Indira Gandhi
National Open University
School of Social Sciences

BECE - 214
Agricultural Development in India

Block

1

AGRICULTURE AND ECONOMIC DEVELOPMENT

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Expert Committee

Prof. G. S. Bhalla
Professor Emeritus
Centre for Studies in Regional Development
Jawaharlal Nehru University, New Delhi

Prof. D. Narasimha Reddy
Formerly in Central University of Hyderabad
Hyderabad

Prof. S. S. Gill
Director General
Centre for Research in Rural and Industrial Development, Chandigarh

Prof. V. C. Mathur
Principal Scientist, Division of Agricultural Economics, IARI, PUSA, New Delhi

Prof. S. K. Singh
Formerly Director, SOSS, IGNOU
New Delhi

Sh. I. C. Dhingra
Formerly in Shaheed Bhagat Singh College
Delhi University, New Delhi

Prof. Madhu Bala
School of Social Sciences
Indira Gandhi National Open University
New Delhi

Prof. Narayan Prasad
School of Social Sciences
Indira Gandhi National Open University
New Delhi

Dr. Kaustuva Barik
School of Social Sciences
Indira Gandhi National Open University
New Delhi

Dr. B. S. Prakash
School of Social Sciences
Indira Gandhi National Open University
New Delhi

Sh. Saugato Sen
School of Social Sciences
Indira Gandhi National Open University
New Delhi

Course Coordinators

Dr. B. S. Prakash, School of Social Sciences, Indira Gandhi National Open University, New Delhi

Content Editing

Prof. D. Narasimha Reddy
Formerly in Central of University of Hyderabad
Hyderabad

Block Preparation Team

	Unit Writers	**Language/Format Editing**
Unit 1	Sh. I.C. Dhingra and Dr. B.S. Prakash	Dr. B.S. Prakash
Unit 2	Dr. B.S. Prakash	Dr. B.S. Prakash
Unit 3	Prof. S.K. Singh	Dr. B.S. Prakash

Print Coordination

Mr. Manjit Singh
Section Officer (Pub.)
SOSS, IGNOU

Cover Design

M/s ADA Graphics
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COURSE INTRODUCTION

The importance of agriculture to the Indian economy is underscored by the large proportion of working population depending on it for their livelihood. Even with the significant improvements made in terms of general literacy level, GDP growth, etc. the excessive dependence of poor and marginalized sections on agriculture is still very high – close to 50 percent of total workforce. Given this structure of the economy, the present course on 'Agricultural Development in India' introduces the students of economics to various aspects of Indian agriculture. The course is distributed over 8 blocks comprising of 27 units. Briefly, block-wise themes and the sub-themes dealt with under each unit are as follows.

Block 1 deals with the relationship between 'agriculture and economic development'. The block begins (in unit 1) by providing the readers with a theoretical overview of the linkage of agriculture with economic growth. Since the land available is limited and any improvement in output should, therefore, be necessarily done with a focus on its utilisation and cropping pattern, the second unit deals with the theme of 'land utilisation and cropping pattern' in India. Further, as water happens to be a critical input needed with its implications extended beyond the socio-political milieu, the third unit discusses the subject of 'water and irrigation resources' required for agriculture. Considering that land and water are the two crucial factors of production in agriculture, and the underlying theoretical knowledge to understand the linkage between agriculture and economic development is important to know, the first block lays the groundwork needed for venturing into the more specific themes of concern in the subsequent blocks/units.

Block 2 discusses the institutional set up for promotion of agriculture. Since the institutional set up that was existing before the country got its independence carried an important bearing on the changes that were brought in it in the post-independence period, the first two units of this block (units 4 and 5) deals with a discussion on the situation of 'land and agrarian relations' that obtained in India during the pre- and the post-independence periods respectively. A major change that was introduced into this mechanism in the post-independence period is the empowering of panchayati raj institutions to help promote rural development in general and agricultural development in particular. In light of this, the third unit of this block is focussed on 'panchayati raj and local self government'.

Block 3 is devoted to a discussion on 'agricultural development through the plans'. Under this, the first unit of the block (unit 7) is devoted to a discussion on the 'role and importance of agriculture in Indian economy' as envisaged in the different Five Year Plans implemented in India. This is in view of the fact that while the primary focus of the first plan period (1951-56) was exclusively kept on agricultural development, in the subsequent plans, the plan-focus shifted to issues like diversification of Indian agriculture, development of forests as integral to concerns of sustainability and rural industrialisation perceived vital to promote non-farm employment avenues. Against this background, unit 8 focuses on 'diversification trends of Indian agriculture'; unit 9 on linkage of 'forestry' with agriculture and unit 10 on 'rural industrialisation programme'.

Block 4 addresses the theme of 'technological changes in Indian agriculture'. The first unit of the block (unit 11) deals with 'green revolution'. In view of the fact that the benefits of green revolution did not reach all sections of the country/crops, although it no doubt heralded a golden era in Indian agriculture, unit 12 deals with the theme of 'new technology and distribution of gains'. Unit 13 focuses on 'trends

in agricultural productivity'. Since the period of green revolution has in a way outlived itself and to sustain the sector in the current times new technological frontiers are needed to be tapped, the last unit of this block (unit 14) deals with the aspect of 'new and emerging agricultural practices'.

Block 5 deals with 'state and agricultural sector'. The involvement of state in the promotion of agriculture has always been considered crucial particularly because of the sector's dominance by the 'small and marginal farmers' segment in India. Several support services requiring public investment like setting up of marketing and storage facilities, promotion of cooperatives, priority lending, etc. have to be made mainly by the government sector. With this background in view, four sub-themes are covered in this block. These are: (i) capital formation in Indian agriculture (unit 15); (ii) agricultural marketing in India (unit 16); (iii) cooperative movement and legislations (unit 17); and (iv) institutional finance, contract farming and food chain (unit 18).

Block 6 and **Block 7** are both devoted to discussing the important issues of the agricultural sector. Block 6 focuses on: (i) food security (unit 19); (ii) agricultural price policy and food inflation (unit 20); (iii) new agricultural strategy (unit 21); and (iv) environmental impact of agricultural progress (unit 22). Block 7 deals with: (i) agricultural taxation, subsidies and insurance (unit 23); (ii) agricultural labour and wages (unit 24); and (iii) small farmer's distress and MGNREGA (unit 25).

With the advent of WTO in the mid-1990s, the agricultural sector is no longer free from international commitments and its associated uncertainties and risks. In this light, the last block of the course (**Block 8**), deals with 'agriculture and international context'. This block consists of two units dealing with the sub-themes of: (i) foreign trade in agricultural goods (unit 26) and (ii) international commitments (unit 27). Taken together, therefore, the eight blocks of the course makes the learners gain knowledge on the theoretical, conceptual and analytical aspects of agricultural development in India.

BLOCK INTRODUCTION

We are very well familiar with the importance of agricultural sector to the Indian economy. Given the fact that an excessively large proportion of total workforce in the country continues to be still dependent on agriculture, the importance of the sector continues to be as paramount now as it was sixty years before i.e. at the time of our independence. Why does it happen to be so? What does the theory of economic development tell us in this regard? Does this dependence on agricultural sector continue to remain like this for many more decades to come? How does the availability and utilisation pattern of two essential inputs to agriculture (i.e. land and water) influence the growth of this sector? These are some of the questions to which the first block of the course addresses.

The Block comprises of three units.

Unit 1 begins with an introduction of the theoretical perspective on how the growth of agricultural sector is traditionally considered important to economic growth. As a country progresses on the path to economic development, whether the relative importance of agriculture continues to be the same or not is an important question to which the theoretical perspectives provided in the unit helps you to know about. In other words, what is the expected shift or transition among the main sectors of the economy? These are the questions to which the unit provide answers. The unit thus lays the foundation to understanding the linkage between agricultural development on the one hand and the overall economic growth/development on the other.

Unit 2 deals with the most important input for agriculture viz. land. What has been the trend in the land utilisation pattern in India? How does the cropping pattern vary and what are the factors that determine this variation? These are the aspects on which unit 2 focuses upon.

Unit 3 deals with the second most important input to agriculture namely 'water'. How is the availability of water and its proper channelling through irrigation important to agriculture? What are the different environmental and ecological factors that are needed to be considered in this context? These issues are dealt with in this unit.

UNIT 1 AGRICULTURE AND ECONOMIC GROWTH

Structure

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1.2.3 Necessary Conditions for the Sectoral Shift: Schultz-Jorgenson

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1.0 OBJECTIVES

After reading this unit, you will be able to:

- explain the relationship between agricultural growth and economic development;
- describe some of the theoretical postulations linking agricultural growth with overall economic growth;
- identify the determinants of agricultural development;
- explain the importance of economic policies to agricultural development; and
- relate the importance of agricultural development to industrial growth in particular and overall economic growth in general.

