# UNIT 13 TRENDS IN AGRICULTURAL PRODUCTIVITY

**Structure**



## 13.0 OBJECTIVES

After reading this unit, you will be able to:

- distinguish between the terms production and productivity;
- define the concept of 'productivity' along with its associated elements like partial factor productivity, total factor productivity, efficiency, etc.;
- present a comparative profile of productivity in total production of food grains and in major crops between India and other countries;
- discuss the trends in land/labour productivity of Indian agriculture;
- identify the causes of low productivity in Indian agriculture; and
- outline the measures required to be taken for increasing the productivity of Indian agriculture.

# 13.1 INTRODUCTION

We have already noted in unit 11 that in terms of overall agricultural production, but for intermittent variations, India has consistently achieved improvement in its total production of food grains. To recall, India's total production of food grains was 72 million tons (mt) in 1965-66, 132 mt in 1978-79 and 234 mt in 2008-09 (in 2011-12 it is estimated to cross 250 mt). Notwithstanding this increasing trend, it is also a fact that the average productivity of Indian agriculture is much lower when compared to many other countries. We have also read in unit 11 that increased use of certain critical inputs under the green revolution (GR) technology (i.e. fertilizers and pesticides) contributed to declining soil fertility with the subsequent experience of stagnation/decline in agricultural productivity in the post-GR years. This is also evident from the figures on aggregate production cited above; the average annual increase in the production of food grains declined steeply from 4.6 mt over the 13-year period of 1966-79 (i.e. 60 ÷ 13) to 2.8 mt (i.e. 86 ÷ 31) over the period 1979-2010. This means while achieving increase in total production is necessary, maintaining or increasing the productivity level, which is more related to the use of factor inputs efficiently, is equally important. In other words, while increasing production is necessary for the growth of the sector, it is not by itself sufficient from the point of view of productivity/efficiency considerations. The concept of productivity, in this sense, is treated equivalent to efficiency. We are also aware that owing to scarcity of land and water resources, the only way to increase our agricultural production is to focus on productivity increase i.e. by an optimum usage of inputs for increasing the level of output. There is, thus, a close relationship (and a positive or negative trade-off which ensues) between achieving increased total production and achieving it with due regard to concerns of productivity/efficiency. In this unit, we focus on the different aspects of productivity like its definition/meaning, components, issues of measurement and variables on which data is required for the same, trends, causes of low productivity, measures needed to increase productivity, etc. We begin with a brief conceptual outline of terminologies in order to be able to appreciate the trends in agricultural productivity discussed later in section 13.3.

# 13.2 CONCEPTUAL OVERVIEW

The above introduction tells us that we must first of all be clear on the distinction between the terms 'production' and 'productivity'. There are also other related concepts like output, value added, factors of production, production function, etc. Each one of this plays an important part when we are dealing with the issue of productivity measurement or trend. Let us, therefore, familiarise ourselves with the meaning or definition of these terms.

## 13.2.1 Production Vs. Productivity

Production, in empirical terms, refers to a quantified assessment of a situation like the total value of our agricultural production. This can be measured and expressed either in units of a physical measure (i.e. millions of tons) or in terms of its monetary value expressed in millions of rupees or dollars. The value of production so expressed is what we commonly refer to as 'output'. The value of output net of value of inputs that has gone into its making (i.e. output minus input; both expressed in same units – particularly in value terms) is what is widely referred to as 'value added'.

The term productivity, on the other hand, refers to a ratio of 'output' to 'input'. Thus, the per hectare agricultural production is a measure of productivity in which 'output' is taken as total production and 'input' is taken as land. An increase in the value of output can be achieved by changing the value of input (i.e. increase or decrease in the amount of land used). Keeping the 'input', in this case land, constant, increase in output can also be achieved by improving the efficiency of land by use of fertilisers or manures, or by a change in the pattern of land use itself by diversification or cropping culture. An increase in output, achieved by keeping the input constant or by a reduction in the input used, would mean that there is an increase in productivity. This can be illustrated by a simple example. Suppose a production unit, unit-1, produces output valued Rs. 100 by engaging 10 persons. The per person productivity of unit-1 is Rs. 10. Suppose another production enterprise, unit-2, employs only 8 persons but produces a similar output also valued at Rs. 100. The per person productivity of unit-2 is Rs. 12.5. Evidently, unit-2 is more productive than unit-1. Alternatively, if by a change in the manner/ proportion of factor-usage, the same 10 persons in unit-1 produce output equivalent to Rs. 125, then the average per person productivity is 12.5 making the productivity of unit-1 higher than that of unit-2. Essentially, therefore, productivity as a concept refers to a ratio [ratio of 'output to input'] and it can be different or varied depending on the efficient use of factors used in production by different units working in a sector or economy. We may recall here that as per classicists, labour and capital are the two main factors of production. However, even among them there is recognition that there are many other factors which have the potential to cumulatively make a greater impact on productivity influencing in the process both these cognizant factors of production.

