# ANALYSIS OF THE GROWTH TRENDS IN AREA, PRODUCTION AND YIELD OF AGRICULTURAL PRODUCTION - FOOD GRAINS IN POST LIBERALIZATION PERIOD IN INDIA

**Abstract**

The trend in the area under cultivation, agricultural production of food grains, and yield per hectare are all measures of its economic impact. This study's goal is to examine the acreage, productivity, and yield of food grain farming in India from 1991–1992 through 2020–2021 after liberalization. To accomplish the goals, secondary data was acquired from the Ministry of Agriculture and Farmers Welfare, the Reserve Bank of India, the Indian government, the Indian Coffee Board, and the Indian Tea Board.The average annual growth rate (AAGR), compound annual growth rate (CAGR), and linear trend line were used to evaluate the growth rate of the area, production, and yield of food grains. The study found that food grain production in lakh tonnes was 1906.81, 2152.91, and 2736.58; food grain yield in kilogrammes per hectare was 1550, 1761.6, and 2181.3; and the average decade rates of area under cultivation of food grains were correspondingly 1229.5, 1220.5, and 1254.5. The area expansion and yield were the primary factors that increased food grain output. Because of this, the emphasis should be on enlarging the area by using enough land and promoting technical advancement and research in India's agricultural sector.

**Keywords**: Area, Food Grains, Agricultural Production, Yield.

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## I. INTRODUCTION

Agriculture is the cornerstone of India's economy. Even though the Indian economy is expanding, the majority of the population still relies mostly on agriculture for their income, hence India still has an agrarian economy. Agriculture provides a variety of raw materials to industry and makes a substantial contribution to global trade. Food security, poverty alleviation, income, and general well-being are all aided by the expansion of food grains... According to Dr. Dhanesh N. Ligade and Santosh P. Mane (2020), the potential pathway of cash crop production may have an impact on food crop productivity. Cash cropping partnerships between smallholders and private firms have been found to have a positive impact on food crop productivity. Similarly, all food grain production levels have increased during the course of the scheduled period, according to Dr. Ummed Singh and Bheem Singh Shekhawat (2020). That is, from 1950–1951 to 2019–2020, there has been a change in the productivity of rice, wheat, coarse cereals, and pulses. Food security in India is seriously threatened by population expansion. The productivity of food grains is the lowest among industrialized and developing nations. The expansion of irrigation systems must be a primary priority in agricultural policy due to the expectation of consistent and significant improvements in agricultural output. The purpose of this study is to determine the degree to which agricultural production of food grains, cultivated land, and yield per hectare have changed since liberalization.

## II. OBJECTIVE

To investigate the trends in India's agricultural productivity, including yield per hectare, area under cultivation, and food-producing crops.

## III. METHODOLOGY

The goal of determining the area, production, and yield of food grains in India was attained using secondary data. The area, production, and yield of India's agricultural production-food grains were calculated using data from the Reserve Bank of India's Handbook of Statistics of the Indian Economy, the Ministry of Agriculture and Farmers Welfare, the government of India, the country's coffee board, and its tea board. The statistics covers India's post-liberalization period, which ran from 1991–1992 to 2020–21. The increase in agricultural production was examined using simple growth rates, compound growth rates, linear trend lines, $R^2$, and decade average rates for food grains (rice, wheat, coarse cereals, and pulses).

## IV. REVIEW OF LITERATURE

Food grain development, instability, and decomposition in India the negative growth rate in coarse grains, which causes volatility in product production, is highlighted by analysis by Ruchi Malik (2017). A 4% annual decline in coarse cereal production is seen. Wheat and pulse production has been rising steadily. Food grain output is rising, but the area that is being farmed is only slowly expanding. Therefore, it is imperative to focus on alternative production techniques in order to increase the output of food grains. The sustainability of crop productivity, which is a fast-growing concern, is examined in Agriculture Productivity Trends in India: Sustainability Issue by Praduman kumar and Surabhi Mittal (2006). The

 

post-green revolution period's high input utilization has resulted in a decline in the total factor productivity of the agriculture sector. The 1980 level of agricultural productivity cannot be maintained in the 1990s. Important policy ramifications include increased agricultural crop supply, natural food supply, and family nutritional security. To promote an increase in total factor production, more funding is needed for agricultural research and development. DharmNarain (1977) focuses on the growth productivity in Indian agriculture by decomposing the absolute change in per hectare productivity rate at constant price of the base period and terms of growth rate of the index rate of productivity. 70% of the increase in production in the first period was attributable to changes in cropping patterns and localization shifts of the area under cultivation of various crops.

