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Research Paper

Determinants of wheat productivity with special reference to Haryana

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ABSTRACT

In this study, we have analyzed the growth, spatial pattern and fond out determinants of wheat productivity in Haryana. The CSS indicates that the Kaithal, Karnal, Jind, Hisar, Fathehabad and Sirsa districts have topped position; while, Gurgon, Rewari and Mehandergarh have last position in the State in the level of wheat crop intensity. Out of these 11 variables, only one variable have been found significantly associated (negative) with wheat productivity (*i.e.*, Irrigation intensity). So, we suggest that government of Haryana should be boost foresting and climate education to increase the rainfall, providing low water absorbable seeds to save the water and appropriate utilization of water, providing sufficient finance as well as providing tractors at low, affordable cost, minimum paper work and minimum security for enhance wheat productivity. Because, continue boosting the wheat productivity is the moral responsibility to North-Western (N-W) states of India in general and Haryana in particular to achieve the goal of 100 per cent hunger free India.

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Key words : Wheat, productivity, Moral responsibility, Spatial pattern

INTRODUCTION

Haryana is an agricultural dominant state of India. It has been contributing approximately 12 per cent to total wheat production of India and is the third largest producer after Uttar Pradesh and Punjab in total wheat production. After green revolution, the progress in wheat production in Haryana has been very fast. The area, production and productivity (yield) of wheat crop in Haryana have increased from 743000 hectare, 1059000 tons, and 1425 kg/ha in 1966/67 to 237100 hectare, 10059000 tons and 4232 kg/ha, respectively in 2006/07 (SAH: 2008). While, same time at national level, the wheat productivity per hectare has increased only from 887 kg/ha to 2708 kg/ha, during the same period (ASG: 2008). Mainly, two factors are responsible for high growth of wheat crop in Haryana, first, the natural climate of State is very congenial to the crop and, second the green revolution programme (GRP) started and implemented with systematic manner and was evenly distributed across the state (Singh and Kodan, 2011). So, the coverage area of irrigation, availability of fertilizers, new technology of harvesting the crop, availability of finance have significantly increased under the GRP. Since, its inception, long time approx forty years implementing the green revolution programme for the agriculture development in India as well as in Haryana. In India, wheat is the second most important staple food after rice and about 60 per cent of its output is contributed by North-Western (N-W) India (Singh, 2008).Total production of food grains in India has increased from 50.82 million tonnes in 1950/51 to 230.67 million tonnes in 2007/07, while, wheat production has also increased significantly from 6.46 million tonnes in 1950/51 to 78.40 million tonnes in 2007/08 (ESI: 2008). Yet, we have not been able to eliminate hunger from India and also we have not achieved the goal of 100 per cent hunger free India causing a serious way of hindrance in the nation. In the changed global economic scenario, the crop economy deserves special attention, regular growth pattern, productivity variations and cost structure in cultivation, paving way to farmers increased margins without affecting the consumers of wheat. Hence, the Government of India should make

systematic efforts in the context of food security . This is because; pressing need is also being felt for increasing the share of exports despite of meeting the domestic requirements. The motive behind the study was to analyze deeply the growth of productivity (yield) of wheat crop and to find out its determinants in general and in Haryana in particular, with the help of simple and advanced statistical techniques.

Why need of the study?

Table 1 obviously indicates that a large scope of wheat production has been available in India in general and in Haryana in particular. So, both governments should take systematic and sustainable steps in context of achieving the optimum level of production of wheat. Thus, farmers' income will be increasing one hand and removing hunger from India other hand. Therefore, the present study is systematic effort in this context. The objectives of the study are as follows: to study the growth of wheat crop in Haryana, to examine the spatial pattern of wheat crop intensity in Haryana; and to search the determinants of wheat productivity in Haryana.

MATERIALS AND METHODS

The necessary relevant data were collected from the Statistical Abstract of Haryana (2008), Agriculture at a Glance (2008), and Economic Survey of India (2010).

