Research Article

Analysis of Agriculture Credit Contribution in Cotton Production of Southern Punjab, Pakistan

Dilshad Ahmad[1]* and Muhammad Afzal[2]

[1]COMSATS Institute of Information Technology Vehari, Pakistan; [2]Faculty Department of Economics, Preston University Islamabad, Pakistan.

Abstract | Cotton has major contribution among cash crops in provision of raw material to local textile industry, exporting cotton lint and livelihood of cotton farmers in Pakistan. Potential productivity in agriculture is possible with introduction of advanced mechanization, which is only feasible with financial injections in this sector. The study in hand has focused the role of credit in the cotton production of southern Punjab. Simple Random Sampling technique was used in the study for selecting the respondents in both districts of cotton area. Pre-tested questionnaire was developed for the collection of data 320 cotton farmers' respondents for the year of 2015-16 including 160-credit user and 160 non-credit users. The study employed stochastic production frontiers function for the empirical estimates of credit on cotton production. Empirical estimates of study have denoted, significant and positive coefficient of credit has positive impact on the production of cotton in both districts Rahim Yar Khan and Muzaffargarh. Credit can also play a significant role an increasing overall agriculture growth and particularly the cotton production of cotton areas. The lower mean technical efficiency in both study areas is 0.78 and 0.72 indicates cotton is not produced at potential level due to technical inefficiency of cotton farmers. Policy measures of the study will supportive to extenuating the problems concerning to small farming community in securing farming institutional credit.

Received | July 12, 2018; **Accepted** | February 13, 2019; **Published** | March 28, 2019
***Correspondence** | Dilshad Ahmad, COMSATS Institute of Information Technology Vehari, Pakistan; **Email:** dilshad@ciitvehari.edu.pk
Citation | Ahmad, D. and M. Afzal. 2019. Analysis of agriculture credit contribution in cotton production of southern Punjab, Pakistan. *Sarhad Journal of Agriculture,* 35(2): 392-399.
DOI | http://dx.doi.org/10.17582/journal.sja/2019/35.2.392.399
Keywords | Credit, Cotton, Stochastic frontier Production Function, Punjab, Pakistan

Introduction

Rapid economic growth and poverty reduction goals have no significance without sustained agriculture growth in agrarian economies, which is historically justified through empirical evidence of most agrarian and industrialized, Asian, European, North American developed and developing countries of the world Hazell et al. (2007). In Pakistan, living of majority population inhabited in rural areas depends on agriculture as a source of income and employment. Stability and smooth growth in agriculture has multiple significant impacts on the living of rural areas, increasing off farm and on farm employment opportunities, increasing purchasing power and contribution to price stability in the economy. Agriculture share in gross domestic product of Pakistan has continuously declining trend through many decades, which is now 19.8 percent of Gross Domestic Product while it is also a major source of employing 42.3 percent labor force of the country, GoP (2016-17).

In the current scenario, availability of appropriate crop inputs seed, fertilizer, pesticides, irrigation and modern technologies for proper application of farming practices are prerequisite for sustainable and stable agriculture growth. Adequate availability of finance is precondition in performing all these farming practices smoothly for enhancing agriculture growth and modernizing agriculture sector. Channeling the credit for increasing farmer's requirements in agrarian economies of developed and developing countries have formulated formal credit institutes Machethe (2004). In this current modernized era, agriculture has transferred from traditional to modern one sector as compared to last few decades and a financial requirement of credit has increased on multifold basis. Formal and informal are two main sources, which provide agriculture credit to the farmers in Pakistan. Relatives, friends, dealers, agents etc. are informal sources of agriculture credit while Zari Taraqiti Banks Limited, Commercial banks and other formal institute's facilities for agriculture credit to the small, medium and large farmers in Pakistan Jan et al. (2012). Credit has facilitated poor farmers in improving their welfare, smoothening consumption pattern and financing investment in human and physical capital to enhancing productive capacity of farmers Okurut et al. (2004).

