Analysis of Trends, Growth and Instability in Rice Production in Andhra Pradesh

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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

The study has been taken up with the objective of investigating the trends, pattern of growth and the extent of instability in area, production and productivity of rice crop in Andhra Pradesh state over a period of five and half decades from 1959-60 to 2013-14. Compound Growth Rate and Coefficient of Variation were used to calculate the annual growth rate and instability. The area, production and productivity of rice in this period has increased by 25, 201 and 138 per cent respectively. In this period, the districts were categorised and grouped under different groups based on average productivity of rice. During the study period many of the districts moved from very low productivity to high productivity group. During 1960s, 17 districts are under very low productivity group (<1500 kg/ha) and in 2010s 13 districts are under high productivity group (>3000 kg/ha). During the period 2014-19 in the divided Andhra Pradesh contribution of different productivity groups to the states paddy production was calculated and concluded that 3 districts under high productivity group (>6000 kg/ha) contributed 52 per cent of the production. During 2010s annual growth rates for area, production and productivity are 4.08, 4.02 and 1.21 respectively. In all the periods in the past five and half decades, production and productivity growth rates are higher than growth rate in area
except in 2010s. Instability was higher in production and area than in productivity. The annual growth rate and the instability of production and area are higher in 2010s. Suitable crop planning is to be initiated, adoption of sustainable management practices are to be intensified to maintain the growth rate and reduce the instability in area and production.

Keywords: Area; growth; instability; production; productivity; rice.

1. INTRODUCTION

Rice is a staple food for more than half of the world population and in Asia alone more than 2000 million people obtain 60-70 percent of their calories from rice and its products. [1] More than 80 per cent of the people in Asia consume rice. India is the second largest producer as well as the consumer of rice in the world [2].

Rice is the principal food crop in India. Rice is grown in an area of 43.79 M ha with a production of 116.42 Mt and productivity of 2659 kg/ha in the country occupying 22 per cent of gross cropped area of the country. Rice contributes 41 per cent of total food grain production occupying 35 per cent of food grain area of the country (2018-19) [3]. With the growing population, by the year 2050, the projected demand for rice would be 137.3 Mt in the country and the demand and supply gap would be 25.8 Mt with the growth rate of 0.36 per cent [4]. The all India compound annual growth rate (CAGR) of area, production and yield of rice from 1970-71 to 2011-12 shows that there has been a steady decline for area under cultivation largely because of changes in cropping pattern. The CAGR of production was 3.62 per cent per annum during 1980-81 to 1989-90. The CAGR of yield was 3.19 per cent during 1980-81 to 1989-90 which declined to 1.82 per cent during 2011-12. This implies that growth rate over the period from 1980-81 to 2011-12 is positive but declining gradually [5]. Under the conditions of low growth rates concerted efforts are required to increase the production in all major producing states to reach the projected demand of rice by 2050.

Combined Andhra Pradesh is the major rice producing state in the country contributing 12.23 per cent of production from 10.25 per cent of rice area in the country. Andhra Pradesh with an average productivity of 2891 kg/ha ranks third in the country and called as Annapuma [6]. Even after division of the state, at present the state contributes 7.08 per cent of production from 5.04 per cent of rice area in the country. With the productivity of 3733 kg/ha, the state still ranks third in the country [3].

This paper aims at analyzing the trends, growth and instability in area, production and productivity for rice crop in Andhra Pradesh in the past five and half decades. An attempt is also made to categorise the districts under different productivity groups in the same period.

2. MATERIALS AND METHODS

The time-series secondary data on area, production and productivity of rice crop in combined Andhra Pradesh state were collected for a period of fifty five years from 1959-60 to 2013-14. The time period under the study is divided into six periods for calculating the trends, growth rates and instability. In the first five periods from 1959-60 to 2008-09, each period covers 10 years. As the state was bifurcated into Andhra Pradesh and Telangana in the year 2014, the sixth period is confined to five years from 2008-09 to 2013-14. The data on area, production and productivity of rice crop divided Andhra Pradesh were collected from 2014-15 to 2018-19 for calculating contribution of different districts to states’ area and production and classification of districts under different productivity groups. The data on production and productivity for the period 2014-15 to 2018-19 was presented in terms of paddy. The data were compiled from various published sources of Directorate of Economics and Statistics, Government of Andhra Pradesh.

