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COMPARING THE PROFITABILITY OF BAKAR AND OTHER VARIETIES OF WHEAT IN DISTRICT CHARSADDA

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Abstract

This study was conducted to estimate the profitability of different varieties of wheat in two villages of District Charsadda, Khyber Pakhtunkhwa Province of Pakistan. A total of 100 respondents were interviewed to collect the data on cost and revenue in the target area. 27.2 percent of the area was under wheat cultivation. 38 percent of the respondents were literate while about 52 percent of the wheat growers were owners. Owner cum tenants and tenants were 15 and 33 percent respectively. Simple budgeting technique was used for estimation. The overall total cost of wheat production was Rs. 20760.2 per acre, while for Bakar variety and other varieties total cost of production were , Rs.[1] 21856 and Rs. 22309 per acre respectively. The overall net return was Rs. 13447.3 per acre; while from Baker variety and other varieties net return were Rs. 11825 and Rs. 12425 per acre respectively. OLS estimation technique was used to analyze contribution of major factors in the wheat yield. The sings of the explanatory variables were found according to our prior expectation of the economic theory. The estimated results of yield function indicated that seed rate, FYM (Farm Yard Manure), NPK (Nitrogen, Phospouras and Potassium) and labor days have positive and significant effect on wheat yield, while number of tractor hours and educational level of the growers have positive but statistically insignificant effect. Finally, it is suggested that extension personal should transfer latest technology and diseases free seeds of wheat to the farmer's for optimum yield.

Key words: *Profitability, wheat verities, ordinary least square, analysis*

[1] Rs. means Rupees. At the prevailing exchange rate is 1 US $ =Rs.106/-

1. Introduction

Pakistan is an agricultural country and agriculture is the mainstay of its economy. Pakistan's economy has undergone considerable structural changes over the years, yet agriculture is the largest sector. It contributes 21.8% to Gross Domestic Product (GDP) and employing 44.7% of the total work force.

More than two-third of country population lives in rural areas and their livelihood continue to revolve around agriculture and allied activities. Like in other developing countries, poverty in Pakistan is largely a rural phenomenon. Therefore, development of agriculture will be a principal vehicle for alleviating rural poverty. Agricultural also provides food and fibers to the burgeoning population and raw material to agribusiness and industrial sector (GoP, 2009). Wheat has played an important role in the development of man civilization and Pakistan is no exception. It cover two third of the acreage under cereals crops in the world. Wheat being the staple food and major source of nourishment of the people of Pakistan, it ranks first in acreage, production and consumption among all food crops. It contributes 14.4% to the value added in agricultural and 3.0% to GDP. The targeted production for the year 2009 is 23.4 million tones as against 25.0 million tones last year, thereby showing a decline of 2.2 percent.

The wheat crop was adversely affected by the shortage of irrigation water to the extent of 23.3 percent over normal supplies during Rabi and the inordinate spike in prices of DAP fertilizer. The water availability during Rabi season (for major crop such as wheat), as of end-March 2008 was, however, estimated at 27.9 MAF, which was 23.4 percent less than the normal availability, and 10.5 percent less than last year's Rabi, adversely affecting the wheat crop, production of which has decreased by 6.6 percent over the last year (GoP, 2009).

Data shows that the average area of cultivation and production of wheat for the last seven years is 8463 thousand hectares and 21459 thousand tons respectively. The area under wheat in Pakistan 2002-03 to 2008-09 increased from 8034 to 9062 thousand hectares, while the production in Pakistan during the same period also increased from 19183 thousand tones to 23421 thousand tones. The main reasons for higher production are: attractive support price of Rs 950 per 40 kg, significant increase in area under crop, timely rains during December, January, March, and subsides on fertilizers etc.

Wheat is occupying 9.0 million hectares that is the largest area under the single crop. It occupies 70% of Rabi crops, 37% of total cropped area and around 74.92% of total area under food grain crops in the country (GoP, 2009).

