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# REGIONAL DISPARITIES IN WHEAT PRODUCTIVITY IN HIMACHAL PRADESH: 1990-91 TO 2020-21

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**Abstract:** *The present research examines the spatio-temporal trends in wheat productivity across different districts in Himachal Pradesh from 1990-91 to 2020-21. The research examines the spatial and temporal trends in wheat productivity across different districts, identifying factors influencing these trends. This study is based on secondary data taken from the Annual season and crop reports of the selected years. By using Singh's (1976) technique for crop productivity analysis, the research categorises districts into high, moderate, and low productivity zones for three key periods: 1990-91, 2005-06, and 2020-21. The results reveal significant regional disparities in wheat productivity. The districts such as Bilaspur, Chamba, Kangra, Solan, Una, and Mandi showed consistent growth due to advanced farming practices, enhanced soil management, and robust government support while in contrast, districts like Kinnaur, Shimla, Kullu, and Lahaul & Spiti experienced significant declines, primarily due to harsh climatic conditions, poor soil fertility, increase in fruit and vegetables and urbanisation pressures. The research highlights the imperative requirement for sustainable farming methods, improved irrigation infrastructure, and regular farmer cooperation to tackle these disparities and ensure sustained agricultural output. The study contributes significant perspectives to agricultural stakeholders and policymakers who seek to improve wheat yield and achieve balanced regional agricultural development in Himachal Pradesh.*

**Key words:** Crop Productivity, Regional Disparity, Trends, Wheat, Production

## Introduction

As the world's population continues to grow, the demand for food is escalating, necessitating an increase in agricultural productivity to meet these demands. Agricultural productivity measures the efficiency with which inputs are used in agriculture to produce an output. The combination of inputs produces a maximum output, the productivity is said to be at its maximum (Ram,2017). It is also a dynamic concept because crop productivity increases with modification of the natural environment and development in the socio-economic environment i.e., the extent of irrigation, farm mechanization, improved verities of seeds, consumption of chemical fertilizers, agricultural infrastructure, marketing facilities, road density, agricultural research and extension services, government policies, etc. (Singh, 1976). Enhancing agricultural productivity is essential for meeting the growing food demand while ensuring agricultural systems. The increase in agricultural productivity can further contribute to growth in rural and urban areas and accelerate the pro-poor development process in a region. (Thirtle et al, 2001). Jha and Tripathi (2011) examine how changes in rainfall and temperature affect wheat productivity in India due to climate change. According to the study, winter rainfall trends vary by location, and wheat yields are adversely affected by rising maximum temperatures, especially during the grain-filling stage. The authors use statistical models to show that temperature variations and yield decline, especially in Haryana and Bihar, are significantly correlated. The study also suggests the need for adaptive agricultural strategies, including heat-resistant wheat varieties and improved irrigation practices. Kaur et.al (2021) in their study found that Himachal Pradesh registered an overall negative change in maize productivity from 1990-91 to 2014-15 and found that regional disparities in maize productivity have minimized during the study period. They also suggest some solutions to solve maize-related problems in Himachal Pradesh. Yadav et al. (2010) highlight the challenges in wheat production in India due to depleting natural resources, climate change, and declining soil fertility.

They highlight the need for technological advancements such as conservation agriculture, hybrid wheat, and marker-assisted selection to enhance yield sustainability. They also discuss India's historical wheat productivity growth and the need for a paradigm shift in breeding strategies and suggest integrating modern genetics with traditional breeding to address emerging constraints and improve long-term wheat production efficiency. Joshi et al. (2007) talk about the state, difficulties, and potential of wheat improvement in India. They highlight the need for high-yield, stress-resistant cultivars by highlighting significant concerns such as heat stress, water scarcity, and newly developing diseases like wheat rust and emphasise how CIMMYT helps create better germplasm that is appropriate for India's varied agroclimatic conditions. Grover and Upadhya (2014), while employing the climate-composite technological index model, observed that higher maximum temperatures adversely affect paddy productivity in Ludhiana. Conversely, increases in minimum temperature, rainfall, and relative humidity were noted to have a positive impact, although statistically insignificant. Sommer et al. (2015) use crop modelling across 18 sites to evaluate how climate change affects wheat productivity in Central Asia. According to the study, rising temperatures promote wheat growth and biomass accumulation, however, in some areas, excessive heat during flowering might reduce grain production. While enhanced transpiration efficiency balances out increased water demand, moderate increases in precipitation have negligible consequences. To maintain wheat productivity in the face of shifting climatic circumstances, the authors stress the necessity of adaptive measures, such as heat-tolerant

