UNIT 3 WATER AND IRRIGATION RESOURCES

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3.0 OBJECTIVES

After reading this unit, you will be able to:

- identify the issues relating to water resources;
- explain the need for irrigation in Indian agriculture;
- discuss the various modes of irrigation practiced in India;
- analyse the relative differences of major, medium and minor irrigation projects;
- compare the utilizable and ultimate irrigation potential;
- point out the overlapping functions of various agencies/authorities engaged in the administration of water and irrigation services in India;

- indicate the importance and debate on inter-linking of rivers; and
- discuss the need for an integrated national water policy.

3.1 INTRODUCTION

From a human perspective, water is many things in one: (i) *a basic life-need and right*, an amenity, a cleaning agent; (ii) a *social good* (e.g. for firefighting, hospital use, etc.); (iii) a requirement for *economic activity* (agriculture, industry, etc.); (iv) an occasional *source of threat* e.g. floods; (v) a part of our *social, political and cultural life*; and (vi) a *sacred substance*. Water is at the same time a local resource, a state resource, a national resource, and a regional resource. India being an agriculture-dominated society requires huge amounts of water for irrigation of the farms as the monsoons are not a reliable water source. Water is thus a resource, a commodity, a basic right. Besides representing culture, it is geopolitical in its character.

India with 2.4 percent of the world's total area has 16 percent of the world's population but has only 4 percent of the total available fresh water supply. This indicates the need for water conservation, development, and optimum use. Fortunately, at a macro level, India is not short of water. The problem, however, lies in its management. The magnitude of this problem can be gauged by the following observations made in the Eleventh Five Year Plan document.

i) There is hardly any city which receives a 24-hour supply of drinking water;

ii) Many rural habitations which had been covered under the drinking water programme are now reportedly slipping back with pockets reporting arsenic, nitrate, and fluoride contents in drinking water posing a serious health hazard;

iii) In many parts, the groundwater table is fast declining due to over-exploitation. This is imposing an increasing financial burden on farmers who need to deepen their wells and replace their pump sets. For the state governments, the burden of subsidy on electricity supplies is increasing;

iv) Many major and medium irrigation (MMI) projects are remaining under execution forever as they slip from one plan to the other with enormous cost and time overruns;

v) owing to lack of maintenance, the capacity of the systems installed is declining;

vi) The gross irrigated area is not rising commensurate to investment in irrigation. The difference between the potential created and area actually irrigated remains large;

vii) Floods are a recurring problem in many parts of the country. Degradation of catchment area and loss of flood plains to urban development and agriculture have accentuated the intensity of floods;

viii) Water quality in our rivers and lakes is not fit for bathing let alone drinking. Untreated or partially treated sewage from towns and cities and untreated or inadequately treated industrial effluents are dumped into the rivers causing these pollution;

ix) polluted water bodies also contaminate groundwater; and

x) water conflicts are increasing about quality of water, people's right over water in upstream areas versus the downstream users, industrial use of groundwater and its impact on water tables, etc.

3.2 WATER RESOURCES IN INDIA

The water resources are classified into two main sources viz. (i) surface water; and (ii) ground water. Their unit of measurement is 'bcm' (billion cubic metres). A large amount of water precipitates and goes out as waste. Further, even the available water also cannot be fully used as utilisation has a bearing on its storage and supply to required places of usage. It is in this context that 'utilizable water resource potential' is to be distinguished from available water source. As we know very well, and we study in the unit later, there are parts of India where there is recurrent situation of floods; equally, there are other parts where there is acute situation of periodic drought. Unless the available excess water in one place is stored and then channelized to another place where it is scarce, the utilization of available water resource leaves a gap. Let us, therefore, begin by taking a look at the available/usable water supply in India.

3.2.1 Utilizable Water Resource Potential

Table 3.1 presents a synoptic picture of available and usable water resource in India. The total availability of surface water is estimated at 1953 bcm of which only 35 percent is utilised. However, out of the total availability of ground water (estimated at 432 bcm), a much higher utilization of nearly 92 percent is there. The scenario is thus indicative of a much higher utilization level of ground water potential as compared to the surface water potential. The two source of water resource taken together, the percentage of current utilization is about 46 percent. Due to the inadequate achievement on creating the infrastructure required to store and channelize (or transport) the surface water potential, there is an excess withdrawal of ground water potential. Evidently, therefore, harnessing the available surface water potential needs to be focused upon more for which required storage capacity needs to be built. The total availability of usable water estimated at 1086 bcm is less than the projected total water requirement of 1180 bcm by the year 2050. The situation thus calls for water conservation and management measures to be pursued seriously. While this is one profile of the availability/utilization of water, another way of looking at its utilization is by its sectoral demand/needs. The

Table 3.1: Availability of Water Resource in India

(figures in 'bcm')

Source of Water by Availability/Usage Potential	Amount of Water
Available surface water	1953
Usable surface water	690 (35.3)
Available ground water	432
Usable ground water	396 (91.7)
Total available water (surface + ground)	2385
Total usable water (surface + ground)	1086 (45.5)
Estimated present quantum of use	600
Projected total water requirement in year 2050	973/1180 (low/high estimate)
Precipitation over the Indian land mass	4000

Source: National Commission on Irrigated Water Resource Development.