Limitation of the study:

Mewat district has not been considered due to insufficient availability of data.

Plan of analysis:

The collected data has been transcribed in to long sheets from going suitable forms, tables have been formulated and analyzed using a wide range of appropriate techniques such as-mean, S.D., C.V., average compound growth rate (ACGR), and multiple regression method. The study covers the period from 1966/67 to 2006/07.

Multiple linear regression analysis:

Multiple regression represents a logical extension of more than two variables analysis, under it, more than one independent variables are used to estimate the values of a dependent variable. The multiple regression equation describes the average relationship between more than two variables and this relationship is used to predict or control the dependent variables. The formula for calculating multiple regression is as follows:

$$Y= a_0 + a_1X_1+a_2X_2 + \dots a_n X_n + \varepsilon \quad \text{..... (i)}$$

Where X_1, X_2 etc are regressor variables, a_1, a_2 and so on, are the parameters to be estimated from the data and ε is the error term following classical ordinary least square OLS assumptions *i.e.*, the deviations ε is assumed to be independent and normally distributed with mean 0 and standard deviation (σ). The empirical model variables, their proxies, and the predicted coefficient signs are summarized in Box 1.

Table 1: State wise yield gap between production potential and actual yield at field level (wheat crop)

State	Yield potential Tones/ha	Actual yield Tones /ha	Per cent yield gap	Yield gap Tones /ha	Area million ha	Possible additional production million Tones
Bihar	3.65	1.78	104.80	1.87	2.03	3.79
Gujarat	4.03	2.68	50.50	1.35	0.73	0.98
Haryana	4.75	3.96	19.80	0.79	2.32	1.83
Himachal Pradesh	2.61	1.38	89.60	1.23	0.36	0.44
Madhya Pradesh	3.29	1.78	84.30	1.51	4.14	6.25
Maharashtra	3.41	1.33	155.50	2.08	0.76	1.58
Punjab	4.46	4.20	6.10	0.26	3.48	0.90
Rajasthan	3.94	2.79	41.30	1.15	2.01	2.31
Uttarakhand	3.38	1.87	80.50	1.51	0.39	0.58
Utter Pradesh	4.20	2.79	50.50	1.41	9.00	12.69
West Bengal	2.76	2.31	19.40	0.45	0.40	0.18
Total	40.48	26.87	702.30	13.61	25.62	31.53

Source: Kurukshetra, May, 2009, p. 10

Box 1: Possible determinants of wheat productivity in Haryana

Sr. No.	Variables	Definition
Dependent variable		
1.	Y	Wheat productivity (Yield per hectare) in kg/ha
Independent variables		
1.	X_1	Rain fall (in inches)
2.	X_2	Average size of land holding
3.	X_3	Irrigation intensity
4.	X_4	Credit/deposit ratio
5.	X_5	Agriculture labours
6.	X_6	No. of factory worker (per lakh population)
7.	X_7	Education rate
8.	X_8	Fertilizer consumption (in kg/ha)
9.	X_9	Pesticide consumption (in kg/ha)
10.	X_{10}	No. of tractor (per ha)
11.	X_{11}	No. of diary co-operative (per ha)

RESULTS AND DISCUSSION

Table 2 depicts that the area, production and yield of wheat crop in Haryana have increased from 743000 hectare, 1059000 tons, and 1425 kg/ha in 1966/67 to 2377100 hectare, 10059000 tons, and 4232 kg/ha, respectively in 2006/07. While, during the period under study, the ACGR of area, production and yields of wheat crop have been 2.95, 5.29 and 2.76 per cent, respectively (Fig. 1). On the other hand, during same time, the ACGR of area, production and yield of wheat crop have only 1.97, 4.85 and 2.83 per cent, respectively at national level (ASG: 2008). It is clear from the ACGR, the production, of wheat crop has significantly increased after implementation of GRP in Haryana. During the same period, the ACGR of area and production has been 2.95 and 5.79 per cent, respectively. Due to GRP, the yield per hectare has radically increased. The main purpose of the GRP was to increase the productivity of food grains, through modernization of agriculture and further to reduce the dependency of food grains on other countries like USA or alternatively the main purpose of GRP was to achieve the self-sufficiency in food grains production in India.

