TFYP STEERING COMMITTEE Sr. No. **23/2001**

REPORT OF
THE STEERING COMMITTEE ON

IRRIGATION

FOR
THE TENTH FIVE YEAR PLAN
(2002-2007)

GOVERNMENT OF INDIA
PLANNING COMMISSION
MAY– 2002

Sompal

Member, Planning Commission

I am grateful to the Planning Commission for giving me the privilege of chairing the "Steering Committee on Irrigation Sector" for the formulation of X Five Year Plan. On behalf of the Committee I have great pleasure in forwarding herewith the Report of the Steering Committee on Irrigation Sector. I take this opportunity to accord my profound thanks to the five Working Groups listed in the Introduction, whose Report provided invaluable inputs for finalisation of this report. In finalisation of the report the Committee had advantage of discussing with the Chairpersons and, Convenors of all the five Working Groups.

The Steering Committee held two meetings, which provided guidelines for the Working Groups, as well as reviewed the output at conclusion. I am thankful to all the members of the Steering Committee who spared their time and shared their vast experience and knowledge. Water Resources Division of the Planning Commission acted as the Secretariat of the Steering Committee and helped to draft its Report.

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INTRODUCTION

The Steering Committee on Water Resources for the formulation of Tenth Five Year Plan was constituted by the Planning Commission vide Office Order No.25(2)-2000(WR) dated 30-11-2000, under the Chairmanship of Shri Sompal, Member, Planning Commission. The Terms of Reference of the Steering Committee included the following :

1. To review the progress of work of each of the Working Groups set up for the Tenth Five Year Plan for Irrigation Sector;
2. To guide the Working Groups on approach, strategy, objectives and targets of all Irrigation Sector programmes under Tenth Five Year Plan and provide appropriate direction to them;
3. To consider the final reports of the Working Groups for Irrigation Sector and take a view on the recommendations of the Working Groups in connection with formulation of strategy for Irrigation Sector during the Tenth Five Year Plan and make suitable recommendations to the Planning Commission for further consideration;
4. The Steering Committee will devise its own procedure for business and may co-opt any other Member(s), if considered necessary.

The Planning Commission also constituted 5 Working Groups to formulate and devise the strategy for the development of various sub-sectors in Water Resources Development during the Tenth Five Year Plan. The Working Groups constituted were as under:

1. Working Group on Command Area Development Programme
2. Working Group on Private Sector and Beneficiaries Participation Programme
3. Working Group on Minor Irrigation Programme
4. Working Group on Major and Medium Irrigation Programme
5. Working Group on Flood Control Programme

The following is the Report of the Steering Committee, taking into account the inputs of the Working Groups, and the discussions held in the meetings of the Steering Committee.

SECTION 1. WATER RESOURCES OF THE COUNTRY

Water is a precious, finite, and in view of growing demand, ultimately scarce natural endowment. The objective of the water sector policy is to optimise its availability for different purposes, especially for supply of water for drinking, food production, livestock, as well as for power generation, navigation, and various commercial and domestic uses. Of equal importance are the objectives of achievement of efficiency, equity and sustainability in the use of water. Sustainability issues are particularly important in the light of the declining per capita availability, and the pollution of water through human intervention. Definitive action is called for to harness the available water resources while also protecting and conserving them.

India, which has 2.45 percent of the world's land resources, has roughly 4 percent of the world's fresh water resources, whereas the country's population is 16 percent of the world's population. Most of the rainfall – 76 percent of it as per India Meteorological Department - in India occurs as a result of the southwest monsoon between June and September, except in the State of Tamil Nadu which falls under the influence of the northeast monsoon during October and November. More than 50 percent of precipitation takes place in about 15 days and less than 100 hours altogether in a year.

In macro terms, India receives an average annual precipitation of about 4,000 Km^3 (Billion Cubic Metres - BCM) including snowfall. Of this, the seasonal rainfall (June to September) is of the order of 3,000 BCM. Out of this, the average annual flow available in rivers is around 1953 BCM[1].

[1] These figures are adopted from the Report of the National Commission in Integrated Water Resources Development. The official figure of the Ministry of Water Resources is 1869 BCM.

However, because of the topographical, hydrological and other constraints, only about 690 BCM of the available surface water can be utilized. With the addition to the annual replenishable ground water resources of 432 BCM, the total utilizable water in the country is assessed as 1122 BCM.

REGIONAL VARIATIONS IN WATER ENDOWMENT

The distribution of water resources in the country over different regions or river systems is skewed, as follows:

Basin	Area, Mha	Water Resource, Km^3	Utilisable Surface Water Resource, Km^3
Ganga-Brahmaputra-Meghna	110.13 (33.5%)	1202[2] (62%)	274 (40%)
West Flowing Rivers south of Tapi	11.31 (3.5%)	201 (10%)	36 (5%)
Other Basins	207.29 (63%)	550[3] (28%)	380 (55%)
Total	**328.73**	**1953**	**690**

The Ganga-Brahmaputra-Meghna system is a major contributor to India's water resources, representing about 60 percent of the total. On the contrary, with eight percent of population, Rajasthan has only one percent of the country's water resources, inclusive of groundwater, rainfall, and surface flows.

[2] &

[3] The figures will be 1111 and 557 respectively if the figure of 1869 BCD is adopted, with resultant change in percentage figures also.

There are significant variations in the endowment of waters not only in different regions of the country, but also in different periods of a year. More than 90 percent of the annual runoff in peninsular rivers and more than 80 percent of the annual runoff in Himalayan rivers occur during months of June to September. Consequently, several areas with high rainfall also experience shortage of water in other seasons, because of the nature of topography made more problematic by denudation of the landscape, compacted soil and high runoff. In such instances, floods in rainy season may be followed frequently by drought in the rest of the year, with negative effect on economy and public welfare.

Topographical features cause the wide gap between total surface water resources and what is utilisable out of it. The overall utilisable surface water is only about 35 % of the total resource. Lack of adequate storage sites on the Ganga and its catchment results in a surplus in the river in the monsoon period. Narrow basin and limited land for irrigation as well as limited storage sites, impose severe limits on utilization of the Brahmaputra. In fact in the Ganga-Brahmaputra-Meghna basin, with a total water resource of 1202 Km^3, what is assessed as utilisable is only 274 Km^3, of which 250 Km^3 pertain to Ganga-sub-basin, and the rest to Brahamaputra and Meghna (Barak) sub-basins.In the case of the peninsular rivers flowing west, the short length and limited land available for irrigation restrict the use of their waters.

AVAILABILITY OF GROUND WATER

According to estimates, the replenishable ground water resource of the country is 431.9 Km^3 consisting of potential due to natural recharge from rainfall (342.4 Km^3) and the potential due to recharge augmentation from canal irrigation system (89.5 Km^3). The distribution of replenishable ground water resource also is uneven. Out of the total replenishable ground water resource from normal natural recharge estimated as 342.43 Km^3) as much as 164 Km^3 occur in the basins of Indus, Ganga, Brahmaputra, and Meghna. In states of Andhra Pradesh, Punjab, Haryana and Jammu & Kashmir, the recharge from canal seepage and return flow of irrigation is significant ranging from 43 to 49 percent.

Groundwater already accounts for more than 45 percent of the total irrigation in the country. The contribution of ground water to achieve self-sufficiency in foodgrain production in the past decades has been remarkable. Use of groundwater is likely to grow in the years ahead because of the untapped potential in northern, eastern and north-eastern parts of the country, as well as the ease and simplicity with which it can be extracted. This dependence on groundwater

should make us wary about the emerging problems. Groundwater in India as elsewhere is affected by depletion due to overdraft, waterlogging, salinization, and other forms of pollution. In many parts of the country the groundwater extraction exceeds annual recharge.

Regional or basin-wise differences in the water resource endowments require that the approach to harnessing of water take these differences into account. The Approach Paper to the Ninth Plan had suggested classifying of regions of the country as follows, based on rainfall, water availability and agro-economic conditions:

- **High Productivity Region :** Relatively high productivity areas having either well developed irrigation system with moderate rainfall (north-western region of Punjab, Haryana and Western UP) or very high assured rainfall (the coastal plains)
- **Water Abundant Low Productivity Region :** Relatively high rainfall areas with abundant surface and ground water availability, but relatively low irrigation development and low productivity in agriculture (Middle and Lower Gangetic Plains, Eastern M.P. and North Eastern Region)
- **Water Scarce Low Productivity Region :** Low surface and ground water availability, and moderate agricultural productivity (the Peninsular India and Eastern Rajasthan and Gujarat)
- **Ecologically Fragile Regions :** The Himalayan slopes and desert areas of Rajasthan While this is the broad picture, each river basin and every micro-watershed requires its own plan to conserve, augment, harness and use equitably the available surface and ground water, to implement recommended measures for improving the productivity of land and water, and to protect and enrich the environment.

IMPENDING PROBLEM OF WATER STRESS

With the existing water resources of the country, per capita availability of water varies in the range of 300 to 13754 cubic metres (cu.m.) per year with the national annual average of per capita availability about 1829 cu.m. in 2001. By 2015 AD the country will be facing water stress conditions with annual per capita availability of water at about 1557 cu.m. The conditions will be further worsening due to continued population growth and by 2050 AD the projected annual per capita availability of 1168 cu.m would take the country to the threshold of water scarce conditions. It is estimated that by 2050 AD, 22% of the geographical area and 17% of population of the country will be under absolute scarcity conditions having access to water availability of less than 500 cu.m per year and 70 % of the area and 76% of population will be on the verge of

affected health and economic activities with access to water availability of less than 1000 cu.m per year, which is identified as stress or scarcity level.

STRATEGIES FOR WATER HARNESSING

Against the available 1122 BCM of water resources, about 600 BCM only have been put to use.

For fuller utilization of the surface water, construction of storage capacities in reservoirs is essential for making water available for use during the non-monsoon seasons, and to provide water to agricultural lands in keeping with the requirement of crop production calendar. Reservoirs are also needed for non-agricultural use of water such as drinking water, industrial use, and hydel electricity generation. Till 1995 a total of about 174 km^3 built up storage had been completed. By adding 76 km^3 of storage capacity under construction, and 3 km^3 in small tanks, a total of 253 km^3 of storage is estimated to be available. Identified future projects will add another 132 km^3 of storage, making a total of 385 km^3. It is essential that the task of completing the capacity under construction, and creation of the remaining identified future capacity, are taken up on an urgent basis and completed within a firm time-frame, in order that the objective of harnessing the water resources optimally, can be fulfilled without waiting for the predicted water stress situation to overtake us.

As earlier mentioned, the existing utilisable flows are likely to be insufficient in future. The National Commission for Integrated Water Resources Development (NCIWRD) (1999) had suggested that to enhance the utilisable flows, it is imperative to look for other possibilities such as:

- Artificial recharge of ground water to increase ground water potential; Water harvesting, watershed development and revival of traditional water storage structures
- Inter-basin water transfers wherever feasible
- Recycling and reuse of water
- Desalination of saline water
- Augmenting water resources through construction of reservoirs in upper-neighbouring countries of the SAARC region.

