

Agricultural Productivity and Productivity Regions in Ganga-Yamuna Doab

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Abstract

In the present paper an attempt has been made to examine variations in crop productivity in Ganga-Yamuna Doab. Using Yang's 'Crop Productivity Index' the paper examines the crop productivity variations of 17 major crops (grouped under cereal, pulses, oilseeds and cash crops) grown in the districts of the region during 1990-94 and 2000-04. It further attempts to identify the variations in crop productivity among different districts of Ganga-Yamuna Doab and how the changes in productivity have been taken place from one period (1990-94) to another period. The paper shows through tables and maps, the extent and nature of productivity variation in the region and draws attention to overcome the inter-district disparities.

Key words: Ganga-Yamuna, Agricultural productivity, Productivity regions, Inter-district variations, Crop yield index, Land holdings.

Introduction

Agriculturally the Ganga-Yamuna Doab is one of the most important part of Uttar Pradesh. It lies between the two important streams – the Ganga and the Yamuna, which cover an area of about 58,400 km². The Doab consists of 23 districts which can be classified into three sub-regions namely, the Upper Doab, the Central Doab, and the Lower Doab (Fig. 1). The entire region of the Ganga-Yamuna Doab forms a part of the Ganga Plain. The alluvial deposits brought down by the Himalayan rivers spread over the entire area and the general slope of the plain very gently runs towards the eastern parts of the state of Uttar Pradesh. The alluvial deposits of the Ganga-Yamuna Doab can be classified into two categories: (i) the *khadar* lands, and (ii) the *bhangar* lands. The *khadar* lands contain newer alluviums, whereas the *bhangar* lands are made up of older alluvium. The *bhangar* lands are marked with the presence of saline and alkaline efflorescence called 'reh', whereas the *khadar* lands are free from it.

Agriculture occupies an important place in the economy of Uttar Pradesh and more specially in the Ganga-Yamuna Doab, it not only provides food to the people but also raw materials to numerous agro-based industries. About 70 per cent of the working population is directly or indirectly engaged in agriculture.

In last three decades agriculture has shifted from subsistence to commercial agriculture. The Ganga-Yamuna Doab is one of the fertile regions of the state of Uttar Pradesh, but comparatively the yields of crops are below than the states of Punjab and Haryana of the country.

So there is a considerable scope for the improvement of agricultural production and productivity per hectare and per agricultural worker, particularly on small and marginal farms which will help to increase income levels and improve the quality of life of the people in the rural areas.

