

## ECONOMIC ANALYSIS OF RICE CROP CULTIVATION IN DISTRICT SWAT

Anwar Hussain\*

### ABSTRACT

A study was conducted at Pakistan Institute of Development Economics, Islamabad, Pakistan during 2010 to make economic analysis of rice (*Oryza sativa*) crop cultivation in district Swat. Three tehsils namely Kabal, Matta and Barikot were selected on the basis of purposive sampling technique. From each tehsil, three villages were selected and seven rice varieties (JP-5, Basmati-385, Sara Saila, Swat-1, Swat-2, Dil Rosh-97 and Fakhr-e-Malakand) were grown. Primary data were collected from 100 respondents (farmers) randomly selected through structured questionnaire. Sample size was allocated to these nine villages on the basis of proportional allocation method. For data analysis, benefit cost ratios, log-linear Cobb-Douglas production function, Wald test and marginal rate of substitutions were estimated. According to the results maximum benefit cost ratio was noted for variety Fakhr-e-Malakand (3.41) followed by Basmati-385 (3.37). This indicates that Fakhr-e-Malakand is the most profitable variety of rice as compared to all other rice varieties. The output elasticities of area, tractor hours, fertilizer, seed, labour and pesticides were observed as 0.3112, 0.0012, 0.5924, 0.6212, 0.5124 and 0.0013, respectively. The input-output relationship holds increasing returns to scale. The farmers should be advised to cultivate high yielding varieties like Fakhr-e-Malakand and also use improved seed.

**KEYWORDS:** *Oryza sativa*; input-output relationship; marginal rate of substitutions; rate of returns to scale; cost benefit analysis; Swat; Paksitan.

### INTRODUCTION

The economy of district Swat is predominantly based on agriculture which is main source of livelihood for local population. The major crops cultivated in Swat include rice, onion, wheat, maize, tomato and vegetables. In kharif season (April-June), rice is mainly grown on area situated near river Swat and is harvested in November and December.

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\*Research Economist, Pakistan Institute of Development Economics (PIDE), Islamabad, Pakistan.

Most of the cultivation is carried out in southern areas of district mainly in Mingora, Barikot, Kabal, Matta and Khwazakhela. The main rice varieties grown in Swat are JP-5, Basmati-385, Sara Saila, Swat-1, Swat-2, Fakhr-e-Malakand and Dil Rosh-97. However, JP-5 is a well-known variety of the district (2).

A number of researchers explored different economic aspects of various crops in general and particularly of rice crop. Khan and Maki (16) studied the relationship between farm size and economic efficiency in Punjab and Sindh. They found that large farm size did not matter for economic efficiency in agriculture sector as compared to small size. Santha (21) studied the economics of rice cultivation in India and compared the production cost, input use and profitability of rice production in three seasons. He found that the Viruppu crop performed better in terms of benefit cost ratio and cost of production. Rebuffel (20) observed that small farmers had comparatively less access to credit as compared to large farmers. Further, 80 percent of small farmers used primitive methods of farming. Sreeja and Chandrabhanu (23) evaluated and identified the economic benefits of fertilization practices for upland rice production. They found that slope of demand curve was greater than the slope of supply curve of paddy; price structure of paddy in Kerala, India. Projected values based on the model showed that instability of supply behavior to adjust changes in price should be changed to reduce the time lag in achieving equilibrium price and output. Parikh *et al.* (19) measured the economic efficiency in Pakistan agriculture sector using econometric techniques. Their views differed from those of Khan and Maki (16) and found that small farms were more efficient than large farms. Dash *et al.* (5) studied per hectare cost and return and level of input used in production for summer rice and observed that on average, per hectare cost of cultivation was Rs. 17113 and average yield per hectare was about 56 quintals, which varied from 52.71 to 58 quintals on sample farms. The average gross and net returns per hectare were Rs. 18923 and Rs. 1920, respectively.