Note: Figure inside brackets is percentage to respective total.

Table 3.2: **Projected Water Demand by Sectors of Usage – 2010 to 2050**

Sector	Demand for Water (in bcm) in year		
	2010	**2025**	**2050**
Irrigation	688 (84.6)	910 (83.2)	1072 (74.1)
Drinking water	56 (6.9)	73 (6.7)	102 (7.0)
Industry	12 (1.5)	23 (2.1)	63 (4.4)
Energy	5 (0.6)	15 (1.4)	130 (9.0)
Others	52 (6.4)	72 (6.6)	80 (5.5)
Total	**813 (100.0)**	**1093 (100.0)**	**1447 (100.0)**

Source: Eleventh Five Year Plan

estimates made for the Eleventh Five Year Plan (2007-12) on the sectoral demand for water in India (Table 3.2) places the highest demand of about 83 percent for irrigation (by the year 2025). While the demand for drinking water is expected to be roughly the same (at about 7 percent of total demand over the period 2010 to 2050), the 'energy sector' and the 'industrial sector' would be requiring a far higher share of water by the year 2050 (as compared to its current and projected demand for the years 2010 and 2025 respectively). Evidently, with improvements in standard of living and growing population, the demand for water from these two sectors of usage (viz. energy and industry) would be higher. Areas of concern, parallel to the increased usage by these sectors, are those of rising pollution levels and the resulting decline in the quality of water resources. These are also, therefore, among the critical areas warranting higher policy and research attention.

Check Your Progress 1 (answer in about 50 words in the space given below)

1) Why is it essential to study water resources? Indicate any three points.

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2) What are the two major sources of water? Which of these two major sources is over exploited?

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3) Distinguish between utilizable water resource and potential water availability.

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4) Which two sectors would require a higher share of water supply in the coming decades? In its light, what are the associated areas of concern requiring urgent efforts?

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3.3 ISSUES RELATED TO MANAGEMENT OF WATER RESOURCES

Some of the problems of water management like flood management, water logging, quality of water, water pollution due to industry practices, etc. were mentioned in the preceding two sections. We shall elaborate a little more on these issues in this section before we switch over to learn about the importance of irrigation to Indian agriculture.

3.3.1 Flood and Flood Management

Every year some part or other of the country gets flooded. Of late, the intensity and severity of floods has been increasing. The Eleventh Plan emphasized *prevention, protection, and management of floods*. Under this, a separate state sector programme called the *Flood Management Programme* has been initiated with an estimated cost of Rs 8,000 crore. For effective management of floods, a multi-pronged approach consisting of measures like: prevention, protection, management, forecasting, and early warning is needed. Floods can be prevented (or significantly moderated) by watershed management of the catchment area of rivers. Watershed management in the hilly catchments of the rivers originating in Nepal, Bhutan, and hilly areas of India should be selectively chosen and implementation should be done through a joint mechanism. *The ideal solution for flood control is the creation of adequate storages in flood prone river systems*. There is a need to build storage reservoirs for the *Ganga and its tributaries in the North and the Brahmputra* and its tributaries in the north-east. These storage projects need to be investigated, designed and executed expeditiously. For the northern tributaries of the Ganga, co-operation with Nepal would be required. Negotiations would need to be pursued with vision and constructive pragmatism. The strategy of flood control through embankments has been pursued by the States over the years but with limited results. A holistic view of an entire tributary or a large stretch of a tributary needs to be taken. Wherever feasible a one time decisive investment for a flood protection project should be made.

Flood management schemes should be integrated with other infrastructural development programmes in the sectors of roads, railways, inland waterways, and canal/command area development works. Drainage improvement in critical areas in the country should be given priority. Dredging at selective locations (like outfalls in the rivers and the tributaries) help reduce flood levels in low-lying areas by quick drainage. Erosion of land by rivers should be minimized through suitable cost effective measures. Protection measures must be based on the recurrence interval of the flood. *There is a need for systematic delineation of flood prone*

areas based on hydrologically suitable methods. The issue of flooding of the lower riparian states by sudden release of water from the dams of upper riparian states is emerging in some of the inter-state river basins. A relook at the operational rules for all the major reservoirs in such basins is needed for addressing this issue.