cultivars and optimal sowing dates. In their study, Devi and Prasher (2018) analysed the annual growth rate of critical cereals, pulses, and vegetables in Himachal Pradesh. Their findings indicate that vegetable crops are showing a rising growth performance in the state compared to grains and pulses. A comparison of crop productivity goes to the heart of economic performance and can also guide planning and development decisions ( Ali and Ali, 2007, and Tripathi and Prasad). Wheat is the primary cereal crop grown across the entire state. It is followed by maize and paddy. It occupies an area of 330 thousand hectares in the state, producing 500 thousand tonnes with an average yield of 1510 kg/ha (Anonymous, 2004). Wheat is grown across the entire state, benefiting from diverse agroclimatic conditions that range from sub-mountain and sub-humid low-hill environments to wet temperate high-hill conditions.

## Objectives

The Study has the following objectives:

1. To know the spatio-temporal patterns of Wheat productivity from 1990-91 to 2020-21
2. To find out the changes in Wheat Productivity during the Study Period
3. To identify the factors affecting changes in regional disparities in Wheat Productivity

## Research Area

Himachal Pradesh, often known as the “Land of Gods,” is a picturesque state in northern India known for its rich cultural heritage, stunning landscape, and vibrant biodiversity. The state, which is in the Western Himalayas, is around 55,673 square kilometers. Its borders are with Tibet (China) to the east, Haryana to the southwest, Uttarakhand to the southeast, Jammu and Kashmir to the north, and Punjab to the west. According to the 2011 census, its total population is 68,56,509 persons.

## Methodology

The study is based on secondary data, and the unit of the study is the district. Three time periods are selected, i.e. 1990-91, 2005-06 and 2020-21. For each time period, three-year averages are taken, like 1989-90, 1990-91, and 1991-92 for 1990-91 and so on. The data on wheat production, average yield, and area under crop are taken from the Annual season and crop reports of 1989-90 to 1991-92, 2004-05 to 2006-07, and 2019-20 to 2021-22. During the study period, no change in the district boundary has taken place because the number of districts remained twelve. Singh's (1976) technique is used to calculate wheat productivity. The Choropleth method is applied for mapping the wheat productivity of Himachal Pradesh. Singh's (1976) technique for crop productivity is as follows:

$$Cp_i = \frac{Ci + Yi}{2}$$

$Cp_i$ = Stands for Crop Productivity Index
$C_i$ = Stands for Concentration Index
$Y_i$ = Stands for Yield Index
The crop concentration index of wheat is calculated by using the following formula:

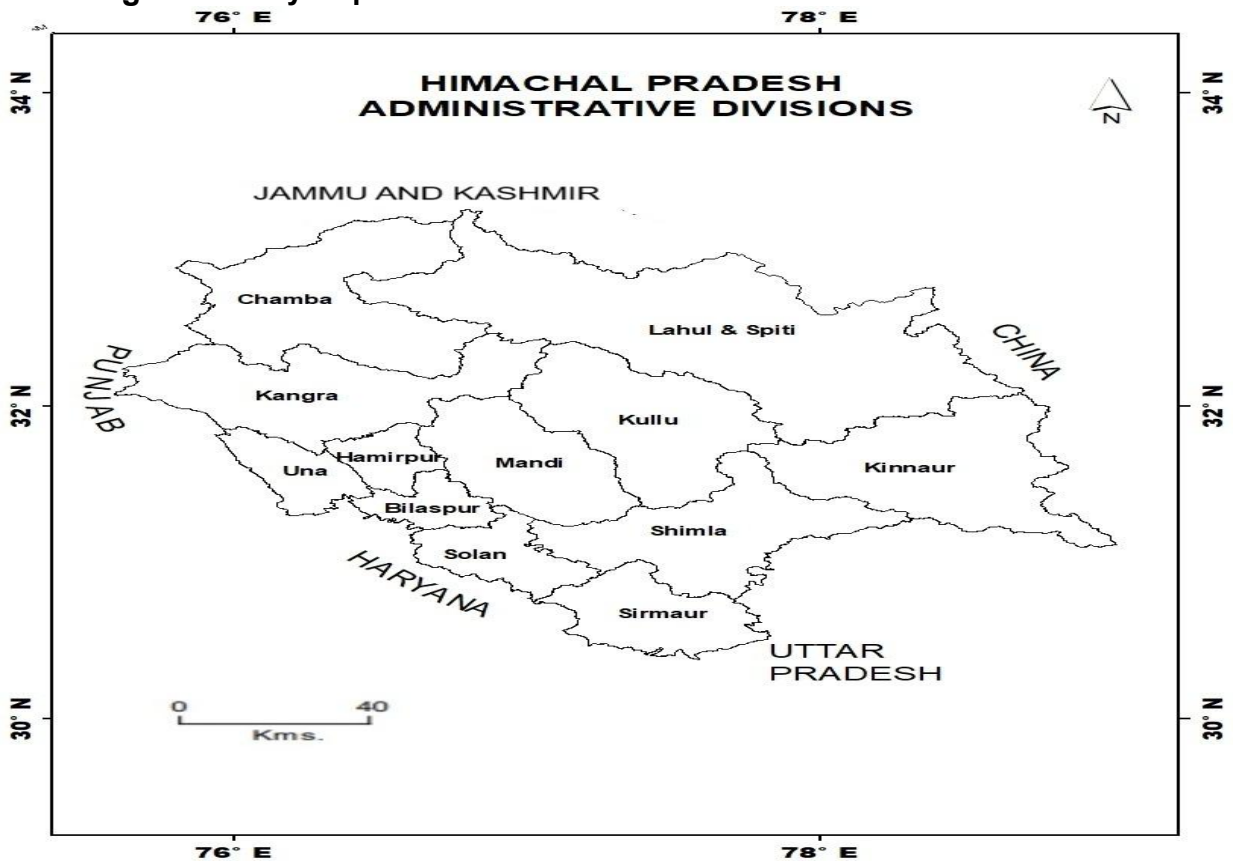
$$C_i = \frac{Cpe}{Cpr} \times 100$$

Ci = Concentration index.
$Cp_e$ = Percent area of crop in an enumeration unit.
$Cp_r$ = Percent area of crop in the entire region.
The formula for calculating the wheat yield index is as follows:

$$Y_i = \frac{Yae}{Yar} \times 100$$

Y = Wheat yield index.
$Ya_e$ = yield in an enumeration unit.
$Ya_r$ = yield of crop under the entire region

**Figure 01: Key Map**




Source: Census of India, 2011

## Discussion

The Spatial-temporal changes in wheat crop productivity in Himachal Pradesh are discussed in the following research:

### A. Levels of wheat Productivity: 1990-91

In Himachal Pradesh, the index value of wheat productivity in 1990-91 ranged from the highest of 170.41 in Hamirpur to the lowest of 61.19 in Kinnaur, which reflects high spatial variations in the level of wheat productivity. To know the factors responsible for spatial variations in levels of wheat productivity, the state is divided into the following three categories:

#### I. Areas of High Magnitude of Wheat Productivity (>160)

This category of high-magnitude wheat productivity includes four districts and covers the northwestern and central parts of the study area. The productivity of wheat ranges from the highest of 170.41 in Hamirpur to 166.80 in Una, 166.39 in Bilaspur and 165.23 in Kangra district. This category touched its western boundary with the fertile plain of Punjab. These districts have become significant areas for wheat cultivation due to favourable geographical and socio-

economic conditions. This category generally experiences modest temperatures, which are ideal for wheat cultivation and the absence of extreme weather conditions helps maintain consistent crop yields. Also, these districts have effective water management and advanced agricultural practices. The combination of these factors encourages farmers to choose wheat cultivation, and the fertile soils in these regions further contribute to increased yields per unit area.

