POLICY
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Agricultural Scientists' Perceptions on National Water Policy

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Introduction

Water is an essential resource for sustaining life and environment. In view of its limited availability and competing demands, it is imperative to utilise it with utmost efficiency. Its development and efficient use are necessary to meet the basic needs of biotic populations and maintain a congenial environment. At various stages in the history of Indian civilisation, knowledge has been building up in improving the development and judicious management of water resources. Our forefathers were conscious of the importance of this precious resource and the consequences arising from its mismanagement as is evident from: No grain is ever produced without water, but too much water tends to spoil the grain. An inundation is as injurious to growth as dearth of water.

— *Narada Smriti XI*, 19

> Rishi Narada enquired from emperor Yudhistira whether the farmers were sturdy and prosperous and whether the dams had water for distribution in different parts of the kingdom.

— *Kaushika Sutra* (3150 B.C.)

Highly prosperous early civilisations around Mesopotamian plains and the Yellow River, Indus and Nile river valleys are known to have perished when they failed to appropriately operate and judiciously manage large water bodies in irrigated agriculture. Equally glaring examples are available from our recent past in India when mismanagement of canal waters contributed to acute problems of land degradation. However, of late, the issues of environment, equity and economic competitiveness which were not considered important a couple of decades ago, have appeared on the centre stage of land and water development programmes. Pressure groups on water- and landrelated environmental issues throughout the world have created an awareness which was reflected in repeated international declarations culminating in the recent Rio-summit.

This awareness has led to formulation of national policies on land use, environment, forests and agriculture in India. Issues relevant to water, figure prominently in all these policies. However, there are differences in areas of focus giving conflicting signals which should be resolved for creating harmony in the implementation of these policies. On the other hand, under pressures of growing biotic populations, fresh water is subjected to several competing demands. In view of the above concerns, the Government of India adopted a National Water Policy in 1987. Although, the policy is an important instrument for the conservation and efficient and equitable use of water, yet critics feel that it has not emerged through extensive national debates among intellectuals, scientists, progressive consumer groups and policymakers.

The National Water Policy (see Annexure A-15.1) indentifies provision of water for drinking, Irrigation, flood control, hydropower, navigation, industrial and other uses in that order, as the primary objectives of water resources develoment. It proposes planned, integrated, multidisciplinary, scientific, and multiobjective development and management of water resources to meet the changing water needs. The policy also lays down that maintenance and enhancement of environmental quality, and social and economic growth with equity, be important considerations in meeting water resources development objectives.

The National Water Policy is essentially a statement of goals and intentions of the government. It has to be set into action through specific programmes, projects, and regulations. This is not easy because specification of objectives for individual projects is subjective and value based. Implementation of the projects involves multiple agencies and requires reliable predictions of responses of the water resource systems to natural inputs, human decisions and complex land-water interactions. These include physical, chemical and biological responses, and future economic, social, political and environmental impacts. Predictions of such responses are difficult because water resources systems are complex. Therefore, the implementation of the National Water Policy calls for a multidisciplinary scientific approach.

Agriculture, being the major user sector using over 80 per cent of available water resource potential, the National Academy of Agricultural Sciences is concerned about its use and consequences. A Round Table was held in August 1994, wherein scientists, technologists, sociologists, economists and policy makers discussed the issues relating to the National Water Policy in depth. This was followed by a national symposium during the Second Agricultural Science Congress in January 1995.

Water Resources (Supply)

The main source of sweet water on earth's surface is precipitation in its various forms. Precipitation is a limited, renewable, natural resource with variable distribution over both space and time. Within the agroecological regions it exhibits certain typical characteristics of distribution and amount received. The precipitation received on the land surface is partly infiltrated and converted into soil water, and used by vegetation. Part of infiltrated water evaporates and the rest seeps down to join the groundwater or appears as springs or streams through subterranean flows. The remaining part of the precipitation on the land surface takes the form of surface runoff or evaporation. Wherever the physiography permits, the surface runoff and groundwater are exploited for various uses.

Assessment of the water balance over space and time provides the basis for estimating the water resource potential. Based on this potential, water is allocated to various uses. In India, information on various aspects of precipitation are fairly well documented over long period of time by India Meteorological Department. Data on infiltration and evaporation losses which also affect the stream and river flows on the one hand and soil water and groundwater on the other are, in general, scanty. Thus, it is very difficult to assign any confidence limits on the assessment of potential and utilisable water resources, and reconcile the assessments projected by various expert panels based on updated scientific information. There is no institutional mechanism to bridge the growing gaps in information provided by various ministries on utilisation of the created irrigation potential. There is an urgent need to resolve the following issues in a given time-frame:

a. There has been a continuous progress in the development of methods in assessment of surface and groundwater resources. However, they need to be reinforced with improved scientific knowledge and precise field data on surface and sub-surface hydrology.

b. The concept of irrigation potential needs in-depth examination to precisely define all terms related to water so as to quantify its use in agriculture. It is necessary to express the irrigation potential in volumetric terms rather than on irrigated crop area basis, as the latter does not account for variations in climatic, soil and crop characteristics. The discrepancies between the data on irrigated area based on land records by the Ministry of Agriculture, and the records of potentials created and utilised by the Ministry of Water Resources need attention (Figure 18.1).

