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## TRENDS IN GROWTH AND DETERMINANTS OF THE RICE PRODUCTIVITY IN HARYANA: AN EMPIRICAL STUDY

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**Abstract:** *Through this study, we analyzed the growth trends of rice crop in India & Haryana and also expose the determinants of rice productivity with the help of appropriate statistical tools and techniques. In this study, we have taken time period from 1970-71 to 2009-10. After analyzed the data, we find that the ACGR of area, production and yield of rice crop in India was 0.37, -0.03 and 2.24 per cent respectively, while in case of Haryana it was 5.58, 7.38 and 2.37 per cent respectively during the same period, and further find that, irrigation intensity, pesticide consumption per hectare and dairy co-operatives per hectare are positively, while number of tractor per hectare is negatively and significantly associated to rice productivity, while education of farmer and agriculture labour per hectare are positively linked to rice productivity, but not significant associated to rice productivity.*

**Keywords:** *Rice, Productivity, Cobb douglas Production Function*

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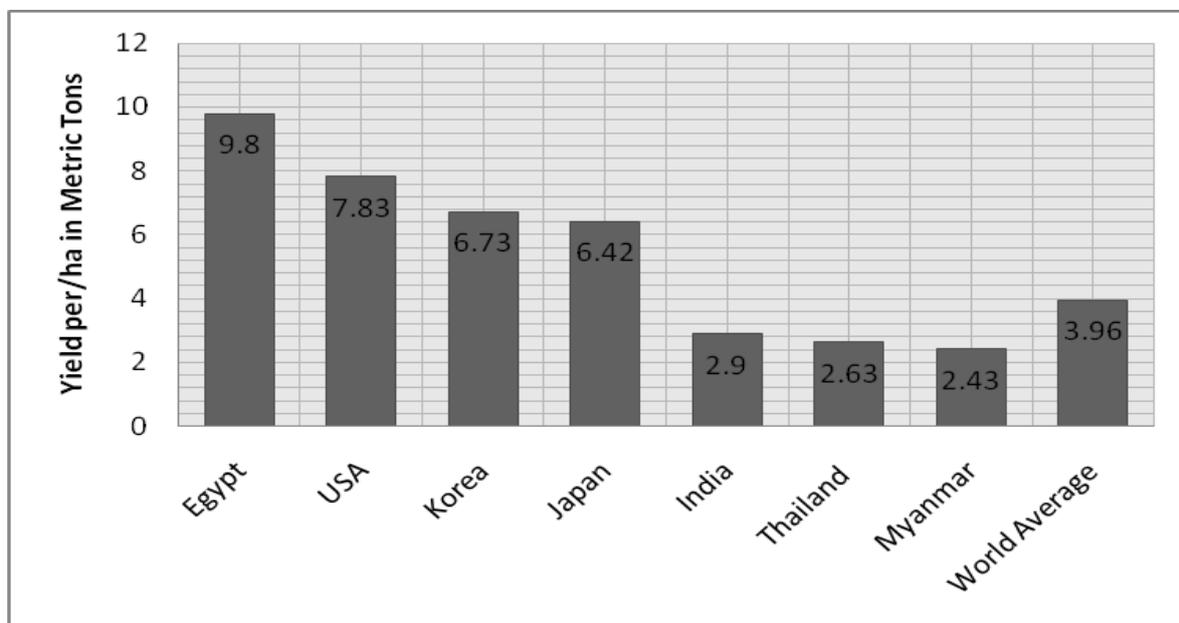
## INTRODUCTION

Rice is the first most important staple food of the country (Singh Ajmer: 2008). Therefore, rice is the important crop of the country (India). In terms of production of rice, India rank is second to China among rice production countries in the World (Kaul et al: 2006). In India, the contribution of agriculture and allied product in total export has 41.97 per cent, rice contribution has 14.35 per cent in total export of agriculture and allied product, while contribution of rice has 0.628 per cent in total export of India (ESI: 2010). The share of India has 2.7 per cent in total World rice export in 2007 (ESI: 2009). West Bengal, Andhra Pradesh and Utter Pradesh have the leading States of India in rice production. Further, jointly the contribution of these States has 40.42 per cent in total rice production of India (ASG: 2008).

