

Original Research Article

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## Trend in Area, Production and Productivity of all Rice and *boro* Rice in Bihar State

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### ABSTRACT

Rice occupies a pivotal place in Indian agriculture and provides 43% calorie requirement for more than 70 % of its people. It accounts for about 42% of total food grain production and 55% of cereal production in the country. The CGAR (from 1997-98 to 2017-18) of area, production and productivity under all rice was found as 1.09 per cent, 0.68 per cent and 0.62 per cent, respectively, while that of *boro* rice it was found as 1.73 per cent, 1.58 per cent and 0.91 per cent, respectively. The annual growth rate for the same period of all rice in zone II of Bihar was 1.18 percent for area, 0.84 per cent for production and 0.72 per cent for productivity while that of *boro* rice of was 1.60 for area, 1.44 per cent for production and 0.90 per cent for productivity. Thereby showing that area, production and productivity of all rice and *boro* rice has increased from 1997-98 to 2017-18 in the state. In Bihar state rice is grown in 3.30 million hectares, covering 60 percent of Net Cropped Area, producing 8.09 million tonnes with the productivity of 2447 kg/ha (DES, 2017-18). The productivity of the crop in the state is far below the national average (2578Kg/ ha). In the state, rice is grown in versatile adaptation from precarious moisture as rainfed upland to deep water area having 3-4 meter water as deep water crop with many intermediate situations in between. The diverse ecological situation, varying climate and pedagogical conditions along with socio-economic diversities make rice cultivation a highly risky venture, resulting in overall poor productivity of the crop in the state. In Bihar around 33 percent of the total rice area in the state is under assured irrigation while remaining 67 percent is under rainfed situation. A large tract of land of Bihar state becomes unsuitable for traditional *kharif* crops due to flood and water logging from rivers and its tributaries from July to October months. The cultivation of rice during *rabi* crop season (November to May) was unknown probably till the new rice cultivars were introduced in eastern part of India through Bangladesh refugees. The cultivation of rice during winter months is termed as

#### Keywords

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## Introduction

India is the second largest producer, consumer and exporter of rice after China. Rice is the most dominant cereal crop accounting 45 per cent of the total food grain production of the country. India produced 112.91 million tonnes of rice from an area of 43.79 million ha during 2017-18. However, the country ranked 9<sup>th</sup> in terms of productivity (2578 kg ha<sup>-1</sup>) in the world which is far below the world average of 3173 kg/ ha (DES,2017-18). It occupies a pivotal place in Indian agriculture and provides 43% calorie requirement for more than 70 % of its people. It accounts for about 42% of total food grain production and 55% of cereal production in the country. It is cultivated in three seasons *i.e.* *Aus* (April to June), *Aman* (June to November) and *Boro* (November to April) rice in India.

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(November to May) was unknown probably till the new rice cultivars were introduced in eastern part of India through Bangladesh refugees. The cultivation of rice during winter months is termed as *boro* rice. *Boro* is a Bengali word derived from Sanskrit word '*Borob*' that refers to special rice cultivation in low land pockets during November to May months. The farmers innovated this rice cultivation with short duration photoperiod insensitive varieties to supplement poor *kharif* harvest. The *boro* rice area in eastern states of Assam, Odisha and West Bengal are mainly distributed in swampy low lands. In Bihar, it is spread in low lying belts of North-Eastern districts namely Purnea, Saharsa, Madhepura, Kisanganj, Supaul, Darbhanga, Katihar and North -Western districts *viz.* East Champaran and West Champaran, where rain water is accumulated and remains stagnated beyond October month. Recently with the introduction of cold tolerant rice varieties *boro* rice has become boon to the farmers of this region.

## Materials and Methods

The study was based the time-series data on area, production and productivity of all rice as well as of *boro* rice in Bihar state and its zone II (from 1997-98 to 2017-18) were collected from various published sources. The data were summarized, tabulated and analyzed using statistical measures like trend analysis.

