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Economics and Resource-Use Efficiency of Wheat Crop under Rainfed Conditions in the Jammu Region of Jammu & Kashmir

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ABSTRACT

Economics of wheat crop revealed that, the cost-benefit ratio was found out to be highest in case of Jammu district and the least in case of Udhampur district. Consequently, the family labour income and farm business income were found in that order respectively. The overall yield of the wheat crop worked out to be 5.92, highest yield found out to be in the Jammu district and lowest in the Rajouri district. Similarly, the cost-benefit ratio was found maximum in the Jammu district, followed by Rajouri district, Udhampur district and finally by Kathua district. Production function analysis revealed that wheat crop yielded constant returns to scale. In addition, variables like human labour, machine labour, fertiliser, manure, etc. proved to be positively significant that could influence the yields of the wheat crop. Except Udhampur district, mustard crop in the rest of the district experienced constant returns to scale. Moreover, variables like machine labour, manure and fertiliser worked out to be significant. On the other hand, in the Udhampur district, rice crop revealed the increasing returns to scale and the rest of the districts showed the constant returns to scale. Human labour, plant protection chemicals and manure came out to be significant. Therefore, such input variables need to be taken care of accordingly.

HIGHLIGHTS

◉ Cultivation of wheat crop was found out to be most profitable in case of the Jammu district, in spite of the fact that the total cost is very high in this district.

◉ Resource use efficiency revealed that the input variables like human labour, machine labour and plant protection chemicals proved to be most important input variables in wheat cultivation.

Keywords: Production function, human labour, machine labour, returns to scale

Rainfed farming is the form of farming practice in which, the water requirements of crops are mainly met by the rainfall activities. If we take into consideration of the possession of the total arable land, India leads the world with the total arable land in possession to the tune of 156.46 million hectares (MoFPI, 2016). Therefore, it is not very strange to observe the fact that the India also leads the other nations in terms of the possession of rainfed area, respectively (NRAA, 2016).

Swaminathan and Rawal (2010) carried out their

research on costs and returns from the cultivation of different types of cotton in rainfed village in Vidarbha region of Maharashtra. In the study, there found the high variability in the production for Bt-cotton in comparison to the other types of cotton. Further, net income from Bt cotton fields was found out to be 7,059 per acre. Though, the advantage of income declined with intercropping. The study further revealed that, on the intercropped plots, the gross value of output per acre from intercropped Bt cotton was only slightly higher than from intercropped premium non-Bt cotton, but as costs were also higher, net incomes turned out to be slightly lower. Further,Tiwari (2011) in his study worked out the per hectare cost of cultivation. The research on cost of cultivation of *kharif* soybean found out to be ₹ 30,740.85, ₹ 28,466.26 and ₹ 29,587.43 for small, large and pooled farms, respectively. In addition, the net income soared from Rs.8,986.56 on large farms to ₹ 13,342.47 on small farms with overall average of ₹ 10,999.42 on pooled farms. Further, the study also carried out the net income per rupee of expenditure and found out that the net income per rupee of expenditure was ₹ 0.43, ₹ 0.32 and ₹ 0.37 on small, large and pooled farms, respectively.

Meshram *et al.* (2018) carried out a study of wheat crop in Wardha district of Vidharba region and found out that the per ha. cost of cultivation of overall adopter at cost 'A', cost 'B' and cost 'C' revealed to be of ₹ 27312.29 per ha., ₹ 35611.35 per ha. and ₹ 39700.51 per ha., respectively. Gross returns were found out to be ₹ 52849.50 per ha. and the overall B:C ratio at cost 'C' was revealed to be 1:1.31.

Research Methodology

The present study was conducted in the Jammu division of the Jammu and Kashmir State. Four districts purposively with the maximum rainfed area (as shown in the table below) in the Jammu & Kashmir state, in descending order, i.e., Rajouri, Jammu, Udhampur and Kathua were selected (Table 1).

