AN ECONOMIC ANALYSIS OF POTATO PRODUCTION IN OKARA DISTRICT, PAKISTAN

Muhammad Amjed Iqbal

PhD Scholar, College of Economics and Management,

Huazhong Agricultural University, Wuhan, P.R. China

amjadiqbal1775@yahoo.com

Qing Ping ✉

College of Economics and Management, Huazhong Agricultural University, P.R. China

qingping@mail.hzau.edu.cn

Sultan Ali Adil

Institute of Agricultural and Resource Economics.

University of Agricultural Faisalabad, Pakistan

sultan_adilpk@yahoo.com

Adnan Nazir

PhD Scholar, College of Economics and Management,

Huazhong Agricultural University, Wuhan, P.R. China

adnan_nazir26@yahoo.com

Muhammad Rizwan

PhD Scholar, College of Economics and Management,

Huazhong Agricultural University, Wuhan, P.R. China

rizwaneco@gmail.com

Abstract

The aim of the present study was to assess the profitability in potato production as a short seasonal enterprise and constraints in potato cultivation in District Okara, Pakistan. A total of 100 farmers, 75 non-contracts and 25 contracts were interviewed. The crop budgets were estimated separately for contract and non-contract farmers to visualise the important factor affecting the yield of potato. To assess empirically a Cobb Douglas type production function was used. The findings of the study reveal that the margins for contract formers such as gross margin/acre was Rs.83,037, gross margin/40kg was Rs.218 and gross margin/ kg was Rs.5.74, which were higher as compared to non-contract farmers. While the non-contract farmers received a gross margin/acre of Rs.45,418, gross margin/40kg of Rs.161.02, gross margin/kg Rs.4.03. Simultaneously the yield of contract farmers (15,172) was higher than non-contract farmers (11,270). Though, by providing finance, cold storage facility, high quality seed and improved irrigation could positively affect the potato output.

Keywords: Potato, Profitability, Margins, Constraint, Contract farmers, Cobb Douglas

INTRODUCTION

In Pakistan about three fifth of the population is living under $2 dollars a day (GoP, 2014). Due to this prevailing poverty, major portion of the population is incapable to purchase and consume quality nutritious food items. Children are normally underweight and of poor health, causing labour force to low productivity (Croppenstedt and Muller, 2000). Pakistan's economy is agro-based, where 43.7 percent of labour force is involved with agriculture (GoP, 14) and almost 70 percent of population directly or indirectly dependentsupon agriculture. Despite its importance in the economy, agricultural production is far behind than its potential level. Small land holdings, minimal or suboptimal use of inputs, due to inadequate purchasing capability of the farmers' are the reasons responsible for low productivity. By connexion of these factors, farmers are forced to grow short duration crops to fetch nominal returns (Ali 2000).

Among short duration crops, potato farming is considered one of the most feasible ventures. Potato is the fourth important crop in world after rice, wheat and maize (FAO 1995). In Pakistan, potato has emerged as a high yielding crop and the area under potato has increased from 3,000 hectares in 1947 to 154,000 hectares in 2009 (GoP, 2009).While Punjab province is the leading potato producer 3,340 thousand tons followed by KPK118.2 thousand tons, Balochistan29.7 thousand tons and Sindh3.9 thousand tons (GoP,2014).Potato consumption in the country is seasonal and high during the harvest season. The annual export of potato

averages about 0.050 metric tons. Albeit Sri Lanka is the main market, followed by Afghanistan (GoP, 2009a). Keeping in view the importance of potato crop in rural economy, the present study was designed to determine profitability and constraints related to potato cultivation.

RESEARCH METHOD

For the present study, District Okarawas, Pakistan was selected as it is one of the major growing areas of Punjab province during 2010. For collection of data, multi stage sampling technique was used (McMillan, 1999), through which four villages were randomly selected with the consultation of extension agent. After identification villages, 25 farmers/ respondents from each village, a total of 100 farmers were interviewed in person. Further the farmers were stratified into 18 non-contract and 7 contract farmers. Contract farmers are those farmers who took seed, fertilizer or spray on credit from the middle man with verbal or written agreement to sell the output to that specific middle man and otherwise are classified as non-contract farmers.