1.1 INTRODUCTION

Agriculture has been the major source of livelihood in the Indian economy. Notwithstanding the major structural changes in the sectoral distribution of the economy (in terms of their employment and income shares in GDP) over the last

six decades, agriculture continues to be the main source of living for a large section of the labour force in India. Agriculture, therefore, continues to be regarded as an important sector to be focused upon in the overall policy thrust of the country. It is estimated that for every additional rupee generated by agricultural production, the various economic linkages in the rural areas add another three rupees to the income. In addition, its multiplier effects influence many of the secondary and tertiary sectors of the urban economy (e.g. industry, transportation, banking, etc.). Although the relative importance of agricultural sector in the total GDP of the Indian economy has registered a marked decline over the last six decades, even at this juncture, for the much desired double-digit growth of the economy to happen, it is estimated that a growth of Indian agriculture by close to 4 percent is essential. If this is so, then one would like to know the 'conditions necessary for agricultural development'. For an answer to this, we turn towards some of the important theoretical postulations.

1.2 CONDITIONS FOR AGRICULTURAL DEVELOPMENT: THEORETICAL BACKGROUND

The role of agriculture in economic development has been recognised and discussed since the time of the 'physiocrats' (i.e. the class of French economists prior to the English classical economic theorists). According to the physiocrats, it was only the agricultural sector which produced an economic surplus over and above the cost of production. They considered manufacturing and commerce as non-productive in the sense that, the value of raw materials handled by these sectors was enhanced only enough to pay for the labour and capital used in the process of production. In view of this, the physiocrats considered agriculture as most strategic to economic development.

The classical economists, during the eighteenth and the first half of nineteenth century, also recognised the importance of agriculture in economic development but by duly linking its growth with that of the industry. For instance, Adam Smith's basic growth model considered the production of an agricultural surplus to support non-farm production essential for overall economic development. An interesting argument of the classical economists in general was the concept of '*circularity*' characterising the interrelationship between 'technology, investment and profit'. This implied that the level of technology depends on the level of investment, investment depends on profits, and profits depend partly on the level of technology. The Classical economists, thus, did not focus on agricultural development *per se*. But they considered economic growth to be implicitly dependent on development of agriculture since in the initial phase of economic transition most of the economies (particularly the agrarian developing economies) would be dependent on agriculture to support the majority of their workforce. One can imagine that even in the modern times, where food riots in many countries have been witnessed, importance of agriculture to produce enough to meet the global requirement has to be ensured wherever the production might actually take place. The classical theories of development, however, did not make an exclusive distinction between growth and development but assumed that development would follow growth in its natural course. It was towards the end of World War II, i.e. around 1945, that development by itself became an important field of study. We shall in this section study four

such theories viz. (i) the Lewis's 'two sector' economic model (1954); (ii) the 'three phase linkage to industrialisation' by Fei and Ranis (1961); (iii) the 'necessary conditions for the sectoral shift' framework by Schultz-Jorgenson (1964); and (iv) the 'agriculture first as a development strategy' or 'a balanced growth approach' advanced by a number of contributors who saw the mutually supporting character of sectoral linkages as central to developmental planning.

1.2.1 Two-Sector Economy Model: The Lewis Argument

W. Arthur Lewis (1954) based his model on the premise that in many developing countries a large reservoir of labour subsisting on low productive subsistence (agricultural) sector existed. Their marginal productivity was very low (close to zero) and hence the surplus labour available at subsistence-wage level could be transferred to the more productive modern (industrial) sector. The transfer can be effected at a wage rate slightly higher than the subsistence wage of the agricultural sector to overcome the friction of moving from the agricultural sector to the 'capitalist sector'. The capitalist sector would, however, need 'skilled workers' but this constraint was viewed by Lewis as a temporary bottleneck which can be overcome by providing training to the 'unskilled workers' to enhance their skill level.

Owing to higher investment and technology, the marginal productivity of labour in the capitalist sector (i.e. industrial sector or the non-agricultural sector) would be higher than the ruling wage rate in the agricultural sector. This, therefore, leaves behind a capital surplus which could be further invested to result in higher levels of capital formation. This, in turn, would make it possible for the employment of more people from the subsistence sector. The increased investment would further push up the marginal productivity of labour within the capitalist sector. This induces the capitalist employers to stop recruiting the surplus labour from agriculture at a level in which the supply of labour would become wage-inelastic. Some critics have pointed out that Lewis' optimism concerning development by absorption of disguised unemployment from agriculture is unrealistic as it is not possible to transfer a large number of workers without a drop in the agricultural output. The Lewis model, however, is based on the assumptions of *rationality* and *perfect competition*. In view of these assumptions (which rarely prevail in reality as the governance/institutional challenges precisely centre around their establishment to minimise the consequences of their violation), Lewis's argument holds good for large agrarian economies. The successive advancements made by others refine Lewis's two-sector theory making it more conform to the practicalities of the capitalist market based economies.

Lewis, in fact, had visualised that the process of labour transfer cannot continue indefinitely and must come to an end at some time point. He, therefore, argued that when that happens, the process of capital formation can be kept going by stimulating immigration from other labour surplus countries or by encouraging export of capital to countries with abundant supplies of labour at the subsistence wage rate. Lewis' model thus provided a framework complete in itself to understand the process of economic development in general. Nonetheless, certain valid criticisms made against his thesis include: (i) the process of labour transfer would also push the agricultural wages contributing to keeping the rate of profit and rate of capital formation lower than expected; (ii) the capitalist employers may use the surplus for

non-productive purposes instead of ploughing it back for development purposes; (iii) to meet their rising expectations, rural poor also may consume more and save less thereby dampening the pace of development; etc. An improvement on this model was suggested by Ranis and Fei who propounded their theory by first analysing the role of the 'neglected' agricultural sector in a static sense, and then generalised the 'static' analysis by introducing the possibility of an increase in agricultural productivity.

1.2.2 Three Phase Linkage to Industrialisation: Fei and Ranis

Fei and Ranis (1961) spelt out three distinct phases of surplus labour transfer from agriculture to industry. The first phase would last till the pool of 'surplus labour' exist. During this phase, the transfer of labour from agriculture to industry would not result in any adverse effect on the agricultural output. In the second phase, when the surplus labour is close to near exhaustion (called the Lewis's turning point), the marginal productivity of labour in agriculture would begin to rise. At this stage, there is positive opportunity cost for the transfer of labour from agriculture to industry i.e. labour cannot be transferred without a fall in output in agriculture. However, even at this state, so far as the industrial wage rate is still higher than the agricultural wage rate (i.e. as long as there is a gap, howsoever minor, in the two sector-wage rates), labour from agriculture can continue to shift to industry resulting in an aggregate increase in the economy's output albeit with a marginal fall in that of agricultural output. But at a point where the marginal product of agricultural labour becomes equal to the industrial wage (i.e. the third phase), further progress in economic growth becomes conditional to: (i) technological progress; and (ii) the absorptive capacity of the economy (by way of improved infrastructure). The central message flowing from Fei and Ranis's analysis is that while in the early stages of economic transformation, agriculture provides the surplus labour without a dent on the aggregate economic growth, in the latter stages, it is not unconditionally so. While to counter this situation, a balanced growth strategy (i.e. growth of both agriculture and industry) was advanced by many theorists, Schultz-Jorgenson provided a 'necessary condition for the sectoral shift'.

1.2.3 Necessary Condition for the Sectoral Shift: Schultz-Jorgenson

Schultz (1964) argued that any withdrawal of workers from agriculture will result in a reduction of agricultural output i.e. he maintained that the marginal productivity of agriculture is never zero or negative. But he firmly believed that the aggregate value of output in the economy can be raised by utilising the surplus labour in agricultural sector if the two critical issues involved can be answered: (i) what are the conditions under which the surplus labour from agriculture can be transferred without reducing the output in agriculture?; and (ii) what are the requirements of a potential labour force so that it can benefit both the sectors in a mutually complementing manner? Applying the idea of 'human capital' to study the age-earning profiles of population flows, Schultz put forward the theory that education would transform raw or unskilled labour to a 'skilled labour' status which would enable them to cope with external shocks. To illustrate this point, he gave the example of farmers in developing economies who have to 'deal with uncertain economic conditions, which are not of their own making'. He argued that education

would make people better able to process information on the economic environment minimising the exploitation that they would otherwise suffer. Jorgenson (1961), a contemporary of Schultz, looked at the issue from the standpoint of the inter-sectoral flow of resources and stated that the growth of the non-agricultural sector is contingent on a positive and growing 'agricultural surplus'. Jorgenson's major contention was that if technological changes in agriculture are not rapid enough, agriculture can never produce either a food surplus or release its 'surplus labour' productively to the industry. Implicit in the theory advanced by Schultz-Jorgenson is, therefore, the message that simultaneous growth of agriculture and industry is necessary both for the efficient transfer of 'surplus labour' as also for a 'sustained growth' of both the sectors in a mutually complementing manner. Schultz-Jorgensen's argument are thus an important link in realising the potential of labour transfer made by Lewis and advanced by Fei and Ranis. We now turn towards the 'balanced growth approach' model in which a strategy of development keeping 'both agriculture and industry under focus' is advanced.