Figure 1

### International Scenario of Rice Productivity

(In Metric Tons/per ha)



Source: Mishra and Puri (2004)

Figure 1 reveals the rice productivity (in metric tons/per ha) of selected countries. It is clear from figure 1 Egypt rank first in rice productivity with 9.8 metric tons/per ha, followed by USA (7.83 metric tons/per ha), Korea (6.73 metric tons/per ha) etc. In case of India, the rice productivity has been only 2.9 metric tons/per ha, while the World average has been 3.96 metric tons/per ha. To conclude, we can say that the productivity of rice in India is so far from the optimum level as well as compared to develop and developing rice procedures



countries in the World. Thus, the present study was made to achieve the following objectives:

1. To find out the growth trends of rice crop in India as well as Haryana.
2. To examine the contribution of Haryana in total rice production of India.
3. To discover the determinants of rice productivity in India in general and Haryana in particular.

## **RESEARCH METHODOLOGY**

The present study is based on secondary data which were collected from Agriculture Statistics at a Glance (2008), Statistical Abstract of Haryana (2008), Economic Survey of India (2009 and 2010), Ministry of Agriculture and Cooperation and Relevant Research Work in this area. Percentage, Average Compound Growth Rate (ACGR) and Cobb-Douglas function were employed for achieved the above objectives.

### **AVERAGE COMPOUND GROWTH RATE (ACGR)**

The average compound growth rate is compound by employing formula:

$$Y = ab$$

By using logarithm, it may be written as:

$$\log y = \log a + t \log b$$

$$Y^* = a^* + t.b^* \text{ (where } \log y = y^*, \log a = a^* \text{ and } \log b = b^*)$$

The value of  $b^*$  is computed by using OLS Method. Further, the value of ACGR can be calculated by followed method:

$$\text{ACGR} = (\text{Antilog } b^* - 1) \times 100$$

### **COBB DOUGLAS TYPE PRODUCTION FUNCTION**

A regression equation was estimated assuming a modified Cobb Douglas type production function. It estimates real contribution of each and every factor affecting rice yield/productivity. Important factors affecting yield (i.e. education, irrigation intensity, number of dairy cooperatives, pesticide consumption per ha, agriculture labour per ha, and number of tractor per hectare have been incorporated in the analysis. Many factors were left out to keep study within manageable limits. Cobb Douglas type production function has been fitted, which is described as below:



$$\text{LOGYIELD} = \beta_0 + \beta_1 \text{LOGEDU} + \beta_2 \text{LOGIRRINT} + \beta_3 \text{LOGDIARY} + \beta_4 \text{PESTCON} + \beta_5 \text{AGRLABOUR} + \beta_6 \text{TRACTORS} + \varepsilon \dots \dots \dots (i)$$

Where:

LOGYILD = natural logarithm of yield per kg/per hectare

LOGEDU = natural logarithm of education of farmer 7+ age,

LOGIRRINT = natural logarithm of irrigation intensity,

LOGDIARY = natural logarithm of number of dairy cooperatives per hectare,

LOGPESTCON = natural logarithm of per hectare pesticide consumption,

LOGAGRLABOUR = natural logarithm of agriculture labour per hectare, and

LOGTRACTOR = natural logarithm of number of tractors per hectare

$\varepsilon$  = random error term independently and identically distributed with zero mean and constant variance.

$\beta_1$  to  $\beta_6$  are coefficient.