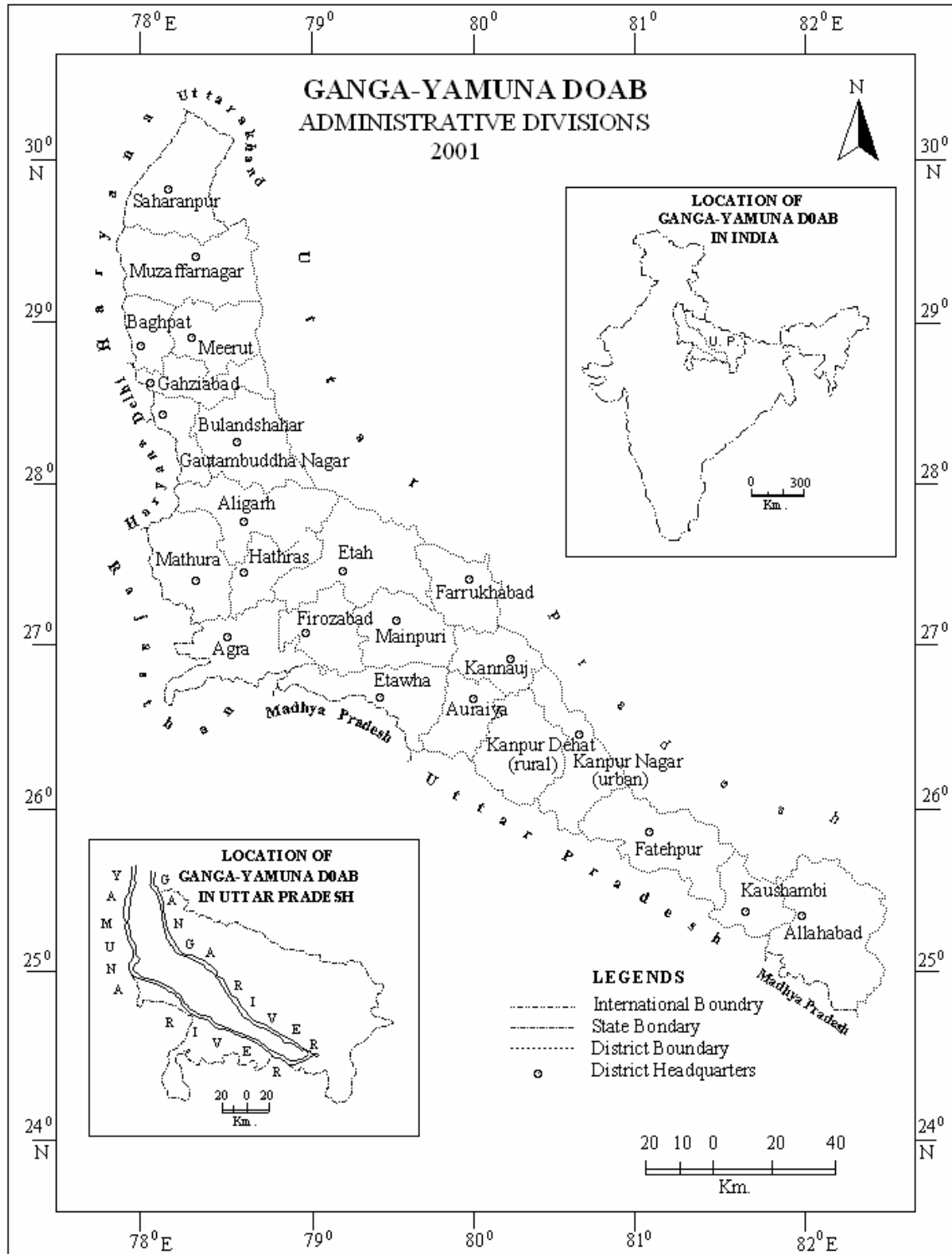
Agricultural productivity has been computed world wide by many scholars using different methods.

Thompson (1926) measured relative productivity of British and Danish farms and express it in terms of gross output of crops and livestock. Kendall (1939) treated agricultural productivity as a mathematical problem and initiated a system of four coefficients (i) productivity coefficient, (ii) ranking coefficient, (iii) money value coefficient, and (iv) energy coefficient.

Stamp (1952) applied Kendall's ranking coefficient technique on an international level to determine agricultural efficiency in a number of countries and by selecting some major crops. Stamp (1958) suggested, a method for measuring the agricultural productivity by converting the total agricultural productivity in calories. Shafi (1960) applied the technique of 'ranking coefficient' of Kendall for measuring the agricultural efficiency in the state of Uttar Pradesh

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Source: Survey Government of India- 2001(Census Department).
 Note-The District Headquarters of Kanpur Nagar (urban) and Kanpur Dehat (rural) is at Kanpur.

Fig.1

taking into account eight food crops grown in each of the forty-eight districts of the state. Agarwal (1965) has suggested 'factoral approach' while measuring agricultural efficiency in Bastar district of Madhya Pradesh.

Shafi (1965) assessed the productivity on the basis of labour engaged in agriculture. According to him it can be computed by dividing the gross production in any unit area by the number of man-hours. Shafi (1967) applied Stamp's 'standard nutrition unit' technique for measuring the efficiency of agriculture in India. Ruttan, et al. (1970) accounted for agricultural labour productivity differences in developed and of less-developed countries by using 'Cobb-Douglas production function'. Bhalla (1978) has considered out put per persons (on constant average price) for measuring productivity of labour in agriculture taking in to account nineteen major crops during the trienniums 1962-65 and 1970-73 for each district of the country of India.

Jasbir et al. (1985) made an attempt to calculate the agricultural productivity by considering the labour productivity, expressed as gross agricultural output in terms of 'grain unit' (one grain unit is equal to 100 kilograms of wheat) per hectare of cropped area or persons actively employed in agriculture. Where gross agricultural output (in rupees) was divided by the wheat support price for converting into a grain unit. Munir (1988) highlighting the weaknesses of Kendall's 'ranking coefficient' and Enyedi's Productivity Index methods attempted to apply Bhatia's and Shafi's methods in calculating the productivity indices of the Sub-Himalayan East region which lies in between the Ghaghara river in the south, and Nepal *tarai* in the north.