1.2.4 Agriculture First Versus Balanced Growth Approach

An important concern shared by many theorists was related to the stimulation of demand in the economy. It is true that in the early stages of economic transformation, the larger section of the population reside in the rural areas depending for their survival mainly on agriculture. They are poor and less educated and, therefore, increasing their incomes in activities of agriculture-centred occupations is important. Unless this is done, the demand for the products of industrial sector also would be less. To deal with this situation, Rosenstein Rodan (1943) advanced the theory of 'big push' aimed at a coordinated expansion of 'production, employment and consumption' in different sectors of the economy. The 'big push' signified a certain minimum high quantum of investment required to deal with the economic obstacles to development. Such a strategy was meant to facilitate a 'balanced growth' of a large number of interrelated economic activities both in the 'farm' and the 'non-farm' sectors in a mutually complementary manner. The approach would help deal with the critical issue of 'vicious circle of poverty' (which is principally due to a lack of effective demand in the rural poor) on the one hand while simultaneously contributing to broadening the 'socio-economic base of the economy' on the other. Such investments in both agricultural and industrial sectors would ensure the realisation of multi-pronged benefits like: (i) augmenting the rural incomes thereby strengthening the demand for industrial and non-agricultural goods; (ii) increasing the supply of goods suitable to the tastes and income levels of large rural population; and (iii) improving the ability of agriculture to provide for industrial capital through foreign trade; etc. The policy challenge is, therefore, to resolve the conflict between the role of agriculture as a net provider of surplus and also its role in providing effective demand. In effect, therefore, the arguments make a case for prioritising agricultural development by fostering linkages between agriculture and the rest of the economy.

Check Your Progress 1 (Answer in about 50 words)

1) What is the concept of circularity?

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2) Who were 'Physiocrats'? State in brief their ideas on economic growth.

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3) What would you identify as common in the theories advanced by Lewis, Fanis and Rae and Schultz-Jorgenson? What holds the key according to Schultz-Jorgenson to realise the potential of 'surplus labour' indicated by Lewis?

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1.3 DETERMINANTS OF AGRICULTURAL DEVELOPMENT

The factors affecting agricultural development are varied. They encompass: physical, technological, economic, socio-cultural, institutional, organisational and political factors. All these factors operate at different levels like: household, village, district, state, nation and the world as a whole. Depending on how they are managed, these factors can have both favourable and adverse effects on development. For instance, if the human resources of a country are not properly developed by proper nutrition, health care, education and training, they are not productively utilised. Such resources become liabilities and obstacles to development. However, if they are properly developed and utilised, they become great assets and major factors contributing to development. Knowledge about the nature and magnitude of the impact of various determinants on agricultural development is necessary for agricultural development to proceed efficiently and effectively.

At a more specific level, good '*rural infrastructure*' is recognised as critical in enhancing agricultural output and productivity. Under this comes many specific factors like: roads, irrigation, electric supply, banking, communications, etc. A more specific variant of agricultural infrastructure is '*social infrastructure*' encompassing factors like: education and health facilities, extension services and information dissemination systems, participatory mechanisms, investments in agricultural research and technology (R and T), etc. Among the major deficiencies in rural infrastructure affecting the progress of agricultural development, in all developing economies in general, is the inadequate financial institutions for mobilising saving and disbursing *credit*. The role of *public investment* is yet another widely

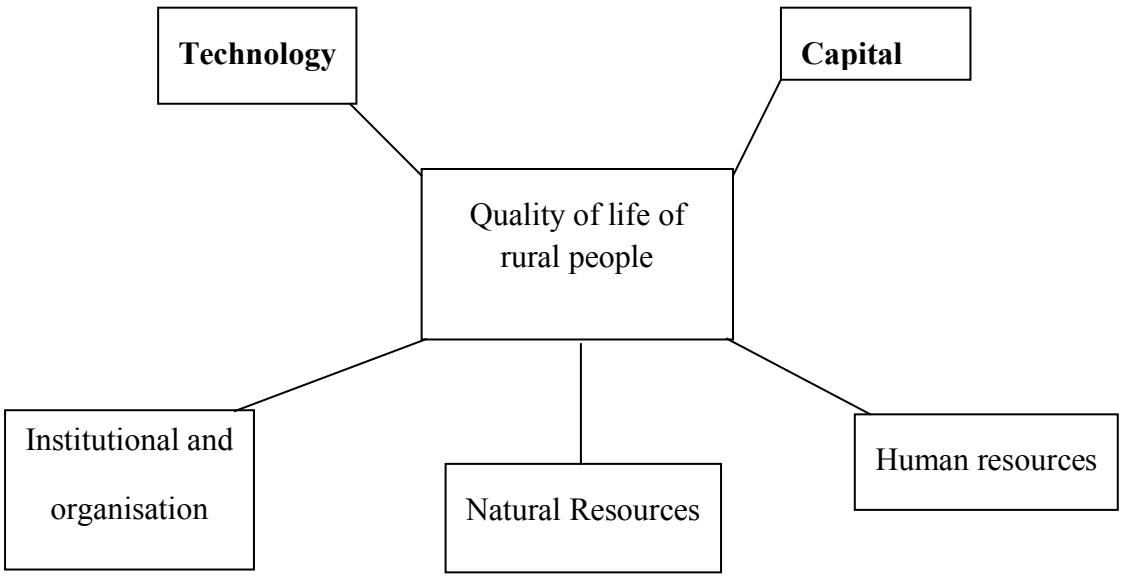

Fig. 1.1: Determinants of Agricultural Development

recognised factor which greatly impacts agricultural development. Public investment in agriculture for establishing facilities like cold storage, marketing outlets, etc. plays a crucial role in developing economies where large proportion of farming community belong to the 'small and marginal farmers' class whose income and living conditions border at poverty level. There is acknowledged evidence in the Indian context that in the post-liberalisation period, the proportion of public investment as a proportion of total gross capital formation has declined steeply. In this context, for capital constrained countries, the PPP (public private partnership) models of attracting investment is considered a viable option to improve the infrastructural facilities that are so vitally required for agricultural development.

1.4 AGRICULTURAL DEVELOPMENT POLICIES

Broadly, 'policy' is defined as a definite course of action selected from among a set of alternatives. In its more general sense, a 'policy process' refers to the formulation, promulgation and application of a course of actions specifically defined. Here, we shall concern ourselves with public agricultural development policies by which is meant actions taken by the government in the pursuit of specific objectives of agricultural promotion.

In this context, it is important to distinguish between: (a) policy; (b) programme; and (c) project. Policy is a comprehensive term subsuming many programmes. A 'programme', in turn, subsumes many projects. A policy has to be translated into a number of programmes before it can be implemented. A programme specifies what is to be done, how, by whom and where. A project is even more specific and detailed in terms of objectives, location, duration, funds, executing agency, etc. A project thus comes out to be the ultimate 'unit' of a policy action. A programme may consist of several projects. An agricultural development project may, therefore, be defined as an investment activity where resources are expended over a period of time to achieve certain pre-set goals.

1.4.1 Goals of Agricultural Development Policy

Agricultural development policies are designed to improve the conditions under which the rural people work and live. The goals of policies are governed by what people desire. A 'policy measure' signifies what people think the government can and ought to do to bring about the desired change. This is the theory of public policy. Changes are desired only when people do not like the way things are going. Pressure for public action arises when people feel they cannot individually bring about the desired changes. They have in mind some norm or some image of an ideal situation which they aspire. These norms become the goals of policy towards which the objectives of specific programmes are directed.

From the 'directive principles of state policy' enshrined in the Indian Constitution, it is possible to discern two dominant goals of an economic policy: (i) increasing the national income; and (ii) improving the distribution of national income among the members of the society. These goals are, therefore, reflected in all economic policies that are specified in the 'five year plans'. A goal which seeks to achieve 'inclusive growth' needs to be seen in the context of the four important dimensions of state policy viz.: (i) improvement of 'quality of life' of the citizens; (ii) generation of 'productive employment' opportunities; (iii) establishment of 'balanced regional development'; and (iv) achievement of 'self-reliance'.

Many agricultural development policies are combinations of various goals having different sets of instruments for its implementation. Broken down into several programmes or projects, a particular government agency is designated to pursue its implementation. These agencies may assign specific projects to be implemented by other voluntary and private agencies under its monitoring and control. In order to curb leakages and inefficient usage of resources, they are limited by various conditions. These conditions are thus the decisive factors which together determine the efficient implementation of projects/programmes.

1.4.2 Classification of Agricultural Development Policies

Tinbergen distinguishes between a qualitative policy and a quantitative policy. A qualitative policy seeks to change the economic structure through the creation of new institutions, modification of existing institutions and promotion of private firms. A quantitative policy seeks to change the magnitude of certain parameters e.g. change in the tax rate. An example which represents both qualitative and quantitative policy is the introduction of an education system free of charge. It is qualitative because it seeks to bring about a change in the economic structure and is quantitative because it represents a change in the fee charged for a service.

