Chapter 5

AGRICULTURAL PRODUCTIVITY
AND
PRODUCTIVITY REGIONS
CONCEPT AND MEASUREMENT OF AGRICULTURAL PRODUCTIVITY

The measurement of agricultural productivity is not a simple task, as it involves a relationship between inputs and outputs in agricultural production. Productivity is not a synonym of fertility; it is generally used to express the power of agriculture in a particular region to produce crops without regards to whether that power is due to the bounty of nature or the efforts of man (Johnson, 1926). The term productivity has been used in different meanings and has aroused many conflicting interpretation, sometimes it is considered as the overall efficiency with which a production system works, while in other words it may be defined as the ratio of output to input in relation to land and overall resources employed in Agriculture.

Thomson (1926) while measuring the relative productivity of “British and Danish Farming” emphasized and expressed it in terms of gross output of crops and livestock. He considered the following seven parameters: (i) the yield per acre of crops, (ii) the livestock per 100 acres, (iii) the gross production or output per 100 acres, (iv) the proportion of arable land, (v) the number of persons employed, (vi) the cost of production expressed in terms of wages and labour costs, rent or interest and (vii) prices relatively profitability and general economic conditions.

Buck (1937) assessed the agricultural progress in China by adopting the approach of gain equivalent. For this purpose he converted all the agricultural products into kilogram, with whatever kind of grain was predominant in the region. A modification in this method was attempted by Clark and Haswell (1967) by expressing the output in terms of Kilograms of ‘wheat equivalent’ per head of population.

Ganguli (1938) in his study of Ganges valley presented a theoretical discussion for computing productivity in agriculture. Firstly, he took in to account the area under any crop “A” in a particular unit is belonging to a certain region. This area expressed as a proportion of the total cropped area under all the selected crops. Secondly, Ganguli tried to obtain the index number of yield. Thirdly, the proportion of area under A and the corresponding index number of yield were multiplied. There are two advantages which are apparent by using this model i.e. (a) the relative importance of the crop A in that unit of study is assessed as indicated by the proportion of the cropped area which is under A
and (b) the yield of the crop A in comparison to the regional standard. The product thus obtained indicates actually an index of the contribution of the crop A to the productivity of the unit considered.

Kendall (1939) treated it as a mathematical problem and inter related a system of four coefficient (a) productivity coefficient, (b) ranking coefficient, (c) money value coefficient and (d) starch coefficient or energy coefficient. According to him the productivity coefficient and the ranking coefficient are concerned only with the yield per unit area, but are not in any way weighted according to the volume of the production. Kendall therefore evolved a measure of crop productivity by using index number technique by which the yield of different crops should be expressed in terms of some common units. For this purpose he pointed out two common units (i) money value as expressed in price, (ii) energy as expressed in starch equivalent.

Kendall’s money value index poses one major difficulty, that data for certain crops are not available, for example, there are many vegetables and beans which are grown mostly for the consumption on the farms and their price data are not recorded in contrast to cereal crops whose data are adequate. While determining the money value coefficient, another difficulty arises with regard to the prices — for example, the prices prevailing in the area should be adopted, or those prevailing in the region or in the country as a whole, in addition to the local variations in the prices which depend on circumstances like proximity to the market or the relative nutritive character of the product. Significant differences in prices per tonnes between the crop affect the final result heavily in favour of the higher priced commodity. In this method, the crop production of each unit area is valued by multiplying the volume of production of a particular crop by the price, and then adding the results for the selected number of crops together. The total is divided by the total acreage in the unit area, a figure of money value per acre per hectare under the crops considered so far as energy coefficient is concerned; an index based on nutritional factor ignores local variation because of the absence of data. Kendall therefore suggests starch equivalent as the most suitable unit. While calculating a coefficient based on starch equivalent it should be decided: (a) Whether a gross or net digestible energy figure is to be taken, (b) whether any allowance is to be made for by-products such as wheat and barley straws or the green stalks of maize, jowar
and bajra and (c) whether any account should be taken of the fact that the energy in
certain foods has first to be fed to livestock and then wheat and milk is to be used for
human consumption. The basic question that arises in the technique is whether the gross
starch equivalent of the various crops should be considered or the net equivalent. Net
energy refers to the amount of energy for work and body building whereas a gross figure
includes the energy employed in the digestive process of the consuming animal and
similar non-realizable forms. Kendall suggested the production of energy be preferred as
the gross figures.