It should be ensured that in the 10^{th} Plan substantial progress is made towards implementation of the measures recommended above.

LAND USE PERSPECTIVE PLAN – CONCEPT OF RIVER BASIN AS PLANNING UNIT

The need for preparation of comprehensive water resources planning with river basin development as the basic planning unit, has been amply emphasized. The plan should indicate a broad frame-work of various works to be taken up in the basins, establish priorities in respect of water use for various purposes; indicate inter se priority of projects; indicate the need for ear-marking water for any specific future purposes, etc. The basin plan needs to be periodically reviewed and revised in the light of changing needs and supplies. Such comprehensive plan should contain information on land resources such as land use pattern, landholding, soil classification, crops information and climatological details. It should also include information on availability of surface and ground water, its quality and present and future demand projections for various uses such as domestic, irrigation, industry, power generation, environmental planning and socio-economic aspects as well as legal and institutional angles.

However, the recommendations relating to River Basin Organisations have largely been unimplementable because of the strong reservations of many of the important states. However, the work taken up in the States of Haryana, Orissa and Tamil Nadu for basin planning studies and preparation of State Basin plans under the WRC Projects may be of help in establishing the feasibility and benefits of river basin planning. As no progress can be made in preparation of comprehensive water resources and river basin development plans without the participation of the States concerned, the effort to persuade States to accept the concept and act on it must continue during the X Plan.

Access to water will continue largely to be determined by natural factors such as rainfall, suitability for reservoir-based irrigation systems, and ground water endowment. These factors do also affect other uses such as drinking water, power generation, and navigation etc. The differences between regions and individual farmers with regard to quantity, quality, and reliability of water supply for their crop husbandry will continue, and will also make the difference between agricultural prosperity and relative backwardness in terms of output and incomes from farming. The costs involved in different irrigation systems also vary. At current prices, during 1998-99 the plan expenditure for major and medium irrigation projects was Rs 1,42,662 per hectare. In respect of Minor Irrigation the estimated cost per hectare of irrigation potential is Rs 60,000 and Rs 25,000 for surface and ground water respectively at current prices. The cost of development of Watershed, which has a wide coverage but aims mainly at soil and water conservation and development of waste land (and not for storing water for irrigation

purposes) was Rs 3000 per hectare during 9th Plan and is recommended to be raised to Rs 4500-Rs 6000 during the 10th Plan.

From the preceding analysis is it apparent that water sector programmes require substantial amount of work on a broad front encompassing not only creation of reservoirs, but for further investigation and planning on the basis of river basins, as well as innovative approaches to water conservation and augmentation through watershed development, rain-water harvesting, other re-charge structures, use of sprinklers and drip irrigation for economy in consumption of water, optimal use of groundwater, recycling of water for non-potable uses, and diversification of agriculture to less water-consuming varieties.

It is important to recognize that in an area such as water resources, there is no single solution applicable in all agro-climatic zones; each approach is valid in its own right and has to be given equal priority along with other solutions. Co-ordination for the entire gamut of activities relating to the water sector should be provided by the Ministry of Water Resources in the Central Government.

One key issue for resolution is the treatment of water resources for purposes of planning and programmes, at different levels. Currently there is a great deal of fragmentation with different agencies bearing responsibilities for their own specific areas. In an area such as water resources, this is obviously not the right approach. As stated earlier, the basic unit is the river basin. Within it, there are different aspects such as watershed development, major irrigation, minor irrigation, conjunctive use of ground and surface waters, provision of water for different users and in particular for drinking water and crop production, livestock, flood control, drought proofing, power generation, fish production, navigation, etc. Prevention of pollution of water, and of degradation of soil and its fertility through water-logging and salinity/alkalinity are also related issues.

At the Central level, watershed programmes are being dealt with under Rural Development and Agriculture Ministries. The latter department has recently also promoted a ground water programme for the Eastern States. Major, Medium, and Minor Irrigation, as well as Flood Control and Command Area Development are dealt with by the Ministry of Water Resources. Part of watershed management comes under Ministry of Environment and Forest, and the responsibility for pollution control and river action plans, are looked after by the Ministry of Environment. Drinking water is looked after in both Rural and Urban Development Departments, whereas investigation and regulation of ground water, a major source for potable water, is under

the Ministry of Water Resources. Much work on rainwater harvesting and ground water recharge are also being done by the Central Ground Water Board.

Water is a resource in economic, environmental, and social terms, and irrespective of user category and political unit that is involved, the costs and benefits of this resource have to be shared by all. At the level of policy framing, efforts are made for achieving coordination through means such as the National Water Resources Council, but the problem of coordination at programme level still remains severe. The danger of such a divided approach resulting in important issues being ignored rather than being coordinated and built into integrated programmes is very real. In the North East, reservoirs have to fulfil multiple functions such as power generation, flood control, and irrigation, whereas in the current set up there is likelihood that projects may in fact deal with a single item to the detriment of other objectives. To neglect watershed development in planning for irrigation projects, is a serious lacuna in the functioning of Ministry of Water Resources.

It has to be admitted that there is no simple solution to the problem of achieving a coordinated approach to water resources. This is a challenge to the capacity of the country's administration to face up to. To begin with there should be a permanent arrangement at the national level for co-ordinating all water related programmes and schemes. This could be in the form of an inter-departmental committee with the Ministry of Water Resources as the nodal Ministry, and others as members. This committee should review all issues having inter-sectoral impacts in terms of water resources, and provide guidance to the Ministries to co-ordinate their activities. Such an arrangement needs to be replicated at the State and District levels also, though the focus would be more narrow. At the river basin level, inter-State coordination committees should be formed to review the integration of various uses and purposes for which water is applied, in order to ensure that the projects are in the best interests of maximizing the potential of each river basin area.

NATIONAL WATER RESOURCES
PROGRAMME COORDINATION COMMITTEE

CHAIRPERSON : Member (Agriculture & Water Resources), Planning Commission –
MEMBERS : Secretaries to Government of India in the following Ministries :
Water Resources, Power, Agriculture, Environment & Forests, Urban Development, Drinking Water Supply, Rural Development, Inland Water Transport, Science & Technology, and Dept. of Space; Chairman, CWC ;CMD, NHPC; Chairman, CGWB

Mandate of the Committee : "To ensure that in all programmes of significance having a bearing on the use, development, conservation, augmentation, productivity, and protection of water resources of the country, fullest mutual understanding is achieved, and all interests and concerns are duly taken into account and coordinated in framing and implementing such programmes."

DEPLETION OF GROUND WATER

As per Central Ground Water Board's 1998 Report, 310 Blocks/Mandals/Talukas/ Watersheds out of a total of 5831, fall under 'overexploited' category (utilization > 100 % of replenishable ground water) and 160 Blocks/Mandals/Talukas/ Watersheds fall under 'dark' category (utilization >85% but <100%) in 13 States of the country, namely, Andhra Pradesh, Bihar, Delhi, Gujarat, Haryana, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Punjab, Rajasthan, Tamil Nadu and Uttar Pradesh. The number of blocks where groundwater has been overexploited and dark blocks has increased from 428 in 1995 to 470 (1998-99).

Overexploitation of ground water leads to other harmful consequences. In Punjab, Haryana and Western Rajasthan, the main consequence has been salinity. In North Gujarat and Southern Rajasthan, the consequence has been fluoride contamination. In the South declining well yields are leading to steeply increasing pumping costs, which is now occurring in the Northern States, too. In West Bengal, there is a serious problem of arsenic contamination. In coastal areas the intense pumping of groundwater for irrigation is causing saline ingress into coastal aquifers. In the States of Gujarat and Maharashtra, ground water depletion is so acute in certain areas that the recharge gets fully exhausted every year. The implication is that if the subsequent monsoon fails, there is nothing to fall back upon, even for drinking water. All these

have the potential to create substantial risks to food production dependent on groundwater, and for water security of the population. Due to excessive mining of ground water, the number of villages where drinking water quality is affected, is also rising in areas where groundwater is the source. On the other hand there are areas in the Ganga-Brahmaputra-Meghna belt where massive development of groundwater could both lead to agriculture based prosperity, as well as moderate the problems of water-logging and floods to which the area is prone.

The problem of water-logging and soil salinity/alkalinity is prevailing in a few major and medium irrigation projects since long. The problem has aggravated with increased use of irrigation waters. The National Commission on Agriculture (1976) estimated that about 6 Mha.of land was affected by waterlogging, in both irrigated and unirrigated lands. Out of this, an area of about 2.6 Mha. of land was found to be affected due to higher water table, and 3.4 Mha. due to surface run-off stagnation. The Working Group constituted by the Ministry of Water Resources in 1991 estimated that about 2.46 Mha. in irrigated commands suffered from water-logging. The States where high water-table has been noticed particularly as a problem, are Punjab, Uttar Pradesh, and some parts of Rajasthan and Maharashtra. The areas with surface stagnation problem are mainly West Bengal, Orissa, Andhra Pradesh, Uttar Pradesh, Tamil Nadu, Kerala, Gujarat, Punjab, and Haryana. The Working Group also estimated that 3.30 Mha. land had been affected by salinity/alkalinity in the irrigated commands. It is reported that the spread of conjunctive use of ground water with that of surface water, especially in Punjab, Haryana and parts of Uttar Pradesh, has substantially lowered the water table and helped to contain water-logging/salinity. Systematic surveys of this phenomenon are yet to be taken up.

Presently, the problem is dealt with as part of the Centrally Sponsored scheme of Command Area Development. For more tangible results, water-logging and salinity need to be tackled at two levels: First, there should be a systematic survey to assess the extent, nature, and location of the water-logged and saline/alkaline lands in the existing project commands; and second, a phased programme should be drawn up to reclaim such lands in a cost-effective manner. The optimum development and utilization of water resources can be achieved by conjunctive use of ground water and surface water resources, and both should be viewed as an integrated resource right from the project planning stage, and developed conjunctively. Tubewells schemes can be integrated with canal irrigation schemes by spacing them suitably along the drainage lines in the distribution area. Such an approach is called for in view of the growing trend towards water-logging, salinity and alkalinity.

QUALITY PROBLEM – AGRICLUTURAL, INDUSTRIAL AND URBAN POLLUTION OF WATERS

Water is highly susceptible to pollution and contamination from a variety of sources such as urban solid and liquid wastes, industrial effluents, organic wastes, and flow of residues of chemicals and fertilisers used in agriculture. Moreover, the environmental impact of urbanization and changing land use resulting from pressure of increasing population, are such as to harm the natural quality of lakes, wetlands, and even underground aquifers, rivers and oceans.