The availability of certified wheat seed was 50000 tons more than last year of 2170000 tons. The availability of urea fertilizer for Rabi crop was 4.714 million tons as compare to the area requirement 2.9 million tons in addition to these, subsidy was extended to phosphoric potassium fertilizer @ Rs 250 per 50 kg and then @ Rs 400 per 50 kg bag to promote efficient use of fertilizer. As a result yield increased by 9.03% in 2006-07 as compare to – 1.95% 2005-06. The main reason of decrease in wheat production in 2007-08 is lower availability of water. The water availability during Rabi season (for major crop such as wheat), for the of end-March 2008 was, however, estimated at 27.9 MAF, which was 23.4 percent less than the normal availability, and 10.5 percent less than last year's Rabi, adversely affecting the wheat crop, production of which has decreased by 6.6 percent over the last year(GoP, 2009).

The major reasons for low productivity and instability includes, delayed harvesting of kharif crops like cotton, sugarcane and rice, and consequent late planting of wheat, non availability of improved inputs like seed, inefficient fertilizer use, weed infestation, shortage of irrigation water, drought in rainfed and terminal heat stress, soil degradation, inefficient extension services. Moreover, farmers are not aware of modern technologies because of weak extension services system.

To achieve higher production of wheat, the best varieties for irrigated area are Pir Sabaq 2004, Saleem 2000, Fakhr-e-Sarhad ,Bakhtawar 92. For Barani area best varities are Tatara, Daman, Per Sabaq 2005 and best sowing period is 25 Oct to 30 Nov. The area, production and yield of wheat in Khyber Pakhtunkhwa for the last seven years are shown in the table I.

Table 1. Areas, Production and Yield of Wheat in Khyber Pakhtunkhwa

Year	Area ('000' hectares)	Production ('000' tones)	Yield (kg/hec)	Yield (kg/acre)
2002-03	732.1	1064.4	1453.90	588.62
2003-04	741.6	1025.1	1382.28	559.62
2004-05	748.5	1091.0	1457.58	590.11
2005-06	721.3	1100.6	1525.85	617.75
2006-07	745.2	1160.4	1557.16	630.43
2007-08	630.6	927.6	1470.98	580.65
2008-09(P)	769.5	1204.4	1565.17	636.24
Average	726.97	1081.93	1487.56	600.49

Source: Govt. of Khyber Pakhtunkhwa, 2008-09
P= Provisional

Table 1. shows that the average area and production of wheat in Khyber Pakhtunkhwa for the last seven years are 726.97 thousand hectares and 1081.93 thousand tons respectively. The area under wheat in Khyber Pakhtunkhwa from 2002-03 to 2008-09 increased from 732.1 to 769.5 thousand hectares. The production of Khyber Pakhtunkhwa during the same period also increased from 1064.4 to 1204.4 thousand tones. The Yield per acre during the same period increased from 588.62 to 636.24 kg

Table 2. Area, Production and Yield of Wheat in Different Districts of Khyber Pakhtunkhwa

S No.	**Districts**	**Area ('000' hectares)**		**Production('000' tones)**		**Yield (kgs/hectare)**	
		2007-08	**2008-09**	**2007-08**	**2008-09**	**2007-08**	**2008-09**
1	Mardan	46.01	49.98	95.51	99.01	2075.85	1980.99
2	Mansehra	20.19	38.13	54.16	95.76	2682.52	2511.41
3	Swabi	44.81	46.89	74.85	93.20	1670.39	1987.63
4	Charsadda	27.22	32.96	64.10	86.37	2354.89	2620.45
5	D.I.Khan	43.69	45.32	61.35	84.39	1404.21	1862.09
6	Peshawar	34.53	35.26	77.97	83.55	2258.04	2369.54
7	D.I.Khan	43.69	45.32	61.35	84.39	1404.21	1862.09
3	Haripur	37.25	37.35	51.90	75.23	1393.29	2014.19
9	Swat	60.992	62.42	94.72	71.29	1552.99	1142.1
10	Bajour	26.76	27.21	28.72	24.75	734.71	909.59

Source: Govt of Khyber Pakhtunkhwa, 2008-09

Table 2. indicates district wise production of Khyber Pakhtunkhwa Province. Mardan is the main wheat producing district in Khyber Pakhtunkhwa. District Charsadda ranks in 4th in wheat production behind district Swabi and wheat is the second major crop of the study area. The area under wheat of district Charsada in 2007-08 to 2008-09 increased from 27.22 to 32.96 thousand hectares. The production during the same period increased from 64.10 to 86.37 thousand tones.