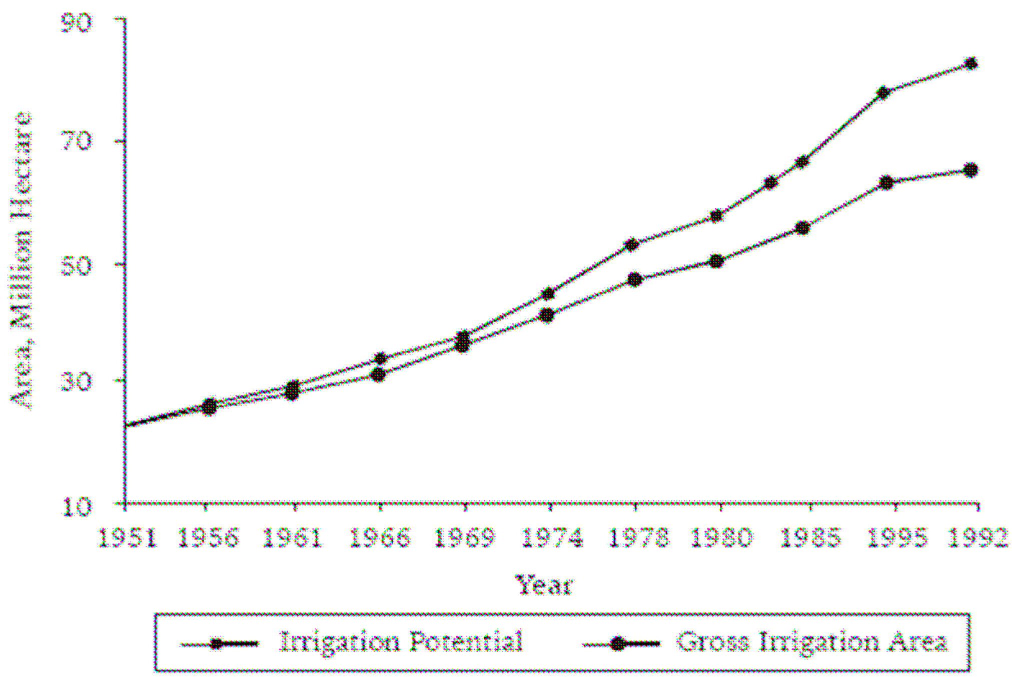

Figure 15.1

Irrigation Development in India: Gap in Irrigation Potential Created and Utilised

As part of the above, discrepancy arises from differences in perceptions and definitions for determining the potential use, an expert panel needs to be constituted to develop uniformity in approaches between the concerned government departments.

c. Sourcewise information on minor irrigation (ponds and other sources and groundwater separately) needs to be systematically collected and documented.

d. There is a need for coordination among ministries of Water Resources, Agriculture and Rural Development on potential developed under the integrated watershed programmes. A perspective plan with a time-frame for development of the ultimate potential when the country will be fully covered under this programme, needs to be evolved.

e. There is lack of national consensus on the role of water in continuing food security. There is growing divergence between the projections by the planners and actual water use by competing non-food crops. According to the Eighth Plan document, the area under irrigated foodgrains is projected as 62, 70, and 78 million ha at the end of Eighth, Ninth and Tenth Five Year Plans, respectively, which leaves a gap of around 10 to 15 million ha in actual irrigated area under foodgrains.

f. Besides river basin- and sub-basin-wise records, presentation of data at agroecological unit level is desirable for realistic developmental planning.

g. The draft National Water Information Bill approved by the National Water Board envisages access to the computerised databank to central and state government agencies. However, it does not provide access to research organisations. All the relevant data must be made accessible to various authorised scientific research organisations so that research inputs can be effectively incorporated in the planning and operation of water resource projects.

h. Tanks are as old as human civilisation. They are the earliest rain harvesting structures used by our ancestors for sustainable growth of human life. They were treated as community assets and maintained by the community both for domestic and irrigation needs. Neglect by the administration and the community during the past two centuries led to the decay of these valuable water-supply systems. In the recent past, however, there have been efforts to restore these tanks to their earlier status. Besides the role of governmental and non-governmental organisations, there is a need to strengthen the role or research and development components in this huge task, particularly with respect to tank design and management practices which can contribute to reduction in evaporation losses, prevention of silting and protection from pollution.

Water Resources (Demand)

Demands of water for domestic, agricultural, industrial, power generation, navigation and recreation are dynamic. Irrigation demand for agricultural sector also varies with time and space due to the differences in agroclimatic conditions, changing cropping patterns, market mechanisms and land uses. The scientific studies with respect to these are very few, and hence, hardly any confidence on the estimates could be afforded on the present and projected water uses.

In the backdrop of the above, the following issues need attention:

a. The quantitative projections of allocations to meet demands of various sectors are not yet specified since actual observations are very limited in most of the sectors. For realistic estimations/projections, database needs to be strengthened.

b. Irrigation demand with respect to agroecological zones considering current and anticipated cropping patterns is yet to be established.

c. There is an urgent need for developing a time-bound research agenda to work out the demands of various sectors in a dynamic frame and develop a basis for conflict resolution among competing demands by various sectors, and within each sector, on considerations of equity, ecology and economics.

Need for Rational Use of Water Resources

The major source of water, namely rainfall, is unevenly distributed giving rise to regions of high water resource availability and extremely dry regions. This is further compounded by its monsoonal character, with about 85 per cent of annual rainfall occurring over 4 to 5 months, with actual number of rainy days varying between 4 and 56, during a year. Water storage can help to even out temporal imbalances in water availability during monsoon season as well as across years. So far, only one-third of identified storage capacity (650 km3) has been achieved. This backdrop calls for appropriate conservation of water resources in rivers, lakes, ponds, soil profile and aquifers, and its rational use during lean periods.

In view of the ever increasing demands for water, there is need for augmenting the resource through interbasin transfers, artificial recharge of aquifers, use of marginal quality water, conjunctive use of surface and groundwater, runoff harvesting in rainfed areas, watershed development, etc.

Agriculture being the major user of water in India, there is a need to enforce rational use of water in this sector. This would encompass development of appropriate cropping patterns, efficient water conveyance and application methods, and irrigation scheduling systems as also rational water pricing, and farmer education and training.