Hirsch (1943) has suggested, crop yield index as the basis of productivity
measurement, it expressed the average of the yields of various crops on another farm in
second locality. Zobel (1950) has attempted to determine the labour productivity. He
considered the productivity of labours as the ratio of the total output to the total man-
hours consumed in the production of that output resulting in output per man hours. This
has been expressed by the following equations:

\[ \pi = f(P, L) \]

where, \( \pi \) = Productivity of labour

\( P \) = Production, and

\( L \) = Labour utilized.

Huntington and Valkenburg (1952) considered land productivity on the basis of
acre yields of eight crops raised vary widely in Europe. For each crop, the average yields
per acre for Europe as a whole was taken as an index of 100, and specified yield in each
country was calculated. Stamp (1958) has chosen calorific value of farm production in
measuring agricultural productivity. He calculated Standard Nutritional Unit (SNU) by
converting all the food production per acre in calories. Taking into consideration, the age
structure of the population, the range of occupation, the weight and height of the people
living under climatic conditions of north Western Europe, the average is 2460 calories a
day or about 9, 00,000 calories per year. “The Nutrition Expert Group of Indian Council
of Medical Research has recommended the daily allowances of Nutrients for Indians.
They published a table to show the caloric intake among adults from 1900 a day for a woman in sedentary work to 3900 for a man engaged in heavy work. For children it was recommended 110 calories per kilogram weight of the body per day for infants under one year to 3000 for teenage boy.

Shafi (1960) has determined the agricultural efficiency in Uttar Pradesh taking into consideration, eight food crops grown in each of the 48 districts of the state. Mackenzie (1962) has measured the efficiency of production in Canadian agriculture by raising the coefficient of output relative to input. He mentions that the concept of productivity measurement is difficult to define and even more difficult to quantify. Commen (1962) while working out the trends of productivity in agriculture of the state of Kerala (India) has measured productivity on the basis of yield per acre.

Chatterjee and Maitrya (1964) has calculated the levels of agricultural development and productivity during 1950-51 to 1957-58 in the state of West Bengal, taking two crops (Rice and Wheat) into consideration. They utilized the acre yield figure for this purpose. Enyedi (1964) while describing geographical types of agriculture in Hungary applied the following formula for calculating agricultural productivity:

\[ \frac{Y}{Y_n} : \frac{T}{T_n} \]

where, \( Y \) = is the yield of crop in the unit area

\( Y_n \) = is the yield of respective crop at National level

\( T \) = is the total cropped area of the unit

\( T_n \) = is the total cropped area at The National level.

Dhondyal (1964) has measured variations in agricultural development and productivity by selecting three representative districts from the three regions of Uttar Pradesh, while assessing the rate of credit, intensive crop enterprises and the influence of irrigation water during 1962-63. Gopalkrishna and Ramakrishna (1964) have taken Andhra Pradesh (1) to measure the degree of variations with respect to (a) agricultural output per acre (Rs) (b) output per head of agricultural production (Rs) and (2) to account
the causes of variations in each of the twenty districts of the state during 1959-60. The variables relating to the level of output per acres are selected as follows: (i) normal level of rainfall, (ii) percentage of current and old fallows, (iii) percentage of area under irrigation, (iv) percentage of literacy, (v) percentage of population in agriculture, (vi) intensity of cropping, (vii) percentage of gross value other than food grains and fodder, (viii) the percentage of area under all crops excluding fodder and food grains, (ix) density of agricultural population per acre and (x) percentage of total area under commercial crops including rice.


Horrin (1964) has suggested that the concept of productivity is based not only on the single relationship i.e. differences in the same agricultural regions or sub region as between successive period and between similar agricultural region in different countries or regions during the same period.

Agarwal (1965) has suggested 'Factorial Approach' while measuring agricultural productivity in Bastar districts of M.P. In this approach, a number of human controlled factors relating to agricultural production as: crop superiority, crop commercialization, crop security, land use, intensity and power inputs have been selected, excluding the environmental factors.

Khusro (1965) has linked assessment of productivity with the output per unit of a single input and output per unit of cost of all inputs in the agricultural production. Pandit (1965) has expressed the connotation of productivity in these words "Productivity is denied in economics as the output per units of input the art of securing an increase in output from the same input or of getting the same output from smaller input".
Sharma (1965) while defining the concept of agricultural productivity has suggested various parameters on which it can be measured. According to him, productivity can be considered in relation to labour, land and capital, it can also be considered in terms of overall resources employed in agriculture. In case of commodities like food grain, fruits and vegetable, sugarcane and edible seeds, he suggests that the output of these commodities be converted into calories. While considering the other non-food crops such as cotton and other fibers the only common measure being the value involves the pricing of different products. For evaluating value of production, farm harvest or wholesale prices have the definite significance. He also emphasized agricultural work force as the basis of productivity measurement e.g. the total number of labour employed (in order to account the interest of labour) or the total number of man hours worked in agriculture per unit of area.

