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Analysis of Wheat Export Performance in India

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Wheat is a plant which is valued highly for its kernel as an edible part and an important source of carbohydrates. India ranks second position in wheat production in the world with a contribution of roughly 13.53 per cent to global wheat output (Naga Latha *et. al.,* 2022). The study analyses the export performance of wheat and examines the trends in the growth performance of wheat in terms of area, production and productivity, export quantity and export value during 1973-2022 which is a period of 50 years. The analysis reveals that the highest compound growth rate in terms of area

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was 1.16 per cent, production was 4.49 per cent and productivity was 3.29 per cent respectively. The results of the study on the compound growth rates during the study periods have shown positive and increasing value which indicates high potential for the export of wheat from India. In the analysis of instability, there exists a high positive correlation between the export quantity and value of export in the overall period. Wheat area, production and productivity exhibit higher variability and instability in the overall period. Period II shows lower variability and instability, indicating increased stability. Period I exhibits moderate variability and instability. The overall period has the highest instability, suggesting unpredictable production. Instability indices show high instability at 126.97 per cent in Period I and 138.18 per cent overall, while Period II exhibits moderate instability at 101.94 per cent. Market volatility, trade policies, economic fluctuations, weather patterns and production variability contribute to these fluctuations. As of trend analysis, there is a positive and significant increase. The NPC value of wheat during the overall period was 0.051, it indicates that the commodity is not protected. NPC<1 indicates that the commodity is exportable and possesses export competitiveness and hence the hypothesis i.e. Indian wheat has better competitiveness in the International market.

Keywords: Production, productivity; export quantity; growth rate and export competitiveness.

1. INTRODUCTION

Wheat (*Triticum aestivum*) is the most extensively grown cereal crop in the world. Since wheat is rich in protein, carbohydrates and vitamins, it is becoming staple food for millions of people across the world.

The productivity of wheat has increased multitudes from 663 kg/hectare in 1947 to 3501 kg/hectare in 2024 (FAOSTAT, 2024).The northern states of Uttar Pradesh, Punjab, and Haryana are the main wheat producers of India. About 112.92 million metric tons of wheat was produced in 2023-2024 across the country (FAOSTAT, 2024).

Wheat is commonly cultivated in the northern part of India as shown in the map including the states of Uttar Pradesh, Madhya Pradesh, Punjab, Haryana and Rajasthan etc [1-5]. In 1978, for the first time in the post-independence period, India emerged as a net exporter of wheat (Chand, 2001). India was one of the major exporters of wheat until May 2022, when the government decided to ban wheat export from the country. The decision was made due to damage to wheat crops by severe heat waves and the ongoing Russia and Ukraine conflict, which in turn led to inflation in wheat prices in the market [6,7].

The Objectives of the study includes

- To estimate the growth in production and export of Wheat.
- To workout the instability in production and export of Wheat.
- To study the trend in domestic and international prices of Wheat.
- To study the export competitiveness of Wheat.

2. MATERIALS AND METHODS

2.1 Period of Study

The data regarding the area, production and productivity of Wheat in India were collected. The data were collected for the last 50 years (1973 to 2022) and the data regarding export quantity and export value were collected for the past 36 years (1987-2022). The period has been divided into sub-periods.

Period I: 1973 to 1997
Period II: 1998-2022
Overall Period: 1973-2022

2.2 Nature and Source of Data

The data of the study was entirely based on a secondary source of data. The secondary data was collected from various Government websites and publications such as the Food and Agriculture Organization (FAO), Agricultural and Processed Food Products Export and Development Authority (APEDA), Agmarknet and Agristat were used for obtaining relevant data for the study.

2.3 Analytical Tools and Techniques

The study was examined by Shende N. V *et.al.* [8] and the estimation was carried out

accordingly. The data was collected from secondary sources subjected to appropriate analytical techniques in order to obtain a meaningful conclusion. The different analytical techniques used for the study were - growth rate analysis, instability analysis, trend analysis and export competitiveness.

2.4 Estimation of Growth Rates

To estimate the growth rate of area, production, productivity, export quantity and export value of wheat in India. The compound growth rate (CGR) was computed by using the exponential growth function as given below.

$$Y = a.bt$$

Where,

Y = Area /Production/ Productivity/Export quantity/Export value
a = Intercept value (value of Y when t = 0)
b = Regression co-efficient
t = Time variable (which takes value 1,2,3…. n).