Godquin and Sharma (2008) examined the role of credit constrains on decision of farmer's household production and consumption. Findings of the study have indicated the gap between farmer's credit requirement and availability of credit negatively disorders the production and consumption sequence of farmer. Inadequate availability of Credit negatively influences the farming practices of inputs supply, purchase of modern technology and reducing production pattern of farming practices. Jan and Manig (2008) study focused on agricultural support services and its impact on agriculture income. Empirical estimates of the study have mentioned credit positively impact on increasing the crop production and income of the farmers. It has also concluded, it is prerequisite for increasing overall agriculture sector productivity to minimizing credit constrains and fair distribution of credit according requirement while ignoring political and bureaucratic influencing measure. Sebopetji and Belete (2009) focused on the proper utilization of credit while examined male and more farming experience farmers have relatively utilized credit more appropriately. Appropriate policy measures regarding to credit disbursement focusing needy and experienced farmers necessary to applied for enhancing the productivity. Asim et al. (2015) analyzed the impact of loanee and Non-loanee farmers on the yield of cotton and wheat production in Sahiwal employing Cobb-Douglas production function. Empirical estimates of study have indicated loanee farmers increased more yield in cotton and wheat production as compared to Non-loanee farmers. Credit has raised the welfare and living standard of farmers increasing productivity of crops and income. Ahmad et al. (2015) investigated the impact of agriculture credit and wheat production in Pakistan employing the Cobb-Douglas Production function. Findings of the study has denoted credit user farmers comparatively higher wheat yield rather than non-credit user farmers. Formal credit institutes need enhance the circle of credit to facilitate maximum farmers and minimize the credit constrains as small farmers can gain benefit and increase productivity.

Abate et al. (2016) examined the role of rural finance in adoption and extent of modernized technologies in agriculture. Findings of the study have indicated the positive and significant impact of institutional credit on adoption and extent of modern technology in farming practices. Financial cooperatives have dominant effect in adoption of technology rather than financial institutions. The study concluded that adoption of the advanced farming practices need to encourage for modernizing and enhancing productivity in agriculture.

Materials and Methods

Social science research usually follows sampling procedure covering the whole population, which has considered an economical procedure owing to financial and time confines constrains. Small representative of a large whole population known as sample, which is characterized with representative and adequacy, Goode and Hatt (1952). Simple random sampling technique has employed for collection of data for the year 2015-16 in the study for sampling procedure of selecting two cotton-producing districts Rahim Yar Khan and Muzaffargarh of southern Punjab of cotton zone in first stage. Two tehsils Rahim Yar Khan and Khan pur from Rahim Yar Khan and Ali pur and Jatoi from Muzaffargarh district were randomly selected in second stage. In the third stage, four villages from each tehsil were randomly selected. In last sampling

stage twenty-cotton farmer, ten loanee and ten non-loanee from each village were randomly selected for sampling procedure of study. A sample size of three hundred and twenty-cotton farmers one hundred and sixty loanee and one hundred and sixty non-loanee randomly selected from two districts with the distribution of eighty loanee and eighty non-loanee cotton farmers from each district.

Stochastic Frontier Analysis (SFA) and Data Envelopment Analysis (DEA) are two parametric and non-parametric approaches mostly used to measure technical efficiency. Stochastic error in the data set measured in parametric while non-parametric is deterministic in nature measure maximum inefficiency. Parametric approach (SFA) used in the study based on econometric technique ease to estimate and more reliable in estimation of efficiency. In Equation (2) as presented the stochastic frontier production function to estimate technical efficiency. Meeusen and Van Den Broeck (1977) and Aigner et al. (1977) firstly developed this model which was further furnished by Jondrow et al. (1982) and Schmidt and Lovell (1979).

$$Y_i = f(X_i; \beta_i) + \varepsilon_i \quad \ldots\ldots (1)$$

As the output indicated by Y_i inputs as X_i parameters of model as β_i and composed error term indicated by ε_i as mentioned in the Equation (1).

$$\varepsilon_i = v_i - u_i \quad \ldots\ldots (2)$$

The normally and actually distributed error term indicated by vi while half-normally and independently distributed farmer or farm specific error term as mentioned ui. The gap of output due to as actual output and maximum one due to natural reason indicated with vi while inefficiency factor reason of farmer indicated as ui. Technically efficiency is gap from maximum to actual output with constant technology.