Saran (1965) has applied Cobb-Douglas ‘Production Function’ approach for the measurement of productivity. The common purpose of this function is to express input output relationship between several inputs and one output in the agricultural systems. The function takes the following form:

\[ Y = AX_1^b X_2^c X_3^d X_4^e \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots X_n^Y \]

Where \( X_1, X_2, X_3, \ldots \ldots X_n \) denotes various inputs like land, labour, capital assets and other working expenses. The values of \( b, e, d \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots y \) represents elasticities of the respective units.

Shafi (1965) has assessed the productivity on the basis of labour population engaged in Agriculture. According to him, it can be calculated by dividing the gross production in any unit area by the number of man-hours or less precisely by the number employed in agriculture.

Dewett (1966) explains that productivity expresses the varying relationship between agricultural outputs and are of the major inputs like land, labour or capita, other complementary factors remaining the same, it may be borne in mind that productivity is physical rather than a value concept.
Shafi (1967 & 1969) applied stamps standard nutrition unit technique for measuring the efficiency of agriculture in India. He has considered the district as the areal unit and has selected all the food crops grown in India. Noor Mohammad (1967) considered net total productivity (being the relationship between the net products and factor inputs) as a method for the measurement of field productivity and also to assess comparison in time and space. The purpose of this measure is to changes in labour and capital inputs in agriculture.

Sinha (1968) has adopted a standard deviation formula to determine agricultural efficiency in India. He has selected twenty five crops grown in the country which were categorized into cereals, pulses, oilseeds and cash crops and specific yields of them were taken. In case of cash crops, their monetary values were calculated in (Rs.) per hectare by incorporating wholesale market prices. Finally the standard scores were computed and to give them weightage, these values were multiplied by the acreage figures i.e. the area of cultivation under the crops.

The Indian Society of Agricultural Statistics in its 30th Annual Conference held at Bhubaneshwar (Orissa) India, discussed some aspects on agricultural productivity in the Indian context. Singh (1972) has applied to measure the agricultural efficiency of Haryana in terms of nutrition units per unit area. He has tried to measure the carrying capacity per square mile in the area unit which can be expressed as:

\[ C_o = \frac{C_o}{S_n} \]

Where, \( C_p = \) Carrying Capacity

\( C_o = \) Caloric output per square mile

\( S_n = \) Standard nutrition for ingestion in calories person per annum
He also gives a measure of the agricultural efficiency of the areal unit relative to the entire region in percentage and expressed as:

\[
L_{ae} = \frac{C_{pe}}{C_{pr}} \times 100
\]

Where, \( L_{ae} \) = the index number of agricultural efficiency

\( C_{pe} \) = is the carrying capacity in terms of population in the component enumeration unit

\( C_{pr} \) = the carrying capacity in the entire region

Raheja et al. (1977) have measured the impact of high yielding varieties based on data collected under the scheme ‘Sample Surveys for Assessment of High Yielding Varieties Programme’ during 1973-74 and regional variations in productivity on the bases of yield per hectare in India.

Besides there are various social scientist who have applied different methods for the assessment of agricultural productivity but W.M. Yang (1965) has based his analysis by computing the yield of different crops in a farm and comparing it with the average crop yield of the entire region, later on, a value in percentage is obtained by dividing the yield per hectare of crops in a particular farm by the average yield of the crop in the entire region. The obtained value is multiplied by 100 and is given the index number, by taking the area, devoted to each crop as a weight and multiplying this by percentage index, the products are obtained. By adding the products and dividing the sum of the products by the total cropped area in the district, the average index obtained is the desired crop index for the particular district, using crop area as weight.
All these researches are aimed to find ways and means for increasing agricultural efficiency. The main objective of agriculture planning in India is to achieve self sufficiency in agricultural production. Therefore, for researchers it is necessary to measure the pattern of agricultural productivity on a micro-level in various regions of the country and to study as to how far the objectives of agricultural planning for the production of different crops have been achieved. In the present study the productivity indices of crops considered for each districts were computed according to methodology as given by W.M.Yang’s, for the two periods 2000-01 and 2010-11. All the major crops grown in the region are classified into four major groups.

a) cereals which includes rice, wheat and maize
b) pulses
c) oilseeds
d) cash crops

The data has been collected from published records of the Directorate of Agricultural Statistics, Kolkata, Bureau of Applied Economics and Statistics, Govt. of West Bengal for the year 2000-01 and 2010-11, taking district as a unit of study. The district wise indices of crop productivity were computed according to the methodology given by Yang’s Crop Yield Index Method.