### Trend analysis

The trend in area, production and productivity were analyzed on the basis of Compound Annual Growth Rate (CAGR). The formula used for estimation of CAGR was as;

$$CAGR = \{(y_n/y_1)^{1/n}\} - 1$$

Where,  
 $y_1$  = Data (I<sup>st</sup> year);

$y_n$  = Data ( $n^{\text{th}}$  year) and  
 $n$  = No. of years.

## Results and Discussion

### Trend in area, production and productivity of total rice and *boro* rice in Bihar & Zone II from 1997-98 to 2017-18

The Compound Annual Growth Rate (CAGR) of total rice in Bihar is presented table 1, which reveals that CAGR for area, production and productivity 1.09, 0.68 per cent and 0.62 per cent, respectively and of *boro* rice in the state was estimated as 1.73, 1.58 and 0.91 per cent, respectively. It shows that area, production and productivity of total rice as well as of *boro* rice has increased in Bihar. It is also indicated from the table that area, production and productivity under *boro* rice increased more as compared to all rice in the state during the period from 1997-98 to 2017-18.

The Compound Annual Growth Rate of total rice in zone II (Bihar) from 1997-98 to 2017-18 was found to be 1.18 per cent for area, 0.84 per cent for production and 0.72 per cent for productivity. The CAGR of *boro* rice in zone II of the state was 1.60, 1.44 and 0.90 per cent for area, production and productivity, respectively. It shows the area, production and productivity of *boro* rice increased more as compared to total rice in zone II also. The area, production and productivity of *boro* rice in state increased more as compared to zone II (Fig. 2 and 4).

### Trend in area, production & productivity of total rice cultivation (District-wise) in Zone II

The trend in area, production & productivity of total rice in Zone II (District-wise) of Bihar is presented in table 2. The table reveals that CAGR of area of total rice for the districts of Araria, Katihar, Khagaria, Kishanganj, Madhepura, Purnea, Saharsa and Supaul of zone II was estimated as 0.77, 2.30, 1.23, 1.23, 1.16, 1.16, 1.32 and 1.10 per cent, respectively. The CAGR for production was found to be 0.58, 1.56, 0.58, 0.84, 1.06, 0.76, 0.79 and 0.81 per cent, respectively for the above districts. It is revealed that highest increase in area (2.30 per cent) and production (1.56) was recorded in Katihar district, while highest increase in productivity was (0.92) in Madhepura district.

The trend in area, production and productivity of *bororice* in Zone II (district-wise) is also presented in table 2. It is revealed from the table that highest CAGR of area (6.61 per cent) and production (5.18 per cent) of *boro* rice was found in Saharsa district while that of highest productivity (1.03 per cent) was estimated for Kishanganj district of zone II. The CGAR of area, production and productivity in all districts of zone II was positive thereby indicated increase of these in all districts during the reference period (1997-98 to 2017-18) (Fig. 1 and 3; Table 3).

**Table.1** Trend in area, production and productivity of total rice and *boro* rice in Bihar & Zone II (per cent) from 1997-98 to 2017-18

Particulars	Area	Production	Productivity
<b>Total Rice (Bihar)</b>	1.09	0.68	0.62
<b>Total Rice (Zone II)</b>	1.18	0.84	0.72
<b>Total <i>boro</i> rice (Bihar)</b>	1.73	1.58	0.91
<b>Total <i>boro</i> rice (Zone II)</b>	1.60	1.44	0.90

The data for study period is appended in Appendix and presented graphically.

**Table.2** Trend in area, production and productivity of total rice and *boro* rice in Zone II of Bihar (Per cent)

District	Total rice (Zone II)			Total <i>boro</i> rice (Zone II)		
	Area	Production	Productivity	Area	Production	Productivity
Araria	0.77	0.58	0.75	1.02	1.03	1.01
Katihar	<b>2.30</b>	<b>1.56</b>	0.68	1.42	1.17	0.82
Khagaria	1.23	0.58	0.47	0.85	0.66	0.78
Kisanganj	1.23	0.84	0.69	0.70	0.72	<b>1.03</b>
Madhepura	1.16	1.06	<b>0.92</b>	4.46	4.57	1.02
Purnea	1.16	0.76	0.66	3.18	3.08	0.97
Saharsa	1.32	0.79	0.60	<b>6.61</b>	<b>5.18</b>	0.78
Supaul	1.10	0.81	0.74	3.00	2.50	0.83