## V. RESULTS AND DISCUSSION

The area under cultivation is the portion of all seeded land that is actively being farmed. Table 1 displays the area in India used for agricultural production, including food grains such rice, wheat, coarse cereals, and pulses, from 1991–1992 to 2020–2021.

**Table 1: Area under cultivation - Food Grains (1991-92 to 2020-21)**
**(Lakh hectares)**

| Year | Cereals | | | | Pulses | Total Food Grains |
|---|---|---|---|---|---|---|
| | Rice | Wheat | Coarse Cereals | Total Cereals | | |
| 1991 – 92 | 427 | 233 | 334 | 993 | 225 | 1219 |
| 1992 – 93 | 418 | 246 | 344 | 1008 | 224 | 1232 |
| 1993 – 94 | 425 | 252 | 328 | 1005 | 223 | 1228 |
| 1994 – 95 | 428 | 257 | 322 | 1007 | 230 | 1237 |
| 1995 – 96 | 428 | 250 | 309 | 987 | 223 | 1210 |
| 1996 – 97 | 434 | 259 | 318 | 1011 | 225 | 1236 |
| 1997 – 98 | 435 | 267 | 308 | 1010 | 229 | 1239 |
| 1998 – 99 | 448 | 275 | 293 | 1017 | 235 | 1252 |
| 1999 – 00 | 452 | 275 | 293 | 1020 | 211 | 1231 |
| 2000 – 01 | 447 | 257 | 303 | 1007 | 204 | 1211 |
| 2001 – 02 | 449 | 263 | 295 | 1008 | 220 | 1228 |
| 2002 – 03 | 412 | 252 | 270 | 934 | 205 | 1139 |
| 2003 – 04 | 426 | 266 | 308 | 1000 | 235 | 1235 |
| 2004 – 05 | 419 | 264 | 290 | 973 | 228 | 1201 |
| 2005 – 06 | 437 | 265 | 291 | 992 | 224 | 1216 |
| 2006 – 07 | 438 | 280 | 387 | 1005 | 232 | 1237 |
| 2007 – 08 | 439 | 280 | 285 | 1004 | 236 | 1241 |
| 2008 – 09 | 455 | 278 | 275 | 1007 | 221 | 1228 |
| 2009 – 10 | 419 | 285 | 277 | 981 | 233 | 1213 |
| 2010 – 11 | 429 | 291 | 283 | 1003 | 264 | 1267 |
| 2011 – 12 | 440 | 299 | 264 | 1003 | 245 | 1248 |
| 2012 – 13 | 428 | 300 | 248 | 975 | 233 | 1207 |
| 2013 – 14 | 440 | 312 | 257 | 1008 | 252 | 1260 |
| 2014 – 15 | 439 | 310 | 242 | 990 | 231 | 1220 |

 

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|---|---|---|---|---|---|---|
| 2015 – 16 | 435 | 304 | 244 | 983 | 249 | 1232 |
| 2016 – 17 | 440 | 308 | 250 | 998 | 294 | 1292 |
| 2017 – 18 | 438 | 297 | 243 | 978 | 298 | 1275 |
| 2018 – 19 | 442 | 293 | 221 | 956 | 292 | 1248 |
| 2019 – 20 | 437 | 314 | 240 | 990 | 280 | 1270 |
| 2020 – 21 | 451 | 316 | 238 | 1005 | 288 | 1293 |

**Note:** Data for 2020-21 are based on fourth advance estimates.

**Source:** Reserve bank of India – Handbook of statistics of the Indian economy 2020-21.

Ministry of agricultural and farmers welfare, government of India,Coffee board of India and the tea board of India.

According to Table 1, over the 30 years from 1991–1992 to 2020–2021, the area under rice cultivation expanded from 427 to 451, wheat from 233 to 316, coarse cereals from 334 to 238 and pulses from 225 to 288, while total cereals increased from 993 to 1005 and total food grains increased from 1219 to 1293. According to data, over a thirty-year period, the area under cultivation for rice increased by 24 lakh hectares, that for wheat by 83 lakh hectares, that for pulses by 63 lakh hectares, that for coarse cereals by 93 lakh hectares, and that for other food grains by 74 lakh hectares.

