Research Article

Net Return and Allocative Efficiency of Sugarcane Production in District D.I. Khan, Khyber Pakhtunkhwa

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Abstract | Sugarcane is the main and industrial crop of Pakistan and a source of direct and indirect employment in the country. Current study was designed to explore net return and resource use efficiency in sugarcane production in district D.I. Khan, Khyber Pakhtunkhwa. To realize the objectives of the study, primary data was collected from 76 sugarcane growers through a well-designed interview schedule. Debartin formula was used to calculate net return, while a Cobb-Douglas type production function (double log form) was employed to estimate sugarcane yield and its determinants in study area. The results revealed that per acre net return after subtracting total cost from gross revenue was Rs. 33,173.65/-. Results illustrate that labor days, seed quantity, tractor hours, urea and pesticides have positive significant effect on sugarcane yield. Resource use efficiency analysis shows that marginal value product (MVP) to marginal factor cost (MFC) ratios for labor days, irrigation, urea, FYM and pesticides are more than unity indicate underutilization of these resources which underlines scope of expansion in these resources. Study results illustrate that land, seed quantity, tractor hours and DAP are over utilized which need readjustment. Study recommends improvement in extension services to guide farmers on proper inputs utilization, low interest rate crop based loans and comprehensive policy of setting right price for output to increase net return and per unit yield.

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Introduction

Agriculture is the largest sector of Pakistan economy. It contribute to economic growth through various channels such as food, provision of raw materials to industrial units, earning of foreign exchange and employment to a large portion of population. Majority of the population, directly or indirectly, depend on this sector. It contributes about 19.5 % to GDP and absorb 42.3% labor force and a source foreign exchange earnings. Despite important role, contribution of this sector is decreasing over the years. Wheat, cotton, rice, sugarcane and maize are major crops in agriculture sector of Pakistan (Khan, 2012; GOP, 2017)

As mentioned above sugarcane is a major crop not only at national level but also at provincial and district levels. During the year 2016-17 at national level its production was 76.6 million tonnes, in Khyber Pakhtunkhwa its was 5.47 million tonnes while in district D.I. Khan its production was 1.65 million tonnes (GOP, 2016; Go KP, 2017). The cultivation of sugarcane provide employment opportunities directly to local labor and indirectly it supports several other like agro-services agencies and inputs suppliers.

Therefore, for growing areas sugarcane crop develop and expend opportunities for earning and employment.

Pakistan has all the resources to produce high yield of sugarcane but it has neither produce sugar for export in international market on a competitive rate nor could get rid of import to meet the local demand (Azam and khan, 2010). At national level rapid growth in urban areas has increased demand for agricultural products but yield of most crops is almost half of the yield of the developed countries. In order to support the increasing population, increased crop production has appeared an inevitable component of modern agricultural system. A number of research studies advocate rising prices of agricultural inputs have renewed concerns about constraint to agricultural productivity along with natural risk, volatility in commodity prices and uncoordinated polices have in the past that contributed to sub-optimal growth and investment in the agricultural sector (Chaudhry and Kayani, 1991; GOP, 2017).

Measurement of success in agricultural production depends on proper interpretation of resources allocation and net return structure. The evaluation of success in terms of effective use of inputs for production and maintenance of sound cost structure lies in the efficiency analysis of the process. Due to lack of data on input costs and prices most of the studies conducted so far have focused technical efficiency (Keith, 2015).

A number of studies have examined the technical efficiency of sugarcane farms in district D.I. Khan ; however, none of the study has been conducted to evaluate growers efficiency in inputs allocation of sugarcane crop. Hence, this study was designed to work out: 1.net return; 2. Sugarcane yield determinants ; 3. allocative efficiency of sugarcane growers in district D.I. Khan; 4. Recommendations for policy intervention based on findings of the study.

The paper has been organized into four sections. In section II, material and methods has been discussed. Section III presents sugarcane growers characteristics, net return and Cobb-Douglas production function estimates. In section IV empirical measures of allocative efficiency along with necessary discussion has been presented. The paper ends with section V, containing concluding remarks and recommendations.

