be addressed for improving the management and planning of water in future.

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The Indian Journal of Public Administration
Vol. XLIX No. 3 - July-September, 2003