Water resources and energy management related issues represent other grey areas demanding attention of water scientists. These issues have an important role in efficient management of water resources, particularly the groundwater. Most of the states are yet to develop an energy plan along with alternate sources of energy for utilisation of untapped reservoirs of groundwater, particularly in the northeastern region. The National Water Policy has not dealt with this aspect

appropriately. An interlinkage between the Energy Policy and the Water Policy of the country is necessary.

Experience gained during the last 45 years has underlined the importance of proactive action with reference to potential negative consequences of taking irrigation water to unirrigated areas. Learning from this experience, we should hereafter make an adequate provision for research and training in each major and medium irrigation project, so that sustainable farming and land-and water-use systems are developed even before water becomes available for irrigation. This will then enable farmers to take to sustainable and scientific water-use practices right from the day irrigation water becomes available and thereby, help to avoid problems like waterlogging and salinisation.

The National Water Policy stresses the need for intensification of research efforts and provides an indicative list of topics on which research efforts should be pursued. But the emphasis therein has been on physical, scientific and technological systems. The sociological, institutional, operational and economic aspects of management which are vital for the success of agriculture, have not been indicated. Therefore, the list needs to be supplemented with items like:

- development of methodologies for assessing irrigation performance,
- development of management information systems,
- improvement of water delivery and application systems,
- water quality protection,
- conjunctive use of surface and groundwater,
- disposal of drainage effluents,
- recycling of industrial and agricultural effluents,
- effective use of marginal quality water, and
- water-use efficiency enhancement through crop improvement and related agronomic practices.

In the past, in most states, the irrigation system used to be centrally managed by a single agency which was responsible for water resource development as also for primary, secondary and tertiary level management. The tasks of water allocation, distribution and monitoring also rested with it. This had to be changed to improve performance. In the seventies, mutidisciplinary authorities were constituted but were not implemented in the true spirit. They have taken the shape of one other department, rather than an integrated multidisciplinary team. Their restructuring in the desired direction is an immediate need.

A consultative group comprising scientists from agricultural and other institutions and departments dealing with development and use of water resources, both at national and state levels, should be constituted for scientific planning of water resource development, management, and utilisation and for strategic guidance to the multidisciplinary authorities.

Linkages between the Ministry of Water Resources, State Departments of Agriculture and Allied Sectors, State Agricultural Universities and ICAR institutions, about the canal water management, reservoir sedimentation, and conjunctive water use planning, execution and management should be strengthened. Institutional linkages need to be forged amongst the Ministry of Environment, Ground Water Board, ICAR institutes and other institutes dealing with the subject to identify researchable issues and undertake research programmes on pollution of groundwater arising from intensive use of agrochemicals in production agriculture.

Skyrocketing cost of development of water resources are making water resources projects, economically unsustainable (Figure 18.2). If market mechanism is allowed to play its role, the chances are that not only enough funds will be generated to develop the water resources, but also the quality of service would improve and the use of water will become efficient. A case in point is that of promoting the groundwater markets that have developed in states like Gujarat and Tamil Nadu.

Figure 15.2
Cost of Creation of Irrigation Potential through Major and Medium Projects

Current rates of canal water and electricity charges based on horsepower of the motor, irrespective of energy used are conducive to wasteful use of water. As enumerated in the National Water Policy, the pricing structure of water is overdue for revision so as to reflect the realistic cost of supply of water as well as to be a deterrent against wasteful use of water. The pricing shall be based on volumetric basis.

Rain Water Management Issues for Dryland Agriculture

Dryland areas in India extend to over 100 million ha of the cropped areas. Here the source of water for crop sustenance is rainwater. The rainfall in these areas varies from 400 mm to more than 1,500 mm per annum, which is received in one or two short rainy seasons. The annual evapotranspiration demand is about 1,500 mm in the high rainfall areas and above 2,000 mm in the low rainfall areas. Appropriate rainwater management is the key to sustainable agriculture in the dryland areas of India. Water use policy issues for different dryland agroecosystems are:

a. *Arid Subtropics:* In this ecozone, water use policy should aim at progressively increasing area under agroforestry and agropastroral land use that have an animal component, and decreasing the annual cropped area. Soil and water conservation by vegetative cover and dune stabilisation techniques should be encouraged. Incentives on promotion of efficient water application methods for high value crops, like arid horticulture, be liberally provided.

b. *Semi-Arid Tropics (SAT):* This zone comprises subtropical northern Indian plains and the peninsular Indian SAT. In this ecozone, the annual rainfall varies between 500 mm and 1,500 mm and the annual evapotranspiration is 2,000 mm or less. Water use policy suggested for different agroecosystems of SAT are:

i. *Subtropical SAT:* Key considerations in water management need to be, conservation of rain water *in situ* and channelling of runoff water into groundwater for recharge. There has to be emphasis on drainage during rainy season in areas with >750 mm rainfall and intensification of post-rainy season cropping systems by providing 1 to 2 life saving irrigations for ensuring stable crop production at increasing thresholds of productivity.

ii. *Dependable Tropical SAT:* The policy for sustainable water use should comprise the creation of a series of interlinked watersheds both in the Vertisol and Alfisol regions. This will permit recapturing the past heritage of Kakatiya and Chola dynasties who developed networks of interlinked small, medium and large tanks involving small groups of individuals, communities and society at large.

iii. *Undependable Tropcial SAT: The* soil and water conservation policy for these areas must emphasise the sustainability of post-rainy season cropping by conserving water in the soil profile.

c. *Bimondal Rainfall Areas:* Rejuvenation of the tank irrigation systems and introduction of limited irrigated-dryland agriculture are the relevant key policy issues for these regions.

d. *High Rainfall Areas of the NE India and Western Ghats:* The key policy issues here are related to land use. The area under agroforestry systems must be increased to sustain agricultural productivity. This region is exposed to excessive soil erosion. This calls for strengthening of research programmes for generation of integrated technology involving engineering and biological inputs for erosion control.