Materials and Methods

Universe of the study

D.I. Khan is the southern district of Khyber Pakhtunkhwa. Being main source for livelihood, its agriculture possess three main features i.e., low land utilization due to limited sources of irrigation, dominance of big land lords and high tenancy ratio. Major crops grown in district D.I.Khan are sugarcane, cotton, rice, wheat, maize and barley.

Sample Selection

A multistage sampling technique was used for sample selection. In the first stage, out of total five tehsils (Proper D. I. Khan, Kulachi, Darabin, Parora and Paharpur) Paharpur was selected based on maximum number of sugarcane growers. In the second and third stages union council Kirri Kashor and villages Umerkhela and Shanki were selected randomly. In the final stage based on Yamane (1967) principle, a representative sample size of 76 willing farmers was interviewed through a well-designed interview schedule. Cochran (1977) technique for proportional allocation was applied for choosing number of sugarcane growers in each village.

Analytical framework

Net return: Formula proposed by Debertin, 2003 was employed to calculate net returns. The method was also tried by various researchers such as Ahmad et al. (2003 and 2004), Hussain et al. (2004) and Ali (2012) in similar research studies. The equation for calculating net returns is provided as follow:

$$NR_i = GR_i - TC_i \quad \text{.....(1)}$$
$$GR_i = P_i * Y$$
$$TC_i = P_{xi} * X_i$$

Where;

P_i = Prevailing market price for per unit yield

Y_i = Yield (Kgs/acre)

X_i = Quantities of inputs applied by the i^{th} farmer

P_{xi} = Inputs prices

Cobb-Douglas type production Function: The determinants of sugarcane yield are assessed by using the Cobb-Douglas type production function given in equation 2. Naveed et al. (2017) has also applied same procedure.

$LnY = \beta_0 + \sum_{i=1}^{n=9} \beta_i \ln X_i + \varepsilon$ ……. (2)

Where,
Ln; natural log, Y_i represent dependent variable in the production function showing yield in kg acre^{-1}; X_1…. X_n inputs (kg acre^{-1}) used in sugarcane production; β_0: constant; β_i: Coefficients for ith inputs or production elasticity ; ε : random error term

Allocative Efficiency: Efficiency analysis require deliberation and systematic review of pertained literature. According to literature almost 60 years ago, Farrell (1957) introduced methodology to measure technical, allocative and economic efficiencies. In this methodology allocative efficiency reflects the ability of a firm to produce at minimum cost inputs ratios. Economist routinely assume that firms try to minimize the cost of production whatever level of outputs the firm has, other behavioral goals deem optimal (Kopp and Diewert, 1982).

Allocative efficiency represent ratio between marginal value product (MVP) for a specific input and marginal factor cost (MFC) of that particular input. Following Qamar et al. (2017) allocative efficiency in inputs use was calculated by using formula given in equation 3:

$$r = MVP/MFC \text{ .....} (3)$$

where r = resource use efficiency; MVP represent value of additional output by using an additional unit of a specific input and it is a product of MPP and price of output.
MVP = $MPP_{xi} \times P_y$ and MFC = P_x = price of one unit of input.

Decision Rule: When r = 1 it indicate efficient utilization of input, when it is less than 1 shows overutilization and greater than 1 indicates underutilization. Inputs needs adjustment when the value is less than or greater than 1.

Results and Discussion

Table 1 presents the socio economic characteristics of sugarcane growers in district D.I. Khan. Data related to socio economic attributes were analyzed using descriptive analysis tools. The grower's educational level and experience were determined by the number of years spend in school and in sugarcane farming. Average age was found 34.86 years with mean farming experience of 11.17 years. which revealed that farmers in D.I.Khan are involved in sugarcane production from early ages. Mean formal education was found 3.53 years, which shows that majority of the sample growers were literate up to primary level. Average family size was noted 11.35. About 61% respondents were found involved in off farm activities to meet their current cash requirement. Mean farm to home distance was recorded 703.64meters, which means that sugarcane growers are operating within a radius of one kilometer. Per cropping season average extension contacts were noted 5.80, which mean that extension contacts in study area are less than one contact per month.