Significance of the regression co-efficient was tested using the 't' test.

2.5 Instability Index analysis

Coefficient of variation (CV) often contains the trend component and thus overestimates the level of instability in time series data characterized by long term trends. The instability index given by Cuddy and Della (1978) which corrects the coefficient of variation was used in the present study to solve this problem. Instability index was estimated by using the following equation

$$\text{Instability index} = CV \times \sqrt{1-R^2}$$
$$CV = SD/\text{mean} \times 100$$

Where,

CV= Coefficient of variation (%),
R^2 = coefficient of determination
SD=Standard deviation

The degree of instability in area, production, productivity, export quantity and export value of wheat was measured by using co-efficient of variation (CV).

2.6 Trend Analysis

The present study analyzes trend in area, production, productivity, export quantity and export value of Wheat was computed for the time series data. To trace the path of process index number method was used.

2.7 Nominal Protection Co-Efficient

The export competitiveness of wheat in India was measured by nominal protection co-efficient (NPC) for the past 36 years. The nominal protection co-efficient (NPC) is defined as the ratio of the domestic price to the world reference price of the commodity under consideration. The NPC determines the competitiveness advantage enjoyed by wheat in the context of free trade. NPC was estimated by using the following formula.

$$\mathbf{NPC = P_d / P_r}$$

Where,

NPC = Nominal protection co-efficient
P_d = Domestic wholesale prices of wheat
P_r = World reference price of wheat

3. RESULTS AND DISCUSSION

3.1 Growth Rate Performance of Wheat

Based on the objectives of the study, the data collected were analyzed using appropriate analytical tools and techniques. The study examined the growth rates of area, production, productivity, export quantity and export value of wheat. The exponential functional form was used to compute the compound growth rate of area, production, productivity and export of wheat during 1973 to 2022. The total study period (1973-2022) was divided into three parts period I (1973-1997), period II (1998-2022) and overall period (1973-2022). The results obtained from this study have been presented and discussed critically.

Table 1 shows that the growth rate of area in period I was 1.16 per cent per annum and is non-significant at one per cent level, growth rate of production and productivity in period I were found to be 4.49 and 3.29 respectively and both were significant over 5 per cent level. The growth rate of production in period II and overall period was significant at 2.10 per cent per annum and 2.90 per cent per annum. The growth rate of productivity in period II was 1.36 per cent per annum and it was non-significant.

Table 1. Compound growth rate of area, production and productivity of wheat in India (1973-2022)

Indicators (CGR %)	Period		
	Period I	Period II	Overall Period
Area	1.16^{NS}	0.80 ^{NS}	0.91 ^{NS}
Production	4.49*	2.10**	2.90*
Productivity	3.29*	1.36*	1.96*

*Note: * - denotes significant at 5% level; ** - denotes significant at 1% level; NS-Non Significant*

The compound growth rate in terms of the area was 1.16 per cent, production was 4.49 per cent and productivity was 3.29 per cent respectively. The production and productivity of wheat have shown positive and significant growth trends for period II. In period I, the production, and productivity of wheat have shown a positive and significant growth trend but the area has shown positive and non-significant growth trends. The overall period of wheat showed a positive and significant growth trend for production and productivity.

The compound growth rate of wheat was observed highest of export quantity and export value was 80.87 per cent and 89.05 per cent respectively in period II. The compound growth rate of export quantity and export value of wheat was found to be positive and increasing in period I, period II and overall period. The results of the study on the compound growth rates during the study periods have shown positive and increasing value which indicates high potential for the export of wheat from India. Hence, the hypothesis reveals that there is significant stable growth in area, production and productivity of wheat in India.

3.2 Instability in Wheat

In order to study the instability in area, production, productivity, export quantity and export value of wheat exports during the study period, co-efficient of variation was worked out, the total period (1973 to 2022) was split into three periods *viz*; period I (1973-1997), period II (1998-2022) and over all period (1973-1997 to 1998-2022) and export quantity and export value was worked out, the total period (1987-2022) split into three periods viz, period I (1987-2005), period II (2006-2022) and overall period (1987-2022). The results are presented in Table 3.