Environmental Concerns in Water Resources Development and Utilisation

The National Water Policy states that all the water resources projects should be planned and executed so as not to cause adverse impact on the environment and the ecology. However, in view of the continuing low irrigation efficiency in the case of major and medium projects, environmental problems like waterlogging, soil salinisation and impairment of water quality have manifested at many places. Only about one-third of the water diverted for irrigation effectively reaches the crop, and the remaining water either runs off or moves down to groundwater body to cause environmental problems. It is estimated that about 24 per cent of the areas irrigated by major and medium projects is threatened by waterlogging and associated problems. Such ill effects are direct consequences of inadequate planning combined with unscientific water management practices.

Efficient management of the developed water resource needs to be the central concern for the two-fold advantage of bringing about enhancement in water-use efficiency and simultaneously, reducing the environmental degradation. In fact, optimising the efficiency of the use of existing water resources should be the first charge of the government.

There has been a general lack of rigorous analysis of the likely environmental impacts associated with a particular project and the exploration of possible modifications or alternatives to shape an informed decision so that environmentally unacceptable and unexpected results could be avoided. What is needed now is that the exact nature of the environmental impacts should be monitored with specific reference to the prevalent cropping systems. This will help to obtain information to evolve corrective strategies and also to provide a better basis for future decisions to develop irrigated agriculture without the environmental damage.

The ecological characteristics have not often received due attention in planning the development of the regional water resources. Developmental patterns tend to be stereotype, imitating the success stories of some regions blindly. Consequently, the positive impacts on agricultural productivity and overall economic growth have not been achieved as targeted while the negative impacts on the environment are discernible. The major irrigation projects in the high rainfall and the black soil regions having accumulated salts in the soil profile, bear testimony of the resultant environmental degradation. In the case of new projects, assessment of the proposals should be made in the context of ecological features and probable ecological effects and realistic benefits. The total project cost should include realistic environmental protection costs. Scientific procedures are now available for such an assessment and it should be further strengthened by employing modern research tools and techniques.

In view of increasing demand of water from domestic and industrial sectors, curtailment of fresh water supplies to agriculture is likely and increasing use of marginal quality water for irrigation is inevitable. Research is needed to develop site-specific management strategies for sustainable agriculture under such situations. At the basin level, provision has to be made for removal of some salts out of the system. This should hold good even in the case of fresh water irrigation, since large quantities of salts are added annually which would eventually cause deterioration in soil and groundwater quality.

With increasing agricultural, domestic and industrial intensification, pollution of groundwater is likely to increase. Groundwater once contaminated is damaged for a long time to come. This should be an important concern since prevention of groundwater pollution is always considered to be a better strategy than adopting ameliorative measures after contamination. This aspect was ignored in the Clause 7.1 of the National Water Policy and needs attention.

In the industrial uses of water for disposing of heat and other wastes, even though the amount of water used is small, its polluting effect on water quality is relatively large. Industry-specific effluent standards have already been developed and wherever they do not exist, they need to be developed. What is needed is an effective regulatory effort for strict enforcement of these standards, since these effluents ultimately find their way into agricultural lands.

An extensive water quality monitoring system for surface and groundwater is required. This will help in identifying the kind, extent and the sources of pollution, and bring to focus the need for undertaking corrective steps. The current monitoring network is obviously inadequate. Moreover, it is always from the states. States will have to be encouraged to build up their secondary and tertiary networks as extensions to large-scale primary network of the Government of India.

The research and development effort in reconciling the conflicts arising from growing intensification of coastal irrigated agriculture and conservation of coastal ecosystem is extremely inadequate. There is an urgent need to establish a research network to take care of multidisciplinary diverse problems relating to the management of coastal ecosystems.

Environment management system with appropriate infrastructure needs to be set up within the water resource management framework and be made an integral part of it for strengthening environmental input in the water resources projects. This should include rigorous analysis of environmental features, improved prediction of ecological effects with possible modifications and options, and regular monitoring of the environmental parameters/impacts to evolve environmental protective strategies.

On-Farm Water Management

There is an immense scope for improving conservation, distribution and on-farm utilisation of irrigation water. The first step for efficient use of any resource is to conserve the same for optimising its availability at the site of use. The water available for irrigation must be allocated optimally to competing regions and crops. The other means for efficient on-farm water management include, optimum scheduling of irrigations based on suitable methods, conjunctive use of water from different sources, improved agronomic practices, etc. Under irrigated agriculture, provision of adequate drainage is crucial for efficient water management.

Apart from providing right amounts of water at the right time and right place, attaining of high water-use efficiency requires that crop yield be maximised with given amount of water. For this, it is essential to adopt improved soil and crop management practices to overcome the constraints to high yield. Tillage, mulching and fertilisation, and combinations thereof have been observed to substantially increase crop yield and, thus, increase water-use efficiencies by reducing evaporation and deep percolation components of soil water balance. Instances can be cited from several areas in respect of quite a few crops where judicious use of crop production inputs along with irrigation water has contributed to the miximisation of the crop yields. “Compared with around 1.4 mt of wheat production in erstwhile Punjab (Current Punjab plus Haryana) during 1950-51, it increased to 20.57 mt of wheat from the same region. This is more than three times of the total wheat production of 6.46 mt in the country during 1950-51. During the same period, the productivity of wheat increased from around 7 quintals to 38.6 quintals per ha in this region. The above inspiring success came from judicious integration of irrigation with a balanced package of wheat crop production inputs.”

