

WATER RESOURCES DEVELOPMENT AND ENVIRONMENT - PRESENT SCENARIO AND FUTURE PROJECTIONS

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Abstract Development of water resources is imperative for a developing country like India to meet the demand for food and fibre for its millions of people. The overall need for water use has been discussed along with the conflicts vis.a.vis environment. Various adverse impacts of water resources projects on environment are summarised. Planning, policies and programmes adopted so far are briefly discussed. The future projections of challenges and of issues valid for the next century have been outlined.

INTRODUCTION

“Water is life” is an old saying, but still a valid one. In the developed countries, clean water is taken for granted, since the same is available by turning a tap. In a developing country like ours, even today people in many areas have to walk several kilometres to fetch a bucket of water which may be contaminated and contain harmful bacteria. Even in urban areas, the water supply is neither sufficient, nor safe. Delhi experiences acute water shortage every year during summer. Chennai and Hyderabad experience similar problems and it was in recent past when water was transported through rail to quench the thirst of urbanites. Due to water being not available in sufficient quantity, when and where it is needed, it has become a burning issue, particularly in association with another vital issue of “Environment”.

Our country, with a geographical area of 3.29 million hectare receives an annual average rainfall of 1170 mm, which together with snow melt yields 4000 cubic km of water. After transpiration, seepage and recharge of groundwater, about 1869 cubic km flows down as surface runoff in the rivers. This is enough to meet nearly all the designed demands. However, the problem is that nearly 85 percent of it occurs in about 4 months of monsoon. This limitation underlines the need for harnessing the country’s rivers through suitable water resource development works to assure water supply.

Some people believe that there is enough ground water to meet all the requirements, without having to resort to surface storage which affect the environment. Unfortunately, experience does not support it. Already, falling ground water levels in various parts of the country, particularly near coastal areas, have led to environmental hazards like salinity intrusions. At a few places ground water is polluted. Toxic wastes have seeped into ground water near industrial areas and have created drinking water problems. Further, ground water needs energy for its extraction which incidently is in short supply. The alternative to ground water is

surface storage in reservoirs behind dams, large and small and in tanks, which have their own merits and demerits.

NEED FOR WATER RESOURCES/PROJECTS

Our country had predominantly an agriculture based economy in the past, and will remain so at least for the near future. Even today, about 70 percent of population is dependent on agriculture. Water resources projects have played a dominant role in the development of agriculture and making the country self reliant for foodgrain production.

Out of the total water resources potential of the country about 690 cubic km of surface water and 450 cubic km of ground water annually is available for use through conventional means. With this it will be possible to irrigate 113 m ha of gross area (now revised to 140 m ha). The irrigation potential created at present is 85 m ha through major and medium projects. The present utilisation is 550 cubic km which is likely to go up to 1050 cubic km (700 cubic km from surface and 350 cubic km from ground water) by 2025 A.D. Thus entire utilisable water resources of the country would be required to be put to use by 2025 A.D.

The United Nations has projected world population in their publications titled "World population prospects - the 1992 Revision" and "Sustaining water-An update (1994)". These indicate that India's population in 2050 A.D. would be around 1346 million (low projection), 1640 million (medium population) and 1980 million (high projection). In India, the foodgrains availability is 525 gms per capita per day as against 980 gms in China and 2850 gms per capita per day in U.S.A Thus, considering the three population projections of the country along with possible three projections for the future per capita daily requirement of foodgrains of 600 gms, 800 gms and 1000 gms for low, medium and high requirement, there would be nine possible alternatives. Assuming that all projections have equal probabilities the requirement can be estimated to be 550 million tonnes in 2050 A.D. Our planning for the future therefore should be based on this requirement of 550 million tonnes and if the actual requirement is less, the surplus can be considered for exports.

The present productivity of irrigated land is 2.5 tonnes/ha and less than 0.5 tonnes/ha for rain fed areas. Assuming that the productivity figures would rise to 3.5 tonnes/ha and 1.0 tonnes/ha respectively due to better irrigation and management practices in 2050 A.D., we will have to create an irrigation potential of at least 130 million ha for food crop alone and 160 million ha for all crops in order to meet the demands of the country in 2050 A.D.