Siddiqui et al. (1999) calculated the productivity indices of North Bihar Plain on the basis of Yang's method. Rahman (2003) attempted to examine variations in crop productivity in North Bihar Plain considering 17 major crops grown in the districts of the region during the period of 1995-2000.

To compute productivity the present study is based on Yang's 'Crop Yield Index' method due to the fact that it considers the yield of all crops compared with the average yield of crops in the region.

The present study attempts to examine variations in agricultural productivity and relative changes that have occurred in agricultural production in two different periods of time 1990-94 and 2000-04 in the districts of Doab. Agricultural productivity is controlled by physical, institutional and technological factors operating in the region. Measurement and comparative analysis of agricultural productivity enables us to outline the areas that are performing efficiently or less efficiently as compared to other farming areas.

Data Base and Methodology

The present study is based on secondary sources of data obtained for two periods of time – 1990-94 and 2000-04. The data were collected from the published records of the Directorate of Agricultural Statistics and Crop Insurance, Krishi Bhawan, and the Institute of State Planning, Jawahar Bhawan, Lucknow, U.P.

The productivity indices of crops considered for each district were computed according to the methodology initiated by Yang (1965) i.e., the computation of Crop Yield Index. For the computation of an index (district Aligarh can be considered as an example). Initially it is needed to take the yields of all the crops considered in the district and compare them with the average yields of the same crops grown in the region. Before computing the crop yields index for Aligarh, the average yield of each of crop cultivated in the entire region should be considered. Then, by dividing the yield per hectare of a crop in the district by the average yield of the same crop in the region, a percentage figure is obtained, which when multiplied by 100, gives an index number, as shown in column 5 of Table 1. By incorporating the area devoted to each crop as a weight to multiply this with the percentage index, the products are obtained as listed in column 6 of the table. By adding the products (of column 6) and dividing the sum of products by the total of crop

area in the district (the sum of column 4), the average index thus obtained is the desired crop index for the district, using area devoted for the cultivation of crop as a weight.

There are 13 major crops grown in the Ganga-Yamuna Doab and all of these together accounted for 94.92 per cent of the total cropped area. For the purpose of analysis these crops were grouped into four broad categories: (a) cereal crops to include rice wheat, maize, barley, jawar and bajra, (b) pulses to include gram, black gram (urad) green gram (moong) lentil (masoor) peas and pigeon pea, (c) oilseeds to include mustard, linseed sesamum (til), groundnut and sunflower (d) cash crops to include sugarcane and potatoes.

Table 2 shows the districts of the Ganga-Yamuna Doab categorized in three distinct categories (on the basis of productivity indices computed) for the years 1990-94 and 2000-04 for the sake of a comparative analysis.

Study Area

The Ganga-Yamuna Doab is an important region of the state of Uttar Pradesh where agricultural development is taking place, and where the role of institutional and technological factors is proportionately changing. A number of schemes for intensive cultivation of rice, wheat, sugarcane, maize, jawar, pulses, and oilseeds have been put into operation.

Table 1: Methodology for the Calculation of Crop Yield Index

Table 1 Methodology for the Calculation of Crop Yield Index					
Name of crop	Yield (qnt/ha)		Area of crop in the district (000 ha)	Crop yield in the district as percentage of the state	Percentage multiplied by area (in ha.)
	Average yield in the state	Yield in the district		Col. 3 ———— x 100 Col.2	Col. 4 x Col. 5
1	2	3	4	5	6
Rice	18.72	17.83	129.50	94.94	11820.03
Wheat	25.25	27.47	2304.01	108.79	250653.25
Maize	16.30	17.64	440.28	108.32	47647.10
Jowar	11.26	7.25	6.29	64.39	405.01
Bajra	11.94	12.62	898.49	105.70	94970.39
Barley	23.60	27.23	377.93	115.38	43605.56
			4151.50	449101.34	

Computation of Crop Yield Index for the district of Aligarh = $\frac{449101.3}{4150.50} = 108.18$ per cent

Productivity Regions – Based on Cereal Crops (1990-94 and 2000-04)

Cereals are the most important crops grown in the Ganga-Yamuna Doab to cover an area of 4,705 thousand hectares (71.26 per cent) of the total cropped area. Rice and wheat together cover 51.66 per cent of total cultivated area.