The study was based on both primary and secondary data. The primary data was based on survey of farmers engaged in rainfed farming through personal interview method, in the above mentioned four districts of the Jammu region. A well-structured

schedule was prepared for collecting information while interviewing the farmers. Within these four districts, two blocks were selected from each district. Subsequently, two villages were selected from each block, thereby, the sum total of sixteen villages. Ultimately, at the last stage, fifteen respondents were selected randomly from each village summing up the total sample size of 240 respondents, respectively.

As far as the statistical analysis is concerned, for the calculation of costs and returns, there was employment of the cost concepts framed by the CACP like Cost A_1, Cost A_2, Cost B_1, Cost B_2, Cost C_1 and C_2. The input items included under each category of costs are indicated below:

- Cost A_1 = All actual expenses in cash and kind incurred in production by the producer. The items covered in cost A_1 are costs on purchasing chick, feed, hired human labor, bullock labour, machine labour, litter, medicine, electricity, depreciation on farm machinery, equipment and farm building, interest on working capital and miscellaneous expenses.

- Cost A_2 = Cost A_1 + Rent paid for leased-in land

- Cost B_1 = Cost A_1 + Interest on value of owned capital assets (excluding land)

- Cost B_2= Cost B_1 + Rental value of owned land and rent paid for leased-in land

- Cost C_1= Cost B_1 + Imputed value of family labor

- Cost C_2* = Cost B_2 + Imputed value of family labor

- Cost C_2= Cost C_2 estimated by taking into account statutory or actual wage rate whichever is higher

- Cost C_3= Cost C_2* + 10 per cent of Cost C_2* to (on account of managerial functions performed by farmer)

For computing resource-use efficiency, it was carried out by employing Cobb-Douglas production function. There is something peculiar about using such type of production function as this production function measures the marginal contribution of each input to that of the total output. In addition to this, it clears the picture about the returns to scale i.e., whether a particular crop/enterprise yield diminishing, constant or increasing returns

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Table 1: District-wise rainfed area of Jammu division (2016-17) (Area in ha)

District	Net area sown	Irrigated area	Rainfed area/ Unirrigated area	Area-Wise Ranking
Jammu	**106798**	**66115**	**40683**	**2**
Samba	32645	10067	22578	7
Udhampur	**48885**	**10212**	**38673**	**3**
Reasi	20937	1439	19498	8
Doda	29848	2495	27353	5
Kishtwar	16044	2815	13229	10
Ramban	19961	1372	18589	9
Kathua	**58797**	**21218**	**37579**	**4**
Rajouri	**53632**	**4768**	**48864**	**1**
Ponch	27336	3501	23835	6
Total	414883	124002	290881	
J&K	757026	336083	420943	

Source: Digest of statistics 2016-17 (J&K).

to scale. As, input combinations/selections tends to differ with respect to the crops, therefore, the regression coefficients had been modified to find out the specific results.

Furthermore, the estimated parameters of production function of crops/enterprises with reference to elasticities of yield, standard errors of regression coefficients, their significance and the coefficient of multiple determination (R^2) has also been presented. The coefficient of multiple determination (R^2) represents the total variation in the dependent variable that has been explained or detailed by that of the independent variable. Moreover, the production elasticity of respective resource variable in multiple regression equation is shown by the regression coefficient of the individual resource variable. This simply connotes the fact that one unit change in the yield associated with one unit change in the concerned input at its geometric mean level, while other factors are being held constant.

The general form of the production function can be expressed as follows:

$$Y_t = \beta_0 \left(\prod_{i=1}^{n} X_i \beta_i \right) u \, (i = 1, 2, 3 \ldots n)$$

Where 'Y' and X_i (i=1,2,3,.....n) represents the levels output and levels of inputs. In addition, the respective constants β_o and $\beta_i's$ ($i = 1,2,3….n$) reflects the efficiency parameters as well as the efficiency parameters along with the production elasticities of the particular input variables for the given

population at a particular period 't'. The term 'u' represents the error term.

