



Research Article

SCENARIO OF WHEAT PRODUCTION DURING THE LAST FOUR DECADES IN UTTAR PRADESH

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Abstract: In the present article, an attempt has been made to investigate the scenario of wheat production in State of Uttar Pradesh by analyzing the time series data on area, production, productivity covering the period 1970-71 to 2010-11. The rice and wheat are still major crops of the State covering about 60 percent of total gross cropped area. The State has witnessed tremendous growth in area (65.23%), production (270.69%) and productivity (125%) of wheat since 1970-71. However, stagnation in growth of these parameters has started during the last decade (2000-2001 to 2010-11). It has been found that on average about 75 percent increase in the productivity has caused differential production in wheat during the last four decades in the State. Therefore, increase in productivity is only alternative to increase the production as there is no scope of bringing more area under wheat cultivation in years to come. The State has potential to increase the productivity as its present average yield is almost 30 Q/ha as compared to about 46 to 47 Q/ha of Punjab and Haryana.

Keywords: Wheat crop, area, production, productivity, scenario, decadal- growth

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Introduction

Wheat, (*Triticum aestivum* L. em. Thell) the world's largest cereal crop belongs to *Graminae* (Poaceae) family of the genus *Triticum*. It has been described as the 'King of cereals' because of the acreage it occupies, high productivity and the prominent position in the international food grain trade. Wheat is consumed in a variety of ways such as bread, chapatti, porridge, flour, suji etc. The term "Wheat" is derived from many different locations, specifically from English, German and Welsh language. Wheat is cultivated mainly in temperate and sub temperate regions of the world. Wheat has distinct history in India. Considerable increase in wheat production during late 60s led to green revolution in the country and makes the country self-sufficient in food grain. This significant contribution of wheat ushered during Green Revolution in India. India stands second rank in production and consumption both next to china in the world. India's share in world wheat production is about 14.13 percent. Wheat is the only crop where its production has increased more than fifteen times since 1950-51 in India (6.5 million tonnes in 1950 -51 to 92.45 million tons in 2012-13) [4]. Similarly, the productivity of wheat has increased 6.63 Q/ha to 31.18 Q/ha during the same period. Area under wheat has also gone up to the extent of 29.65 million hectares during 2012-13 as against 9.75 million hectares in 1950-51. Uttar Pradesh is one of the leading States of the country in the wheat production. During the year 2011-12 in Uttar Pradesh, the acreage under wheat production was 9.731 million hectares with production of 30.29 million tonnes and average productivity of 31.13q/ha. Uttar Pradesh ranks first in area and production among all the states of the country. However, its productivity is less than some of the states like Punjab and Haryana. The share of Uttar Pradesh in area and production of wheat is about 32.59 and 31.9 percent, respectively in the country. In the present investigation, the scenario of wheat production of last four decades in the state of Uttar Pradesh have been studied using data from the Bulletins of Directorate of Agricultural Statistics and Crop insurance, Government of Uttar Pradesh.

Materials and Methods

Data

The present investigation was based on secondary data. The time series data pertaining to the period from 1970-71 to 2010-11 on area, production and productivity of wheat crop have been used from the Bulletins of Directorate of Agricultural Statistics and Crop insurance, Krishi Bhawan, Lucknow, Government of Uttar Pradesh to study the scenario of wheat production in the state.

Methods

To study the overall scenario of wheat production in Uttar Pradesh, some appropriate statistical methodologies have been used. These statistical methodologies are systematically described here.

Cropping pattern

The cropping pattern in Uttar Pradesh has been worked out by ratio of area under a crop to gross cropped area multiplied by 100 to express it in percentage in a particular year, i.e.

$$\text{Cropping pattern} = \frac{\text{Area Under Crop}}{\text{Gross Cropped Area}} \times 100$$

Effect of change in acreage and productivity on differential production of wheat crop

An attempt has been made to the study the effect of change in acreage and productivity of wheat crop on the differential production between two points of time Following various works in the past [1-5]. Let Y, A and P be the production, acreage and productivity of a particular potato crop at a given point of time. The Y can be expressed as

$$Y = P \cdot A$$

Let ΔY , ΔA , ΔP be change in production, acreage and productivity of the crop after a specific period of time. So, we have

Table-1 Cropping pattern (in % of gross cropped area)