3.3.2 Water Logging

Related to the flood problem is the issue of *water logging*. Water logging refers to the condition where the underground water table rises close to the surface and water collects in topographical depressions due to insufficient drainage. The land situation in a typical waterlogged area can be classified into: (a) waterlogged lowland (called *chaur* in north Bihar); (b) midland which are temporarily flooded but remain dry from December onwards; and (c) uplands which are not flooded at all. Water logging occurs mainly as a result of obstruction to natural drainage created by roads, railways, canals, aerodromes, townships etc. Irrigation without proper drainage also leads to water logging. The most urgent task in a new package for waterlogged areas, therefore, is to make a comprehensive drainage plan by linking up the *chaurs* with the nearest water-course. This requires careful planning and coordination across villages and panchayats. The total area affected by water logging in the country is estimated at about 6 million hectares (mha).

3.3.3 Sustainability of Water

One of the major challenges associated with water resource management relates to ensuring the *sustainability of water*, both in *qualitative and quantitative terms* so as to meet the needs. Groundwater use has to be restricted to a level of its average recharge. Quality of water has to be improved by protecting the water sources from biological and chemical contamination. The threats to *water quality* are from: (i) untreated industrial effluents; (ii) municipal wastes from habitations; (iii) pollution from open defecation: and (iv) run-off from farms containing fertilizers and pesticides. Up-scaling the total sanitation campaign (TSC) programme for rural sanitation, strict enforcement of industrial effluent standards, and treatment of all municipal wastes are needed. At the same time, farming practices have to be modulated to use as little chemical fertilizers and pesticides as required by applying them in ways that minimize residues in run-off water.

3.3.4 Lack of Coordination Between Multiple Agencies

The government has constituted various water management systems and authorities for ensuring adequate availability of water for domestic and agricultural use. The ministry of water resources is responsible for implementing major, medium, and minor irrigation projects (see 3.4.2 for details); the department of land resources for watershed management; the department of rural development for the implementation of several development and employment promotion programmes; and the department of agriculture for ensuring water use efficiency. Likewise, rural drinking water is dealt with by the department of drinking water supply within the ministry of rural development. With increasing urbanization, issues of urban and industrial water supply is gaining in importance, demanding coordinated action with rural-centred schemes, for very often they are both tapping the same source of water supply. Presently, besides institutional weaknesses, there is lack of coordination between concerned department officials (resulting in delays in implementation and implementation of projects without proper technical assessment)

as also in the inadequate technical and managerial capacity of officials involved. The absence or ineffectiveness of 'water users associations' (WUAs), is also among the significant gap in the institutional machineries developed.

3.3.5 Inter-Basin Transfers Through Inter-Linking of Rivers

The idea of linking water-surplus Himalayan rivers with water-scarce parts of western and peninsular India has been doing the rounds for the past 150 years. The idea, in essence, is to link 37 rivers through 30 links, dozens of large dams and thousands of miles of canals. This would be the largest water project in the world providing a permanent solution to the paradox of floods and droughts. Of the 30 links proposed, 14 are in the Himalayas and 16 in the peninsula. The task force on the *inter-linking of rivers* has drawn up a set of proposals for the transfer of about 220 bcm of water. However, concerns have often been expressed by experts and environmentalists on the following grounds: (i) rivers change their course in 70-100 years and once they are linked, future changes can create uncertain problems; (ii) creation of canals would result in large-scale deforestation in certain areas; (iii) possibility of new dams posing threat to habitated land needing rehabilitation of affected people to new areas; and (iv) seismic threats of unknown nature are also posited. Interestingly, providing a well-argued debate to this conundrum of mutually conflicting concerns, in a document entitled *India's River Linking Project: The State of the Debate*, the authors Tushaar Shah et. al. layout *seven reasons* why revisiting the river linking issue is a good idea. These are: (i) a $2-trillion Indian economy may take more enthusiastically to the idea of massive water infrastructure investments that it earlier did not have the confidence to envisage; (ii) improved performance of public systems in infrastructure creation and management in road, power, etc. has possibly restored public confidence in the government's capacity to deliver; (iii) pressures to improve the rehabilitation and resettlement (RandR) of project-affected people has gained ground to result in institutionalised mechanisms to be put in place; (iv) transforming extant water scarcity into economic water scarcity would improve the financial viability and sustainability of water infrastructure; (v) increasing disposable incomes have begun to prompt voters to demand better water services in the urban areas and similar pressures could arise for agricultural water demand (owing to diversification of Indian agriculture that generates higher output-value per cubic metre of water whereby the farmers will be willing to pay substantially more than they pay today); (vi) rising energy costs will make pump-irrigation increasingly unattractive; and (vii) rapid growth in urban agglomerations would seriously strain the groundwater-dependent supply systems making inter-basin water transfers for water needs economically viable and politically compelling. In the backdrop of all these developments, the government of India has yet again announced its ambition to interlink the major rivers. The policy is at the stage of being discussed and debated with strong views regarding the merits and demerits of the plan being expressed.