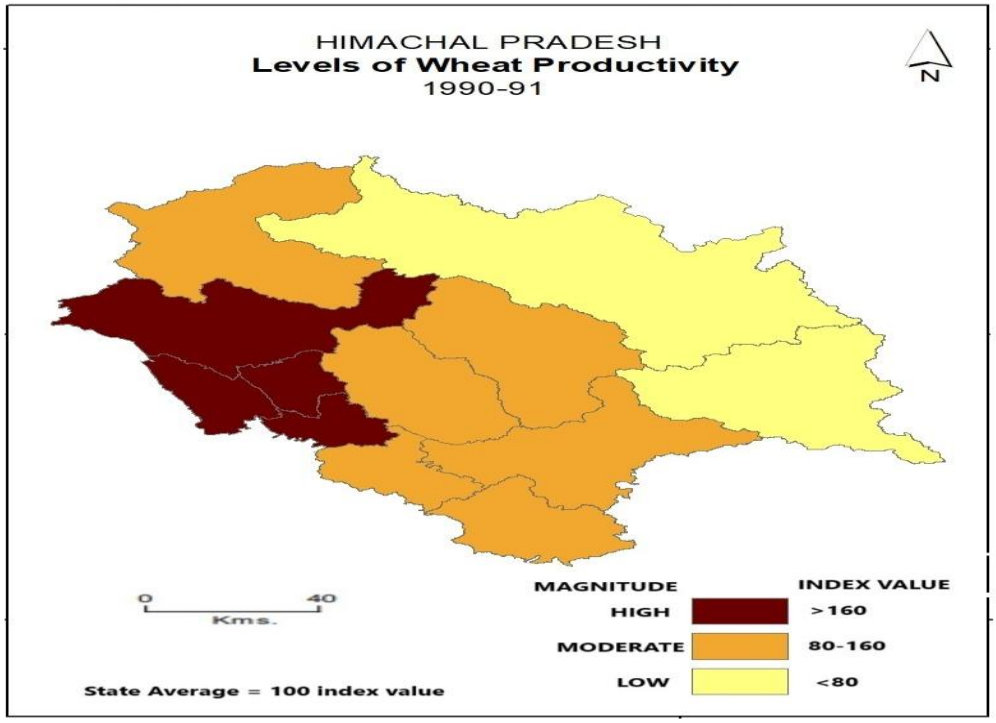
### II. Areas of Moderate Magnitude of Wheat Productivity (80-160)

This Area of Moderate Wheat Productivity covers six districts and the central and southern parts of the study area. The Index value of Wheat Productivity varies from the highest of 153.06 per cent in Kullu to 120.31 in the Chamba district. Volcanic rocks typically characterize these areas, shallow soils with black and brown colours, and alluvium, as well as steep hills and mountains varying from high steepness to low steepness, thick pastures, and slopes of hills and mountains. These districts face more variable weather, such as unseasonal rains and drought, which negatively impact wheat production. Mixed results in farming practices, moderately fertile soil conditions, soil erosion, limited irrigation facilities, and less accessible agricultural land result in moderate wheat productivity.

### III. Areas of Low Magnitude of Wheat Productivity (< 80)

This category consists of two districts named Lahaul & Spiti and Kinnaur, which mainly cover the northeastern and eastern parts of Himachal Pradesh and are covered with high-peak mountains and Glaciers. The index value of Wheat Productivity varies between 72.90 in Lahaul & Spiti and 61.19 in Kinnaur. The concentration of wheat crops is also low in both districts because of the extremely challenging growing climate conditions, high altitude, poor soil fertility and lack of advanced agricultural practices.

**Figure 02: Levels of Wheat Productivity**



## B. Levels of Wheat Productivity: 2005-06

The wheat productivity index across different districts of Himachal Pradesh in the 2005-06 period shows significant variations, ranging from a high of 178.05 in Hamirpur to a low of 58.63 in Lahaul and Spiti. To identify the factors which lead to spatial variations in levels of wheat productivity, categorised into the following three categories:

### I. Areas of High Levels of Wheat Productivity (> 160)

This high category of wheat productivity covers four districts of Himachal Pradesh, and here, the wheat productivity index value ranges from 178.05 in Hamirpur, 175.55 in Bilaspur, 168.08 in Una, and 162.10 in Kangra. These districts lie between the foothills of the Shiwalik, are suitable for agricultural activities and have the largest cropped area. These districts have comparatively developed infrastructure as compared to the other districts of the state, followed by favourable physical elements. Moreover, Well-distributed and adequate rainfall also helps increase wheat production in this category.

### II. Areas of Moderate Levels of Wheat Productivity (80-160)

This category holds six districts, namely Solan, Mandi, Kullu, Sirmaur, Chamba and Shimla. In this category, the wheat productivity index ranges from the highest of 156.86 in Solan to the lowest of 90.86 in the Shimla district. Diverse climatic conditions, hilly terrain and slopes like in Chamba and Sirmaur lead to soil erosion, which affects soil fertility and minimises wheat production. Shimla district has low wheat productivity due to most areas being under horticulture crops.