Water Use

In India, the monsoon period is only for 3 to 4 months in a year and the quantum of rainfall varies from very good to drought conditions. The utility of water also fluctuates, so additional storages are needed to store water available from good years to meet the deficit in drought years.

Water for Drinking

Storage reservoirs play an important role in providing municipal and industrial water needs to a high degree of reliability. Water resources projects by virtue of their carry over storage capacity meet the demand of drinking water even when the monsoon fails. The National Water Policy (1987) had accorded the highest priority to drinking water. Most of the cities/towns and villages are dependent upon the supplies from water resources projects. The municipal and industrial demands of Delhi were being met from Yamuna till 1950's. At present, the demand of extra water is met from Bhakra and Ram Ganga. Future requirements beyond 2001 A.D. are proposed to be met from storages at Tehri, Kishau and Renuka dams. Similarly, municipal and industrial demands of Mumbai are being met from Bhatsa and Vaitarna dams.

Water for Irrigation

The country would need 550 million tonnes of foodgrains by 2050 A.D. The productivity has increased considerably in irrigated area as compared to rainfed area but still more is required. Irrigation is the biggest consumer of water. Water resources projects not only provide assured water supply to crops but help in generating agro-based industries and employment opportunities in rural and urban areas. This would prevent the migration of rural population to the cities and towns. Projects like Nagarjunasagar, Bhakra and Hirakud have boosted the foodgrain production of the country. The food production which was at a level of 51 million tonnes at the time of Independence rose to 212 million tonnes today; it is all due to assured supply of water from water resources projects. It has resulted in our country becoming self reliant in foodgrains.

Water for Energy

Water is a source of energy. Hydropower is renewable, reliable and pollution free unlike Fossil power. At present the country's installed capacity is only 18,300 MW against the potential of 85,000 MW. If entire hydro-power potential is tapped and developed, the country can save millions of tonnes of coal every year. It would reduce environmental pollution. Even for generating thermal power, water is required. The present water use by thermal and nuclear power plants is estimated as 4 cubic km. Thus, super thermal stations at Rihand and Korba would not have been possible, but for the water storage facilities created nearby.

Water and Recreation

Reservoirs are generally sites of tourist attraction and places of recreation. Brindawan Garden at Krishnarajasagar dam (Karnataka) is a famous example. Mata Tila dam (U.P), Jayakwadi (Maharashtra), Nagarjunasagar (Andhra Pradesh) etc., have been developed as tourist resorts. Water resources projects improve the environment in the neighbourhood.

Flood Control

Floods are a natural phenomenon and cause universal damage and misery to life and property. Dams and other flood control measure works help in regulating the floods. Rivers like Damodar and Kosi, once known as rivers of sorrow of Bengal and Bihar, have been tamed. Ukai dam on Tapi river proved to be a boon to the people of Surat city which used to experience the ravages of Tapi river every alternative year. People have now forgotten the miseries experienced by their fore-fathers.

PRESENT AND FUTURE WATER USE

Principal consumptive use of water is in irrigation. From 22 m ha irrigation potential in 1950-51, the potential has increased to 85 m ha in 1993-94 utilising 550 cubic km of water. The consumptive use for thermal and hydropower generation is estimated as 19 cubic km.

The population of the country is expected to stabilise somehow between 1500 million to 1800 million by the year 2050 A.D. It is estimated that irrigation water use would increase to 630 cubic km by 2025 A.D. and may reach a level of 770 cubic km by 2025 A.D. The demand of water for various designated uses are as listed below in Table 1.

Table 1 Demand of water for various uses

Purpose	Demand (cubic km)		
	1990	2000	2025
1. Domestic use	25	33	52
2. Irrigation	460	630	770
3. Energy	19	27	71
4. Industrial use	15	30	120
5. Others	33	30	37
Total	552	750	1050
<i>Distribution</i>			
Surface water	362	500	700
Groundwater	190	250	350

WATER RESOURCES DEVELOPMENT

By the end of 20th century, the country will be utilising nearly all the utilisable water resources for beneficial use. By 2025 A.D. no additional surface water source would be available for meeting the increasing demand. This situation, therefore, warrants for urgent need for chalking out suitable strategies for planning, development, conservation and management of available water resources in an optimal way.