**Table 1**

**Trends in Growth of Rice Crop in India and Haryana**

Year	India			Haryana		
	Area	Production	Yield	Area	Production	Yield
1970-71	37.59	42.22	1123	269.2	460	1697
1975-76	39.48	48.74	1235	303.5	625	2063
1980-81	40.15	53.63	1336	483.9	1259	2606
1985-86	41.14	63.83	1552	584.0	166	2797
1990-91	42.69	74.29	1740	661.2	1834	2775
1995-96	42.84	76.98	1797	830.0	1847	2225
2000-01	41.71	84.98	19.01	1054.3	2695	2557
2005-06	43.66	91.79	2102	1046.6	3194	3051
2009-10	41.87	41.87	2133	-	3625	-
ACGR	.037	-0.03	2.24	5.58	7.38	2.37

Source: Agriculture Statistics at a Glance (2008), Hand Book of Statistics on the Indian Economy (2010) and Statistical Abstract of Haryana (2008)

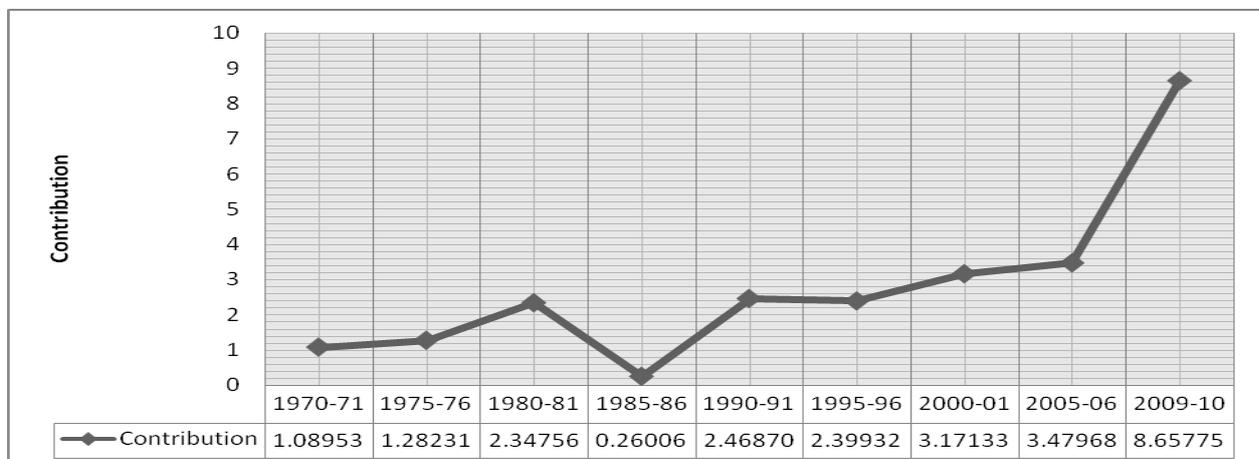
In India, the contribution of rice crop has 42.34 per cent (Approx) in total food grain crops, 35.36 per cent in total area cultivation under food grain crops, while the average yield per hectare of rice has 2011kg/ha [1914 kg/ha in Kharif and 3027 kg/ha in Rabi season] (ASG: 2008). West Bengal, Andhra Pradesh and Utter Pradesh have the leading States of India in rice production. Further, jointly the contribution of these States has 40.42 per cent in total



rice production in India (ASG: 2008). The area, production and yield (productivity) were 37.59 million hectare, 42.22 million tons and 1123 kg/ha and it have increased from 41.87 million ha, 41.87 million tons and 2133 kg/ha in 2009-10. During the same period the average compound growth rate (ACGR) of area, production and productivity has been .037, -0.03 and 2.24 per cent respectively. In case of Haryana, the contribution of rice crop has 24.02 per cent in total area under food grain crops, while 23.60 per cent in total food grain production. The area and yield of rice crop have increased from 269.2 thousand ha, 460 thousand tons and 1697 kg/ha in 1970-71 to 1046 thousand ha and 3051 kg/ha in 2005-06, while production has increased from 460 thousand tons to 3625 tons from 1970-71 to 2009-10. The ACGR of area, production and yield has been 5.58, 7.38 and 2.37 per cent respectively during the same period.