Table 3. Area, Production and Yield of Wheat in District Charsadda

Year	Area ('000' hectares)	Production ('000' tones)	Yield (kg/hec)	Yield (kg/acre)
2002-03	26.65	62.80	2356.55	954.07
2003-04	26.99	60.48	2240.48	907.07
2004-05	27.24	64.37	2362.50	956.47
2005-06	26.25	64.93	2473.27	1001.32
2006-07	27.12	68.46	2523.93	1021.83
2007-08	27.20	63.23	2324.57	941.12
2008-09	32.96	86.37	2620.44	1065.22
Average	27.77	67.23	2414.53	978.16

Source: Govt. of Khyber Pakhtunkhwa, 2008-09

Table 3 depicts that the average area and production of wheat in District Charsadda for the last seven years are 27.77 thousand hectares and 67.23 thousand tones respectively. The area under wheat in District Charsadda from 2002-03 to 2007-08 increased from 26.65 to 32.96 thousand hectares. The production during the same period also increased from 62.80 to 86.37 thousand tones. The Yield during the same period increases from 954.07 to 1065.22 kg per acre.

Charsadda lies between 34 03'and 34 28' North latitudes and 71 28' and 71 53' East longitudes. It is bounded by Malakand district on the North, Mardan district on the East, Nowshera and Peshawar districts on the south and Mohmand agency on the West. The total area of the district is 996 square kilometers. The Kabul River enters at the point near the West of the district. The swat river is the important tributary of the Kabul River. The main crops of the area are sugarcane, wheat, barley, tobacco, fodders, rice, maize and different kind of fruits and vegetables. The district has a very extensive irrigation system.

The main sources of irrigation are canals. Agriculture is the major source of employment in the area. In present times, the domestic price of wheat touches the highest peak, not because of low production but because of mismanagement and political interference. The shortage of this basic staple crop leads to many social, economic problems. To overcome these problems, the best strategy would be to achieve self sufficiency by considerable increase in the productivity of the local wheat crop, which is far below the potential level of yield. The other main reasons of the low wheat yield in Pakistan are the adoption of low yielding varieties, imbalance and untimely use of fertilizers, low plant population, heavy weed infestation, late planting of long duration varieties, and moisture stress in rain field areas and above all, lack of sufficient irrigation water. (Byerlee et. al, 1986).

Due to low or negative net returns, farmer are shifting from food grain (wheat) toward high value crops as exporting crops. Since with existing population growth of 1.3%, demand for food commodities increases at faster rate. There is need not to shift from food grain. With the help of extension effort, the promotion and transfer of improved cultural and intensive management practices will increase the yield (Akhter, 1999).

Wheat is an important crop in Charsadda district and provides employment to the local people and generates income for the farmers. The finding of this research provides guidelines to wheat growers to increase production and revenue per unit area .This study provides base for further research on a number of aspects relating to wheat production and trade having the following objectives.

- To estimate the cost and net return from wheat production in the study area.
- To determine the contribution of important variables in wheat yield and net return.

- To make comparison of different varieties of wheat yield in the study area.
- To make recommendations based on the findings of the study.

2. Review of Literature:

Morris et al (1997) examined the wheat production in various regions of Bangladesh on the basis of financial and economic analysis through pilot level data, including data on elevation and different soil characteristics. Data were collected from 421 farmers during 1993 throughout Bangladesh wheat growing areas with an effort to determine the factor that force farmer planting decision and influence the relative profitability of wheat comparing with alternative crops. The data were use to developed budget for two irrigated crops (Wheat and Boro rice) and three non irrigated crops (Wheat, Oil Seeds and Pulses) grown during the Rabi season. The financial and economic analysis of competing production factors were compared in each five zones to determine the degree to which government polices and market activities may have affected financial and economic profitability.