For calculating the crop yield index for a district, the average yield of each crop grown in the region must be known. The percentage value of the crop yield in the district is then calculated by dividing the yield per hectare of the crops in whole West Bengal region. This value that gives the index number of the crops in the district is multiplied by the area under the crops in the district. The product which comes is added and divided by the sum of total area under different crops in a district. The average index is thus obtained which is the desired crop index of a district, using crop as a weight.

On the basis of productivity index, all the districts of West Bengal region have been grouped in to three categories (high, medium, low) for cereals, pulses, oilseeds and cash crops as shown in Table 5.2.

The productivity of different section of crops viz. cereals, pulses, oilseeds and cash crops for the year 2000-01 has been described below:
Table- 5.1

Methodology of Calculating Crop Yield Index as proposed by W.M. Yang’s

<table>
<thead>
<tr>
<th>Name of the Crops</th>
<th>Area of crop in the district (in hectares)</th>
<th>Yield in kg. per hectare</th>
<th>Crop yield in the districts as per cent to the state</th>
<th>Percentage multiplied by area in hectare</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Average yield in the district</td>
<td>Average yield in the state</td>
<td>5 = col.3/col.4*100</td>
</tr>
<tr>
<td>1 Rice</td>
<td>221700</td>
<td>2360</td>
<td>2287</td>
<td>103.19</td>
</tr>
<tr>
<td>Wheat</td>
<td>49400</td>
<td>2511</td>
<td>2485</td>
<td>101.05</td>
</tr>
<tr>
<td>Maize</td>
<td>3400</td>
<td>3096</td>
<td>2503</td>
<td>123.69</td>
</tr>
<tr>
<td>Gram</td>
<td>7600</td>
<td>1275</td>
<td>917</td>
<td>139.04</td>
</tr>
<tr>
<td>Mung</td>
<td>400</td>
<td>358</td>
<td>579</td>
<td>61.83</td>
</tr>
<tr>
<td>Masur</td>
<td>7000</td>
<td>1073</td>
<td>901</td>
<td>119.09</td>
</tr>
<tr>
<td>Khesari</td>
<td>3900</td>
<td>1074</td>
<td>1053</td>
<td>101.99</td>
</tr>
<tr>
<td>R &amp; M</td>
<td>34800</td>
<td>1083</td>
<td>956</td>
<td>113.28</td>
</tr>
<tr>
<td>Linseed</td>
<td>300</td>
<td>599</td>
<td>334</td>
<td>179.34</td>
</tr>
<tr>
<td>Sesamum(Til)</td>
<td>300</td>
<td>353</td>
<td>861</td>
<td>41.00</td>
</tr>
<tr>
<td>Sugarcane</td>
<td>5400</td>
<td>67667</td>
<td>67821</td>
<td>99.77</td>
</tr>
<tr>
<td>Potato</td>
<td>2400</td>
<td>17642</td>
<td>25606</td>
<td>68.90</td>
</tr>
<tr>
<td>Jute</td>
<td>24000</td>
<td>1861</td>
<td>2182</td>
<td>85.29</td>
</tr>
<tr>
<td>Total</td>
<td>360602</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Computation of Crop Yield Index of Malda district= 37362201.35/360600 = 103.61

Source: Yang, W.M. (1968): Methods of Farm Management Investigation For Improving Farm Productivity, No. 80, F.A.O., Rome

Productivity Regions - Cereals (2000-01)

Cereals occupy an important place in Agriculture of West Bengal. They occupy 5918.4 thousand hectares area, which account for 64.91 per cent of the total cropped area of the region.
Productivity region of cereals have been depicted in (Figure 5.1) whereas the number of districts in each category is given in (Table 5.2). The region of high productivity of cereals lies in the central, southern, eastern and western part of the study area which includes the districts of Murshidabad, Nadia, Hoogly, Burdwan, Birbhum and Bankura, with an area of 2112.2 thousand hectares with crop indices of above 105. The high productivity in this region is due to the assured irrigation facilities, sufficient amount of fertilizers consumption, high yielding varieties of seeds and agricultural implements and machinery. The concentration of medium productivity spread in central, south-eastern and southern part of the study region, it includes the districts of Uttar Dinajpur, Dakshin Dinajpur, Malda, North 24 Parganas, Purba Medinipur and Paschim Medinipur. Altogether they cover an area of 2231.9 thousand hectares with crop indices of 90 to 105. The area under low productivity of cereals lies in northern, southern and western part of the study region which includes the districts of Darjeeling, Jalpaiguri, Cooch Behar, South 24 Parganas, Howrah and Purulia, with an area of 1493.3 thousand hectares. Here the crop indices is below 90.