To estimate the cost of each input the method designed by Ahmad *et al.* (2003 and 2004) was adopted. Profitability (net income) was estimated by deducting total cost from gross income.

Net Income = Gross Income − Total Cost

The gross income was calculated by multiplying the average yield with the price of the given product.

*Gross Income = Yield of the Product * Price of the Product*

Cobb-Douglas Production Function

The Cobb-Douglas production function in its stochastic form may be expressed as:

$$y = Ax_1^{\beta 1}x_2^{\beta 2}x_3^{\beta 3}e^{\varepsilon}$$

Where y is output and x_1, x_2, x_3 are the inputs, $A, \beta_1, \beta_2, \beta_3$ are coefficients to be estimated and *e* is the error term.

The equation shows that relationship between output and the inputs is non-linear. So further the Cobb Douglas production function was transformed into log-log form to assess empirically. The equation derived is given as under:

$$LnY = C + \beta_1 lnx_1 + \beta_2 lnx_2 + \beta_3 lnx_3 + \ldots + \beta_9 lnx_9 + \mu_i$$

Whereas,

Ln = Natural logarithm

Y= Yield of potato in kg

x_1 = *In* of cost of land preparation per acre

x_2 = *In* of seed rate in kg per acre

x_3 = *ln* of number of irrigation applied to one acre

x_4 = *ln* of the number of spray per acre

x_5 = *ln* of nutrients (N+P+K in kgs)

x_6 = *ln* of nutrients applied by contract farmer (N+P+K in kgs)

x_7 = *ln* of number of irrigations applied by contract farmer

x_8 = *ln* of the number of spray applied by contract farmer

x_9 = Dummy for farmer, 1 = contract farmer 0 = Non contract farmer

Thus the written model is linear in parameter. So it is non-linear in the variable *y* and *x* but linear if we take the log of these variables. Hence it is log-log, double log, or log-linear model, where μ_i = stochastic disturbance term, $\beta_1 \dots \beta_9$ =Coefficients of respective variable(Gujarati, 2003).

EMPIRICAL RESULTS AND DISCUSSIONS

The aim of this analysis is to identify the profitability in potato enterprise. Though, potato crop requires number of inputs before and during the growing period. For seedbed preparation, seed, water, fertilizer, weed control and other operations require a large amount of investment. All such inputs used in quantity and factor shares are given in Table 1.

Table 1: Budget for producing 1 Acre of Potato Crop

Particulars	Unit	Quantity	Rate (Rs.)	Amount (Rs.)
Fixed Costs				
Land Rent (3.08)*	Acre	1	6,011.0	6,011.0
Water Rate	Acre	1	95.0	95.0
Total Fixed Cost				**6,106.0**
Variable Costs				
Land Preparation	No.	7.14	5,711.2	5,711.2
Seed	Kg	1,399	14.9	20,789.1
Sowing with planter	No.	1	645.3	645.3
Sowing Manually	No.	3.3	496.2	496.2
FYM trolley	No.	2	254.0	254.0
Labour Cost for FYM	Man days.	1	154.9	154.9
Urea	bags	4.3	830.4	3,570.6
DAP	bags	2.3	2,156.4	4,959.7
Potash	bags	1.6	1,410.8	2,257.3
Labour charges for Fertilization	Man days.	1	250.0	250.0
Irrigation	No.	9.33	646.3	6,030.0
Labour Charges for irrigation	Man days.	9.33	93.8	874.7
Weedicide	No. of sprays	1	423.5	423.5
Labour charges for Weedicide	Man days.	1	120.0	120.0

Table 1…

Pesticide	No.	8.4	4,688.0	4,688.0
Pesticide Labour (2.5 hour/spray)	Man days	3	93.8	281.3
Harvesting Charges	No.	306.15	6.94	2,124.0
Labour Charges	No.	7.93	250	1,982.0
Transportation cost	Rs.	12,246	0.29	3,551.3
Cost of 120 kg bag	Rs.	116.5	93.68	10,914.7
Total Variable Cost				**70,077.7**
Cost of Production				**76,183.8**
Physical Productivity	Kg	12,246	10.1	**123,807.1**