Issues Demanding Urgent Attention

a. As much as 50 per cent of the water released at the project head-works is lost in transmission to the canal outlets. Additional loss occurs in water courses which is directly proportional to their lengths and duration of water flow. Lining of water courses reduces these losses to bare minimum and has found favour with the farmers of command areas. Lining of main canals may also be considered if losses are excessive or there is a threat of waterlogging and soil salinisation. Where the groundwater can be exploited for irrigation, there is hardly any justification for lining as the farmer has better control over groundwater which adds to timeliness of water applications. Where groundwater is unfit for irrigation, seepage from canal network can play havoc with soil productivity.

b. Optimal allocation of available irrigation water among competing regions and crops is possible with the knowledge of water production functions of crops. At present, precise production functions are lacking and there is an urgent need to develop the same at least for important crops in different regions. Improper allocation of water undermines the equity aspect. For example, in Maharashtra, only 3 per cent of total cropped area occupied by sugarcane is claiming 76 per cent of irrigation water, while other crops are denied even a lifesaving irrigation.

c. Efficient use of irrigation water requires that water be applied to growing crops at appropriate times and in adequate amounts. Where sufficient water is available to fully meet the crop water requirements, irrigation must be applied before yield-or quality-reducing stress occurs. Scheduling irrigation with limited water is a big challenge to agricultural scientists and needs rigorous research. Available information on simulation and optimisation models can be used to develop optimal irrigation schedules to crops.

d. Modern irrigation techniques like sprinkler and drip should be promoted where water is scarce, and the topographic and soil conditions do not permit efficient irrigation by conventional methods. Promotion of such water-saving devices should be an objective of the National Water Policy.

e. Irrigability of command areas, needs to be ascertained and land should be developed, and farmers educated about irrigation management before letting water into the command area. Concept of irrigability of soil has to be considerably fine-tuned with respect to different crops. There is considerable scope for research on this account and should be included in the list of topics to be researched.

f. Consolidation of landholdings is essential to enthuse farmers to invest in irrigation system at the farm level.

g. A group of experts concerned with canal water distribution and efficient on-farm use of irrigation water together with economists and, sociologists and progressive farmers, be constituted in each canal command with the following mandate:

    i) To overcome the existing mismatch between crop water requirement and supply of water because of rigid canal schedules.

ii) To work out the procedures to ensure uniform supply to head-end and tail-end farmers by making compensation in time for the reduced tail-end discharge.

iii) To develop a multidisciplinary performance assessment system for assessing the impact of irrigation projects from the points of view of economics environment and equity. Such a performance assessment system should be built into irrigation management practices. This will help to initiate timely mid-course corrections, when needed and keep the efficiency of the system high.

This group shall be an integral part of the CADAs.

Elimination of Constraints to Higher Yields

a. Conjunctive use provides a greater control on timeliness of irrigation and should be encouraged by making adequate energy available to farmers at a reasonable cost. In order to ensure sustained availability of groundwater, average annual withdrawals should not exceed average annual recharge. Where fresh water is in short supply, groundwater of marginal quality could be advantageously used in combination with good quality water or for alternate irrigations. Recommendations concerning saline and sodic water developed by Indian scientists from field experiments are now available and should be used.

b. Development of conjunctive use system requires knowledge regarding geology of groundwater basin and aquifers, hydrology of surface and groundwaters, existing surface and groundwater facilities and storage and transmission characteristics of the basins. Although, some efforts have been made in India to predict groundwater behaviour using simulation and optimisation models, these need to be strengthened.

c. Drainage has to be an integral part of the irrigation system, particularly when perennial irrigation is contemplated. This consideration does not find a mention in the National Water Policy. Hence, provisions in Clause 10 on irrigation will have to be adequately amplified to cover this critical aspect.

d. Excess water in the root zone causes aeration stress in crops other than rice. This situation develops on fine-textured, low permeability soils after a heavy rain/irrigation or in waterlogged soils. Surface and sub-surface drainage has been shown to improve crop production.

Development of Human Resource in Water Science and Technology

Water science and technology deals with the study of nature and occurrence of water, assessment of its quantity and quality, collection, distribution, management, use, recycling, pollution treatment and the associated economic aspects. Thus, water science and technology is central and basic to many aspects of water resources development and management, operation and is multidisciplinary in nature.

Appropriately trained manpower is required in all the state and central departments to facilitate modernisation and management of irrigation systems and other works related to improved water management.

At present, a cadre of water management technologists to extend the known technology concerning optimal irrigation scheduling and agronomic practices for increasing water-use efficiency of crops is lacking. There is strong need to create such a cadre in the state departments.

There is a need to start postgraduate degree programmes in water science and technology to train manpower to cater to the research and development needs in this area for persons with bachelor's degree in agricultural engineering, civil engineering or agriculture. The universities have necessary capability for initiating such programmes. Modern developments in the areas of crop sciences, physical sciences, computer sciences, social sciences, management sciences, operations research etc., can be advantageously utilised in the teaching and training of professional staff in the areas of water resources management.

Short-term training programmes for in-service officers could appropriately be utilised by the development departments along with proper financial and promotional incentives and institution of departmental fellowships. This will be a suitable mechanism to upscale job-related skills of the technical staff which can enhance their capabilities in tackling many a practical field level problems in water management.

Water and Land Management Institutions (WALMIs) have done a good job in training different levels of in-service staff of irrigation departments and this activity should continue. They should be linked closely with agricultural or engineering universities for a healthy mutual interaction and optimising the use of educational resources, particularly libraries and highly trained faculty.

Though the various agencies associated with water science and technology at the state, national and international levels have been making efforts to impart training and create public awareness, a systematic approach is yet to be followed. More emphasis should be placed on courses dealing with water issues in programmes for farmers, village-level workers, public as well as informal professional education.

The science and technology support to research in water sciences has suffered because of inadequacy of investment and trained manpower. Fortunately, the existing universities have the capability to generate the human resources through formal education and inservice training at all levels for functionaries involved in water management and the farmers. The facilities need to be appropriately strengthened for this purpose.