**Table 2:Trends in the Area of Agriculture Production – Food Grains**

| **Items** | **Linear trend line** | **Coefficient of $R^2$** |
|---|---|---|
| Rice | Y = 429.84 + 0.3187X | 0.0658 |
| Wheat | Y = 240.73 + 2.4158X | 0.8427 |
| Coarse Cereals | Y = 339.16 + 3.4798X | 0.6409 |
| Total cereals | Y = 1007.1 – 0.8133X | 0.1363 |
| Pulses | Y = 205.81 + 2.1438X | 0.5293 |
| Total Food grains | Y = 1213.2 + 1.3089X | 0.1571 |

**Source:** Authors calculation

Table 2 illustrates the $R^2$ coefficient determination as well as the trends in the field of agricultural output – food grains. Rice, wheat, coarse cereals, total cereals, pulses, and total food grains each had constants of 429.84, 240.73, 339.16, 1007.1, 205.81, and 1213.2, and coefficients of 0.3187, 2.4158, 3.4798, -0.8133, 2.1438, and 1.3089, respectively. The coefficient determination reveals how much of the variance in the dependent variable can be explained by the independent variables, which are 0.0658, 0.8427, 0.6409, 0.1363, 0.5293, and 0.1571.

 

**Table 3: Simple Growth Rates of Area under cultivation - Food Grains (1991-92 to 2019-20)**
**(Lakh hectares)**

| Year | Cereals | | | Total Cereals | Pulses | Total Food Grains |
|---|---|---|---|---|---|---|
| | Rice | Wheat | Coarse Cereals | | | |
| 1991 – 92 | - | - | - | - | - | - |
| 1992 – 93 | -2.11 | 5.58 | 2.99 | 6.59 | -0.44 | 1.07 |
| 1993 – 94 | 1.67 | 2.44 | -4.65 | 2.58 | -0.45 | -0.32 |
| 1994 – 95 | 0.71 | 1.98 | -1.83 | 3.80 | 3.14 | 0.73 |
| 1995 – 96 | 0.00 | -2.72 | -4.04 | -5.27 | -3.04 | -2.18 |
| 1996 – 97 | 1.40 | 3.60 | 2.91 | 10.16 | 0.90 | 2.15 |
| 1997 – 98 | 0.23 | 3.09 | -3.14 | -3.19 | 1.78 | 0.24 |
| 1998 – 99 | 2.99 | 3.00 | -4.87 | 5.25 | 2.62 | 1.05 |
| 1999 – 00 | 0.89 | 0.00 | 0.00 | 4.08 | -10.21 | -1.68 |
| 2000 – 01 | -1.11 | -6.55 | 3.41 | -5.42 | -3.32 | -1.62 |
| 2001 – 02 | 0.45 | 2.33 | -2.64 | 7.40 | 7.84 | 1.40 |
| 2002 – 03 | -8.24 | -4.18 | -8.47 | -17.96 | -6.82 | -7.25 |
| 2003 – 04 | 3.40 | 5.56 | 14.07 | 21.16 | 14.63 | 8.43 |
| 2004 – 05 | -1.64 | -0.75 | -5.84 | -6.58 | -2.98 | -2.75 |
| 2005 – 06 | 4.30 | 0.38 | 0.34 | 5.39 | -1.75 | 1.25 |
| 2006 – 07 | 0.23 | 5.66 | 32.99 | 4.03 | 3.57 | 1.73 |
| 2007 – 08 | 0.23 | 0.00 | -26.36 | 6.37 | 1.72 | 0.32 |
| 2008 – 09 | 3.64 | -0.71 | -3.51 | 1.80 | -6.36 | -1.05 |
| 2009 – 10 | -7.91 | 2.52 | 0.73 | -7.48 | 5.43 | -1.22 |
| 2010 – 11 | 2.39 | 2.11 | 2.17 | 11.21 | 13.30 | 4.45 |
| 2011 – 12 | 2.56 | 2.75 | -6.71 | 7.05 | -7.20 | -1.50 |
| 2012 – 13 | -2.73 | 0.33 | -6.06 | -1.41 | -4.90 | -3.29 |
| 2013 – 14 | 2.80 | 4.00 | 3.63 | 2.93 | 8.15 | 4.39 |
| 2014 – 15 | -0.23 | -0.64 | -5.84 | -4.44 | -8.33 | -3.17 |
| 2015 – 16 | -0.91 | -1.94 | 0.83 | 0.15 | 7.79 | 0.98 |
| 2016 – 17 | 1.15 | 1.32 | 2.46 | 7.13 | 18.07 | 4.87 |
| 2017 – 18 | -0.45 | -3.57 | -2.80 | 3.02 | 1.36 | -1.32 |
| 2018 – 19 | 0.91 | -1.35 | -9.05 | 1.36 | -2.01 | -2.12 |
| 2019 – 20 | -1.13 | 7.17 | 8.60 | 4.31 | -4.11 | 1.76 |
| 2020 - 21 | 3.20 | 0.64 | -0.83 | 1.52 | 2.94 | 1.81 |