### 13.2.2 Partial Factor Productivity and Total Factor Productivity

Since labour and capital are the two major factors of production, a distinction between 'labour productivity' and 'capital productivity' is commonly made in literature. However, while labour and capital are the two most important factors of production, it is also true that a host of other factors like industrial climate, organisational culture, education & training, research & development, extension services, infrastructure, political stability, etc. also cumulatively goes to determine the contribution to output by labour and capital. In view of this, the concepts of 'labour productivity' (LP) and 'capital productivity' (CP) are referred to as partial factors of productivity. And since by including the residual factors as a third component to represent all other factors which when taken into account signifies the productivity in its totality, the residual factor is referred to as 'total factor productivity'. Usually, in empirical exercises LP is measured as the ratio of 'value added to employment' which provides us an indicator of 'per person or per employee output (or income like in per capita income)'. An improvement in LP over time is thus indicative of the rise in the average level of contribution to production made by workers in that sector. Note that in the illustrative exercise cited in 13.2.1 above, the productivity index computed is LP. Likewise, CP is measured as the ratio of 'value added to capital' in which the denominator is the total capital used in production. CP, thus, provides us a measure of value added per unit of capital used in production. Measurement of TFP is done by two methods called 'growth accounting approach' and 'econometric approach'. We will keep more details on this out of our present discussion as it is outside the purview of our immediate focus vis-a-vis productivity trends in Indian agriculture.

### 13.2.3 Allocative Efficiency and Technical Efficiency

In the productivity indicator expressed as a ratio of two quantities viz. output and input, the numerator is the total value of 'production' and the denominator is the total value of inputs that has gone into its making. Our main concern is to identify the factors contributing to an inefficient use of resources so that by concentrating on minimising them, a more efficient usage of resources (i.e. inputs) resulting in an optimum realisation of output can be achieved. Viewed from this perspective, a productivity measure (or index) is an indicator of efficiency. If the efficiency (i.e. higher productivity) is attained by a better allocation of resources it is called 'allocative efficiency'. If, on the other hand, the productivity increase is a result of the change in the method of production (like adoption of new technology or a better organisation of methods of production) then the efficiency is referred to as 'technical efficiency'. Empirical studies in productivity analysis, besides measurement of productivity indicators, are also concerned with the identification of the factors contributing to efficient production in terms of the above two types of efficiency. The ratio of value added to total/gross output, which tells us the value added per unit of gross output generated, is another direct measure of efficiency. This measure of efficiency is published in the reports of the Annual Survey of Industries published by CSO (Central Statistical Organisation) in India.

### 13.2.4 Depreciation and Deflators

It is necessary to use appropriate deflators for converting the nominal values (also called current values) of value based variables like output, value added and wages in order to enable making temporal comparison of changes over time. The usage of deflators converts the variables in current values (also called nominal values) to a constant base making them standardised so that comparison made over time is with respect to a common base. Deflation of value based variables is necessary because the money value changes over time; for instance, Rs. 100 in 1970 and Rs. 100 in 2011 are not the same as the value of money decreases due to changes in prices (mostly inflation) over time. In empirical work, for deflating the value of output (or value added) we use the Wholesale Price Index (WPI). For deflating wages paid to workers, the Consumer Price Index (CPI) is used. In empirical works on productivity, deflating value based variables is very much necessary to get a realistic idea about the ground reality in the real situation.

### 13.2.5 Production Function

A production function is an equation that specifies the output of a firm for all combinations of inputs. In other words, given a common technology under use, the function provides us with a mathematical form of the expected levels of output to varied combinations of inputs used. Recall that when different firms are operating using a given level of technology, the deployment of factors are done by individual firms with an eye on their expected returns i.e. higher output and profits in which there will be some variation from firm to firm as all firms cannot use the factor inputs in exactly the same measure. Alternatively, a production function can be defined as the specification of the minimum input required to produce expected quantities of output within the potentials of available technology. A production function can be expressed as: $Q = f(X_1, X_2, X_3,...,X_n)$ where $Q$ = quantity of output and $X_1, X_2, X_3,...,X_n$ are the quantities of factor inputs (such as capital, labour, land, raw materials, etc.). The most commonly used form of production function is the Cobb-Douglas production function which is expressed as:

$Q = a X_1^b X_2^c$..... The advantage of this form is that by taking logarithm on both sides, the exponential character of the equation gets reduced or transformed into a linear form like: $Q = a + bX_1 + cX_2 + dX_3 + ...$ making it easier for estimating the coefficients involved. Depending on the nature of data that we have we can estimate the parameters a, b, c, etc. by applying what is called as the least squares principle. You will study about this method of estimation in your course on statistics viz. EEC 13 of your BDP programme. We might mention in passing that if we have data on all variables in annual time series, keeping our inputs restricted only to two factors viz. labour and capital, and considering the coefficient 'd' to represent all other factors with $X_3$ taken as the time variable 'T' [taken in chronological order of 1, 2, 3,..... years], the coefficient 'd' would provide us a measure of 'total factor productivity'. The coefficients of $X_1$ and $X_2$ viz. b and c representing the parameter for the variables labour and capital respectively, besides providing estimates of the labour and capital partial factor productivities, also carry major economic significance. If the two coefficients are kept constrained as necessarily adding up to unity (i.e. b + c = 1) it would amount to assuming that there is constant returns to scale i.e. doubling the inputs will double the output, tripling the inputs will triple the output, etc. If this assumption is relaxed i.e. if we allow the sum of these two coefficients to assume values below and above unity, it would amount to considering the model with variable returns to scale. In particular, if the sum of co-efficients is greater than 1 then it means there is increasing returns to scale (i.e. doubling the inputs will more than double the output). If it is less than 1, then it means there is decreasing returns to scale i.e. doubling the inputs will less than double the output. Note also that 'b' is the partial elasticity of output with respect to labour input i.e. it measures the percentage change in output holding the capital input constant. Likewise, 'c' is the partial elasticity of output with respect to capital input, holding the labour input constant.

