MEASUREMENT OF AGRICULTURAL PRODUCTIVITY OF THE GREAT INDIAN PLAINS

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Productivity is essentially a measure of the efficiency with which inputs are utilized in production, other things being equal. There is a substantial literature relating to methodological procedures for measuring productivity in agriculture.[1/] Professor Stamp while attemtping to measure crop productivity per unit area emphasises that areal differences in crop productivity are the result partly of natural advantages of soil and climate partly of farming efficiency Farming efficiency refers to the properties and qualities of the various inputs, the manner in which they are combined and utilized for production and effective market demands for the output. The increase in agri-

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cultural productivity is largely related to the choice of inputs and their relative quantities, the technicques and skill with which they are utilized in the production processes, and the output that they produce.

The measures of agricultural productivity which are most frequently understood are those of land productivity, and refers to the relation of a single input or a group of inputs to the total output or to a part thereof /yield per hectare, output per man hour or output per unit of capital/. The data required to measure the productivity of a single input are more likely to be available than are those require for measures of overall productivity. Besides, the aggregation of total inputs may tend to obscure the effect of changes in their composition.

The International Commission of Agricultural Typology is seized of this problem and the Chairman of the Commission Prof. Kostrowicki sent a questionnaire to over 100 scholars which embodied the following two questions:

1/ What methods of measuring intensity of agriculture should beapplied in typological studies of various orders.

2/ What methods, measures and indices should be used to define land, labour and capital productivity of agriculture in typological studies of various orders.

About fifty geographers from all over the world responded and suggested various approaches to the measurement of agricultural intensity. The Chairman of the Commission, while commenting on the different approaches, pointed out that a special study testing various methods and techniques to be used in the

studies of various scales was needed and the Commission is continuing its work on this problem.[5/]

The productivity of land, the most permanently fixed of the three conventional categories of inputs has assumed special importance with the rapid increase of population. It India where land is scarce, measures that help in increasing the output per hectare of land provide the most ready means of achieving the immediate increase in production required to keep pace with demand. As Professor Stamp has put it, in a world short of food, what matters in many perhaps most, countries is the actual amount of food produced, and making some allowance for quality, the higher the output per unit area, the greater is the efficien cy of the farmer.[4/]

Adopting the approach, the author attempted to measure the agricultural efficiency of Uttar Pradesh on the basis of arce yield of eight selected crops. The districts were placed in the order of output per acre for each crop. The places occupied by each district in respect to the total selected crops were then averaged and from these averages the ranking coefficient of agricultural efficiency of each district was obtained. If a district was at the top of every list, it would have a ranking coefficient of one, and if it were at the bottom of every list, it would have a ranking coefficient equal to the total number of districts considered.[2/] Stamp while commenting on this method points out that the aim of this technique is to measure actually the crop productivity per unit area which depends partly on the natural factors of climate and soil and partly on the management and organization of the farmer. It will be seen that in this approach insignificant acreage under certain crops which show high adsptations with regard to

physical factors in the same or in different regions may have higher yield per acre than those crops which occupy substantial acreages with relatively poor adapterability to physical conditions. The ranking coefficient on the basis of average would therefore be biased and may not present a correct picture of agricultural efficiency.

Prof. Enyedi while discussing geographical types of agriculture refers to a formula for determing an index of productivity coefficient.

$$\frac{Y}{Yn} \cdot \frac{T}{Tn}$$

Where Y = the total yield of the respective crop in the unit area
Yn = the total yield of the crop on national scale
T = total crop area of the district
Tn = total crop area on national scale

Enyedi has illustrated this formula by quoting a suitable example. Of the national crop area of 5,7 m hectares wheat is grown on 1 m hectare with a yield of 15 quintals/hectare.
Thus the yield total amounts to 15 million quintals. In one of the districts /A/, the total crop area is suppose; 50.000 hectares and that of wheat is 15.000; and the yield of wheat amounts to 23 quintals/hectare. The total yield of wheat in the district would amount to 345.000 quintals. Applying the above formula, $\frac{345.000}{15.000.000} : \frac{50.000}{5.700.000}$, the index for the district /A/ is 2,62 i.e. the area of the district is 162 % more productive for wheat than is the total crop area of the country.[1/]