Months of land utilized under potato crop

The above mentioned table indicates the costs for growing one acre of potato crop. On the basis of cost per acre of all inputs with their application cost values of gross margin, gross income and net return were calculated. Gross margin were calculated by subtracting variable cost from total revenue and net return was calculated by subtracting total cost from total revenue. Gross Income is the market value of produce of one acre. However the average 1399 kg seed was used valuing Rs.20,789, followed by irrigation cost. The results show that majority of the farmers were applying seed within the recommended rate by the department of agriculture. Government of Punjab has recommended the seed rate of 1200-1500 kg per acre for potato crop (Government of Punjab 2003). However in 3.08 month of land coverage by potato crop 9.3 irrigations were given, valuing Rs.6030.Moreover, on an average 4.3 bags of urea were used valuing Rs.3570.6. While 2.3 bags of DAP were used valuing Rs.4959.7, and 1.6 bags of Potash valuing 2257. Likewise Rs.4688 incurred on pest control, and Rs.423 for weed control. Likely, 306 mds were harvested from one acre costing Rs.2124. Though for packing the produce to the 116 bags were used costing Rs.10914. While for transporting the produce to the market Rs.3551 incurred. On overall basis, the variable cost was estimated Rs.70077, and the total cost of production was Rs.76183. From investing in one acre an output of 12246 kgs of potatoes were obtained, and were sold on Rs.10.1 per kg which gave Rs.123807 as gross income.

Table 2: Values of Gross Margin, Gross Income and Net Return

Particulars	Values	Particulars	Values
Total Cost	76,183.8	Yield md/acre	306.15
VC	70,077.7	VC/md	228.90
Gross Margin/acre	53,729.32	Price/md	404.4
Gross Margin/40 kg	175.50	TC/md	248.84
Gross Margin/ kg	4.39	Gross Income/40 kg	404.40
Gross Income/ kg	10.11	Net Return/acre	47,623.28
Net Return/40kg	155.56	Net Return/kg	3.89

The aforementioned table shows different values obtained from cost of production and revenue obtained from it. The table divulges that gross margin was value Rs. 53,729, while gross margin/40kgwas Rs.175.50, gross margin/kg Rs.4.39, gross income/kg Rs.10.11 and net income/40kg was estimated Rs.155.56. Lastly the net return was Rs.47. 62 and net return/kg was Rs.3.89. As all values of gross income, gross margin and net return are positive. However these results co-related with Ahmad *et.al;* (2005).Further the results indicate that there is good benefit in growing potato crop. This is due to the high output price of the crop.

Relative Share of Various Costs in farm budget

The relative share of various inputs i.e. seed, fertilizer, land rent, labour and land preparation were the major constituents in cost of production. However the proportion of each cost was estimated and is given hereafter.

Table 3: Share of various inputs in total cost of production of potato

Different Items	PKR
Cost of Production	76,183.8
Factor Share (%)	
Land Preparation	7.50
Seed	27.29
Fertilizer	14.49
Irrigation	7.92
Weedicide	0.56
Pesticide	6.15
Labour*	9.09
Transportation Cost	4.66
Land Rent	7.89
Others**	14.45
Total	**100**

* It includes labour used for sowing manually, sowing with planter, harvesting labour, and application of weedicide, irrigation, fertilizer, farmyard manure and spray.
** It includes the water rate and cost of 120 kg bags used in one acre for potato produce.

In the above table share of different operations were calculated from the total cost. The seed cost held the key share of 27.29% followed by the fertilizer 14.49% in total cost. Similarly, Elrasheed and Balal (2009) in Sudan revealed that the share of seed cost in total cost of production is highest. Furthermore 'others' which includes the cost of bags used for filling the potato crop and water rate accumulating a share of 14.45%. Moreover, the share of labour cost for applying the different tasks was 9.09% and the share of irrigation was 7.92%. However the cost of pesticide had a share of 6.15% in the overall production cost respectively.