The fitted Cobb-Douglas production may be represented in the mathematical form for the present case with six input variables (in case of crops) as follows:

$$Y = a_o X_1^{b1} X_2^{b2} X_3^{b3} \ldots \ldots \ldots \ldots \ldots X_n^{bn} e^n$$

In the above functional model, 'Y' depicts the dependant variable, 'X_i' depicts the independent variable, 'a' is the constant representing the intercept or the production function and finally 'bi' reflects the regression coefficients of the respective resource variables. The elasticity of production is represented by the regression co-efficient obtained from this function. The nature of returns of scale is reflected by the sum of 'bi'. Now, this function has been transformed into linear form by employing the use of logarithmic transformation. The modified form of the logarithmic transformation was then turns out to be:

$$Log \, Y = Log \, a + b_1 \, Log \, X_1 + b_2 \, Log \, X_2 + \ldots \ldots \ldots + bn \, Log \, X_n + u \, Log \, e$$

The fitted Cobb-Douglas production for the present case (in case of crop enterprise) with six variables has been represented as follows:

$$Y = a_o X_1^{b1} X_2^{b2} X_3^{b3} X_4^{b4} X_5^{b5} X6^{b6}$$

On log transformation, the modified linear from of the above function is :

$$Log\ Y = Log\ a_o + b_1\ Log\ X_1 + b_2\ Log\ X_2 + b_3\ Log\ X_3 + b_4\ Log\ X_4 + b_5\ Log\ X_5 + b_6\ Log\ X_6$$

Where,

Y = Gross returns of the crop enterprise in rupees per acre as a dependent variable

X_1 = Total cost on seed input in rupees per acre.

X_2 = Total cost on human labour in rupees per acre.

X_3 = Total cost on machine labour in rupees per acre.

X_4 = Total cost on manure in rupees per acre.

X_5 = Total cost on fertilisers in rupees per acre

X_6 = Total cost on plant protection chemicals in rupees per acre

Marginal value productivity

The marginal value of resource productivity reflects the addition of gross value of farm production per unit increase in the 'i^{th}' resource with all the resources fixed at their geometric mean levels. The MVP for both the agricultural as well as the allied-agricultural inputs was worked out by employing the following formula (Heady and Dillion, 2002):

$$MVP = b\ \frac{\overline{Y}}{\overline{X}}\ P_y$$

Where,

b = Regression coefficient of particular independent variable

Y = Geometric mean of dependent variable

X = Geometric mean of independent variable

P_y = Price of dependent variable.

Statistical significance

It was measured by t-statistic i.e.,

$$\text{t-statistic} = \frac{\text{Regression coefficient}}{\text{Standard error}}$$

RESULTS AND DISCUSSION

Table 2 clears out the picture regarding the cost and returns of wheat crop in the four districts under study. The total cost has been found highest i.e., ₹ 9682.51 per acre, which was subsequently been followed by Kathua district (₹ 9065.65 per acre), Udhampur district (₹ 7315.58 per acre) and finally by Rajouri district (₹ 6756.09 per acre). The overall average, thereby, was found out to be ₹ 8716.17 per acre. It is imperative to find out that the Udhampur and Rajouri district were also employing bullock labour along with the machine and human labour. As far as the returns are concerned (Table 4), the net returns were also found highest in case of Jammu district which was found out to be ₹ 6788.36 per acre. The lowest was found in the case of Udhampur district (₹ 4004.89 per acre). In addition, the net returns in case of Kathua and Rajouri was revealed to be ₹ 6225.24 per acre and ₹ 4070.75 per acre with the overall average found out to be ₹ 4761.10 per acre. The cost-benefit ratio was therefore, found highest in case of Jammu district (1:1.70), followed by Kathua district (1:1.69), Udhampur district (1:1.54) and Rajouri district (1:1.60). The overall cost-benefit ratio came out to be 1.63. To find out the wider picture, family labour income as well as the farm business income has also been calculated. The former was found highest in case of Jammu district (₹ 7605.72 per acre) and lowest in case of Rajouri district (₹ 4667 per acre), whereas, the latter was therefore, found highest in the Jammu district (₹ 7944.40 per acre) and lowest in case of Rajouri district (₹ 4772.24 per acre). Subsequently, the overall family labour income and farm business income was found out to be ₹ 5452.76 per acre and ₹ 5691.17 per acre.