Infact there are seven districts which form high productivity region. These districts are namely, Saharanpur, Muzaffarnagar, Meerut, Bulandshahar, Ghaziabad, Mathura and Agra. Here the high productivity indices are due to several institutional and technological factors which have

contributed a lot in last three decades. The districts characterized with medium productivity category are namely, Firozabad, Mainpuri, Etawah and Kanpur (rural). The factors responsible for the medium productivity may be traced from the socio-economic conditions of farmers which are not conducive for the fast development. The areas marked with low productivity of cereals are found in the districts of Aligarh, Etah, Farrukhabad, Kanpur Nagar, Fatehpur and Allahabad. Most of the districts marked with low productivity have very poor quality of the soil.

During the period of 2000-04 six new districts created form the part of the Ganga-Yamuna Doab. These districts are Baghpat, Gautambudh Nagar, Hathras, Kannauj, Auriya and Kaushambi. During this period the cultivation of cereals covered an area of 4,654 thousand hectares, which was more or less the same as it was during 1990-94. During this period total number of districts forming high productivity remained the same as they were in 2000-04. But the districts of Mathura, Ghaziabad, Saharanpur slipped from high productivity category to medium productivity category and their place was occupied by two newly created districts of Baghpat and Kannauj. Forming part of medium productivity category the total number of districts increased from 4 to 12. The districts of Firozabad, Etawah, Kanpur (rural), maintained their previous position of 1990-94, while Mainpuri district slipped to low productivity category. The new districts which experienced medium productivity are namely, Saharanpur, Gautambudh Nagar, Ghaziabad, Hathras, Mathura, Etah, Farrukhabad, Auriya, Kanpur Nagar. The districts which show low productivity are namely, Mainpuri, Fatehpur, Allahabad and Kaushambi.

B. Productivity Regions – Based on Pulse Crops (1990-94 and 2000-04)

Pulses are other important crops grown in the region. They occupied 556 thousand hectares (8.41 per cent) of the total cropped area. There are only five districts which show high productivity are namely, Saharanpur, Agra, Etawah, Kanpur (rural) and Fatehpur. The districts of Muzaffarnagar, Ghaziabad, Mainpuri, Etah, Kanpur (urban) and Allahabad show medium productivity. The remaining districts of Meerut, Bulandshahr, Aligarh, Mathura, Firozabad and Farrukhabad are characterized with low productivity.

Total area under pulse crops cultivation decreased from 556 thousand hectares during 1990-94 to 460 thousand hectares during 2000-04. During this period the districts of Saharanpur, Agra, Etawah, Kanpur Dehat and Fatehpur occupied their previous position, while the districts of Meerut, Etah, Kannauj, Auraiya, Kanpur Nagar, Kaushambi enjoyed high productivity. The districts of Muzaffarnagar, Mainpuri and Allahabad again characterized with medium productivity as it was during 1990-94. During the period of 2000-04, districts of Aligarh, Firozabad and Farrukhabad were characterized with medium productivity. Under the low

Table 2: Crop Yield Indices for the Districts of Ganga-Yamuna Doab

1990-94				2000-04			
Index range	Category	No. of Districts	Name of the District	Index range	Category	No. of Districts	Name of the District
Cereal Crops							
Above 116.50	High	7	Saharanpur, Muzaffarnagar, Meerut, Bulandshahr, Ghaziabad, Mathura, Agra	Above 107.50	High	7	Muzaffarnagar, Meerut, Bagpat, Bulandshahr, Aligarh, Agra and Kannauj
116.5-103.50	Medium	4	Firozabad, Mainpuri, Etawah, Kanpur Dehat	107.50-96.20	Medium	12	Saharanpur, Gautambudh Nagar, Ghaziabad, Hathras, Mathura, Firozabad, Etah, Farrukhabad, Etawah, Auraiya, Kanpur (urban), Kanpur (rural)
Below 103.30	Low	6	Aligarh, Etah, Farrukhabad, Kanpur Nagar, Fatehpur and Allahabad	Below 96.20	Low	4	Mainpuri, Fatehgarh, Allahabad, Kaushambi
Pulse Crops							
Above 102.50	High	5	Saharanpur, Agra, Etawah, Kanpur Dehat, Fatehpur	Above 101.40	High	11	Saharanpur, Meerut, Agra, Etah, Kannauj, Etawah, Auraiya, Kanpur (urban), Kanpur (rural), Fatehpur, Kaushambi
102.50-92.20	Medium	6	Muzaffarnagar, Ghaziabad, Mainpuri, Etawah, Kanpur Nagar, Allahabad	101.40-82.10	Medium	6	Muzaffarnagar, Aligarh, Firozabad, Mainpuri, Farrukhabad, Allahabad
Below 92.20	Low	6	Meerut, Bulandshahr, Aligarh, Mathura, Firozabad, Farrukhabad	Below 82.10	Low	6	Baghpat, Bulandshahr, Gautambudh Nagar, Hathras, Mathura

Table 2 (contd...)