2.1 Growth Rate Analysis

Compound growth rates for area, production and productivity for each period was worked out by fitting the exponential function of the form.

\[ Y = ab^t \]

Where
- \( Y \) = the area/production/productivity
- \( B \) = the regression coefficient
- \( t \) = time variable
- \( a \) = constant

2.2 Instability

Instability of area, production and productivity were calculated using coefficient of variation by using the following formula.
CV = $\sigma / \mu$

Where
- $\sigma$ = standard deviation
- $\mu$ = mean

The statistical tools viz., simple averages, trends, percentages were applied to analyze the data. The districts are categorised under five productivity groups based on productivity levels in the past five and half decades. The average productivity level in each period is considered for grouping the districts under each category. The number of districts is different in different periods as new districts are created in the state. Prakasam, Rangareddy and Vizianagaram districts formed in 1970, 1978 and 1979 years respectively.

3. RESULTS AND DISCUSSION

Rice is the major food grain crop in Andhra Pradesh state occupying 30 per cent of the total cropped area in the state. It is observed that Andhra Pradesh state witnessed significant increase in area, production and productivity of rice in the past five and half decades.

3.1 Trends in Area, Production and Productivity in United Andhra Pradesh

The trends in area, production and productivity of rice in Andhra Pradesh state is presented in Table 1.

The area, production and productivity of rice in combined Andhra Pradesh have increased over the period of 1959-60 to 2013-14. The area increased from 32.44 lakh hectares to 40.85 lakh hectares recording 25 per cent increase in the past five and half decades. In the same period, 201 per cent increase in production was recorded due to the combined effect of increase in both area and productivity. The productivity has increased steadily from 1296 kg/ha to 3079 kg/ha recording 138 per cent in the same period. The increase in the productivity may be attributed to the adoption of improved varieties and management practices by the farmers in the state [8].

The combined Andhra Pradesh has 23 districts and the productivity levels vary across these districts due to various factors such as soil type, soil fertility, irrigation sources, rainfall pattern, climatic conditions etc. An attempt is made to see the differences in productivity of rice in different districts in the past five and half decades.

Based on the average productivity levels of rice the districts have been categorised in to the following five groups for analysis.

- High Productivity Group (Productivity > 3000 kg/ha)
- Medium Productivity Group (Productivity 2500-3000 kg/ha)
- Medium-Low Productivity Group (Productivity 2000-2500 kg/ha)
- Low Productivity Group (Productivity 1500-2000 kg/ha)
- Very Low Productivity Group (Productivity < 1500 kg/ha)

In the period of 1959-60 to 2013-14 many of the districts moved from very low to high productivity group. In 1960s 17 districts are under very low productivity group and 3 districts are under low productivity. In 90s only one district is under high productivity group which has increased to 8 in 2000s and 13 in 2010s. It is observed the productivity levels of the districts increased in this period. Though many of the districts moved to medium and high productivity groups still the North Coastal districts are under low productivity group. Steps are to be initiated to increase the productivity in these districts also.

Table 1. Trends in area, production and productivity of rice in Andhra Pradesh

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Area ('000ha)</td>
<td>3244</td>
<td>3499</td>
<td>3653</td>
<td>3858</td>
<td>3730</td>
<td>4085</td>
</tr>
<tr>
<td>Production ('000tonnes)</td>
<td>4163</td>
<td>5379</td>
<td>7647</td>
<td>9658</td>
<td>14241</td>
<td>12534</td>
</tr>
<tr>
<td>Productivity (kg/ha)</td>
<td>1296</td>
<td>1541</td>
<td>2134</td>
<td>2554</td>
<td>2986</td>
<td>3079</td>
</tr>
</tbody>
</table>

Source: [7]
## Table 2. Districts under different productivity groups of rice in combined Andhra Pradesh