It is essential that a wide range of measures known to science and environmentalists are taken to retrieve the water bodies which are already affected, and to prevent further aggravation. Water quality is being monitored, for surface and ground waters, through a network of monitoring stations of the CWC and CGWB. Prevention of pollution calls for concerted measures by the authorities in charge of urban water supply and sewerage, as well as pollution control boards. Awareness among the public and developing a respect for quality of water as a basic requirement of environmental health, are essential measures. The actions to be taken have been identified as follows:

- Rain water harvesting in both urban and rural areas should be made compulsory, and the entire range of watershed development measures – check-dams, sub-surface dykes, clearing of channels and water bodies of weed infestation and silt, vegetative treatment of catchment areas, etc. – should be encouraged to increase availability of water, recharge ground water, and improve water quality.
- Treated water can be reused for non-potable uses. In urban areas prevention of leakage will help conserve considerable amounts of water, and reduce costs of water supply. Demand management should be given a greater role in such matters is mandating the use only of low-capacity cisterns in WCs, ban on use of treated water for non-priority uses such as car-washing, gardening, etc.
- The use of drip/sprinkler system of irrigation has resulted in economical use of precious irrigation water but the accessibility of the system has been limited to rich farmers due to high cost of installation of the system. The efforts of Government have been to promote them through subsidies. It would be appropriate if the various taxes, excise, etc. are completely revamped or removed rather than provide subsidies. The methods of irrigation like hydrums and mangal turbines and treadle pumps need to be promoted in the abandoned surface water areas as well as in areas where the ground water is at shallow depth.

- Water quality testing facilities are being set up in all districts under the Rural Drinking Water programmes. Testing of water through this facility should be made a regular feature, to track of changes in water quality. Testing facilities should be enlarged by creating them in all schools, colleges, technical institutes, agricultural research centres, PHCs, etc.
- Encroachments on tank beds is one of the main reasons for loss of capacity in the traditional irrigation tanks. Tank restoration should be taken up on priority. A Central legislation should be enacted to recover and rejuvenate all lands under water bodies as per revenue records, which may have been diverted to other uses.
- Use of chemical fertilizers and pesticides in agriculture should be optimised; prevention of water-logging and salinization of land should be made a priority item of work. 'Polluter pays' principle should be implemented and effluent treatment made mandatory in all industries using water.
- Pollution of water bodies is most severe where human settlements have developed. This is mostly on account of poor sanitation arrangements, for both human excreta and the solid and liquid wastes generated in towns and cities. Unfortunately, there is little awareness of the impact of insanitary conditions of the cities on health, and the long term adverse impact on environment. In both urban and rural areas, sanitation, and solid waste management, should get attention and support, and not only water supply as has been the practice. Adequate provision should be made for proper O&M of the sewage treatment plants, sanitary land-fills, hospital waste disposal units, etc. Urban water bodies such as lakes should be maintained in pristine pure condition.
- Urban compost should be taken up as an integral part of SWM systems, and the costs of production should be kept down to make the compost attractive to farmers.
- Action plan for cleansing rivers and prevention of pollution of all water bodies should be intensified in cooperation with the urban local authorities, industries, and pollution control boards. Fullest involvement of the public in such programmes should be ensured. Care should be taken for the proper operation and maintenance of treatment plants for sewage and industrial effluents.

SECTION 2 : DEMAND OF WATER FOR IRRIGATION

Provision of assured water supply to agriculture is one of the uppermost objectives of water resource programmes. 83 per cent of developed water use is for agriculture, and already, irrigated agriculture accounts for 56 per cent of all foodgrain production in the country, even though the coverage of irrigation in the area under foodgrains was estimated in 1997-98 to be 40.6 percent. With more of the water resosurces being harnessed, with increased efficiency in water used in crop production, and with increasing demand for water from other users, the proportion of water resources applied or available to irrigation is expected to register a decrease in due course. The estimated total water requirement for various sectors of use is projected for 'Low' demand and 'High' demand, is as follows taking both surface and ground water :

Water Requirement for Different Uses

(Quantity in $Km^{3)}$

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

The funding for the irrigation sector with respect to total Plan size of States from the Fifth Plan onwards has steadily been declining as indicated below:

Period	Irrigation funding as percent of total State Plans
Fifth Plan (1974-78)	23.25%
Sixth Plan (1980-85)	20.85%
Seventh Plan (1985-90)	11.85%
Eighth Plan (1992-97)	18.48%
Ninth Plan (1997-2002)	14.93%

Though the outlay on irrigation has declined as a proportion of total Plan size, the amounts being invested and the capacities created presently are unprecedented in the history of the country. However, both shortfall of resources, and problems in project implementation and management, have affected the achievement of targets in creation and utilization of irrigation capacity.

ULTIMATE IRRIGATION POTENTIAL

The assessment of ultimate irrigation potential of the country made in 1972 has been revised, mainly on account of reassessment of ground water potential by the CGWB from 40 Mha to 64.05 Mha. The UIP from minor surface water schemes were also revised from 15 Mha to 17.38 Mha. Consequently the UIP stands revised from 113.5 Mha to 139.9 Mha, as follows:

UIP (in Million Hectares)		
Sector	Existing	Revised
i) Major and Medium Irrigation	58.46	58.46
ii) Minor Irrigation		
a. Surface Water	15.00	17.38
	55.00	81.43
b. Ground Water	40.00	64.05
Total:	113.46	139.89

A RETROSPECTIVE ON WATER RESOURCES DEVELOPMENT IN THE COUNTRY : MAJOR AND MEDIUM IRRIGATION

In the pre-plan period prior to 1951, irrigation potential created through major and medium sector was 9.70 Mha. In the First Five Year Plan (1951-56), the country launched a major irrigation programme. The compulsion to develop irrigation was on account of the loss of much of the irrigated area to Pakistan, and the shortage of food in the country calling for large-scale imports. A number of Multipurpose and Major Projects were taken up, such as Bhakra Nangal, Nagarjunasagar, Kosi, Chambal, Hirakud, Kakarapar and Tugabhdra. Simultaneously, minor irrigation schemes including ground water were given emphasis under the Agriculture Sector, with financial assistance from the Centre. In subsequent Plan periods, several new projects commenced, till in the 4th Plan (1969-74), emphasis shifted to the completion of ongoing projects, integrated use of surface and ground water, adoption of efficient management techniques and modernization of existing schemes. The Fifth Plan saw a number of new projects, and also the launch of the CADP as a CSS with the objective of reducing the lag between potential created and optimum utilization of available land and water. During the Annual Plans of 1990-91 and 1991-92 and 8th Plan, new starts were restricted considerably and greater emphasis was laid on completion of projects. In the 8th Plan there was more emphasis on a number of new items, such as user participation, renovation and modernization, repairs and improvements to minor irrigation projects, and use of sprinkler and drip irrigation programmes, conjunctive use of surface and ground waters. Since then additional potential created till the end of 8th Plan was about 23.35 Mha (provisional), making the cumulative total as 32.95 Mha. By the end of the 8th Plan, the projects completed, along with minor irrigation and ground water development, have created an estimated potential of about 90 Mha. Progress during the 9th Plan is reviewed separately below.

MINOR IRRIGATION

Surface water Minor Irrigation schemes were the principal source of irrigation during the period before planning process commenced. Minor Irrigation structures such as tanks both met the need for irrigation and helped in recharging of ground water. Out of the total potential of 139.89 Mha, 17.38 Mha is planned to be achieved through the surface minor schemes.

Ground water accounts for about 38.5% of the total utilisable water, but is higher at 45.78% of the UIP. The groundwater potential of the country increased from 6.5 Mha at the beginning of planning to 44.35 Mha by the end of the 8th Plan. Utilisation also rose during this

period from 6.5 Mha to 41.50 Mha, registering an achievement of almost 65% of the potential. Large untapped ground water resources still exist in the eastern region where groundwater is available at a depth of 5 to 10 metres. There is scope for exploitation by means of shallow tubewells in this area. However, inadequate and erratic supply of electricity has been a major problem in states with weak rural electricity infrastructure. In several States, and in particular in Uttar Pradesh and Bihar, the number of farmers making their own arrangements for diesel pumpsets for tubewell irrigation is substantial. Pumpsets may be owned, or hired/borrowed by farmers. These farmers suffer additional cost and effort involved in procuring and installing the diesel sets, their maintenance, and the day to day problem of obtaining fuel for which ready cash is a requirement.

MAJOR AND MEDIUM IRRIGATION : PERFORMANCE REVIEW OF IX PLAN

The outlay for IX Plan as finally provided was Rs 42959.34 crores with the target to create additional potential of 9.81 Mha. The performance during the first three years was cumulative expenditure of about 65% of the total outlay for IX Plan with potential creation at 22% of the target of 9.81 Mha. The expenditure during 9th Plan is likely to surpass the agreed outlay and may, it is estimated, reach Rs 50,950.43 crores. While Punjab is spending almost double the agreed outlay, Gujarat and Karnataka will overshoot by 64% and 58% respectively, expenditure is likely to be higher than agreed also in Maharashtra and Uttar Pradesh (including Uttaranchal). Actual achievement of additional potential created, is likely to be 4.14 Mha. Thus the IX Plan will see total potential created through major and medium irrigation to rise to 37.09 Mha, or 63.43% of the ultimate irrigation potential. The target to reach the potential of 58.5 Mha is expected to be achieved only by the end of the XII Plan. Experience shows that compressing the time period for project completion is not a task only of availability of financial resources, but of overcoming many hurdles in project implementation such as land acquisition, and project and contract management to coordinate the different aspects of reservoirs, water conveyance and distribution arrangements, and on farm development. Subject to proper management of projects, the total requirement of funds for completion of the targeted achievement of 58.5 Mha is estimated to be Rs 180,000 crores.

The phenomenon of higher expenditure with lower physical progress indicates thin spreading of the outlays, as well as higher revised project costs which were not taken into account for want of information. Spill-over of projects into successive Plan periods is a festering problem of our project execution. Projects need to be made based on proper

investigation and study, and frequent change in scope of work has to be avoided; projects also need to be prioritised for funding so as to create potential commensurate with the investment in the shortest possible time.

It is assessed that among the pre-Fifth and Fifth Plan projects, 21 major and 19 medium projects would have been completed during the IX Plan. However, 76 major and 62 medium projects of this category will spill over into the X Plan which is a matter for concern. The position of completion of projects at the end of IX Plan is likely to be as under:

	MAJOR PROJECTS	MEDIUM PROJECTS
A) Completed up to end of VIII Plan	124	708
B) Likely completion during IX Plan	25	45
Total	149	753

The overall position of spillover projects at the end of IX Plan would be as follows:

Plan of Start	Major	Medium	ERM
I	1	-	-
II	5	-	-
III	9	4	-
AP-1966-69	3	-	-
IV	14	4	3
V	44	54	6
AP-1978-80	7	13	1
VI	32	40	11
VII	10	28	12
1P-1990-92	2	-	-
VIII	19	62	20
IX	13	37	36
TOTAL	**159**	**242**	**89**

The projects completed during IX Plan include 13 Major and 13 Medium projects in drought prone districts, and 17 major and 20 medium projects in tribal areas. At the beginning of the X Plan, 80 major and 86 medium projects in drought prone districts will still be incomplete, as also

76 major and 118 medium projects in tribal areas. Among the latter, 34 major and 35 medium projects fall in the category of being in both drought prone and tribal areas.

STRATEGY AND SIZE FOR X PLAN

Per capita availability of water has been steadily declining while net sown area has remained around 140 to 142 Mha. There is no alternative to increasing the productivity of land and water resources. The objective of the irrigation sector should be to attain higher cropping intensity with improved irrigation efficiency. The development of irrigation facilities will on one hand increase the productivity of existing crops, and on the other, also facilitate the expansion of gross cropped area through multiple cropping.

