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Technical efficiency of bajra crop on different size of farms in western region of Uttar Pradesh

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Abstract
Uttar Pradesh is the 2nd largest state in India. The economics of Uttar Pradesh is mainly based on agriculture and about 65% of the total population is dependent on agriculture the main crop of Uttar Pradesh is Wheat. Wheat is the state's principal food crop and sugarcane is the main commercial crop. It is produced in the largest part of the state in about 24% of agricultural Land. Taking into account the significance of the aforementioned facts to measures the technical efficiency of Bajra crops on different size of farms in western region of Uttar Pradesh year 2014-15. The results of investigating technical efficiency of the sample farm households under bajra crops indicated that output produced was less than the potential output to the extent of about 19 per cent in bajra, respectively. On overall basis, however, much variation observed across farm size groups.

Keywords: Agriculture, technical efficiency, Cobb-Douglas production function

Introduction
Agriculture plays a vital role in India's economy, as 54.6 per cent of the population is engaged in agriculture and allied activities (Census 2011) and it contributed 17.4 per cent to the country gross value added for the year 2016-17 (at current prices). As per the land use statistics (2014-15), the total geographical area of the country is 328.7 million hectares of which reported net sown area is 140.1 million hectares and gross cropped area is 198.4 million hectares with a cropping intensity of 142 per cent. The net area sown shared 43 per cent of the total geographical area. There has been a continuous decline in the share of agriculture and allied sector in the gross value added from 18.6 per cent in 2013-14, 18.0 per cent in 2014-15, 17.5 per cent in 2015-16 and 17.4 per cent in 2016-17 at current prices (Agriculture Annual Report, 2017-18) [3]. The 2017 global hunger index had rated India under 'serious' category with respect to under nutrition child stunting and child birth weight India was ranked 100 among 119 countries for which global hunger index was constructed. The population of India is projected to be 1.65 billion by 2050. Various studies indicate that the demand for food grains will grow by about 50 percent in 2050. (IFPRI, 2018). Climate change is also posing serious threat to food security in India. The intensity and extent of extreme climate events, such as drought, high rise and fall in temperature, floods, untimely and unevenly rainfall are adversely affecting agricultural production, farm incomes and food security. The available estimates reveal a loss of 10-40 per cent in food production due to rise in temperature (Joshi, 2016). Various estimates suggest that India will experience an increase of 2.2 to 2.9 degree Celsius in average temperature by 2050 affecting overall production of crops. In addition, increasing demand for industrialization, urbanization, housing and infrastructure is forcing conversion of agricultural land to non- agricultural use; therefore, the scope for expansion of the area available for cultivation is limited (Saxena, 2017) [13]. The state of Uttar Pradesh has seen regular fluctuation in the growth rate in area, production and yield. The fluctuation shows the vulnerability of the sector to seasonal conditions. (Koshal, 2012) [14]. Category wise variation in resources across the farm size groups lead to varying efficiency in production of crops. Majority of the land holdings are very small in the region. The adoption of well proven technology is constrained due to small size of holdings and poor farm resources.

The Cobb-Douglas production function was used to compute the technical efficiency. It was found that the Cobb- Douglas approximation gave a fair fit with the range of observations. The study also computed the technical efficiencies of different states. The researcher found that for each state there was a different estimate of efficiency, according to the factors of production included in the analysis Farrell (1957) [6]. Examined the technical efficiency, Allocative efficiency and economic efficiency for a sample of sixty farmers in the Dajabon region by using maximum likelihood techniques were used to estimate a Cobb-Douglas production frontier, which was then used to derive its corresponding dual cost frontier. These two frontiers were the basis for deriving farm-level efficiency measures Boris (1997) [5]. Technical inefficiency in the production of rice was negatively related with farm size, education of the farmer, experience, extension contacts and percentage of good land and positively related with age and fragmentation of the land Reddy and Sen (2004) [11]. Examined the technical efficiency and environmental impact of Bt cotton & Non Bt cotton in North India for the period from 2007-08, using stochastic frontier production function and the environmental impact quotient (EIQ). The results revealed that average technical efficiency was higher in Bt cotton farming. Roughly 80 per cent of Bt cotton farms fall in the efficiency range of 80 to 95 per cent; this figure reduced to 60 per cent on Non Bt cotton farms Manjunatha *et al.* (2011) [9]. Examined the technical efficiency of cocoa production in south west Nigeria for the period 2012. The result showed that cocoa enterprise was profitable, and in terms of technical efficiency, cocoa farmers in the region were relatively production efficient Ekiti state had the highest mean efficiency relative to Ondo state and Osun state. They also reported that the years of schooling had a positive influence on the technical efficiency of farmers while area of land cultivated and age of cocoa trees had a negative influence. Examined the efficiency in foodgrains production in India for the period from 1960-61 to 2013-14, using DEA and SFA frontier approach. High average efficiency in farming operations for both the frontier methods was observed. The period after 1990 had witnessed improved agricultural performance as inferred from the frequency distribution of the efficiency scores which indicated that during this period the overall efficiency scores had been higher and there was not a single year in which the efficiency levels had been less than 90 per cent Mathur (2018) [10]. Taking into account the significance of the aforementioned facts a study of technical efficiency in major crops was planned for western region of Uttar Pradesh. So in this case "Examine the technical efficiency of major crops on different size of farms in western region of Uttar Pradesh".