3.3.6 Water Conflicts

The recent protests of farmers at Maval near Pune are a grim reminder that conflicts over the use of water for rural and urban needs may well escalate in the future in the face of rapid rise in urban population. Farmers might feel more and more alienated from the government on issues of land acquisition and water diversion

for non-agricultural purposes and may not buy the latter's assurances. Whether it is the *NOIDA* land acquisition fracas, or water diversion to industry from irrigation projects in *Maharashtra*, or the agitation by farmers in *Orissa* for a greater share of water from the *Hirakud dam*, the farmers are increasingly feeling short-changed. As a result, there have been protests against power projects in Maharashtra due to apprehensions that the new plants will reduce the quantity of water available for irrigation. The *Twelfth Plan* (2012-2017) approach paper lays special emphasis on water management but more evidence of serious forethought on how such situations can be sorted out are still awaited.

3.3.7 Inter-State River Disputes

Among all water-related conflicts, the inter-State river-water dispute is the most prominent. None of the States in a river-basin owns the river, but all of them assert user rights. For resolving any future potential inter-state river-water dispute, therefore, efforts should be directed for instituting legislated mechanisms for negotiations, conciliation, etc. to obviate the dispute. At the Centre, the Inter-State Council which is a constitutional body, must play a crucial role in this regard. Adjudication (as provided by Article 262 of the Constitution and the Inter-State Water Disputes Act 1956 as amended in 2002) should be a last resort mechanism after the potentials of the above measures to be instituted are duly exhausted.

3.3.8 Inter-Country Water Issues

There should be institutional arrangements for consultation and coordination involving all the countries concerned with a particular boundary or trans-boundary river. Failing a multilateral arrangement, the second-best course of bilateral arrangements should be strived for.

Check Your Progress 2 (answer in about 50 words in the space given below)

1) Mention the problems relating to water resources.

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2) Why is it necessary to have flood management schemes?

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3) Mention the different agencies/authorities involved in water management?

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3.4 IRRIGATION IN INDIA

We noted from Table 3.2 that 'irrigation' is and continues to be the most important of all the water uses in the country accounting for the highest share of water usage (more than three-fourths or 75 percent) by sectors. Irrigation is regarded as the most effective means for improving the agricultural production. Further, by applying a particular type of irrigation suitable to the crop/soil, more developed varieties of crops can be raised. It is true that even the improved variety of manures and seeds cannot increase the crop yield in the absence of required contribution by water. Moreover, owing to the moisture content of the soil in a well irrigated land, with adequate irrigation during the wet season, a secondary crop can be grown during the dry period with limited water supply. Apart from these major reasons, some of the other equally important reasons for irrigation can be stated as follows.

i) Due to the uncertainty of *monsoons*, irrigation is necessary to protect crops from drought;

ii) It *does not rain equally* in all parts of the country. So irrigation is necessary for agriculture in less rainfall areas.

iii) *Soils of some areas are sandy and loamy* and therefore porous for which a major portion of rainwater sinks down very quickly. Such soils cannot retain water like the alluvial soil and the black soil. Hence, irrigation is essential for farming in the areas having, sandy and loamy soils.

iv) Rain-water flows down very quickly along the *slopes of hillsides*. So irrigation is necessary to grow crops in such areas.

v) India is an agriculturally populous country with more than 50 percent of people still depending on agriculture. In order to grow food-crops and agricultural products in large quantities to feed the growing millions, intensive farming and rotation of crops are essential. Extensive irrigation is, therefore, necessary for more production. Through proper and timely irrigation methods, the production of crops including both food and non-food crops can be increased.

3.4.1 Modes of Irrigation

The different modes of irrigation can be divided into two classes: (i) flow irrigation and lift irrigation; and (ii) minor/medium/major irrigation. The water from a reservoir or tank usually flow well when the source of water supply is situated at a place higher than the level of the fields. Such irrigation is known as the *flow irrigation* and is generally possible in plain areas. But where the farm lands lie at a higher level, it becomes necessary to *lift the water (by pump*) to irrigate land. Water is therefore lifted from wells and tanks by a suitable method like electric motor pumps or diesel pump sets. This method of irrigation is known as *Lift Irrigation*. Another popular method is *sprinkle irrigation* which is practiced for irrigating crops requiring less water. Further, based on the difference of water storage facility like wells or tanks and the path created for the water to flow from the source of supply to the agricultural land, distinction between tank irrigation, well irrigation and canal irrigation is also made. Out of the total area under irrigation in India, about 40 percent of the area is irrigated by canals, 40 percent by wells and 12 percent by tanks. The rest 8 percent are irrigated by other sources.