Table 1: *Sugarcane growers characteristics*

Characteristics	Mean	±Std.Deviation
Age (Year)	34.86	10.68
Experience (Year)	11.17	6.56
Education (Year)	3.53	3.26
Family size (No.)	11.35	3.00
Off.Farm.Income (Dummy)	0.61	0.48
Farm to Home Distance (meter)	703.64	325.79
Ext contacts (No.)	5.80	1.52

Source: Field Survey, 2014-15

Per acre cost of sugarcane production

Major cost components in the sugarcane production are variables given in Table 2. On average per acre total cost of sugarcane production was Rs. 80,397.34/-. In variables tractor cost was higher (26.78%) followed by seed cost (26.42%), labor days (16.91%), land rent (9.14%), DAP (7.53%), pesticides (6.26%), urea (3.83%), irrigation (1.78%) and FYM (1.35%) respectively. In district D.I. Khan tractor hours, seed and labor days are major contributing factors in per acre cost of production.

Where LR = Land Rent in study period, DAP = Diammonium phosphate, FYM = Farmyard manure, ML
= Milliliter, No. = Number, Kg = Kilogram

Net Return Of Sugarcane Production in Study Area

Three main factors (per unit output price, yield and cost of production) determine the net return of sugarcane production**.** During study period sugarcane was visualized as bumper crop, so the price per kg fixed was lower (Rs. 5). Table 3 presents details of these particulars. Average yield was noted 22714.21 kg

acre^{-1}.Subtracting associated per acre cost from gross revenue, net return arise Rs. 33,173.65/.

Table 2: *Per acre cost of sugarcane production in district D.I. Khan*

Variable	Unit	Quantity	Price/ unit	Cost	%
LR	Rs.	--	--	7,345.00	9.14
Labor	No.	46.89	290	13,598.10	16.91
Seed	Kg.	3267.37	6.5	21,237.91	26.42
Tractor	Hour	23.92	900	21,528.00	26.78
Irrigation	No.	15.89	90	1,430.10	1.78
Urea	Kg.	76.96	40	3,078.40	3.83
DAP	Kg.	75.71	80	6,056.80	7.53
FYM	Kg.	724.19	1.5	1,086.29	1.35
Pesticides	ML	8394.74	0.6	5,036.84	6.26
Total	--	--	--	80,397.43	100.00

Source: Field Survey, 2014-15

Table 3: *Per acre gross revenue and net return of sugarcane production in study area*

Particulars	Unit	Quantity	Price/Unit	Value (Rs.)
Yield/Acre	Kg.	22714.21	5	113571.05
G.R				113571.05
T.C/Acre				80397.40
N.R				33173.65

Source: Field Survey results.
Where G.R, T.C and N.R indicate Gross Revenue, Total Cost and Net Revenue respectively

Cobb-Douglas Production Function

Estimates of cobb-Douglas type production function are presented in Table 4. Table summarize inputs, their coefficients, t ratios and p values. The coefficients shows percent change in sugarcane yield due to one percent increase or decrease in the amount of a particular input keeping all others constant. The estimated coefficients for labor days, seed quantity, tractor hours, irrigation and urea are positive and-statistically significant at 5% level. Results demonstrates that these inputs has influence on sugarcane production in study area. According to results 1% increase in labor days, seed quantity, tractor hours, irrigation and urea increase sugarcane yield by 0.132, 0.171, 0.065, 0.088 and 0.075 % respectively. Land , DAP and FYM carry positive coefficients but they are statistically non-significant. The value of return to scale (summation of estimated coefficients) was noted 0.703, show decreasing return to scale, which is mostly observed in agricultural sector. Similar result has also been reported by Qamar et al. (2017).