Table 2. Compound Growth Rate of Export Quantity and Export Value of Wheat in India (1987-2022)

Indicators (CGR %)	Period		
	Period I	Period II	Overall Period
Export Quantity	31.20**	80.89**	12.06**
Export Value	41.59**	89.05**	20.30**

*Note: * - denotes significant at 5% level; ** - denotes significant at 1% level; NS-Non Significant*

Table 3. Instability analysis for area, production and productivity of wheat in india (1973-2022)

Period	Area		Production		Productivity	
	CV	Instability Index	CV	Instability Index	CV	Instability Index
Period I (1973-1997)	9.15	4.19	31.02	6.54	23.5	4.07
Period II (1998-2022)	6.68	2.21	16.87	5.58	11.19	4.74
Overall Period (1973-2022)	12.08	3.62	38.63	10.22	27.34	7.79

CV: Coefficient of variation

Table 3 reveals that wheat area exhibited instability of 4.19 per cent and 2.21 per cent in Period I and II, respectively, with the highest instability occurring in the overall period at 3.63 percent. The coefficient of variation for wheat area was 9.15 and 6.68 per cent for the Period I and II, respectively, with the highest variation of 12.08 per cent observed in the overall period.

Wheat production exhibited instability of 6.54 and 5.58 per cent during Period I and II, respectively, with the highest instability of 10.22 per cent in the overall period. The Coefficient of variation for wheat production was 31.02 and 16.87 per cent for Period I and II, respectively, with the highest variation of 38.63 per cent in the overall period.

Wheat productivity exhibited instability of 4.07 and 4.74 percent in Period I and II, respectively, with the highest instability of 7.79 per cent in the overall period. The Coefficient of variation for wheat productivity was 23.50 and 11.19 per cent for Period I and II, respectively, with the highest variation of 27.34 per cent in the overall period.

Wheat area, production and productivity exhibit higher variability and instability in the overall period. Period II shows lower variability and instability, indicating increased stability. Period I exhibits moderate variability and instability. The overall period has the highest instability, suggesting unpredictable production. Improved economic stability and more predictable weather patterns are observed in Period II.

Table 4 indicates significant fluctuations in wheat export quantities. The coefficient of variation reveals high variability of 132.26 per cent in Period I and 137.28 per cent in Period II, with a peak of 143.29 per cent in the overall period. Instability indices show high instability at 126.97 per cent in Period I and 138.18 per cent overall, while Period II exhibits moderate instability at 101.94 per cent. Market volatility, trade policies, economic fluctuations, weather patterns and production variability contribute to these fluctuations.

It was also reveals that substantial volatility in wheat export values. Coefficient of variation values are 136.18 per cent in Period I, 143.19 per cent in Period II and 190.03 per cent in overall period.

Instability indices demonstrate high instability at 124.81 percent in Period I and 170.39 per cent in overall period, contrasting with moderate instability of 101.41 per cent in Period II. These findings suggest export values fluctuate significantly across periods, with improved stability in Period II potentially being short-lived. Urgent risk management is necessary due to overall Period elevated instability.

3.3 Trend Analysis of Wheat: Index Number

The index numbers were estimated for area, production, productivity, export quantity and export value of wheat in India. The basic object for estimating index numbers was to make the trends of wheat. For this analysis, the data pertaining to the years 1973 to 2022 i.e. past 50 years were used. The index numbers were worked out for the area, production, productivity, export quantity and export value of wheat in India. It is seen from the data, the index numbers of the area, production, productivity, export quantity and export value of wheat in India have shown a gradual increase in almost all the periods. According to the table, the data compared the area (104.16) Was high in 1973 in period I and the lowest index number value was found in 1975 (90.98), the area (103.64) was high in 2000 in period II and the lowest index number value was found in 2019 (95.81). The production (105.07) was high in 1973 and it was found that it is lowest in the year 1974 (87.42) in period I and in period II it is found that it is high in2014 (104.68) and lowest in the year 2010(92.32). The value of productivity in period I is high in 1986 (102.91) and it is lowest in the year 1974 (89.67) and in period II the value is