Productivity Regions - Pulses (2000-01)

In our predominantly stuffy vegetarian diet, pulses form a very important part as they provide us rich amount of protein. In this study region, only five crops (gram, mung, masur, khesari, maskalai or urd) are taken into account. They occupy 274.5 thousand hectares (3.01 per cent) of the total cropped area of region. Productivity regions of pulses are shown in (Figure 5.2). The high productivity region of pulses occupies an area of 63.6 thousand hectares with crop indices of above 106. It includes the districts of Malda, Burdwan, Bankura, Purba Medinipur and Paschim Medinipur. The medium productivity regions spread in northern, central and southern part of the study region, with an area of 155.4 thousand hectares. It includes the districts of Jalpaiguri, Cooch Behar, Murshidabad, Nadia, North 24 Parganas, South 24 Parganas and Howrah with crop indices ranging between 78 to 106. The low productivity region covers an area of 35.3 thousand hectares, it spreads in remaining five districts namely, Darjeeling, Uttar Dinajpur, Dakshin Dinajpur, Hoogly and Purulia. Here the crop indices are below 78.
WEST BENGAL
PRODUCTIVITY REGION
CEREALS (2000 - 2001)

INDEX VALUE
HIGH  ABOVE 105
MEDIUM  90 - 105
LOW  BELOW 90

K = KOLKATA

Fig. 5.1
WEST BENGAL PRODUCTIVITY REGION PULSES (2000 - 2001)

INDEX VALUE
HIGH ABOVE 106
MEDIUM 78 - 106
LOW BELOW 78

K = KOLKATA

Fig. 5.2
Table – 5.2
Number of Districts under Different Productivity Regions with their Indices (2000-2001)

<table>
<thead>
<tr>
<th></th>
<th>Cereals</th>
<th>Pulses</th>
<th>Oilseeds</th>
<th>Cash Crops</th>
<th>Con</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category</td>
<td>Indices</td>
<td>No. of Dist.</td>
<td>Category</td>
<td>Indices</td>
<td>No. of Dist.</td>
</tr>
<tr>
<td>HIGH</td>
<td>Above 105</td>
<td>6</td>
<td>HIGH</td>
<td>Above 106</td>
<td>5</td>
</tr>
<tr>
<td>MEDIUM</td>
<td>90 - 105</td>
<td>6</td>
<td>MEDIUM</td>
<td>78 - 106</td>
<td>8</td>
</tr>
<tr>
<td>LOW</td>
<td>Below 90</td>
<td>6</td>
<td>LOW</td>
<td>Below 78</td>
<td>5</td>
</tr>
</tbody>
</table>

Source: Based on Yang’s Crop Yield Index Method
Productivity Regions - Oilseeds (2000-01)

Oilseeds occupy 598.6 thousand hectares (6.56 per cent) of cropped area of the study region. Productivity regions of oilseeds are shown in (Figure 5.3). The high productivity area has covered an area of 272.9 thousand hectares with crop indices above 101, which includes the districts of Malda, Murshidabad, Burdwan, Birbhum, Purba Medinipur and Paschim Medinipur. There are five districts namely, Dakshin Dinajpur, Nadia, North 24 Parganas, Hoogly and Bankura covering an area of 241.1 thousand hectares with crop indices ranging between 82 to 101. The remaining seven districts namely, Darjeeling, Jalpaiguri, Cooch Behar, Uttar Dinajpur, South 24 Parganas, Howrah and Purulia showing low concentration of oilseeds. Altogether they cover an area of 84.6 thousand hectares with crop indices below 82.

Productivity Regions - Cash Crops (2000-01)

Cash crops are the most important group of crops grown in West Bengal. Among cash crops, jute, sugarcane and potatoes have been taken into account covering an area of 934.3 thousand hectares (10.24 per cent) of the total cropped area of the region. Productivity regions of cash crops are shown in (Figure 5.4). The high productivity region of cash crops occupies an area of 606.1 thousand hectares with crop indices above 103. It includes the districts of Murshidabad, Nadia, North 24 Parganas, Howrah, Hoogly, Burdwan, Bankura and Paschim Medinipur. Medium productivity region extends over only two districts namely, Malda and Purba Medinipur covering an area of 57.2 thousand hectares with crop indices ranging between 84 to 103. But the low productivity region covers extensive area in northern, eastern and southern part of the study region, it includes the districts of Darjeeling, Jalpaiguri, Cooch Behar, Uttar Dinajpur, Dakshin Dinajpur, South 24 Parganas, Birbhum and Purulia covering an area of 270.8 thousand hectares. Here the crop productivity indices is below 84.