Methodology

The study is based on primary study and it is conducted in the western region of Uttar Pradesh. The technical efficiency of major crops of region is examined using primary data. Stratified random sampling and Cluster sampling technique has been adopted for the selection of respondent households of the western region for the agriculture year 2014-15.

Sampling Technique

At the first stage out of total six divisions in the western region of Uttar Pradesh two divisions *viz*., Meerut Division and Aligarh Division were selected randomly. From each selected division two districts had been selected purposively, each one with highest and lowest productivity of major crops. In Meerut Division, Meerut District was selected on the basis of high productivity and Ghaziabad District was selected on the basis of low productivity District, purposively. In Aligarh Division, Aligarh district was selected on the basis of high productivity, whereas, Kashganj District was selected on the basis of low productivity district, purposively. At next stage one development block was selected randomly from each selected district. From Meerut District, Mawana development block and from Ghaziabad district, Muradnagar Development block were selected randomly. Similarly from Aligarh district, Koil development block and from Kashganj district, Kashganj development block were selected randomly. Thereafter, one village was selected randomly from each selected development block and three adjoint villages were also included to form a cluster to select respondent farmers. At last stage sixty farmers (15 each from marginal, small, medium and large farm size groups) were selected randomly from each cluster. Hence, total sample size comprised of 240 farm households to collect primary data for the study. Under Mawana development block Tigri village was selected randomly and Khalidpur, Niloha and Kareempur adjacent villages were included to form cluster. In case of Muradnagar development block Didholi village was selected randomly and Sultanpur, MohammadPur and Jalalabad adjacent villages included to form cluster. Similarly under Koil development block Joraver Nagar village was selected randomly and Gadiyawali, Boner, Balrampur and Girdharpur adjacent villages were included to form cluster. In case of Kashganj development block Janhageerpur village was selected randomly to form a cluster with adjacent Mahawar, MohammadPur and dolna villages.

Different crops are grown in various seasons in the region, however, major crops of the region are those crops which together accounted for nearest 75 per cent of the gross cropped area arranged in descending order. Major crops were selected on the basis of cropping pattern of western region of the Uttar Pradesh state in 2014-15 shown in table No. 1.

Table 1: Major Crops grown in western region of Uttar Pradesh (2014-15)

Crop	Per cent of gross cropped Area	Cumulative Total
Wheat	39.00	39.00
Paddy	18.33	57.33
Sugarcane	14.33	71.33
Bajra	8.56	79.89
Potato	4.25	84.14
Maize	3.56	87.7
Urd	0.86	88.56

So, according to cumulative total of the per cent area in term of major crops wheat, sugarcane paddy and bajra are found as major crops of the western region of Uttar Pradesh on the basis of cropping pattern 2014-15, which is shown in the above table but bajra crop selected at random for measuring technical efficiency in western region of Uttar Pradesh.

Analytical framework

The estimation of technical efficiency in the production of bajra crops are indicated as difference in the rates of adoption of technical change. It also help to determine the effectiveness of growth promoting institutions such as education, extension services, and credit institution of production practices available to the farmers. Technical efficiency is examined to identifying the possibilities for further increase in output of any crop while conserving the resource use. The technical

efficiency refers to the proper choice of production function among all those activity in use by various farmers in the agriculture. Estimation of technical efficiency involved two stage procedures. Initially, estimates are obtained of frontier function a model which is neutrally upwardly scaled version of the ordinary least squares or average model. In the second stage, individual farms deviation from the frontier is used to estimate the technical efficiency. This also indicate that how much extra output could be obtained if a particularly farm was to reach on the frontier. For the measurement of technical efficiency the uniform weighted average prices of input and output are used for all the sampled farmers. Quantities of output and input on per hectare basis are used as the weights.
The index of technical efficiency is constructed using the following formula:

$T.E.j = Yj/ Y^*j$

OR

$$\ln T.E.j = \ln Yj - \ln Yj^* \quad (1)$$

Where,
T.E.j = Technical Efficiency of jth farmer
Yj = Actual gross return in Rs./ha of jth farmer
Yj * = Potential (maximum possible) gross return of jth farmer at present input use
Ln = Natural logarithm
Three methods are generally used for developing frontier production function as well as for calculating potential (maximum possible) gross return i.e. Y*j. These are Linear Programming, Corrected Ordinary Least Square (COLS) Technique and Maximum Likelihood Method.
Out of these, Corrected Ordinary Least Square technique is used in the present study to develop frontier function for each farmer, because COLS technique is simple and very widely used method for developing frontier production function (Russell and Young, 1983). Due to presence of multicollinearity, per farm crop cultivation data were transformed in per hectare input use and output of for different farm size groups, calculate zero order correlation matrices.

Corrected ordinary least squares (COLS) method
The Cobb- Douglas production function, as hypothesized in equation (1) stated as followed in log form:

$$Y = a X1^{b1} X2^{b2} X3^{b3} X4^{b4} X5^{b5} X6^{b6} X7^{b7} + Vi$$
or
$$\log Yj = a_0 + biXi + Vi. \quad (2)$$

Where,
Yj = Gross income from jth crop of the ith farm (Rs. per ha.)
Xi = Level of tth variables used in jth crop (quantity /value per hectare)
a = Constant term
bi = Regression Coefficients of the respective resource
Vi = Error term

After the estimation of above production function, the estimated value of lnYj * has been estimated for each farmer, using the original data set. Then residual, μj is calculated as follows:

$$\mu j = \ln Yj - \ln Yj \wedge \quad (3)$$

where,
lnYj = Actual gross return in Rs./ha of jth farmer
lnYj^ = gross return of jth farmer, calculated by using original input data set in above estimated production function (2).

By the equation (3) a series is found. Among all the μj, the larger positive (+) is selected and denoted as μj max. Then, the correction is made in production function (2) by sifting the constant term upwardly by an amount equal to the value of μj max.
Thus the new form of production function has beecom as follows:

$$\ln Y = (\ln a + \mu j \max) + bi \ln Xi. \quad (4)$$

By combining the term (ln a) and (μj max), a new term is found and called as "ln a0". this (ln a0) has been assumed as the constant term for the frontier production function of estimated production function.
The form of frontier production function is as follows:

$$\ln Y = \ln a0 + bi \ln Xi. \quad (5)$$

By the use of frontier production function and the farmer's original input data set, Yj* estimated for each farmer. Therefore, technical efficiency of the farm households, across farm size group, has been worked out.

Result & Discussion on technical efficiency
As explained in the above section, the technical efficiency has been measured through an index of actual output of a farmer and the maximum possible output at his given level of resource use. At the first step, Cobb-Douglas production function has been estimated at the average resource use level of the sample farmers. Then the frontier production function has been obtained by finding the largest error amount (i.e., μj = ln Yj – ln yj ^) and shifting the intercept of estimated Cobb-Douglas production function to find out the largest possible output level at the average resource use of the sample farmers.

Cropping pattern followed by sample farm households in the western region of Uttar Pradesh
In the western region the technical efficiency indices have been constructed for each farm in different size group as well as for overall farm size group by estimated COLS frontier. Based on cropping pattern followed by farm households, bajra, wheat and sugarcane appeared as major crops which together contributed 70 per cent of gross cropped area in the western region of the state, during 2014-15. On the basis of cumulative total of the selected crops, total three crops; *viz*., wheat, sugarcane and bajra emerged as the major crops of the western region of Uttar Pradesh based on primary survey, out of these crops bajra crop selected for estimating the technical efficiency on different size of farms which is shown in table 2 & 3.