### 13.2.6 Isoquants

Theoretically, it is considered that for a given technology there exists a unique production function. Given this, since to achieve a desired level of output, the inputs $X_i$ (i = 1,2,....) can be variously employed, the production function for a given technology is a curve obtained by plotting different combinations of $X_i$s yielding the same level of output. Such a curve, called as isoquant, therefore provides a whole range of alternative ways of producing the same level of output by adopting various combinations of inputs. The idea will be more clear if we consider an illustration using a hypothetical situation as shown in Table 13.1. The Table considers two inputs, labour and capital, and lists various levels of output that can be obtained by employing different combinations of the two inputs. For instance, let us consider an output level of 200 for which there exists three combination of inputs viz. (4, 1), (3, 2), and (1, 4). By plotting these three points on a graph (see Figure 13.1) we get the isoquant-1 ($Q_1$). Similarly, $Q_2$, $Q_3$ and $Q_4$ are isoquants drawn from the combination of inputs to yield levels of output of 290, 345 and 450. In other words, higher *isoquants* represent higher level of production from which optimum factor combination to produce a certain units of a commodity can be chosen.

**Table 13.1: Production Function Showing the Level of Output that can be Obtained by Employing Two Inputs Labour (*L*) and Capital (*K*)**

| Units of Capital Employed | Units of Labour Employed | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 1 | 40 | 90 | 150 | 200 | 240 | 270 | 290 |
| 2 | 90 | 140 | 200 | 250 | 290 | 315 | 335 |
| 3 | 150 | 195 | 260 | 310 | 345 | 370 | 335 |
| 4 | 200 | 250 | 310 | 350 | 385 | 370 | 390 |
| 5 | 240 | 290 | 345 | 385 | 420 | 450 | 475 |
| 6 | 270 | 320 | 375 | 415 | 450 | 475 | 495 |
| 7 | 290 | 330 | 390 | 435 | 470 | 495 | 510 |

**Data Sources**: Data on labour or employment for the agricultural sector (as also for other sectors at various levels of disaggregation) is available in the decennial census reports as also in the quinquennial NSSO survey reports on Employment and Unemployment. Data on value added and capital formation, again for all sectors, is available in the National Accounts Statistics (NAS) published by CSO. Using data from these sources and by suitably adjusting for data requirements like price differences, interpolation of data for intervening years, etc. we can estimate productivity trends by sectors. While these are secondary sources of data by government agencies, another source of secondary data is CMIE (Centre for Monitoring Indian Economy), a private source, which has also become very popular. There are also published estimates like per hectare yield, data on global rank in terms of area, production and yield for many countries, etc. which help us get an international comparative perspective of productivity trends. We will study about these from some of these sources on productivity trends in the agricultural sector in the next section.