Comparison of crop budget of contract and non-contract farmers on per acre basis

A comparative analysis was done for contract and non-contract farmers in terms of cost incurred on various inputs. The cost of different inputs for contract and non-contract farmers varies from farmer to farmer. If we compare the production of contract and non-contract farmers on per acre basis, then higher output was observed for the contract farmers. There was a significance difference of the production level of contract and non-contract farmers. The reason may be that contract farmers are more conscious about their production as compared to no-contract farmers. However results indicate that majority of contract farmers were poor.

Table 4: Comparison of Budget for Contract and Non Contract Farmers

Particulars	Contract Farmers			Non Contract Farmers		
Particulars	Qty	Rate (Rs)	Amount	Qty	Rate (Rs.)	Amount
Fixed Costs						
Land Rent (Rs)	1	6,117.77	6,117.77	1	5,975.46	5,975.46
Water Rate (Rs.)	1	95.00	95.00	1	95.00	95.00
Total Fixed Costs (Rs.)			**6,212.77**			**6,070.46**
Variable Costs						
Land Preparation (Rs.)	6.88	5,500.00	5,500.00	7.23	5,781.60	5,781.60
Seed (Kg)	1,308.00	12.31	16,101.50	1,330.67	14.86	19,773.80
Sowing with planter(Rs.)	1	647.46	647.46	1	635.82	635.82
Sowing manually (Rs.)	3.44	516.66	516.66	3.20	481.25	481.25
Fym (trolly) (No.)	1.05	272.22	285.83	1.20	245.00	294.00
Labour Cost for FYM (Rs.)	1	177.77	177.77	1	121.00	121.00
Urea (bags)	4.30	924.18	3,974.00	4.28	802.83	3,436.13
DAP (bags)	2.40	2,165.00	5,196.00	2.24	2,178.90	4,880.93
Potash (bags)	1.02	2,082.40	2,124.00	1.07	2,145.54	2,295.73
Labour for Urea, DAP and Potash	1	250.00	250.00	1		250.00
Irrigation (No.)	9.60	611.97	5,875.00	9.24	658.10	6,080.84
Labour charges for Irrigation	9.60	93.75	900.00	9.24	93.75	866.25
Weeding (No. of sprays)	1.00	426.00	426.00	1.00	422.67	422.67
Labour charges for weedicide (No. of spray)	1	120.00	120.00	1	120.00	120.00
Pesticide	7.91	4,420.00	4,420.00	8.56	4,777.33	4,777.33
Pesticide Labour (No.)	3	93.75	281.25	3	93.75	281.25
Harvesting Charges	379.32	5.35	2,032.00	281.76	7.64	2,154.67
Labour Charges	7.54	250	1,884.00	8.05	250	2,014.67
Transportation cost	15,172.80	0.29	4,248.38	11,270.40	0.28	3,155.71
Cost of 120 kg bag	126.44	113.40	14,338.30	93.92	117.55	11,040.29
Total Variable Cost			**69,298.15**			**68,863.95**
Total Cost of Production			**75,510.92**			**74,934.41**
Physical Productivity (kg)	**15,172.80**	**10.04**	**152,334.91**	**11,270.40**	**10.14**	**114,281.90**

The table 4 depicts the variable and fixed costs separately for contract and non-contract farmers. The sum of fixed costs for contract farmers was Rs.6212 higher as compared to non-contract farmers Rs.6070. The contract farmers used 1308 kg of seed with value Rs.16101whereas the non-contract farmers applied 1330kg of seed costing Rs.1977. In case of fertilizer contract farmers applied more fertilizers i.e. urea 4.30 bags, DAP 2.40 and potash 1.02 bags, likewise the non-contract farmers applied 4.28 bags of urea, DAP 2.24 bags and potash 1.07 bags respectively. Likewise contract farmers applied 9.60 irrigations with an expenditure of Rs.5875 and non-contract farmers spent Rs.6080 to apply 9.24 irrigations. The cost of pesticide for contract farmers was low Rs.4420 as non-contract farmers Rs.477.33. So the cumulative variable cost for contract farmers was high Rs.75510 but for the non-contract farmers' the total variable cost of Rs.74934incurred.The physical productivity for contract farmers was high 15172 kg and for non-contract farmers the yield was 11,270 kg respectively. The possible reason behind this was that majority contract farmers were poor and they obtained inputs on credit. Though the behaviour of farmer is usually yield oriented, so in this way they could acquire better yield. Likely, similar findings are also revealed by Ahmed et.al; (2005)