Table 2: Cropping pattern followed on sample farm household in western region of Uttar pradesh during 2014-15 (Hectare per farm)

Crop	Farm Size Group				
	Marginal	Small	Medium	Large	Overall
Maize	0.03(3.17)	0.12(5.23)	0.32(7.35)	0.58(8.45)	0.2(5.62)
Jowar	0.28(27.91)	0.36(15.65)	0.46(10.66)	0.59(8.48)	0.65(18.26)
Urd	0(0.00)	0.03(1.3)	0.04(0.99)	0.1(1.4)	0.03(0.84)
Bajra	0.04(4.37)	0.34(14.78)	0.71(16.45)	1.15(16.62)	0.41 (11.52)
Wheat	0.32(31.88)	0.75(32.61)	1.35(31.20)	2.11(30.45)	1.15(32.3)
R&M	0(0.00)	0.01(0.44)	0.01(0.35)	0.06(0.88)	0.01(0.28)
Potato	0.003(0.33)	0.05(2.17)	0.09(2.14)	0.14(2.08)	0.04(1.12)
Pea	0.03(3.24)	0.05(2.17)	0.08(1.76)	0.11(1.57)	0.08(2.25)
Sugarcane	0.29(29.10)	0.59(25.65)	1.26(29.10)	2.08(30.07)	0.99(27.81)
Gross Cropped Area	1.008	2.3	4.32	6.93	3.56
Net Cultivated Area	0.65	1.45	2.79	4.15	2.29
Cropping intensity in per cent	155.08	158.44	154.79	166.97	155.46

Table 3: Major Crops Grown in Western Region

Major crops in Western Region		
Crop	Area (per cent to GCA)	Cumulative Total
Wheat	32.30	32.30
Sugarcane	27.81	60.11
Bajra	11.52	71.63
Maize	5.62	77.25
Potato	1.12	78.37
Pea	2.25	80.62
Urd	0.84	81.46
R & M	0.28	81.74

Figures in parentheses indicate per cent to gross cropped area

Technical Efficiency of Bajra Crops

On the basis of primary survey three major crops; i.e., sugarcane, wheat and bajra, out of these bajra crop was selected for measuring the technical efficiency of the selected farm household in the western region of Uttar Pradesh. The efficiency index for each farm household category wise as well as for overall farm size is presented in appendix. The descriptive statistics as well as the distributions of farmers (category wise) according to their technical efficiency status (in per cent term) are given in tables 3,4 & 5 for bajra crop.

Status of technical efficiency in bajra cultivation

The technical efficiency index across farm category and overall farm households are presented in appendix. The descriptive statistics as well as the distributions of farmers (category wise) according to their technical efficiency class (in per cent term) are given in tables 6,7 & 8.

Bajra production function estimates: The table 10 reveals that on marginal farms, the quantity of fertilizer has significantly contributed to the value of gross returns. In case of small farmers, bajra production responded significantly and positively to the quantity of fertilizer and machine cost. It indicates that there was room for improving gross return from bajra production by increasing the level of these inputs.

In case of medium and large farmers, value of seed has significantly contributed to the value of gross returns. For overall bajra growers, seed, human labour, and plant protection chemicals have been found positive and contributed significantly. The coefficient of fertilizer has been found to be negative and significant, which indicates that there is further scope of increasing the returns by enhancing levels of these inputs. The coefficient of seed and fertilizer are significant.

Table 4: OLS estimates of the production function in bajra crop in western region during 2014-15

Particulars	Marginal	Small	Medium	Large
Intercept	8.213* (2.338)	2.712(2.389)	6.243**(2.597)	10.620*(3.007)
Seed	0.061(0.102)	0.240(0.148)	0.519*(0.157)	0.319*(0.075)
Human labour	-0.059 (0.080)	-0.117 (0.14)	0.028 (0.043)	0.086 (0.090)
Irrigation	0.187 (0.191)	-0.016 (0.098)	-0.019 (0.087)	0.038 (0.034)
Fertilizer	-0.245* (0.177)	0.466*** (0.191)	0.172 (0.194)	-0.243 (0.277)
Insecticide	0.131 (0.103)	-0.101 (0.146)	0.067 (0.216)	0.040 (0.090)
Machine power	0.240 (0.236)	0.372**** (0.189)	-0.222 (0.170)	-0.039 (0.133)
R square	0.75	0.74	0.82	0.86

Note: *,**,***,****indicate significance at 1, 2, 5, and 10 per cent levels, respectively. Figures in parentheses indicate standard errors.

Table 5: Descriptive statistics of Technical Efficiency of bajra crop in Western region of Uttar Pradesh based on COLS frontier model

Technical efficiency	COLS frontier in sugarcane production			
	Marginal farmers	Small farmers	Medium farmers	Large farmer
Minimum efficiency level	0.60	0.65	0.64	0.64
Maximum efficiency level	0.99	0.99	0.99	0.99
Mean efficiency level	0.81	0.82	0.80	0.81
Variance	0.004	0.004	0.004	0.005
Standard deviation	0.06	0.07	0.06	0.07
Coefficient of variation	8.07	8.31	8.05	8.44

On the above table 10 &11, reveal that in bajra production, lowest per cent medium and large farm size groups, whereas, at overall level 58 per cent has been recorded. Highest efficiency level has been found more than 99 per cent across the farm size groups.

