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DETERMINANTS OF EFFICIENCY IN SMALL SCALE AGRI-FARM PRODUCTION: A CASE OF MUZAFFARGARH-PAKISTAN

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ABSTRACT- *Productive efficiency of agriculture-farmers is essential for the growth of the economy. So it is an important issue to check the productive efficiency of farmers in Pakistan The major objective of this study was to find out determinants of efficiency in small scale agriculture-farm production in district Muzaffargarh. We used primary data which was collected through a structured questionnaire. Two hundred (200) farmers, who were cultivating major crops, were randomly selected Multiple Regression and Correlation methods were used to draw results. We found that firms have technical efficiency between the range of scores 0.41 to 1.00 and 0.81 mean. The regression analysis showed that coefficients of age of the farmer, expenditures on diesel, fertilizers, pesticides and seeds, farm size, hired labor loan access, liabilities, profit and interest rate have a positive effect on productive efficiency of farmer while the coefficients of education of farmer, has a negative effect on their productive efficiency. Thus, we conclude that education is necessary to attain maximum level of productive efficiency.*

Key words*: Education, Productive efficiency, interest rate, input costs.*

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1.INTRODUCTION

Pakistan is one of the developing economies of the world and agriculture sector of Pakistan is major contributor to its GDP. More than 60% population of Pakistan lives in the villages and depends indirectly or directly on this sector for income. Agriculture sector of Pakistan employs 43% labor force of the country (Pakistan Economic survey 2012-2013). Main crops of Pakistan are sugarcane, rice, wheat and cotton. Pakistan ranked as 3rd largest producer in cotton, 5th in sugarcane, 11th in rice and 10th largest wheat producer in the world (UNFAOSTAT, 2008). Punjab is agriculturally rich province of Pakistan. Agriculture production in Pakistan is inefficient as it is producing less than its potential. Agriculture sector of Pakistan is one of the most important sectors of the economy but it always ignored by rulers in the sense that high price of inputs and low price of output commodities, which results in less profits or losses to the farmers.

This research is an attempt to analyze the productive efficiency of small scale agri-farmers and also to find out major determinants of efficiency in agriculture production in district Muzaffargarh, Punjab. For this purpose, we have selected the farmers which were producing wheat, cotton, sugarcane and rice. These are major crops of District Muzaffargarh. Farm size is also an important factor for the efficiency of agri-farms. As farm size increases it requires more efforts and management abilities of the farmer (Khai and Mitsuyasu,2011). These management capabilities are associated with education and experience of the farmer. Loan access is also another important factor. Easy access to loan makes the farmer able to fulfill the needs of cultivation. Most of the farmers have less access to loan formally and as a result they have to borrow loan from informal channel. Informal sources of loan charge high interest rates for borrowing as compared to formal sources. In this way farmer waste his chances of potential profit (Audu, et al. 2013 and Akpalu et al. 2012).

1.1. Main Research problem:

Our main research problem is to explore the determinants of efficiency in small scale agriculture farm production with special reference to District Muzaffargarh, Pakistan.

1.1. Objectives of study:

The major objectives of the study are as given below:-

- To analyze the productive efficiency of small scale agri-farm production in District Muzaffargarh.
- To identify the factors which are affecting the efficiency of small scale agri-farm production.
- To find out the socio economic condition of small scale agri-production farmer.
- To make suggestions how to improve productive efficiency of small scale agriculture farms

2. LITERATURE REVIEW:

Awan and Aslam (2015) emphasized that agriculture productivity has direct effect on economic growth because agriculture sector has substantial share in GDP.

Awan and Hashmi (2014). contended that small and medium enterprises played a vital role in increasing productivity and knowledge sharing.

Awan and Farah (2016) discussed problems of small entrepreneurial firms and stressed that Government should patronize these firms in order to generate employment and increase productivity.

Nto (2011) explored the Productivity in agri production firms and its determinants in Abia State, Nigeria. The examination discoveries are that govt. should expand speculation on work compel which will build human abilities. In any

case, it likewise demonstrates that there is negative connection between inputs and TFP. Morenikeji (2012) discussed the effect of little and medium scale farms in the age of work in logos state. Monetary exercises through production and little and medium scale ventures age will put critical effect on maintainable improvement.

Ikemet (2012) broke down the hurdles of small and medium-sized farm in Nigeria. The study reveals that small and medium ventures in Nigeria have poor bookkeeping framework. Chelogoi (2013) examined the impacts of the microfinance on small scale production in Kenya. A big portion of the organizations are in miniaturized scale classification and their distinctions are male youthful and much instructed. They are putting huge impact on the development of their ventures. Abanis (2013) conducted study on the production efficiency in small and medium scale farming in western Uganda. The general results demonstrated that the level of productivity is low among small and medium farms.