DEVELOPMENT VS ENVIRONMENT

No development is feasible without some impact on environment. However, there are certain inherent environmental issues which need to be resolved and managed with utmost care, lest the water resources projects may become a cause of concern. Water resources planners have for centuries been aware of most of the environmental issues and took mitigation measures at planning stage itself. Submergence of land, displacement of people, deforestation, loss of flora and fauna, waterlogging and salinity are some of the adverse impacts associated with construction of projects. Some of these impacts can either be eliminated completely or mitigated to large extent through proper planning, policies and ameliorative measures.

Displacement

Displacement of people is a humane problem. By and large people have attachment to the land traditions, culture and way of life and normally do not want to part with them. It is not that our forefathers were not aware of these problems. In fact, Epigraphical Report No.397 of 1909 mentions that whenever private lands were acquired for the construction of irrigation works, the owners were provided with other lands in compensation. Government of Andhra Pradesh resettled 5100 families affected by Nagarjunasagar dam project in 34 newly established villages in 1959. The Maharashtra Resettlement Act, 1976 provides for many amenities to project affected persons which include providing free residential plots of size 370 sq.m to agriculturist families having less than 5 family members. Additional area of 185 sq.m for every 3 additional family members, subject to a ceiling of 740 sq. m, is provided. Even to non-agriculturist families with 5 family members a residential plot of 185 sq.m is given. Additional 92.5 sq.m for every 3 additional family members subject to a maximum of 370 sq.m is given. Provision also exists for acquisition and reservation of 15 percent of command area for resettlement purposes. In Bhima project, assistance was given to more than 50 percent of the project affected people by providing lift irrigation facilities on the periphery of the reservoir.

The Narmada Water Disputes Tribunal (1979) award for Sardar Sarovar project has laid down very liberal guidelines for rehabilitation of project affected persons. These include provision of free residential sites in rehabilitation colonies having civic and community facilities like hospitals, panchayat ghars, schools etc. Every displaced family from whom more than 25 percent of their land holdings is acquired would be offered irrigable land equivalent in area to the land acquired subject to the prescribed ceiling in the State concerned and to a minimum of 2 hectares. Other measures include cash grants, training facilities, employment opportunities etc. Landless persons would be rehabilitated in agricultural or non-agricultural sector, as the case may be and would be entitled to a stable means of livelihood.

Deforestation

Deforestation undoubtedly is a major concern in our country. It not only leads to soil erosion, frequent floods, and desertification but also causes shortages of fodder, firewood and loss of productivity due to degradation. It is estimated that on an average, forest cover is being lost at the rate of 1.5 million hectare per year. Contribution of water resources projects to such a loss is quite insignificant. It is assessed that only 4 percent of the total forest loss is due to irrigation projects. The National Forest Policy adopted in 1988 ensures environmental stability and maintenance of ecological balance in the country. The National goal is to have a minimum of 33 percent of the total geographical area of the country under forest cover.

The Department of Environment and Forests, Government of India have issued detailed guidelines for the diversion of forest land for non-forest purposes. According to these guidelines, where no forest land is available, compensatory afforestation should be undertaken over an equivalent area of non-forest land and where non-forest land is not available, compensatory afforestation should be undertaken in degraded forests over twice the extent of area being diverted.

Catchment Area Treatment

Catchment area treatment aims at improving the productivity of land, arrests soil erosion and improves the carrying capacity. It appears that the issue of catchment area treatment of water resources projects has been resolved. Only direct draining areas are required to be treated at project cost pari-passu with the construction of the project.

Waterlogging

Waterlogging is not a problem directly linked with the construction of water resources projects, but mainly a water management problem. Apprehensions have been expressed that each hectare of new area brought under irrigation through surface water resources project leads to an equivalent area being lost due to waterlogging. But this is not true. Waterlogging results due to excessive soil moisture provided by frequent flooding of irrigated land, overflow of run off from irrigation, seepage from canals, artesian wells and improper sub-surface drainage. As a consequence, the system does not function properly, thereby affecting the growth of plants and crop productivity. It is estimated that waterlogged area resulting from irrigation is small and has been found to vary between 1.5 percent to 10 percent of the benefitted area. Various measures like surface and sub-surface drainage in the command area, lining of canals, conjunctive use of surface and ground water have been taken up to reduce the problem. Over a million shallow tubewells, in Punjab and Haryana together, have performed the task of vertical drainage in a remarkable way and reduced waterlogging. In fact extraction of water by such tubewells and strict discipline in water management operations would counter the ill effect of waterlogging.