Karim et al (1999) observed the efficiency of wheat production in high Ganges flood plain regions by using probabilistic frontier production function. The parameters of production were estimated by using cross sectional production data of 76 farmers for the year 1997. There was a big production difference between averaged and best practiced farmers. The technical, allocative and economic efficiencies were estimated at 10, 14 and 23 percent respectively, which accounted for 39 percent of less gross return to averaged farmers as compared to that of 'best practice' farmers. The highest efficiency was recorded because of the use of triple super phosphate followed by muriate of potash, animal power, irrigations and seeds. Allocate efficiency estimated of human labors and fertilizer showed that these inputs were underutilized. It was further calculated that the gross return of 73 percent of the farmers could be increased by 67 percent through the efficient use of their current level of resources.

Bahrawar et al (2000) determined the effect of the necessary factors on wheat production in North West Frontier Province (NWFP) Pakistan. Regression analysis technique was used to determine the relationship of wheat production and five explanatory variables (credit, fertilizer, area, maximum prices, tube wells and rain fall). Data used for analysis cover the period 1984-85 to 1995-96. On the basis of analysis and calculation, it was concluded that efficient use of quality fertilizers and timely irrigation will bring a dramatic increase in wheat production. On the other hand small farmer's credit program and increase in wheat prices have little impact on wheat production.

3. Materials and Methods

This section discusses the mechanics of the research study. It explains the universe of the study, sampling technique, data source and analytical techniques.

3.1 Description of the Universe

This study was conducted in the two villages namely Shrpao and Tangi of District Charsadda. District Charsadda is an important farming region of Khyber Pakhtunkhwa. The soil and climatic conditions of District Charsadda are very suitable for agricultural crops. Main crops of the area are sugarcane, wheat, barley, tobacco, fodders, rice maize and different kind of fruits and vegetables. Most of the cropped area of Charsadda districts is irrigated through canal water coming from river Kabul.

3.2 Data Collection Procedure and Sample Size

This research was based on primary as well as secondary data. The primary data was collected through interview schedule, while the secondary data was amassed from various published and unpublished sources.

3.3 Sampling Technique

A total of 100 respondents were interviewed about different aspects of the farmers' cost and return data, which were supported by secondary data about prices of input and output.

The respondents were randomly selected through proportional allocation sampling technique from two villages of District Charsadda. Out of which 53 respondents were belong to Sherpao village and 47 to Tangi village. The proportional allocation formula is given as follows.

3.4 Data Analysis

The collected data was transferred to tally sheets and then punched into Computer. Statistical Package for Social Sciences (SPSS) and Shazam software were used for data analysis. The net returns of wheat growers of different tenurial status in the research area were calculated by using the following formula (Debertin, 1986).

$$TR = Py * Qy \quad (1)$$

$$TC = \Sigma Vi * Xi \quad (2)$$

$$NR = TR - TC \quad (3)$$

Where; TR is total revenue per acre, Py is Price of output per kilogram, Qy is Quantity of wheat produced in kilograms per acre.

3.5 Modeling of Wheat Yield in the Study Area

For wheat yield the following multiple regression models were used. These were used to ascertain about how different factors i.e. per acre seed rates, number of irrigations, tractor hours, per acre fertilizer nutrients applied, farmyard manure, number of labors used and educational level of the growers contributed towards higher wheat yield.

3.6 Estimation of Wheat Yield

The following empirical multiple regression models were estimated by using the ordinary least square (OLS) method (Gujarati, 2003 pp 257-258).

$$Y = f(SR, IRRIN, TKH, NPK, FYM, LBR, EDU) + ei \quad (4)$$

Where; Y is wheat yield in kgs per acre, SR is seed rate in kgs per acre, IRRIN is number of irrigation per acre, TKH is number of tractor hours per acre, NPK is NPK applied in kgs per acre, FYM is FYM applied in kgs per acre, LBR is total labors hours or man days per acre, EDU is Educational level of the growers and ei is error term

3.7 Estimation of comparison of the mostly sown wheat variety and other wheat varieties

The following dummy model will be use for comparison of total cost (TC), net return (NR), and yield of the largely sown variety and other verities (Gujarati, 2003 pp. 297-305).

$$TC = \beta 0 - \beta_1 D \quad (5)$$
$$NR = \beta 0 - \beta_1 D \quad (6)$$
$$Yield = \beta 0 - \beta_1 D \quad (7)$$

4. Results and Discussion

Socio-economic characteristics of wheat growers: The salient features of the wheat growers of the research area regarding their educational level, land tenure system and land holding are discussed follows:

Educational status: Data shows that that majority of the wheat grower (62 percent) in the study area were illiterate.