**Table.3** Area, production and productivity of rice in Bihar

Year	Area ('000 ha)	Production ('000 tonnes)	Productivity (Kg/ha)
1997-98	3621.33	5395.08	1489.81
1998-99	3110.89	4670.65	1501.39
1999-00	665.47	945.25	1420.44
2000-01	3656.84	5444.37	1488.82
2001-02	3564.54	5301.22	1487.21
2002-03	3584.70	5085.57	1418.69
2003-04	3667.66	5568.09	1518.16
2004-05	3140.12	2472.16	787.28
2005-06	3251.24	3709.29	1140.88
2006-07	3364.01	5027.95	1494.63
2007-08	3477.37	4458.98	1599.30
2008-09	3495.27	5589.98	1599.30
2009-10	3124.03	3640.21	1165.23
2010-11	2845.37	3112.62	1093.92
2011-12	3350.94	8237.97	2458.41
2012-13	3298.89	8322.01	2522.67
2013-14	3150.81	6649.59	2110.44
2014-15	3263.37	8241.62	2525.49
2015-16	3232.31	6802.22	2104.44
2016-17	3339.78	8238.77	2466.86
2017-18	3306.98	8093.16	2447.29
<b>CAGR (%)</b>	<b>1.09</b>	<b>0.68</b>	<b>0.62</b>

Source: <https://aps.dac.gov.in/>

**Table.2** Area, production and productivity of *boro* rice in Bihar

<b>Year</b>	<b>Area (‘000 ha)</b>	<b>Production (‘000 tonnes)</b>	<b>Productivity (Kg/ha)</b>
<b>1997-98</b>	120.94	231.89	1917.40
<b>1998-99</b>	128.80	264.46	2053.30
<b>1999-00</b>	124.87	246.81	1976.45
<b>2000-01</b>	126.13	214.18	1698.12
<b>2001-02</b>	182.25	195.59	1073.21
<b>2002-03</b>	120.32	197.56	1073.21
<b>2003-04</b>	116.89	169.90	1450.58
<b>2004-05</b>	116.22	166.20	1430.03
<b>2005-06</b>	113.25	182.83	1614.35
<b>2006-07</b>	109.44	163.99	1498.49
<b>2007-08</b>	110.44	172.29	1560.04
<b>2008-09</b>	105.53	178.24	1689.06
<b>2009-10</b>	95.67	176.64	1846.42
<b>2010-11</b>	84.46	163.01	1930.08
<b>2011-12</b>	96.16	182.65	1899.39
<b>2012-13</b>	105.10	285.79	2719.23
<b>2013-14</b>	92.21	215.95	2342.03
<b>2014-15</b>	82.27	181.56	2206.95
<b>2015-16</b>	81.07	200.42	2472.29
<b>2016-17</b>	84.32	224.33	2660.35
<b>2017-18</b>	67.87	143.83	2119.38
<b>CAGR (%)</b>	<b>1.73</b>	<b>1.58</b>	<b>0.91</b>