Dipeolu and Kazeem (6) in Nigeria estimated three functional forms i.e. linear, semi-logarithmic, and double logarithmic where Cobb-Douglas production function (4) revealed that farmers lacked adequate experience in improved farming technologies. It further showed an average productivity of 0.994 tons per hectare which was low, compared to potential rice yield of 2-3 tons per hectare. Young *et al.* (24) described that both government and non-governmental institutions should devise appropriate policy about production systems i.e. marketing, transport storage, production costs, marketing margins, consumption, exports, capacity of land and water resources to increase production. Ishida and Asmuni (12) in Malaysia presented an

economic analysis of rice production so as to trace the impact of agricultural modernization on paddy income. They concluded that farm mechanization had positive impact on paddy income. Haq *et al.* (8) using Cobb-Douglas type of production function technique investigated the relationship of farm size and input use and its effect on production and gross/net incomes in potato. They concluded that labour, seed, farmyard manure, nitrophos and labours were the factors significantly contributed towards output. Lohano and Mari (18) assessed the input-output relationship of onion crop in Hyderabad district, Sindh, using Cobb-Douglas production function and found that input-output relationship of onion crop was characterized by constant returns to scale. Ahmad, *et al.* (1) determined the cost and revenue for potato crop and compared it for two districts of Punjab namely Okara and Kasur. They found significant difference in cost and revenue in these districts. They also considered funds availability, seed quality and stability in price as responsible factors to increase production of potato crop and its profitability. Arifullah (3) noted that yield potential was low (13-23%) as compared to world average yield for various crops in general and particularly for IRRI rice, onion, wheat, sugarcane and chickpea. He suggested to decrease the cost of production alongwith increasing per hectare yield. Khan *et al.* (15) examined the relationship between energy inputs and rice production in Dera Ismail Khan, district of Pakistan, using cross-sectional data collected on the basis of stratified random sampling technique. The results showed that increase in energy consumption at farm level increased rice yield and therefore, farmers with high cost of production could get better return of their crop.

Hussain and Khattak (10) made the economic analysis of sugarcane crop in district Charsadda (Khyber Pakhtunkhwa), using primary data collected from 100 respondents and Cobb-Douglas production function. They noted that area under sugarcane crop, tractor hours, fertilizer, seed, labour and pesticides were the significant variables affecting sugarcane crop in the district.

The present study mainly focuses on input-output relationship and cost-revenue comparison of different rice varieties in district Swat.

## **MATERIALS AND METHODS**

This study was conducted at Pakistan Institute of Development Economics, Islamabad, Pakistan during the year 2010. Three tehsils of district Swat (Kabal, Matta and Barikot) were selected on the basis of purposive sampling technique. These tehsils qualify most of the characteristics favorable for the cultivation of food grain crops. In addition, selected areas are situated on the

bank of River Swat where food grains in general and particularly rice crop are grown extensively. From each tehsil three villages were selected i.e. Akhunkalay, Hazara and Dagai from tehsil Kabal; Parai, Aboha and Kota from tehsil Barikot while Asharai, Durashkhela and Baidara from tehsil Matta. While selecting these villages weightage was given to those which were nearest to River Swat.

The analysis is based on primary data, which were collected from 100 respondents (farmers) through structured questionnaire. The data included the cost components mainly land preparation, raising nursery, fertilizer, transplanting, pesticides, land rent, harvesting, irrigation, cleaning and threshing. Information on revenue components mainly paddy production and rice straw was also collected. The sample size used was quite logical because the villages were homogeneous in terms of land conditions (field, soil type and irrigation sources), cropping pattern, population and farming activities. Sample size was allocated to these nine villages on the basis of proportional allocation method. Further, respondents were selected randomly from each village.

To compare the cost and revenue of different rice varieties at a glance, benefit cost ratios were calculated with formula used by Santha (21):

$$\text{Benefit cost ratio for rice varieties} = \text{TRR} / \text{TECR} \dots (1)$$

where TRR is the per acre total revenue generated from variety of rice and TCR is the total per acre cost of rice variety.

To show the input-output relationship, log linear Cobb Douglas production function (4) was used. This model was also used by Khattak and Hussain (17) and Haq *et al* (8). However, in present study it was modified by including some additional variables. The same technique was also used to find out the contribution of various inputs towards output. This model is widely used in agriculture for determining the nature of returns to scale. The following log linear Cobb-Douglas production function was applied, using the least square method.

$$\ln RP = \ln a_0 + a_1 \ln RA + a_2 \ln TRHR + a_3 \ln FERTR + a_4 \ln SDR + a_5 \ln LABR + a_6 \ln PSTR + e_j \dots (2)$$

The above model was then converted into following general form:

$$RP = a_0 \times RA^{a_1} \times TRHR^{a_2} \times FERTR^{a_3} \times SDR^{a_4} \times LABR^{a_5} \times PSTR^{a_6} \times e_j \dots (3)$$

where RP = Total paddy production (kg)

RA = Area under rice crop (acres)

TRHR = Tractor hours for cultivated area of rice  
 FERTR= Total fertilizer used on cultivated area of rice (bags)  
 SDR = Seed used on cultivated area of rice (kg)  
 LABR = Total labour used on cultivated area of rice (man days)  
 PSTR= Total pesticides/insecticides used on cultivated area of rice (Rs.)  
 $a_0$  = Shows the impact of innovations or technology.  
 $a_1, a_2, a_3, a_4, a_5$  and  $a_6$  Output elasticities of RA, TRHR, FERTR, SDR, LABR and PSTR, respectively.