Tenurial status of respondents: Field Survey shows that 52of the growers were owners, 33 percent were tenant and remaining 15 percent are owner cum tenant in the study area.

Budgets summary of wheat production: Following are the detail sub heading discussing each and every element of budget summary of wheat production. Inputs involved in production and net return were also discussed in detail.

4.1 Cost of wheat production

Agricultural inputs and their cost play an important role in wheat yield, return and profitability. The detail study of the cost of wheat production tells us about the contribution of most important inputs in wheat production and their economic significance in yield and profitability. Cost of wheat production consist of land preparation, seed and its application, chemical fertilizer, farm yard manure, irrigation water, weeding/hoeing, pesticides, harvesting, marketing, and transportation.

Table IV shows the accounting and economic significance of important inputs and their respective cost in the wheat production. A detailed description of wheat production budget is as follows.

4.2 Per acre cost of different wheat varieties (Bakar and Other Varieties)

One of the objectives of this study was to estimate and compare the cost and revenue per acre of largely sowing wheat variety Bakar and Other varieties in the research area. Therefore, the costs of all the activities employed during the production process were calculated. These activities are land rent, land preparation, sowing, and weeding, fertility inputs, harvesting, threshing and marketing cost. The relevant data pertaining to the above mentioned activities is outlined in Table V.

4.3 Land preparation cost

Preparing land for crop production serves many purposes. It includes the creation of a seedbed, where planted seeds are in contact with the soil moisture, so they will germinate to establish quickly. Weeds control is necessary, because they usually compete with crops for moisture, nutrients and light. Plough breaks the soil crust and hardpans, improving water penetration, aeration, shapes of the soil for irrigation and erosion control.

The primary and most essential step in wheat cultivation is land preparation that enhances the water holding capacity of the soil for long time and also it maximizes the ability of wheat plant to get optimal nutrients from soil. The components of land preparation include ploughing (through bullock/tractor) and land planking (bullock/tractor).

Table 4. shows that most of the respondents used tractors for land preparation and bullocks were used by few farmers in the study area. Average cost per acre of tractor and bullocks were recorded as Rs. 2570 and 996 respectively. The average land preparation cost in the study area was Rs. 3566 per acre, which was 17.1 percent of the total cost of wheat production.

Table 5. show the average cost of tractor and bullocks of different varieties of wheat. Average cost of tractor and bullocks of Bakar was Rs 2550, 1018 and other verities were Rs 2590 and 974 respectively. The average land preparation cost in the study area of Bakar and other varieties were 3568 and 3564 per acre, which was 16.3 and 15.9 percent of the total cost of wheat production.

Table 4. Per acre cost of wheat production

Items	Units	Quantity	Rate/unit	Cost (Rs.)	%
Tractor	Hrs	5	514	2570	
Bullock	Hrs	2	498	996	
Land preparation cost	Rs.	-	-	3566	17.18
Seed cost	kg	53.5	36	1926	
Urea	kg	92	19	1748	
DAP	kg	50	49.5	2475	
Application cost (labor)	Days	3	180	540	
FYM+ Transportation cost	kg	1335.5	1	1335.5	
Application cost (labor)	Days	2	180	360	
Fertility input cost	Rs.	-	-	8024.5	38.65
Irrigation application cost (labor)	No.	4	200	800	
Irrigation cost (labor)	Rs.	-	-	800	3.85
Pesticide charges	Kg/liter	1.5	555.5	833.25	
Pesticide cost	Rs.	-	-	833.2	4.01
Harvesting	Rs			2651.5	12.72
Land rent per acre	Rs.	1	4000	4000	19.20
Packing cost	Rs/Bag	25.5	9	229.5	
Transportation cost(Farm to road)	Rs.			656.5	
Total marketing cost	Rs.	-	-	885	4.20
Grand total (prod. + mkt. cost)	Rs.	-	-	20760.2	100

Source: Field Survey, 2009.