Sedimentation

Denudation of forests, indiscriminate grazing, poor land management and agricultural operations in the catchment area causes soil erosion. This results in loss of top soil and reservoirs are victims of these activities. Sediment flow in a river is a natural phenomena and water resources projects do not accelerate the sediment inflow into the rivers. In fact provisions are kept in all reservoirs for trapping the sediments in the form of dead storage. Apprehensions of excessive sediment inflow in some projects is because of use of empirical relations for assessment of silt inflow rate in the absence of observed silt data at the planning stage.

The soil conservation measures in association with comprehensive watershed management programmes initiated by Government of India in the catchment areas have reduced the entry of sediments into the river and reservoirs. Now, with the modern technology and equipment, more reliable and up to date information is being collected on silt inflow. The proper assessment and identification of suitable remedial measures can then be devised thereon considering the site conditions.

Submergence of Flora and Fauna

Water Resources projects are generally located in high mountains and as such submergence of forest, flora and fauna becomes inevitable. The water spread area results in flooding of the neighbourhood, destruction of plant life, displacement of wild life and loss of breeding grounds. There are conscious and concerted efforts to ensure that the proposed reservoir does not submerge or affect adversely endangered rare species of animals plants or having medicinal value. At times project sites endangering rare species of plants, animals etc., have been abandoned. A typical example is the Silent Valley project, which was shelved as it was to affect prime virgin forest.

Aquatic Life

One of the criticism often levelled against water resources projects is that dams pose barriers across the rivers and affect migration of fish species like salmon, trout and mahseer. The provision of artificial propagation facilities have successfully taken care of these problems at a number of project sites. In fact reduction of river fisheries production can be compensated by rearing of fish in the reservoir. Many new varieties of fishes having taken hold in the newly created environment. In fact, Ukai project can be cited as an instance of improvement of pisciculture where no commercial fisheries existed in the river before impoundment.

Health Impacts

Reservoirs generally have large water spread area with shallow weed infesting shore lines which provide breeding grounds for mosquitoes, snails and to spread of water borne diseases like malaria, schistosomiasis etc. In fact spread of diseases can be mitigated by taking preventive measures of insecticides, nursing of

predatory fishes etc. The dreaded disease like schistosomiasis which is attributed to the creation of large Aswan dam in Egypt is absent in our country.

Building of large water bodies ensures perennial supply of water in the command area and nearby town as a source of drinking water. In fact it helps in changing life style in addition to improvement of health due to better sanitary conditions. The socio-economic survey conducted for Indira Gandhi Nahar Project revealed a general improvement in the health of the people in the command area.

Submergence of Minerals Deposits and Architectural Monuments

Large water bodies at times threaten submergence of mineral deposits, archaeological monuments or shrines. Such structures at times may have to be shifted block by block to new site of habitat and reconstructed. Shifting of Abu Simbel temple in case of Aswan dam and Supaneshwar temple for Sardar Sarovar dam are typical examples. The Dargah of Galiakot was protected from submergence by a ring bond when Kadana dam was constructed.

Water Quality

Today, water pollution is an acute problem faced in many parts of the country. It is increasing by leaps and bounds with the waste effluent being discharged into rivers without treatment. It is not a problem directly from water resources developmental activity but due to development of the area and increase of industrial/urban activity. However, water resources project can be a boon for maintenance of water quality in rivers downstream by storing water behind the dam and flushing the river at regular intervals.

PLANNING, POLICIES AND PROGRAMMES

It has been widely accepted that the problems of reconciling development and environment results from failure to consider them simultaneously and from adopting a compartmentalised approach rather than multidisciplinary and integrated approach.

National Water Policy (1987)

The National Water Policy adopted in 1987 has emphasised the need for a multi-disciplinary approach to planning, formulation, clearance and implementation of projects including catchment area treatment and management, environmental and ecological aspects, rehabilitation and resettlement of affected people. The policy suggests that co-ordinated development of surface and ground water and their consumptive use should be envisaged right at the planning stage. The recycling and reuse of water should be an integral part of resources development. The policy suggests that adverse impacts, if any, on the environment should be offset by adequate compensatory measures.