The present productivity of agriculture is capable of substantial improvement, which will be a necessity keeping in view population of growth and requirement of food in, say, the year 2050. Increase in productivity of the rain-fed agriculture has to be achieved through effective watershed management. Careful crop planning, less water consuming and short duration crops etc., are needed where water is scarce and should be conserved.

While public investment in irrigation has fallen over successive plan periods, new trends in project financing have arisen in the form of AIBP assistance from the Centre, and innovative measures such as establishment of irrigation corporations and market borrowings to finance project construction. External assistance to irrigation projects has dwindled though a few States have on-going Water Resources Consolidation Projects with World Bank assistance. It is necessary to recognize that environmental and rehabilitation/resettlement issues, as well as reluctance to levy water rates to meet even the O&M costs are the reasons for withdrawal of funding agencies from this sector, especially in respect of Major and Medium projects. During IX Plan, three States, namely Gujarat, Karnataka and Maharashtra resorted to market borrowing amounting to Rs 2000 crores, Rs 3000 crores and Rs 8000 crores respectively. Whether such borrowings can be sustained in future, and if not, the impact on project financing, are issues requiring consideration.

Working Group has in its Report repeatedly emphasized that the most over-riding reason for non-completion of projects is the *non-availability of requisite funds* in annual plans resulting in thin spreading of available resources. NCIWRD Report on the other hand has emphasized ***prioritisation of projects and better project management***. **Needless to say, given the large number of projects taken on hand, the frequent changes in project scope, and the**

escalation of project costs due to a variety of reasons, there is little likelihood that the outlay in the budgets can ever match the total demand. This calls for a fresh look at new starts during the X Plan period, especially in those states where commitments to on-going projects are substantial.

The strategy recommended for X Plan is as follows:

- **Old projects which have already achieved 90% or more of the targeted potentials should be considered as completed projects;**
- **Projects with 70 to 80 % achievement of potential should be reviewed for achievable potential so as to decide on completion status of these projects;**
- **According to the status of completion of various components of all on-going projects of the pre-Fifth and Fifth Plan period, the projects should be split into Phase-I, Phase-II etc., and phase-wise completion indicated;**
- **On-going projects should be prioritised using the guidelines of NCIWRD;**
- **Ear-marking should be done for projects with incurred expenditure of more than 85% of the estimated cost;**
- **Higher priority may be accorded to the pre-Fifth and Fifth Plan projects in allocation of AIBP funds with a view to completing these projects during X Plan;**
- **The inter-state projects, which are 13 in number, deserve special attention as lack of provision of funds by one of the beneficiary states affects overall progress of the project. It is recommended that earmarking of funds should be done to ensure desired progress and early completion of these projects.**

The Statement showing State-wise outlay for ongoing projects of X Plan with and without escalation of latest estimated cost is as follows:

Sl. No.	Name of State	Proposed Outlay for Ongoing Projects without Escalation of LEC				Proposed Outlay for Ongoing Projects with Escalation of LEC
		MAJOR	MEDIUM	ERM	TOTAL	
1	Andhra Pradesh	5295	302	1697	7294	8023
2	Arunachal Pradesh	0	0	0	0	0
3	Assam	156	59	78	293	322
4	Bihar	1282	212	72	1566	1723
5	Jharkhand	2092	422	0	2514	2765
6	Goa	184	0	0	184	202
7	Gujarat	11925	242	1628	13795	15175
8	Haryana	204	0	203	407	448
9	Himachal Pradesh	87	55	0	142	156
10	Jammu & Kashmir	0	162	81	243	267
11	Karnataka	6803	192	493	7488	8237
12	Kerala	761	417	148	1326	1459
13	Madhya Pradesh	5152	151	59	5362	5898
14	Chhattisgarh	643	107	0	750	825
15	Maharashtra	8373	1867	116	10356	11392
16	Manipur	237	32	19	288	317
17	Meghalaya	0	61	0	61	67
18	Mizoram	0	0	0	0	0
19	Nagaland	0	164	0	164	180
20	Orissa	3760	204	1059	5023	5525
21	Punjab	887	124	406	1417	1559
22	Rajasthan	3377	8	505	3890	4279
23	Sikkim	0	0	0	0	0
24	Tamil Nadu	66	65	0	131	144
25	Tripura	0	61	0	61	67
26	Uttar Pradesh	4709	5	365	5079	5587
27	Uttaranchal	991	0	0	991	1090
28	West Bengal	749	22	485	1266	1393
	Union Territories					
	TOTAL	57733	4944	7414	70091	77100

The balance of irrigation potential to be created through the on-going major and medium projects is 18.171 Mha, and the proposed creation of potential during the 10th Plan is 11.144 Mha. The total spill-over cost of the ongoing projects during post-9th Plan period will be Rs 177739 crores, of which the proposed outlays for the 10th Plan are 70091 crores (without escalation) and 77,100 crores (with escalation) respectively. The outlays required during 10th Plan for completion of pre-Fifth and Fifth plan projects are about 24396 crores. These should be funded on priority and completed during 10th Plan.

It is anticipated that 103 Major, 240 Medium and 62 ERM projects may be completed in X Plan period if adequate provision of funds is made. The Working Group has estimated that with full financial provision, the creation of potential in the X Plan may be 11.14 Mha, and proportionately less for lesser provision. **However, experience of the IX Plan amply demonstrates that it is not the financial provision alone that determines the potential created, but the manner in which funds are applied – to complete the projects which are in advanced stages, or to continue parallel activity on a large number of projects with few getting completed fully on phase-wise.**

NEW PROJECTS

State governments have proposed altogether 67 major, 130 medium and 34 ERM new projects for the X Plan. The outlay proposed in X Plan for the new projects is Rs 20,100 crores, more than 50% of which relates to the State of Andhra Pradesh (Rs 10358 crores), followed by Uttar Pradesh (Rs 2709 crores). Haryana and Orissa States have proposed outlays exceeding Rs 1000 crores each for new projects in the X Plan, with all others proposing below Rs 1000 crores. There are no major and medium proposals from Arunachal Pradesh, Bihar, Himachal Pradesh, Chhatisgarh, Maharashtra, Mizoram, Nagaland, Sikkim, Tripura and Uttaranchal. **New projects may be taken up selectively, keeping in view the necessity for removal of regional imbalances and development of drought prone and tribal areas.** On completion of all the ongoing major, medium and ERC projects o f the IX Plan almost 84% of the ultimate potential through major and medium irrigation sector will be developed leaving about another 9.35 Mha for further development. The 13 major projects taken up during IX Plan will add another 0.52 Mha of potential.

FINANCING OF IRRIGATION PROJECTS IN THE MAJOR AND MEDIUM SECTOR

The burden of financing irrigation projects in the public domain is largely being borne by the State Governments. While this is important for capital formation in rural and agricultural sectors, the States have their limitations of resources which need to be acknowledged. The large number of projects which are incomplete and proceeding at a slow speed, testify mostly to the shortage of resources.

States have been taking recourse to market borrowings to a limited extent, but this may not be sustainable as some of the borrowings have been made at high rates of interest. There is need to develop mechanisms whereby institutional and market funds at the current relatively lesser rates of interest are funnelled to irrigation projects. External assistance to this sector is also dwindling, and is now largely confined to a few Water Resources Consolidation projects, tank irrigation projects, and watershed development projects. There is need to explore using multilateral funding also for major and medium irrigation projects once again. While environmental concerns will need to be addressed, the issue of resettlement and rehabilitation should not come in the way of external financing, because they meet a genuine need which must be provided in any case**. Discussions within the country with financial institutions and with external agencies should commence on augmenting investment in irrigation projects. If necessary, the projects should be based on greater viability in terms of recovery of at least a part of the capital cost from the beneficiaries, who should be offered incentives such as matching grants or subsidy linked to credit. Such measures are imperative as the alternative, already experienced in many projects, is interminable delays in completion of projects.**

ACCELERATED IRRIGATION BENEFIT PROGRAMME

Since its inception in 1996-97, up till 31-3-2002, Central Government have released total of Rs 8480 crores. The number of projects assisted has been on the increase, and a total of 140 Major and Medium projects apart from Minor Irrigation, have received varying amounts of funding support under AIBP. The number of projects completed with AIBP assistance is 19. It is noteworthy that the AIBP funds have been applied to projects of different vintages, and in fact the bulk of the funds released have been spent on project of relatively recent start, as seen from the progress of these projects. In recent changes, AIBP on more relaxed conditions has been

introduced conditional on raising water user charges, and a 'Fast Track' provision for projects which can be completed in one year has been made with full project financing.

AIBP accounted for about 12 % of the total investment on major and medium irrigation projects in the IX Plan. There is a good case for ear-marking the AIBP funds in the X Plan for the Fifth and pre-Fifth Plan projects which have already received AIBP assistance. The central outlay on Major and Medium Irrigation should be adequate to fill the gap in States' resources, in order that all on-going works can be completed in the 10th Plan period. **This may call for raising the present AIBP outlay from an anticipated 15,000-20,000 crores during 2002-07 (10th Plan period) to about Rs 40,000 crores. The scheme should also be changed from a loan scheme to substantially a grant scheme, since the States will have difficulty repaying these Central loans.**

PRIVATE SECTOR PARTICIPATION

The Working Group on Private Sector and Beneficiary Participation has closely looked at the issue of private sector entry into the irrigation sector. As observed, there are no successful models for this in developing countries. Irrigation projects involve very large investments and low returns, which make them unattractive to private investors. The practice of non-recovery of charges adequate for O&M, let alone for a reasonable return on investment, is not a conducive atmosphere for encouraging private investment into this sector. It may be noted that the borrowings by Irrigation Corporations, where market funds are used for investment in the irrigation projects, are not based on any return from the irrigation, but on guarantee of repayment by the State Governments from budgetary provisions. Therefore they are also not a step in making financially viable entities in the irrigation sector. Even with a major project cost being met by the State, it is unlikely if private sector will as yet find the sector attractive for their entry. The Working Group has suggested that the private sector may sell water in bulk to agencies in charge of distribution systems. Unless there is guarantee of reasonable charges and prompt payment, there will be little interest in this sector from private entrepreneurs. However, the Working Group has suggested taking up pilot projects in small and medium size categories.

MINOR IRRIGATION

Against an assessed total potential of 17.38 Mha under minor surface irrigation works, the potential created is 12.25 Mha (1997), with nearly 40 percent of it through tank irrigation. Minor irrigation , basically using local resources of water to serve the needs of people, was the mainstay of irrigated agriculture till larger projects with spread-out commands were taken up in

the last century. The tank system had multiple uses apart from irrigation, including prevention of flash floods, pisciculture, water for the cattle, source of silt and mud, and recharging of ground water. During the planning era the number of tanks went up from about 5 lakhs to 15.13 lakhs in 1986-87, but there has been a decline in the gross command area under tanks from 4.78 Mha to 3.07 Mha between 1962 and 1986, mainly due to poor maintenance practices.