$e_i$  = The residual term (absorbs the effect of those variables, which are not included in the model).

The equations indicate that rice production is dependent variable whereas RA, TRHR, FERTR, SDR, LABR and PSTR are explanatory variables. Irrigation cost was excluded from the set of explanatory variables because it was available free of cost in the study area.

To check whether the rice crop is characterized by constant, increasing or decreasing returns to scale, Wald test (1952) was used. This test is widely used for determining the rate of return to scale, which imposes restrictions on values of population parameter estimates.

Under the null hypothesis  $H_0$ , the Wald statistic has an asymptotic  $\chi^2(z)$  distribution, where  $z$  is the number of restrictions under  $H_0$ . In case of linear regression model, the null hypothesis is  $Rb-r = 0$ .

The Wald statistic is:  $W = (Rb-r)'(Rs^2(X'X)^{-1}R')^{-1} = (Rb-r)$  which is asymptotically  $\chi^2(z)$  under  $H_0$ . where  $R$  is a known  $z \times k$  matrix, and  $r$  is a  $z$  vector, respectively.

Assuming that the errors  $e_i$  are independent and identically normally distributed, the finite sample F-statistic is:

$$F = W/Z = \frac{(\hat{e}'\bar{e} - e'e)/z}{\frac{(e'e)}{T-K}}$$

Here  $\bar{e}$  is a vector of residuals from restricted regression and  $T$  is the number of observations. In this case, the F-statistic compares the residual sum of squares computed with and without restrictions imposed. Further, Chi-square statistic is equal to the F-statistic times the number of restrictions under test (14).

In this case, there is only one restriction i.e. sum of exponents equals one for rice crop. If two test statistics are identical with  $p$ -values of both statistics, this indicates that the null hypothesis of constant returns to scale can be decisively rejected. If the sum of exponents on explanatory variables equals one, then the input-output relationship holds constant returns to scale for rice crop i.e. any proportional increase in rice inputs results in an equal increase in rice output. If the sum of exponents on explanatory variables is greater than one, then input-output relationship holds increasing returns to scale i.e. rice output increases faster than rice inputs. If the sum of exponents on explanatory variables is less than one, then input-output relationship holds decreasing returns to scale i.e. rice output increases slower than inputs of rice. This approach was used for Lohano and Mari (18) for onion crop.

The marginal rate of substitution among inputs was calculated, to show how the scale of production responds if quantity of one input is changed while others stay unchanged. The approach was adopted by Dawson and Lingard (7). The marginal rate of substitution among inputs was calculated using the following formula:

$$MRS_{(X/Y)} = L/M \times YX^{-1} \dots\dots(4)$$

Here  $MRS_{(X/Y)}$  represents marginal rate of substitution of input X for Y, L is the output elasticity of X and M is the output elasticity of Y. In this study the inputs used were RA, TRHR, FERTR, SDR, LABR and PSTR.

All variables were valued at the prevailing market prices during 2010. Further, simple arithmetics, averages, classification and tabulation were also used as analytical tools. Statistical packages such as SPSS and Eviews were used for deriving the results.

## RESULTS AND DISCUSSION

### Average cost of components and revenue

Average per acre cost for all varieties became to Rs. 16,208, which included cost of seed (Rs. 273), fertilizers (Rs. 655), labour usage (man days) (Rs. 6600), transplanting (Rs. 1800), harvesting (Rs. 1200) and threshing (Rs. 1260) (Table 1) in addition to other costs (Table 1). This cost is higher as compared to per acre cost computed by Hussain *et al.* (11), which was Rs. 13,565. This is due to increasing trend of prices of inputs over time.

Table 1. Average per acre cost and revenue of all varieties in all villages.