Mburu (2014) examined the impact of ranch estimate on financial proficiency among wheat growers and to propose approaches to enhance wheat production in the nation. Specialized productivity will put beneficial outcome on production of wheat in both small and large scale farming.

Ahmed (2014) analyzed the status and determinants of small cultivating family units' nourishment needs and job of market role in improving sustainable development in Pakistan. The results show that ranch family units see increment in sustenance costs, trim ailments, absence of water and increment in living costs.

Biam (2015) broke down the Economic proficiency of small scale soya bean farmers in Nigeria. The study found that lion's share of soya bean crop is gone to big farmers and small farmers get very little in monetary term and in that way they suffer poverty and hunger.

Tuan (2015) conducted study on the compulsory and Sufficient Conditions for Agri production success at micro level farming systems in Northern Vietnam. The study affirms that introduction of technology in agriculture will bring beneficial

outcome on little scale cultivating through neighborhood government and conceivable contributors for viable cultivating.

Zahorsky (2016) studied the Determinants of productivity in horticulture in CEE nations. He finds that normal used agri production zone, normal sponsorships standard homestead and the preparation of the administrator are putting inconsequential impact on proficiency.

Kuboja (2017) investigated to drive a factual proportion of benefit effectiveness among little scale honey bee managers in Tanzania. The investigation uncovers that normal preparing of beekeepers has positive association with benefit productivity.

Farrell (1957) explained two kinds of efficiency measures, input-oriented measure and output-oriented measure. Both of these two measures were equal when constant returns to scale and unequal when production on variable returns to scale (fare and lovell 1978).

Chelogoi et al. (2013) stated that Kenya's economic growth and development depends on donor funding. The study examined the effect of the micro finance institutions on small scale production growth. Research design is based on primary data. The data collected was analyzed using descriptive and inferential statistics. Evans Growth Model was used to examine the effects of micro finance institutions on small production growth. Growth Model equation is

Mburu et al. (2014) attempted to estimate efficiency in wheat production with technical and allocative efficiency. Tobit model and dual stochastic efficiency technique has been applied to measure Technical efficiency (TF), Economic efficiency (EF) and Allocative efficiency (AE). Technical efficiency is linked with Iso Quant Curve to estimate the efficiency of production. Allocative efficiency means the ability to produce at a given level of output using the cost minimizing input approach.

2.1. Distinction of this study:

According to our view, the present study is our first attempt to analyze the productive efficiency of small scale agri farm production by using such variables which have never been included together in an econometric model. The study is very important because no empirical work have so far been done on determinants of efficiency of micro and small scale agri- farm production in Muzaffargarh distinct of Punjab.

Production is a multi-dimensional process with different types. Production of any kind of product starts with the aim of profit. Producer always wants to maximize production with minimum cost to maximize profit. There are two ways of production process, firstly, producer tries to maximize its production on given cost and secondly, producer tries to minimize cost on given production. Production is also divided into two dimensions in case of factor intensity, firstly, labor intensive production technique, secondly, capital intensive production technique.

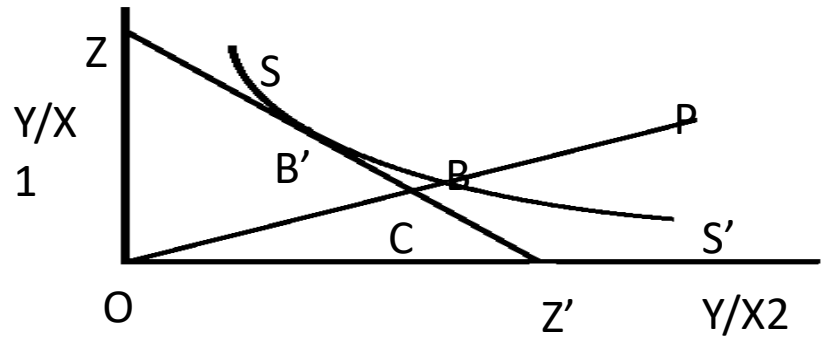
3 THEORETICAL FRAMEWORK:

3.1 Efficiency Theory:

The efficiency theory was presented by Charnes, Cooper and Rhodes in 1978. It is an attempt to measure the productive efficiency. Three kinds of efficiencies, firstly, capability of a firm to produce maximum level of output at a given level of inputs, known as technical efficiency, secondly, capability of a firm to use inputs at optimum level at their given prices, known as allocative efficiency, and thirdly, technical efficiency combined with allocative efficiency known as economic efficiency. Efficiency of a production firm is defined as "a producer is efficient if an increase in at least one input is required in order to an increase in output. At this stage we will measure productive efficiency. There is one method to measure the productive efficiency of the firm. Data envelopment analysis (DEA) which is non-

parametric approach to measure the productive efficiency and does not requires any functional form to measure productive efficiency. In this stage (DEA) data envelopment analysis approach is used to measure the productive efficiency. DEA does not estimate any relation between inputs and output, but the calculated efficiency score of different firms may be used for the comparison of productivity of the firms. We will use one output variable and twelve inputs to measure the productive efficiency of 200 farmers with the use of data envelopment model.