Now the comparison of contract and non-contract farmers for different values such as Total Cost, Total Variable Cost, Gross Margin, Gross Income and Net Return is given as.

Table 5: Comparison of contract and non-contract farmers for different values

Particulars	Contract Farmers	Non Contract Farmers
Total Cost (Rs.)	75,510.396	74,934.292
Total Variable Cost (Rs.)	69,297.62	68,863.832
Total cost	199.06	265.95
Yield md/acre	379.32	281.76
Variable Cost/md	182.64	244.405
Price/md	401.6	405.6
Gross Margin/acre	83,037.292	45,418.03
Gross Margin/40 kg	218.96	161.2
Gross Margin/kg	5.74	4.03
Gross Income/40 kg	401.6	405.6
Gross Income/kg	10.04	10.14
Net Return/acre	76,824.51	39,347.568
Net Return/40 kg	202.54	139.65
Net Return/kg	5.06	3.49

All the values of gross margins for contract formers such as gross margin/acre Rs.83,037,gross margin/40 kg Rs.218 and gross margin/ kg Rs.5.74 are high as compared to non-contract farmers having values with gross margin/acre Rs.45,418, gross margin/40kg Rs.161.02, gross margin/kg Rs.4.03. Both contract and non-contract farmers have positive and high values of

margins as revealed by Ahmed *et al.* (2005). The yield of contract farmer per acre 379mds was high as non-contract famers having 281.76 mds. Similarly the net return/acre, Rs.76,824, net return/40 kg Rs.202 and net return/ kg Rs.5.06 were high for contract farmer as compared to non-contract farmers with values of net return/acre 39,347, net return/40kg Rs.139 and net return/kg Rs.3.49. So the experience of contract farming in Potato production gave good results. Because in Okara there are large numbers of farmers who have small land holding and they do not have enough resources for investment. They need different inputs and resources for agriculture. If resources are given to them then they can obtain better yield. Because majority of farmers are always suffering from financial constraint, if they are financed in any way then a higher productivity can be achieved. So there is need of credit financing to these poor farmers. Then there will be an improved impact on overall production.

Other thing that is very important is that potato is a short durational crop, so the middle men do not feel fear in giving inputs on credit, and hopes the return of investment after just three months. Social pressure also plays an important role for the farmers to return payment to the middle man.

Production Function Analysis

A Cobb Douglas type of production function was used to analyse various factors affecting the yield per acre of potato.

Table 6: Production Function Estimates

Variables	Coefficient	S.E	T value	Sig.
Constant	6.331	1.782	3.553	0.001
Ln of cost of land preparation	-0.077	0.98	-0.773	0.441
Ln of seed rate in kg per acre	0.195*	0.221	2.082	0.040
Ln of No. of Irrigation applied	0.038	0.156	0.356	0.722
Ln of the No. of Spray	0.361*	0.079	3.40	0.001
Ln_fert.	-0.010	0.027	-0.107	0.915
Ln_cont_fert	2.874*	0.087	1.73	0.086
Ln_cont_irri	0.742	0.299	0.696	0.488
Ln-cont-spray	0.614*	0.218	1.885	0.063
Dummy variable for contract	-4.08*	1.342	-1.923	0.05