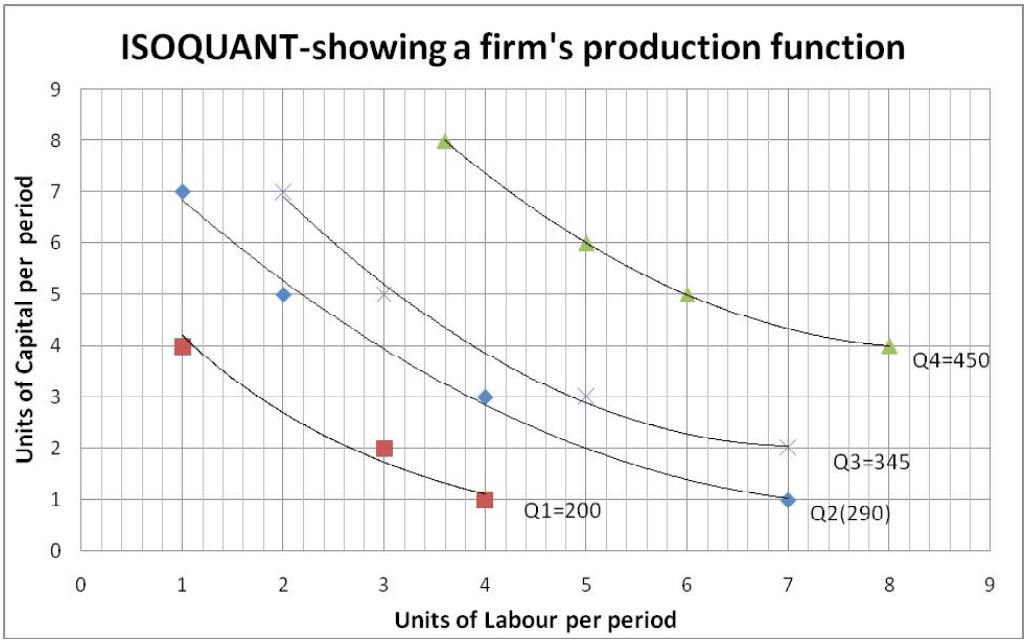


**Fig. 13.1 : ISOQUANT Showing a Firm's Production Function**

**Check Your Progress 1** [answer questions 2 to 4 in about 50 words in the space given]

1) Fill in the blanks.

   a) The average annual increase in the production of food grains during the years 1966-79 was ..... mt. Over the next three decades of 1979-2010, this annual increase steeply declined to ..... mt.

   b) While achieving increase in total production of food grains is ..... for agricultural growth, what is even more important is achieving increase in .....

   c) The variable that we get by subtracting total inputs from total output is called ..... .....

   d) Unit-1 produces items worth Rs. 1,00,000 by engaging 100 persons. Another unit, unit-2, produces similar items using similar technology worth Rs. 1,40,000 by engaging 125 persons. Which of these two units is more productive than the other? What are the values of labour productivity of these two units? Which kind of efficiency, allocative or technical, would you say has contributed to the higher productivity of the more productive of these units?

   e) Capital productivity is measured as the ratio of ..... to ..... In essence, it gives us the ..... ..... ..... ..... ..... of .....

2) Why is the productivity ratio/indicator equated with 'efficiency'? Which is the other direct indicator which is taken as a measure of efficiency?

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3) Why is it necessary to deflate the value based variables in exercises on empirical measurement of productivity? Which price indices can be used to deflate output and wages?

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4) Why is the Cobb-Douglas production function advantageous to apply in practice? Which method is used to estimate its coefficients? How is a relaxation on the assumption of constant returns to scale obtained?

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## 13.3 PRODUCTIVITY IN INDIAN AGRICULTURE

There are two main annual publications which furnish data useful for computing productivity indicators. One is, as already mentioned, National Accounts Statistics (NAS) which publishes data on GDP at factor cost by industry of origin and gross capital formation by industry. A second source is the Economic Survey (ES) which collates data published from different sources. The ES also publishes data on: (i) Wholesale Price Index (WPI) and Consumer Price Index (CPI) besides publishing data both at constant prices and current prices; (ii) area under principle crops aggregated to 'all commodities' and indexed to a base year taken as 100; and (iii) yield per hectare of food grains. Data on global ranking of countries in major agricultural crops by area/production/yield and yield per hectare are published by Indian Agricultural Statistics (an annual publication by the Union Ministry of Agriculture) and CMIE. In this section, using the data from these sources, we shall draw a profile of the productivity trends in Indian agriculture in respect of productivity indicators like: land productivity, labour productivity, etc.

### 13.3.1 Land Productivity

The land productivity (measured as kg per hectare) shows that there is a steady increase right from 1961 to 2009-10 (Table 13.2). The decline in the year 2010 is due to the data for the latest year being provisional which is likely to be revised when more accurate estimates become available. The observed increase (in absolute figures) needs to be verified by the decadal growth rate which evens out the changes over time averaging the growth to an annual indicator. The growth rates calculated at decadal intervals shows the following:

**Table 13.2 Yield Per Hectare of Food Grains (kg/hectare): 1961-2010**

| Year | 1960 -61 | 1970 -71 | 1980 -81 | 1990 -91 | 2000 -01 | 2004 -05 | 2005 -06 | 2006 -07 | 2007 -08 | 2008 -09 | 2009 -10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Yield | 710 | 872 | 1023 | 1380 | 1626 | 1652 | 1715 | 1756 | 1860 | 1909 | 1798 |

**Source**: Economic Survey, 2010-11, Table A-19.

**Note**: CAGRs (compound annual growth rates): 1971-81: 1.6 percent; 1981-91: 3.0 percent; 1991-2001: 1.7 percent; 2001-09: 2.0 percent; post-reform years growth (1991- 2009): 1.7 percent.

- The highest growth of 3 percent was in the decade of 1981-91 [i.e. the post green revolution (GR) decade].
- There was a steep decline in the growth rate of land productivity during the subsequent decade of 1991-2001 to 1.7 percent per annum. This, however, improved slightly during the subsequent period of 2001-2009 to 2 percent per annum.
- The average growth rate over the 19 year period of post-reform years (i.e. 1991 2009) is 1.7 percent. This is much lower than the growth during the post-GR years (1981-91) of 3 percent.