Particulars	Unit	Quantity	Rates (Rs.)	Amount/acre (Rs.)
<b>Land preparation</b>	Hour			
(i) Ploughing with tractor	Day	3	200	600
(ii) Puddling with bullocks		1	500	500
<b>Raising nursery</b>				
(i) Seed	kg	7 <sup>[1]</sup>	39	273
(ii) Nursery bed preparation	Day	2	120	240
(iii) Nursery maintenance	Day	1	120	120
(iv) Nursery pulling, transport	Day	4	120	480
<b>Fertilizers</b>				
(i) DAP	kg	25	9	225
(ii) Urea	kg	50	8.6	430
<b>Transplanting</b>	Day	15	120	1800
<b>Irrigation</b>	Day	4	120	480
<b>Cleaning/handling</b>	Day	7	120	840
<b>Pesticides</b>				
(i) Furadan (Insecticides)	kg	16	50	800
(ii) Machety (weedicides)	ml	800	300	300
(iii) labour charges	Day	3	120	360
<b>Harvesting</b>	Day	10	120	1200
Threshing				
(i) Tractor charges	Hr	1	300	300
(ii) Labour charges	Day	8	120	960
<b>Gunny bags charges</b>	Bag	20	40	800
<b>Land rent</b>	--	--	--	5500
<b>Total average cost on all varieties</b>	-	-	-	16, 208

Average paddy production for all varieties was calculated as 36 maunds from one acre area amounting to Rs. 38556 (Table 2). Average amount of rice straw from all varieties was Rs. 4357 per acre. Thus total and net revenue from all varieties was calculated Rs. 42913 and Rs. 26705, respectively (Table 2). Further, average per acre cost was minimum in Dil Rosh-97 (Rs. 16185) followed by Sara Saila and Swat-1 (Rs. 16235 each). Maximum per acre cost was noted in JP-5 (Rs. 16385/-) (Table 3).

Table 2. Average total and net revenue of all varieties in all villages.

Yield	Quantity (maund*)	Rate (Rs./maund*)	Total amount (Rs.)
(i) Paddy	36	1071	38556
(ii) Straw		4357	4357
Total revenue			42913
Net revenue			26705

\*Maund=40kg

<sup>1</sup> In study area, farmers were using on average 7 kg seed per acre for local rice varieties. This seed rate was also recommended by local Agriculture Research Station, Swat. However, Pakistan Agricultural Research Council recommends 12-14 kg seed per acre for basmati rice.

Table 3. Village and variety-wise average cost of production and revenue.

Tehsil	Village	Cost and revenue (Rs./acre)																	
		JP-5		Basmati-385		Sara Salla		Dil Rosh 97		Swat-1		Swat-2		Fakhr-e-Malakand					
		Cost	Rev- enue	Cost	Rev- enue	Cost	Rev- enue	Cost	Rev- enue	Cost	Rev- enue	Cost	Rev- enue	Cost	Rev- enue	Cost	Rev- enue		
Kabal	Akhaun	16300	44500	16200	54500	16000	44000	16100	34000	16100	36000	16300	35400	16200	55000				
	kalay																		
	Dagai	16200	44500	16300	54400	16200	39000	16200	34000	15550	34000	16100	35000	16100	55000				
Barikot	Hazara	16500	43900	16500	54900	16300	40500	16300	32500	15900	35000	16550	35600	16450	55100				
	Parai	16000	44500	15900	54300	16400	42000	16300	34000	16200	35000	15400	36000	15400	55600				
	Aboha	16250	44100	15985	54000	16000	40000	15990	33500	15990	35500	16500	33500	16300	54900				
	Kota	16285	44600	16000	54600	16500	44500	15900	34000	16100	34500	16100	36000	16000	56000				
Matta	Asharai	16310	44300	16200	55300	15900	45500	16300	32500	16200	36000	15900	34500	15800	56000				
	Durash	16360	44100	16300	55100	16200	45000	16400	33000	16300	35000	16000	35600	15550	56900				
	Khela																		
	Baldara	17260	41500	17054	57000	16615	42000	16175	35800	17775	36700	17805	36100	18905	35000				
	Average	16385	44000	16271	54900	16235	42500	16185	33700	16235	35300	16295	35300	16295	55500				

### Benefit cost ratios (BCRs) of different rice varieties

The BCR for varieties ranged from 2.08 to 3.41 (Table 4). Variety Fakhr-e-Malakand possessed the highest BCR value (3.41), indicating that it is the most profitable variety of rice as compared to all other rice varieties. In some earlier studies (9, 11) also variety Fakhr-e-Malakand was found to be the most profitable variety as compared to other rice varieties.