Figure 1: Input Oriented Measure of Efficiency



There are three kinds of efficiency namely, technical efficiency, allocative efficiency and economic efficiency. Suppose firm is producing at point "P" which is not efficient point as depicted in figure-1. The iso-quant (SS') representing the fully efficient firm, according to input-oriented measure of efficiency, when a firm is producing at point "P" which is not efficient point and (ZZ') is an iso-cost line of firm. Technical efficiency is OB/OP, allocative efficiency is OC/OB and economic efficiency is OC/OP.

Technical efficiency of production: TE = OB/OP

Allocative efficiency of production: AE = OC/OB

Economic efficiency of production: EE = OC/OP

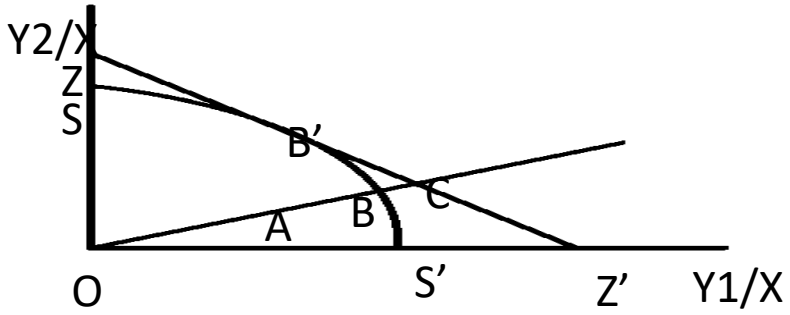
OR

Economic Efficiency = Technical Efficiency × Allocative Efficiency = (OB/OP)×(OC/OB) = OC/OP

In figure-1 "B" is an efficient point.

Output-oriented measure of efficiency tells that what level of output can be increased without changing the input quantities if a firm is producing double outputs with the use of a single input (fare and Lovell 1978).

Figure 2: Output Oriented Measure of Efficiency



If an organization is producing double outputs (Y_1 and Y_2) with the use of single input (X). Assume that the constant returns to scale has been applied on the production of an organization. Now productive efficiency of an organization under constant returns to scale according to output-oriented measure of efficiency explained with the help of figure-2 (Farrell 1957).

Suppose an organization is producing at point "A" which is not efficient point as depicted in figure-2. The fully efficient firm can represent (SS`) the production possibility curve. According to output-oriented measure of efficiency, when a firm is producing at point "A" which is not efficient point and (ZZ') is iso-revenue line of firm. Technical efficiency is OA/OB, allocative efficiency is OB/OC and economic efficiency is OA/OC.

Technical efficiency of production:	Technical Efficiency =	OA/OB
Allocative efficiency of production:	Allocative Efficiency =	OB/OC
Economic efficiency of production:	Economic Efficiency =	OA/OC

OR

Economic Efficiency = Technical Efficiency × Allocative Efficiency = (OA/OB) × (OB/OC) = OA/OC

B is an efficient point in Figure 2.

Returns to scale is defined as a rate of change in output due to one percent change in inputs. Returns to scale reflect three laws (laws of return) law of constant returns to scale define that an increase in output proportionate to an increase in inputs. Law of decreasing returns to scale defines that an increase output less than that proportional increase in inputs. Law of increasing returns to scale defines that an increase in output more than that increase in inputs (H, Varian 2010).

4. RESEARCH METHODOLOGY:

4.1 Research Area:

District Muzaffargarh is one of the agriculturally rich districts of Punjab province. Total population of the district is approximately at 4,322,009 in 2018. Main crops of the district are sugarcane, wheat, rice and cotton. The district consists of four tehsils Jatoi, Ali pure, Kotadu, Muzaffargarh.

4.2 Sample of study:

Two hundred (200) farmers were randomly selected as a sample in the study from four tehsils of district Muzaffargarh. 45 respondents were selected from Alipur, 65 from Muzaffargarh, 62 from Kot Addu, and 28 from Jatoi. The division of number of respondents between all the four tehsils of the district Muzaffargarh is on the basis of population proportion of each tehsil through simple random sampling technique.