**Source:** Authors calculation

The annual growth rate, also known as the simple growth rate or the average annual growth rate (AAGR), refers to the percentage change of a specific variable over a given time period, as shown in Table 3. The simple growth rate of food grains including rice, wheat coarse cereals, and pulses did not follow a same pattern from 1991-92 to 2020-21. During the post-liberalization period, the annual growth rate of these items may be increased or decreased. Food grains have been growing at a negative rate in several of these years.

 

**Table 4: Agricultural Production - FoodGrains (1991-92 to 2020-21)**
**(Lakh tonnes)**

| Year | Cereals | | | Total Cereals | Pulses | Total Food Grains |
|---|---|---|---|---|---|---|
| | Rice | Wheat | Coarse Cereals | | | |
| 1991-92 | 746.8 | 556.9 | 259.9 | 1563.6 | 120.2 | 1683.8 |
| 1992-93 | 728.6 | 572.1 | 365.9 | 1666.6 | 128.2 | 1794.8 |
| 1993-94 | 803 | 598.4 | 308.2 | 1709.6 | 133 | 1842.6 |
| 1994-95 | 818.1 | 657.7 | 298.8 | 1774.6 | 140.4 | 1915 |
| 1995-96 | 769.8 | 621 | 290.3 | 1681.1 | 123.1 | 1804.2 |
| 1996-97 | 817.3 | 693.5 | 341.1 | 1851.9 | 142.4 | 1994.3 |
| 1997-98 | 825.4 | 663.5 | 304 | 1792.9 | 138.3 | 1931.2 |
| 1998-99 | 860.8 | 712.9 | 313.3 | 1887 | 149.1 | 2036.1 |
| 1999-00 | 896.8 | 763.7 | 303.4 | 1963.9 | 134.1 | 2098 |
| 2000-01 | 849.8 | 696.8 | 310.8 | 1857.4 | 110.7 | 1968.1 |
| 2001-02 | 933.4 | 727.7 | 333.7 | 1994.8 | 133.7 | 2128.5 |
| 2002-03 | 718.2 | 657.6 | 260.7 | 1636.5 | 111.3 | 1747.8 |
| 2003-04 | 885.3 | 721.6 | 376 | 1982.8 | 149.1 | 2131.9 |
| 2004-05 | 831.3 | 686.4 | 334.6 | 1852.3 | 131.3 | 1983.6 |
| 2005-06 | 917.9 | 693.5 | 340.7 | 1952.2 | 133.8 | 2086 |
| 2006-07 | 933.6 | 758.1 | 339.2 | 2030.8 | 142 | 2172.8 |
| 2007-08 | 966.9 | 785.7 | 407.5 | 2160.1 | 147.6 | 2307.8 |
| 2008-09 | 991.8 | 806.8 | 400.4 | 2199 | 145.7 | 2344.7 |
| 2009-10 | 890.9 | 808 | 335.5 | 2034.5 | 146.6 | 2181.1 |
| 2010-11 | 959.8 | 868.7 | 434 | 2262.5 | 182.4 | 2444.9 |
| 2011-12 | 1053 | 948.8 | 420.1 | 2422 | 170.9 | 2592.9 |
| 2012-13 | 1052.4 | 935.1 | 400.4 | 2387.9 | 183.4 | 2571.3 |
| 2013-14 | 1066.5 | 958.5 | 432.9 | 2457.9 | 192.5 | 2650.4 |
| 2014-15 | 1054.8 | 865.3 | 428.6 | 2348.7 | 171.5 | 2520.2 |
| 2015-16 | 1044.1 | 922.9 | 385.2 | 2352.2 | 163.5 | 2515.7 |
| 2016-17 | 1097 | 985.1 | 437.7 | 2519.8 | 231.3 | 2751.1 |
| 2017-18 | 1127.6 | 998.7 | 469.7 | 2596 | 254.2 | 2850.1 |
| 2018-19 | 1164.8 | 1036 | 430.6 | 2631.4 | 220.8 | 2852.1 |
| 2019-20 | 1188.7 | 1079 | 477.5 | 2744.8 | 230.3 | 2975 |
| 2020-21 | 1223 | 1095 | 512 | 2829 | 257 | 3087 |

**Note:** Data for 2020-21 are based on fourth advance estimates.

**Source:** Reserve bank of India – Handbook of statistics of the Indian economy 2020-21.

Ministry of agricultural and farmers welfare, government of India, Coffee board of India and the tea board of India.