Source: <https://aps.dac.gov.in/>

**Table.3** Area, production and productivity of rice in Zone II of Bihar

<b>Year</b>	<b>Area (*000 ha)</b>	<b>Production (*000 tonnes)</b>	<b>Productivity (Kg/ha)</b>
<b>1997-98</b>	784.817	1006.271	1282.17
<b>1998-99</b>	657.846	753.811	1145.88
<b>1999-00</b>	232.370	335.949	1445.75
<b>2000-01</b>	816.142	1016.100	1245.00
<b>2001-02</b>	786.944	885.950	1125.81
<b>2002-03</b>	791.625	903.155	1140.89
<b>2003-04</b>	877.709	1190.465	1356.33
<b>2004-05</b>	741.595	623.144	840.28
<b>2005-06</b>	751.058	810.448	1079.08
<b>2006-07</b>	742.048	791.260	1066.32
<b>2007-08</b>	732.334	676.272	923.45
<b>2008-09</b>	684.893	766.827	1119.63
<b>2009-10</b>	722.054	870.152	1205.11
<b>2010-11</b>	680.157	785.162	1154.38
<b>2011-12</b>	707.524	1306.333	1846.34
<b>2012-13</b>	705.698	1517.307	2150.76
<b>2013-14</b>	706.496	1476.594	2090.02
<b>2014-15</b>	687.362	1557.307	2265.63
<b>2015-16</b>	669.644	1322.969	1975.63
<b>2016-17</b>	714.761	1513.372	2117.31
<b>2017-18</b>	660.056	1202.453	1821.75
<b>CAGR (%)</b>	<b>1.18</b>	<b>0.84</b>	<b>0.72</b>

Source: <https://aps.dac.gov.in/>

**Table.4** Area, Production and Productivity of *boro* rice in zone II of Bihar

<b>Year</b>	<b>Area (‘000 ha)</b>	<b>Production (‘000 tonnes)</b>	<b>Productivity (Kg/ha)</b>
<b>1997-98</b>	95.23	188.729	1981.82
<b>1998-99</b>	102.608	230.31	2244.56
<b>1999-00</b>	101.71	214.124	2105.24
<b>2000-01</b>	103.654	176.325	1701.09
<b>2001-02</b>	138.931	138.629	997.83
<b>2002-03</b>	98.571	158.559	1608.58
<b>2003-04</b>	96.209	144.268	1499.53
<b>2004-05</b>	95.037	135.59	1426.71
<b>2005-06</b>	93.872	163.815	1745.09
<b>2006-07</b>	90.691	136.16	1501.36
<b>2007-08</b>	90.791	141.833	1562.19
<b>2008-09</b>	88.713	150.172	1692.78
<b>2009-10</b>	83.294	160.256	1923.98
<b>2010-11</b>	74.264	145.704	1961.97
<b>2011-12</b>	90.353	172.561	1909.85
<b>2012-13</b>	91.791	256.453	2793.88
<b>2013-14</b>	75.904	181.939	2396.96
<b>2014-15</b>	68.119	156.834	2302.35
<b>2015-16</b>	68.513	170.119	2483.02
<b>2016-17</b>	73.08	200.879	2748.75
<b>2017-18</b>	58.19	129.046	2217.67
<b>CAGR (%)</b>	<b>1.60</b>	<b>1.44</b>	<b>0.90</b>