The questionnaire was designed for the collection of data about the operations of selected crops farms. Information on farm size, farmer education, experience expenditures on, seed, diesel, pesticides, fertilizers profit, etc., were collected. Data on inputs and output was collected on per acre basis during field survey.

4.3 Variables and their definitions:

The selected variables and their definitions are given below: -.

- **Average per acre profit (Prft);** means the average per acre net profit for a year.
- **Farm size (Farm);** means the land in acres where wheat, cotton, rice or sugarcane cultivated.
- **Expenditure on fertilizer (Exp.F);** means per acre expenses or cost on fertilizer used for the production during a year.
- **Expenditure on seeds (Exp.S);** means per acre expenses or cost of seeds used during a year.
- **Expenditure on pesticides (Exp.P);** means per acre expenses or cost of pesticides used during a year.
- **Expenditure on diesel and Mobil oil (Exp.D);** means per acre expenses or cost of diesel and mobil oil used either for preparation of land for the cultivation or for the irrigation purpose.
- **Expenditure on maintenance of machinery (MM);** means the average per acre expenditures on maintenance of machinery during a year.
- **Salaries of permanent labor (Spl);** means per acre amount of salary paid to the permanently hired labor during a year.
- **Salaries of temporary labor (Stl);** means per acre amount of salary paid to the temporarily hired labor during a year.
- **Age of farmer (Age);** means the farmers `age in years.
- **Family size of farmer (Fms);** means the total number of family members of the farmer.
- **Education of farmer (Edu);** means the total number of educational years of the farmer.
- **Experience of farmer (Er);** means the years of work experience of farmer in the same business.
- **Amount of fixed assets (Fix);** amount of fixed assets in PKR. All the fixed inputs like tube well, building, and machinery etc used in the production process.

● **No. of hired labor (Hl);** means the number of employed workers for the cultivation. The workers who must be paid for their services.

● **No. of family labor (Fl);** means the number of family members working for the cultivation.

● **Other source of income (Oy);** means any other source of income of the farmer. It was a dummy variable '1' for yes and '0' for no.

● **Type of that other source of income (Toy);** means if the farmer had any other source of income then what type of that other source of income. It was a dummy variable '1' for agriculture based and '2' for non-agriculture based.

● **Amount of income from that other source (Aoy);** means amount of income in terms of money PKR from that other source of income.

● **Loan access (La);** means access of the farmer to the loan. It was a dummy variable '1' for easy '0' for otherwise.

● **Taken loan (Tla);** means did the farmer taken any loan for the cultivation. It was a dummy variable '1' for taken loan and '0' for did not take any loan.

● **Type of loan (Fla);** means the type of loan taken by the farmer. Two types of loans formal (loan from the financial institutions) informal (loan from the friends etc), it was a dummy variable '1' for formal and '2' for informal.

● **Interest rate (r);** means the cost of borrowing (the farmer must have to pay the amount for the use of principle amount).

● **Amount of liabilities (Lib);** means the amount of money payable.

● **Payments of utility bills (Ubil);** means amount of payments for the use of utilities. Payments of farmer for the use of electricity.

4.3 Hypothesis:

We have developed following hypothesis for our study: -

Hypothesis 1

H_0: There is no significant relationship between productive efficiency in small scale agri-production and age of farmer.

H_1: There is significant relationship between productive efficiency in small scale agri-production and age of farmer.

Hypothesis 2

H_0: There is no significant relationship between productive efficiency in small scale agri-production and education of farmer.

H_1: There is significant relationship between productive efficiency in small scale agri-production and education of farmer.

Hypothesis 3

H_0: There is significant no relationship between productive efficiency in small scale agri-production and expenses on diesel.

H_1: There is significant relationship between productive efficiency in small scale agri-production and expenses on diesel.

Hypothesis 4

H_0: There is no significant relationship between productive efficiency in small scale agri-production and expenses on fertilizer.

H_1: There is significant relationship between productive efficiency in small scale agri-production and expenses on fertilizer.

Hypothesis 5

H_0: There is no significant relationship between productive efficiency in small scale agri-production and expenses on pesticides.

H_1: There is significant relationship between productive efficiency in small scale agri-production and expenses on pesticides.

Hypothesis 6

H_0: There is no significant relationship between productive efficiency in small scale agri-production and expenses on seeds.

H_1: There is significant relationship between productive efficiency in small scale agri-production and expenses on seeds.

Hypothesis 7

H_0: There is no significant relationship between productive efficiency in small scale agri-production and farm size.

H_1: There is significant relationship between productive efficiency in small scale agri-production and farm size.

Hypothesis 8

H_0: There is no significant relationship between productive efficiency in small scale agri-production and hired labor.