Heady classifies agricultural policies into: (i) development policies and (ii) compensation policies. A development policy seeks to: (i) increase the supply of commodities and resources, and (ii) improve the quality of products and inputs. A compensation policy is aimed at compensating its target group in various manners e.g. subsidies, price support, etc.

Check Your Progress 2 (Answer in about 50 words)

1) Mention the principal determinants of agricultural development.

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2) Policy subsumes projects. Do you agree with this statement.

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3) Distinguish between development policy and compensation policy with an example for each.

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1.5 AGRICULTURAL DEVELOPMENT: A PRELUDE TO INDUSTRIALISATION

The process of economic transformation theorised by Lewis generally holds for all economies i.e. both developed and developing. The pace of its transformation, however, varies directly with the pace in which the necessary institutional mechanisms are established by a country. Associated with such a transformation, the proportion of workforce dependent on agriculture would decline and those in the non-agriculture sector (i.e. industry and services) would increase. Table 1.1 presents a comparative profile of the relative shares of the three main sectors of economies in employment and income (i.e. national income) for India and the developed economies. While the proportion of workers in the agricultural sector in India is even now around 52 percent, for the developed countries it is in the range of just 1 to 5 percent. The share of industrial employment (in the total employment) of India which is about 14 percent now, is just about half of that in the developed economies. Further, the level of industrial employment over the six decade period of 1950-2010 in India has risen by just about 4 to 5 percentage points (it was about 9-10 percent around 1950s) which speaks of a far lower achievement on the extent of industrialisation achieved in India over the fairly long six decade period. Notwithstanding this, the extent of decline in the share of agricultural employment, over this six decade period is not small: it has declined from as high as 72 percent at the time of independence to 52 percent in the post-2000 years. While this decline indeed supports the hypothesis of labour transfer from agriculture to non-agriculture (i.e. industry + services) as proposed by Lewis, there is still a substantial way to go for India to attain the levels of the developed economies.

Table 1.1: Structural Composition in Employment (Empt.) and Income for India and Developed Economies

(percent)

Principal Economic Sectors	Developed Economies post-2000		India (2009-10)	
	Income	Empt.	Income	Empt.
Agriculture	1-4	1-5	14.6	52
Industry	22-30	21-33	28.6	14
Services	68-73	63-74	57.2	34

On the distribution of income by three broad economic sectors, however, both in respect of industries and services India is close to the developed economies level. The trend suggests the need to focus on a more rigorous policy of rural industrialisation programme. You will read more about our rural industrialisation programmes and their achievement in the unit 10 of this course. Meanwhile, it is important for us to know in what way agriculture makes significant contribution to the overall economic development. We now turn to take a look at this below.

1.5.1 Contribution of Agriculture to Economic Growth

Kuznets identified four possible types of contribution that the agricultural sector is capable of making to *overall economic development*. These are:

- *product contribution* i.e. making available food and raw materials;
- *market contribution* i.e. providing the market for producer and consumer goods of the non-agricultural sector;
- *factor contribution* i.e. making available labour and capital to the non-agricultural sector; and
- *contribution to trade* and thereby foreign exchange earnings (i.e. capital inflow).

The above contributions of the agricultural sector can be further elaborated as follows.

i) **Source of Supply of the Basic Wage-goods i.e. Food items**

A scarcity of food creates imbalance in the economy which works as a constraint for economic development. In the absence of adequate domestic supply there will be no surplus for exports.

ii) **Food Scarcity and General Price Level**

One of the main reasons why aggregate demand for food products is rising in the developing countries is population growth rate which is around 2.5 percent per annum. At the same time, there is a higher rise in per capita income (about 3.4 percent per annum) and therefore there is a relative rise in the income elasticity of demand for food. Let us denote the percentage change in income by Y_{ED}. It has

been estimated that the Y_{ED} for food is approximately 0.5 to 0.6 for most developing countries compared with 0.2 to 0.3 for the developed countries. Under these conditions, the increase in food demand is given by the equation: $D = P + (Y_{ED})\ Y$; where D is the rate of growth of food demand, P is the rate of population growth and Y is the rate of growth of per capita income. Substituting these figures in the above equation, we get: $D = 2.5 + 0.5\ (3.4)$ or 4.2 percent, as an approximation of the situation in a 'typical' developing country. If domestic food production is not growing at around this rate, scarcity of food would arise pushing prices of food items upwards. Food items being the basic wage-goods, an increase in food prices is a sufficient justification for a demand for higher wages in the industrial sector. Higher wages in the industry lead to cost escalations, particularly in those industries in which the wage bill is a substantial component of the total cost of production. This results in major macro economic disturbances which is a matter of serious concern for the economic health of any country.

iii) **Food Scarcity and BOP**

While it is possible to supplement any domestic shortfall of food grains by imports, this could lead to a balance of payment (BOP) problem. This in turn may make it necessary for the country to forego the more essential imports of capital goods like machinery, technical know-how, etc. In such a situation, the growth potential of the economy would be stifled.

iv) **Food Scarcity and Human Capital Formation**

Until quite recently, economists tended to regard food strictly as consumption good. It is now accepted that a part of food utilisation should be considered as investment as it is vitally needed to maintain the quality of the labour force. In its absence, the consequences of malnutrition would affect the potential human capital resulting also in worker absenteeism and productivity decline. As it is, food consumption in developing countries is deficient not only in calories but also in proteins. This is one of the reasons why labour force is relatively less productive in developing countries.

v) **Inputs for Industry**

The raw materials required for agro-based industries are entirely to be obtained from the agricultural sector. In spite of all technological and scientific advancements, it has not been possible for industries to adequately obtain the supply of agricultural raw materials like cotton, jute, sugarcane, etc. Also, as we know well by now the increasing demand for labour (consequent to increase in industrialisation) needs to be met, in the transitional years, by drawing upon the surplus labour in the agricultural sector. As more and more workers are released from agriculture, the remaining workers in agriculture must increase their productivity to maintain food supplies. There is thus a spiralling effect of increased inputs to both industry and agriculture. There would be increased need of R and D efforts to increase agricultural output.

vi) **Source of Foreign Exchange**

In its infant stage, industry earns little foreign exchange but creates strong demand for it in terms of its need for machinery, technology and other inputs not available locally. If agriculture does not provide foreign exchange from exports, the country

would again be confronted with the BOP constraint impeding the industrial progress of the country.

vii) **Source of Capital Formation**

A well-developed agriculture can make a net contribution to capital formation in non-agricultural sector. There are three arguments in support of this view: (i) capital-output ratio in agriculture is relatively low compared to industry so that there is greater scope for raising productivity in agriculture requiring only moderate outlays of capital; (ii) there is a relatively stronger tendency for sectoral terms of trade to move in favour of agriculture leading to an increase in farm incomes at a relatively higher rate than the non-farm incomes; and (iii) the consumption levels to which the farm population is traditionally habituated are generally low and these are not likely to increase commensurately with the rise in incomes which accrue with agricultural development.

viii) **Market for Industrial Products**

The influence of agricultural development on the consumption of industrial goods through the demand route works in both the directions: (i) increased agricultural production and growing income stimulate demand for industrial goods; and (ii) the terms of trade between the agricultural and the industrial sectors would tilt in favour of agriculture making the industrial goods costlier. The terms of trade effects in rural areas are different for the lower and higher income group persons. While for those in lower income groups, the demand would be inelastic both for the wage goods and the industrial goods, from higher income group persons, there would be differing impact on demand owing to higher income accruing from rising agricultural prices. Thus, agricultural performance can affect the demand for industrial goods both through output effect and the terms of trade effect. To sum up, therefore, increasing agricultural productivity makes an important contribution to the programmes of industrialisation and general economic development. This is, in fact, one of the ***necessary conditions*** which must be fulfilled before an economy gets itself ready for a process of self-sustained growth.

1.5.2 Agriculture's Dependence on Industry

The above review underscores the importance of dovetailing the agricultural development policies and programmes with that of the industrial development programmes. To reinforce this point, we can list out the various ways in which industry contributes to agricultural progress.

- Most of the modern inputs, including fertilisers, pesticides and even water, are made available by industry.
- Industry supplies the machinery required on the farms.
- Agricultural engineering is a significant branch of industry.
- Most of the research that has gone into bringing about '*green revolution*' in India has been undertaken in what can be described as an industrial culture.
- Industry helps raise the necessary infrastructure required for agricultural progress. This may be in the form of: transportation and communication, trade and commerce, banking and marketing channels, etc.

- Industry helps meet the growing demand for consumer goods in the rural sector in the wake of growing population and income in the agricultural sector.