Land productivity depnds partly on fertility of land and substantially on the technology and inputs used. As we have seen earlier, the GR technology did improve productivity per hectare but it also affected fertility of soil in many areas due to excessive use of chemical fertilizers. Since the availability of arable land is

fixed, increase in production of foodgrains depends solely on the increase in productivity. The trend growth rate in land productivity in the last decade (2001-09) was about 2 percent which is close to the rate of growth of population. This indicates that there is no threat to foodgrain availability in India in the immediate future. However, there is increasing pressure on land for non-agricultural use, and unless land productivity increases meeting the food grain needs of growing population would become a problem.

### 13.3.2 Labour/Capital Productivity

The trends in labour productivity (Table 13.3) also shows that the peak in this respect was in the post-GR years centred around 1991 (0.95 tonnes per agricultural worker). In the post-reform years, there is a steep decline in LP (0.83 tonnes around 2001). There is, however, an improvement in the post-2000 years to nearly its 1991 level. It is important to note that the effect of capital infusion (by way of improved seeds, fertilizers, irrigation, mechanised machineries deployed, infrastructure improvement due to public investment, etc.) also reflects in the trends of LP. The trend for capital productivity (CP) [obtained as a ratio of GDP at factor cost for agriculture and allied activities and gross capital formation in agriculture (using NAS-2010 data at constant 2004-05 prices)] shows that CP has steadily declined from 8.5 in 2004-05 to 7.8 in 2006-07, 7.2 in 2007-08, 5.8 in 2008-09 and 5.7 in 2009-10. The trends in LP and CP, thus, suggests that there is need for more infusion of capital into agriculture and allied activities and infrastructure to improve agricultural productivity.

**Table 13.3 Labour Productivity in Agriculture: 1961-2011**

| Year | Total Food Production (in millions of tonnes: mt) | No. of Agricultural Workers (in millions) | Labour Productivity (in tons) |
|---|---|---|---|
| 1961 | 82.0 | 131.15 | 0.62 |
| 1981 | 129.59 | 147.98 | 0.87 |
| 1991 | 176.39 | 195.32 | 0.95 |
| 2001 | 196.81 | 235.06 | 0.83 |
| 2011 | 241.56 | 258.57* | 0.93 |

**Source**: (i) Registrar General of India, 2001 (for number of agricultural workers).
(ii) For total food production, Ministry of Agriculture, GoI.

**Note**: (i) Data for 2011 is an estimate by adding 10 percent of workers in 2001 figures based on the increase in the rural population of 12.18 percent over 2001-2011.
(ii) Figure for 2011 are advance estimates.

### 13.3.3 Productivity from an International Perspective

The global average of the proportion of total land under cultivation to the total geographical area is about 32 percent. As compared to this, India's proportion of total land under agriculture is higher at 46.1 percent. India's position in this respect is better than countries like U. S. A. (40 percent) and Brazil (10 percent). However, the productivity of land vis-a-vis the potential of HYV seeds as realised by India and what has been achieved by other countries compares very unfavourably for India (Table 13.4). This is also borne out by the relative poor ranking for India

for major agricultural crops in spite of its position in terms of production being among the top ranking countries (Table 13.5). While the actual low productivity levels across all crops in India is a cause for concern, it also holds the promise that there is room for increasing the productivity which would ensure better production levels to meet the growing needs of the country. The international perspective, however, reinforces the attention required to be given for raising the productivity levels of Indian agriculture.

**Table 13.4: Productivity in India vis-a-vis Other Countries**

**(Kg/Hec)**

| | *India* | | *World's Largest Producer* | | *World's Most Productive* | |
|---|---|---|---|---|---|---|
| ***Crop*** | ***Potential of HYV Yield*** | ***Actual Yield*** | **Country** | **Yield** | **Country** | **Yield** |
| Rice | 4,000-5,810 | 3,002 | China | 5,807 | Australia | 8,813 |
| Wheat | 6,000-6,800 | 2,743 | China | 3,295 | Ireland | 7,556 |
| Jowar | 3,000-4,200 | 1,196 | US | 3,704 | Italy | 5,949 |
| Maize | 6,000-8,000 | 1,841 | US | 4,505 | Netherlands | 25,000 |

**Source:** CMIE *Indian Harvest*, 2011.

**Table 13.5: India's Global Rank in Major Agricultural Crops**

| Crop | Rank | | |
|---|---|---|---|
| | **Area** | **Production** | **Yield** |
| Rice (paddy) | 1 | 2 | 52 |
| Wheat | 1 | 2 | 38 |
| Coarse Grains | 3 | 4 | 125 |
| Pulses | 1 | 1 | 138 |
| Oilseeds | 2 | 5 | 147 |
| Cotton | 1 | 4 | 77 |
| Jute | 1 | 1 | 13 |
| Tea | 2 | 1 | 13 |
| Sugarcane | 2 | 2 | 31 |

**Source**: GoI, MoA, Indian Agricultural Statistics, 2007.

## 13.4 THE ISSUE OF LOW PRODUCTIVITY

As noted above, productivity of Indian agriculture is low as compared to the productivity at the global level. In particular, Tables 13.4 and 13.5 showed that even though India ranks number one in terms of area under cultivation of rice and wheat, the yield levels are abysmally low compared to China and Australia. Similar contrast in yields exist for coarse cereals and other crops. Even the most productive states in the country fall short of world standards in terms of yields of major crops.