H_1: There is significant relationship between productive efficiency in small scale agri-production and hired labor.

Hypothesis 9

H_0: There is no significant relationship between productive efficiency in small scale agri-production and access to loan.

H_1: There is significant relationship between productive efficiency in small scale agri-production and access to loan.

Hypothesis 10

H_0: There is no significant relationship between productive efficiency in small scale agri-production and liabilities.

H_1: There is significant relationship between productive efficiency in small scale agri-production and liabilities.

Hypothesis 11

H_0: There is no significant relationship between productive efficiency in small scale agri-production and profits.

H_1: There is significant relationship between productive efficiency in small scale agri-production and profits.

Hypothesis 12

H_0: There is no significant relationship between productive efficiency in small scale agri-production and interest rate.

H_1: There is significant relationship between productive efficiency in small scale agri-production and interest rate.

4.5. Analytical techniques:

We used descriptive analysis, correlation analysis and regression analytical techniques for analysis of data.

5. DATA ANALYSIS:

5.1. Descriptive statistics:

Descriptive analysis has been made through the statistical software E-views. We have estimated minimum value, maximum value, Range, mean, standard deviation, variance, kurtosis and skewness and kurtosis to explain the entire data. Above table demonstrate characteristics of panel data and shows overall trend of variables.

Table 1: Descriptive statistics

Date: 08/15/18 Time: 16:35
Sample: 1 200

	AGE	EDU	PRFT	EXPD	EXPF	EXPP	EXPS	R	LA	FARM	HL	LIB
Mean	42.09694	8.739796	21929.59	9576.531	10111.17	9890.816	8720.204	0.018878	0.168367	8.331633	0.984694	0.020408
Median	41.5	10	16000	10300	10500	10400	10000	0	0	5	0	0
Maximum	70	24	70000	19500	19500	110500	14000	0.2	1	50	8	1
Minimum	20	0	1200	1200	1100	1100	4200	0	0	1	0	0
Std. Dev.	10.81622	4.929102	13342.52	2688.711	2490.179	8138.709	2485.8	0.044684	0.37515	9.671911	1.583495	0.141754
Skewness	0.248472	-0.181479	1.166493	-0.479234	-0.744927	10.07426	-0.308511	2.170936	1.772526	2.520707	1.524647	6.783866
Kurtosis	2.318932	2.671145	3.795512	3.33101	5.026819	122.1923	1.943158	6.390245	4.141848	9.63211	4.738904	47.02083
Jarque-Bera	5.804927	1.959059	49.6179	8.397194	51.67589	119337.7	12.23067	247.8225	113.2815	566.7727	100.6295	17328.99
Probability	0.054888	0.375488	0	0.015017	0	0	0.002209	0	0	0	0	0
Sum	8251	1713	4298200	1877000	1981790	1938600	1709160	3.7	33	1633	193	4
Sum Sq. Dev.	22813.16	4737.73	3.47E+10	1.41E+09	1.21E+09	1.29E+10	1.20E+09	0.389353	27.44388	18241.44	488.9541	3.918367
Observations	196	196	196	196	196	196	196	196	196	196	196	196

The data given in the table show that average age of farmer, his education, expenses on diesel, expenses on fertilizer, expenses on pesticides, expenses on seeds, farm size, hired labor, access to loan, liabilities, profits and interest rate are 100.5561,

years 9576.531, 10111.17, 9890.816, 8720.204, 8.331633, 0.984694, 0.168367, 0.020408, 21929.59 and 0.018878 Units, respectively.

The median trend of the data as age, education, expenses on diesel, expenses on fertilizer, expenses on pesticides, expenses on seeds, farm size, hired labor, access to loan, liabilities, profits and interest rate are 41.5 Years 100, 10300, 10500, 10400, 10000, 5,0,0,0,16000,0.

The maximum values of age, education, expenses on diesel, expenses on fertilizer, expenses on pesticides, expenses on seeds, farm size, hired labor, access to loan, liabilities, profits and interest rate are 70 years 576, 19500, 19500, 110500, 14000, 50, 8, 1, 1,70000 and 0.2 units, respectively.

The minimum values of the data as age, education, expenses on diesel, expenses on fertilizer, expenses on pesticides, expenses on seeds, farm size, hired labor, access to loan, liabilities, profits and interest rate are 20 years, 0, 1200, 1100, 1100, 4200, 1, 0,0, 0, 1200, 0 units, respectively.

The standard deviation which shows how much the members of a group differ from the mean value for the groups such as age, education, expenses on diesel, expenses on fertilizer, expenses on pesticides, expenses on seeds, farm size, hired labor, access to loan, liabilities, profits and Interest rates are 10.81622 Years, 87.44664, 2688.711, 2490.179, 8138.709, 2485.8, 9.671911, 1.583495, 0.37515, 0.141754, 13342.52 and 0.044684 units, respectively.