The high wheat crop intensity areas were calculated among all 20 districts of Haryana. In order to reveal the spatial pattern and to determine the high intensity of wheat crop in all districts of Haryana the CSS values have also been calculated with the help of SS and the same have been categorized into three parts - high, medium and low level of, wheat crop intensity (Table 4). On the basis of CSS, we found that Kaithal, Karnal, Jind, Hisar,

Table 2: Trend in growth of wheat crop in Haryana (Production, yield, area under wheat crop)

Year	Area in '000 hac.	Production in '000 Tones	Yield in kg/per hac.
1966/67	743.0	1059.0	1425.0
	(100)	(100)	(100)
1970/71	1129.3	2342.0	2074.0
	(151.99)	(221.11)	(145.54)
1975/76	1226.0	2428.0	1980.0
	(165.00)	(229.27)	(138.94)
1980/81	1479.0	3490.0	2360.0
	(199.05)	(329.55)	(165.61)
1985/86	1701.3	5260.0	3094.0
	(228.97)	(496.69)	(217.12)
1990/91	1850.1	6436.0	3479.0
	(249.00)	(607.77)	(244.14)
1995/96	1972.1	7291.0	3697.0
	(265.42)	(688.40)	(259.13)
2000/01	2354.8	9669.0	4106.0
	(316.93)	(913.00)	(288.14)
2005/06	2302.7	8853.0	3844.0
	(309.90)	(835.97)	(269.75)
2006/07	2377.1	10059.0	4232.0
	(319.93)	(949.85)	(296.98)
Average	1713.5	5688.7	3029.1
ACGR	2.95	5.79	2.76

Source: Statistical Abstract of Haryana: 2008

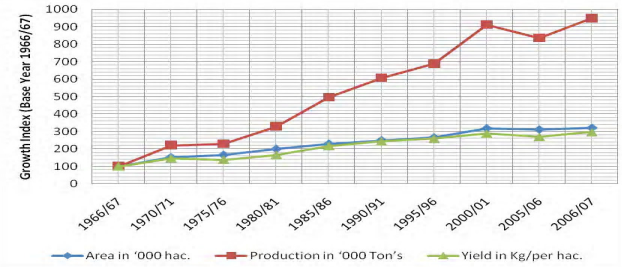


Fig.1: Growth index of area, production and yield of wheat crop in Haryana

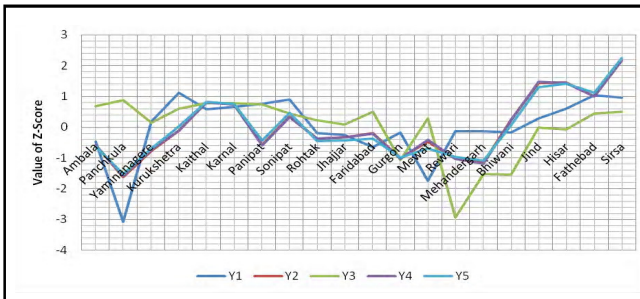


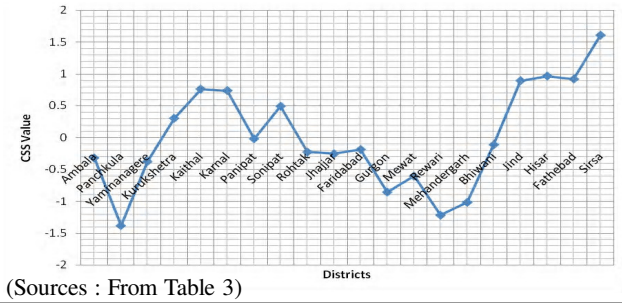
Fig. 2: Value of Z-score and each selected variables district wise