Productivity Region - Based on Composite Index (2000-2001)

A composite index has been formulated after calculating agricultural productivity for each group of crops in West Bengal. The value of each districts are given in the table 5.2 and their spatial patterns are shown in the figure 5.5. It will be seen from this figure there are 5 districts namely, Nadia, Burdwan, Hoogly, North 24 Parganas and South 24 Parganas of high productivity region. It lies in the eastern and south-eastern part of the
WEST BENGAL
PRODUCTIVITY REGION
OILSEEDS (2000 - 2001)

INDEX VALUE
HIGH
ABOVE 101
MEDIUM
82 - 101
LOW
BELOW 82

K = KOLKATA

Fig. 5.3
study region. The productivity indices is above 142, it covers an area of 2959.07 thousand hectares or 32.45 per cent of the total cropped area of the study region. The medium productivity region scattered over 6 districts namely, Malda, Murshidabad, Birbhum, Howrah, Bankura and Medinipur. They spread over central and south-western part of West Bengal, with productivity indices ranging between 105 to 142. Altogether they cover an area of 3277.06 thousand hectares or 35.94 per cent of the total cropped area. The low category of agricultural productivity occupies the remaining 6 districts namely, Darjeeling, Jalpaiguri, Cooch Behar, Uttar Dinajpur and Purulia extended over northern and western part of the region. They together occupy an area of 2381.13 thousand hectares or 26.11 per cent of the total cropped area of the entire region.

Productivity Regions - Cereals (2010-11)

Cereals occupy an important place in Agriculture of West Bengal. They occupy 5364.8 thousand hectares area, which account for 60.74 per cent of the total cropped area of the region. Productivity region of cereals has been depicted in Figure 5.6 whereas the number of districts in each category is given in (Table 5.3). The region of high productivity of cereals lies in the central, southern, eastern and western part of the study area which includes the districts of Dakshin Dinajpur, Malda, Murshidabad, Hoogly, Burdwan and Birbhum with an area of 2053.1 thousand hectares. The high productivity in this region is due to the assured irrigation facilities, sufficient amount of fertilizers consumption, high yielding varieties of seeds and agricultural implements and machinery. The concentration of medium productivity region spreads in central, south-eastern and southern part of the study region and it includes the districts of Uttar Dinajpur, Nadia, North 24 Parganas, Purba Medinipur and Paschim Medinipur. Altogether they cover an area of 2211.2 thousand hectares. The area under low productivity of cereals lies in northern, south-eastern and western part of the study region which includes the districts of Darjeeling, Jalpaiguri, Cooch Behar, South 24 Parganas and Purulia, with an area of 1148.2 thousand hectares.
### Table 5.3

<table>
<thead>
<tr>
<th>Category</th>
<th>Indices</th>
<th>No. of Dist.</th>
<th>Category</th>
<th>Indices</th>
<th>No. of Dist.</th>
<th>Category</th>
<th>Indices</th>
<th>No. of Dist.</th>
<th>Category</th>
<th>Indices</th>
<th>No. of Dist.</th>
<th>Composite</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIGH</td>
<td>Above 99</td>
<td>7</td>
<td>HIGH</td>
<td>Above 105</td>
<td>3</td>
<td>HIGH</td>
<td>Above 105</td>
<td>6</td>
<td>HIGH</td>
<td>Al</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>MEDIUM</td>
<td>78 - 99</td>
<td>6</td>
<td>MEDIUM</td>
<td>79 - 105</td>
<td>10</td>
<td>MEDIUM</td>
<td>82 - 105</td>
<td>7</td>
<td>MEDIUM</td>
<td>127</td>
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<td></td>
</tr>
<tr>
<td>LOW</td>
<td>Below 78</td>
<td>5</td>
<td>LOW</td>
<td>Below 79</td>
<td>5</td>
<td>LOW</td>
<td>Below 82</td>
<td>5</td>
<td>LOW</td>
<td>Be</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

g's Crop Yield Index Method
WEST BENGAL
PRODUCTIVITY REGION
CEREALS (2010 - 2011)

INDEX VALUE
HIGH ABOVE 104
MEDIUM 90 - 104
LOW BELOW 90

K = KOLKATA

Fig. 5.6
WEST BENGAL
PRODUCTIVITY REGION
PULSES (2010 - 2011)

INDEX VALUE
HIGH
ABOVE 99
MEDIUM
78 - 99
LOW
BELOW 78

K = KOLKATA

Fig. 5.7
Productivity Regions - Pulses (2010-11)