SN	Crops	1970-71	1980-81	1990-91	2000-01	2010-11
1	Total Cereal	67.80	71.65	68.04	69.61	67.75
(i)	Rice	19.04	21.52	22.03	23.34	22.1
(ii)	Wheat	25.45	33.01	33.62	36.51	37.63
(iii)	Other Cereal	23.31	17.12	12.39	9.76	8.02
2	Total pulses	16.05	11.78	8.01	10.64	9.56
3	Total oil seed	3.00	2.88	3.10	3.40	4.31
4	Sugarcane	5.80	5.55	7.28	7.66	8.3
5	Potato	0.70	1.08	1.32	1.56	2.15
6	Other crops	6.66	7.19	7.42	7.13	7.92
7	Total gross cropped area	23207144 (100)	24573897 (100)	25479842 (100)	25304147 (100)	25615000 (100)

Table-2 Triennium average ending at year shown of area (in million ha.), production (in million tonnes) and productivity (in tonnes/ha.) of wheat its changing pattern over four decades

Description	1970-71	1980-81	1990-91	2000-01	2010-11	Percent Change in 1980-81 over 1970-71	Percent Change in 1990-91 over 1980-81	Percent Change in 2000-01 over 1990-91	Percent Change in 2010-11 over 2000-01	Percent Change in 2010-11 over 1970-71
Area	5.81	8.07	8.63	9.35	9.60	38.90	6.93	8.34	2.70	65.23
Production	7.14	11.57	18.63	24.99	28.69	49.56	60.09	34.16	14.78	270.69
Productivity	1.35	1.51	2.16	2.67	2.99	13.53	43.04	23.61	11.98	124.81

Table-3 Effect of change in area and productivity on differential production of wheat (million tonnes)

Decades	Year	Differential Production (ΔY)	Area effect ($P\Delta A$)	Productivity effect ($\Delta\Delta P$)	Interaction effect ($\Delta\Delta P\Delta A$)
I	1970-71 to 1980-81	3.83 (100%)	0.30 (7.81%)	3.17 (82.72%)	0.36 (9.39%)
II	1980-81 to 1990-91	7.06 (100%)	0.84 (11.89%)	5.24 (74.23%)	0.98 (13.88%)
III	1990-91 to 2000-01	6.02 (100%)	1.55 (25.75%)	4.40 (73.09%)	0.07 (1.16%)
IV	2000-01 to 2010-11	3.70 (100%)	0.68 (18.40%)	2.91 (78.66%)	0.09 (2.44%)

Table-4 Measures of instability index (%) of area, production and productivity of wheat in last four decades and overall

Decades	Period	Area	Production	Productivity
I	1970-71 to 1979-80	3.992	11.996	10.207
II	1980-81 to 1989-90	1.964	5.604	4.342
III	1990-91 to 1999-00	1.182	3.796	3.745
IV	2000-01 to 2009-10	0.858	5.036	4.633
Overall	1970-71 to 2009-10	5.506	8.205	6.838

$$Y + \Delta Y = (A + \Delta A)(P + \Delta P)$$

$$Y + \Delta Y = AP + \Delta A P + \Delta P A + \Delta P \Delta A$$

Therefore, we have

$$\Delta Y = \Delta A P + \Delta P A + \Delta P \Delta A$$

Thus, the total differential production is composed of three components: (i) $P \Delta A$: Effect of change in acreage of the crop, (ii) $\Delta P A$: Effect of change in productivity of the crop, and (iii) $\Delta P \Delta A$: Interaction effect due to change in acreage and productivity of the crop. The contribution of change in acreage, productivity and their interaction to the total differential production of the crops has been worked out for each period separately and also for overall period.

Measure of instability in wheat production

High growth and low instability in wheat production are prerequisites for sustainable agricultural performance. Important concern is that technological change in wheat production has increased variability, which is considered to be one of the threats to food security. Since the magnitude of growth and instability in wheat production has serious implications for policymakers. The level of instability in the area, production and productivity of wheat crop will be estimated using suitable statistical tools. The simple coefficients of variation (C.V.) often contain the trend component and thus overestimate the level of instability in time series data characterized by long term trend. To overcome this problem, a measure of instability is estimated by using Cuddy Della Valle Index which corrects the coefficient of variations and it is given by

$$\text{Instability index} = \text{cv} \sqrt{1 - R^2}$$

where, R^2 is the coefficient of determination from a time trend regression adjusted by the number of degree of freedom.

Results and Discussion

An attempt has been made in this section to capture a general feature of development of the wheat production in Uttar Pradesh since 1970-71 onwards.