5.2 Correlation Analysis:

The results of correlation analysis are shown in Table 2

Table 2: Correlation Matrix

Covariance Analysis: Ordinary											
Sample: 1 199											
Included observations: 196											
Correlation											
Probabili	AGE	EDU	PRFT	EXPD	EXPF	EXPP	EXPS	R	LA	FARM	HL	LIB
AGE	1											
EDU	-0.233	1										
	0.001	-----										
PRFT	-0.032	-0.021	1									
	0.6573	0.7697	-----									
EXPD	-0.022	-0.021	0.0008	1								
	0.7624	0.769	0.9916	-----								
EXPF	-0.044	0.1243	0.1607	0.0421	1							
	0.5432	0.0825	0.0244	0.558	-----							
EXPP	-0.032	-0.08	-0.194	0.2249	0.0465	1						
	0.6544	0.2623	0.0065	0.0015	0.5177	-----						
EXPS	-0.052	-0.038	0.0695	0.4854	0.1401	0.1397	1					
	0.4693	0.5959	0.3328	0	0.0501	0.0509	-----					
R	-0.082	0.0534	0.2424	0.2154	0.0979	-0.001	0.0648	1				
	0.2538	0.4574	0.0006	0.0024	0.1723	0.9875	0.367	-----				
LA	-0.098	-0.009	0.3343	0.2144	0.0789	0.1441	0.1399	0.3478	1			
	0.1737	0.8952	0	0.0025	0.2714	0.0439	0.0506	0	-----			
FARM	0.1933	0.1562	0.0966	0.2143	0.1305	0.0317	0.1752	0.0607	0.1513	1		
	0.0066	0.0288	0.1779	0.0026	0.0684	0.6593	0.0141	0.3983	0.0343	-----		
HL	0.104	0.1802	-0.179	0.1632	-0.007	0.0788	-0.061	0.007	-0.022	0.2876	1	
	0.1469	0.0115	0.0119	0.0222	0.925	0.2722	0.3919	0.9224	0.7645	0	-----	
LIB	0.0154	0.0957	0.0333	0.051	0.088	0.0344	0.1909	0.4246	0.2244	0.2045	0.1842	1
	0.8301	0.1821	0.6431	0.4774	0.2202	0.6323	0.0073	0	0.0016	0.004	0.0098	-----

Correlation matrix explains bi-variate relationship between two independent or dependent and independent variables. Correlation matrix analyses the relationship among two variables and how one variable is related to another variable. Correlation matrix also explains problem of Multi-collinearity. If coefficients of correlations among two explanatory variables have absolute value equal or above 0.80, there is serious problem of Multi-collinearity. Table presents correlation among some selected variables and verifies no problem of Multi-collinearity, as all values are less than 0.49.

5.3. Interpretation of Results:

5.3.1. Age of Farmer

In the row of age of farmer in this matrix tells there exists no problem of Multi-collinearity, as values of correlation are less than 0.20. Age of farmer has significant correlation with education and farm size. Age of farmer has insignificant

correlation with expenses on diesel, expenses on fertilizer, expenses on pesticides, expenses on seeds, hired labor, access to loan, liabilities, profits and interest rate.

5.3.2 Education

In the row of education in this matrix tells no serious problem of Multi-collinearity, as values of correlation are less than 0.16. Education has significant correlation with expenses on fertilizer, farm size, and hired labor. Education has insignificant correlation with expenses on diesel, expenses on pesticides, expenses on seeds, access to loan, liabilities, profits and interest rate.

5.3.3 Expenses on diesel

In the row of expenses on diesel in this matrix tells no serious problem of Multi-collinearity, as values of correlation are less than 0.49. Expenses on diesel has significant correlation with expenses on pesticides, expenses on seeds, farm size, hired labor, access to loan and interest rate. Expenses on diesel have insignificant correlation with expenses on fertilizer, liabilities and profits.

5.3.4 Expenses on Fertilizer

In the row of expenses on fertilizer in this matrix tells no serious problem of Multi-collinearity, as values of correlation are less than 0.17. Expenses on fertilizer have significant correlation with expenses on seeds, farm size and profits. Expenses on fertilizer have insignificant correlation with expenses on pesticides, hired labor, access to loan, liabilities, and interest rate.

5.3.5 Expenses on pesticides

In the row of expenses on pesticides in this matrix tells no serious problem of Multi-collinearity, as values of correlation are less than 0.15. Expenses on pesticides have significant correlation with expenses on seeds, access to loan and profits.