The writer adopted this formula to determine the productivity coefficient index in respect of twelve food crops of India. From the productivity indes of each crop of a district the percentage of the productivity level in relation to the national scale for that crop was obtained. The percentages of all the twelve crops thus obtained were added up to indicate the food crop productivity level of that district compared to the national level. The plus figures of productivity percentages of all the districts were arranged in the descending order and medians, quartiles and octiles were worked out which resulted in eight ranks /I to VIII/. The minus figures of the productivity percentages were arranged separately in a descending order and the median was worked out which gave two ranks IX and X.[3/]

While appreciating the value of the formula in determining index of an area with reference to the national scale there are certain cases where the results obtained by the formula is influenced by the imagnitude of the area under a particular crop when the yield of the district is either the same or is less than the national yield. For example, when the yield of the district is the same as the national yield even then the district, by the computation of the formula, has a higher productivity coefficient than that of the national scale.

Example:

Yield of wheat in the district	= 15 quintals/hectares
National yield of wheat	= 15 quintals/hectares
Area of the district under wheat	= 15.000 hectares
Area under wheat at the national level	= 1.000.000 hectares
Total crop area of the district	= 50.000 hectares
Total crop area at national level	= 5,7 million hectares

Applying the formula $\frac{Y}{Yn} : \frac{T}{Tn}$

$$\frac{225.000}{15.000.000} \times \frac{5.700.000}{50.000} = 1,71$$

Productivity coefficient = 171 - 100 = + 71 %

The example shows that the district /B/ although having the same yield of wheat as the national yield is shown to be 71 % more productive which is hardly tenable.

Similarly there may be a case when the district yield is less than the national yield, but the area under that particular crop whose productivity coefficient is to be determined is more than in the instance cited by Professor Enyedi. In this case too, although the district yield is less, its productivity index would be higher than the national level.

Example:

Yield of wheat in the district = 12 quintals/hectares
Yield of wheat at the national level = 15 quintals/hectares
Area of wheat in the district = 20 hectares
Area of wheat at the national level = 1.000.000 hectares
Y = 240.000 quintals
Yn = 15.000.000 quintals
T = 50.000 hectares
Tn = 5,7 millions hectares

According to the formula the result of the productivity index of the district /C/ would be as follows:

$$\frac{240.000}{15.000.000} \times \frac{5.700.000}{50.000} = 1,82$$

Productivity coefficient = 182 - 100 = 82 %

It will be seen that althocgh the productivity of the district with regard to wheat is less than that of the national level, the formula shows that the district is 82 per cent more productive than the national level.

Taking the same example which Professor Enyedi has quoted, of only the yield of wheat per hectare is decreased /the yield of wheat in the district per hectare is taken to be less than the figure cited/. and other things remain equal, the productivity coefficient of the district again would be higher than the national level.

Example:

Yield of wheat in the district = 12 quintals/hectare
Yield of wheat at the national level = 15 quintals/hectare
Area under wheat in the district = 15.000 hectares,
Area under wheat at the national level 1.000.000 hectares
Total crop area of the district = 50.000 hectares
Total crop area at the national level = 5,7 million hectares
According to the forumla the productivity coefficient of the district with respect to wheat = $\frac{180.000}{15.000.000} \times \frac{5.700.000}{50.000} = 1,37$

Productivity coefficient = 137 - 100 = + 37 %

It will be seen from the above measurements that in a particular district although the yield hectare of a crop may be equal to the national level or even less than the national level, the productivity coefficient index with respect to that crop is higher than the national level.

The writer has made an attempt to modify the formula wherein the productivity coefficient of a particular crop may be in conformity with higher or lower yield per hectare of that crop in the district relative to the national level.

In the modified formula the summation of the total yield of all the crops in the district is divided by the total area under the crops considered in the district and the position thus obtained is examined in relation to the total yield of all the crops considered at the national level divided by the total area under those crops. The formula would read as follows:

$$\left/\frac{Yw}{t} + \frac{yr}{t} + \frac{ymi}{t} \cdots n\right/ : \left/\frac{Yw}{T} + \frac{Yr}{T} + \frac{Ymi}{T} \cdots n\right/$$

$$\text{or } \frac{y}{t} : \frac{Y}{T}$$

An attempt has been made to determine the productivity index of the Great Plains of India on the basis of the above formula.