Dependent Variable = Natural log of yield in Kg

The results attained from the model depict that out of 9 regressors incorporated in the model 5 regressors were significant, while others were not affecting significantly potato yield. The variables which are significant those variables are affecting positively the yield while others were not very much significantly affecting the yield of potato. The variables like seed rate, no of spray,

fertilizer used by contract farmers, spray by contract farmers and dummy variable for contract were significant in the regression. The coefficient of seed rate in the model was positive (0.195) and significant. It means that 1% increase in the seed rate would increase the yield by 0.195%.This had significant coefficient (0.361). It shows that 1% increase in number of spray would increase the yield 0.361%.The coefficient was positive and significant (2.87). This means that 1% increase in fertilizer applied by contract farmer would increase the yield 2.87%.This was also significant with coefficient (0.614). This explains that 1% increase in number of spray applied by contract farmers would upturn the yield by 0.614%.However the coefficient of contract depicts that non contract farmers' did not have a positive effect on the output.

It is revealed that farmers used below than the optimum amount of these significant independent variables. Elhori *et.al;* (2009) and Elhori *et.al;* (2013) unveiled such type of findings in their studies related to potato production. They stated that farmers applied different practices such as seed, irrigation, and lesser spray than the recommended level due to financial shortage. As potato is a short durational crop and requires more expenditure in the form of costly seed, more fertilizer, sprays, and excessive labour as compared to other crops. So it is necessary to fill in the requirements of potato farmers through credit or any other ways.

Summary Statistics of the Model

The summary reveals that the independent variables used in the model have 37 per cent influence on the dependent variable. Although the value of R-square and adjusted R-square were 0.376 and 0.314 respectively. However the overall model was statistically significant as shown by F value.

Table 7: Summary Statistics of the model

Particulars	Values
Number of Observations	100
R^2	0.376
Adjusted R^2	0.314
F value	6.030

Production and Marketing Constraints

Agriculture in district Okara has a vital role. There were many opportunities and facilities for farmers in this district. Similarly marketing channel for vegetable commodities is somewhat easy. Buyers of different vegetables and other produce are always available. But still there were many production and marketing constraints observed. The major constraint was the shortage of canal water. Other constraints were i.e. non-availability of fertilizer, inadequate funds,

adulterated inputs, high price of land rent, non-availability of quality seed, inadequate extension services, high cost of labour, low output price of produce, high cost of cold storage facilities and high transportation cost respectively.

CONCLUSION

It is reality that with the passage of time size of land holding is reducing due to the division and subdivision of land. It is easy for poor farmers to get return from vegetables. Potato has been taken up by many small farmers to meet their need to raise an income from limited land holding. The findings of this study also divulge that profitability of contract farmers was higher as compared to non-contract farmers. On the other hand the adopted Cobb Douglas type of production function also ascertains various factors affecting the yield. The R^2 of the model was 0.376. This depicts that 37 per cent variation in yield has been explained by the independent variables.

SUGGESTIONS

Factors contributing to yield and the problems limiting the yield of potato were identified. Following recommendations are made to increase the yield and income for potato growers.

- ✓ As it was observed that majority of farmers were not using inputs such as fertilizer and seed according to recommendations given by the Department of Agriculture, Punjab. This realizes the role of extension workers. It is the responsibility of extension workers to provide information to the concerned people regarding use of various inputs. They should provide latest information relating to production techniques and technologies.

- ✓ Plant breeding research is required for evolving new varieties which give high yield and should have resistant against disease and pest attacks.

- ✓ Potato cultivation is an input intensive crop. There is requirement of more funds to raise a successful crop. Majority of farmers have small land holdings and they are poor. They do not have the sufficient funds to purchase different inputs and fertilizer on time. So Government should finance the small farmers through micro credit scheme. Farmers should have easily access to these schemes i.e. access of credit should be easy for farmers. So that farmers can purchase timely inputs and can assure maximum returns.

- ✓ Adulterated inputs especially pesticide and fertilizer were reported in the study areas. Steps should be taken to abandon adulterated inputs. Department of Agriculture is

already working on this line especially relating to pesticide. There is need to broaden and strength their roles and they should be given more authority to control these malpractices.

✓ There is need to strength the marketing institutions for smooth process of marketing the produce.

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