Irrigation Management Policy

The Ministry of Water Resources have evolved a "National Irrigation Management Policy" which aims at optimal utilisation of water resources and stresses on providing adequate drainage facilities and conjunctive use of surface and ground water. Water and Land Management Institutes (WALMI) have been set up in different parts of the country to improve management, technical, institutional and operation and maintenance capabilities for increasing productivity. They provide training to field functionaries on efficient and optimal use of water to ensure productivity.

Command Area Development Programme

After Independence, a large number of irrigation projects were constructed for improving agriculture production and productivity. But it was realised that the irrigation potential thus created with huge investments was not being fully utilised due to various problems. Substantial gap existed between potential created and potential utilised.

The Command Area Development Programme was, therefore, initiated in 1974 as an integrated programme to include all such crucial activities which are essential for increasing agricultural production in the command to ensure better utilisation of created irrigation potential. Initially 60 projects covering a culturable command area of 15 million hectare were taken up in 1974. Presently there are 204 projects which are covered under the programme with a CCA of approximately 22 million hectares spread over in 22 States and two Union Territories.

The aim of this programme is not to create new water resources development projects but to reap the maximum benefit from existing projects through construction of field channels, field drains, warabandi etc. Since April 1997, reclamation of waterlogged areas due to excessive irrigation has also been added for grant under CAD programme. Central assistance in the form of loan and grant is being provided in this regard.

Participatory Irrigation Management (PIM)

It is a known fact that no worthwhile management of the irrigation system is feasible without the participation of farmers who have the maximum stake in the use of water resources. The National Water Policy has also strongly advocated that farmers should be involved in the distribution of water, operation and maintenance of the conveyance system and recovery of water rates. The central sponsored scheme by Ministry of Water Resources provides assistance to the farmers association for it. The Ministry of Water Resources have also taken steps to set up a Non -Governmental Organisation called Indian Network on Participatory Irrigation Management (India NPIM), which will act as a clearing house for information about PIM and promote its implementation.

Draft Resettlement And Rehabilitation Policy

Ministry of Water Resources has formulated the draft of Resettlement and Rehabilitation Policy recently for the benefit of Project Affected Persons (PAPs) from construction of major and medium projects. The policy aims to ensure providing at least the same level of benefits, if not better, to the oustees of water resources development projects. The policy ensures that the oustees are comfortable in their new environment by providing land for their dwelling and agriculture. The infrastructural facilities like school, health centre, market place etc., are also being provided within easy reach of their dwelling place. The purpose of the policy aims to ensure that the oustees are well settled in their new place. The draft policy has been circulated to State Governments for their views and suggestions before implementation.

Policy for Abatement of Pollution

During 1972, the Ministry of Environment and Forests came out with a policy statement for abatement of pollution. It lays emphasis on pollution prevention in place of the conventional end of the pipe treatment and also identified adoption of best available and practicable technologies. The focus of various programmes, as such, has shifted from merely identifying changes in disposal techniques to issues such as promotion of clean and low waste technologies, improvement of water quality, formation of database, standards, institutional and human resource development.

The Ganga Action Plan - Phase I was initiated in 1985 to combat problem of pollution of the main stream of Ganga. The action plan envisaged treatment of domestic wastes in 27 cities, construction of electric crematoria, low cost sanitation measures and river front development. Most of the schemes under Phase I have been completed and Phase II of Ganga Action Plan was initiated for pollution abatement of Yamuna and Gomati rivers at an estimated cost of Rs. 421 crore. Phase II of GAP envisages action plan for river Damodar also.

Legal Measures

The Parliament had enacted the Water Act, 1974 (Prevention and Control of Pollution) under which central and state Pollution Control Boards were established for monitoring quality of water. In 1977, Water Act (Prevention and Control of Pollution) was enacted to help augment resources by the Pollution Control Boards and to control water pollution. In 1986, the Parliament enacted the Environment Protection Act which covers all environmental aspects related to water and land. This act provides punishment to offenders who contravene the provisions of the act. The act was amended in 1990 to provide more teeth to the controlling agencies for safeguarding environment.