Table 3 : Spatial pattern of high wheat crop intensity area in Haryana (District wise: 2006/07)

Sr. No.	Districts	Y_1	Y_2	Y_3	Y_4	Y_5	CSS
1.	Ambala	-0.4649	-0.5838	0.67861	-0.5887	-0.629	-0.317
2.	Panchkula	-3.0645	-1.6186	0.88321	-1.5822	-1.523	-1.381
3.	Yaminanagere	0.16903	-0.7691	0.15573	-0.7355	-0.695	-0.375
4.	Kurukshetra	1.10821	-0.1204	0.61041	-0.1103	0.033	0.304
5.	Kaithal	0.56505	0.82166	0.79228	0.80954	0.827	0.763
6.	Karnal	0.65588	0.74444	0.79228	0.73595	0.761	0.738
7.	Panipat	0.75398	-0.5683	0.74681	-0.5887	-0.430	-0.017
8.	Sonipat	0.88114	0.34287	0.45127	0.33118	0.463	0.494
9.	Rohtak	-0.1888	-0.3675	0.22393	-0.3677	-0.455	-0.226
10.	Jhajjar	-0.2632	-0.3367	0.08753	-0.3311	-0.430	-0.254
11.	Faridabad	-0.6466	-0.1979	0.49674	-0.2207	-0.364	-0.186
12.	Gurgon	-0.1743	-1.0008	-1.0719	-1.0303	-0.993	-0.854
13.	Mewat	-1.7347	-0.4757	0.29213	-0.4047	-0.695	-0.603
14.	Rewari	-0.1379	-1.0162	-2.9360	-1.0303	-0.960	-1.216
15.	Mehandergarh	-0.1379	-1.1398	-1.5265	-1.1775	-1.092	-1.014
16.	Bhiwani	-0.1779	0.23476	-1.5493	0.22078	0.066	-0.11
17.	Jind	0.27258	1.43945	-0.0034	1.4719	1.291	0.894
18.	Hisar	0.59957	1.45489	-0.0716	1.4351	1.424	0.968
19.	Fathebad	1.03555	0.99155	0.45127	0.99353	1.126	0.919
20.	Sirsa	0.95017	2.16535	0.49674	2.17105	2.252	1.607

Source: Author's Calculations

Note: Y_1 = Yield per Hectare; Y_2 = Wheat Crop Area under Irrigation; Y_3 = Wheat Crop Area under HYV; Y_4 = Wheat Crop Areas as per cent to Gross Cropped Area in Haryana; Y_5 = per cent share in Total Wheat Production in Haryana and CSS = Composite Standard Score



(Sources : From Table 3)

Fig. 3: Spatial pattern of high wheat crop intensity area in Haryana (Value of composite standard score)

Fathehabad and Sirsa districts have high wheat crop intensity; Ambala, Panchkula, Yammunager, Kurukshetra, Panipat, Sonipat, Rohtak, Jhajjar, Faridabad, and Mewat districts have medium wheat crop intensity and only three districts out of 20, namely, Gurgon, Rewari and Mehandergarh have low wheat crop intensity. The maximum CSS has been recorded in Sirsa districts and minimum in Panchkula district. The range of wheat crop intensity has been + 1.607 to – 1.381.