In short, therefore, there is ample justification to support the mutually complementary nature of interdependence between agriculture and industry during the process of economic development and structural transformation. The relative forces of inter-sectoral demand and supply of resources, products and factors not only sets the pace of development but are also a manifestation of the stage of growth. However, the linkages between the sectors are such that for sustained development, a rise in agricultural productivity would have to first precede, and in later stages keep up with the development of the non-agricultural sectors.

Check Your Progress 3 (Answer in about 50 words)

1) In which respect India's progress is closer to that of the developed economies? Answer using the distribution of sectoral income shares.

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2) What are the four types of contribution identified by Kuznets from the agricultural sector to the overall economic development of a country?

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3) How does food scarcity impacts on human capital formation?

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4) Increasing agricultural development would need additional R and D efforts to sustain the growth of both agriculture and industry: why?

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1.6 LET US SUM UP

The unit began with a review of major theories which have advanced arguments on how agricultural development is a necessary condition for overall economic development. We noted that paying adequate attention to human development efforts [by way of social sector investment (i.e. on education, health, infrastructure, etc.)] is vital for an all round development of the economy. The importance of policies, programmes and projects in realising the targets and goals set for the sectoral development in general, and agricultural development in particular, was also noted. We saw that: (i) India is at an intermediate stage of development wherein the process of sectoral labour transfer postulated by Lewis and others is working; and (ii) growth of agricultural production to yield an annual 4 percent increase is necessary for sustaining the harmonious economic advancement of the country. Towards the end of the unit, we saw how imperative it is for ensuring the successful implementation of both the agricultural and industrial sectors in a mutually complementing manner.

1.7 KEY WORDS

Balanced growth approach : An approach in which both the agricultural and the industrial sectors are equally focused upon for development.

Two sector economic model : A model in which the total economy is considered to be dichotomous with: (i) a low productive agricultural sector shouldering a reservoir of labour force the marginal productivity of whom are very low; and (ii) a more productive non-agricultural sector (i.e. industry + services) whose growth and sustenance depends on a successful agricultural sector. The models built on this premise provide a clarity of the policy focus needed for realising the optimum developmental goals.

1.8 SUGGESTED BOOKS FOR READING

1) Ashok Gulati and Tim Kelley, *Trade Liberalisation and Indian Agriculture*, Oxford, New Delhi, 2003.

2) G.S. Bhalla, *Indian Agriculture Since Independence*, NBT, New Delhi, 2007.

3) Kartar Singh, *Rural Development: Principles, Policies and Management*, Sage, 3rd Edition, 2009.

4) Ranis, Gustav (2004), *Arthur Lewis's Contribution to Development Thinking and Policy*, The Manchester School, Volume 72, No. 6, December, pp 712-723.

1.9 ANSWERS/HINTS TO CHECK YOUR PROGRESS EXERCISES

Check Your Progress 1

1) Refers to the interrelationship between 'technology, investment and profit'. See section 1.2.

2) See Section 1.2 and answer.

3) See Sections 1.2.1 to 1.2.3 and answer.

Check Your Progress 2

1) (i) physical/technical/economic/….etc.; (ii) rural/social infrastructure; (iii) credit; and (iv) public investment.

2) See Section 1.4 and answer.

3) See Section 1.4.2 and answer.

Check Your Progress 3

1) See Section 1.5 and Table 1.1 and answer.

2) See Section 1.5.1 and answer.

3) See Section 1.5.1 (iv) and answer.

4) See Section 1.5.1 (v) and answer.

UNIT 2 LAND UTILISATION AND CROPPING PATTERN

Structure

2.0 Objectives

2.1 Introduction

2.2 Profiles of Land Utilisation

2.2.1 Classification of Land by Type of Use

2.2.2 Trends in Land Utilisation Pattern in India

2.3 Soils and their Variability

2.3.1 Types of Soil

2.3.2 Factors Influencing Soil Erosion

2.4 Cropping Pattern in India

2.4.1 Types of Cropping Pattern

2.4.2 Reasons Why Cropping Pattern Differ

2.4.3 Factors Influencing Cropping Pattern

2.4.4 Emerging Trends in Cropping Pattern

2.4.5 Long-Run Effects of Current Trends in Cropping Pattern

2.5 India's Position in World

2.6 Let Us Sum Up

2.7 Key Words

2.8 Some Useful Books

2.9 Answers/Hints to Check Your Progress Exercises

2.0 OBJECTIVES

After going through this unit, you will be able to:

- explain why it is important to study the trends in land utilisation;
- identify the factors influencing land utilisation trends in India;
- distinguish between gross/net cropped area and cropping intensity;
- discuss the factors contributing to changes in cropping pattern in a region; and
- critique the long-run effects of the trends in the cropping pattern of India.

2.1 INTRODUCTION

The availability of land in a country is constant limited by its geographical boundaries. Given the need for meeting the needs of land requirement by competing sectors (e.g. industry, town/city development) which quite often needs to be done by reducing the land used for agricultural purposes, there is little scope to expand the available land for cultivation. The requirement of food grains, on the other hand, is ever increasing owing to increasing population, changing tastes and

preferences due to improved income levels, and factors dominating the globalised economic scenario. While it might be argued that producing agricultural products within a country is not so important in a globalised world, in a developing country like India where large majority of population depends on subsistence agriculture as a means of sustenance for their very livelihood, agricultural production needs to be supported by policy measures (e.g. credit supply, extension services). The commercial viability of an agricultural activity has assumed critical significance in the context of globalised economy. Many factors, therefore, underscore the importance of studying the underlying factors responsible for influencing the land utilisation pattern in general, and within it, the pattern of crop production in particular. The present unit seeks to address the twin themes of land utilisation and cropping pattern in the Indian context.

2.2 PROFILES OF LAND UTILISATION

It is a fact that various parts of land meant for agriculture also cannot be used effectively for cultivation. This will become clear when we take a look at the alternative uses to which land is generally put into. Further, as said before, a large portion of available land is used for non-agricultural purposes. In effect, therefore, actual land available for cultivation (called 'gross cropped area') is always limited. We begin by first of all familiarising ourselves about the classification of land by their 'type of use'. Subsequently, we take a look at the profile of the distribution of land in India by their 'type of use' with a focus on what changes have taken place in their pattern of usage over a period of time. For this, we will take the two points of time for comparison: the point near to the time of independence (1950) and the latest year for which data are available (2008). We will see that the total area under cultivation, despite increased land usage for non-agricultural purposes has, in fact, increased over time. How has this become possible? What has contributed to this achievement? These are the aspects on which we will be able to know in this section.

2.2.1 Classification of Land by Type of Use

The total land area is broadly classified by their 'type of use' into the following: (i) cultivated land (i.e. net sown area); (ii) fallow land (area ploughed but left without being sown); (iii) area under non-agricultural use; (iv) barren and uncultivable land; (v) permanent pasture and other grazing land; (vi) land under miscellaneous tree and crops (outside of 'net sown area'); (vii) area under 'forest'; and (viii) area classified under 'cultivable waste'. An example of area under non-agricultural use is land used for industries. Land under forest and permanent pasture/grazing is needed for maintaining ecological balance in terms of the need of animals and other organisms in the universe. The classification of land by their broad profile of use, therefore, suggest that the agricultural output by crop cultivation can only be increased by better practices and application of technological advances. Better and innovative practices of agriculture are, thus, imperative from the point of view of meeting the concerns of food security in general and poor farmers in particular.

There are some important issues related to land utilisation in the context of developing economies like India whose large share of population is dependent on agriculture. First and foremost is the presence of large number of fragmented holdings. While agriculture continues to dominate the employment-income profiles of families dependent on such small holdings, the scope for implementing new

methods of cultivation is limited in such cases. Many factors like capital constraint, low literacy level, etc. hinders from pursuing a path of innovative practices. Along side, there are issues of poor/mis-utilisation of land and its impact/effect on environmental degradation. Secondly, making available land for industrialisation is always a major thrust of developmental policy. This is owing to a trend that is prevalent the world over where, the developmental path is leading to a structural shift from a higher dependence on agriculture to that in industry. This trend, besides underscoring the competing claims on land by industry, also points out to the policy dimension of dealing with disturbed livelihood, relocation and environmental concerns. In recent years, under the policy of rehabilitation and resettlement (R and R), there have been measures under which, job assurance, in addition to financial compensation for the acquired land, is guaranteed by legislative provisions. Initiatives like afforestation measures, aimed at increasing the share of forest land and address environmental concerns, have been among the policy thrust of the government.

2.2.2 Trends in Land Utilisation Pattern in India

The trend in land utilisation pattern over the period 1950 to 2008 is presented in Table 2.1. Major features of land utilisation profile flowing from the data in the Table are as follows:

- Gross cropped area has increased by 63.94 million hectares (mha) [from 131.89 mha in 1950 to 195.83 mha in 2008] over the period of 1950-2008. Further, close to 70 percent of total land area (68.9 percent in 2008 as compared to 56 percent in 1950) is covered by the net cropped area and area under 'forests'.
- The net sown area (i.e. land actually used for cultivation) has increased by 22.1 mha from 41.8 to 46.1 percent of 'total reported area on land utilisation' over the period 1950-2008.
- Area under non-agricultural use, which mainly includes land used for industrial and town/city development, has increased from 3.3 percent in 1950 to 8.4 percent in 2008. This is an indication of increasing urbanisation and industrialisation in the country.