Expenses on pesticides have insignificant correlation with farm size and hired labor, liabilities and interest rate.

5.3.6 Expenses on seeds

In the row of expenses on seeds in this matrix tells no serious problem of Multi-collinearity, as values of correlation are less than 0.20. Expenses on seeds have significant correlation with farm size, access to loan and liabilities. Expenses on seeds have insignificant correlation with hired labor, profits and interest rate.

5.3.7 Farm size

In the row of farm size in this matrix tells no serious problem of Multi-collinearity, as values of correlation are less than 0.29. Farm size has significant correlation with hired labor, access to loan and liabilities. Farm size has insignificant correlation with profits and interest rate.

5.3.8 Hired labor

In the row of hired labor in this matrix tells no serious problem of Multi-collinearity, as values of correlation are less than 0.19. Hired labor has significant correlation with hired liabilities and profits. Hired labor has insignificant correlation with access to loan and interest rate.

5.3.9 Access to Loan

In the row of access to loan in this matrix tells no serious problem of Multi-collinearity, as values of correlation are less than 0.35. Access to loan has significant correlation with hired liabilities, profits and interest rate.

5.3.10 Liabilities

In the row of liabilities in this matrix tells no serious problem of Multi-collinearity, as values of correlation are less than 0.43. Liabilities have significant correlation with interest rate. Liabilities have insignificant correlation with profits.

5.3.11. Profit

In the row of profits in this matrix tells no serious problem of Multi-collinearity, as values of correlation are less than 0.42. Profits have significant correlation with interest rate.

6. REGRESSION ANALYSIS:

The results of regression analysis are given in Table 3

Table 3: Results of regression analysis

Method: Least Squares				
Date: 08/15/18 Time: 16:26				
Sample (adjusted): 1 199				
Included observations: 196 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-6632.56	6729.529	-0.98559	0.3256
AGE	139.5464	82.3702	1.694137	0.0919
EDU	762.1843	492.9687	1.546111	0.1238
EDU*EDU	-49.59988	27.40661	-1.809778	0.072
PRFT	1.119821	0.071143	15.7405	0
EXPD	1.923582	0.388797	4.947528	0
EXPF	1.696186	0.345172	4.914037	0
EXPP	0.97326	0.109274	8.90661	0
EXPS	0.741171	0.406017	1.825466	0.0696
R	-67973.44	22693.98	-2.995219	0.0031
LA	1169.562	2559.355	0.456975	0.6482
FARM	137.7049	97.03446	1.419134	0.1576
HL	3000.234	586.3822	5.116515	0
LIB	11490.76	6982.537	1.645643	0.1016
R-squared	0.7504	Mean dependent var		80383.92
Adjusted R-squared	0.732572	S.D. dependent var		22182.28
S.E. of regression	11471.23	Akaike info criterion		21.60182
Sum squared resid	2.39E+10	Schwarz criterion		21.83597
Log likelihood	-2102.978	Hannan-Quinn criter.		21.69662
F-statistic	42.08979	Durbin-Watson stat		1.941806
Prob(F-statistic)	0			

6.1 Interpretation of results:

6.1.1 Education

If education increases by one year then agriculture production will fall by -49.59988 units. So agriculture productivity is negatively linked with education in this model. Education is significant at 7.2% level in linear model.

6.1.2 Age

If age increases by one year than agriculture productivity rise up to139.5464 units. So agriculture productivity is positively linked with age. Age is significant at 9% level in linear model.

6.1.3 Profit

If farmer profit increases by one thousand rupees than agriculture productivity rise up to1.119821 Rs. Agriculture productivity is positively linked with profit. Profit is significant at 0% level in linear model.

6.1.4 Expenditure on diesel

If farmer expenditure on diesel increases by one thousand rupees than agriculture productivity rises up to 1.923582 Rs thousand rupees. So agriculture productivity is positively linked with expenditure on diesel. Expenditure on diesel is significant at 0% level in linear model.

6.1.5 Expenditure on fertilizer

If farmer expenditure on fertilizer increases by one thousand rupees than agriculture productivity raises up to1.696186Rs thousand rupees. So agriculture productivity is positively linked with expenditure on fertilizer. Expenditure on fertilizer is significant at 0% level in linear model.

6.1.6. Expenditure on pesticides

If farmer expenditure on pesticides increases by one thousand rupees than agriculture productivity rises up to 0.97326Rs thousand rupees. So expenditure on pesticides and agriculture productivity are positively linked with in this model. Expenditure on pesticides is significant at 0% level in linear model.

6.1.7. Expenditure on seeds

If farmer expenditure on seeds increases by one thousand rupees than agriculture productivity rises up to 0.741171Rs thousand rupees. So expenditure on seeds and agriculture productivity are positively linked with in this model. Expenditure on pesticides is significant at 7% level in linear model.