### III. Areas of Low Magnitude of Wheat Productivity (<80)

It comprises two districts of Himachal Pradesh named Kinnaur (68.15), and Lahaul and Spiti (58.63). Kinnaur, Lahaul and Spiti districts experience harsh climatic conditions, including severe cold, high altitude, and short growing seasons, which are not conducive to wheat cultivation. Thus, farmers are by it and reduce the area under wheat cultivation which is unfavored geo-climatic conditions. All these factors led to low levels of wheat productivity in this category.

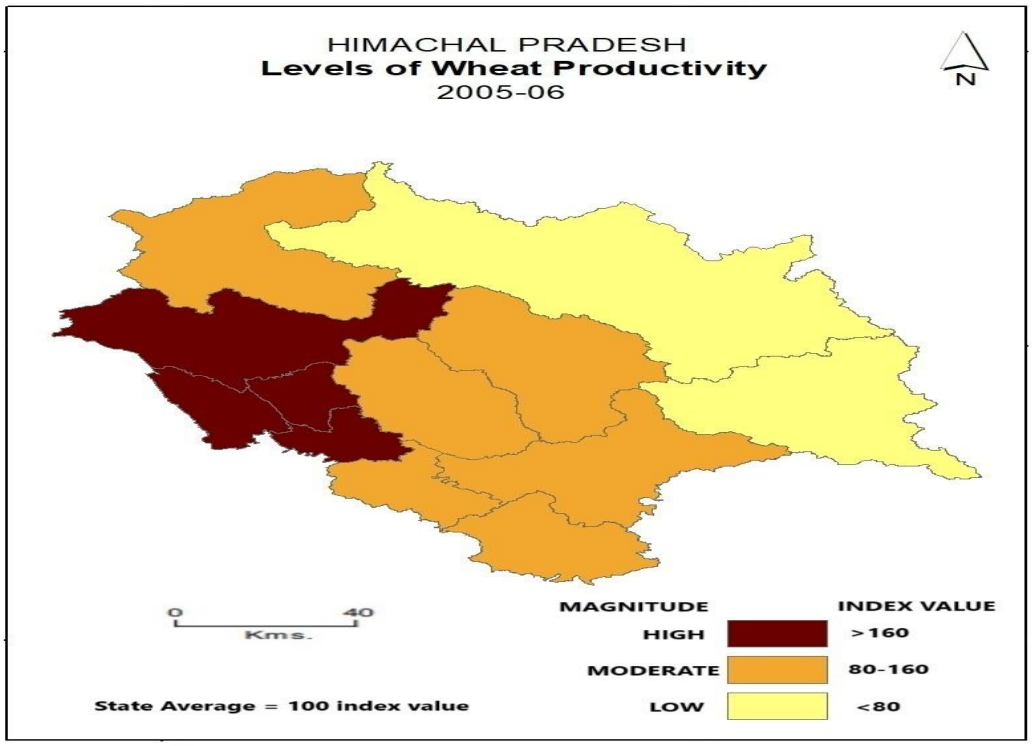
## C. Levels of Wheat Productivity: 2020-21

In 2020-21, the index value of wheat productivity has been calculated which ranges from the highest of 188.25 in Una District to the lowest of 35.04 in Kinnaur District. To identify the factors that contribute to variations in wheat production levels, fig.4 is grouped into three categories:

### I. Areas of High Magnitude of Wheat Productivity (> 160)

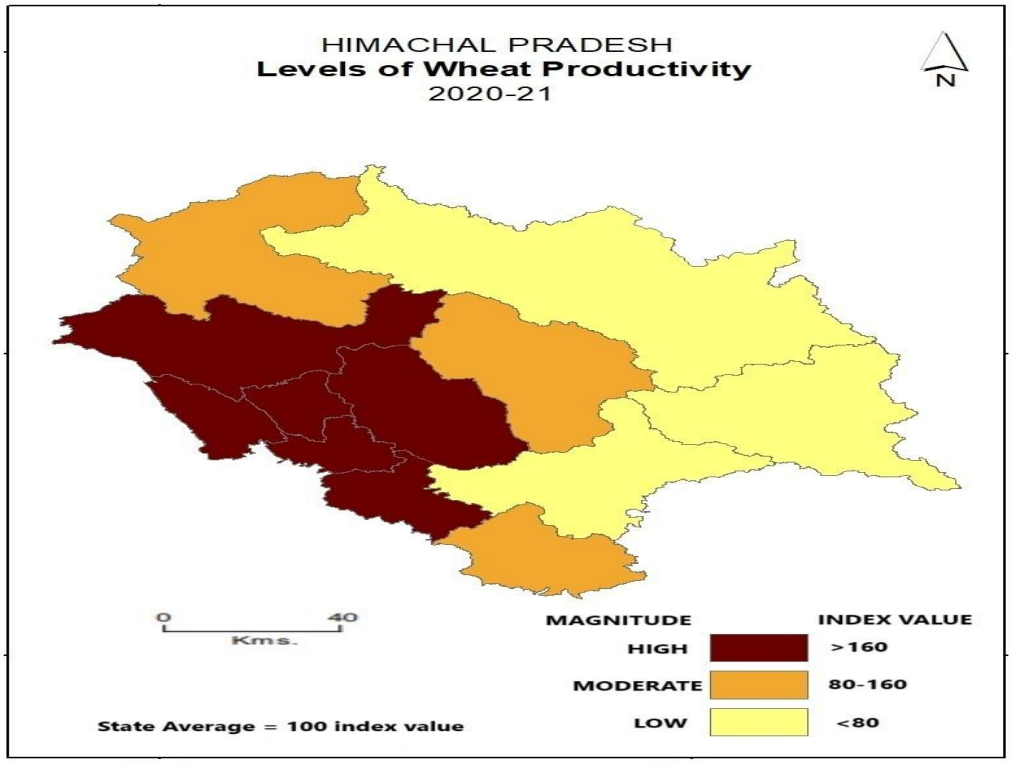
This category of high-magnitude wheat productivity includes six districts named Una, Bilaspur, Solan, Kangra, Hamirpur and Mandi. The index value of wheat productivity varies from the highest of 188.25 in Una to the lowest of 160.22 in Mandi. This category covers the Western part of the study area, which shares its boundary with the fertile plains of Punjab and has one-third of the state population. These districts have favourable geo-climatic conditions followed by a high rate of innovative agricultural technology and mechanization, which has resulted in high wheat production and leads to a high magnitude of wheat productivity in this category.

**Figure 03: Levels of Wheat Productivity, 2005-06**




Source: Annual season and crop report of Himachal Pradesh – 2004-05 to 2006-07

**Figure 04: Levels of Wheat Productivity, 2020-21**




Source: Annual season and crop report of Himachal Pradesh – 2019-20 to 2021-22

### ii. Areas of Moderate Magnitude of Wheat Productivity (80-160)

Here, the index value of wheat productivity lies between 110.20 in the Kullu district to 147.98 in the Sirmaur district. These are well-known wheat productivity areas. Here, the magnitude of wheat productivity is owing to a considerable area under fruits, vegetables, etc. Secondly, followed by climatic conditions are moderately conserved due to rainfall in the upper reaches, which affects its yield per fertile and consequently results in a moderate level of wheat productivity in these districts.

### iii. Areas of Low Magnitude of Wheat Productivity (<80)

The low-magnitude category of wheat productivity consists of three districts, namely Shimla, Lahaul and Spiti, and Kinnaur. These districts cover the eastern and northeastern parts of the study area. Here, the index value of wheat productivity lies between 35.04 per cent in Kinnaur to 70.84 in the Shimla district. These districts have unfavourable climates, which make the cultivation of wheat difficult. The deciding factor for low wheat productivity is the shifting of the area from wheat to fruits and vegetables because these fetches assured higher economic returns as compared to wheat crops.