Oilseed Crops							
Above 101.00	High	5	Aligarh, Mathura, Agra, Firozabad, Etawah	Above 96.80	High	7	Meerut, Baghpat, Ghaziabad, Gautambudh Nagar, Agra, Firozabad, Etawah
101.00-86.30	Medium	9	Muzaffarnagar, Meerut, Bulandshahr, Ghaziabad, Mainpuri, Etah, Farrukhabad, Kanpur Nagar, Kanpur Dehat	96.80-80.10	Medium	11	Saharanpur, Muzaffarnagar, Aligarh, Hathras, Mathura, Mainpuri, Etah, Farrukhabad, Kannauj, Auraiya, Kanpur (rural)
Below 86.30	Low	3	Saharanpur, Fatehpur and Allahabad	Below 80.10	Low	5	Bulandshahr, Kanpur Nagar, Fatehpur, Allahabad, Kaushambi
Cash Crops							
Above 101.40	High	8	Saharanpur, Muzaffarnagar, Meerut, Ghaziabad, Agra, Firozabad, Bulandshahr, Mainpuri	Above 98.80	High	9	Bulandshahr, Saharanpur, Muzaffarnagar, Meerut, Baghpat, Ghaziabad, Hathras, Agra, Firozabad
101.40-90.30	Medium	3	Aligarh, Mathura, Farrukhabad	98.80-85.30	Medium	8	Gautambudh Nagar, Aligarh, Mathura, Mainpuri, Farrukhabad, Etawah, Auraiya, Kanpur (rural)
Below 90.30	Low	6	Etah, Etawah, Kanpur Nagar, Fatehpur, Allahabad, Kanpur Dehat	Below 85.30	Low	6	Etah, Kannauj, Kanpur (urban), Fatehpur, Allahabad, Kaushambi