Of late, there has been a growing realisation for improving the quality of life of rainfed farmers. The current national and international initiatives *vis-à-vis* the magnitude of these problems are inadequate. A special effort needed for these areas to disseminate existing improved technologies and to further refine site-specific soil and water conservation technologies through research. Constitution of national/state water management cadre as suggested earlier will need to be appropriately strengthened and extended, to meet the demands in rainfed areas.

Water Law: Policy Direction

The National Water Policy is silent on this aspect. However, the following issues demand attention:

a. The doctrine of riparian rights, basis of water legislation in India needs to be reinterpreted in the light of perceived societal necessities of the time and more importantly, the need to be in tune with the constitutional values. Interpreting Article 21 of the Constitution of India expansively so as to include right to water as a fundamental right to life, the Supreme Court has given a new dimension to principles of water laws. Further, the Constitution in Article 39(b) (Directive Principles of State Policy) has made it incumbent on the state to ensure that the ownership and control of the material resources of the community are so distributed as to best subserve the common good. Water being a precious natural and common prosperity resource, water law must take into account the principles of access, justice and social equity.

b. Law needs to recognise the hydrological unit of water resources and provide for conjunctive use of surface and groundwater, resulting in integration of administration of surface water rights and groundwater rights. Groundwater should be presumed to be tributary to natural streams.

c. Law must also incorporate notions of accountability of water bureaucracy to ensure access to the availability of water and provide for expeditious remedies for violation of rights. Water related disputes may be entrusted to water 'Adalats' for speedy resolution of disputes.

d. There is an urgent need to have legislation on groundwater. The legal regulations have, of necessity, to be region specific, namely groundwater abundant regions, scarcity regions and islands surrounded by oceans. The Government of India has already formulated a model groundwater bill but the states have not yet established the legislative measures in that direction. Proper climate needs to be created in the country for the acceptance of such legal measures.

e. Development and regulation of interstate river waters, mandates cooperation amongst basin states along with the existing procedures for compulsory adjudication of disputes by tribunals. Constitution may be amended to incorporate a provision on interstate agreements (compacts) in respect of interstate rivers.

f. The existing law on water quality needs to be effectively implemented for prevention of pollution of surface and groundwaters. Groundwater pollution being more serious and hazardous than surface water pollution would require different institutions for prevention and abatement of pollution.

Water Rights

There is need to institute an effective water rights regime which should incorporate the economic, technical and organisational requirements. From an economic point of view, water rights system should allow (i) definition of water rights on a private/individual basis and (ii) transferability/ exchange of water rights among users. Defining rights on an individual basis establishes an upper limit for water withdrawal and use. Such limits would provide incentives for individuals to use water more efficiently. Similarly, transferability or renting out of water rights enables individuals to directly realise themselves the economic benefits emerging from selling the amount of water they saved by their conservation efforts.

Although, private rights system is necessary for ensuring efficiency, it is not sufficient for promoting equity and ecological security in water use. For this purpose, the rights system should be designed in such a way as to allow effective social control not only to set limits for collective withdrawal but also enforce and monitor water allocation and distribution across regions and individual users. In this respect, it is necessary to design the private rights system itself within the public trust framework. This framework provides for a hierarchical system of rights and duties applicable for the state, community, and individuals.

Under the public trust framework, the state has the duty and responsibility for establishing legal guidelines for instituting a water rights system, setting limits for overall water withdrawal in a regional context, providing technical information, and coordinating water allocation across regions/communities. The village-level community organisation (e,g. *panchayats*, user groups, etc.) have the duty for allocating individual water rights consistent with the legal guidelines established by the state-level legislation, enforcing the monitoring of water withdrawals by individual, creating a forum both for promoting water rights transfers as well as resolving allocational disputes among the users. The individual users have water rights that specify their water entitlements which they can either use on their own farms or sell to others. Notably, water rights of individuals within the public trust framework are not absolute but subject to the regulatory rights of the state and communities.

The water rights system operating within the public trust framework allows social control and decisionmaking at the stage of water rights distribution and decentralised private decisionmaking at the stage of actual water utilisation. It provides an institutional synthesis with greater potential for conflict resolution. Moreover, such a system also proves to be a rare policy instrument that could simultaneously address all the three major goals of sustainable development, i.e. ecological security, economic efficiency and social equity in the context of water resources.

While ecology and equity requirements can be taken care of at the stage of water rights allocation, where social control is exercised to set limits for collective withdrawals as well as to ensure more equitable distribution of water across regions and individuals, economic efficiency is achieved at the water utilisation stage by allowing transferability and water exchanges that ensures the water to flow into the most productive uses and regions. The transferability of water rights is an important requirement for promoting socially optimal water resources use and income distribution.

Research studies, especially on establishing water balance at the regional and village levels, identifying organisational forms, developing distribution criteria etc., are extremely inadequate and should be strengthened urgently. The economic and ecological compulsions for an institutional change will eventually overwhelm issues like political exigency, practical difficulties, etc., which seem to have delayed the institutional change so far. It is about time now to formulate a viable national policy for establishing a water rights system in India. The National Water Policy, limits itself to management of irrigation systems by farmers and does not go beyond that, into the aspects of water rights and the need for establishing and regulating them. The existing provisions of Clause 12 need to be substantially expanded.

Social Issues

The National Water Policy emphasises that:

> Efforts should be made to involve farmers progressively in various aspects of management of irrigation systems, particularly in water distribution and collection of water rates. Assistance of voluntary agencies should be enlisted in educating the farmers in efficient water management.

It is now well recognised that strengthening government assistance to farmer management systems is more cost-effective compared to assistance to government-managed systems. Farmers' participation may be encouraged in respect of watershed development, water harvesting, soil conservation, wasteland development, village tank operation, social forestry, mitigation and management of water related natural hazards and irrigation water management. The recent amendment to the Constitution of India devolving powers to the people through the *panchayat raj* system should be advantageously used.