**Table 01: Levels of Wheat Crop Poductivity: 1990-91 to 2020-21**

| # | Districts | Index value of wheat Productivity 1990-91 | Index value of wheat Productivity 2005-06 | Index value of wheat Productivity 2020-21 |
|---|---|---|---|---|
| 1 | Bilaspur | 166.39 | 175.55 | 181.10 |
| 2 | Chamba | 120.31 | 125.81 | 132.89 |
| 3 | Hamirpur | 170.41 | 178.05 | 164.07 |
| 4 | Kangra | 165.23 | 162.10 | 169.35 |
| 5 | Kinnaur | 61.19 | 68.15 | 35.04 |
| 6 | Kullu | 153.06 | 149.98 | 110.20 |
| 7 | Lahual and spiti | 72.90 | 58.63 | 54.61 |
| 8 | Mandi | 148.30 | 155.57 | 160.22 |
| 9 | Shimla | 121.90 | 90.86 | 70.84 |
| 10 | Sirmaur | 148.25 | 135.98 | 147.98 |
| 11 | Solan | 140.80 | 156.86 | 169.74 |
| 12 | Una | 166.80 | 168.08 | 188.25 |
| | **Himachal Pradsesh** | 150 | 150.04 | 150.05 |

Source: Annual season and crop report of Himachal Pradesh – 1990-91,2005-06 and 2020-21

## iv. Changes in Level of Wheat Productivity

The changes in wheat productivity in Himachal Pradesh from 1990-91 to 2020-21 reflect a compound relationship of climatic, agricultural, socioeconomic, and technological factors. The index value of overall wheat productivity remains almost the same or shows very little positive change. A study of Table 2 has shown the following points.

### i. Changes in Level of Wheat Productivity from 1990-91 to 2005-06

From 1990-91 to 2005-06, the index value of wheat productivity in Himachal Pradesh showed varied patterns across different districts.

a. High index value of wheat productivity in 1990-91 had four districts which remained the same in 2005-06. This was largely confined to western parts of the Himachal Pradesh. These districts had witnessed an increase in index value due to adopting high-yield wheat varieties,

soil conservation practices, and improved agricultural techniques. The districts that had high productivity in 1990-91 were Hamirpur, Bilaspur, Una, and Kangra, shown positive changes of 9.16 per cent, 7.64 per cent and 5.50 per cent. The wheat productivity index shows an increase in the Hamirpur, Bilaspur and Una districts, while the Kangra district shows a decline in the index value of -3.13 per cent but took place in the high productivity category.

b. The moderate index value of wheat productivity had six districts in 1990-91: Kullu, Chamba, Mandi, Solan, Sirmaur, and Shimla, and it remained the same in 2005-06. The Shimla district shows a sharp decline in an index value of -31.03 per cent because most of the area is under fruits and vegetables. The remaining districts show a positive change in their index value but continue to be in the moderate category.
c. The number of districts in the low category was two in 1990-91, which also remained the same in 2005-06. This category covers the eastern and northeastern parts of the study region. Kinnaur district shows a positive change of 6.96, but Lahaul & Spiti shows negative growth with -14.27 per cent. Due to harsh climatic conditions and undulating terrain, wheat productivity is very low.

### ii. Changes in Level of Wheat Productivity from 2005-06 to 2020-21

From 2005-06 to 2020-21, wheat productivity in Himachal Pradesh displayed various increased levels across different districts.

a. The category of high productivity had four districts in 2005-06, which increased to six in 2020-21. The districts Solan and Mandi joined the high category with a positive increase of 12.88 per cent and 4.65 per cent, indicating the advantages of continued adoption of advanced farming methods and government support.
b. The moderate category had six districts in 2005-06, which decreased to three in 2020-21. The Solan and Mandi districts joined the high productivity category, but Shimla left the moderate category due to a decline of -20.02 per cent in index value. The Kullu also shows a decline of -41.78 per cent in index value. This decline in index value is due to adverse climatic conditions, which are partially suitable for wheat cultivation and fewer irrigation facilities.
c. In 2005-06, the low productivity category had two districts, which increased to three in 2020-21. The districts in the low category in 2005-06 were Kinnaur and Lahaul & Spiti. The district that moved from the moderate to the low category was Shimla, where more area is confined to fruits and vegetables.