**Figure 2**

**Contribution of Haryana in Total Rice Production (1970 to 2010)**

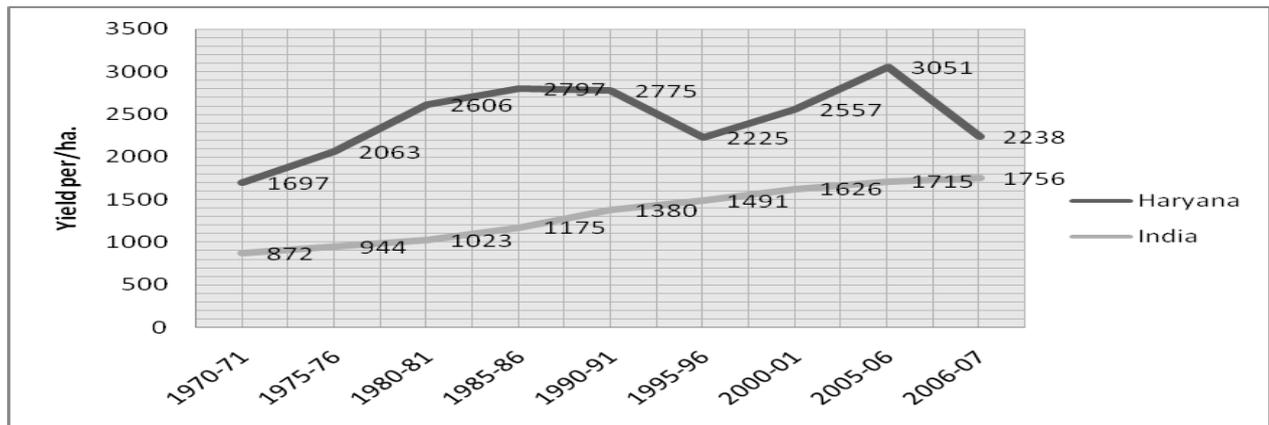


Source: Authors Calculations from *Agriculture Statistics at a Glance (2008)*, *Hand Book of Statistics on the Indian Economy (2010)* and *Statistical Abstract of Haryana (2008)*

It can be observed from figure 2 that the contribution of Haryana in total rice production of India was 1.08953 in 1970-71 and it increased to 8.65775 in 2009-10. The trend line in figure 2 shows that the contribution of Haryana has continuously increased except 1985-86. The trend line also reveals that the maximum contribution of Haryana has 8.65775 in 2009-10, while minimum had 0.26006 in 1985-86. The ACGR of contribution of Haryana in rice production have been 7.41 per cent during the period under consideration.



**Figure 3**  
**Trends of Rice Productivity in India and Haryana**



Source: Agriculture Stastics at a Glance (2008) and Stastical Abstract of Haryana (2008)

It can be observed from figure 3 the rice productivity of Haryana State has much more as compared to aggregate level of India from 1970-71 to 2006-07. The trend line in figure 3 reveals that the rice productivity at aggregate level of India has been continuous increasing trend, while in case of Haryana, the rice productivity was increased from 1970-71 to 1990-91 and after it decreased to 1995-96 and again increased to 2005-06 and further decreased in 2006-07.

**Table 2**  
**Correlation Matrix**

Variables	YIELD	IRRINT	AGLABOU R	EDUTIOC A	PASTCON	TRACTOR	DIARY
YIELD	1	.344	.396	-.244	.650(**)	.027	.161
IRRINT	.344	1	-.295	.153	.050	-.167	-.234
AGLABOUR	.396	-.295	1	-.549(**)	.346	.121	-.125
EDUTIOCA	-.244	.153	-.549(**)	1	-.179	.387	-.100
PASTCON	.650(**)	.050	.346	-.179	1	.512(*)	.056
TRACTOR	.027	-.167	.121	.387	.512(*)	1	.000
DIARY	.161	-.234	-.125	-.100	.056	.000	1

\*\* Correlation is significant at the 0.01 level (1-tailed).

\* Correlation is significant at the 0.05 level (1-tailed).