3.4.2 Sources of Irrigation

Sources of Irrigation are broadly divided into: (a) groundwater sources and (b) surface water sources. Surface water sources are further divided into (i) *Minor Irrigation and* (ii) *Major and Medium Irrigation Projects.*

Groundwater Sources

The development of ground water is mostly done through individual efforts and private investment either supported by institutional finance or through other sources of borrowing. Over the period 1951–2007, irrigated area from groundwater increased by 6.3 times. Groundwater use has thus expanded more rapidly as it provides individual control over irrigation. Its growth is also stimulated by *spread of electrification and subsidized power*. Due to this reason, even in the command area of major irrigation projects, farmers often use groundwater to supplement canal water and maximize agricultural production. *This has led to over-exploitation of groundwater in the country*. As the groundwater recedes, wells have to be deepened and more energy has to be used to pump up the water. Major reasons for low performance of minor irrigation projects are: (i) poor economic status of small and marginal farmers; (ii) non-availability of assured power supply; (iii) highly subsidized water rates in canal command, whereas, no provision of subsidy for development of groundwater; (iv) in hard rock areas, probability of obtaining ground-water resource is low; and (v) over-extraction in critical areas has caused depletion of water tables resulting in failure of wells. The over extraction aspect has in fact become so critical that it merits a separation discussion.

Concerns about groundwater: The growing dependence on groundwater has taken the form of unsustainable extraction, contributing to lowering of the ground water table in many parts of the country. Depletion of water table has resulted in failure of groundwater sources in many parts of the country. Between 1995 and 2004, the proportion of *unsafe districts* (classified into: semi-critical, critical, and over exploited) has grown from 9 percent to 31 percent, the proportion of *area affected* from 5 percent to 33 percent, and the *population affected* from 7 percent to 35 percent. A major contributor to this rapid depletion in the water table is the overwhelming dependence on deep drilling of groundwater through tube wells which account for over 40 percent of irrigation. The 'ultimate irrigation potential' (UIP) through groundwater resources has been assessed to be about 64 million hectares (mha) in the country. Out of this, about 46 mha had been realised by the end of the *Tenth Plan (2002-2007)* period. Since groundwater is an open access resource and everyone is entitled to it, it is over-exploited without any concerns for its sustainability. This has contributed to increase in the ***cost of irrigation*** requiring farmers to periodically deepen their wells. In order to address the issues of sustainability and ownership of groundwater, the government had set up an expert group on *Ground Water Management and Ownership*. The group recommended that the ownership of the groundwater below the land will continue to remain with the owner of the land as long as the exploitation of groundwater is not causing depletion in the ground water levels of other landowners and public at large. Wherever the groundwater level falls below the replenishable level, the affected area will be declared as an area under threat and further exploitation will be regulated. The Central Ground Water Authority, under the provisions of Environment Act 1986, is empowered to make such declarations and it would be

the responsibility of the state government to ensure that the exploitation in the area is regulated. The regulation of the groundwater usage can be effectively made by the government only with the co-operation of user groups and community participation involving the panchayati raj institutions (PRIs). The user groups will be responsible for regulating the ground water usage among various sectors like irrigation, drinking, and industrial usage. Such regulations by the user group can be further made effective only if the State/Central Ground Water Board (CGWB) monitors and provides information on safely extractable water on the basis of water table levels recorded scientifically.

Minor Irrigation Projects

Sources of surface irrigation with cultivable command area (CCA) of 2000 ha are called minor irrigation projects. Though several such projects were undertaken in the post-independent period, most of the minor irrigation sources in the country are tanks. These tanks are often referred to as traditional sources of irrigation. There has been steep decline in the area irrigated under these traditional sources due to lack of proper maintenance.

Major and Medium Irrigation Projects

As an approach to the water crisis and irrigation requirements, the government took up building of huge dams and water reservoirs on various rivers to provide safety against the frequent floods and for the effective use of natural water resource by providing irrigation facilities to the surrounding field and farms. Such projects were also for generation of hydroelectricity. The chief aims of these projects, specially designated as multipurpose projects, are therefore: (i) flood control, (ii) irrigation, (iii) generation of hydro-electricity, (iv) navigation, (v) soil conservation, (vi) afforestation, (vii) pisciculture, (viii) water supply, etc. In addition to this, these projects have also been spots of *tourist interest*. Owing to generation of hydro-electricity, industrial growth has also been aided in these regions. To name some major dams and water reservoirs in India: (i) Nagarjuna Sagar Dam, Andhra Pradesh; (ii) Sardar Sarover Project built on river Narmada, Gujarat; (iii) Bhakra Nangal Dam built on river Sutlej, Himachal Pradesh; (iv) Gobind Sagar and Maharana Pratap Sagar Dam, Himachal Pradesh; (v) Krishna Raja Sagara Dam on Cauvery River, Karnataka; (vi) Tunga Bhadra Dam, Andhra Pradesh; (vii) Neyyar Dam, Kerala; (viii) Narmada Dam Project, Madhya Pradesh; (ix) Hirakund Dam Built on Mahanadi River, Orissa; (x) Farakka Barrage, West Bengal.