Table 5. Per acre cost of different wheat varieties (Bakar and Other Varieties)

Varieties	Bakar					Others Varieties			
Items	Units	Qty.	Rate per units	Total	%	Qty.	Rate per units	Total	%
Tractor	Hrs	5	510	2550		5	518	2590	
Bullock	Hrs	2	509	1018		2	487	974	
Land preparation cost	Rs	-	-	3568	16.3	-	-	3564	15.9
Seed cost	Kg	53	36	1908		50	39	1944	
Urea	Kg	94	17.8	1673.2		90	20.4	1836	
DAP	Kg	65.8	50	3294		47	52.2	2456	
Application cost (labor)	Days	4	180	720		4	180	720	
FYM+ Transportation cost	Kg	1234	1.1	1387		1437	1.03	1484	
Application cost (labor)	Days	1	180	180		1.5	180	270	
Fertility input cost	Rs.	-	-	9128.6	41.9			8710	31.4
Irrigation cost (labor)	No	4	199.5	798		4	244	976	
Irrigation cost	Rs.	-	-	798	3.6			976	4.3
Pesticide charges	Liter	1.5	369.3	554		1.5	371	557	
Pesticide cost	Rs.	-	-	554	2.5	-	-	557	2.4
Harvesting	Rs	-	-	2688	12.2	-	-	2615	11.7
Land rent per acre	Rs.	1	5000	5000	22.8	1	5000	5000	22.4
Packing cost	Bag	25	8	200		26	10	260	-
Transportation cost	Rs.	-	-	686		-	-	627	-
Total marketing cost	Rs.	-	-	886	4.0	-	-	887	3.9
Grand total (prod+mrt cost)	Rs.	-	-	21856	100			22309	100

Source: Field Survey, 2009.

4.4 Net return per acre from wheat

Wheat is the main source of income for the farmers of the research area. The return from wheat depends on farmer's interest in the activities to farming and also investment in inputs, level of wheat yield and farms management practices. The returns also depend on prices of wheat output received by wheat growers.

Net return (NR) obtained from wheat was calculated by subtracting per acre total cost (TC) from per acre total gross revenue (TR), as follow;

$$= TR - TC$$
$$= Py * Qy \_ \Sigma Vi * Xi \quad (8)$$
$$= 34207.5 - 20760.2$$

= Rs. 13447.3 per acre.

Net Return per Acre from Bakar and Others Varieties:

From Bakar

$$= TR - TC$$
$$= Py * Qy \quad - \quad \Sigma Vi * Xi \qquad (9)$$
$$= 25 * 1347 \quad - \quad 21856$$
$$= 33681 \quad - \quad 21856$$
$$= Rs.\ 11825\ per\ acre$$

From Others Varieties

$$= TR - TC$$
$$= Py * Qy \quad - \quad \Sigma Vi * Xi \qquad (10)$$
$$= 25 * 1389 \quad - \quad 22309$$
$$= 34734 \quad - \quad 22309$$
$$= Rs.\ 12425\ per\ acre$$

The equation 9 shows the net return (NR) and yield per acre of Bakar variety, which were Rs. 11825 and 1347 Kgs. Similarly equation 4.3 shows the net return (NR) and yield per acre of other varieties, which were Rs.12425 and 1398 Kgs.

4.5 Major determinations of wheat yield

Higher wheat yield can be achieved by adopting better management and cropping practices. Different factors that contribute toward higher wheat yield are seed rate, number of irrigation, no of tractor hours, NPK applied, farmyard manure, total labor used and educational level of the growers. We postulate the following wheat yield model to examine which of the aforementioned determinants significantly affect the wheat yield.

$$Y = 263.23 + 6.41\ SR + 28.43\ IRRIN + 7.22\ TKH + 3.20\ NPK + 0.46\ FYM + 6.59\ LBR + 3.33\ EDU \qquad (11)$$

(59.57) (2.12) (10.36) (5.99) (1.32) (0.27) (1.81) (7.47)

{4.41} {3.02} {2.74} {1.20} {2.42} {1.70} {3.64} {0.44}

$R^2 = 0.8742, \quad R^2_{adjusted} = 0.8646, \quad F = 91.31, \quad D.W = 2.03, \quad N = 100$

(Figures in parenthesis ( ) are standard errors and parenthesis {} t-ratios)

The above estimated linear model, in general, yields good result. The signs of explanatory variables are in line with our prior expectation of the economic theory. All the explanatory variables carry positive signs. F-test determines the overall goodness of fit/significance of the model. In our case, as $F_{calculated} = 91.31 > F_{tabulated} = 2.09$, therefore, the model is overall significant. The coefficient of determination, $R^2 = 0.8742$, suggests that 87.42 percent variation in the dependent variable (output) has been explained by the independent variables (Input). The coefficients representing seed rate, farmyard manure, NPK, tractor hours and labor days were positive and statistically significant. ($t_{calculated} > t_{tabulated} = 1.65$), similarly, numbers of tractor and education have a positive but insignificant impact on wheat yield.