Table 2.1: Land Utilisation Pattern (in mha)

Land by Type/Use	1950		2008	
	Area	%	Area	%
A Total geographical area	328.73		328.73	
(i) Net sown/cropped area	118.75	41.8	140.86	46.1
(ii) Fallow land	28.12	9.9	25.15	8.23
(iii) Area under non-agricultural use	9.36	3.3	25.54	8.4
(iv) Barren uncultivable land	38.16	13.4	17.3	5.7
(v) Permanent pasture/grazing land	6.68	2.3	10.4	3.4
(vi) Land under miscellaneous trees/crops/groves	19.8	6.96	3.3	1.1
(vii) Areas under 'forest'	40.5	14.2	69.7	22.8
(viii) Area under 'cultivable waste'	23.0	8.1	13.1	4.3
B Reporting area for land utilisation	284.37	100.0	305.35	100.0
C Gross cropped area	131.89		195.83	
Cropping Intensity (%) [percentage of **C** to **A** (i)]	110.1		139.0	

Note: Percentage indicated in columns 3 and 4 are to total reported area on land utilisation which is addition of figures indicated under (i) to (viii).

Source: Ministry of Environment and Forests (MoEF), 2010.

- Proportion of barren/uncultivable land has decreased from 13.4 percent in 1950 to 5.7 percent in 2008. This is an indication of the progress made in the area of waste land development.
- Area under permanent pasture/grazing land has increased from 2.3 percent to 3.4 percent over the period 1950-2008.
- Area under forest has increased from 14.2 percent to 22.8 percent over 1950-2008.
- Area under cultivable waste has decreased from 8.1 percent to 4.3 percent over 1950-2008.

The net effect of improvement in land utilisation pattern is indicated by 'cropping intensity'. In simple terms, cropping intensity indicates the number of times a field is used for growing crops in a year. This is expressed as a percentage of 'gross cropped area' to 'net cropped area'. Interestingly, this has increased from 110 percent to 139 percent over the period 1950-2008. Evidently, as the above analysis reveals, this achievement has been possible by a reduction in the *proportion of barren/uncultivable land* and *area under cultivable waste*, both of which have been steeply reduced (i.e. improved) indicating more efficient use of land over time. What is equally important to note is that this has been achieved by a simultaneous steep increase in the area under 'forest' and land under 'permanent pasture/grazing' both of which are important from the point of view of maintaining the larger ecological balance.

2.3 SOILS AND THEIR VARIABILITY

The type and quality of soil greatly determines the type of crops that can be grown in a region. It is an important input to plant growth and a natural material found everywhere but with differing type/quality. The type of soil benefits different type of crops through their unique physical, chemical and biological properties. For instance, 'alluvial soil' is rich in potassium and is well suited for crops like paddy, sugarcane and plantain. Likewise, 'red soil' has high iron content and is well suited for growing different type of grams (e.g. red, bengal, green), groundnut and caster seed. High yields and good produce can be achieved only when the right type of soil is used for crops to which it is most well suited. The quality of soil available in an area can be tested at soil testing laboratories. For areas in which suitable soil is not available, nutrients in the form of fertilizers can be added to enrich it. This is where scientific testing of soil is useful. Soil also gets depleted of its fertility if a particular crop is cultivated repeatedly in the area. Soil is also susceptible to erosion by natural factors like wind and rain, besides others. The depth/quality of soil therefore varies across regions. In this section, we shall briefly familiarise ourselves with the types of soil prevalent in different parts of India and the factors contributing to its erosion.

2.3.1 Types of Soil

The classification of soil depends upon the region/factor of its influence. Depending on the regional and the natural factor endowments (e.g. mountainous area, desert area, soil near to sea coast, etc.), the colour of the soil and their fertility levels vary. While some soil are distinguished for their colour (e.g. red soil, black soil, etc.), certain others (e.g. laterite, alluvial, etc.) are identified for their properties based on their chemical/geographical characteristics. A profile of types of soil and

the regions in the country where they can be found can be broadly stated as follows.

i) **Red Soil**: These are soil that is reddish in colour due to the presence of various iron oxides. Soils of this kind are deficient in organic content which are important in keeping the fertility characteristic of soil high. Nearly 2/3rd of the cultivated area in Tamil Nadu consist of this type of soil. Other parts of southern India (viz. Karnataka, Goa, Daman and Diu, Andhra Pradesh), South Eastern Maharashtra, Chattisgarh, Orissa and Jharkand, parts of Bihar and West Bengal (i.e. south-western belt touching up to the Eastern Indian frontier) are also abundant with red soil.

ii) **Black Soil**: These are soil derived from the deccan plateau. They vary in colour from dark brown to deep black. Soil of this kind are rich in organic matter and is well suited for growing cotton. They are also rich in useful chemicals like calcium, potassium and magnesium. Crops like cotton, tobacco, chilly, oil seeds, jowar, ragi and maize grow well in this type of soil. These are found in large parts of Mahrashtra and parts of western M. P., Gujarat and Tamil Nadu. Black soil found in uplands are relatively less productive than those in the lower reaches.

iii) **Brown Soil**: This is the third type of soil distinguished by its colour with its surface being brownish in colour. This is the normal soil found in most parts of the country and are moderately rich in organic content.

iv) **Laterite Soil**: Laterite soils are found in the hills of Karnataka, Kerala, M.P., eastern ghats of Orissa, W. B. and T. N. They are rich in organic matter in the lower elevations and are suitable for growing paddy. In the higher elevations, they are suitable for growing tea, cinchona, coffee and rubber. These soils prevail in those regions where there is an intermittently moist climate.

v) **Alluvial Soil**: This is the largest and most important soil group in India contributing to the highest share of soil variety in agriculture. Formed by the depositions of Ganges and Bramhaputra rivers in the North and East (i.e. the regions of U. P., W. B. and Assam) and by the deltaic/coastal regions of West/South (i.e. Gujarat, T. N. and Kerala), these are rich in lime but is also considerably saline and alkaline.

vi) **Desert Soil**: These are sandy soil low in organic content. They are found in western Rajasthan, Haryana and Punjab. Influenced by the Indus rivers and the Aravalli range of hills, these soils are also alkaline to saline. In spite of many water soluble minerals, they are low in nutrient content. They are, however, suitable for growing coconut, cashew and casuarinas in areas where there is high rainfall.

vii) **Terai Soil**: Terai soil are found in the hills of Himalayan region spanning the states of J and K, U. P., Bihar and W. B. They are formed by the downward movement of materials from the lower Himalayan regions.

viii) **Saline and Alkaline Soils**: These contain high amounts of soluble salts rendering an estimated 7 million hectares of land in India unsuitable for cultivation.

2.3.2 Factors Influencing Soil Erosion

Soil gets eroded by factors like rain, wind, overgrazing of animals and human activities like construction. Erosion by ***water*** is the most serious problem in India

particularly in the eastern parts which experience serious problem of flooding during rainy seasons. Soil erosion by water is estimated to affect about 5334 million tonnes of soil per year. Of this, close to 30 percent is permanently lost out to sea. Next to water, ***wind*** is a major factor contributing to soil erosion. This is a serious problem in 'arid (i.e. dry having no rain) and semi-arid' regions of Rajasthan, Haryana, Gujarat and Punjab. Erosion by wind is also prevalent in coastal areas where sandy soil predominates. Besides these natural factors, human induced factors like excessive removal of natural vegetative cover (by extension of agriculture to marginal areas and excessive grazing) also contribute to higher soil erosion by wind.

Another major cause of soil erosion and degradation is ***water logging***. Due to floods during rainy season (a natural factor) and excessive application of water in irrigated areas and canal seepage (a man made factor) the problem of water logging persists affecting large parts of cultivated land in India. Besides hampering crop growth, water logging has the potential of reducing/degrading soil productivity. The adverse effect of water logging is estimated to have exposed close to 8 million hectares of land in India. An yet another factor of soil quality degradation, which is but a form of erosion of soil quality, is ***salinization***. Due to increased application of canal irrigation by drawing on water from deep inside the ground level, the distance between ground water level and the upper layer of soil is increased. This is also what is referred to as falling ground water table levels. By a process of evaporation of water from the soil surface, the shifting water level causes 'soil salinization'. This process further leads to a chemical reaction called 'alkalization' whereby the quality of soil gets deeply eroded. In other words, disturbing the natural factors by drawing water excessively from deep within the earth's interiors has the potential of reducing the quality of soil by salinization/alkalization. This is also a man-made process of disturbing the ecological balance for which many socio-political factors have contributed in India.