Problems Relating to Major Irrigation Projects

The expenditure on major irrigation projects has been more than on agriculture RandD. The huge resources spent on irrigation is not reflected in terms of expansion of the area under irrigation. There are reports from specific studies that many distributaries linked to old canals are running dry. Major irrigation projects normally have a gestation period of 15–20 years while medium projects take 5–10 years for completion. Against these norms, a large number of major as well as medium projects are continuing for 30–40 years or more. The reasons for this include: (i) inadequate funds due to thin spreading of funds over many projects; (ii) cost escalation due to time over-run; (iii) change in scope of works; (iv) unforeseen bottlenecks involving other agencies; (v) opposition by the project-affected persons; etc. Although irrigation is a state subject, to facilitate the completion of stalled or

delayed multipurpose projects in states suffering from resource crunch, the centre launched the 'accelerated irrigation benefit programme (AIBP)' in 1996-97.

Micro Irrigation Systems

Micro irrigation systems comprise of drip and sprinkler irrigation. Of late, this has emerged as a tool for effective management of water resources. Unlike other irrigation systems, they distribute water evenly. *Drip irrigation* is ideally suited for horticulture crops and cash crops such as sugarcane. It is estimated that drip irrigation saves 25-60 percent of water and provide up to 60 percent increase in yield. *Sprinkler irrigation* are useful in plain land for cereals crops. They also are estimated to save up to 25–33 percent of water. Out of the 69 mha net irrigated area in the country, only 0.5 mha is covered under drip irrigation and 0.7 mha under sprinkler irrigation. Maharashtra with 46 percent of its area covered under drip irrigation leads the country in this regard with Karnataka, Tamil Nadu, and Andhra Pradesh (with 21, 14 and 12 percent of their respective area under drip irrigation) being some of the other states which have tried out with the drip irrigation system. There is a view that while sanctioning new irrigation projects, implementation of micro irrigation in at least 10 percent of the command area should be made mandatory.

3.4.3 Ultimate Irrigation Potential (UIP)

The demand for irrigation water in India is very large. However, the limits to storage and transfer of water restrict the potential for irrigation. The creation of irrigation potential depends upon the efficiency of the system for delivering the water and its optimal use at the application level. Similarly, in the case of groundwater, innovative methods of recharging the groundwater by storing water in flood plains along the river banks would enhance the UIP from groundwater. Traditionally, efforts to address water supply problems have focused on major and medium irrigation projects. Consequently, wherever water supply for irrigation does not reach by such major/medium projects, use of ground water for irrigation has become the common practice. The annual extraction of groundwater in India, estimated at 210 billion cubic metres, is by far the highest in the world. Today, groundwater provides for more than 60 percent of the net irrigated area in the country. It also accounts for over 85 percent of the addition to the irrigated area in the last 30 years. The area irrigated by canals and tanks has also undergone a decline even in absolute terms since the 1990s. Since the recharging of ground water so much excessively drawn is not paid attention to, the acute problem of 'concerns about ground water' discussed earlier has arisen.

We had noted in the previous unit that the net sown/cropped area in India in the year 2008 was 140.9 mha (million hectares). Out of this, the medium and major irrigation (MMI) projects are estimated to have an UIP of 58.5 mha (i.e. 41.5 percent) and minor irrigation an UIP of 60.4 mha (i.e. 42.9 percent). Thus, the potential to provide irrigation facility by both these type of projects (i.e. major/ minor irrigation projects), in their ultimate capacity creation and realisation, is about 85 percent of total net sown/cropped area in the country. There is a critical need, therefore, to increase the irrigation potential by better methods of irrigation in the country.

3.5 PROGRESS OF IRRIGATION UNDER FIVE YEAR PLANS

The planned development of irrigation sector started right from the First Five Year Plan (1951–56). New projects to expand the area covered under irrigation were taken up in all the subsequent plans, up to the Annual Plans of 1966–69. Since many schemes of irrigation were incomplete and running under backlog, during the Fourth Five Year Plan, emphasis was shifted to the *completion of ongoing schemes*. The widening gap between the potential for creation and its actual realisation was acknowledged in the Fifth Plan (1974-78). To rectify this, the *Command Area Development (CAD)* programme was launched. The Annual Plans 1978–80 and the subsequent Sixth Plan witnessed new starts with the focus continuing to remain on *completion of previously launched projects*. By the end of the Eighth Plan (1996–97), central assistance was provided under the Accelerated Irrigation Benefit Programme (AIBP) to help the State Governments in expediting the completion of the projects. What has been the extent of additional irrigation capacity created over the last six decades period? What factors have hindered the achievement of the ultimate irrigation potential? Let us take a quick look at this. In 1950, the total net sown area was 118.8 mha of which provision of irrigation could be provided to about *17 percent* of the total farm land (i.e. about 20.2 mha of net sown area). By 2008, the gross irrigated area in the country had increased by 3-fold to 62.3 mha. Notwithstanding this, with a total net sown area of 140.9 mha in 2008, the achievement could account for only 44 percent of net irrigation facility in the country. Although the plan expenditure (i.e. outlay) on irrigation has increased from Rs. 441.8 crore in the First Plan to Rs. 95,743.42 crore in the *Tenth Plan* (2002-2007), the share in total plan expenditure has decreased from 23 percent in the First Plan to 6.3 percent in the Tenth Plan. Apart from inadequate allocation in the planned budgets, the reasons for lack of progress/efficiency centred around issues like: (i) financial viability of irrigation systems created; (ii) need to introduce 'systemic irrigation reforms' in the country; and above all, (iii) the need for a national water policy. We shall take a quick look at these aspects in sections 3.6 to 3.8 below.