6.1.8. Interest Rate

If interest rate increases by one percent than agriculture productivity will fall down by 67973.44Rs thousand rupees. So interest rate and agriculture productivity

are negatively linked in this model. Interest rate is significant at 3% level in linear model.

6.1.9 Loan Access

If the option of loan access increases by one percent than agriculture productivity rises up to 1169.562 Rs thousand rupees So loan access and agriculture productivity are positively linked in this model. Loan access is significant at 65% level in linear model.

6.1.10. Farm size

If the option of farm size increases by one percent than agriculture productivity rises up to 137.7049 Rs thousand rupees So farm size and agriculture productivity are positively linked in this model. Farm size is significant at 16% level in linear model.

6.1.11.No. of hired labor (HI)

If no of hired labor increases by one percent than agriculture productivity rises up to 3000.234 Rs thousand rupees So hired labor and agriculture productivity are positively linked in this model. Farm size is significant at 0% level in linear model.

6.1.12. Amount of liabilities (Lib)

If the amount of liability increases by 1 percent than agriculture productivity rises up to 11490.76 Rs thousand rupees So amount of liabilities and agriculture productivity are positively linked in this model. Amount of liabilities is significant at 10% level in linear model.

6.2 R-Squared

In linear model, explanatory variables are affecting agriculture productivity by about 75%.

6.3 Probability (f-stat)

F-Statistics probability value is less than 10% so model is significant.

6.4 Durban-Watson

According to Durban-Watson test, in this model auto correlation exists. Because the rule of thumb is, "if values 1.95 to 2. Then there is no autocorrelation".

6.5 Akaike criteria:

The value of Akaike criteria information in this model is 21.60182.

7. CONCLUSIONS:

Agriculture productivity is negative relationship with general education in this study. So agriculture related education can enhance the productive efficiency of farmer. Agriculture productivity is positively linked with age. With the passing of time the experience of famer will increase and as such agriculture productivity. Agriculture productivity is positively linked with profit. Profit means the difference between total cost and total revenue. If cost remains low, then it will affect production significantly. Agriculture productivity is positively linked with expenditure on diesel. Expenses of diesel will facilitate the farmer by ploughing land and water availability properly and timely. Agriculture productivity is positively linked with expenditure on fertilizer as well. When farmer will feed land with proper fertilizer it will increase the production efficiency. Agriculture productivity is positively linked with expenditure on pesticides. When proper and timely pesticide has been sprayed to crops, it will reduce the chances of disease and increase the production of crops. Expenditure on seeds and agriculture productivity are positively linked. When good and quality seeds have been sowed in time, it will increase productivity of soil. Interest rate and agriculture productivity are negatively linked in this model. When interest rate is high farmer will not be able to get more loan than his productive efficiency will be low. If interest rate is low farmer will borrow more loan, then his productive efficiency will be high. Loan access and agriculture productivity are positively related. When loans are easily available to farmer his productive efficiency will increase. Farm size and agriculture productivity are positively linked in this model, when farmer is ploughing

more land its production will increase. Hired labor and agriculture productivity are positively correlated. When farmer hires more labor, his man power will enhance and his productivity efficiency will increase. Amount of liabilities and agriculture productivity are also positively related. When farmer has to pay more liabilities he will put his proper attention towards his productive efficiency.

7. POLICY RECOMMENDATIONS:

On the basis of the above conclusions, we would like to make the following policy recommendations: -

1.Agriculture related education can enhance the productive efficiency of farmer. So the education of the farmers may increase through refresher courses and workshops.

2. The costs of agriculture inputs may be reduced so that the profit of the farmers will increase and he devote more efforts to increase the yield of his crops.

3. The quality of seed, fertilizer and pesticides must be ensured and these three inputs are made available in ample quantity at the time of cultivation.

4. Loan at low interest rates may be provided and it may be lent on soft terms. Most of the farmers could not purchase seed, fertilizers and pesticides due to lack of money and consequently the yield of their crops is declined. When loans are easily available to farmer his productive efficiency will increase.

5. The farmers may be encouraging to cultivate more and more soil in order to get maximum production of crops. When farmer is ploughing more land its production will increase.

6. Focus may be given on increasing per acre yield because it will enhance the income of the farmers. It will put healthy effect on the living standard of small scale farmer and his family. Farmer will be able to provide basic education to his children in proper environment, give basic health facilities to his family. It will also uplift both his family socio economic conditions.

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CONTRIBUTION OF AUTHORS AND CONFLICT OF INTEREST

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Both authors read the manuscript carefully and declared no conflict of interest with any person or institution.