 

Table 4 shows that agricultural production increased from 1991-92 to 2020-21, with food grains of rice increasing from 746.8 to 1223, wheat increasing from 556.9 to 1095, coarse cereals increasing from 259.9 to 512, total cereals increasing from 1563.6 to 2829, pulses increasing from 120.2 to 257, and The simple growth rate of food grains including rice, wheat coarse cereals, and pulses did not follow a same pattern from 1991-92 to 2020-21. During the post-liberalization period, the annual growth rate of these items may be increased or decreased. Food grains have been growing at a negative rate in several of these years.

**Table 5:Trends in the Agricultural Production - Food Grains (1991-92 to 2020-21)**

| **Items** | **Linear Trend Line** | **Coefficient of $R^2$** |
|---|---|---|
| Rice | Y = 536.16 + 16.753X | 0.9078 |
| Wheat | Y = 708.78 + 14.955X | 0.8702 |
| Coarse Cereals | Y = 267.08 + 6.5382X | 0.7471 |
| Total cereals | Y = 1512.1 + 38.237X | 0.9001 |
| Pulses | Y = 205.81 + 2.1438X | 0.6917 |
| Total Food grains | Y = 1612.5 + 42.125X | 0.8907 |

**Source:** Authors calculation

Table 5 shows the post-liberalization trends in agricultural production – food grains, as well as the linear trends and R2 coefficient determination. Rice, wheat, coarse cereals, total cereals, pulses, and total food grains each had constants of 536.16, 708.78, 267.08, 1512.1, 205.81, and 1612.5, with coefficients of 16.753, 14.955, 6.5382, 38.237, 2.1438, and 42.125. The coefficient determination reveals how much variance in the dependent variable can be explained by the independent variables, which are 0.9078, 0.8471, 0.9001, 0.6917, and 0.8907.

**Table 6: Simple Growth Rate - Production of Food Grains (1991-92 to 2020-21)**

| **Year** | **Cereals** | | | **Total Cereals** | **Pulses** | **Total Food Grains** |
|---|---|---|---|---|---|---|
| | **Rice** | **Wheat** | **Coarse Cereals** | | | |
| 1991-92 | - | - | - | - | - | - |
| 1992-93 | -2.44 | 2.73 | 40.78 | 6.59 | 6.66 | 6.59 |
| 1993-94 | 10.21 | 4.60 | -15.77 | 2.58 | 3.74 | 2.66 |
| 1994-95 | 1.88 | 9.91 | -3.05 | 3.80 | 5.56 | 3.93 |
| 1995-96 | -5.90 | -5.58 | -2.84 | -5.27 | -12.32 | -5.79 |
| 1996-97 | 6.17 | 11.67 | 17.50 | 10.16 | 15.68 | 10.54 |
| 1997-98 | 0.99 | -4.33 | -10.88 | -3.19 | -2.88 | -3.16 |
| 1998-99 | 4.29 | 7.45 | 3.06 | 5.25 | 7.81 | 5.43 |
| 1999-00 | 4.18 | 7.13 | -3.16 | 4.08 | -10.06 | 3.04 |
| 2000-01 | -5.24 | -8.76 | 2.44 | -5.42 | -17.45 | -6.19 |
| 2001-02 | 9.84 | 4.43 | 7.37 | 7.40 | 20.78 | 8.15 |
| 2002-03 | -23.06 | -9.63 | -21.88 | -17.96 | -16.75 | -17.89 |

 