Cropping pattern

The decadal cropping pattern since 1970-71 onwards has been worked out and is presented in the [Table-1]. It is obvious from the result of the [Table-1] that technological changes in crop production, during green revolution and past green revolution period, particularly in wheat and rice have marginalized the production of other cereal crops. Area under cereal crops have almost remained 67.75 to 67.80 percent of gross cropped area over last four decades, and presently it constitutes about 68 percent of the gross cropped area. However, the area under wheat and rice has steadily increased over the last four decades. The area under rice has increased from 19.04 percent in 1970-71 to 22.10 percent in 2010-11. The area under wheat has increased from 22.45 percent in 1970-71 to 37.63 percent in 2010-11. On the other hand, area under other cereal crops has drastically decreased from 23.31 percent in 1970-71 to 8.62 percent in 2010-11. This shows that most of the area under other cereal crops (barley, etc.) has shifted to wheat and other crops. The situation of total pulses during last forty years has been very gloomy.

The area under total pulses has steadily decreased over every decade since 1970-71 onwards, and it has reduced to near half, i.e. about 9.56 percent at present from about 16.05 percent in 1970-71. Among the pulse crops, drastic reduction in the area has been found during eighties (from 16.05 to 11.78 %), which was period of active green revolution period, indicating thereby that some of the area under pulse have shifted to wheat crop. The area under Total oilseeds has increased to 4.31 % in 2010-11 from 3.00 % in 1970-71. This shows that oilseeds crops have also taken over some of the area from the area under pulse crops during the last forty years. Two cash crops, viz. sugarcane and potato have also showed increasing trend in its area since 1970-71 onwards. The potato registered a continuous growth in its area (from 0.70 % to 2.15%), and same case is with sugarcane (from 5.80 % to 8.3%) over last forty years. The most significant result has been found in other crops, which has registered about 8.00 percent at percent as compared to 6.66 percent in 1970-71.

This is probably because of diversification of agriculture in recent years and farmers have shifted the area towards more remunerative crops like vegetable, medicinal, aromatic plants, fruit crops *etc.*

Changing pattern in area, production and productivity of wheat

The triennium averages of area (in million hectares), production (in million tonnes) and productivity (in kg/hectares) and its percent change in different decadal periods under wheat crop are depicted in [Table-2].

Area

The results of the [Table-2] revealed that there has been increasing pattern of the area under wheat over the different decadal periods but this increasing pattern has been slow during the last three decades. About 65.2 percent increase in its area has been reported in 2010-11 since 1970-71. The maximum increase of 38.9 percent was obtained during seventies followed by 8.34 percent and 2.70 percent and 6.93 percent in progressive decades. This shows that the increasing area under wheat is likely to reach at the stagnation stage in times to come if this trend of changing continues to be so.

Production

The triennium averages of production (in million tonnes) and its percent change in different decadal periods with respect to wheat crop are presented in [Table-2]. A quite rosy picture of wheat production has been observed in the State during the entire period under study. Its production has accounted for about 270.69 percent increase since 1970-71 till 2010-11. The maximum increase of 60.93 percent was obtained during eighties, followed by 49.56 percent during seventies, 34.16 percent during nineties and 14.78 percent during the last decades. The changing pattern of wheat production over different decades indicated a likely stagnation in future, unless efforts are made to increase its productivity because there is little scope to bring more area under wheat in the state. It may be mentioned here that there is still scope of increasing productivity of wheat in Uttar Pradesh as presently its average yield is less than wheat producing States like Punjab and Haryana.

Productivity

The triennium averages of productivity of wheat crop in different decadal period are given in the [Table-2]. for different decades. The percent changes over different decades are also depicted in this table. There has been increase in the productivity of wheat by 124.81 percent since 1970-71 till 2010-11. It can be also observed from the table that the maximum increase of 43.04 percent in the productivity of wheat has been found during eighties (peak period of green revolution) followed by 23.61 percent during nineties. The increase in the productivity during seventies and nineties has been worked out to be 13.53 and 11.90 percent, respectively. It's very obvious from the result of the [Table-2] that the productivity of wheat has increased with slow pace during the last decades, almost 11.98 percent per year. The overall scenario of the wheat production can be visualized from the changing pattern given in the [Table-2]. It is suggested that wheat production can be increased only by increasing the productivity of wheat in the State. It may be noted that wheat productivity in the state is still relatively less (31.12 q/ha) than some of the states like Punjab and Haryana (about 46 to 47 q/ha). Therefore, there is still scope of increasing wheat production in the state. Such increase in wheat productivity can be achieved through intervention of proper policy by state government, farm scientists and farmers.

Effect of changes in acreage and productivity and their interaction on differential production of wheat crops

As it is obvious that production of a crop is the product of its acreage sown and its productivity. Any change in its acreage or productivity or simultaneous changes in both would result change in production. In order to study the effect of these changes on differential production of wheat crop, the differential production during the last four decades has been decomposed into three components viz. (i) effect due to changes in acreage, (ii) effect due to changes in productivity and (iii) interaction effect due to simultaneous changing in acreage and productivity, using the methodology described in Section-2. The results are presented in the [Table-3] for each period separately.