Empirical analysis of the study was obtained, employing the stochastic frontier Cobb Douglas type Production Function, which is ease to capitation, flexibility, ability to represent and proper characteristics of uniformity, Bhanumurthy (2002). Standard linear regression used for the analysis of sample linear logarithmic data form of the study. Impact of credit on cotton productivity of district Rahim Yar Khan was analyzed with fitted to data set with the following functional form 1.

$$\ln \text{cotton } Y_i = \psi_0 + \psi_1 \ln \text{area} + \psi_2 \ln \text{seed} + \psi_3 \ln \text{ferti} + \psi_4 \ln \text{pesti} + \psi_5 \ln \text{irriga} + \psi_6 \ln \text{culti} + v_i - u_i \quad \ldots. (1)$$

In cotton Y= natural log of cotton yield mds per acre, ln area= indicates the natural log of cultivated area for cotton crop, In Seed = natural log of cottonseed cost Rs/per acre, In ferti = natural log of fertilizer cost Rs/per acre, In pesti = natural log of pesticides cost Rs/per acre, In irriga = natural log of irrigation cost Rs/per acre, In culti = natural log of cultivation cost Rs/per acre variable in model. ψ_1, ψ_2, ψ_3, ψ_4, ψ_5 and ψ_6 as the parameters of output elasticities of the model while the u as the disturbance term in the model. Employing the stochastic frontier likelihood approach the model in Equation (2) used to estimate the factors of technical inefficiency of district Rahim Yar Khan.

$$u_i = \varphi_0 + \varphi_1 \text{age} + \varphi_2 \text{edu} + \varphi_3 \text{credit} + \varphi_4 tubewell + \varphi_5 \text{watershortage} + \varphi_6 \text{contact to extension} + \mu_i \quad \ldots. (2)$$

The stochastic error term indicated with the μ_i, estimated parameters as φ_i and constant value as φ_o. Technical efficiency determinant as Age= age of farmer in years, Edu= education of farmer in schooling years, Credit= credit amount in Rs, Tubewell= water sources in no, Water shortage= lack of irrigation water in percentage, extension contact= agricultural officials contact in no.

Equation (3) denotes the data set functional form analyzing the impact of credit on cotton production of district Muzaffargarh. All the variables in the Equation (3) of Muzaffargarh have same description as justified in the above Equation (1).

$$\ln \text{cotton } Y = Y_0 + Y_1 \text{area} + Y_2 \ln \text{seed} + Y_3 \ln \text{ferti} + Y_4 \ln \text{pesti} + Y_5 \ln \text{irriga} + Y_6 \ln \text{culti} + v_i - u_i \quad \ldots (3)$$

In Equation (4) estimating the technical inefficiency of district Muzaffargarh, stochastic frontier likelihood approach used in the study with the same description of variables as given in the above Equation (2).

$$u_i = \eta_0 + \eta_1 \text{age} + \eta_2 \text{education} + \eta_3 \text{credit} + \eta_4 tubewell + \eta_5 \text{watershortage} + \eta_6 \text{contact to extension} + \mu_i \quad \ldots. (4)$$

Cotton farmers schooling year's frequency distribution of credit user and non-credit user of district Rahim Yar Khan have reported in Table 1. Almost twenty-three percent credit user cotton farmer having 9 to 10 years schooling whereas eighteen percent have 13 to 14 years schooling while more than half cotton farmers, which uses credit, have schooling 9 years and above. Cotton farmers not using credit almost twenty nine percent are illiterate while twenty one percent

having only limit of five years of schooling so more than seventy percent farmers not using credit having only the maximum eight years of education. Credit user and non credit user frequency distribution have indicted higher education motivate farmers to utilize credit availability properly and increasing cotton production while illiterate or less educated have minimum preference regarding to such option.