Table 5 reveals the determinants of wheat productivity in general and Haryana in particular. To find out the wheat productivity, 11 possible variables were selected. Out of these 11 variables, only 1 variable have been found significantly associated (negative) with wheat productivity (*i.e.*, irrigation intensity). Out of 11 variables, six (*i.e.,* average size of land holding, irrigation intensity, no of factory worker (per one lak population), and education rate, fertilizer consumption and dairy co-operative per ha) variables have been negatively associated with wheat productivity; while, five variables

Table 4 : Spatial pattern according to high level of wheat crop intensity area in Haryana (District wise: 2006/07)

CSS value	High level of wheat crop intensity	No. of districts	Name of the district
Above + 0.50	High	6	Kaithal, Karnal, Jind, Hisar, Fathehabad and Sirsa
+ 0.50 to -0.75	Medium	11	Ambala, Panchkula, Yammunager, Kurukshetra, Panipat, Sonopat, Rohtak, Jhajjar, Faridabad, and Mewat
Below -0.75	Low	3	Gurgon, Rewari and Mehandergarh

(Source: From Table 3)

Table 5 : Determinants of wheat productivity in Haryana

Variables	Unstandardized coefficients		t	Sig.
	B	Std. Error		
(Constant)	7333.605	3366.840	2.178	.066
Rain fall (in inches)	.793	1.528	.519	.620
Average size of land holding	-249.162	238.027	-1.047	.330
Irrigation intensity	-4.806*	1.090	-4.410	.003
Credit-deposits ratio	1.481	3.371	.439	.674
Agriculture labourers	32.764	34.049	.962	.368
No of factory Worker (per one lak population)	-.033	.053	-.623	.553
Education Rate	-33.879	36.543	-.927	.385
Fertilizer Consumption	-.194	.827	-.234	.822
Pesticide Consumption	69.777	152.803	.457	.662
Tractor per ha.	1864.639	5595.773	.333	.749
Dairy Co-operative per ha.	-80799.119	59759.845	-1.352	.218

Source: Researcher's Calculations
Note: **Significant 5 per cent and *** Significant 10 per cent

(*i.e.,* rain fall (in inches), credit-deposits ratio, agriculture labourers, pesticide consumption and tractor per ha) have been positively associated with wheat productivity. The 'F' statistics strongly indicates that all 11 possible variables were jointly significant influencing the wheat productivity; the value of R^2 is .912. It means 91.20 per cent variance in wheat productivity by 11 selected variables.

Conclusion and policy recommendations:

In this study, we have analyzed the growth, spatial pattern and, moreover, find out the determinants of wheat productivity in Haryana, with the help of simple and advanced statistical tools. For this purpose, both types of data *i.e.*, time series and cross sectionals data were taken. The forgoing analysis clearly indicates that, the performance of Haryana in wheat production has been better than the aggregate of all India for the same period (Table 1). The CSS indicates that the Kaithal, Karnal, Jind, Hisar, Fathehabad and Sirsa districts have topped the position with above + .50 CSS; while, Gurgon, Rewari and Mehandergarh have the last position with below -0.75 CSS in the State in the level of wheat crop intensity. Low availability of water and soil nature both are the main causes behind the low crop intensity in Gurgon, Rewari and Mehandergarh districts. To find out the wheat productivity, 11 possible variables were selected. Out of these 11 variables, only one variable have been found significantly associated (negative) with wheat productivity (*i.e.,* Irrigation Intensity). Five variables out of eleven variables {*i.e.*, rain fall (in inches), credit-deposits ratio, agriculture labourers, pesticide consumption and tractor per ha} have been positively associated with wheat productivity. Therefore, the government of Haryana should boost the foresting and climate education to increase the rainfall, providing low water absorbable seeds to save the water and appropriate utilization of water, providing sufficient finance as well as providing tractors at low, affordable cost, minimum paper work and minimum security. Because, yield gap of wheat productivity is 0.79 per cent per ha or 1.83 million tones in Haryana (Table 1). Thus, a large scope is available in Haryana to wheat production; while wheat is the second most important staple food after rice in India and about 60 per cent of its output is contributed by North-Western (N-W) India . So, there is no doubt, Punjab, UP and Haryana are playing important role in food security in India. The natural climate of the State (Haryana) is very congenial to the crop. Thus, continue boosting the wheat productivity is the moral responsibility to North-Western (N-W) states of India in general and Haryana in particular to achieve the goal of 100 per cent hunger free India.

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