### 13.4.1 Causes of Low Productivity

Causes for low productivity can be classified into four broad heads viz. (i) demographic factors; (ii) institutional factors; (iii) technological factors; and (iv) policy bias/weakness.

**Demographic Factors**

- India's total population has increased from 1.03 billion in 2001 to 1.21 billion in 2011 causing demand for more food of both the conventional and the modern kind. But the availability of land is limited and the soil fertility has declined. This is a compelling demographic situation which has caused the land productivity to remain low despite the fact that there is an increasing trend in land productivity over the period of 1961-2010. This is also borne out by the stagnating labour productivity trends particularly in the last two decades.
- Although the industrial sector is expected to absorb the surplus labour from agriculture, due to inadequate employment growth in the industries, the pressure on agriculture for livelihood continues to be high. This is despite the fact that the number of workers engaged in agriculture is declining over time. There is also fragmentation of land holdings resulting in the average size of holdings in India becoming so small (less than two hectares) that they are economically unviable for applying modern methods of production. This is compounded by the poor economic conditions of large number of small farmers due to which implementation of better agricultural practices has continued to remain constrained. The result is low productivity in agriculture per unit of land.

**Institutional Factors**

- At the time of independence, India inherited a semi feudal agrarian structure with the ownership and control of land concentrated in the hands of a few landlords and intermediaries. Even with the efforts made over the last six decades at instituting land reforms and the partial success we have attained in some respects, the actual cultivator continues to work under hindering conditions to produce more.
- Added to the issue of absentee landowners, increasing tenancy in relatively better irrigated areas, lack of security of tenure, the inadequate infrastructural support in terms of adequate and timely agricultural credit, good rural transport system, marketing/storage facility, etc. have continued to be deterrent factors. There is inadequacy of institutional credit to farmers and continued dependence on high cost informal credit. These factors have cumulatively hindered the achieving of higher productivity in Indian agriculture.
- With increasing dependence on purchased inputs, growing risks associated with new technology, and volatile prices the farming sector faces formidable problems. There have recently been instances when the farmers have faced the problem of 'bumper crops spelling disaster' as they had to sell them off at lower rates due to inadequate storage facility. Such factors have, therefore, continued to act as deterrent for increasing the productivity.
- Institutional development for promotion of entrepreneurship like it has happened in the developed countries are yet to take deep roots in India. All progress made in this direction have at best remained stray examples marking for efforts made at pockets rather than at many places in general. In contrast

countries like China have successfully introduced competition in their agricultural operations to bring about a greater level of efficiency in spite of small size of holdings.

- Lack of investment in general, and falling levels of public investment in recent years in particular, have continued to hamper the achieving of higher levels of productivity in Indian agriculture. Public investment in agricultural R & D did not keep pace with the growing challenges. On the contrary, exposure to private trade in improved seeds not only increased costs but also risks, inhibiting small farmers from undertaking measures to improve productivity.

**Technological Factors**

- Majority of Indian farmers are not exposed to new technologies both due to their poor conditions as also due to the lack of reach by scientists and extension workers. There has been decline in the extension facilities especially since the introduction of reforms and fiscal constraints on public expenditure. As a result, they have continued to operate with traditional methods which are low yielding. In other words, inadequate availability of modern inputs and methods have remained a factor for low productivity.

- Even with all the efforts and investment made in spreading irrigation facilities, less than 50 percent of total agricultural sector has been covered by irrigation. Dependence on uncertain monsoon due to low reach of assured irrigation facility has remained a continuing reason for low productivity in agriculture.

- Inadequate and poor post-harvest technology, which is estimated to result in a loss of close to 30 percent of agricultural produce, has been a major constraint in realising the potential value of agricultural output produced.

- There has been no major breakthrough in the technological front for many decades. This is termed as 'technology fatigue' contributing in no small measure for the stagnating agricultural productivity in the country.

**Policy Bias/Weakness**

- Indian agriculture has suffered from subtle policy bias with an excessive dependence of policy favouring industry. The state's involvement in promotion of industry was much more than it was for agriculture. High protection offered to industry past the stage of infancy, has made private investment to veer more towards industry than agriculture.

- Infrastructural development also had a similar bias in favour of industry than agriculture. This is despite the fact that the agricultural sector also received policy support on many fronts. So much so, a recent study of 2007 (by the International Food Policy Research Institute) has established that the support for agriculture in India has been inconsistent and largely counter-cyclical to world prices. This is to say, agricultural support increased when world prices were relatively low and decreased when world prices were high.

## 13.4.2 Measures to Increase Agricultural Productivity

It naturally follows from the above that the measures for increasing agricultural productivity can also be stated in terms of: (i) institutional; (ii) technological; and (iii) incentive structure needed. Briefly, these can be elaborated as follows:

### 13.4.2.1 Institutional Reforms

- Establishment of better agrarian relations through land reforms, arrangements for adequate agricultural financing, wider and equitable distribution of agricultural inputs for technologically suitable methods are vitally needed for raising agricultural productivity. It is important to state that while many of the institutional arrangements are already in place, their effective implementation which has lacked needs to be focussed upon.