<table>
<thead>
<tr>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>High Productivity (&gt;3000 Kg/Ha)</td>
<td>Guntur(1)</td>
<td>EG, EG, Krishna, Guntur, Prakasam, Nellore, Kurnool, Karimnagar(8)</td>
<td>EG, EG, Krishna, Guntur, Prakasam, Nellore, Kurnool, Chittoor, Karimnagar, Medak, Nizamabad, Warangal, Nalgonda (13)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medium Productivity (2500-3000 Kg/Ha)</td>
<td>WG, Guntur(2)</td>
<td>WG, EG, Krishna, Prakasam, Nellore, Kadapa, Karimnagar, Nalgonda (9)</td>
<td>Chittoor, Anantapur, Rangareddy, Medak, Nizamabad, Warangal, Khammam, Nalgonda (8)</td>
<td>Kadapa, Anantapur, Adilabad, Rangareddy, Mahabubnagar, Khammam (6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medium-Low Productivity 2000-2500 Kg/Ha)</td>
<td>WG, Krishna, Prakasam, Nellore, Chittoor, Kadapa, Karimnagar, Nalgonda (9)</td>
<td>Srikakulam, Vizianagarm, Chittoor, Anantapur, Rangareddy, Hyderabad, Nizamabad, Warangal, Khammam (9)</td>
<td>Srikakulam, Vizianagarm, Mahabubnagar, Adilabad, Kadapa(5)</td>
<td>Vizianagarm (1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Productivity (1500-2000 Kg/Ha)</td>
<td>WG, EG, Nizamabad (3)</td>
<td>WG, EG, Krishna, Guntur, Chittoor, Kadapa Anantapur, Kurnool, Karimnagar, Nalgonda, Nizamabad, Hyderabad(12)</td>
<td>Srikakulam, Vizianagarm, Mahabubnagar, Medak, Adilabad (4)</td>
<td>Visakhapatnam(1)</td>
<td>Visakhapatnam, Srikakulam (2)</td>
<td></td>
</tr>
<tr>
<td>Very-Low Productivity (&lt; 1500 Kg/Ha)</td>
<td>Srikakulam, Visakhapatnam, Krishna, Guntur, Nellore, Chittoor, Kadapa Anantapur, Kurnool, Mahabubnagar, Hyderabad, Medak, Adilabad, Karimnagar, Warangal, Khammam, Nalgonda(17)</td>
<td>Srikakulam, Visakhapatnam, Krishna, Guntur, Nellore, Mahabubnagar, Medak, Adilabad, Warangal, Khammam(9)</td>
<td>Visakhapatnam, Adilabad(2)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
During the period 2014-19, the average area, production and productivity of paddy recorded in divided AP are 22.17 lakh hectares, 121.92 lakh tonnes and 5503 kg/ha respectively. After bifurcation of the state taking the average paddy productivity for the years 2014-2019 the districts are categorised in to five groups and contribution of districts under different productivity groups to the states area and production were calculated.

It is observed that more than 50 per cent of the paddy production in the state is contributed by three districts occupying 45 per cent of area under rice in the state. 84 per cent of the production has come from high and high to medium productivity groups from 76 per cent of rice area in the state. The results conclude that eight districts of the state has major contribution for the rice production in the state and the area is concentrated in these districts. Only 16 per cent of the production is contributed by the districts having the productivity levels less than 5000 kg/ha. It is necessary to study the comparative advantage of different crops in low productivity districts and suitable crop plans are to be developed for these districts.

The decade wise annual growth rates of area, production and productivity in the past five and half decades are presented in Table 4. In all the periods production and productivity growth rates are higher than growth rate in area up to 2008-09. Area has registered negative growth rates in 1960s and 1990s. Highest growth in area is recorded in 2010s, mainly due to the crop concentration and interest shown by the farmers in rice cultivation. Highest growth in production and productivity is recorded in 1970s which may be attributed to the introduction of green revolution and adoption of the improved varieties and package by the farmers [9]. Rice maintained a positive and high growth trend in Telangana in the periods 1983-91 and 2003-2012 [10]. During the period 1985-85 to 2010-11 linear growth rate is positive for area, production and productivity [11].

The instability in area, production and productivity of rice shows that instability in area under rice cultivation is maintained at below 10 up to 1998-99 and recorded more than 10 in 2000 and 2010s. In 2010s higher instability is associated with high growth rate in area.

### Table 3. Contribution of districts under different productivity groups to the total paddy production in the state in the past 5 years (2014-19)