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|---|---|---|---|---|---|---|
| 2003-04 | 23.27 | 9.73 | 44.23 | 21.16 | 33.96 | 21.98 |
| 2004-05 | -6.10 | -4.88 | -11.01 | -6.58 | -11.94 | -6.96 |
| 2005-06 | 10.42 | 1.03 | 1.82 | 5.39 | 1.90 | 5.16 |
| 2006-07 | 1.71 | 9.32 | -0.44 | 4.03 | 6.13 | 4.16 |
| 2007-08 | 3.57 | 3.64 | 20.14 | 6.37 | 3.94 | 6.21 |
| 2008-09 | 2.58 | 2.69 | -1.74 | 1.80 | -1.29 | 1.60 |
| 2009-10 | -10.17 | 0.15 | -16.21 | -7.48 | 0.62 | -6.98 |
| 2010-11 | 7.73 | 7.51 | 29.36 | 11.21 | 24.42 | 12.09 |
| 2011-12 | 9.71 | 9.22 | -3.20 | 7.05 | -6.30 | 6.05 |
| 2012-13 | -0.06 | -1.44 | -4.69 | -1.41 | 7.31 | -0.83 |
| 2013-14 | 1.34 | 2.50 | 8.12 | 2.93 | 4.96 | 3.08 |
| 2014-15 | -1.10 | -9.72 | -0.99 | -4.44 | -10.91 | -4.91 |
| 2015-16 | -1.01 | 6.66 | -10.13 | 0.15 | -4.66 | -0.18 |
| 2016-17 | 5.07 | 6.74 | 13.63 | 7.13 | 41.47 | 9.36 |
| 2017-18 | 2.79 | 1.38 | 7.31 | 3.02 | 9.90 | 3.60 |
| 2018-19 | 3.30 | 3.73 | -8.32 | 1.36 | -13.14 | 0.07 |
| 2019-20 | 2.05 | 4.11 | 10.89 | 4.31 | 4.30 | 4.31 |
| 2020-21 | 2.89 | 1.52 | 7.23 | 3.07 | 11.59 | 3.77 |

**Source:** Authors calculation

The annual increase rate of agricultural production is shown in Table 6. From 1991-92 to 2020-21, in terms of food grains. Food grains such as rice, wheat coarse cereals, and pulses do not grow at a linear rate. The annual growth rate of these products may change during the post-liberalization period. When compared to prior years, agricultural production Of food grains has had a negative growth rate in several years.

**Table 7:Food grains- Yield Per Hectare 1991-92 to 2020-2021**
(Kg/hectare)

| | **Cereals** | | | | | |
|---|---|---|---|---|---|---|
| **Year** | **Rice** | **Wheat** | **Coarse Cereals** | **Total Cereals** | **Pulses** | **Total Food Grains** |
| 1991-92 | 1751 | 2394 | 778 | 1574 | 533 | 1382 |
| 1992-93 | 1744 | 2327 | 1063 | 1654 | 573 | 1457 |
| 1993-94 | 1888 | 2330 | 939 | 1701 | 598 | 1501 |
| 1994-95 | 1911 | 2559 | 929 | 1763 | 610 | 1546 |
| 1995-96 | 1797 | 2483 | 940 | 1703 | 552 | 1491 |
| 1996-97 | 1882 | 2679 | 1072 | 1831 | 635 | 1614 |
| 1997-98 | 1900 | 2485 | 986 | 1775 | 567 | 1552 |
| 1998-99 | 1921 | 2590 | 1068 | 1856 | 634 | 1627 |
| 1999-00 | 1986 | 2778 | 1034 | 1925 | 635 | 1704 |
| 2000-01 | 1901 | 2708 | 1027 | 1844 | 544 | 1626 |
| 2001-02 | 2079 | 2762 | 1131 | 1980 | 607 | 1734 |
| 2002-03 | 1744 | 2610 | 966 | 1753 | 543 | 1535 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 2003-04 | 2077 | 2713 | 1221 | 1983 | 635 | 1727 |
| 2004-05 | 1984 | 2602 | 1153 | 1903 | 577 | 1652 |
| 2005-06 | 2102 | 2619 | 1172 | 1968 | 598 | 1715 |
| 2006-07 | 2131 | 2708 | 1182 | 2021 | 612 | 1756 |
| 2007-08 | 2202 | 2802 | 1431 | 2151 | 625 | 1860 |
| 2008-09 | 2178 | 2907 | 1459 | 2183 | 659 | 1909 |
| 2009-10 | 2125 | 2839 | 1212 | 2075 | 630 | 1798 |
| 2010-11 | 2239 | 2988 | 1531 | 2256 | 691 | 1930 |
| 2011-12 | 2393 | 3177 | 1590 | 2415 | 699 | 2078 |
| 2012-13 | 2461 | 2117 | 1617 | 2449 | 789 | 2129 |
| 2013-14 | 2424 | 3075 | 1677 | 2438 | 764 | 2101 |
| 2014-15 | 2390 | 2872 | 1729 | 2373 | 744 | 2070 |
| 2015-16 | 2400 | 3034 | 1579 | 2392 | 656 | 2056 |
| 2016-17 | 2494 | 3200 | 1750 | 2525 | 786 | 2129 |
| 2017-18 | 2576 | 3368 | 1934 | 2657 | 853 | 2235 |
| 2018-19 | 2638 | 3533 | 1944 | 2752 | 757 | 2286 |
| 2019-20 | 2722 | 3440 | 1991 | 2772 | 823 | 2343 |
| 2020-21 | 2713 | 3464 | 2146 | 2815 | 892 | 2386 |