Table 4. Instability analysis for export quantity and export value of wheat in India (1987-2022)

Period	Export Quantity		Export value	
	CV	Instability Index	CV	Instability Index
Period I (1987-2005)	132.26	126.97	136.18	124.81
Period II (2006-2022)	137.28	101.94	143.19	101.41
Overall Period (1987-2022)	143.29	138.18	190.03	170.39

Table 5. Index number for area, production and productivity of wheat in India (1973-2022)

Period I (1973 – 1997)	Area	Production	Productivity
Highest Index Number	104.16 (1973)	105.07 (1973)	102.91 (1986)
Lowest Index Number	90.98 (1975)	87.42 (1974)	89.67 (1974)
Period II (1998 – 2022)			
Highest Index Number	103.64 (2000)	104.68 (2014)	105.68 (2014)
Lowest Index Number	95.81 (2019)	92.32 (2010)	91.82 (2015)

Table 6. Index number for export quantity and export value of wheat in India (1987-2022)

Period I (1987– 2005)	Export Quantity	Export value
Highest Index Number	299.53 (1996)	299.41 (1996)
Lowest Index Number	0.0002 (1999)	0.0004 (1999)
Period II (2006 – 2022)		
Highest Index Number	291.51 (2006)	286.26 (2006)
Lowest Index Number	0.016 (2010)	0.01 (2009)

Table 7. Nominal protection co-efficient for export competitiveness

Period	Year	Domestic Prices (P_d) (Rs/Kg)	International Prices (P_r) (Rs/Kg)	NPC (Pd / Pr)
Period I	1987-2005	5.5	111.25	0.049
Period II	2006-2022	17.83	362.5	0.0510
Overall Period	1987-2022	11.66	236.87	0.0509

high in 2014 (105.68) and it is lowest in the year 2015 (91.82). The export quantity is found higher in the year 1996 (299.53) and it is found lowest in the year 1999 (0.0002) in period I and in period II it is highest in the year 2006 (291.51) and found lowest in 2010 (0.016). The export value in period I is found to be highest in the year 1996 (299.41) and found lowest in the year 1999 (0.0004) and in period II the value is highest in the year 2006 (286.26) and lowest in the year 2009 (0.01).

3.4 Export Competitiveness of Wheat

The export competitiveness of tea was analyzed using Nominal protection co-efficient.

Table. 7 shows that, at an overall period level, the NPC values of wheat was 0.050, it indicates that the commodity is not protected. NPC<1 indicates that the commodity is exportable and possesses export competitiveness. It was observed that, during the period I and period II average NPC values was 0.049 and 0.051, respectively which indicates same like as overall period. From the above Table period II (0.051) having high export competitiveness compared to the period I and over all period. Because NPC decreasing means there was an increase in International price in the world market compared to the domestic market. Hence, the hypothesis i.e. Indian wheat has better competitiveness in International market.

4. CONCLUSION

There exists a high positive correlation between the export quantity and value of export in the overall period and high variability in area, production, and productivity of wheat. Market volatility, trade policies, economic fluctuations, weather patterns and production variability contribute to these fluctuations.

It happened due to an increase in price per unit of export quantity of wheat. Though this may be good for a short duration from the economic point of view, in the long run it is likely to have an adverse effect on the wheat exports as other countries will be able to sell better quality wheat at a lesser price. Wheat showed a positive and significant growth trend for production and productivity. Indian wheat has better competitiveness in the International market.

5. POLICY IMPLICATIONS

Implement a Minimum Support Price (MSP) to safeguard farmers' interests. Invest in storage,

transportation, and market facilities to reduce losses and increase efficiency. Conduct price forecasting and transmission analysis to inform farmers' decisions. Enforce stringent quality standards to boost export competitiveness.

Promote certification programs for exporters to enhance credibility. Streamline procurement processes and develop efficient transportation networks Encourage crop diversification to reduce dependence on wheat.

Focus on domestic market needs while exploring export opportunities. Implement policies to address stagnation in area growth and promote sustainable wheat production.

By addressing these areas, policymakers can capitalize on India's successes in wheat export, production, and productivity, ensuring a resilient wheat sector [1]. Effective government policies and programs can facilitate changes in agricultural production, as seen in various countries [1].

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

I hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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