<table>
<thead>
<tr>
<th>Productivity groups</th>
<th>Number of districts</th>
<th>Area ('000 Ha.)</th>
<th>Percent of state's rice area</th>
<th>Production ('000 Tonnes)</th>
<th>Percent of state's rice production</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Productivity (&gt;6000 kg/ha)</td>
<td>3</td>
<td>1012</td>
<td>45.6</td>
<td>6350</td>
<td>52.1</td>
</tr>
<tr>
<td>High-Medium 5000-6000 kg/ha)</td>
<td>5</td>
<td>685</td>
<td>30.9</td>
<td>3893</td>
<td>31.9</td>
</tr>
<tr>
<td>Medium Productivity (4000-5000 Kg/ha)</td>
<td>3</td>
<td>203</td>
<td>9.2</td>
<td>874</td>
<td>7.2</td>
</tr>
<tr>
<td>Medium-low Productivity (3000-4000 Kg/ha)</td>
<td>1</td>
<td>210</td>
<td>9.5</td>
<td>758</td>
<td>6.2</td>
</tr>
<tr>
<td>Low Productivity (&lt;3000 Kg/ha)</td>
<td>1</td>
<td>107</td>
<td>4.8</td>
<td>318</td>
<td>2.6</td>
</tr>
<tr>
<td>TOTAL</td>
<td>13</td>
<td>2217</td>
<td>100</td>
<td>12193</td>
<td>100</td>
</tr>
</tbody>
</table>

Source: [7]. Note: Production and productivity is for paddy

### Table 4. Annual growth in area, production and productivity of rice in Andhra Pradesh

<table>
<thead>
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</tr>
</thead>
<tbody>
<tr>
<td>Area</td>
<td>-0.07</td>
<td>1.97</td>
<td>0.07</td>
<td>-0.27</td>
<td>0.99</td>
<td>4.08</td>
</tr>
<tr>
<td>Production</td>
<td>0.60</td>
<td>4.62</td>
<td>2.22</td>
<td>0.89</td>
<td>2.94</td>
<td>4.02</td>
</tr>
<tr>
<td>Productivity</td>
<td>0.51</td>
<td>2.88</td>
<td>2.15</td>
<td>1.19</td>
<td>1.80</td>
<td>1.21</td>
</tr>
</tbody>
</table>
4. CONCLUSION

Rice is the major food grain crop in Andhra Pradesh state occupying 30 per cent of the total cropped area in the state. During the past five and half decades, production increased by 201 per cent contributed by both area and productivity. In combined Andhra Pradesh during 2010s, 13 districts fall under high rice productivity group (>3000 kg/ha) and 6 districts fall under medium productivity group (2500-3000 kg/ha), 1 district under medium low productivity (2000-2500 kg/ha) and two districts under low productivity group (1500-2000 kg/ha). North coastal districts are under low productivity group even in 2010s. In-depth study about the location specific factors responsible for the low productivity districts is necessary to initiate necessary measures for tackling the problems/constraints. No district remained in very low (<1500kg/ha) productivity group in 2010s. During the period 2014-2019, in divided Andhra Pradesh, 52 per cent of paddy production is contributed by three districts with the productivity level of paddy at more than 6000 kg/ha. Only 16 per cent of the production is contributed by the districts having the productivity levels less than 5000 kg/ha. It is necessary to study the comparative advantage of different crops in these districts and suitable crop plans are to be developed for these districts to encourage crop diversification. In all the periods in the past five and half decades, production and productivity growth rates are higher than growth rate in area except in 2010s. The annual growth rate and the instability of area and production are increasing in 2010s. Suitable crop planning is to be initiated, adoption of sustainable management practices are to be intensified to maintain the growth rate and reduce the instability in area and production.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Table 5. Instability in area, production and productivity of rice in Andhra Pradesh

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</thead>
<tbody>
<tr>
<td>Area</td>
<td>7</td>
<td>9</td>
<td>9</td>
<td>8</td>
<td>15</td>
<td>13</td>
</tr>
<tr>
<td>Production</td>
<td>11</td>
<td>19</td>
<td>17</td>
<td>10</td>
<td>19</td>
<td>11</td>
</tr>
<tr>
<td>Productivity</td>
<td>6</td>
<td>12</td>
<td>9</td>
<td>6</td>
<td>7</td>
<td>4</td>
</tr>
</tbody>
</table>

Area under rice increased in this period inspite of higher instability which may be due to the perception of the farmers regarding profitability and risk in rice cultivation compared to other crops. Higher instability in production is recorded in 70s, 80s and 2000s. Productivity is stable in all the periods except in 70s and 80s where instability is 12 and 9 which might be due to increase and fluctuations in that period due to the effect of green revolution and adoption of improved technologies. The instability in the production might be due to the instability in both area and productivity. The fluctuations in area may be attributed to climatic factors, release of canal water etc., which influence the cropping pattern. The fluctuations in productivity may be attributed to biotic factors like pests and diseases and abiotic factors like rainfall, cyclones. Concerted efforts are required to stabilise the area and productivity for sustained production in the state.


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