NCIWRD Report has emphasized the need for renovation and modernisation of tanks and other local water resources on priority. Large numbers of small local water management projects in rainfed regions can make a significant dent on the productivity of such lands and help less fortunate farmers, while improving local environment, when taken up as part of integrated watershed development. In a basin plan there is place for structures of different dimensions. Small structures are particularly important in the rainfed areas which will not get the benefit of irrigation facilities at any stage of development. The Working Group on Watershed Development, Rainfed Farming, and Natural Resources Development has assessed that 88.5 Mha of area requires tobe covered by treatment/reclamation of land under watershed development programme during the next four Five Year Plans, commencing with the 10^{th} Plan. The total cost on average for this programme will be Rs 72,750 crores inclusive of escalation. **There is considerable experience by now in the techniques of integrated watershed development, and many success stories especially involving the contribution of non-governmental and community-based organizations. There is every need to strengthen these strategies and structures as the appropriate policy for the two-thirds of cropped area of the country which will not, even in the ultimate stage, benefit from the development of major and medium systems comprising dams and canals.**

GROUND WATER DEVELOPMENT

The NCIWRD Report has gone into the issue of ground water resource and its utilisation. Availability of ground water is widely dispersed, and it forms an important source of water for drinking and irrigation. Ground water accounts for more than 45 per cent of the total irrigation in the country. The number of ground water abstration structures have increased from 4 million in 1951 to 17 million in 1997. The contribution of ground water in the achievement of food self-sufficiency has been remarkable, and its utilisation is likely to increase manifold. However, problems of over-extraction and depletion, as well as contamination of the source, have reached alarming levels. As per the National Water Policy, development of ground water resources is to

be limited to what is replenishable. The increasing trend of 'over-exploited' and 'dark' category of blocks has earlier been noted.

The Indo-Gangetic alluvial plain, with an area of around 25,000 sq. kms., is one of the largest ground water reservoirs in the world. More investigations by the CGWB are required for ascertaining the static ground water resources of the country. Meanwhile, thanks to the simplicity and ease of its extraction, and the advances in drilling and pumping technologies, more and more of the groundwater will be extracted by farmers through their own initiatives.

The Working Group on Minor Irrigation for the X Plan, has set a physical target of 3 Mha from surface water resources and 5 Mha from ground water resources, in the minor irrigation sector, making a total of 8 Mha to be achieved as additional irrigation potential. Break up of 3 Mha from surface water resources is proposed as 2.4 Mha from new MI schemes and 0.6 Mha from Renovation of existing tanks. The measures recommended include the following:

- **Modernisation of existing tanks resulting in increase of additional irrigation potential;**
- **Restoration of lost irrigation potential;**
- **Renovation of existing minor irrigation tanks in tribal districts;**
- **Construction of new minor irrigation schemes.**

The Working Group has drawn pointed attention to the deterioration of many tanks resulting in loss of about 1.7 Mha of net command area. Apart from renovation and restoration, measures to improve irrigation efficiency have to be taken. The Steering Committee further recommends that the water bodies which have been lost over the years through breaching of tanks and other reservoirs should be compensated through creation of new water reservoirs, and any breaching of a water reservoir or channel should invariably be compensated in terms of new structures for holding or flow of water. The Committee has suggested setting up of a Minor Irrigation Development Organization to ensure that high standards are maintained in investigation, design and execution of MI projects. As regards ground water, this resource can be augmented by re-charging techniques. Stress has to be laid on conjunctive use of surface and ground water in the irrigated command of minor irrigation schemes. Integrated approach for ground water management needs to address identification and protection of potential source of fresh ground water, along with sustainable ground water development, data base management, monitoring network, conjunctive use of water in irrigated command areas, recharge of ground water, and evaluation studies of ground water development.

Priority has to be given to exploration work by CGWB to achieve economical and sustainable development of ground water and augmentation of ground water resources by recharging technique.

Development of irrigation is of particular significance in the Eastern, North-eastern and Central regions of the country where the productivity of agriculture has hitherto been low. In the Eastern and North-Eastern region although there is adequate ground water potential it has not been harnessed to the desired extent. The utilization of ground water potential in these States is only about 20% of the existing potential. This calls for development, and the Department of Agriculture and Cooperation has formulated a scheme on minor irrigation development in this region. It is necessary that in X Plan minor irrigation development in Eastern and North-Eastern region is taken up on a massive scale by enhancing the investment substantially.

FINANCING OF MINOR IRRIGATION INCLUDING GROUND WATER

Construction, maintenance and modernization of minor irrigation tanks continues to be a function of the State, and to some extent, of the Panchayat Raj institutions. Ground water is however, mostly in the private sector, because ground water structures are located usually on individual farmer's land, and used exclusively by him. The Working Group on Minor Irrigation has projected a total outlay of Rs 12500 crores on Minor Irrigation groundwater schemes, of which Rs 10000 crores will be institutional finance from NABARD and the balance, i.e. 20% of the cost, will be private investment. **As a measure of poverty alleviation, development of minor irrigation and especially individual tubewells/borewells is without parallel. NABARD, Commercial Banks and Co-operative Banks should be fully involved in the task of financing ground water development schemes, by provision of individual loans for farmers, as well as irrigation cooperatives.**

SECTION 3 : ISSUES IN EFFICIENCY, SUSTAINABILITY AND EQUITY

POST-REVIEW OF PERFORMANCE OF THE COMPLETED PROJECTS

The sector is also besieged by a number of features relating to project and financial management, system efficiency, and equity among different users, which have serious implications for the sustainability of the programmes for water utilization that we have implemented, and ultimately, of the productivity of land and water.

Irrigation projects, often on actual commissioning, and almost invariably with passage of time, display several forms of inefficiencies. In several cases the deterioration in physical systems has taken place to such an extent that large investments have become inevitable to bring them back to a stage of even normal day-to-day functioning. The Working Group on Major and Medium Irrigation has reported that in about fifty percent of cases, it is observed that the irrigation potential actually achieved is very much on the lower side than projected at the planning stage. Adverse impacts such as water-logging, salinity, alkalinity, deforestation, harmful effect on flora and fauna, etc., are also noticed. It is therefore necessary to carry out performance evaluation of irrigation projects. Guidelines for these studies have been provided in the CWC in March 1997. It is proposed that the **evaluation of project hydrology and project performance on the five aspects of irrigation performance, economic performance, management performance, environmental and ecological performance, and socio-economic and agro-economic performance should be taken up.**

Post evaluation may have important points for improving the performance of the project already implemented by bringing out lacunae and suggesting solutions. Information and lessons derived from the experience and evaluation of earlier projects should form an important input in raising the quality of project formulation, enabling better use of resources and preventing compounding of errors. Dissemination of the post-evaluation findings and using its feedback among those responsible for planning, design and execution of projects are equally important.

However, the figure of ultimate irrigation potential needs periodic review in accordance with the revision in the scope of harnessing additional water resources, and technological advancement. The second census of Minor irrigation may help establish a revised figure for surface minor irrigation. A review of the ultimate potential on account of major and medium irrigation sector is also necessary and should be taken up by the States to provide a more realistic base for formulation of future plans.

INCREASING THE EFFICIENCY OF IRRIGATION SYSTEMS

Productivity levels in Indian agriculture have been a cause of concern. In regard to irrigation, inability to irrigate properly the whole of the planned area for irrigation, insufficient quantities of water supplied, shortcomings in timeliness, reliability and equity all over the command, low efficiency in regard to conveyance, distribution and application of irrigation are considered main causes in the lower productivity of irrigated agriculture and also of the low satisfaction levels amongst the irrigated farmers. Inefficiency in management and operation of irrigation systems include various problems like the gap between potential created and potential utilised, the inability of the conveyance system to carry the required water, the large losses during conveyance, distribution, and application, the non-maintenance of the field application system, and in-appropriate method of field application such as the continuation of flood irrigation and the lack of field channels.

The inequity in water distribution on one hand fails to irrigate part of the land, gives insufficient supply to some part of the land and at times causes damage to some lands due to over-irrigation and consequent problems of water-logging and salinity. Lack of surface and sub-surface drainage in the area compound these problems. Since inequitable large volumes of surface water becomes available, no water stress is felt, the conjunctive use of ground water does not take place and consequently the ground water table rises into the root zones causing water-logging. Depending on the salinity balance (dictated by the salinity in the irrigation waters, the salinity in the soils) the soils carry away through drainage and salt accumulation takes place and at times comes up to the water surface causing somewhat irreversible damage to the land and its productivity. The Working Group on Crop Husbandry, Demand and Supply Projections and Agricultural Inputs has observed that the unsustainable practices like excessive use of water together with imbalanced use of fertilizers especially in the Green Revolution areas of northern and north-western parts of the country have affected the soil health adversely. While agricultural inputs are supplied with subsidy, there is inadequate investment in irrigation and maintenance of canals, to mention only the items pertaining to this Committee.

Problems of existing irrigation systems may not be limited to those related to irrigation efficiency and equity. At times the water availability itself may be inadequate or may have become inadequate due to upstream development. The cropping pattern may have changed from those for which the system was planned.

A number of programmes such as CAD Programme, programmes of farmers' participation in irrigation management, the National Water Management Programme, the Water

Resources Management and Training programme, etc. were undertaken with the objective of tackling this range of problems. This is an area calling for substantial new initiative including detailed post facto evaluation/review of the system and their performance. A proper operational plan both for normal and emergent situation is rarely available in most projects, and the system is operated on ad hoc day to day basis. Technical solutions (e.g., canal lining, automation, where appropriate) and introduction of conjunctive use of water resources hold out ways to deal with the problems along with modern irrigation techniques such as drip and sprinkler, rotational supply of water, and participatory irrigation management.

Various definitions of irrigation efficiency in its different forms such as conveyance efficiency, distribution efficiency, field application efficiency and overall or project efficiency, and analytical tools for determining these at the basin or project level, are available. **Recognized performance indicators such as 'equity' and 'adequacy' are basically combinations of efficiencies and uniformities and can be calculated from the same data. What is important is that projects which are in urgent need of study should be taken up for detailed analysis and followed up by action for rectification.**

STATUS OF MAINTENANCE

It is stated that in pre-independence period, irrigation projects were net revenue earners to the state after meeting O&M costs. Viewed as instruments of development, irrigation projects could no longer be set up with a profit motive. However, in the process the concept of reasonable user charges adequate to meet the O & M expenditure and special repairs, has also been largely given up. To re-introduce the concept is indeed proving to be an uphill task, which unfortunately has an adverse effect on the long-term health and sustainability of projects. The maintenance of most of the irrigation projects completed prior to independence, and also those completed since planning started, has been far from satisfactory.

As regards revenues from irrigation projects, they fall far short of the requirement of O&M expenditure, and most of the funds for O&M come from the non-plan budgets of the State Governments. There is a wide gap between the Receipts and Working Expenses per ha. of irrigated area due to low water rates, poor collection of revenue, mounting wage bills and rising cost of material, transport etc.