- Another major aspect of institutional reform refers to improving the efficiency of delivery systems. This includes overall rural development measures and empowering democratic institutions like the panchayati raj. This would require suitable devolution of functions for economic and social development including transfer of necessary resources.

### 13.4.2.2 Technological Improvements

Technological improvements can be classified under two heads viz. (i) biological and (ii) others. The biological innovations refer to focusing on factors that bring about greater land productivity. This would mean developing land saving methods and practices (such as development of better seeds and fertilisers) of a nature that are environmentally sustainable. Other innovations contain several components as follows.

- It is not technical information alone which helps poor farmers. They also require supportive measures like input supplies, extension services, credit facility, post-harvest assistance like storage/marketing, etc. Agro-service centres which hire out consultants and supply sprayers, tractors and threshers must be widely spread out throughout the country. As complementary measures, cooperatives on the lines that are efficiently functioning in countries like Taiwan should be encouraged on a nationwide basis. In the absence of these services, the Indian farmers' ability to adopt modern techniques of crop production, developed in the lab, cannot be increased. And in its absence, increasing the productivity of Indian agriculture will remain crippled.

- Returns to research are known to be high. In the light of this, research efforts should focus on methods and practices which can be applied on smaller farms and dry regions. However, since there is a lower limit beyond which the applicability of technology and capital intensive practices cannot be applied in an economically viable manner, it is necessary to establish institutional mechanisms to help poor farmers with small plots of land to pool their resources and work together. Content of research should be both on plant breeding for food grains and other crops including farm management. Resources need to be spread across issues of land management, farming systems and agro-forestry. Suitable policy changes to encourage private research are also needed as the days which heavily depended on public investment alone are not only impracticable, they cannot also help raise productivity. Since the agricultural sector at the present level of socio-economic development in India continues to be heavily dominated by poor and marginal farmers, institutional development of the desired kind need to be promoted by the government. State must assume greater role as the regulator of efficiency and equity concerns of the society.

- Developments in IT (i.e. information technology) involving ecologically sound concepts and systems like integrated intensive farming systems, expansion of

e-chaupals, removing the constrains on the access/use of remote sensing data (except in case of security sensitive maps/data) of value to farming practices, etc. should be put to greater use for improvement of output and productivity. Projects of e-chaupals presently operating in only some states should be expanded to cover all the states.

### 13.4.2.3 Incentives for Raising Productivity

Improving small farm productivity: The major challenge in this regard is that nearly 80 percent of the land holdings in India are below 2 hectares in size. Unless factor productivity is increased, small farm agriculture will become un-remunerative. However, the smaller the farm, the greater is the need for marketable surplus in order to get returns in cash. Therefore, improving small farm productivity, as a single development strategy, can make the greatest contribution both for raising output/productivity and eliminating hunger and poverty. Accessibility to modern inputs like fertilizers, pesticides and improved seeds at reasonable prices across the nation to small farmers is a must in this respect. Other measures, both on the price and non-price fronts, crucially needed are the following.

- Stabilize the returns from agriculture, especially in rain-fed conditions, by effective crop-insurance schemes.
- Improve the scale of production, which is known to act as a major constraint in increasing productivity by application of modern inputs and methods, by pooling of resources. The concept of public land banks, outlined earlier in unit 5, should be implemented in earnest to overcome the problem of small scale agricultural operations.
- Promote industry-agriculture linkage through 'contract farming' providing the farmers access to better inputs and technology. The collaboration would also help the corporate sector in getting steady supply of quality raw materials.
- Dovetail the industrial reforms to reforms of agriculture by way of rationalising and restructuring the fertiliser industry. It is unrealistic to expect farmers to pay for higher protection and the resulting inefficiency of the fertiliser industry which has deeply set in because of past protective policies pursued to promote its expansion.
- Reorient the public procurement and price support policies and arrangements to redefine their objectives better. A lot of food channelized to these distribution centres have been wasted in corruption and inefficiency rendering the entire system suffer from a non-existing mismatch of demand and supply.
- Remove electricity and irrigation subsidies through reforms of a nature that are capable of addressing the underlying causes of low cost recovery and poor financial performance.
- Noted agricultural economist Schultz had observed more than six decades ago that the poor farmers in developing economies are wise and they only need to be supported properly to capitalise on their wisdom. Extending this logic it is argued that farmers should be involved in different layers of developmental activity concerning their welfare. In particular, their due representation in decision making bodies like input supplying agencies and output marketing boards should be encouraged to act as a catalyst for better resource efficiency and increase the overall profitability of the sector.

- It is also argued that if all farmers are motivated to invest their meagre resources into their land and work in a coordinated manner the output of the sector can be doubled without any additional government investment in the form of subsidies. This calls for promotion of peoples involvement policies and measures by which our East Asian neighbours have reached their present heights. India has to badly catch up on this front during the next 2 to 3 decades if the interests of attaining food security by raising the productivity levels is to be attained.
- Increased farm productivity would need many more workers in an expanded and modernised agricultural sector than the present. In other words, with the declining share of workforce in agriculture the increased productivity level would not only improve the income levels of farmers but also generate additional employment on the non-farm sector. For this, the sector only needs to be modernised with the right approach as outlined above. Herein lies the real challenge which is more easily said than done.