**Table 4. Benefit cost ratios for different rice varieties.**

Rice variety	Average yield/acre (kg)	Total rice revenue (TRR) (Rs/acre)	Total cost of rice (TCR) (Rs/acre)	Benefit cost ratios BCR = TRR/TCR
JP-5	1800	44,000	16385	2.69
Basmati-385	1950	54,900	16271	3.37
Sara saila	1700	42,500	16235	2.62
Dil Rosh-97	1650	33,700	16185	2.08
Swat-1	1680	35,300	16235	2.17
Swat-2	1680	35,300	16295	2.16
Fakhr-e-Malakand	2000	55,500	16295	3.41

### Estimation of log linear rice production function

R-square and adjusted R-square values indicated that the fit is good (Table 5). The high value of  $R^2$  (=0.81) showed that 81 percent of variations in the (log of) total rice product was explained by the (log of) included explanatory variables. Most of the explanatory variables had a strong relationship with the dependent variable.

**Table 5. Estimated log linear rice production function results.**

Dependent variable: ln RP Sample: 1-100				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.3612	0.1234	11.03079	0.0000
ln RA	0.3112	0.1243	2.50362	0.0141
ln TRHR	0.0012	0.00032	3.75000	0.0021
ln FERTR	0.5924	0.19994	2.962889	0.0531
ln SDR	0.6212	0.10995	5.649841	0.0213
ln LABR	0.5124	0.1922	2.665973	0.0019
ln PSTR	0.0013	0.34125	0.00381	0.45123
R-squared	0.8113	Durbin-Watson stat		1.8921
Adjusted R-squared	0.8122			

F-Statistic	12451	Prob(F-Statistic)	0.00001
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The results suggests the following model:

$$\ln RP = 1.3612 + 0.3112 \ln RA + 0.0012 \ln TRHR + 0.05924 \ln FERTR + 0.6212 \ln SDR + 0.5124 \ln LABR + 0.00126 \ln PSTR \dots (5)$$

or in the most general form:

$$RP = 3.900872 \times RA^{0.3112} \times TRHR^{0.0012} \times FERTR^{0.5924} \times SDR^{0.6212} \times LABR^{0.5124} \times PSTR^{0.00126} \dots (6)$$

where  $a_0 = e^{1.3612} = 3.900872$

The results indicated that RA, TRHR, LABR, FERTR and SDR are statistically significant variables while PSTR is statistically non-significant variable. The reason is that the farmers rarely used pesticides/insecticides as the possibility of diseases in rice crop was too low in the study area. Usage of fertilizer was also at minimum level due to fertile land suitable for rice crop cultivation.

According to eq. 5 and 6, value of rice area elasticity of production (0.3112) indicated that if rice area increases by 1 percent remaining all other inputs unchanged, the rice production will increase by 0.31 percent. This elasticity is lower as compared to the area elasticity of rice production computed by Shaikh and Shah (22) which was 0.192. Khattak and Hussain (17) estimated the area elasticity of rice production as 0.197, while Hussain (9) estimated rice area elasticity of rice production as 0.2457. The results further showed if TRHR increase by 1 percent, rice production will increase by 0.0012 percent taking all other variables unchanged. The output elasticities of FERTR, SDR, LABR and PSTR are 0.5924, 0.6212, 0.5124 and 0.0013, respectively which can be interpreted in the same way. Khattak and Hussain (17) also estimated the elasticity of seed and fertilizer as 0.545 and 0.126, respectively. The differences in these values are due to study period and number of sample observations.

The high coefficient observed for seed (rice input) indicated that it is the most cost efficient. Value of Durbin Watson statistic (1.89) showed that no problem of autocorrelation exists. The value of F-statistic alongwith its probability showed the overall significance of included explanatory variables.

### Rate of returns to scale

In the context of input-output relationship, it is necessary to show how the inputs and output go side by side. The sum of all output elasticities (3.4009)

(greater than one) (Table 5), indicates that rice production is characterized by increasing returns to scale. These results are consistent with those of Hussain (9) and Khattak and Hussain (17), where rice production in district Swat was characterized by increasing returns to scale.

The Wald-Test (1952) also supports these findings (Table 6). The test has the null hypothesis that rice production is characterized by constant returns to scale and has only one restriction i.e.  $a_1+a_2+ a_3+ a_4+ a_5 + a_6 =1$ . As, the Chi-square statistic is equal to F-statistic times the number of restrictions under test (identical), and also the *p*-values lead us to reject null hypothesis of constant returns to scale.