Table 2 shows the association between rice productivity (yield per hectare) and irrigation intensity, agriculture labour per ha, education of farmer, per hectare pesticide consumption, number of tractor per hectare and number of dairy cooperative per hectare. Irrigation



intensity, agriculture labour, per hectare pesticide consumption, number of tractor per hectare and number of dairy cooperative per hectare are positive associated, while education of farmer is negative associated to rice productivity (yield) per hectare in the State. Out of these, only one variable (i.e., pesticide consumption per hectare) is statistically significant linked to productivity of rice.

**Table 3**  
**Determinants of Rice Productivity**

Variable	Un-standardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	.696	1.434		.485	.637
IRRINT	.329*	.159	.314	2.066	.063
AGLABOUR	.234	.134	.324	1.750	.108
PASTCONS	.412*	.083	.829	4.964	.000
TRACTOR	-.534*	.227	-.440	-2.349	.039
DAIRY	.093*	.051	.256	1.830	.094
EDUCATIO	.752	.622	.238	1.209	.252
F-Statistics (df:6,11)				8.524 (F-statistics)	.001
R-Square					.823
Adjusted R-Square					.726
Standard Error of the Estimate					.06107

**Dependent Variable:** YIELD PER HECTARE (PROXY OF PRODUCTIVITY)

**Independent Variables:** IRRIGATION INTENSITY, AGRICULTURE LABOUR, PESTICIDE CONSUMPTION, NUMBER OF TRACTOR PER HECTARE, NO. OF DAIRY COOPERATIVES AND EDUCATION

The effects of all factors studied were investigated through multiple regression analysis. The Cobb Douglas type production function has been estimated using the ordinary least square (OLS) method. The R-square value of 0.823 can be regarded as quite a good fit in view of cross sectional data involved in this study, since it implies that about 82.30 per cent variation in yield explained by independent variables included in the study. The F-Statistics also indicate that the combination of all individual variables is good. The value of irrigation intensity coefficient has .329. It indicates that one percent increase in irrigation intensity increasing the yield by .329 per cent. The coefficient of agriculture labour was found .234, but it is not statistically significant. The coefficient of pesticide consumption per hectare has also highly significant (.412). This indicates that one percent increase in use of pesticide consumption per hectare increased yield by .412 per cent. The coefficient of number of



tractor per hectare has negative (-.534) and it is statistically significant. It means one per cent increase in use of tractor in cultivation of rice crop yield decreased by .534 per cent. The coefficient of number of dairy cooperatives per hectare has .093 and it is also statistical significant. It means number of dairy cooperatives per hectare improves the .093 per cent yield per hectare of rice. No doubt, education plays a vital role in adoption of improved technology and attaining higher productivity level. The educated farmers could manage various farm practices in a better way (Ishtiaq Hassan et al. 2010). The result of the study indicated that coefficient of education was positive (.752), but not statistically significant. It means that one per cent increase in education could enhance rice productivity by .752 per cent.

## **CONCLUSION**

Throughout this study, we analyzed the growth trends of rice crop in India & Haryana and also find out the determinants of rice productivity with the help of appropriate statistical tools and techniques. In this study, we have taken time period from 1970-71 to 2009-10. After analyzing the data, we find that the ACGR of area, production and yield of rice crop in India was 0.37, -0.03 and 2.24 per cent respectively, while in case of Haryana it was 5.58, 7.38 and 2.37 per cent respectively during the period under study. The contribution of Haryana in total rice production of India was 1.08953 in 1970-71 and it increased to 8.65775 in 2009-10. The minimum contribution of Haryana had 0.26006 per cent in 1985-86. The ACGR of contribution of Haryana in rice production has 7.41 per cent during the period under consideration. The rice productivity of Haryana State has much more as compared to aggregate level of India from 1970-71 to 2006-07. The study also indicates that, irrigation intensity, pesticide consumption per hectare and dairy co-operatives per hectare are positively, while number of tractor per hectare is negatively and significantly associated to rice productivity. Both, education of farmer and agriculture labour per hectare are positively linked to rice productivity, but not significant.

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