Sample data show the following in four States:

(Rs in lakhs)

Year	Andhra Pradesh	Assam	Gujarat	Haryana

	O&M Expdr.	Revenue	O&M Expdr.	Revenue	O&M Expdr.	Revenue	O&M Expdr.	Revenue
1992-93	7695	-	173	-	1701	696	8600	1405
93-94	8884	7448	175	-	1730	875	9846	1281
94-95	8813	5787	287	-	1495	724	10087	1484
95-96	10309	4958	303	0.62	2363	1078	13003	752
96-97	10129	6980	348	0.14	2525	1088	14224	2801
97-98	10909	7007	429	0.05	2719	941	12485	4328
98-99	12627	9316	565	0.40	3005	849	15157	4016

A serious issue is the high share of establishment costs in O&M. Since this takes away the bulk of the outlay, the working expenditure in 1998-99 were as follows : Assam-0.8% of the total O&M expenditure; Haryana-6.9%; Andhra Pradesh – 13.4%; Gujarat (for major projects) – 44.6%.

It is essential that there is agreement at all levels on certain basic principles relating to O&M, water rates, and farmers' participation. These could be:

- **The performance of irrigation systems is to be maintained at a satisfactory level by regular and timely physical services which can ensure reliability of the supplies. It is essential to provide adequate funds for the works component under O&M so that the related structures perform satisfactorily.**
- **There is need to revise the water charges on the basis of related costs for works so that O&M expenditure could be fully met from the revenue recovered through the revised water charges.**
- **In the revised water charges, while the components for works should be fully provided, the expenditure on establishment costs should be kept within the prescribed ceiling of 25 percent of the O&M costs.**
- **There is an urgent need to implement programmes which will reduce the overburden of excess staff which eats into the limited funds available for O&M.**
- **Formation of Water Users' Association should be encouraged to take charge of the system thereby also reducing the establishment charges.**

- **The revised water rates should cover the entire annual O&M cost plus a percentage of the gross value of the produce per ha so as to provide for the modernisation of the system.**

EXTENSION, RENOVATION AND MODERNISATION SCHEMES

ERM schemes, if properly planned, will cover not only engineering aspects of the irrigation system but also agronomic and management aspects. Typically, ERM schemes aim at avoiding excessive losses in the distribution system and field channels, a re-appraisal of the irrigation water requirements and frequency of water application, the conjunctive use of ground water to the extent possible, improvement in the drainage conditions of the command area, modifications to canal structures and construction of new structures as necessary, adequate on-farm development, proper water management and provision for satisfactory maintenance of the system. The reasons for initiating ERM projects range from defective planning and designing to deteriorated condition of conveyance system due to poor maintenance/deferred maintenance, capacity loss due to sedimentation, changes in hydrological conditions and cropping patterns, new information relating to earthquakes or floods necessitating changes in project features, etc.

During the Ninth Plan the progress of ERM schemes which have spilled over from the 8th Plan has been rather tardy. Some of the schemes such as Tungabhadra HLC Stage II (AP), Ghataprabha Stage III (Karnataka) etc. were taken up as far back as in III/V Plan and not completed, and expenditure has not led to commensurate increase in potential created**. Several schemes are practically complete, i.e., Utilised Potential of more than 95% has been achieved, but are still shown as continuing. These could be treated as completed and closed.**

It is apparent that having started ERM schemes, the States face inadequacy of funds which are allocated on priority for ongoing projects for new creation of potential, and where substantial investment already made will be fruitless unless they are completed. ERM works should be carefully chosen and thin spreading in this set of works should be avoided as with new projects. Wherever substantial investment has already been made in ERM schemes, and benefits maximized with relatively less expenditure, such works should be completed on priority. **There is a case for abandoning some of the works which have shown negligible progress during the 9th Plan and where paucity of funds is likely to continue. An exhaustive review of these works should be taken in the background of resource position and priorities in utilizing the resources, and an appropriate case-by-case decision taken within a short period of time.**

IRRIGATION AND DRAINAGE

The need to integrate surface field drainage network with a new irrigation project, is well-established as the means to prevent water logging and salinity problems which may subsequently call for a lot of effort and expenditure to cure. This may increase the project cost by about 20 %. Specifications have been laid down to identify lands having limitations of either soil, topography or drainage when used for irrigation leading to water-logging or salinity after a short period of sustained use. Thus the problem areas can be identified with a reasonable degree of accuracy and preventive measures can be taken in this area by constructing drainage schemes simultaneously with the irrigation project. This will provide adequate arrangement to drain out the excess water from the fields through the root zones before it could cause any damage. There is a choice of open or pipe drains, with the latter having a higher initial cost but less maintenance. In deep heavy soils where traditional horizontal sub-surface drains are not effective, vertical drainage with a battery of wells can be established. Encouraging results have been achieving in protecting valuable land against water-logging in the Western Yamuna Canal area of Haryana through pumping out the excess sub-surface water into the open canals. This can be adopted in other areas with a similar problem. **Pilot studies to establish effectiveness of 'bio-drainage' in both command areas and areas naturally prone to water logging, need to be taken up during the 10th Plan.**

ISSUES IN PRICING OF WATER AND REVENUES FROM IRRIGATION

"Water is both an economic and social good. Water used for irrigation is an economic good and its logical pricing is a key to improving water allocation and encouraging conservation". (NCIWRD Report, 1999)

Canal water rates are generally area based depending on crops and seasons, and reliability of supplies. Charges are low and widely variable, and have not been revised for many decades in most states.

Practices vary from state to state based on the principles adopted : free supply of water, free supply of water and electricity, free supply to some categories of farmers, irrigation charges combined with land revenue, seasonal rates, rates related to land classification, differential rates for perennial and non-perennial canals, class of projects etc. Revenues are low and have been

dropping in relation to the working expenses which, on the other hand, have been rising on account of overstaffing.

Revenue returns can be increased by expanding the benefited area, by saving water. There are various ways to reduce working expenses but redeployment of excess staff would be a necessity. Even though the existence of excess staff in Irrigation Departments is a known fact in a majority of states, a study to find out ways in which the excess staff can be re-deployed so as to avoid use of scarce O&M outlays to salaray costs, is yet to be taken up. Apart from reluctance to revise rates, physical and operational inadequacies of the facilities resulting in low and uncertain utility; in order to overcome resistance, it would be necessary to improve reliability and efficiency. **Increase in water tariff could be acceptable only when basic restructuring is done by reducing establishment costs, better technical management, and establishing participatory systems.** Charging by area crop basis instead of volumetric basis results in substantial wastage, and provides no incentive to farmers to save water which can be used to irrigate larger areas. There is a need to evolve norms of water rates based on the volumetric system.

The issues of water rates, O&M efficiency and adequacy, modernization of degenerated installations, and participatory management are all inter-related, and the sooner this is recognized and comprehensive action initiated, the better for improving the efficiency and serviceability of irrigation systems.

From the recommendations of various committees and groups the following picture emerges :

- Many expert groups have favoured the levy of a fixed charge ('membership charge'), and a variable charge per ha of irrigation to meet annual O&M cost, and one percent interest on capital cost. The objective is to move towards full-cost recovery. The physical and operational structures have to be modified for volumetric system of tariffs.
- Volumetric basis has to be the ultimate method, combined with improvement of existing systems, creation of autonomous financial self-reliant entities at the system level with participatory management of users.
- The present O&M allocations are too low because of budgetary constraints. Realistic O&M costs should be worked out on pilot representative systems with adequate funding, which can be used for fixing of rates; there should be a ceiling on establishment charges.

- In addition to full recovery of O&M charges, a charge related to the value of the product should recovered and used to modernise the system with supplementation from the budget.
- However, if the additional revenue realized is only going to be used to meet the staff salaries, little purpose would have been achieved. The action to deal with the problem of excess staff should be taken up simultaneously.
- Group formation should be encouraged, but supply on volumetric basis with substantially lower rate for group supply than the individual consumers charged on crop area basis.
- Charge should be crop/season based rather than crop/area based, with proportionately higher rates for water intensive crops.

BENEFICIARIES' PARTICIPATION

The management of irrigation systems, especially the lack of sufficient focus on water distribution and maintenance aspects, have led to sub-optimal utilisation of the created potential, and contributed to inequitable distribution and less efficient use of available supplies. Inadequate control and near absence of rotational canal schedules and *warabandi* in many new schemes make the designed supply more deficient, as farmers in head reaches draw disproportionately large quantities of water. Inadequate maintenance has resulted in reduction of canal capacities and higher seepage losses, and added to the problems of deficient water supply. Absence of night irrigation leads to excessive return of irrigation water back to the natural drainage system, which is a wasteful practice in a high-cost system.

Irrigation management is legally regulated by the various State irrigation statutes. The Irrigation Acts enacted by the British administration did not incorporate the concept of beneficiaries/farmers' participation in the management of irrigation systems. The singular exception was the Madhya Pradesh Irrigation Act 1931, which empowered the State government to set up irrigation panchayats for every village that had, inter alia, been assigned the functions of distribution of water and collection of irrigation fees and remittance to the government. However, this model was controlled by the bureaucracy.

While this has been the position, as has been noted earlier irrigation in pre-independence days was a net revenue earner to the State. Farmers' participation in developing a *warabandi* system was already in vogue in several States even prior to Independence. In the period since planning began, the participation of farmers became a necessity in order to make the potential created actually used, because of the gap between the two. The area of action for Command Area

Development Projects was below outlets, which was owned by and operated by farmers according to their needs of growing irrigated crops. Thus a line was drawn, with canal system above outlets being operated, maintained and managed by the concerned irrigation departments. While some of the activities below outlet were for individual land owners to perform, there were others where group activity was called for. It had to be recognized that the objective of establishing irrigation systems could not be fulfilled unless an efficient interface was established between the farmer and the many departments which were to provide him services in such matters as guidance on on-farm development, supply of inputs, efficient system of distribution of water, extension support, creation of transportation and marketing facilities, and action to deal with water-logging and salinity. Maintenance and efficient operation of irrigation structures and systems are matters of vital interest to the farmer, but his participation was not provided for above the outlet level.

In recent periods there has been a great deal of fresh thinking on the role of the beneficiary farmer. There are demands to bring the farmer to centre-stage and reform the irrigation system and its structure. The problems of maintenance and of other factors contributing to low productivity have already been narrated earlier. A top down approach not responsive to the problems faced by farmers, is blamed for this state of affairs. The recommended solution to reform the sector through making PIM the centre-piece. This goes beyond the establishment of WUAs which look after the minors and below. Command Area Development Programme aimed primarily at improving tertiary on-farm physical systems and emphasis was on construction of field channels, field drains, land levelling/shaping, and introducing *warabandi* etc. However, it has gradually been realised that building of infrastructure below the outlet level alone is not sufficient, and that it is necessary to improve the irrigation system as a whole and involve the farmers, particularly, in water distribution and management aspects of irrigation. For the success of Farmers' Participation, attitudinal changes on the part of the Irrigation Administration would be required, and as such their controlling and paternalistic attitude towards farmers would have to change to promote a spirit of partnership between irrigation officials and farmers.