4.5.1 Diagnostic tests for Major determinations of wheat yield

After obtaining the estimated results, the following diagnostic tests were performed.

- Durbin-Watson (D.W) and Runs test to test the problem of Autocorrelation.
- Park and Goldfeld-Quandt tests to test the problem of Heteroscedasticity
- Test based on Auxiliary Regression and Correlation Matrix of variable to test Multicollinearity problem.

4.5.2 Test for autocorrelation problem

The problem of autocorrelation exists when the error term of one observation correlates with that of another observation. It is generally thought that autocorrelation is more a problem of cases which used time series data then the ones which employ cross-sectional data. However we used two tests to see whether or not our model faces the problem of autocorrelation. The two tests used are Durbin-Watson (D.W) and Runs test. By testing this through Durbin-Watson (D.W) test our estimated D.W = 2.03 do not fall in autocorrelation zone implying that, there are no chances of autocorrelation in our estimated model. Run test revealed that numbers of runs, as calculated by the computer package (Shazam software) are 53 which lie within 95% confidence interval as worked out in equation (4.8). So we accept our null hypothesis of randomness of residuals suggesting that there exists no problem of autocorrelation in our estimated model.

4.5.3 Test for heteroscedasticity problem

Of the several important standard assumptions of classical linear model, one assumption is homoscedasticity; where homo means equal and scedasticity means spread or variance. Homoscedasticity thus refers to as equal or same variance (σ^2). In case variance ($\sigma^{2)}$ is not constant, we face the problem of "Heteroscedasticity". To check the presence of the problem of heteroscedasticity, we used two tests namely park test and Goldfeld-Quandt test (Gujarati, 2003, pp. 403-410). The park and Goldfeld-Quandt test shows that there seems no problem of heteroscedasticity because $t_{calculated}$ of all explanatory variables except NPK are statistically insignificant.

4.5.4 Test for multicollinearity problem

According to a basic assumption, the explanatory variables should not be correlated with each other. If this assumption is violated, then there exists the problem known as multicollinearity. To check whether this problem of multicollinearity exists, we estimate a correlation matrix between variables. The result shows that there may be multicollinearity among the variables as the coefficients of correlation are higher than 0.80 except in EDU.

4.6 Remedies

There are no unfailing guides to remove or eliminate multicollinearity because it is essentially a problem of the sample or data being used. One of the remedial measure is to drop the mostly correlated variables. But it is not an easy task as the economic theory does not permit to drop relevant variables from the model, we may commit a specification error which may pose a more serious problem than that of multicollinearity (Gujarati, 2003, pp. 363-370).

It is often suggested that the log transformation of the data may reduce the problem to some extent. So we transformed the data to log-linear form and got some improved results, as follows.

$$\begin{aligned} lnY &= 1.80 + 0.29\ lnSR + 0.82\ lnIRRIN + 0.25\ lnTKH + 0.21\ lnNPK \\ &\quad (0.12)\ \ (0.88)\ \ (0.32)\ \ (0.22)\ \ (0.92) \\ &\quad \{14.82\}\ \{3.30\}\ \ \{2.50\}\ \ \{1.11\}\ \ \{2.36\} \\ &\quad + 0.36\ lnFYM + 0.13\ lnLBR \\ &\quad (0.30)\ \ (0.35) \\ &\quad \{1.19\}\ \ \{3.47\} \end{aligned} \qquad (12)$$

$R^2 = 0.8578,\quad R^2_{adjusted} = 0.8486,\quad F = 93.51,\quad D.W = 2.00,\quad N = 100$