Table 1: *Rahim Yar Khan credit user and non-credit user education frequency distribution.*

Credit user cotton farmers			Non credit user cotton farmers		
Schooling years	Fre-quency	%age	Schooling years	Fre-quency	%age
Illiterate	8	10	illiterate	23	28.75
1-5years	7	8.75	1-5years	17	21.25
6-8years	10	12.5	6-8years	15	18.75
9-10years	18	22.5	9-10years	12	15
11-12 years	12	15	11-12 years	8	10
13-14 years	14	17.5	13-14 years	3	3.75
Above 14 years	11	13.75	Above 14 years	2	2.5
Total	80	100	Total	80	100

Frequency distribution of district Muzaffargarh credit user and non-credit user cotton farmers has reported in Table 2. Almost twenty-three percent credit user farmers have schooling 11 to 12 years whereas twenty-one percent have 9 to 10 years schooling which indicates more than seventy percent using credit-having schooling 9 and above. Thirty-four percent farmers are illiterate which not using credit and sixteen percent are 1 to 5 year schooling it is determined that more than seventy percent farmer not using credit having maximum eight years of schooling. Frequency distribution of credit user and not credit user indicates farmers with higher education prefer to use credit to increasing cotton production whereas less educated farmer having minimum preference in credit use.

Credit sources and utilization frequency distribution of credit user of district Rahim Yar Khan of cotton farmers have reported in Table 3. Credit beneficiaries avail both formal and non-formal sources for credit while formal sources play dominant role in credit disbursement. Almost more than seventy-five percent credit beneficiaries borrow from formal sources Zari Taraqiti Bank Limited and commercial banks while twenty-four percent from non-formal sources, dealer's, agent's, relatives, friends and others. Credit users utilize credit according to their personal interests as mentioned in the Table 3. Frequency distribution indicates only forty-one percent credit utilized for cotton crop inputs and machinery while almost sixty percent credit utilized for land purchase, marriages, traditional ceremonies, house construction etc.

Table 2: *Muzaffargarh credit user and non-credit user education frequency distribution.*

Credit user cotton farmers			Non credit user cotton farmers		
Schooling years	Fre-quency	%age	Schooling years	Fre-quency	%age
Illiterate	4	5	Illiterate	27	33.75
1-5years	8	10	1-5years	13	16.25
6-8years	14	17.5	6-8years	12	15
9-10years	17	21.25	9-10years	11	13.75
11-12 years	18	22.5	11-12 years	7	8.75
13-14 years	10	12.5	13-14 years	6	7.5
Above 14 years	9	11.25	Above 14 years	4	5
Total	80	100	Total	80	100

Table 3: *Rahim Yar Khan Farmers Credit sources and utilization frequency distribution.*

Credit sources for credit users			Credit utilization for credit user		
Credit Sources	Fre-quency	%age	Credit utilization	Fre-quency	%age
Commer-cial banks	18	22.5	Cotton crop inputs	28	35
ZTBL	43	53.75	Purchase of ma-chinery	5	6.25
Dealers/ Agents	11	13.75	Purchase of land	12	15
Others	8	10	Others non pro-ductive	35	43.75
Total	80	100	Total	80	100

Table 4 indicates district Muzaffargarh cotton farmer's frequency distribution of credit sources and credit utilization. More than seventy-three percent credit beneficiaries access the credit from formal sources Commercial banks and Zari Taraqiti Bank Limited while twenty seven percent borrow from non-formal sources dealers, agents, relatives, friends etc. Farmer borrows credit from both formal and non-formal sources while formal sources have dominant role in credit disbursement. Credit utilization frequency distribution also presented in Table 4. Only thirty-nine percent credit users utilized credit for crop farming practices cotton crop inputs and farming machinery while more than sixty-one percent farmers

use the credit for land purchase, marriages, house construction traditional ceremonies and others.

Table 4: *Muzaffargarh farmers credit sources and utilization frequency distribution.*

Credit sources for credit users			Credit utilization for credit user		
Credit Sources	Frequency	%age	Credit utilization	Frequency	%age
Commercial banks	19	23.75	Cotton crop inputs	23	28.75
ZTBL	39	48.75	Purchase of machinery	8	10
Dealers/ Agents	13	16.25	Purchase of land	10	12.5
Others	9	11.25	Others non productive	39	48.75
Total	80	100	Total	80	100

Results and Discussion

The empirical estimates of stochastic frontier Cobb-Douglas Production Function regression analysis of coefficients in Rahim Yar Khan and Muzaffargarh as mentioned in Table 5 and 6. The constant (intercept) value is 0.352 and 0.359 in both models denotes, as such output of cotton can attainted without using any inputs.