3.6 FINANCIAL VIABILITY OF IRRIGATION SYSTEMS

A major problem affecting irrigation systems in the states is the *severe erosion of the financial status* owing to *very low water charges*. Not only does this encourage inefficient water use and a tendency for head-end canal users to shift to water intensive crops, it also creates an environment in which *irrigation charges do not cover even the operating costs* leading to progressive neglect of maintenance which further reduces efficiency. The pricing of irrigation water is obviously a critical issue. It is argued that as access to irrigation leads to an increase in the productivity of land and, therefore, in the income of the farmers, water should be treated like any other input and priced on the basis of the cost of supply, leaving it to the farmer to decide which combination of inputs (including quantum of irrigation) would be to his best advantage. This will also incentivize a more careful use of water leading to choice of cropping patterns more in tune with location-specific agro-ecological conditions. Further, since the present rates are far below where they ought to have been, the hikes would have to be brought

about in a manner that also addresses the genuine concerns of the farmers. The case for pricing irrigation water is weakened by the uncertain quality of irrigation service in terms of quantum and reliability. Nonetheless, to some extent it is also a consequence of financial weakness resulting from low pricing. *The challenge, therefore, is to define an agenda of reforms that can improve the performance of canal irrigation in India*.

3.7 NEED FOR SYSTEMIC IRRIGATION REFORMS

The equitable and optimal use of water from canal irrigation has been a matter of continuing concern. It is estimated that the overuse of irrigation water in the country has resulted in a *low irrigation efficiency* of about 25-35 percent in most cases. The reasons that contribute to low irrigation efficiency are identified as: (i) completion of dam work ahead of canals; (ii) dilapidated irrigation systems; (iii) unlined canal systems with excessive seepage; (iv) lack of field drainage; (v) improper field levelling; (vii) absence of proper volumetric supply; (viii) inadequate extension services; and (ix) low rate for water.

From the viewpoint of irrigators, the performance of an irrigation system is judged by the level of water control it offers. Water control is defined as the capacity to apply the proper quantity and quality of water at the optimum time to the crops. A drastic reform at the level of irrigation commands is critical for improving the performance of large irrigation projects. This entails deployment of a very different profile of human resources (moving away from exclusively engineer-centric departments towards more multi-disciplinary structures) who would be able to face the real challenges of mobilizing farmers to actively participate in irrigation management. It also requires innovative pedagogies for training farmers on the technical and managerial aspects of running the systems. There is considerable loss of water due to seepage in unlined channels. It is possible to retrieve one third to one half of the seepage losses from channels through pumping and about 80 percent of the losses by lining them. However, owing to financial and other constraints, it has not been feasible to take up the work of lining of all the channels with the work mainly taken up in phases.

The actual irrigation requirement in an area depends on several factors such as type of soil, climate, contribution from effective rainfall, crop types, etc. The operation of an irrigation system is governed mainly by the demands of the predominant crop. The schedule of irrigation supplies should aim at meeting the various requirements of plant growth on time. Where these cannot be met in full, the running of channels should conform to the more crucial stages of growth of the predominant crop.

Check Your Progress 3 (answer in about 50 words in the space given below)

1) State five reasons for the need of irrigation in India.

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2) Mention the three major modes of irrigation, run on project basis, in India? Which one of these is giving cause to rapidly depleting water table levels?

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3) What are the main objectives of multipurpose river valley projects?

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4) Indicate the main concerns about ground water usage?

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5) Why is the issue of pricing of irrigation water important?

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3.8 NEED FOR A NATIONAL WATER POLICY

Water management policies formulated include: (i) irrigation management policy, (ii) national policy guidelines to allocate water resources when rivers flow through multiple states, (iii) national commission for 'integrated water resources development plan', and many more. The ministry of water resources is responsible for laying down policy guidelines and programs. It also oversees the regulation and development of inter-state rivers. The ministry derives assistance from nearly fifteen organizations under its control. However, water being a state subject, the state governments have primary responsibility for use and control of this resource.

A radical rethinking on water resource management has become necessary as there has been serious mismanagement of water leading to a near-crisis. There are multiple perspectives of water like: (i) the rights perspective, (ii) social-justice/ equity perspective, (iii) women's perspective, (iv) community perspective, (v) the state perspective, (vi) hydrological perspective, (vii) engineering perspective, (viii) citizen/water-user perspective, (ix) economic perspective, and (x) the historical, cultural and sacred perspectives. If all these perspectives are to be integrated and

harmonized into a coherent whole, we need an overarching national perspective. Some *non-water policies* create difficulties for good water policy like: (i) electricity tariff policies encouraging the over-exploitation of groundwater; (ii) price support and procurement policies encouraging the cultivation of wheat and paddy and discouraging changes in cropping patterns; (iii) trade policies encouraging exports leading to export of water-intensive products, (iv) the pollution and contamination of water sources from industries; and so on. All these policy relationships need to be harmonized so that different policies work together and not against one another.