(Figures in parenthesis ( ) are standard errors and parenthesis {} t-ratios)

The above estimated log-linear model, in general, gives good results. The signs of explanatory variables are in the line with our prior expectation of the economic theory. All the explanatory variables carry positive signs. F-test determines the overall goodness of fit/significance of the model. In our case, as $F_{calculated} = 93.51 > F_{tabulated} = 2.17$, therefore the model is overall significant. The coefficient of determination, $R^2 = 0.8578$, suggest that the 85.78 percent variation in the dependent variable (output) has been explained by the independent variables (Input). The coefficients representing seed rate, numbers of irrigation, NPK and labor days were positive and statistically significant. ($t_{calculated} > t_{tabulated} = 1.65$). Similarly, tractor hours and farmyard manure have a positive but insignificant impact on wheat yield.

4.7 Comparison of different verities of wheat yield by using dummy variables approach

The superiority of the dummy variable approach over the t-test is that the dummy variable approach gives the direction as well as magnitude of the differences (Gujrati 2003 pp.297-305).

$$Y = \beta_o + \beta_i D \qquad (13)$$

D = Dummy variable for varieties and D= 1 if Bakar and D= 0, for Other varieties.

Estimated dummy variable model for Bakar variety and Other varieties.

$$\begin{aligned} TC &= 22314 - 494.54D \\ &\quad (636.6)\ \ (514.3) \\ &\quad \{61.36\}\ \ \{0.96)\} \\ NR &= 12367 - 505.08D \\ &\quad (409.6)\ \ (579.3) \\ &\quad \{30.19\}\ \ \{0.87) \\ Yield &= 1279.7 - 38.2D \\ &\quad (95.26)\ \ (2.0) \\ &\quad \{13.43\}\ \ \{19.00) \end{aligned}$$

(Figures in 1st and 2nd parenthesis are standard errors and t-ratios, respectively)

The results of dummy variable approach indicate that the total cost of wheat production of the farmers, who did not use Bakar seed was Rs. 22314 per acre, while the total cost of production of the farmers who used Bakar variety was Rs. 21819.4 (22314 – 494.54) per acre. The net revenue from Bakar variety is less than the net revenue from other varieties,

which is Rs. 11862(12367 – 505.08) and 12367 per acre. Similarly the yield of Bakar variety is 1241.5 Kg per acre, which is less than the yield of other varieties by 38.2 Kg per acre. The results also indicate that the t-ratios slopes coeffidients of the total cost and net return are statistically insignificant, while the t-ratio of yield is significant.

5. Conclusion and Recommendations

The main costs contributing factors are seed cost, fertility input cost including NPK and FYM, rent of land and harvesting cost. These estimations were applied on both Bakar and other varieties of wheat grown in the study area. Among them seed rate in kg, DAP, FYM in kg, land rent and harvesting were high cost contributing factors in the research area. It is also concluded that yield and net return of the other varieties of wheat are more than the largely sown and traditional Baker variety. Similarly the net return to farmers from Bakar and other varieties of wheat were found, as Rs. 11825 and 12425 per acre respectively. The regression analysis of wheat yield shows that seed rate, FYM applied, NPK applied, tractor hours and labors days were the main contributing factors in higher wheat productivity. The results of the study were consistent with the studies of Morris et al. (1997), Karim et al. (1999) and Bahrawar et al. (2000) who also suggested same factors are the main sources and causes of productivity.

Based on the findings of the study, the following recommendations are made to improve wheat productivity and net returns to the farmers in the study area.

- This study indicate that wheat yield is low relative to others main wheat growing countries of the world and therefore, it is recommended that the scientists should introduce high yielding and disease resistant varieties, according to the environment of the crop sowing area.
- Disease is a major problem in the study area. Therefore, it is recommended that government and policy makers transfer modern pesticide/fungicide for the growers to control the disease problem. Biological control will be the best.
- Extension personal should transfer latest technology and disease free seeds of wheat to the farmer's for optimum yield.
- The major cost effecting inputs are fertilizers and certified seeds, so it is needed to produce these inputs at cost effective technologies in side Pakistan or import at low cost. Less cost will ensure more profits.
- Conventional verities like Bakar should be replaced with modern and high yielding verities consistent with the local environment.

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