In our predominantly starchy vegetarian diet, pulses form a very important part as they provide us rich amount of protein. In this study region, only five crops (gram, mung, masur, khesari, maskalai or urd) are taken into account. They occupy 197.0 thousand hectares (2.23 per cent) of the total cropped area of the region. Productivity regions of pulses are shown in (Figure 5.7). The high productivity region of pulses occupies an area of 94.1 thousand hectares with crop indices of above 99. It includes the districts of Nadia, South 24 Parganas, Burdwan, Birbhum, Bankura, Purba Medinipur and Paschim Medinipur. The medium productivity regions spread in central, western and southern part of the study region, with an area of 90.3 thousand hectares. It includes the districts of Uttar Dinajpur, Malda, Murshidabad, North 24 Parganas, Howrah and Purulia with crop indices ranging between 78 to 99. The low productivity region covers an area of 12.4 thousand hectares, spread in remaining five districts namely, Darjeeling, Jalpaiguri, Cooch Behar, Dakshin Dinajpur and Hoogly. Here the crop indices are below 78.

Productivity Regions - Oilseeds (2010-11)

Oilseeds occupy 670.7 thousand hectares (7.59 per cent) of cropped area of the study region. Productivity regions of oilseeds are shown in (Figure 5.8). The high productivity area covers an area of 77.8 thousand hectares with crop indices above 105, which includes the districts of North 24 Parganas, South 24 Parganas and Purba Medinipur. There are ten districts namely, Uttar Dinajpur, Dakshin Dinajpur, Malda, Murshidabad, Nadia, Howrah, Hoogly, Burdwan, Birbhum and Paschim Medinipur covering an area of 527.9 thousand hectares with crop indices ranging between 79 to 105. The remaining five districts namely, Darjeeling, Jalpaiguri, Cooch Behar, Bankura and Purulia showing low concentration of oilseeds. Altogether they cover an area of 64.2 thousand hectares with crop indices below 79.

Productivity Regions - Cash Crops (2010-11)

Cash crops are the most important group of crops grown in West Bengal. Among cash crops, jute, sugarcane and potatoes have been taken into account covering an area of 1127.4 thousand hectares (12.76 per cent) of the total cropped area of the region.
ductivity regions of cash crops are shown in (Figure 5.9). The high productivity region of cash crops occupies an area of 366.0 thousand hectares with crop indices above 80. It includes the districts of North 24 Parganas, Howrah, Hoogly, Burdwan, Bankura and Paschim Medinipur. Medium productivity region extends over only seven districts namely, Uttar Dinajpur, Dakshin Dinajpur, Malda, Murshidabad, Nadia, Birbhum and Purba Medinipur covers an area of 441.8 thousand hectares with crop indices ranging between 82 to 105. But the low productivity region covers extensive area in northern, eastern and southern part of the study region, it includes the districts of Darjeeling, Jalpaiguri, Cooch Behar, South 24 Parganas and Purulia covering an area of 197.6 thousand hectares. Here the crop productivity index is below 82.

Productivity Region - Based on Composite Index (2010-2011)

A composite index has been formulated after calculating agricultural productivity each group of crops in West Bengal. The value of each districts are given in the table and their spatial patterns are shown in the figure 5.10. It will be seen from this figure there are 6 districts namely, Dakshin Dinajpur, Burdwan, Bankura, Hoogly, Paschim Dinipur and Purba Medinipur of high productivity region. It lies in the south-western southern part of the study region. The productivity indices is above 175, it covers an area of 3360.60 thousand hectares or 38.06 per cent of the total cropped area of the study region. The medium productivity region is scattered over 7 districts namely, Malda, Murshidabad, Birbhum, Nadia, North 24 Parganas, South 24 Parganas and Howrah. They extend over north-central, central and south-western part of West Bengal, with productivity indices ranging between 127 to 175. Altogether they cover an area of 5269.3 thousand hectares or 39.80 per cent of the total cropped area. The low category of agricultural productivity occupies the remaining 5 districts namely, Darjeeling, Jalpaiguri, Uttar Dinajpur and Purulia extended over northern and western part of the region. They together occupy an area of 1953.93 thousand hectares or 22.14 per cent of total cropped area of the entire region.
WEST BENGAL
PRODUCTIVITY REGION
OILSEEDS (2010 - 2011)

INDEX VALUE
HIGH    ABOVE 105
MEDIUM  79 - 105
LOW     BELOW 79

K = KOLKATA

Fig. 5.8
WEST BENGAL
PRODUCTIVITY REGION
CASH CROPS (2010 - 2011)

INDEX VALUE
HIGH ABOVE 105
MEDIUM 82 - 105
LOW BELOW 82
K = KOLKATA

Fig. 5.9
WEST BENGAL
PRODUCTIVITY REGION
COMPOSITE INDEX (2010 - 2011)