The model bill on groundwater [the Groundwater (Protection, Conservation, Management and Regulation) Bill, 2011] accords top priority to livelihood needs (generally estimated at 70-150 liters per capita per day) and spells out the need to use water for livestock, fishing, irrigation, power generation, industrial and recreational uses. As noted from Table 3.2, irrigation accounts for over three-fourths of all water used. There is scope to reduce water usage in crops like rice and sugarcane. With appropriate water tariffs, industries will be persuaded to adopt water recycling and conservation practices. Likewise, municipal bodies can reassess water pricing for residential consumers to reduce wastage. Conflicts over land and water may become disturbingly common if we do not develop the institutional framework and long-term policies to ensure their equitable distribution.

3.9 LET US SUM UP

Rainfall in most parts of the country is confined to the four rainy months of June to September. However, crops need moisture throughout the period of growth particularly during crucial stages. This can be met only by artificial watering or irrigation. The requirements of irrigation has increased with population growth and the consequent increased need for food production. Though India currently has around 60 mha of land under irrigation, the highest in the world, it is still just a little more than two-fifths of the country's arable land (around 44 percent as indicated in section 3.5). There is a need for adopting water conservancy through local efforts as also the proper assessment of cropping pattern and soil characteristics. Irrigation projects falter because of leakages and activists who oppose such projects. Unscientific use of irrigation water has led to lower levels of efficiency. Notwithstanding all these, there is an urgent need to expand irrigation to meet the increased requirements of food and raw materials of a growing population. Towards this end, water resources have to be harnessed fully and managed and utilized efficiently. Financial policies too need to be reoriented to achieve these objectives.

3.10 KEY WORDS

Command area development programme : Carried the objective of bridging the gap between creation and utilization of irrigation potential aimed at optimizing the agricultural production from irrigated land in different states.

Flow irrigation : Water in a reservoir or tank usually remains at a higher level so that when a channel is

connected to it, water flows down the channel serving the purpose of a canal for irrigating the land. It is generally possible in the plain areas.

Interlinking of rivers : One of the most effective ways to increase the irrigation potential, mitigate floods and droughts and reduce regional imbalance in the availability of water. It aims at transferring water from the surplus rivers to deficit areas.

Lift irrigation : Where the farm lands lie at a higher level and the canals or tanks lie at a lower level, it becomes necessary to lift the water by pump etc. to irrigate the land. Nowadays the ground water is used for irrigation by lifting it by means of electric or diesel pump sets. Water is also lifted from wells, tanks or rivers by pumps.

Micro irrigation : Comprise of drip and sprinkler irrigation techniques. Has emerged as a tool for effective management of resources saving water and electricity. Distributes water evenly unlike other irrigation systems. Drip irrigation is ideally suited for horticulture crops.

Minor irrigation : All ground water and surface water schemes that have a cultivable command area up to 2,000 ha. individually are classified as minor irrigation schemes.

Multi-purpose river-valley projects : Many purposes like flood control, irrigation, generation of hydro-electricity, navigation, soil conservation, afforestation, pisciculture, water supply, etc. are sought to be solved by creating reservoirs and by constructing strong dams and embankments or bonds in the river beds.

3.11 SOME USEFUL BOOKS/REFERENCES

1) Aiyer, Ramaswamy R (2011), National Water Policy: An Alternative Draft for Consideration, *Economic and Political Weekly Supplement*, June 25.

2) Banerjee, Rahul (2011): National Water Policy, *Economic and Political Weekly*, August 13.

3) Government of India (2008), Eleventh Five Year Plan 2007-12, Planning Commission, New Delhi.

4) Shah, Tushaar (2004): Water and Welfare: Critical Issues in India's Water Future, *Economic and Political Weekly,* March 20.

3.12 ANSWERS/HINTS TO CHECK YOUR PROGRESS EXERCISES

Check Your Progress 1

1) See section 3.1 and answer.

2) See section 3.2, 3.2.1 and Table 3.1 and answer.

3) See Table 3.1 and answer.

4) See section 3.2.1 and answer.

Check Your Progress 2

1) See section 3.3 and sub-section headings from 3.3.1 to 3.3.8 and answer.

2) See section 3.3.1 and answer.

3) See section 3.3.4 and answer.

Check Your Progress 3

1) See section 3.3 and answer.

2) See section 3.3.1 and answer.

3) See Table 3.4.2 (on major irrigation projects) and answer.

4) See section 3.4.2 (under concerns about ground water) and answer.

5) See section 3.5 and answer.