There are, however, in-built resistances to change in both the irrigation bureaucracy and the farmers. The prolonged prevalence of Government-managed systems has sapped the initiative of the farmers and made them dependent n the Government and they are reluctant to take up any responsibility for management. However, once convinced of the usefulness of change, they are not averse to it. Farmers have not yet been made fully aware of the benefits of

PIM and are consequently apprehensive that the CADA/Irrigation Department are only anxious to transfer their responsibility of operation and maintenance and collection of water charges to them. They also fear that the Irrigation Department may not co-operate with them, after actual transfer of O&M and other functions has taken place. At the same time, they may not be sure of their own ability to properly operate the system and to manage the affairs of the Association, to collect water charges and resolve conflicts. When PIM is promoted purely on voluntary basis, the farmers who are used to receiving irrigation water at a nominal charge do not perceive any compelling need to take over the responsibility, which may involve a substantial financial burden. Again, amongst the irrigators, those who are enjoying more than their fair share of irrigation waters, mostly the head-end farmers who benefited from disproportionate share of waters in early phases and have continued in this iniquitous situation, have also no incentive to join the PIM programme. This voluntary participation approach, entirely at the option of the irrigators, without the pressure of suitable disincentives or compulsions, has been an important reason for its slow progress, particularly in view of the conflicts of interests between head-end and tail-end farmers. In particular, the more powerful farmers in collusion with officials have prevented the establishment of such systems.

The Working Group on PIM for the Ninth Plan favoured substantial forward movement and suggested a target of 10% of the irrigated area to be covered by PIM by the of the Plan period. During the Ninth Plan period about 2000 pilot projects were to be taken up. The selection of these pilot projects was envisaged to be such that all minors of at least one distributary were covered. Funds were provided for the PIM initiative under the CADP towards management subsidy. Overall progress in terms of removing legal bottlenecks, formation of WUAs and introducing certain policy measures in several states :

To-date achievements in PIM including Ninth Five Year Plan

- The Government of Andhra Pradesh enacted in 1997 “AP Farmers’ Management of Irrigation System Act” under which 9800 WUAs have been formed and elections held. A majority of them relate to Minor Irrigation schemes. In case of Major and Medium irrigation schemes the WUAs have been formed at the level of sub-distributary or minor canal level. The State has adopted the policy of getting development works executed through the WUAs. There has been significant initiatives of farmers involvement in overall canal management. Certain functions like collection of water charges and annual maintenance of physical systems are being gradually taken over by the farmers

organisations. The State Government has issued orders on sharing of water charges among the various farmers' organisations and the irrigation department. The O&M expenses will henceforth be borne by the farmers' organisations for the physical systems under their jurisdiction. The State has utilised part of financial assistance received under APERP and other World Bank financed schemes for carrying out *minimum rehabilitation* besides CADP funds before transfer of management to farmers' organisations.

- Government of Gujarat, with a strong tradition of co-operative movement, has accorded high priority to the policy of involvement of farmers in irrigation management. The State has taken up 13 pilot projects to study the modalities of implementation of PIM. It adopted a policy to accord priority to those schemes for rehabilitation where farmers were ready to form Associations and share part of the costs. 278 WUAs have already been formed in the state. In the areas to be commanded by the Sardar Sarovar Project, it has been decided , as a matter of policy, to supply water only the WUAs on volumetric basis, and not to individual farmers. For this purpose, WUAs are being formed, with minor as the basic unit, in an area of 17 lakh ha. The WUAs are being made responsible for the construction and O&M of the tertiary system serving Village Service Areas.
- In Maharashtra, 247 WUAs are already reported to be functioning, and 307 WUAs are at various stages of formation and would be operational soon. The present Irrigation Act is proposed to be amended. The State has decided to supply water to WUAs on volumetric basis, and to take up the work of renovation of irrigation sub-systems before handing over to WUAs. Priority shall be given to complete the works where WUAs are already formed.
- Legislative changes have also been made or are being considered to facilitate setting up of WUAs and PIM in Assam, Goa, Gujarat, Karnataka, Madhya Pradesh, Orissa, Rajasthan and Tamil Nadu.
- Progress in various States is as follows:

Sl. No.	Name of the State	No. of WUAs formed			Total area covered in lakh ha.
		Major & Medium	Minor Irrig.	Total	
1	Andhra Pradesh	2046	7754	9800	43.15
2	Assam	47	230	286	0.34
3	Bihar	37	N.A.	37	1.06
4	Gujarat	N.A	N.A.	378	0.82
5	Goa	N.A.	N.A.	43	0.05
6	Haryana	2575	N.A.	2575	3.00
7	Karnataka	864	N.A.	864	3.04
8	Kerala	N.A.	N.A.	3930	1.51
9	Madhya Pradesh*	N.A.	N.A.	2416	26.30
10	Maharashtra	236	11	247	0.92
1	Orissa	163	N.A.	163	0.74
12	Punjab	957	N.A.	957	1.05
13	Rajasthan	401	N.A.	401	1.86
14	Tamil Nadu	1398	131	1529	7.56

The Working Group on Private Sector and Beneficiaries' Participation for the X Plan has recommended that during the X Plan period, a programme of Command Area Development and Management should be implemented, and coverage achieved of 10 Mha under the programme. The programme will cover both Command Ares Development and management aspects of irrigation and should vigorously promote and improve the performance and efficiency of irrigation system of the country as a whole, and will be available for any existing project with CCA of 500 ha upwards, where the farmers show their readiness to take responsibility of managing transferred system in a more effective and viable manner. This requires financial support assessed as Rs 4800 crores of which Rs 4000 crores will be for minimum rehabilitation of physical system, and the balance for support to WUAs, motivation/awareness, capacity building, monitoring, evaluation, etc. Funding is to be shared in the ratio of 60% (Centre), 30% (States) and 10% (farmers, with an additional 10% from farmers for a fund for maintenance and upgradation of the irrigation system). The Working Groups favours setting target dates for

Government to withdraw from water distribution and maintenance of the canal system. However, Government will continue to own the dam, reservoir and the main canals, and the Irrigation Dept. should continue to operate and maintain them. While it is desirable to carry out minimum rehabilitation before transfer/turnover of components of irrigation system to WUAs, for which adequate funds at the rate of Rs 4000 per ha of CCA will have to be made available through CADAM funds, it should not be a pre-condition for setting up of WUAs. Furthermore work should not be taken up before WUAs are actually formed and have been operational for some time should be fully involved in prioritisation of the works to be done and should be encouraged to undertake actual construction with technical support of the Department. If the work of rehabilitation is done by the Department, it should e supervised by WUAs for transparency. Revision of water rate should be done to recover full O&M cost and at least of 10% of the capital cost. Participation of NGOs, should be encouraged.

RECOGNIZING FARMERS AS THE LARGEST STAKE-HOLDERS IN IRRIGATION PROJECTS

A more radical view is that a Federation of Water Users' Associations should be formed, in case of minor irrigation and medium irrigation projects, at the project level, managing the dam, main canal and branches. PIM should not stop at distributory level. To make PIM more successful and satisfactory in major irrigation projects, the branches in the main canal should also be brought under PIM, and CADAM therefore should provide funds for promoting PIM in the higher reaches of medium and major irrigation projects. New projects henceforth should have a built-in PIM.

COMMAND AREA DEVELOPMENT PROGRAMME

The Centrally Sponsored Command Area Development Programme was launched during 1974-75 at the beginning of the 5th Five Year Plan, as an integrated and coordinated approach to irrigation water management, and to bridge the gap which was noticed at that time between the irrigation potential created and that utilised. The programme, which included on-farm development and delivery of inputs and extension services, had for action the area below outlets, which was owned and operated by the farmers according to their needs of growing irrigated crops. Activities under CADP include:

On Farm Development (OFD)

- Development of field channels and field drains within the command of each outlet.
- Land levelling and shaping on an outlet command basis.

- Reclamation of waterlogged areas. Introduction of *warabandi* and fair distribution of water to individual farmer, possibly through promotion of farmer's participation in irrigation management and through improved communication system including wireless.
- Realignment of field boundaries, wherever necessary and possible, ain combination with consolidation of land-holdings.

Supply of all inputs and services, including credit; Strengthening of extension services

Selection and introduction of suitable cropping patterns, again through adaptive trials, demonstration and training

Development of ground water irrigation, to supplement surface water irrigation through conjunctive use of ground and surface waters by promoting cooperation with related line department. Subsidy to small and marginal farmers was envisaged for groundwater development and sprinkler-drip irrigation.

Development and maintenance of the main and intermediate drainage systems

Modernisation, maintenance and efficient operation of the irrigation system up to the outlet with capacity of one cubic foot per second (cusec) flow.

Increase the production and productivity of agriculture through cooperation amongst different disciplines and departments with adaptive trials, demonstration and training inputs.

Monitoring and evaluation for mid-term correction/improvement through organised cells and through field visits by officials and consultants.

The core activities under Central assistance are the field channels, field drains, land levelling-shaping, and *warabandi.*

COVERAGE OF CADP

There are reported 1645 Major and Medium Irrigation projects in the country, out of which 1047 are completed and 598 are on going. So far, a potential of about 34 Mha has been created under M&M projects. CADP presently covers 236 of these projects in 28 States and 2 Union Territories, which are mostly completed, covering a CCA of nearly 23 Mha or 68 % of the potential created. Commencing with 60 M&M projects in 1974-75, the number went up to 265 projects of which 29 or 11 % have been dropped. There is apprehension that the funds of the project are thinly spread, making it difficult to complete the projects taken up. During the 9th Plan the achievement of the core components of the Programme were as follows:

Field Channels – 14,76,000 ha

Warabandi – 15,00,000 ha

Field Drains – 229,000 ha

Land levelling and shaping – 79,000 ha

Overall achievement since inception has been (till end of 1999-2000):

Construction of Field channels – 14.96 Mha

Warabandi – 9.66 Mha

Land levelling and shaping – 2.16 Mha

Field Drains – 0.93 Mha

The total outlay for the 9th Plan from central sector was Rs 840 crores, against which releases in the first four years were Rs 605 crores. The Working Group has assessed that to complete the ongoing projects would require a provision of Rs 5400 crores, with additional requirement for conjunctive use of ground and surface water of Rs 400 crores, removal of system deficiencies – Rs 600 crores; and drainage provision and upkeep – Rs 500 crores.

The positive impacts of CADP have been recorded by evaluation studies as better utilisation of the created irrigation potential, increase in irrigation intensity and water use efficiency, introduction of suitable cropping pattern promoting high efficiency in place of low efficiency crops, increase in agricultural production, increased use of fertilizers, improved variety of seeds, improvement in farm income, and positive environmental impact. However, there is still much to be done, as revealed by the summary of evaluation:

SUMMARY OF EVALUATION OF CADP, JUNE 1997 BY JPSA, NEW DELHI

The study covers CAD activities, which were spread over 24 States, 54 CADAs, 203 projects and 21.1 Mha of CCA. Potential created and utilised then we 14.94 and 11.98 Mha respectively. Till March 1997, central assistance was about Rs 1688 crores. States had spent Rs 2580 crores by March 94. In all, thus, an amount of Rs 3200 crores seems to have been spent on CADP per ha of CCA. Ten projects one from each of the States of AP, Gujarat, Karnataka, MP, Orissa, Rajasthan, UP, WB, TN were studied by the consultant. Some of the observations are :

Field Channels : The progress of construction of FCs was slow. The major impediments were – short period of survey and construction and inadequate funding and attention by State Governments. Increased Central grant of 80% may help to hasten progress, which otherwise might take more than 20 years to complete.