**Note:** Data for 2020-21 are based on fourth advance estimates.

**Source:** Reserve bank of India – Handbook of statistics of the Indian economy 2020-21.

Ministry of agricultural and farmers welfare, government of India, Coffee board of India and the tea board of India.

Table 7 shows that the yield per hectare of agricultural production-food grains increased from 1751 to 2713, wheat increased from 2394 to 3464, coarse cereals increased from 778.9 to 2146, total cereals increased from 1574 to 2815, pulses increased from 533 to 892, and total food grains increased from 1382 to 2386 over the 30-year period 1991-92 to 2020-21.

**Table 8: Trends in the Yield of Agricultural Production - Food Grains**

| **Items** | **Linear Trend Line** | **Coefficient of $R^2$** |
|---|---|---|
| Rice | Y = 1497.4 + 39.924X | 0.9302 |
| Wheat | Y = 2297.6 + 32.766X | 0.6482 |
| Coarse Cereals | Y = 712.37 + 40.602X | 0.8978 |
| Total cereals | Y = 1656.4 + 32.388X | 0.9073 |
| Pulses | Y = 514.68 + 9.4209X | 0.7177 |
| Total Food grains | Y = 1341.7 + 3.568X | 0.9300 |

**Source:** Authors calculation

Table 8 shows post-liberalization changes in agricultural production yield For food grains, with both linear and R2 coefficient determination. Rice, wheat, coarse

 

cereals, total cereals, pulses, and total food grains had constants of 1497.4, 2297.6, 712.37, 1656.4, 514.68, and 1341.7, and coefficients of 39.924, 32.766, 40.602, 32.388, 9.4209, and 3.568, respectively. The coefficient determination shows how much of the variance in the dependent variable can be explained by the independent variables (0.9302, 0.6482, 0.8978, 0.9073, 0.7177, and 0.9300).

**Table 9: Average Decadal Rate in the Area, Production and the Yield of Agriculture Production – Food Grains**

| | **Decadal** | **Cereals** | | | **Total Cereals** | **Pulses** | **Total food Grains** |
|---|---|---|---|---|---|---|---|
| | | **Rice** | **Wheat** | **Coarse Cereals** | | | |
| Area | 1991-92 2000-01 | 434.2 | 257.1 | 315.2 | 1006.5 | 222.9 | 1229.5 |
| | 2001-02 2010-11 | 432.3 | 272.4 | 296.1 | 990.7 | 229.8 | 1220.5 |
| | 2011-12 2020-21 | 439 | 305.3 | 244.7 | 988.6 | 266.2 | 1254.5 |
| Production | 1991-92 2000-01 | 811.64 | 653.65 | 309.57 | 1774.86 | 131.95 | 1906.81 |
| | 2001-02 2010-11 | 902.91 | 751.41 | 356.23 | 2010.55 | 142.35 | 2152.91 |
| | 2011-12 2020-21 | 1107.19 | 982.44 | 439.47 | 2528.97 | 207.54 | 2736.58 |
| Yield | 1991-92 2000-01 | 1868.1 | 2533.3 | 983.6 | 1762.6 | 588.1 | 1550 |
| | 2001-02 2010-11 | 2086.1 | 2755 | 1245.8 | 2027.3 | 617.7 | 1761.6 |
| | 2011-12 2020-21 | 2521.1 | 3128 | 1795.7 | 2558.8 | 776.3 | 2181.3 |

**Source:** Authors calculation

Table 9 displays the average decade rate in area, production, and yield of agricultural production - food grains over the last thirty years. The average change in rice, wheat, coarse cereals, total cereals, pulses, and total food grains between 1991-92 and 2020-21 was 4.8, 48.2, -70.5, -17.9, 43.3, and 16 lakh hectares. Food grain yields per acre are 653, 594.7, 812.1, 796.2, 188.2, and 631.3, with production rates of 295.55, 328.79, 129.9, 754.11, 75.59, and 829.77 lakh tonnes, respectively.