Table 4: *Estimates of Cobb-Douglas production function in District D.I. Khan*

Variables	Unit	Parameter	Coefficient	T-ratios	P-Value
Constant	--	β_0	4.24	17.65	0.000
LASCC	Acre.	β_1	0.13	1.74	0.225
Labour	Person day	β_2	0.132	2.22	0.023
Seed	Kg.	β_3	0.171	5.81	0.000
Tractor	Hour	β_4	0.065	2.21	0.020
Irrigation	No.	β_5	0.088	5.13	0.000
Urea	Kg.	β_6	0.075	2.83	0.005
DAP	Kg.	β_7	0.014	0.070	0.840
FYM	Kg.	β_8	0.028	1.76	0.271
Pesticides	ML	β_9	0.073	4.86	0.000

Note: LASCC = Land allocated to sugarcane crop during the study period, DAP = Diammonium phosphate, FYM = Farmyard manure, ML = Milliliter,

Table 5: *Allocative efficiency of sugarcane growers*

Variable	APP	MPP	MVP (Rs.)	MFC (Rs.)	MVP/MFC	Remark
Land (Acre)	7188.04	934.45	4672.23	7345.00	0.64	Overutilization
Labor(No.)	484.41	63.94	319.71	290.00	1.10	Under
Seed (Kg)	6.95	1.19	5.94	6.50	0.91	Over
Tractor (Hours)	949.59	61.72	308.62	900.00	0.34	Over
Irrigation(No.)	1429.47	125.79	628.96	90.00	6.99	Under
Urea(Kg)	295.14	22.14	110.68	40.00	2.77	Under
DAP (Kg)	300.02	4.20	21.00	80.00	0.26	Over
FYM (Kg)	31.36	0.88	4.39	1.50	2.93	Under
Pesticides (ml)	2.71	0.20	0.99	0.60	1.65	Under

Source: Survey Data 2014-15

Allocative efficiency of sugarcane growers

Resource use efficiency in sugarcane production has been summarized in Table 5. Underutilization was observed in labor days (having ratio of 1.10), irrigation(6.99), urea(2.77) , FYM (2.93) and pesticides (1.65). During field survey this was observed that high inputs prices, weak financial positions, lake of knowledge and low output price are responsible factors for underutilization. The allocative efficiency of land (0.64) , seed quantity (0.91) , tractor hours (0.34) and DAP (0.26) was greater than 1, showing over utilization of these resources. According to study results the farmers should reduce these inputs for more production. Under utilization below economic optimum level in case of land has also been reported by Girei and Giroh (2013) in their study. Over utilization of seed in sugarcane has also been reported by Ragia (2003) in similar study. During survey it was observed that over utilization of tractor hours was due to carrying out all operations through tractor, use of animals for field activities were found negligible in sugarcane crops. Result of over utilization for DAP are in contrast with results reported by Abid et al. (2011) and Ashfaq et al. (2012).

Conclusions and Recommendations

Net return and resource use efficiency in sugarcane production was calculated. According to field survey land, labor, seed quantity, tractor hours, irrigation, urea, DAP, FYM and pesticides are important determinants of sugarcane yield. In study area underutilization of resources was noted for labor days, irrigation, urea, FYM and pesticides. Lake of knowledge, weak financial position, high inputs prices and low product price were the main reasons of underutilization. Overutilization was noted for land, seed quantity, tractor hours and DAP. In order to increase net return and ensure efficient use of inputs, improvement in extension services, low interest rate loans and comprehensive policy of setting right price for output need attention.

Author's Contribution

Amjad Ali: Collected and analysed the data and wrote the article.
Rajan Shrestha: Interpreted the results and improved the manuscript for fluent reading.
Ghaffar Ali: Helped in overall technical guidance.
Irfan Ullah: Worked on the settings of methodolgy nad compiled the references.
Salman Khan: Made data entry.

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