The positive and significant coefficients of area and seed in both study areas indicates as cotton area and seed increase cotton production increases and these findings are in line with the studies of Basnayake and Gunaratne (2011), Barnes (2008), Ahmad and Afzal (2012) and Fatima et al. (2016). The variable of fertilizer with positive and significant coefficient in Rahim Yar Khan while negative and significant coefficient in Muzaffargarh indicates as fertilizer use increase cotton production increases in Rahim Yar Khan while decrease in Muzaffargarh. Fertilizer findings of Rahim Yar Khan are similar with study of Fatima et al. (2016) and contradiction with Muzaffargarh findings. Pesticides coefficient in both study areas negative and significant denotes as pesticides use increase cotton production reduces and these findings are similar with the study of Ahmad and Afzal (2012) and in contrast with study of Ahmad and Ahmad (1998), Bashir et al. (2005) and Fatima et al. (2016). The coefficient of irrigation and cultivation (ploughing) is positive and significant in both study areas, indicates as irrigation and cultivation increases cotton production increases in both study areas and these findings are in line with the studies of Ahmed et al. (2002), Hassan (2004), Ahmad and Afzal (2012) and Fatima et al. (2016).

Table5: *Stochastic production frontier parameters estimates of maximum likelihood of district Rahim Yar Khan.*

Variables	coefficients	Standard error	t-ratio
Constant	0.352	0.497	7.098***
ln area in acres	0.990	0.265	3.725***
ln seed	0.737	0.667	1.104*
ln fertilizer	0.153	0.542	2.836**
ln pesticides	-0.591	0.483	-1.224*
ln irrigation	0.755	0.874	8.636***
ln cultivation	0.410	0.394	1.039*
Inefficiency Effects			
Constant	0.596	0.169	3.525***
Age	-0.318	0.376	-8.468***
Education	-0.716	0.805	-8.891***
Credit	-0.182	0.332	-5.511***
Tubewell	-0.576	0.291	-1.977*
water shortage	0.409	0.217	1.884*
contact to extension	-0.128	0.662	-1.935*
Variance parameters			
Sigma-square	0.608	0.101	5.995
Gamma	0.762	0.505	0.150
Likelihood function	56.132		

****at1percent level of significance **at 5percent level of significance *at 10percent level of significance.*

In the estimation of technical inefficiency, function in both study areas as indicated in the Table 5 and 6. The coefficient of age and education in both study areas is negative and significant which mentions as age and education increase technical inefficiency reduces of cotton farmers findings are similar with the studies of Bakhsh (2006), Ahmad and Afzal (2012) and Fatima et al. (2016). Credit and tubewell with negative and significant coefficient indicates as cotton farmer more access of credit and tubewell for irrigation it reduces the inefficiency of cotton farmers and these findings are in line with studies of Ahmad and Afzal (2012). Water shortage with the positive and significant coefficient in both study areas indicates as water shortage increases technical inefficiency of cotton farmer increases and these findings are in line with the study of Ahmad and Afzal (2012) and Ahmad et al. (2016). The coefficient of agriculture extension with negative and significant coefficient in both study areas indicates

as farmers more access of agriculture extension less technically inefficient and findings are similar with studies of Hassan (2004) and Ahmad et al. (2016).

Table 6: *Stochastic production frontier parameters estimates of maximum likelihood of district Muzaffargarh.*

Variables	coefficients	Standard error	t-ratio
Constant	0.359	0.487	7.372***
ln area in acres	0.967	0.208	4.640***
ln seed	0.348	0.739	4.712***
ln fertilizer	-0.590	0.573	-1.030*
ln pesticides	-0.390	0.468	-8.331**
ln irrigation	0.139	0.649	2.142**
ln cultivation	0.719	0.541	1.329*
Inefficiency Effects			
Constant	0.440	0.179	2.451**
Age	0.183	0.344	5.338***
Education	-0.509	0.820	-6.212***
Credit	-0.211	0.920	-2.298**
Tubewell	-0.100	0.814	-1.235*
water shortage	0.504	0.194	2.598**
contact to extension	-0.171	0.858	-1.995*
Variance parameters			
Sigma-square	0.788	0.117	6.719
Gamma	0.836	0.389	0.214
Likelihood function	36.67		

****at 1percent level of significance **at 5percent level of significance *at 10percent level of significance.*

Table 7: *Rahim Yar Khan and Muzaffargarh districts cotton farmer distribution on basis of technical efficiency.*