ENVIRONMENTAL ASPECTS

Water is a vital important resource for survival, but often its overall significance and total contribution to the economic development of the country are not fully realised, because its benefits are looked on sectorally and negative impacts are exaggerated. Even in government departments, relationships between the different ministries are not as good as they should be. Water Resources projects are lifeline of progress and prosperity of the country and they are indispensable since they are linked with the Indian economy. They are the source of welfare to the masses. However, due to strong opposition for the construction of large dams for their likely adverse impacts on the environment, such projects are not favoured. On the other hand, it is argued that the environmental impacts for different alternatives are not evaluated in many projects properly before their implementation.

GUIDELINES FOR ENVIRONMENTAL IMPACTS ASSESSMENT

Historically, water resources developers have been unable to measure adequately environmental impacts within the framework of Benefit Cost analysis. The focus was only on the monetary aspect. It may be due to the absence of any requirement earlier to incorporate environmental considerations into resource development programme. But with the awareness of environmental impacts and new legislations, it has become necessary to incorporate them in the overall assessment of the project. Recognizing this fact, several agencies both national and international have developed guidelines and methodologies for environmental impact assessment.

There was no proper mechanism earlier for assessing the environmental impacts of water resources projects. Various international agencies like World Bank, Asian Development Bank, United Nations (ESCAP), National Environment Board of Thailand, Ministry of Environments and Forests, Central Water Commission (CWC) have now issued guidelines for environmental impact assessment. These guidelines vary considerably in scope, quality and operational usefulness.

The guidelines prepared by Ministry of Environment and Forests (MoEF) in 1978 aimed at examining and carrying out rigorous assessment of environmental impacts so that necessary mitigative measures could be incorporated in the project right at its inception stage. The guidelines for site selection as well as identification of mitigative measures were prepared and circulated to project authorities. It was imperative to analyse whether the adoption of environmental measures would result in short term or long term social and economic benefits or not. Special emphasis was laid in the guidelines on the health impacts, plant genetic resources, aquatic life, waterlogging, salinity, deforestation and soil conservation while considering the techno-economic viability of the project. It was made mandatory in these guidelines that ecological considerations should be incorporated at every stage of planning and construction phase.

MoEF in 1985 prepared a list of the type of data and basic information on the environmental impact studies. The same was sent to the project authorities along with the guidelines for EIA of River Valley Projects for their use. These guidelines and the checklist, type of data required etc., was not exhaustive.

CWC in September, 1992 published "The guidelines for Sustainable Water Resources Development and Management" to meet the Indian needs for data collection, analysis, impact assessment and management plans. The guidelines suggested that Environment Management Plan (EMP) is necessary to ensure sustainable development and to limit the stress on the system within its carrying capacity. The new guidelines were broadly divided into six categories viz.,

- (i) Environmental reconnaissance
- (ii) Environmental study
- (iii) Prediction
- (iv) Assessment
- (v) Management for sustainable development
- (vi) Environmental monitoring

The objective of these guidelines was that field functionaries could collect the requisite data, carry out the Environmental Impact Assessment studies and prepare the Environmental Management Plans themselves.

Constraints

The guidelines issued by Ministry of Environment and Forests for preparing EIA of river valley projects and those issued by CWC for sustainable water resources development and management, no doubt, would provide useful information to field functionaries for preparing environmental impact assessment and environmental management plans, which are mandatory for taking up water resources development projects. The guidelines though are comprehensive, yet they may not be adequate enough for preparing the detailed project reports. Field functionaries are ignorant about the complexities involved in making the studies. The creation of infra-structural facilities for providing hands on training in preparation of Environmental Impact Assessment and Environmental Management Plans in water resources sector is lacking and there is an urgent need for the same. It would be of immense benefit to the field functionaries if a detailed step by step method for carrying out Environmental Impact Assessment is evolved.

In our country, a major constraint is the lack of information on environmental issues and the training process for dissemination of the developed expertise. The normal practice is to train a few selected university and departmental officials, some within the country and a few outside the country, and develop a core group of trained personnel. Unfortunately the information does not trickle down to lower levels involved in the studies. At the higher management level, there is not enough understanding of the techniques used and the tendency is not to consider them seriously. The decisions are guided by the socio-political considerations. The lower and younger workers become frustrated due to lack of communication, and training,

since no one takes the studies made by them seriously. Therefore, a high priority should be given for improving the communication and training of the people. There are at least four ways to improve this situation which are as under:

- (i) Define concisely the environmental problems and the alternative mitigative measures.
- (ii) Conduct hands on training, workshops etc., with examples on how Environmental Impact Assessment studies are conducted along with preparation of Environmental Management Plans.
- (iii) Illustrate through some case studies the impacts under pre and post development scenario.
- (iv) Develop improved and simple methods for displaying the results to decision makers.