The following issues have not been adequately addressed in the past and need detailed examination for development of appropriate subsystems:

a. Type and elements of the modes of transfer of the management of water resources to the Water Users' Associations (WUAs) (e.g. decisions on cropping systems, water releases, collection of water rates, maintenance of infrastructure, restoration and management of village tanks, organising inputs etc.).

b. Changes needed in the roles of governmental agencies and farmers' organisations.

c. Legal policy, infrastructural and institutional issues.

d. Evaluation of the impacts of management transfer.

e. Adequate training of farmers' organisations.

f. Role of NGOs and other catalytic agencies.

g. Renovation of physical systems before affecting transfer.

h. Provision of adequate funds for major repairs and proper guidelines for use of financial resources and technical advice,

i. Role of WUAs in deciding cropping patterns.

ANNEXURE A-15.1

NATIONAL WATER POLICY

The Need for a National Water Policy

1.1 Water is a prime natural resource, a basic human need and a precious national asset. Planning and development of water resources need to be governed by national perspectives.

1.2 It has been estimated that out of the total precipitation of around 400 million hectare metres in the country, the surface water availability is about 178 million hectare metres. Out of this, about 50 per cent can be put to beneficial use because of topographical and other constraints. In addition, there is a groundwater potential of about 42 million hectare metres. The availability of water is highly uneven in both space and time. Precipitation is confined to only about three or four months in a year and varies from 10 cm in the western parts of Rajasthan to over 1000 cm at Cherrapunji in Meghalaya. Further, water does not respect state boundaries. Not merely rivers but even underground aquifers often cut across state boundaries. Water as a resource is one and indivisible—rainfall, river waters, surface ponds and lakes, and groundwater are all part of one system; water is also a part of a larger ecological system.

1.3 Floods and droughts affect vast areas of the country, transcending state boundaries. A third of the country is droughtprone. Floods affect an average area of around 9 million hectares per year. According to the National Commission on Floods, the area susceptible to floods is around 40 million hectares. The approach to the management of droughts and floods has to be coordinated and guided at the national level.

1.4 Even the planning and implementation of individual irrigation or multipurpose projects, though done at the state level, involve a number of aspects and issues such as environmental protection, rehabilitation of project-affected people and livestock, public health, consequences of water impoundment, dam safety, etc. On these matters common approaches and guidelines are necessary. Moreover, certain problems and weaknesses have affected a large number of projects all over the country. There have been substantial time and cost over runs on projects. In some irrigation commands, problems of waterlogging and soil salinity have emerged, leading to the degradation of good agricultural land. There are also complex problems of equity and social justice in regard to water distribution. The development and exploitation of the country's groundwater resources also give rise to questions of judicious and scientific resource management and conservation. All these questions need to be tackled on the basis of common policies and strategies.

1.5 The growth process and the expansion of economic activities inevitably lead to increasing demands for water for diverse purposes—domestic, industrial, agricultural, hydropower, navigation, recreation, etc. So far, the principal consumptive use of water has been for irrigation. While the irrigation potential is estimated to have increased from 19.5 million hectares at the time of Independence to about 68 million hectares at the end of the Sixth Plan, further development of a substantial order is necessary if the food and fibre needs of a growing population are to be met. The country's population which is over 750 million at present, is expected to reach a level of around 1,000 million by the turn of the century.

1.6 The production of foodgrains has increased from around 50 million tonnes in the fifties to about 150 million tonnes at present, but this will have to be raised to around 240 million tonnes by the year 2000. The drinking water needs of people and livestock have also to be met. In keeping with the objectives of the International Drinking Water Supply and Sanitation Decade Programme (1981-1991), adequate drinking water facilities have to be provided to the entire population in both urban and rural areas and sanitation facilities to 80 per cent of the urban population and 25 per cent of the rural population by the end of the decade. Domestic and industrial water needs have largely been concentrated in or near the principal cities, but the demand from rural society is expected to increase sharply as the development programmes improve economic conditions in the rural areas. The demand for water for hydro- and thermal- power generation and for other industrial use is also likely to increase substantially. As a result, water, which is already a scarce resource, will become even scarcer in future. This underscores the need for the utmost efficiency in water utilisation and a public awareness of the importance of its conservation.

1.7 Another important aspect is water quality. Improvements in existing strategies and the innovation of new techniques resting on a strong science and technology base will be needed to eliminate the pollution of surface and groundwater resources, to improve water quality and to step up the recycling and reuse of water. Science and technology, and training have also important roles to play in water resources development, in general.

1.8 Water is one of the most crucial elements in developmental planning. As the country prepares itself to enter the 21st century, efforts to develop, conserve, utilise and manage this important resource have to be guided by national perspectives. The need for a national water policy is thus, abundantly clear; water is a scarce and precious national resource to be planned, developed and conserved as such, and on an integrated and environmentally sound basis, keeping in view the needs of the states concerned.

Information System

2. The prime requisite for resource planning is a well-developed information system. A standardised national information system should be established with a network of databanks and databases, integrating and strengthening the existing central and state level agencies and improving the quality of data and the processing capabilities. There should be free exchange of data among the various agencies and duplication in data collection should be avoided. Apart from the data regarding water availability and actual water use, the system should also include comprehensive and reasonably reliable projections of future demands for water for diverse purposes.

Maximising Availability

3.1 The water resources available to the country should be brought within the category of utilisable resources to the maximum possible extent. The resources should be conserved and the availability augmented by measure for maximising retention and minimising losses.

3.2 Resource planning in the case of water has to be done for a hydrological unit such as a drainage basin as a whole, or for a subbasin. All individual developmental projects and proposals should be formulated by the states and considered within the framework of such an overall plan for a basin or sub-basin, so that the best possible combination of options can be made.