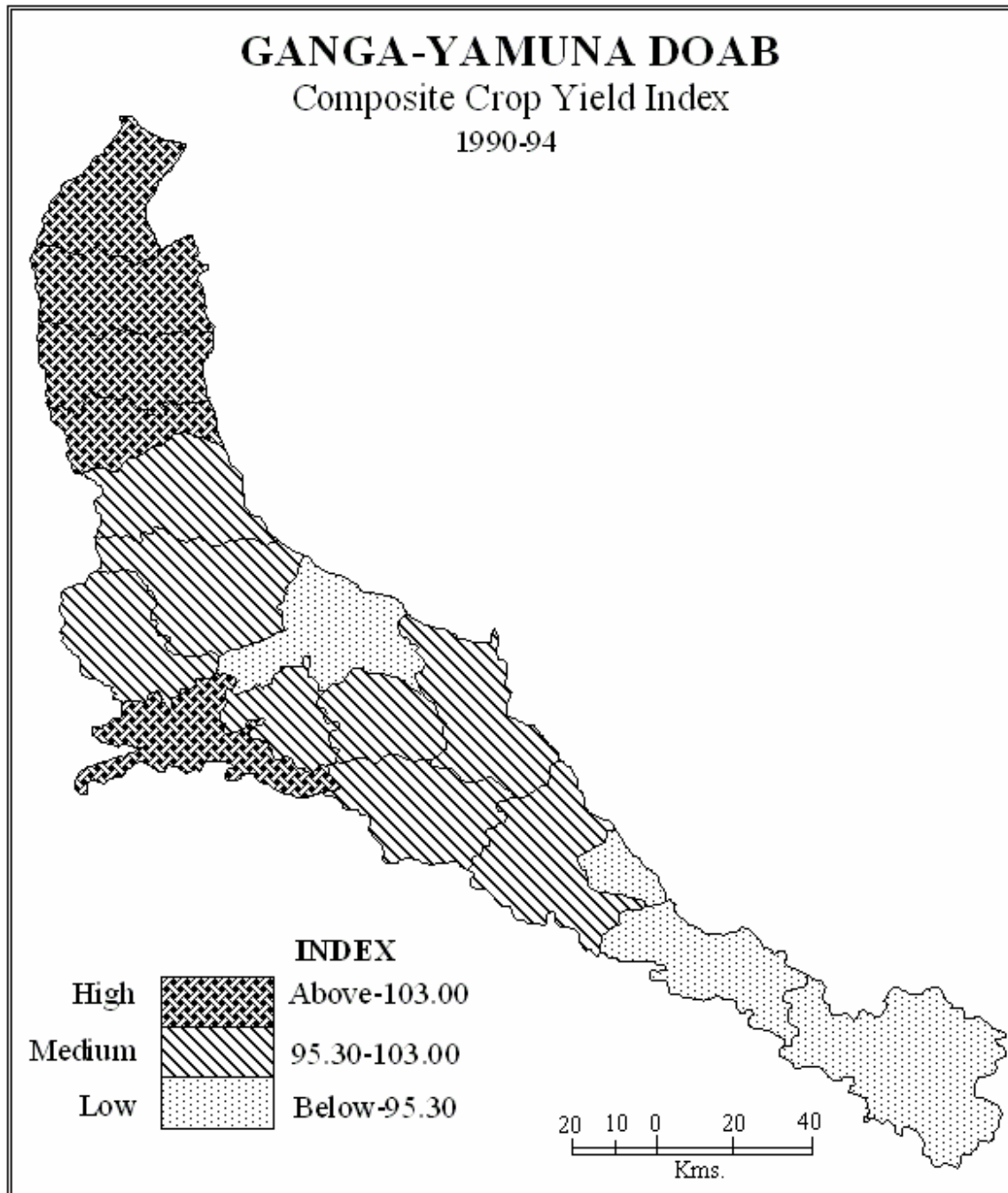


Fig.2

productivity category the districts of Bulandshahr and Mathura retained their previous position, while the districts of Baghpat, Ghaziabad, Gautambudh Nagar, and Hathras were the districts which show low productivity in 2000-04.

C. Productivity Regions – Based on Oilseed Crops (1990-94 and 2000-04)

Cultivation of oilseeds constitutes an important position in the agricultural economy of the Ganga- Yamuna Doab. They covered an area of 537 thousand hectares (8.09 per cent) of the total cultivated area. High productivity of oilseeds can be seen in the districts of Aligarh, Mathura, Agra, Firozabad and Etawah. In these districts, farmers use high-yielding variety of oilseeds and

better marketing facilities make this region more conducive for the production of oilseeds. The area under medium productivity of oilseeds includes