The Environmental Impact Assessment technique is an aid, for determining the environmental impacts of water resources development projects. However, while carrying out these studies, it should be done with caution and common sense, and should not become a mechanical tool to perform evaluation. The assessment of parameters during environmental evaluation studies could be subjective and, therefore, requires to be improved upon with the passage of time and experience gained in this field.

ENVIRONMENTAL MONITORING

The Ministry of Water Resources has constituted a high level Environmental Monitoring Committee (EMC) under chairmanship of Member (WP&P), CWC in 1990 to monitor the progress of implementation of environmental safeguards of the water resources projects, stipulated by Ministry of Environment & Forests while clearing the projects. The inter Ministerial/inter Agency committee monitors and reviews the mechanism established by project authorities to monitor the ecology of the project area. To date, 85 projects have been identified and 17 projects cleared for close monitoring by the National Committee. The Committee has visited 15 projects till now and seen the implementation of environmental safeguards. States and project level monitoring committees have also been set up for review, co-ordination and ensuring the implementation of environmental safeguards in water resources development projects.

CHALLENGES AND ISSUES FOR NEXT CENTURY

Though these are innumerable however, it would be worth to study them under the sub-heads given below.

Maintenance of River Eco-System

For sustainable development, which could meet the food and fibre demand of the burgeoning population in the Twenty First century and also in order to maintain

the eco-systems of river basins, which provide surface irrigation, there is an urgent need of creating a data base on the prevailing eco-system and the likely modifications due to human interference at regular intervals of time. The creation of data base on environmental parameters is a major task which will require both time and money. There is a need to study the impact of water pollution, industrial waste water, impact of leeching of fertilizers and pesticides and mining activities. There is also an urgent need to assess the minimum flow required downstream for maintaining the eco-system. Recently, Ministry of Environment and Forests during the TAC meeting of NWDA opined that a flow of the order of 10 percent of 'average lean season flow' should be maintained. But the high level committee on Yamuna suggested that a minimum of 10 cumec is necessary.

Abatement of Pollution

The Government of India have enacted various acts and legislations for pollution abatement, yet they are not found effective in implementation, perhaps due to weak implementing mechanism or time consuming legal procedures or inherent lacunae in the enforcement procedures. There is, therefore, an urgent need to strengthen the existing enforcing mechanism and enactment of new laws so that the guilty are punished at the earliest opportunity.

Ground Water Exploitation and Recharge

The ground water table in several parts of the country is going down due to excessive withdrawal of ground water. Near coastal areas intrusion of saline sea water is creating problems.

Last year the problem of falling ground water levels was brought to the notice of the Supreme Court through a Public Interest Litigation petition. The Supreme Court after hearing all the concerned parties, passed an order on December 10, 1996 directing the Central Government to constitute the Central Ground Water Board as an Authority for the purpose of regulation and control of ground water management and development in the country under Sub-section 3 of Section 3 of the Environment (Protection) Act, 1986. The main objective of the Authority is to regulate and manage the ground water development in the country, with a view to preserving and protecting it.

Resettlement and Rehabilitation Policy

Resettlement and rehabilitation (R&R) is a humane problem. It is not mere the resettlement of the project affected families in the new environment, but also deals with various problems linked to their sentiments, customs, traditions and deep attachments towards their old habitations as well their linkages with the new environment. It is often seen that the host villagers envy the special status enjoyed by the Project Affected Persons (PAPs) which results in mini wars at times. It results in disparity between the persons who were lucky enough to have their properties affected by submergence and others who were lucky enough to have their

properties affected by submergence and others who were not The R & R problems associated with tribal population are more complex and need to be handled with utmost care.

Siting of Industries

The rapid urbanisation and industrialisation has led to discharges of enormous volume of sewage and industrial wastes (both treated and untreated) into the rivers. Most of the rivers in the country are polluted and there is not enough fresh water available for dilution. This, therefore, warrants for policy for siting of industries and zoning of the river basin. The issue/policy of locating water intensive industries very close to urban centres and/or on to the river banks is necessary with a view to bring down the water consumption and prevent discharges of industrial effluent in the water course.