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

1) Mention the different uses of land into which the total land area is classified?

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2) Does the available trends on land utilisation in India indicate a decline in the total land area used for crop cultivation? Do you see any indication of progress in waste land development?

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3) Which type of soil is well suited for growing: (a) tea, coffee and rubber; and (b) coconut and cashew nuts? In which state(s) are these type of soils found? Are saline/alkaline soils good for crop cultivation?

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4) Mention the four factors which contribute to soil erosion indicating any two of them which are man-made.

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2.4 CROPPING PATTERN IN INDIA

Cropping pattern has many dimensions. We shall specify two of its main types here. In one of its first dimension, it could be viewed in terms of number of crops grown in an area/field. From this perspective, it refers to the type of cropping system pursued (e.g. mono-cropping, multiple cropping, etc.). We shall elaborate more on this in section 2.4.1. In another one of its profiles, it is indicated by the type of crops grown (e.g. rice based cropping pattern, maize based cropping pattern, etc.). This is also linked to the two popular cropping seasons commonly heard about in India as *rabi* season cropping pattern (post-monsoon crops) and *khariff* season cropping pattern (monsoon crops). Under this, the crop occupying the highest percentage of the sown area of the region is taken as the **base** crop with all other crops sown considered as ***substitute*** crops. Under this base-substitute referencing, the *rabi* season cropping pattern is distinguished for 'wheat/ gram-based' and 'jowar-based' cropping patterns. On the other hand, under the *khariff* season cropping pattern, the base crops grown/sown are many viz. rice-based, cereal-based, maize-based, jowar-based, bajra-based, groundnut-based, cotton-based, etc.

2.4.1 Types of Cropping Pattern

Mono-cropping and Multiple-cropping: If a single crop is grown on a piece of land year after year it is refereed to as monoculture or ***mono-cropping***. Such a practice may be followed either because of extreme suitability of climate or due to the socio-economic condition of the farmer involved. It also can be due to the specialisation of the farmer in growing that particular type of crop. For instance, in canal irrigated areas, under waterlogged conditions, only rice is grown because no other crop is possible to be grown in such conditions. Growing more than one crop on the same piece of land in one calendar year is known as multiple-cropping. Multiple-cropping therefore implies intensification of cropping in time and space dimension i.e. more crops at one time and more crops on same amount of land at any given period. Three other types of cropping pattern (discussed

below) viz. inter-cropping, mixed-cropping and sequence-cropping are all variants of this particular type of multiple-cropping system practiced.

Inter-cropping: Inter-cropping refers to growing more than one crop simultaneously on a single piece of land with a definite row pattern. The practice can be followed with a certain defined ratio like 5 : 1 in which after every five rows of a particular crop the sixth row would be of a different crop. The system affords cropping intensity to be achieved over space dimension. Initially, the system of inter-cropping was practiced as an insurance against crop failure. More recently, the objective of inter-cropping has changed to achieving higher productivity besides stability in production. For successful inter-cropping, certain conditions are required to be ideally fulfilled. These are: (i) competition for light should be minimum among the different crops sown; (ii) complementarity must exist between crops sown; (iii) the time of peak nutrient demand of component crops should not overlap; and (iv) the difference in maturity of component crops should be at least 30 days.

Mixed-cropping: Mixed-cropping refers to growing two or more crops simultaneously without any definite row pattern. This practice is most commonly followed in dry land tracts. Under this system, seeds of different crops are mixed in certain proportion and sown. The objective is to meet family requirement of cereals, pulses and vegetables.

Sequence-cropping: Sequence-cropping refers to growing more than one crop in a sequence on the same piece of land in a farming year. Depending on the number of crops grown, the system may be called as double, triple, quadruple cropping pattern for crops involving two, three and four crops respectively.

Relay/Ratoon-cropping: A system of cropping in which the next crop is sown before harvesting the produce of the earlier crop is known as relay-cropping. Ratoon-cropping (or ratooning) refers to raising a crop with re-growth coming out of roots or stalks of previously harvested crop.

Integrated Farming System: This refers to following different types of cropping systems besides pursuing other allied areas of animal husbandry like dairying, poultry, fishery, bee-keeping, etc. The emphasis is on following a holistic method in a harmonious manner so as to maximise returns with efficient utilisation of resources subject to least damage to soil and environment.

2.4.2 Reasons Why Cropping Patterns Differ

The basic reason why cropping patterns differ over regions is that the amount of rainfall received varies widely from place to place. Based on the average amount of rainfall received in a season, the cultivated area in the country is broadly classified into three categories viz. (i) area receiving rainfall above 1150 milli meter (mm), (ii) area receiving rainfall within the range of 750-1150 mm and (iii) area where rainfall is below 750 mm. Most areas of Assam, Kerala, Orissa and West Bengal come under the first group. Basic problem in these area is limited irrigation and poor drainage. The major crop grown in these areas is rice. The states of T.N., U.P. and Andhra Pradesh come under the second category. These areas provide ample potential for setting up minor and major irrigation facilities. Areas coming under the third category, which offer little scope for improving cropping intensity due to relatively less rainfall, include parts of A. P., Karnataka, Maharashtra and Rajasthan. Besides the factor of variation in rainfall and irrigation facilities in a region, other reasons which contribute to differences in cropping pattern are:

- traditional social practices and dietary habits;
- crops with practicable disease/pest control management suitable to local ecological environment;
- crops which are most profitable or high yielding i.e. considerations of commercial viability; and
- combination of crops which ensure stability and risk coverage yielding profit maximisation and cost minimisation.

2.4.3 Factors Influencing Cropping Pattern

Various factors like socio-economic conditions of farmers, cultural factors, climatic conditions, etc. determine or influence the cropping pattern in a region. Major factors in this respect can be stated as follows.

i) **Size of the Land Holding**: As stated in the introduction to the unit, in India small and marginal farmers constitute the majority of farming community. Due to this reason, mono-cropping pattern has been highly prevalent as it fulfils the food requirement of the farmers' household. The situation is characteristic of subsistence farming offering little scope for commercial crop husbandry.

ii) **Literacy**: Practicing better cropping methods require a certain level of educational level. This is hindered in the Indian context due to prevalence of high illiteracy among the small and marginal farmer community who dominate the sector. The application of scientific methods involved in mixed/mono-cropping patterns requiring technological inputs is hindered due to this factor.

iii) **Financial Requirement/Stability**: Owing to poor economic condition of large number of farmers, cropping patterns involving medium to high capital requirements cannot be practiced by farmers. They are compelled to adopt low cost cropping pattern which will also yield low output and income.

iv) **Disease and Pest Management/Control**: This is linked to factors of poor financial and educational status of small farmers mentioned above. Owing to this, farmers cannot adopt modern disease/pest control measures.

v) **Ecological Suitability**: The cropping pattern of a region highly depends on ecological suitability to crops. Adoption of cropping pattern suitable to the local ecological factors require application of soil testing and usage of inputs required for the prevailing conditions. Once again, socio-economic status become the hindering factor in coping with this type of natural endowment condition.

vi) **Moisture Availability**: This is linked to climatic factor vis-à-vis amount of rainfall in the region. To counter this, modern irrigation facilities are needed. Besides, adoption of dry land farming techniques also could be required. All this requires a certain level of knowledge and economic base which is not supportive of adopting best farming practices in India.

The various factors enumerated above are essentially inter linked with counter influencing effects of one with the other. Emerging trends, however, indicate improvement in these ground realities in spite of large sections continuing to suffer from similar disabilities. We shall now take a look at these trends in the next section.

2.4.4 Emerging Trends in Cropping Pattern

India leads world in agricultural production enjoying the second position in the world with regard to overall agricultural production. Nonetheless, there are some disturbing trends continuing to dominate the cropping pattern in India. These may be stated as follows:

- Of all the types of agricultural production (viz. food grains, cereals, pulses, fruits and vegetables, etc.), there is a dominance of cereal crops. Since cereals indicate the basic needs of poor people, the trend is suggestive of large number of poor people engaged in subsistence farming. Since majority of farming community comprise of 'small and marginal farmers' (i.e. whose average holding is between 0-5 acres: see 'key words' at the end of the unit), the trend is one of dominance of poor people engaged in agricultural activities for self-consumption. The same fact also conveys that their inability to divert to non-food cash crops which require higher level of inputs. Although there has been an increase in the supply of farm loans and grants, the basic trend continues to be still disturbing.
- Second, despite improvement in agricultural productivity over time, it is still much lower when compared to global productivity levels. Worldwide evaluation studies reveal that the mean agricultural output in India is just 30-50 percent of the maximum average output in the world.
- The low productivity levels is also underscored by the ratio of employment to GDP. While more than 50 percent of an estimated total labour force of close to 500 million persons continue to remain in agriculture, the net contribution to agricultural production (i.e. GDP) is about 15 percent. While it is significant that the dependence of people in agriculture has come down from the level of close to 70 percent at the time of independence to about 50 percent now, it is still far higher than the corresponding level in developed countries (where about less than 5 percent of workforce produce far higher than India's average production levels). The trend is signifying of lower usage of scientific advances owing to the low level of socio-economic status of small farmers.
- There is a distinct shift from food grains production to cash crops like fruits and vegetables (with about 10 percent of global production of fruits today being from India and holding the first position in the world in respect of some fruits like papaya, mangoes, sapota, banana, etc.). In spite of this, the shift towards high valued commercial crops, in terms of global commercial standards, is still very small. The result is an insignificant impact on the global crop output and India's overall share therein.
- The population of India is increasing at a faster pace than its capacity to produce wheat and rice. This trend needs to be reversed and improved if the import of these commodities from other countries needs to be curtailed.