The Great Indian Plain stretches between 22 and 33°North latitude, and 74 and 89°40' E long, and covers an area of 308,975 sq.miles or 800,245 sq.kms comprising 81 districts. It covers 26 per cent of the total area of the country but contains 40 per cent of the total population.

The Great Indian Plains are one of the largest and most densely populated alluvial plains of the world. Stretching along the foot of the Himalayas, they fan out at both ends as to include humid Bengal Basin in the east and the relative dry plain in the west. Physiographically the Great Indian Plain is divided into two sub-divisions: Northern plains and Eastern Plains.

The northern plain is divided into four units: Punjab plain, Ganga-Yamuna Doab, Rohilkhand plain and Avadh Plain.The Ganga-Yamuna Doab is by far the largest and most densely populated. Farther east to the Doab, lies the low lying Rohilkhand and the Avadh Plain.

The Eastern Plain is sub-divided into four Units: North Bihar Plain, South Bihar Plain, Assam Valley and Bengal Basin.

The Ganga-flows along the southern border of the North Bihar Plain, and receives on its left bank three of the major Himalayan rivers-Ghaghra, Gandak and Kosi, and many other minor rivers. The monotogy of the North Bihar flat landscape is somewhat relieved in the South Bihar Plain.

The Bengal Basin embraces most of the alluvial plains of West Bengal where the Ganga delta occupies the major portion of Bengal Basin.

Agriculture is the main occupation of the people of the Great Plains of India where the population consists predominently of cultivators wholly or partly dependent on cultivation.

The writer has made an attempt to determine the productivity index of the Great Plains on the basis the above mentioned formula. It will be seen from Fig. 2. that the productivity index is highest in the districts of Ganga-Yamuna Doab, namely, Muzaffarnagar, Meerut, Bulandshahr, and the districts of Bengal Basin, namely Birbhum, Burdwan, Hooghly and Calcutta. Farrukhabad and Bijnor, which are very close to the Ganga-Yamuna Doab, also enjoy the highest productivity index.

Figure 2 further shows that Punjab-Haryana Plains have productivity index of the order renaging between III and VI. The productivity index of the whole of Haryana Plain with the exception of Mahendergarh ranges between IV & VI. The productivity index of Mahendergarh is however IX Patiala and Ludhiana in the whole of Punjab and Haryana Plain have the highest productivity index, and in the context of the Great Indian Plain their index is rated of the third order, while the remaining part of the Punjab Plain has productivity index ranging between IV and VI.

The position is complex with regard to the Avadh Plains Rohilkhand Plains and the Ganga-Yamuna Doab. The productivity index of the Doab ranges between /II and V/ but in the Doab there are some districts which have the highest productivity in the Indian Plain as a whole. These districts are Muzaffarnagar and Meerut and Bulandshahr. In the Rohilkhand Plain with the exception of Bijnor and Farukhabad districts which have

the productivity index of I, the productivity index ranges between V and VI. The productivity index of the Avadh Plains, ranges between IV and VI, while productivity index of the sub-montane districts /Bahraich, Gonda, Basti and Gorakhpur/ is slightly below the national level whereas that of Basti and Bahraich is far below the national level.

The productivity index of the whole of the North and South Plain is below the national level. The districts of the North Bihar Plain generally have the lowest productivity index. The productivity index of the Assam Valley ranges between the order of V and VI, while that of the Bengal Basin ranges between III and VI. Four of the districts of the Bengal Basin, namely Birbhum, Burdwan and Hooghly, and Calcutta have the highest productivity of I.

The above study shows that the productivity index of the sub-montane districts of the Avadh Plains, and the whole of the Bihar Plains have productivity, far below the national level and should receive the first attention in the improvement of the productivity of the area from the planners. Most of the districts of the Punjab and Haryana Plains, Brahamputra Valley and the Avadh Plains have productivity index which varies from low to medium, while the productivity index of most of the districts of Ganga-Yamuna Doab ranges between high and very high.

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