Among marginal farm households only 3.33 per cent of the farmers have been found efficient as low as between 51 to 60 per cent. About 13 per cent of the farmers are found in the 61 to 70 per cent efficiency level. Most of the farmers, 43.34 per cent, are found between 81 to 90 per cent efficiency. The per cent of the small farms in the range of 90-100 per cent has been about 13.33. The mean efficiency level of the marginal farmers in the bajra production observed at 82 per cent indicating that, on an average, about 18 per cent less output is being produced as compared to the frontier (potential) level of output.

Among small farm households about 13.33 per cent of the farmers have been found efficient between 61-70 per cent; whereas, 33.33 per cent of farmers are found between 71 to 80 per cent efficiency levels. Most of the farmers, 36.67 per cent, are found between 81 to 90 per cent efficient. Only 16.67 per cent of the farmers managed to be in the 91-100 per cent efficiency level. The mean efficiency level of the small farmers in the bajra production is observed as 83 per cent indicating that, on an average, about 17 per cent less output is being produced as compared to the frontier (potential) level of output.

Table 6: Descriptive statistics of technical efficiency of bajra crop based on COLS frontier model in Western region of Uttar Pradesh (Number)

T.E. Rating (%) intervals	Farm size group			
	Marginal	Small	Medium	Large
51-60	1(3.33)	0(0.00)	0(0.00)	0(0.005)
61-70	4 (13.33)	4 (13.33)	5 (16.67)	1 (3.33)
71-80	8 (26.67)	10 (33.33)	13 (43.33)	12 (40.00)
81-90	13 (43.34)	11 (36.67)	8 (26.67)	14 (46.67)
91-100	4 (13.33)	5 (16.67)	4 (13.33)	3 (10.00)

Note: Figure in parentheses show per cent to total number of sample farm households

In medium farm households about 16.67 per cent of the farmers have been found efficient as low as between 61 to 70 per cent levels. Majority of the farmers, 43.33 per cent are found up to 71-80 per cent efficient. Only 26.67 per cent of the farmers are found in the 81-90 per cent efficiency level; whereas, 13.33 per cent of the farmers were in the 91-100 per cent efficiency level. The mean efficiency level of the medium farmers in the bajra production observed 81 per cent, indicating that, on an average, about 19 per cent less output is being produced as compared to the frontier (potential) level of output.

In large farm households, only 3.33 per cent of the farmers have been found efficient between 61-70 per cent levels; whereas, 40.00 per cent of the farmers were in the 71 to 80 per cent efficiency level. Majority of the farmers; i.e., 46.67 per cent are found 81 to 90 per cent efficient. Only 10.00 per cent of the farmers registered in the class of 91 to 100 per cent efficiency level. The mean efficiency level of the large farmers in the bajra production observed 82 per cent indicating that, on an average, about 18 per cent less output is being produced as compared to the frontier (potential) level of output.

Conclusion

On the basis of above findings, it is concluded that there is a need to introduce suitable innovation in the region to increase the productivity of bajra. The result of investigation of technical efficiency of the sample farms under bajra crop indicates that 20 per cent less than the potential output is being obtained on the medium farm households. According to technical efficiency rating, up to 50 per cent farmers belong to inefficiency levels. Inefficiency is quite high as compared to sugarcane and wheat. Hence, more emphasis is required on bajra crop. So, it is a matter of concern for the policy makers.

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Appendix I: Technical efficiency indices of Bajra producer obtained by COLS method in Western region of Uttar Pradesh during 2014-15