**Table 6. Wald test results.**

Null Hypothesis: $a_1 + a_2 + a_3+ a_4+ a_5 + a_6 =1$		Probability
F-statistic	5.213452	0.0038
Chi-square	5.213452	0.0015
t-statistic	9.254535	0.0000

Here  $a_1, a_2, a_3, a_4, a_5$  and  $a_6$  are the coefficients of RA, TRHR, FERTR, SDR, LABR and PSTR, respectively.

**Marginal rate of substitution of different inputs at mean values of rice inputs**

Marginal rate of substitutions (MRS) was calculated using to show how the scale of production responds if quantity of one input is changed while others stay unchanged. The ratios of output elasticities are presented in Table 7.

**Table 7. Rice output elasticities ratios.**

Inputs	Inputs					
	$a_1=0.3112$	$a_2=0.0012$	$a_3=0.5924$	$a_4=0.6212$	$a_5=0.5124$	$a_6=0.0013$
$a_1=0.3112$	1.0000	0.0039	1.9036	1.9961	1.6465	0.0042
$a_2=0.0012$	259.3333	1.0000	493.6667	517.6667	427.0000	1.0833
$a_3=0.5924$	0.5253	0.0020	1.0000	1.0486	0.8650	0.0022
$a_4=0.6212$	0.5010	0.0019	0.9536	1.0000	0.8249	0.0021
$a_5=0.5124$	0.6073	0.0023	1.1561	1.2123	1.0000	0.0025
$a_6=0.0013$	239.3846	0.9231	455.6923	477.8462	394.1538	1.0000

The data (Table 8) further showed that MRS of RA for LABR is 30, indicating that one unit of rice area (one acre area) can be substituted for 30 units of labour (in man days) without changing the product scale. Similarly, MRS of RA for FERTR is 1.1, indicating that one unit of rice area (one acre area) can be substituted for 1.1 units of fertilizer bags without changing the product

scale. MRS, RA for SDR and PSTR is 13.2 and 478.8, respectively. MRS of TRHR for LAB is 0.035 and FERTR for PSTR is 455.7 showing significance of the rice inputs.

**Table 8. Marginal rate of substitutions (MRS) between rice inputs.**

<b>Substitution between inputs</b>	<b>MRS</b>
Substitution of RA for TRHR	864.444
Substitution of RA for FERTR	1.051
Substitution of RA for SDR	13.360
Substitution of RA for LABR	30.365
Substitution of RA for PSTR	478.769
Substitution of TRHR for RA	0.001
Substitution of TRHR for FERTR	0.001
Substitution of TRHR for SDR	0.015
Substitution of TRHR for LAB	0.035
Substitution of TRHR for PST	0.554
Substitution of FERTR for RA	0.952
Substitution of FERTR for TRHR	822.778
Substitution of FERTR for SDR	12.715
Substitution of FERTR for LABR	28.903
Substitution of FERTR for PSTR	455.692
Substitution of SDR for RA	0.075
Substitution of SDR for TRHR	64.708
Substitution of SDR for FERTR	0.079
Substitution of SDR for LABR	2.273
Substitution of SDR for PSTR	35.838
Substitution of LABR for RA	0.440
Substitution of LABR for TRHR	15.766
Substitution of LABR for FERTR	0.002
Substitution of LABR for SDR	1.806
Substitution of LABR for PSTR	0.002
Substitution of PSTR for RA	0.028
Substitution of PSTR for TRHR	0.063
Substitution of PSTR for FERTR	864.444
Substitution of PSTR for SDR	1.051
Substitution of PSTR for LABR	13.360

### CONCLUSION AND RECOMMENDATIONS

The study concludes that average per acre cost for all varieties in all villages was Rs. 16,208. Average total and net revenue for the farmers from all varieties were Rs. 42913 and Rs. 26705, respectively. Fakhr-e-Malakand was the most profitable variety in terms of total and net yield. The inputs such as area, tractor hours, fertilizer, labour and seed were found statistically significant. The output elasticities of area, tractor hours, fertilizer, seed, labour and pesticides were estimated as 0.3112, 0.0012, 0.5924, 0.6212,

0.5124 and 0.0013, respectively. It showed that rice input-output relationship holds increasing returns to scale. The marginal rate of substitution of area for labour was 30, and that of rice area for tractor hours was 864. The farmers should cultivate profitable variety i.e Fakhr-e-Malakand, for which proper awareness to the farmers is necessary.

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