Source: <https://aps.dac.gov.in/>

Figure.1 Area, production and productivity of rice in Bihar

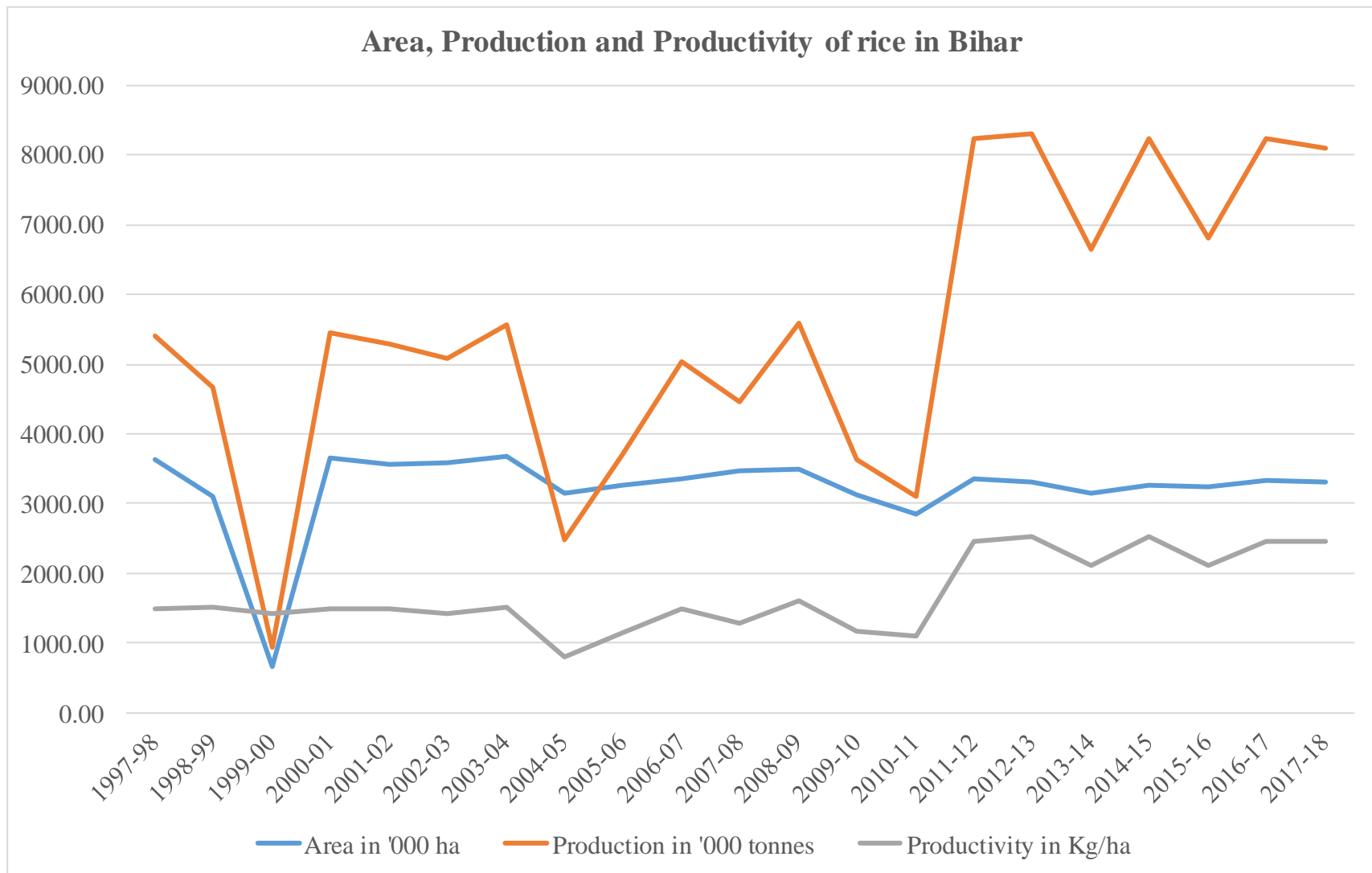
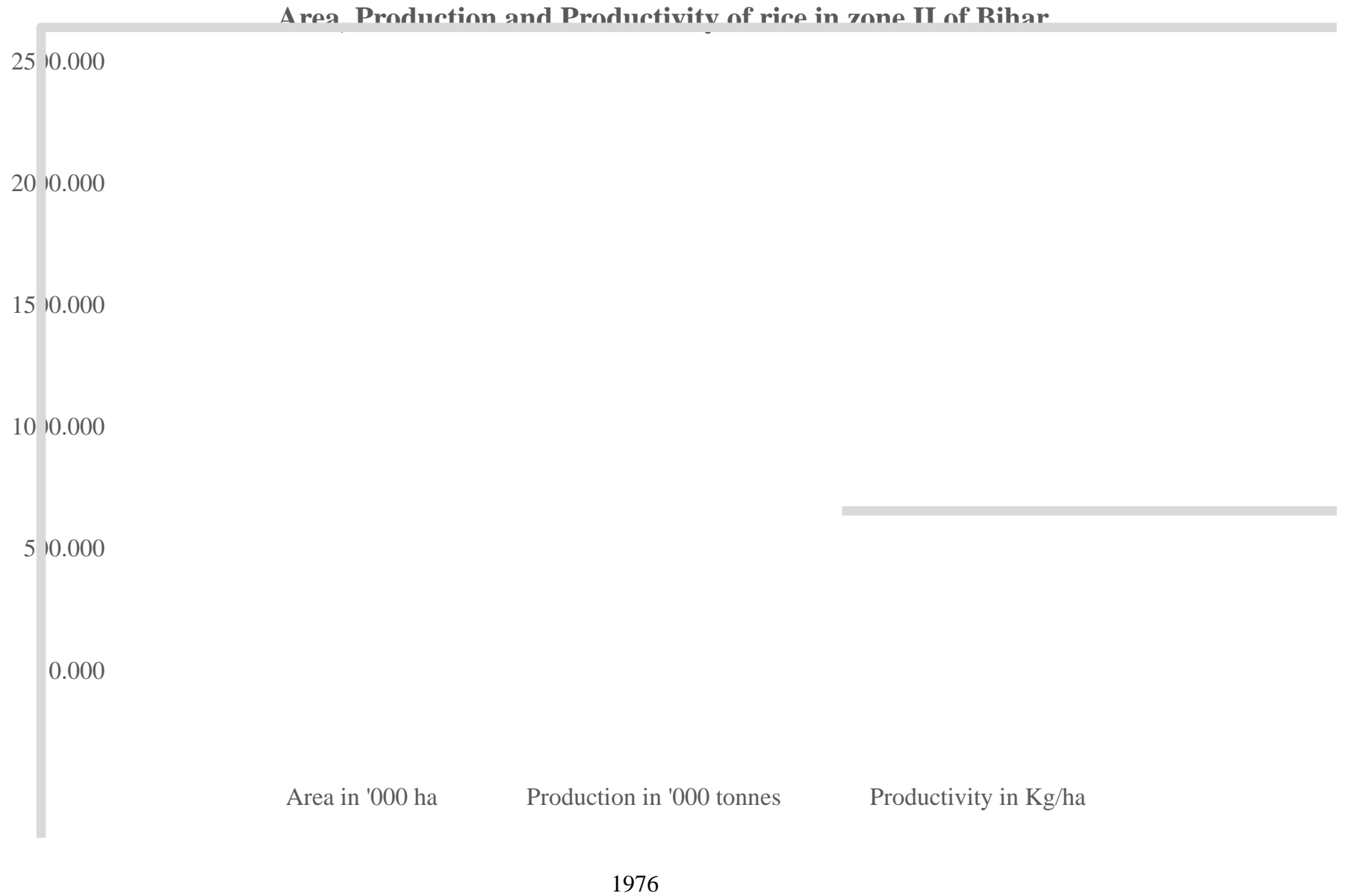