	Rahim Yar Khan		Muzaffargarh	
Technical efficiency	Frequency	Percentage	Frequency	Percentage
Less than 0.70	63	39.38	78	48.75
0.71 to 0.80	11	6.87	15	9.38
0.81 to 0.90	10	6.25	8	5
More than 0.90	76	47.5	59	36.87
Minimum technical efficiency		0.37(37%)		0.33(33%)
Maximum technical efficiency		0.98(98%)		0.97(97%)
Mean technical efficiency		0.78(78%)		0.73(73%)

In Table 7 frequency distribution of technical efficiency of both districts as mentioned. Mean technical efficiency of Rahim Yar Khan is 0.78 with the range of 0.37 to 0.98 while in Muzaffargarh mean technical efficiency is 0.73 with the range of 0.33 to 0.97. These findings indicate, as there exist much potential in increasing the productivity of cotton crop in both study areas with increasing the technical efficiency of cotton farmers in both study areas.

Conclusion and Recommendation

In the economy of Pakistan, agriculture has cornerstone status regarding to wellbeing of rural population and economic growth of the country. Diffusion of adequate and quality based inputs with technical advances is prerequisite to minimize yield gap in crops. A significant increasing trend in credit access has smoothly ever-increasing agriculture productivity. Findings of the study have denoted, credit significantly increased cotton productivity and welfare of cotton farmers in southern areas of Punjab. Cotton farmers utilize only 41 percent and 38 percent credit in Rahim Yar Khan and Muzaffargarh for crop inputs while utilize 59 percent and 62 percent for other non crop purposes which indicates lower coefficient of credit in both districts. Results of study have indicated proper policy inference as cotton productivity can further enhanced by utilizing credit purely for cotton inputs rather non-productive activities. Formal institutes disburse major share of credit 78 percent and 72 percent in both districts comparative to non-formal institutes so formal institutes need to adopt proper policy measure enhancing credit ratio and make ensure potential use of credit only for crop productivity. The lower mean technical efficiency in both study areas indicated to enhancing the expertise of farmers to produce the cotton at potential level. Findings of the study justify the significance of credit increasing the cotton productivity in Rahim Yar Khan and Muzaffargarh.

Acknowledgements

This study has no funding sources.

Author's Contribution

In this manuscript initial idea, data collection, methodology, write up was contributed by Dilshad Ahmad while results and suggestions and proof reading was contributed both authors Dilshad Ahmad and Muhammad Afzal.

References

Abate, G.T., S. Rashid, C. Borzaga and K. Getnet. 2016. Rural finance and agriculture technology adoption in Ethiopia: Does the institutional design of lending organizations matter? World Dev. 84. pp: 235-253. https://doi.org/10.1016/j.worlddev.2016.03.003

Ahmad, M. and A. Ahmad. 1998. An analysis of the sources of wheat output growth in the Barani area of the Punjab. Pak. Dev. Rev. 231-249. https://doi.org/10.30541/v37i3pp.231-249

Ahmad, M., G.M. Chaudhry, M. Iqbal and D.A. Khan. 2002. Wheat productivity, efficiency, and sustainability: A stochastic production frontier analysis [with comments]. Pak. Dev. Rev. 643-663. https://doi.org/10.30541/v41i4IIpp.643-663

Ahmad, D. and M. Afzal. 2012. The determinants of technical efficiency of cotton farmers in the southern Punjab (Pakistan). Int. J. Phys. Soc. Sci. 2(12): 156-171.

Ahmad, N., I. Jan, S. Ullah and S. Pervez. 2015. Impact of agricultural credit on wheat productivity in district Jhang, Pakistan. Sarhad J. Agric. 3191: 65-69.

Ahmad, D., M.I. Chani, A. Rauf and M. Afzal. 2016. Economic analysis of cotton cultivation under agro-climatic conditions of district Muzaffargarh. Am-Eur. J. Agric. Environ. Sci., 16(8): 1498-1503.

Aigner, D., C.K. Lovell and P. Schmidt. 1977. Formulation and estimation of stochastic frontier production function models. J. Econ. *6*(1): 21-37. https://doi.org/10.1016/0304-4076(77)90052-5

Asim. 2015. Does credit play a role in increasing the yield of wheat and cotton: A case study of district Sahiwal". Mediterr. J. Soc. Sci. 6(4): 482-486.