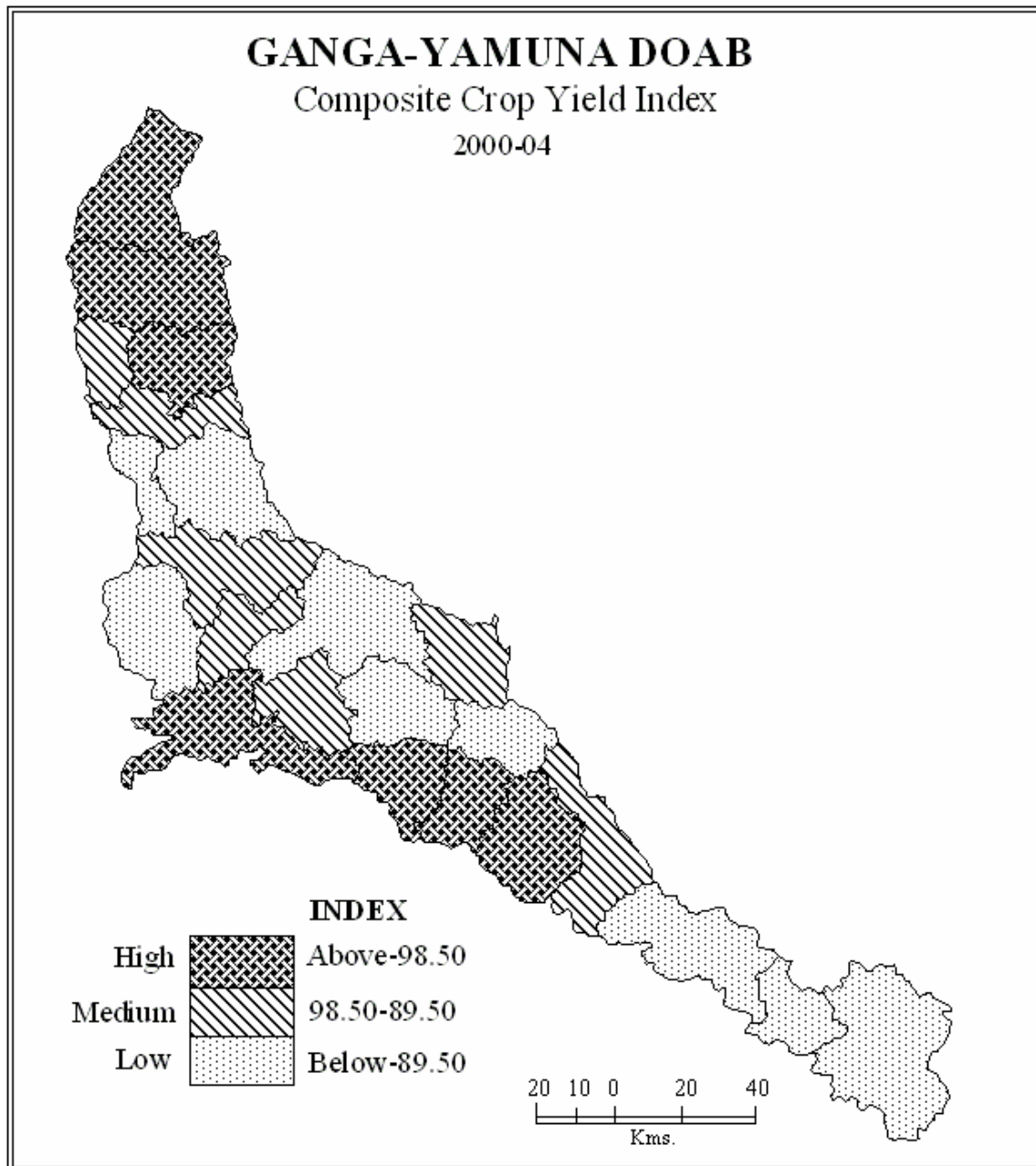


Fig.3

the districts of Muzaffarnagar, Meerut, Bulandshahr, Ghaziabad, Mainpuri, Etah, Farrukhabad, Kanpur Nagar, and Kanpur Dehat. The districts of Saharanpur, Fatehpur and Allahabad fall under low category of productivity.

The total area brought under oilseeds cultivation decreased from 537 thousand hectares (1990-94) to 470 thousand hectares (2000-04). During this period the districts of Agra, Etawah and Firozabad occupied their previous position, being with very high productivity, while the districts

of Meerut, Bagpat, Ghaziabad, Gautambudh Nagar joined with the areas marked with high productivity during 2000-04. The districts having medium productivity were namely, Muzaffarnagar, Mainpuri, Etah, Farrukhabad and Kanpur (rural), they retained their previous position, while the districts of Saharanpur, Aligarh, Hathras, Mathura, Kannauj, Auraiya were under this category. During 2000-04 the number of districts with low productivity increased from 3 to 5. The districts of Allahabad, Fatehpur occupied their previous position, while the districts of Bulandshahr, Kanpur (urban) and Kaushambi remained to show low productivity.

D. Productivity Regions – Based on Cash Crops (1990-94 and 2000-04)

Cultivation of cash constitutes the second ranking crops, and plays an important role in the agricultural economy, particularly in the upper Doab districts Cash crops covered 808 thousand hectares of land and accounted for 12.24 per cent of the total cropped area.

Out of seventeen districts, there were eight districts which attained high productivity; they were namely, Saharnapur, Muzaffarnagar, Meerut, Bulandshahr, Ghaziabad, Agra, Firozabad and Mainpuri. There were three districts which attained medium productivity namely, Aligarh, Mathura and Farrukhabad. The remaining six districts formed low productivity which were namely, Etah, Etawah, Kanpur (rural and urban), Fatehpur and Allahabad.

The area occupied by cash crops (potatoes and sugarcane) increased from 808 thousand hectares (1990-94) to 865 thousand hectares (2000-04). The number of districts with high productivity increased from eight to nine. The districts of Saharanpur, Muzaffarnagar, Meerut, Ghaziabad, Bulandshahr, Agra and Firozabad retained their previous position, while the districts of Bagpat and Hathras attained the high productivity during the period of 2000-04. With medium productivity, the districts of Aligarh, Mathura, Farrukhabad retained the same position, while the districts of Kanpur (rural), Gautambudh Nagar, Mainpuri, Etah, Auraiya experienced medium productivity. Having productivity of low order, the districts of Etah, Kanpur (urban), Fatehpur and Allahabad retained the previous position, while the districts of Kannauj and Kaushambi show medium productivity.