Realignment of field boundaries and consolidation of holdings: Lack of completed land records is a major reason holding up this component. The study recommended that the entire process of

realignment of field boundaries and consolidation of holdings and land levelling should be taken up as a single package.

Extension service support : The study observed that the effort needs improvement.

Selection and introduction of suitable cropping pattern : High water use crops like paddy, sugarcane were introduced in head reach, which caused water-logging on the one hand, while depriving tail enders of water, on the other.

Conjunctive use of surface and ground water : Major constraints were small and fragmented holdings, poor economic status of farmers, lack of institutional financial support, poor supply of electricity and diesel, and inadequate subsidy.

Modernisation, maintenance and efficient operation of the irrigation system up to one cusec outlet: Proper upkeep, maintenance and operation of the system was found lacking.

Development and maintenance of the main and intermediate drainage systems : Maintenance was not done. The study emphasized proper survey of areas affected by water-logging and secondary salinisation through various methods including remote sensing. The need for building a sound database for this purpose was expressed. Reclamation of waterlogged areas is proposed as a thrust area.

The Working Group on Command Area Development Programme for the Tenth Plan has estimated that out of 23 Mha which is the CCA of the 236 projects under CADP, as much as 8 Mha still require construction of Field Channels, for which the funds required as per norms are Rs 4800 crores. This is the major incomplete item. Other components of Warabandi, Land levelling and shaping, and Field drains require a further Rs 600 crores. It is also suggested that the reclamation of water logged areas in 100,000 ha, system correction and drainage upkeep be introduced into CADP which may require Rs 1200 crores.

Command Area Development programmes need to be energized for quick implementation, to achieve the fullest potential created. The Water and Land Management Institutes should be involved in developing specific action plans based on survey of the needs under each irrigation command for CAD works. The keys to successful CAD implementation are comprehensive planning of all the relevant components of the programme, and participation of the farmers in the command areas.

SECTION 4 : FLOOD MANAGEMENT

Devastation by floods has become an annual feature in India, with eastern and north-eastern regions being most vulnerable. Floods cause enormous damage to life, property, and disrupt infrastructure. To those affected, they are a source of psychological end emotional instability.

Flood management is therefore an important area of governmental action. It does not aim at total elimination of floods or total immunity. A multi-pronged strategy ranging from modifying the floods by means of structural measures to learning to live with the floods by means of other non-structural measures is the pragmatic approach. Through them it is possible to achieve a reasonable degree of protection and reduce the havoc of floods.

While measures have been taken over a long period of time, statistics do not show mitigation; on the other hand, there is greater loss. The Ninth Plan document recorded that the total area affected annually is about 7.56 Mha, of which cropped area was about 3.52 Mha. Current set of data from States shows that the area affected is about 7.56 Mha of which cropped area is 3.55 Mha. The number of human lives lost has risen from 1504 lives on an average per annum, to 1595 lives. There is enormous loss of houses, crops and cattle every year currently estimated at about Rs 1347 crores per annum. Increased occupation of the flood plains and increased developmental activities are probably responsible for the continuing high levels of flood damage. It is evident that the problems needs to engage the most earnest attention of the authorities till more is done to reduce the magnitude of the annual losses.

As a matter of fact, considerable amount of work has already been done to establish the strategy for mitigation of flood damages, and these are contained in various documents of which the most important ones are the Report of the Rashtriya Barh Aayog (1980), the National Water Policy (1987), the Report of the Task Force to review the impact of the recommendations of the RBA (1996), and the National Commission on Integrated Water Resources Development (1999). The substance of these recommendations and measures may be grouped as follows :

A. FLOOD PLAIN ZONING : Flood Plain Zoning and its management is necessary, and in its absence, periodic displacement and rehabilitation of large number of people has become a common feature, and huge amounts are paid by way of compensation. Master Plan should be made for regulation of man-made activities – settlements and economic activity – in the Flood Plain Zones and if necessary rehabilitation should be made on permanent basis with employment potential nearby.

Unauthorised river bed cultivation needs to be prevented. Encroachment by people in flood plains should be tackled effectively.

State Governments should get flood risk maps prepared and follow up with appropriate measures, which include Flood Plain Zoning Act.

B. FLOOD DAMAGE DATA : Flood damage may be reported basin-wise separately for unprotected areas, protected areas and areas between embankments.

C. STRUCTURAL MEASURES : Master Plan for flood control in a basin should form an integral part of Master Plan for optimum utilisation of land and water resources. Construction of flood moderation measures should be taken up especially in North East. Adequate flood cushion be provided in reservoirs, wherever feasible, to facilitate better flood management. Operation/rue curves of major reservoirs to be reviewed and revised. For evaluating performance of existing and future flood control works, appropriate data base should be built up. While physical flood protection works like embankments and dykes continue to be necessary, the emphasis should be on non-structural measures for the minimisation of losses, such as flood plain zoning.

Erosion problems to be considered neither in isolation nor on an ad hoc basis. Sound watershed management through extensive soil conservation, catchment area treatment, preservation of forests and increasing the forest area and the construction of check dams, should be promoted to reduce the intensity of floods.

Raised platforms be constructed in areas prone to frequent floods near villages. Adequacy of existing sluices, roads and railway bridges, culverts and drainage channels to be examined.

D. FLOOD FORECASTING : CWC to expand and modernise flood forecasting systems. An extensive network for flood forecasting be established for timely warning to the settlements in flood plains.

E. FLOOD RELIEF : National Council for mitigating disaster should be formed. Specific flood prone area programme similar to drought prone area should be launched.

F. CATEGORIES OF FLOOD PRONE AREAS : Flood prone areas are categorized into five groups – those affected every year, at least once in five years, once in 25 years, once in 100 years, and areas within the river embankments or high banks. The Working Group has re-emphasized that the State Governments should immediately arrange to prepare maps showing the areas coming under each of the above five categories. The areas that are protectable can be then worked out scientifically. Alongside, it is also necessary to identify water-logged areas to take action to remove drainage congestion as a Flood Control Schemes.

9TH PLAN REVIEW

The Working Group on Flood Control Programme has noted with concern that the share of flood control measures in the Plan has steadily been declining. In the Ninth Plan, however, the expenditure is expected to be higher than the approved outlay in both the State and the Central sectors. Despite this, the Plan expenditure on flood management is less than the relief expenditure, which is a point the States should keep in mind. A large number of schemes taken up on the one hand, and the reduced outlays in the face of cost escalations, have resulted in very heavy spillover amounts into the Tenth Plan. Physical achievement in the Ninth Plan is assessed to be 1.14 Mha being benefited, which should be added to 15.29 Mha at the beginning of the Ninth Plan reported to be provided with a reasonable degree of protection.

Review of Structural Measures : The estimate of area prone to floods, as assessed in the Report of the Rashtriya Barh Aayog, was 40 Mha., out of which the Report estimated that 32 Mha. could be given reasonable degree of protection, against which the achivement is 16.43 Mha. Among protective measures, from 1954 to 1993, 16,199 km of new embankments and 32,003 km of drainage channels have been constructed. 906 town protection works have been completed and 4721 villages raised above flood levels. Besides, storage reservoirs in general also have contributed to control of flood by way of reducing frequency/intensity of floods while the reservoirs with flood cushion have provided more effective protection. This is contained in the Report of the NCIWRD. The Commission has commented positively on the useful role played by embankments and dams/reservoirs in moderating the effect of floods. However, both the Commission and the Working Group have emphasized the need for performance review of selected embankments, and the latter Report also suggests the setting up of an expert group to review the major dams of India to suggest if the reservoir regulation can be modified for better flood management in the future.

Review of Non-structural Measures : Flood Forecasting – CWC is presently responsible for issuing flood forecasts in 157 stations of which 132 stations are for river stage forecast and 25 are for inflow forecast. On an average about 6000 flood forecasts are issued every year with an accuracy level that has ranged from 94.3% to 97.9 %. Under the cooperation programme with Bhutan and Nepal, hydro-meteorological data on rivers flowing from these countries into India are also collected and the data used for formulation of early and better forecasts of these rivers.

The Working Group has emphasized the need to continue flood-proofing, and flood plain and flood risk zoning through extensive mapping of the areas, using remote sensing technology and satellite imagery.

STRATEGY FOR X FIVE YEAR PLAN AND INVESTMENT PRIORITY

The extent of the flood problem is enormous. It is therefore essential that the Central Government and its agencies complement the efforts of the State Governments in speedily completing many of the critical flood management works that have been languishing for several decades in the absence of adequate funds, inadequate organizational and implementation capacity. On-going schemes of earlier plans should be completed expeditiously. The important measures to be taken are:

- Undertake construction of dams and reservoir schemes with adequate flood cushioning facilities for long term solution of flood problems.
- Raising and strengthening of the embankments constructed, to stabilize the benefits of these measures. New embankments or anti-erosion works for locations where flooding and damages are recurrent.
- Integrating flood management schemes with other infrastructural development programmes in the sector of roads, railways, inland waterways, and canal/command area development works. Extensive river training and control structures for inducing river flows along its central course and away from its banks. Provision of drainage and adequate vented sluices to clear congestion and water-logging in habitable areas and valuable agricultural areas.
- The Indus and the Ganga-Brahmaputra-Meghna river systems originate in the Himalayas and their Basin covers, partially or wholly, seven countries, viz., Afghanistan, Tibet region of China, Pakistan, Nepal, Bhutan, India, Bangladesh and Myanmar. These rivers affect the most flood prone areas of India. The participation and active cooperation of all the co-basin countries would be required to discuss and agree upon a cooperative framework. Storage reservoirs such as Pancheswar, Saptkosi High Dam. Kamla, Bagmati, Chisapani (Karnali), Sikta, Kali Gandaki I & II, Seti, and other need to be undertaken at the earliest. An Indo-Bhutan Joint Rivers Commission to be set up.
- Development of improved silt and water management techniques for improved flood management.

- Priority for protection of additional areas in dominant flood prone states to lessen annual damages and expenditure on relief.
- Flood proofing programme such as raised platforms and quick drainage facility to be extended to areas other than North Bihar. In the State of Uttar Pradesh, the State Government had earlier undertaken raising of villages to safe heights by construction of ring-bund around populated areas, raising of plinths of houses above the High Flood Level, and raising the level of ground at some important locations of the village.
- Drainage congestion improvements to be treated as an integral part of flood management. Development of natural swamps and lakes into detention basins.
- Risk maps and flood plain zoning. Morphological studies with use of satellite imagery for mapping the behavioural pattern of the Ganga, the Brahmaputra and the Meghna river systems.
- Coordination with Ministry of Agriculture on watershed development, for adoption of a common approach keeping in view the flood problem.