Bakhsh, K., B. Ahmad and S. Hassan. 2006. Food security through increasing technical efficiency. Asian J. Plant Sci. 5(6): 970-976. https://doi.org/10.3923/ajps.2006.970.976

Bashir, M., D. Khan and M. Iqbal. 2005. An analysis of allocative efficiency of wheat growers in northern Pakistan [with Comments]. Pak. Dev. Rev. 643-657. https://doi.org/10.30541/v44i4IIpp.643-657

Barnes, A. 2008. Technical efficiency estimates of Scottish agriculture: A note. J. Agric. Econ. 59(2): 370-376. https://doi.org/10.1111/j.1477-9552.2008.00156.x

Basnayake, B.M.J.K. and L.H.P. Gunaratne. 2011. Estimation of technical efficiency and its determinants in the tea small holding sector in the mid country wet zone of Sri Lanka. Sri Lankan J. Agric. Econ. 4.

Bhanumurthy, K.V. 2002. Arguing a case for the cobb-douglas production function. Rev. Common Stud. Delhi, India. 75-91.

Fatima, H., M.A. Khan, M. Zaid-Ullah and K.N. Saddozai. 2016. Technical efficiency of cotton production in Pakistan: A comparative study on non Bt and Bt-cotton farms. Sarhad J. Agric. 32(4).

Godquin, M. and M. Sharma. 2008. If only I could borrow more? Production and consumption credit constraints in the Philippines team (Univ. Paris I-La Sorbonne) and CNRS. 106-112, Bd. de Hospital, 75013 Paris, mariegodquin (univ-paris 1 IFPRI, 2033, K Street NW, Washington DC 20006-1002, USA.

Goode, W.J. and P.K. Hatt. 1952. Methods in social research, McGraw- hill, New York, NY.

GoP. 2016-17. Economic survey of Pakistan. Minist. Finance, Islamabad.

Hassan, S. 2004. An analysis of technical efficiency of wheat farmers in the mixed farming system of the Punjab, Pakistan. Doctoral dissertation, Univ. Agric. Faisalabad.

Hazell, P., C. Poulton, S. Wiggins and A. Dorward. 2007. The Future of small farms for poverty reduction and growth. Discussion paper 42, May 2007. Int. Food Policy Res. Inst. (IFPRI). Washington, DC: Washington, DC: IFPRI.

Jan, I. and W. Manig. 2008. Influence of participation in agricultural support service on income from agriculture: results from the multiple regression model (a case from rural Northwest Pakistan). Sarhad J. Agric. 24(1): 129-136.

Jan, I., S. Munir, A. Usman and M. Idress. 2012. Agricultural credit markets in north west Pakistan: Implication for the development policy. Sarhad J. Agric. 28(3): 521-529.

Jondrow, J., C.K. Lovell, I.S. Materov and P. Schmidt. 1982. On the estimation of technical inefficiency in the stochastic frontier production function model. J. Econ. 19(2-3): 233-238. https://doi.org/10.1016/0304-4076(82)90004-5

Machethe, L. 2004. Agriculture and poverty in south

Africa: Agriculture can reduce poverty paper presented at the overcoming underdevelopment conference, Pretoria South Africa.

Meeusen, W. and J. van Den Broeck. 1977. Efficiency estimation from Cobb-Douglas production functions with composed error. Int. Econ. Rev. 435-444. https://doi.org/10.2307/2525757

Okurut, F.N., M. Banga and A. Mukungu. 2004. Micro finance and poverty reduction, Uganda: achievement and challenges". Res. Ser. No: 41. Econ. Policy Res. Centre EPRC, Makerere Univ.

Schmidt, P. and C.K. Lovell. 1979. Estimating technical and allocative inefficiency relative to stochastic production and cost frontiers. J. Econ. 9(3): 343-366. https://doi.org/10.1016/0304-4076(79)90078-2

Sebopetji, T.O. and A. Belete. 2009. An application of probit analysis in factor affecting small scale farmers decisions to take credit: A case study of the greater letaba local municipality in south Africa. Afr. J. Agric. Res. 4(8): 718-723.