Carrying Capacity

The concept of carrying capacity clarifies that demands on water resources projects should be well within the carrying capacity of the eco-system, and this concept is gaining momentum with water resources planners also. This ensures that the eco-sensitive and bio-rich zones are fully protected for the overall well being of the society. It thus implies that the siting of the water resources development projects are not finalised based on engineering considerations alone but also environmental considerations as well.

Benefit Cost Ratio

The concept of Benefit Cost Ratio (B/C ratio) needs to be changed if environmental parameters are to be considered in the water resources planning, since they would prove to be a great burden to the project. If, once it is agreed that environmental concerns are necessarily to be integrated into the planning process then either the procedure of working B/C ratio should undergo a change or B/C ratio need not be insisted upon.

Multi Disciplinary Approach

The National Water Policy, 1986, clearly advocated that water resources projects should be planned, formulated and implemented using integrated and multi-disciplinary approach. As such planning cells are required to be set up in the States which have to be manned by personnel belonging to various disciplines like civil engineering, economics, social science, agriculture, environmental science etc.

Environmental Impact Assessment

The Ministry of Environment and Forests while clearing the developmental projects insists that EIA and EMP studies are mandatory vide their notification

dated 27.1.1994. There are no proper clear cut guidelines available in preparing EIA and EMP. The guidelines issued by Ministry of Environment and Forests and those developed by CWC provide some assistance in preparation of EIA and EMP. Still they are not enough for the field engineers. There is an urgent need for providing detailed guidelines for preparation of these as well as training to field functionaries in preparation of these statements.

Environmental Safeguards Implementation

The Ministry of Environment and Forests while clearing water resources projects stipulate many safeguards which the project authorities accept at that stage. However, some of the safeguards are not implementable due to various reasons. As such, there is an urgent need for reviewing the wide sets of safeguards that are stipulated by MOEF and only essential and implementable safeguards should be insisted upon while clearing the projects.

Institutional Mechanism

During the Twenty First century, social and environmental considerations of water resources development and management will become more rigorous. Water Quality Management will dominate the water quantity management. Water management can be rational only if institutions responsible for such management are efficient and are strengthened. Under the present scenario several agencies, departments and Ministries of Central and State Government are looking after it in a fragmented fashion. There is an urgent need for bringing in major institutional changes to deal with such a vital subject 'water' in a holistic manner.

Debatable Issues

Several issues like impact of water resources projects on micro climate, health, big v/s small dams, reservoir induced seismicity, development of more liberal R & R plans, deforestation, waterlogging, minimum flow requirement, bio-diversity etc., are highly debated upon in various forums. There is a need to develop national consensus on these issues. Perhaps more research is required to be carried out in this field. The issues raised on green house gases, acid rains, reduction of ozone layers etc. at various fora are no doubt important and need to be considered, however, they are not of immediate concern in the developing countries. A common man in India is more worried of the facts that most of the rivers are polluted, water courses dried up, air is not fit to breathe etc. So the priority for us is to attend to their problems first rather than debate on such global issues.

CONCLUSIONS

Today, the most pressing demand in the country is to provide basic amenities within the easy reach of people. The country has to cope with the growing

population and the priority task of the policy makers is to meet the increasing demands of the people keeping in view the welfare of the society. The controversies concerning water resources development need to be resolved. It is necessary to protect our environment from pollution and eco-degradation. Everyone wishes that our natural resources are conserved and damage to environment are minimised.

The development is not the cause of most of the environmental problems, but the cure. The statement made by late Prime Minister of India, Mrs. Indira Gandhi at Stockholm conference, 1972 that "Poverty is the greatest pollution" still holds good, although some feel otherwise. Developmental projects can be planned in such a manner so as to minimise environmental degradation, but they cannot be reduced to zero since all developmental activities have environmental impacts both positive and negative.

Our endeavor should be to develop our resources to the maximum with minimal environmental degradation. The Agenda 21 adopted in the historic "Earth Summit" at Rio-de-Janeiro attended by 115 Heads of States and Governments, is a blue print for sustainable development. A number of items, including protection of fresh water resources in quality and quantity, form an integral part of the agenda. We are committed to Agenda 21 and so to the programme of sustainable development of Water Resources.

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