### iii. Overall Changes in Level of Wheat Productivity from 1990-91 to 2020-21

From 1990-91 to 2020-21, wheat productivity in Himachal Pradesh showed increasing and decreasing trends across districts, influenced by various factors such as climatic conditions, soil health, agricultural practices, and government policies.

a. In 1990-91, the category of high productivity had four districts, which increased to six in 2020-21. In 1990-91, the districts in the high category were Hamirpur, Bilaspur, Kangra, and Una. In 2020-21, the districts in the high category are Hamirpur, Bilaspur, Kangra, Una, Solan and Mandi. The Solan district joined the high category with an overall increase of 28.95 per cent,

and Mandi with 11.93 per cent. Further districts also show increasing trends, but the Hamirpur district shows a decline of -6.34 per cent in index value.

b. The moderate districts had six districts in 1990-91, which decreased to three in 2020-21. The districts of Solan, Mandi and Shimla left this category. Solan and Mandi joined the high-productivity category, and Shimla joined the low-productivity category with an overall decline of -51.05 districts. The Chamba district shows an overall increase of 12.58, and districts Sirmaur and Kullu show a decrease of -0.27 per cent and -42.86 per cent in the index value of wheat productivity.

c. The low category of wheat productivity had two districts in 1990-91, which increased to three in 2020-21. The Shimla district left the moderate category and joined the low category with a decline of -51.05 per cent in the index value. The Kinnaur and Lahaul & Spiti also show a decline of -26.14 per cent and -42.86 per cent in the index value of wheat productivity. The main reasons for the decline in the wheat productivity index are severe soil erosion, poor irrigation efficiency, and reduced agricultural land availability.

**Table 02: Changes in the Level of Wheat Productivity: 1990-91 to 2020-21**

| # | Districts | Change 1990-91 to 2005-06 | Change 2005-06 to 2020-21 | Change 1990-91 to 2020-21 |
|---|---|---|---|---|
| 1 | Bilaspur | 9.16 | 5.54 | 14.70 |
| 2 | Chamba | 5.50 | 7.08 | 12.58 |
| 3 | Hamirpur | 7.64 | -13.98 | -6.34 |
| 4 | Kangra | -3.13 | 7.25 | 4.12 |
| 5 | Kinnaur | 6.96 | -33.10 | -26.14 |
| 6 | Kullu | -1.07 | -41.78 | -42.86 |
| 7 | Lahaul and Spiti | -14.27 | -4.02 | -18.29 |
| 8 | Mandi | 7.28 | 4.65 | 11.93 |
| 9 | Shimla | -31.03 | -20.02 | -51.05 |
| 10 | Sirmaur | -12.27 | 11.99 | -0.27 |
| 11 | Solan | 16.06 | 12.88 | 28.95 |
| 12 | Una | 1.29 | 20.17 | 21.46 |

Source: Annual season and crop report of Himachal Pradesh – 1990-91,2005-06 and 2020-21

## Conclusion

The study has deduced significant changes in wheat productivity that have taken place during the study period. In 1990-91, the district of Hamirpur had the highest productivity index of 170.4, while the district of Kinnaur had the lowest productivity index of 61.19. In 2005-06, the index value of wheat productivity also varied from the lowest of 58.63 in the Kinnaur District to the highest of 178.05 in the Solan District. Whereas, in 2020-21, the index value of Wheat productivity also varied from 181.09 in Bilaspur to 35.04 in the Kinnaur district. From 1990-91 to 2020-21, five districts, namely Bilaspur, Chamba, Solan, Una, and Mandi, have achieved consistent increases in wheat productivity due to improvements in farming practices, irrigation facilities, and the adoption of advanced technology. On the other hand, districts such as Kinnaur, Shimla, Kullu, and Lahaul & Spiti have experienced a significant decline in wheat productivity because of soil erosion, climate change impacts, and inadequate resource management because most of the area has shifted to fruits and vegetables but Hamirpur, Kangra, and Sirmaur districts have recorded moderate decrease in wheat productivity owing to already having moderate to high wheat productivity in 1990-91. Thus, due to socio-economic, road accessibility and technological

advancement, farmers have shifted some areas to vegetable and fruit crops, ultimately resulting in low to moderate wheat productivity. Overall, from 1990-91 to 2020-21, the district of Solan recorded the highest growth of 28.95 index value, while Shimla had the highest decline rate of -51.05 in index value of wheat productivity. Overall, the wheat productivity index in Himachal Pradesh has gone through a fluctuating trend during the study period. These varied trends generally highlight the need to implement sustainable agricultural methods, enhance soil quality, and provide farmers with continuous economic and marketing support to ensure an increase in wheat production and food security in Himachal Pradesh over the long run. The study has found that regional disparities in wheat productivity in Himachal Pradesh have widened, which is not a healthy sign for wheat production.

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