3.3 Appropriate organisations should be established for planned development and management of a river basin as a whole. Special multidisciplinary units should be set up in each state to prepare comprehensive plans taking into account not only the needs of irrigation but also harmonising various other water uses, so that the available water resources are determined and put to optimum use having regard to subsisting agreements or awards of tribunals under the relevant laws.

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

3.5 Recycling and reuse of water should be an integral part of water resource development.

Project Planning

4.1 Water resource development projects should, as far as possible, be planned and developed as multipurpose projects. Provision for drinking water should be a primary consideration. The projects should provide for irrigation, flood mitigation, hydroelectric power generation, navigation, pisciculture and recreation wherever possible.

4.2 The study of the impact of a project during construction and later on, human lives, settlements, occupations, economic and other aspects should be an essential component of project planning.

4.3 In the planning, implementation and operation of projects, the preservation of the quality of environment and the ecological balance should be a primary consideration. The adverse impact, if any, on the environment should be minimised and should be off-set by adequate compensatory measures.

4.4 There should be an integrated and multidisciplinary approach to the planning, formulation, clearance and implementation of projects, including catchment treatment and management, environmental and ecological aspects, the rehabilitation of affected people and command area development.

4.5 Special efforts should be made to investigate and formulate projects either in, or for the benefit of, areas inhabited by tribal or other specially disadvantaged groups such as Scheduled Castes and Scheduled Tribes. In other areas also, project planning should pay special attention to the needs of Scheduled Castes and Scheduled Tribes and other weaker sections of society.

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

4.7 Time and cost overruns and deficient realisation of benefits characterising most irrigation projects should be overcome by upgrading the quality of project preparation and management. The under-funding of projects should be obviated by an optimal allocation of resources having regard to the early completion of ongoing projects as well as the need to reduce regional imbalances.

Maintenance and Modernisation

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

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

Safety of Structures

6. There should be proper organisational arrangements at the national and state levels for ensuring the safety of storage dams and other water-related structures. The central guidelines on the subject should be kept under constant review and periodically updated and reformulated. There should be a system of continuous surveillance and regular visits by experts.

Groundwater Development

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

7.2 Exploitation of groundwater resources should be so regulated as not to exceed the recharging possibilities, as also to ensure social equity. Groundwater recharge projects should be developed and implemented for augmenting the available supplies.

7.3 Integrated and coordinated development of surface water and groundwater and their conjunctive use, should be envisaged right from the project planning stage and should form an essential part of the project.

7.4 Overexploitation of groundwater should be avoided near the coast to prevent ingress of seawater into sweet water aquifers.

Water Allocation Priorities

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

- drinking water
- irrigation
- hydropower
- navigation, and
- industrial and other uses.

However, these priorities might be modified, if necessary, in particular regions with reference to area-specific considerations.

Drinking Water

9. Adequate drinking water facilities should be provided to the entire population both in urban and in rural areas by 1991. Irrigation and multipurpose projects should invariably include a drinking water component, wherever there is no alternative source of drinking water. Drinking water needs of human beings and animals should be the first charge on any available water.

Irrigation

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

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

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

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

Water Rates

11. Water rates should be such as to convey the scarcity value of the resource to the users and to foster the motivation for economy in water use. They should be adequate to cover the annual maintenance and operation charges and a part of the fixed costs. Efforts should be made to reach this ideal over a period. While ensuring the assured and timely supplies of irrigation water. The water rates for surface water and groundwater should be rationalised with due regard to the interests of small and marginal farmers.

Participation of Farmers and Voluntary Agencies

12. Efforts should be made to involve farmers progressively in various aspects of management of irrigation systems, particularly in water distribution and collection of water rates. Assistance of voluntary agencies should be enlisted in educating the farmers in efficient water use and water management.

Water Quality

13. Both surface water and groundwater should be regularly monitored for quality. A phased programme should be undertaken for improvement in water quality.

Water Zoning

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

Conservation of Water

15. The efficiency of utilisation in all the diverse uses of water should be improved and an awareness of water as a scarce resource should be fostered. Conservation consciousness should be promoted through education, regulation, incentives and disincentives.

Flood Control and Management

16. There should be a master plan for flood control and management for each flood-prone basin. 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. Adequate flood-cushion should be provided in water storage projects wherever feasible to facilitate better flood management. An extensive network for flood forecasting should be established for timely warning to the settlements in the flood plains, along with the regulation of settlements and economic activity in the flood plain zones, to minimise the loss of life and property on account of floods. While physical flood protection works like embankments and dykes will continue to be necessary, the emphasis should be on non-structural measures for the minimisation of losses such as flood forecasting and warning and flood plain zoning, so as to reduce the recurring expenditure on flood relief.

Land Erosion by Sea or River

17. The erosion of land, whether by the sea in coastal areas or by river water inland, should be minimised by suitable cost-effective measures. The states and union territories should also undertake all requisite steps to ensure that indiscriminate occupation and exploitation of coastal strips of land are discouraged and that the location of economic activities in areas adjacent to the sea, is regulated.

Drought Management

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

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

Science and Technology

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

- hydrometeorology;
- assessment of water resources;
- snow and lake hydrology;
- groundwater hydrology and recharge;
- prevention of salinity ingress;
- water-harvesting;
- evaporation and seepage losses;
- economical designs for water resource projects
- crops and cropping systems;
- sedimentation of reservoirs;
- the safety and longevity of water-related structures;
- river morphology and hydraulics;
- soils and material research;
- better water management practices and improvements in perational technology;
- recycling and reuse;
- use of seawater resources.

Training

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

Conclusion

21. In view of the vital importance of water for human and animal life, for maintaining ecological balance and for economic and developmental activities of all kinds, and considering its increasing scarcity, the planning and management of this resource and its optimal, economical and equitable use has become a matter of utmost urgency. The success of the national water policy will depend entirely on the developmental and maintenance of a national consensus and commitments to its underlying principles and objectives.