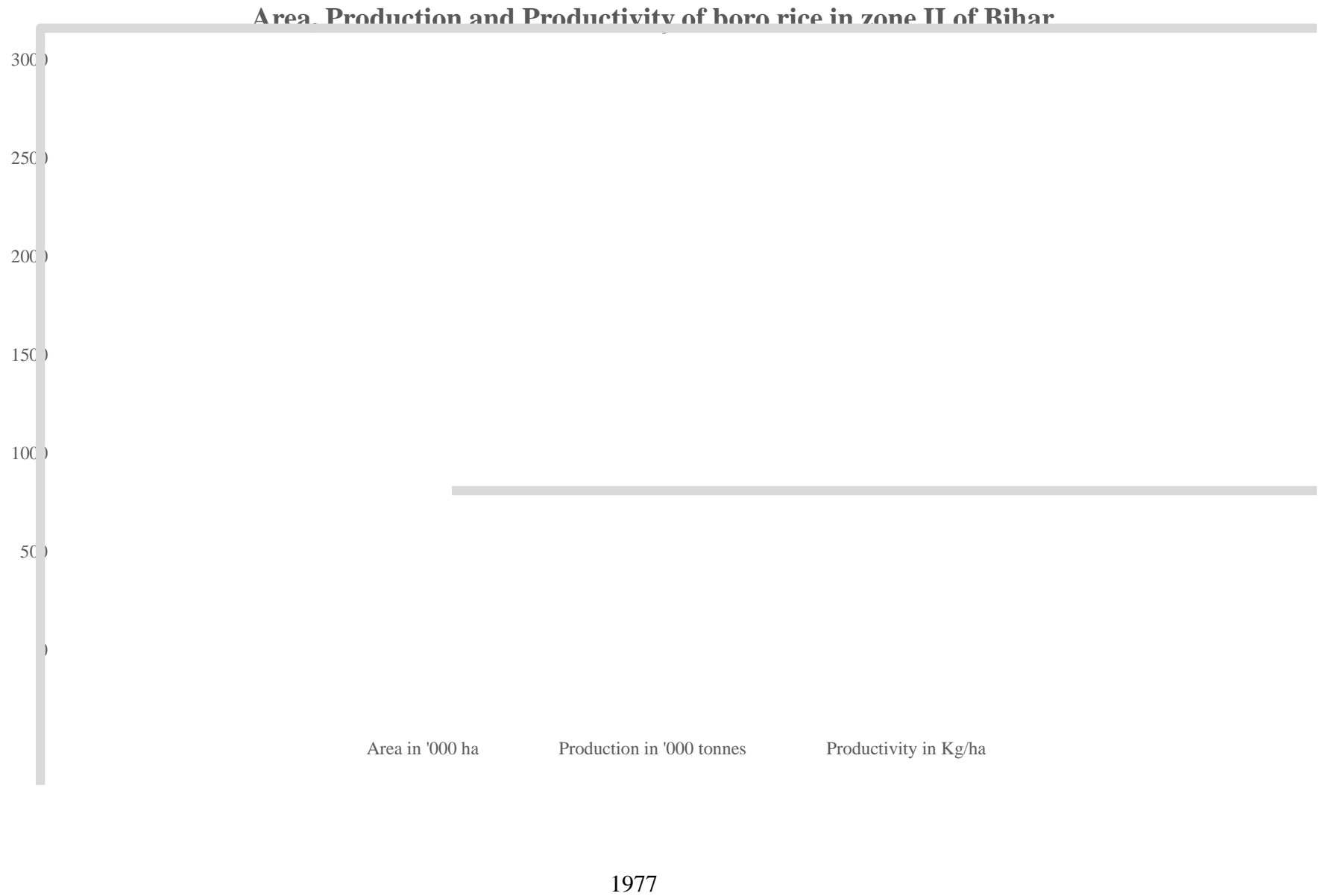
Figure.2 Area, production and productivity of *boro* rice in Bihar