Indeed, it is rightly argued that much of the Indian agriculture has the required resilience to be competitive and can flourish under a liberalised trade regime. However, to club the leakages and make it efficient, domestic reforms (more than the reforms on the external trade front) are needed. This should, therefore, be the immediate short term focus of policy thrust.

**Check Your Progress 2** [answer questions 2 to 6 in about 50 words in the space given]

1) Fill in the blanks

   a) The highest growth rate in agriculture attained so far is ..... percent and is in the period .....

   b) The post-reform growth in agriculture is ..... percent during 1991-2001 and ..... percent during 2001-2009.

   c) The highest labour productivity in agriculture attained in India so far is ..... tons. This declined to ..... tons in 2001 but again increased to ..... tons in 2011.

   d) The trend in capital productivity in agriculture during the years 2005-09 has steadily .....

2) In what way the existing demographic situation in India has been a compelling factor in keeping the land productivity low?

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3) Mention any two factors to establish that there has been a policy bias affecting agriculture growth vis-a-vis industry.

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4) In what respect the biological innovations should focus in order to improve the Indian agricultural productivity?

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5) Do you agree that emphasis on 'research' is important to increase agricultural productivity? What would you suggest as the direction in which efforts in this regard should be made?

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6) Give one example each on the fronts of price and non-price measures which you think is crucially needed to set the course of Indian agriculture on a more productive path.

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## 13.5 LET US SUM UP

Even though in absolute terms over a long term of close to six decade period there has been a steady increase in the total agricultural production in India, in relative terms the agricultural productivity is stagnant/declining. Furthermore, in comparison to other developed countries the productivity levels of Indian agriculture is very low. This, along with the fact that our population has been ever increasing making a heavier demand on food needs/varieties, demands that our growing concern for 'food security' can be addressed only by focusing on increasing the agricultural productivity levels. The measures which need to be taken to achieve this objective falls on institutional, technological, price and non-price fronts. The unit has spelt out these aspects with a touch of the related conceptual, theoretical and empirical dimensions.

## 13.6 KEY WORDS

**Productivity** : Refers to a ratio of output to input. It brings out the relative picture, as compared to the absolute picture, in which even though in absolute terms the output might be increasing

over time, in productivity terms it might not be so. In particular, land productivity, labour productivity and capital productivity refers to the per unit level of output in which the factor inputs considered are land, labour and capital respectively.

**Total Factor Productivity** : While labour and capital are the two classical factors of production, many other factors not so easily recognizable together accounts for or determines the level of productivity or productivity returns. These are education and training, industrial climate, political stability, etc. It has been empirically demonstrated that the contribution to overall output from TFP is much more than that of the two main factor inputs viz. labour and capital. Measurement of TFP, however, requires greater amount of data like price indices used in deflating value based variables like output, value added, etc.

**Growth Rate** : Refers to a single empirical indicator of the average growth per year over a period like a decade. The compound annual growth rate or CAGR is obtained by applying the formula: $P_n = P_0(1 + r/100)^n$ where $P_0$ is the base/ initial year value, $P_n$ is the $n^{th}$ year value, 'n' is the no. of years over which the growth rate is sought to be determined and 'r' is the growth rate to be calculated. In microsoft Excel, we can get the value of 'r' by keying in the formula:= rate (n,,-$P_0$,$P_n$ )*100. Note that there are two commas after 'n' and a 'minus' sign before $P_0$. The multiplication by 100 is made to get the percentage growth rate. Using the data provided in Table 13.2, you can compute the simple average/annual growth rate and see that its value will be slightly higher than that of CAGR.

**Isoquants** : Refers to a curve of the production function corresponding to a particular technology. For a two-input situation, it can be thought of as a graph plotted by taking the quantity of one input (say, labour) measured on the X-axis and the second input (say, capital) measured on the Y-axis. Thus, if there are many possibilities of obtaining the same level of output using different combinations of the two inputs, we can draw a curve connecting the points corresponding to the different pairs of two input values. Such a curve, drawn to bulge inwards (as the desired level of output is

generally sought to be obtained by applying the minimum values of inputs) is called as an isoquant.

## 13.7 SOME USEFUL REFERENCES

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## 13.8 ANSWERS/HINTS TO CYP EXERCISES

**Check Your Progress 1**

1) For a) and b) see 13.1 and answer; for c), d) and e), see 13.2 and answer.

2) See 13.2.3 and answer.

3) See 13.2.4 and answer.

4) See 13.2.5 and answer.

**Check Your Progress 2**

1) a) and b) see 13.3.1 and answer; c) and d) see 13.3.2 and answer.

2) See 13.4.1 and answer.

3) See 13.4.1 and answer.

4) See 13.4.2.2 and answer.

5) See 13.4.2.2 and answer.

6) See 13.4.2.3 and answer.