Farm size group					
Sl. No.	**Marginal**	**Small**	**Medium**	**Large**	**Overall**
	T.E.	T.E.	T.E.	T.E.	T.E.
1	0.8639	0.9619	0.8800	0.7897	0.7227
2	0.8700	0.6826	0.7960	0.8576	0.7493
3	0.8198	0.8402	0.9928	0.7787	0.7238
4	0.7827	0.6720	0.8321	0.7597	0.6800
5	0.8129	0.7022	0.7912	0.8207	0.6245
6	0.9545	0.8973	0.9248	0.7306	0.6914
7	0.9231	0.8632	0.6422	0.8151	0.7217
8	0.8664	0.8660	0.9817	0.8310	0.6917
9	0.8081	0.9897	0.8005	0.8161	0.7473
10	0.8190	0.8844	0.8291	0.7708	0.6088
11	0.7923	0.7817	0.7625	0.8701	0.5830
12	0.9275	0.8447	0.7993	0.7871	0.7440
13	0.8965	0.9933	0.6805	0.9106	0.7641
14	0.6839	0.9060	0.7573	0.8526	0.6550
15	0.6042	0.7494	0.7517	0.6424	0.6791
16	0.8062	0.8756	0.7424	0.8572	0.6285
17	0.9037	0.7912	0.7552	0.8188	0.7444
18	0.9937	0.7964	0.6804	0.8716	0.8590
19	0.8818	0.6533	0.7568	0.7405	0.6877
20	0.6852	0.8820	0.8086	0.8344	0.7319
21	0.8094	0.7201	0.9484	0.9312	0.8028
22	0.7972	0.7545	0.8322	0.7700	0.6539
23	0.8559	0.8155	0.8759	0.8170	0.9411
24	0.8162	0.7897	0.6692	0.8863	0.6557
25	0.7369	0.7700	0.8834	0.9924	0.6984
26	0.8334	0.8164	0.8916	0.8072	0.7072
27	0.8016	0.9917	0.7855	0.7196	0.6425
28	0.6157	0.7435	0.7018	0.8766	0.6795
29	0.6599	0.7696	0.8509	0.7801	0.6691
30	0.8781	0.9901	0.8043	0.7889	0.7330
31					0.7466
32					0.6666
33					0.7443
34					0.7741
35					0.8635
36					0.6545
37					0.7262
38					0.6485
39					0.5946
40					0.7453
41					0.7472
42					0.6892
43					0.7146
44					0.8209
Average T.E.	0.8167	0.8265	0.8070	0.8175	0.8169

Appendix II: Zero Order correlation matrix between independent variable and dependent variable for Marginal farmers of Bajra crop in Western region

	X1	**X2**	**X3**	**X4**	**X5**	**X6**	**Y**
X1	1						
X2	0.431831	1					
X3	-0.09962	0.54307	1				
X4	-0.1756	-0.34608	-0.13013	1			
X5	0.199832	0.070209	0.459142	-0.2042	1		
X6	0.001729	-0.01536	-0.16319	-0.1085	0.264319	1	
Y	0.178532	0.241423	0.217072	-0.2075	0.389843	0.196116	1

Appendix III: Zero Order correlation matrix between independent variable and dependent variable for Small farmers of Bajra crop in Western region

	X1	X2	X3	X4	X5	X6	Y
X1	1						
X2	0.267701	1					
X3	-0.09614	0.189369	1				
X4	-0.03323	0.199031	0.344767	1			
X5	0.192428	0.160255	0.010108	0.271108	1		
X6	-0.11243	-0.07134	0.051374	0.445222	0.137126	1	
Y	0.21549	-0.12319	-0.14434	-0.20072	-0.11008	-0.0242	1

Appendix IV: Zero Order correlation matrix between independent variable and dependent variable for Medium farmers of Bajra crop in Western region

	X1	X2	X3	X4	X5	X6	Y
X1	1						
X2	0.184982	1					
X3	-0.06583	-0.22256	1				
X4	-0.30058	-0.29547	0.22817	1			
X5	0.164693	0.061485	-0.01951	-0.44574	1		
X6	0.111489	0.017747	0.527689	-0.42008	0.19314	1	
Y	-0.3135	-0.25969	0.233446	0.045895	-0.1575	0.280789	1

Appendix V: Zero Order correlation matrix between independent variable and dependent variable for large farmers of Bajra crop in Western region

	X1	X2	X3	X4	X5	X6	Y
X1	1						
X2	0.065143	1					
X3	0.15228	0.073644	1				
X4	0.029418	-0.17151	-0.05341	1			
X5	0.065797	0.179039	0.052119	0.071792	1		
X6	-0.04908	-0.14169	0.057759	0.059949	-0.1678	1	
Y	0.054786	0.181032	-0.21246	0.051543	-0.1770	0.285326	1

Note: X1 = Expenditure on seed per ha.
X2 = Expenditure on human labour per ha.
X3 = Expenditure on irrigation charges per ha.
X4 = Expenditure on fertilizer per ha.
X5 = Expenditure on ppc per ha.
X6 = Expenditure on tractor power per ha.
Y = Gross return in Rs. Per ha.