INDEX VALUE
HIGH  ABOVE 175
MEDIUM  127 - 175
LOW  BELOW 127

K = KOLKATA

Fig. 5.10
Table 5.4
Areal Change in Agricultural Productivity in West Bengal from 2000-01 to 2010-11

<table>
<thead>
<tr>
<th>Category</th>
<th>Cereals</th>
<th>% of Change</th>
<th>Pulses</th>
<th>% of Change</th>
<th>Oilseeds</th>
<th>% of Change</th>
<th>Cash Crops</th>
<th>% of Change</th>
<th>Change in Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>-107.10</td>
<td>-5.34</td>
<td>+30.50</td>
<td>+32.41</td>
<td>-195.10</td>
<td>-250.77</td>
<td>-240.10</td>
<td>-65.60</td>
<td>401.53</td>
</tr>
<tr>
<td>Medium</td>
<td>-20.70</td>
<td>-0.94</td>
<td>-65.10</td>
<td>-72.09</td>
<td>+286.80</td>
<td>+54.33</td>
<td>384.60</td>
<td>+87.05</td>
<td>-263.12</td>
</tr>
<tr>
<td>Low</td>
<td>-345.10</td>
<td>-30.06</td>
<td>-22.90</td>
<td>-184.68</td>
<td>-20.40</td>
<td>-31.78</td>
<td>-73.20</td>
<td>-37.04</td>
<td>-427.21</td>
</tr>
<tr>
<td>W.B.</td>
<td>-472.90</td>
<td>-8.82</td>
<td>-57.50</td>
<td>-29.22</td>
<td>+71.30</td>
<td>+10.64</td>
<td>+71.30</td>
<td>+7.09</td>
<td>-284.21</td>
</tr>
</tbody>
</table>

Source: Bureau of Applied Economics & Statistics, Govt. of West Bengal.
Pattern of Change in Agricultural Productivity (2000-01 to 2010-11)

The pattern of areal change in Agricultural productivity of West Bengal between 2000-01 to 2010-11 are depicted in Table 5.4. This table illustrates the change in area and their percentage change of various crops. It is evident from the table that during the last decade, high productivity area under cereals has recorded a significant decrease 107.10 thousand hectares, while medium and low productivity area suffered with a great loss by 20.70 thousand hectares and 345.10 thousand hectares respectively. The decrease in terms of percentage was 5.34 per cent for high productivity, 0.94 per cent for medium productivity and 30.60 per cent for low productivity. Thus the area under high, medium and low productivity of cereals on the whole shows a negative sign.

The high productivity area of pulses has increased with a gain of 30.50 thousand hectares, contributing 32.41 per cent. The medium productivity and low productivity suffered with a great loss of 65.10 thousand hectares or 72.09 per cent and 22.90 thousand hectares or 184.68 per cent respectively. Oilseeds of the region has increased its area under medium productivity and decreased its area under high and low productivity. The high productivity area of oilseeds has decreased by 195.10 thousand hectares which accounts for 250.77 per cent of the total area under oilseeds. The medium productivity has increased by 286.80 thousand hectares contributing 54.33 per cent of the total oilseeds area, but low productivity has declined to 20.40 thousand hectares, covering 31.78 per cent of the total area under oilseeds.

Cash crops are the last group of crops grown in West Bengal. The high productivity has declined to 240.10 thousand hectares, which accounts for 65.60 per cent. The medium productivity has increased to 384.60 thousand hectares, constituting to 87.05 per cent of the total area, while low productivity area has recorded a decrease of 73.20 thousand hectares or 37.04 per cent of total area under cash crops.

The productivity regions based on composite index reveals that high productivity area in West Bengal has increased by 401.53 thousand hectares, commanding 11.95 per cent of the total area. Medium productivity region has decreased by 263.17 thousand hectares or 7.48 per cent of the total area, whereas low productivity area has also decreased by 427.20 thousand hectares or 21.86 per cent of the total area of the region.
On the whole in West Bengal, the productivity area under cereals has declined by 472.90 thousand hectares (8.82 per cent), while the productivity area under pulses also decreased by 57.50 thousand hectares (29.22 per cent). The productivity area under oilseeds and cash crops has shown significant increase by 71.30 thousand hectares (10.64 per cent) and 71.30 thousand hectares (7.09 per cent) respectively. The overall productivity area are also decreased by 284.20 thousand hectares (3.22 per cent). It may be seen from the analysis that farmers of West Bengal are highly inclined towards the cultivation of oilseeds and cash crops rather than cereals and pulses, because these crops give maximum returns to the farmers.
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