2.4.5 Long Run Effects of Current Trends in Cropping Pattern

The long run effects of current cropping pattern can be stated in terms of the following.

Increased Use of Fertilisers and Pesticides: Increased use of inorganic fertilisers and pesticides has led to increased toxicity in the agricultural produce. Heavy use of chemical fertilisers and pesticides have also caused extensive water and environmental pollution. This has led to many health problems in the community. Along side, there has been an immunity among pests leading to pesticides used becoming ineffective.

Use of Hybrid and High Yielding Varieties: Increased use of hybrid and high yielding varieties have resulted in the extinction of local varieties which were known for their higher nutritional levels. This has led to awareness on the importance of adopting natural and organic farming techniques. However, the scale in which such practices are operated needs to be enhanced in order to make a real dent into the system. It must be noted that these very methods were also the ones which contributed to the realisation of green revolution benefits. A balance between the traditional practices and the modern methods needs to be established.

Increased Water Demand: The agricultural sector is estimated to take up close to 70 percent of total water used. Further, with increased cropping intensity the requirement of water for agriculture would increase. This has deprived the demand for water from other competing sectors. The higher requirement of water has depleted the ground water levels. Consequent to increased irrigation facilities, many minor and major irrigation projects have had to be launched. Quite often, these projects have created social and environmental disturbance. The trend has been one of increased acquiring of agricultural land for non-agricultural purposes. While this trend in itself cannot be questioned, as the labour absorptive and the productivity levels of agriculture cannot match with that of industry, it has required the adopting of water conservation methods and practices.

Depletion of Forest Areas: One of the feared long run effects of higher cropping intensity was reduced forest area which is important for maintaining ecological balance. However, we noted in section 2.2.2 that measures of afforestation has contributed to not only maintaining but improving the overall forest cover in the country in general. Nonetheless, in specific areas and pockets local disturbance of ecological standards is a reality due to increased crop production and other non-agricultural activities. This is a matter of concern which needs to be tackled at the local levels.

In short, each of the factors identified above as areas of long term concern, is also a two-edge potent tool having both the beneficial and harmful effects. Striking a balance to get the benefits of a practice/method without undermining the consequential ill impacts is the developmental challenge that needs to be faced effectively.

2.5 INDIA'S POSITION IN WORLD

India ranks first in the production of buffalo milk in the world. There are a number of other products in which India ranks first in the world for its production (e.g. fresh fruits, coriander, jute, spices, pulses, castor oil seed, millets, safflower seeds, limes, lemons, cashew nuts, dry chillies and pepper, ginger, turmeric, goat milk, etc.). We rank second in the world in the production of paddy rice with an overall production of close to 148 million tonnes (mt) in 2008. Other items in which India

ranks second as the biggest producer in the world are: wheat, cow milk, fresh vegetables, sugar cane and ground nuts, cabbages, fresh vegetables, cotton seed, brinjal, garlic, silk, cardamom, wheat, onions, sugarcane, dry beans, tea, groundnut, cauliflower, green peas, pumpkins, potatoes, inland fish, etc. The number of products in which India ranks third in the global market include: sorghum, tobacco, coconuts, rapeseed, tomatoes, hen's egg, etc. In coffee production, India ranks sixth in the world. Thus, having noted in the earlier sections the various profiles of Indian agriculture together acting as challenges confronting the sector in general, it is equally important to know that we are also among the world leaders in many products of agriculture.

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

1) In the context of cropping pattern, how is a 'base' crop distinguished from a 'substitute' crop?

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2) Mention the three variants of 'multiple cropping'? What is meant by 'integrated farming system'?

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3) Besides rainfall, which other factors contribute to differences in cropping pattern over regions?

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4) Mention any five factors that influence the cropping pattern in India? Which is a factor influencing the cropping pattern that can be tackled by modern irrigation facilities?

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2.6 LET US SUM UP

The unit has dealt with the twin themes of land utilisation and cropping pattern in India. We began with an understanding of the broad classification of land uses. These were grouped into 8 uses amongst which we noted that land for agricultural usage has remained the top ranking area right from 1950 to 2008. This trend, has not been at the expense of depleting forest reserves or the land required for permanent pasture and grazing. In fact, land available for both these purposes, which are important for maintaining the overall ecological balance, has increased over time. This fact tells us that other measures initiated like afforestation, general awareness campaign, etc. have had their positive effect on the land utilisation pattern in the country. In crop production, while different types of cropping pattern are practiced, there is a need to focus on some critical areas of concern like small land holdings, low literacy levels, improving the economic ability, etc. All these are contributing to the relative lower levels of application of scientific methods of cropping practice. Despite the several drawbacks hampering the Indian agriculture, in the production of many farm products India is among the world leaders.

2.7 KEY WORDS

Cropping Intensity : Ratio of Gross Cropped Area to Net Cropped Area

Net Sown Area : Same as Net Cropped Area. This can be expressed in the form of an equation as follows:Net Sown Area = Gross Sown Area – {fallow land + cultivable waste} + K times (area cropped more than once); where K is the number of times a piece of land is used for cultivation.

Small/Marginal Farmers : A term commonly used in the Indian context. It refers to farmers with land holding of less than 2.5 hectares (1 hectare = 2.5 acres) of land. A small farmer is defined as one with less than 2 hectares of land while a marginal farmer is defined as one with less than 1 hectare of land. RBI, for the purpose of priority lending [under 'weaker sections within the priority sector'], defines 'small and marginal farmers' as those with "land less than 5 acres of non-irrigated land or 2.5 acres of irrigated land" and land-less labourers, tenant farmers, and share croppers'. They are characterised by having to remain compulsorily on their farming work having no other option suitable to their situation. Being poor, they use the land to grow crops for self-consumption; hence the word 'subsistence farming or farmers' also. Since they are large in number, and their ability to adopt modern

methods of cultivation is low (because of factors like low level of literacy and lack of input required for practicing modern methods), raising their productivity and income levels is a major policy challenge. Changing the archaic land laws in a major way, called as land reforms, is advocated as much needed in this regard.

Salinity/Alkalinity : Refers to the content of salt making the water/ soil saline. When such soil comes into contact with hot sun rays it results in a chemical reaction rendering the soil 'alkaline' in nature. Such soil is most ill-suited for farming purposes.

2.8 SOME USEFUL BOOKS

Chadha G K , S. Sen and H. R. Sharma (2004), *Land Resources , State of Indian Farmer: A Millennium Study*, Vol. 2, Academic Publishers, New Delhi.

Govt. of India (2001), Report of the Working Group on Agricultural Statistics (for the X Five Year Plan), Planning Commission, New Delhi.

(http://planningcommission.nic.in/aboutus/committee/wrkgrp/wgagristat.pdf)

Rajiv Ranjan Shrivastava (2007), *Emerging Trends of Cropping Pattern in India*, DK Publishers, New Delhi.

2.9 ANSWERS/HINTS TO CHECK YOUR PROGRESS EXERCISES

Check Your Progress 1

1) See section 2.2.2 and answer.

2) See section 2.2.2 and answer.

3) See section 2.3.1 and answer.

4) See section 2.3.2 and answer.

Check Your Progress 2

1) See section 2.4 and answer.

2) See section 2.4.1 and answer.

3) See section 2.4.2 and answer.

4) See section 2.4.3 and answer.

UNIT 3 WATER AND IRRIGATION RESOURCES

Structure

3.0 Objectives

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3.2 Water Resources in India

- 3.2.1 Utilizable Water Resource Potential

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- 3.3.1 Flood and Flood Management
- 3.3.2 Water Logging
- 3.3.3 Sustainability of Water
- 3.3.4 Lack of Coordination Between Multiple Agencies
- 3.3.5 Inter-Basin Transfers Through Inter-Linking of Rivers
- 3.3.6 Water Conflicts
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3.4 Irrigation in India

- 3.4.1 Modes of Irrigation
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3.6 Financial Viability of Irrigation Systems

3.7 Need for Systemic Irrigation Reforms

3.8 Need for a National Water Policy

3.9 Let Us Sum Up

3.10 Key Words

3.11 Some Useful Books/References

3.12 Answers/Hints to Check Your Progress Exercises

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.