**Figure.3** Area, production and productivity of rice in Zone II of Bihar



**Figure.4** Area, production and productivity of *boro* rice in zone II of Bihar



It may be concluded from the study that area, production and productivity of *boro* rice has increase more as compared to total rice in Bihar. The probable reason for this may be because of that *boro* rice system takes advantage of residual moisture after the harvest of *khari*rice. Such area with high moisture retention capacity are low-lying ditches where water is stored or gets accumulated, areas adjoining canals and roads, Chaur-lands/Tal lands, etc are suitable for *boro* rice cultivation. *Boro* rice is a winter season, photo insensitive, transplanted rice cultivated with supplemental irrigation. It gives the farmers a chance to grow a *rabiseason* crop, which normally they could not grow.

In the state *boro* rice is normally grown under irrigated condition. The average rainfall in Bihar as well as in zone II is high but it does not distribute uniformly, so at the time of rice cultivation, it cannot meet the actual water requirement of the crop in respect to time and space. Therefore, a long area of cultivable land remains fallow during winter season due to insufficient soil moisture. With the increase in irrigation facilities, *boro* rice crop is now being taken in areas outside its traditional boundaries and a new cropping system is emerging (Singh, 2003). Irrigation can therefore bring more areas under *boro* rice cultivation. Another factor that affects the *boro* rice cultivation is fall of water table below ground surface. Lack of appropriate variety and water management practice is a limiting factor for successful *boro* rice cultivation under shrinking water condition. Therefore, appropriate agronomic management is a prerequisite to exploit full potential of the available resources. To realize the maximum possible benefits from *boro* rice, it is essential to develop appropriate package of practices for successful cultivation and yield maximization. Among the various cultural practices appropriate varieties and water management practice may play important for yield maximization.

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