E. Productivity Regions–Based on Composite Crop Yield Index (1990-94 and 2000-04)

To delineate the general pattern of productivity and demarcate high, medium and low productivity regions a composite yield index computed for the districts of Ganga-Yamuna Doab. The regions are shown in Fig. 2. It is evident from the figure that, high productivity with an index value of above 103 consists of 5 districts. Out of these 5 districts, four belong to upper Doab namely, Saharanpur, Muzafarnagar, Meerut, Ghaziabad, and one from central Doab namely, Agra. The districts with high productivity received high doses of fertilizers and there has been an assured provision of irrigation with pumping sets.

There were eight districts marked with medium productivity and show a range of variation in productivity index values between 95.30 and 103. The districts belonging to medium productivity were namely, Bulandshahr, Aligarh, Mathura, Firozabad, Mainpuri, Farrukhabad, Etawah and Kanpur (rural). There were 4 districts namely, Etah, Kanpur Nagar, Fatehpur and Allahabad, which show low productivity.

During the period of 2000-04, 6 more districts were created to form the total number from 17 to 23. Characterized with high productivity with the index value of above 98.50 the number of districts increased from 5 to 7. The districts of Saharanpur, Muzaffarnagar, Meerut and Agra retained their previous position, while a district of Ghaziabad slipped from high to medium productivity. The districts of Etawah, Auraiya and Kanpur (rural) formed high productivity region in 2000-04. In the medium productivity category characterized with the index values from 89.50 to 98.50, there were 3 districts of Aligarh, Firozabad and Farrukhabad which retained their

previous position. The districts of Baghpat, Hathras, Ghaziabad and Kanpur (urban) were also classed within the medium productivity in

Table 3: Composite Crop Yield Indices for the Districts of Ganga-Yamuna Doab

1990-94				2000-04			
Index range	Category	No. of Districts	Name of the District	Index range	Category	No. of Districts	Name of the District
Cereal Crops							
Above 103.00	High	5	Saharanpur, Meerut, Muzaffarnagar, Ghaziabad, Agra	Above 98.50	High	7	Saharanpur, Muzaffarnagar, Meerut, Agra, Etawah, Auraiya, Kanpur (rural)
103.09-95.30	Medium	8	Bulandshahr, Aligarh, Mathura, Firozabad, Mainpuri, Farrukhabad, Etawah, Kanpur Deahat	98.50-89.50	Medium	7	Bagpat, Ghaziabad, Aligarh, Hathras, Firozabad, Farrukhabad, Kanpur (urban)
Below 95.30	Low	4	Etah, Kanpur Nagar, Fatehpur, Allahabad	Below 89.50	Low	9	Bulandshahr, Gautambudh Nagar, Mathura, Mainpuri, Etah, Kannauj, Fatehpur, Allaahbad, Kaushambi

2000-04. The districts having low productivity increased from 4 (in 1990-94) to (in 2000-04), which may be partially due to the creation of new districts. The low productivity was characterized with the index value below 89.50. There were 9 districts namely, Bulandshahr, Gautambudh Nagar, Mathura, Mainpuri, Etah, Kannauj, Fatehpur, Allahabad and Kaushambi which form low productivity region.

Conclusion

The overall analysis shows that during the period of 1990-94, there were only four districts with low productivity, while during the period 2000-04, the number of districts characterized with low productivity increased to nine. Agricultural performance over a large part of the Doab is characterized with marked productivity variations. These variations in productivity are influenced by the physical and socio-economic factors. Soil fertility as determined by the constituents of a number of nutrients play a vital role in enhancing crop growth and yield per hectare. In the Doab region there is a substantial variation in respect of soil fertility. Among the socio-economic factors, the size of landholdings is also responsible for decision making of farmers. There is a preponderance of small and semi-medium holdings, and the fields are highly fragmented (also some efforts have been made to consolidate the fields) which show low yields in farming areas.

Therefore, it is needed that the productivity of crops per hectare be increased at least in medium and low productivity areas. Application of new agricultural technology brought with high-yielding varieties will be of great help. The task of increasing agricultural productivity can also be achieved by dividing the Doab into a number of micro agro-climatic zones and intensive efforts should be made to evolve new high-yielding varieties which may suit to each agro-climatic zone, taking into consideration the factors of socio-economic and cultural background of the region.

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