Decade I

During the first decade, the wheat production has increased substantially and positive differential production of 3.83 million tonnes has been found. A large share of it can be attributed to the effect of positive change in its productivity, *i.e.* 82.7 percent, while 7.83 percent due to effect of positive change in its acreage and 9.39 percent due to interaction effect of change in productivity and acreage simultaneously. This finding can also be validated by the result of the [Table-2].

Decade II

Positive differential production has also been found to be maximum of 7.06 million tonnes during decade II. The effect of positive change in its acreage has contributed 11.89 percent to it, while share of upward change in its productivity has been found to be 74.23 percent. The share of interaction effect due to positive change in acreage and productivity simultaneously has been found to be 13.88 percent.

Decade III

The production of wheat has increased during the third decade also and consequently positive differential production of 06.02 million tonnes has been recorded. This has been achieved due to upward change its acreage and its share to it was 25.75 percent. The effect of change in productivity was found to be positive and its share stood at 73.09 percent. The interaction effect due to positive change in acreage and productivity simultaneously has contributed to it by 1.16 percent.

Decade IV

A positive differential production of 3.70 million tonnes has been observed in case of wheat during last decade, where effects of change in its acreage, productivity, and their interaction have contributed 18.40, 78.66 and 2.44 percent, respectively. The overall results of the [Table-3] show that the increased production of wheat during different decades has been observed and it are largely due to increase in its productivity, *i.e.* about more than 75 percent of the increased production can be attributed to it.

Measures of instability index in area, production, and productivity of wheat

It is a matter of paramount concern that variability has increased due to technological changes in crop production in general as well as in wheat production in particular. Therefore, the measure of instability in wheat production has been determined by using Instability Index (%) as described in materials and methods section. The instability index for area, production and productivity have been computed for four decades, *i.e.* 1970-71 to 1979-80 (I-decade), 1980-81 to 1989-90 (II-decade), 1990-91 to 2000-01 (III-decade), 2000-01 to 2009-10 (IV-decade) and also for the entire period (1970-71 to 2009-10, overall) under study. The results are presented in [Table-4].

Area

The instability index in case of area of wheat has ranged between 0.858 to 3.992 percent. However, it was maximum during the first decade and minimum during the last decade. Low value of instability indicates stability in the area. This shows clearly that the area under wheat has been more stable during last decade as compared to previous three decades. That means that the area under wheat during the last decade (2000-01 to 2009-10) seemed to be almost stable showing thereby little bit increase or decrease. It can also be observed that the area under wheat has been quite instable during seventies, the start of green revolution in the state.

Production

The instability index have been found to be quite high in wheat production. It has varied between 5.036 percent to 11.996 percent. The maximum instability index has been recorded during the first decade and it was minimum during third decade. The production of wheat remained more instable during the first decade. This could be attributed is the uncertainty of adoption of new varieties of wheat by the farmers, which were launched as a package of green revolution in the state.

During the last three decades, the instability was less as compared to the first decade. This means that technological changes have induced steady increase in the wheat production during three last decades.

Productivity

Similar results have been obtained in case of productivity. The low value of instability index of productivity (3.745 to 4.633 percent) shows that the productivity of wheat has been more consistent than its area and production during the last three decades. That means productivity of the wheat has increased steadily over the decades and also during the entire period of the study. However, it was found to be quite unstable, i.e. 10.207 percent, during the first decade.

Concluding Remarks

It is very obvious from the results that the rice and wheat are major crops of the State covering about 60 percent of gross cropped area (2010-11). Area under wheat has increased by 65.23 percent in 2010-11 since 1970-71. However, it recorded only 2.70 percent increase during 2000-01 to 2010-11. This means that stagnation in area has started during the last-decade and it will continue to be so in years to come because of need of land for infrastructural developments. The production of wheat has increased by about 270 percent during the same period, but the pace of growth of production was quite low (14.78%) during the last decade, it was probability because of low growth in productivity of wheat during this decade. Although the increase in the productivity of wheat has been recorded to be about 125 percent during the last four decades but it was only about 12 percent during the last decade. It is evident from the results that on an average change in productivity have contributed about 75 percent in differential production of wheat. It is now almost sure that bringing more area under wheat cultivation is impossible. Therefore, substantial growth in the productivity of wheat can only be option to increase the wheat production in the State. Such growth in the productivity is possible by policy intervention as the State average yield of wheat is still low about 30 Q/ha as compared to some States like Haryana and Punjab (about 46 to 47 Q/ha).

Application of research: The results of the research will help the policy formulators as inputs to prepare agricultural development programmes.

Research Category: Crop science

Abbreviations: C.V.-coefficient of variation.

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