 

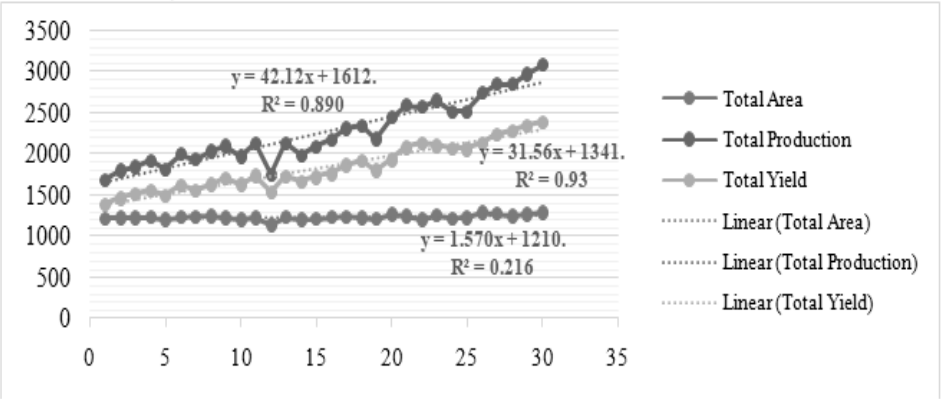


**Figure1:** Trends of Area, Production and the Yield Food Grains - 1991-92 to 2020-21

**Source:** Authors calculation

Figure 1 depicts trends in food grain area, production, and yield from 1991-92 to 2020-2021, indicating that the rate of expansion of area under cultivation is 1.5704, total yield is 31.568, and total production of food grains is 42.125.

**Table 10: Compound Annual Growth Rate of the Area of FoodGrains – 1991-92 to 2020-21**

| | Rice | Wheat | Coarse Cereals | Total Cereals | Pulses | Total Food Grains |
|---|---|---|---|---|---|---|
| CAGR – Area | 0.19 | 1.06 | -1.16 | 0.04 | 0.85 | 0.20 |
| CAGR – Production | 1.72 | 2.36 | 2.37 | 2.07 | 2.66 | 2.11 |
| CAGR – Yield | 1.52 | 1.28 | 3.56 | 2.02 | 1.79 | 1.90 |

**Source:** Authors calculation

Table 10 shows that the CAGR from 1991-92 to 2020-21 shows that rice cultivation area is the smallest when compared to production and yield. The region of coarse cereals rate is negative in the case of wheat, which has a positive symbol. When compared to the area under cultivation, the overall production and yield per hectare of food grains is higher.

## VI. CONCLUSION

Over the last three decades, the acreage, output, and yield of food grains have all increased significantly. Rice acreage increased by 24 lakh hectares, wheat acreage increased by 83 lakh hectares, pulses acreage increased by 63 lakh hectares, coarse cereals acreage decreased by 93 lakh hectares, and total food grains acreage increased by 74 lakh hectares. 0.0658, 0.8427, 0.6409, 0.1363, 0.5293, and 0.1571. The coefficient determination area under cultivation demonstrates how much of the variance in the dependent variable can be explained by the independent variables of the food grains. From 1991-92 to 2020-21, the

 

simple growth rate of food grains such as rice, wheat coarse cereals, and pulses did not follow the same pattern.The annual growth rate of these items may be increased or decreased during the post-liberalization period. In several of these years, food grains have grown at a negative rate. The coefficients for determining food grain production are 0.9078, 0.8471, 0.9001, 0.6917, and 0.8907. 0.9302, 0.6482, 0.8978, 0.9073, 0.7177, and 0.9300 are the coefficients that determine yield per hectare. Rice, wheat, coarse cereals, total cereals, pulses, and total food grains changed by 4.8, 48.2, -70.5, -17.9, 43.3, and 16 lakhs hectares over the decade. Food grain production rates are 295.55, 328.79, 129.9, 754.11, 75.59, and 829.77 lakh tonnes, with yields per acre of 653, 594.7, 812.1, 796.2, 188.2, and 631.3, respectively. The CAGR from 1991-92 to 2020-21 shows that rice cultivation area is small in comparison to production and yield. The region of coarse cereals rate is negative in the case of wheat, which has a positive symbol. When compared to the area under cultivation, the overall production and yield per hectare of food grains is higher. The rate of rise in food grain yield and output is encouraging, but it is too slow in comparison to previous years. The pace of growth in the cultivated area is the slowest. Modern seed types, fertilizers, irrigation facilities, as well as technological and institutional assistance, can all be used to increase and change the area, production, and yield of food grains in India.

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