Further, Table 5 finally represents the production pattern on wheat crop cultivation under rainfed conditions in the four districts under study. The highest yield and price were found in the case of Jammu district and the lowest in the case of Rajouri district with the average comes about 5.92 quintals per acre in case of yield and ₹ 1756.75 per quintal.

The resource-use efficiency of wheat crop has been presented in Table 5. For the Jammu district, the sum of elasticities revealed to be 1.03, thereby, reflecting the constant returns to scale. In addition, the coefficient of determination (R^2) came out to be 99.68. Thus, more than 99 per cent variability in output was jointly explained by six explanatory (regressor) variables. Careful analysis of the table

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Table 2: Item-wise cost structure of wheat crop under rainfed conditions in four districts (₹/acre)

Sl. No.	Items	Jammu	Kathua	Udhampur	Rajouri	Overall average
(A)	**Variable Cost**					
(a)	Seed	1157.52	1112.15	1012.15	880.16	1040.50
	Farm produced seeds	810.26	778.51	809.72	704.13	775.65
	Purchased seeds	347.26	333.65	202.43	176.03	264.84
(b)	Manure	563.09	504.56	296.84	287.37	412.97
	Farm produced manure	450.47	403.65	267.16	258.63	344.98
	Purchased manure	112.62	100.91	29.68	28.74	67.99
(c)	Chemical fertilisers (NPK)	871.62	874.66	590.05	460.04	699.09
d)	Human Labour	1834.36	1572.45	1333.19	1392.50	1533.13
	Owned	817.36	586.45	766.59	596.25	691.66
	Hired	1017.00	986.00	566.60	796.25	841.46
(e)	Machine Labour	1274.07	1190.79	1055.45	1180.33	1175.16
	Owned	424.69	396.93	263.86	295.08	345.14
	Hired	849.38	793.86	791.59	885.25	830.02
(f)	Bullock labour	0.00	0.00	885.15	1159.66	1022.41
	Owned	0.00	0.00	531.09	773.11	652.10
	Hired	0.00	0.00	354.06	386.55	370.31
(g)	Plant protection chemicals	394.23	343.04	92.78	36.09	216.54
(h)	Interest on working capital	426.64	391.84	368.59	377.73	391.20
	Total	6521.53	5989.49	5634.20	5773.88	6490.98
B)	**Fixed Cost**					
(a)	Depreciation on farm buildings & equipment	621.39	579.10	128.50	43.35	343.09
(b)	Estimated rental value	2200.91	2167.47	1372.73	833.62	1643.68
(c)	Land revenue	0.00	0.00	0.00	0.00	0.00
(d)	Interest on fixed capital	338.68	329.59	180.15	105.24	238.41
	Total	3160.98	3076.16	1681.38	982.21	2225.18
	Total Cost (A+B)	9682.51	9065.65	7315.58	6756.09	8716.16

Table 3: Concept-wise cost of cultivation of wheat crop under rainfed conditions in four districts (₹/acre.)

Sl. No.	Particulars	Jammu	Kathua	Udhampur	Rajouri	Overall average
1.	**Cost A_1**					
(a)	Hired Labour	1017.00	986.00	566.60	796.25	841.46
(b)	Machine Labour	1274.07	1190.79	1055.45	1180.33	1175.16
(c)	Bullock Labour	0.00	0.00	885.15	1159.66	1022.41
(d)	FYM	563.09	504.56	296.84	287.37	412.97
(e)	Seed	1157.52	1112.15	1012.15	880.16	1040.50
(f)	Fertilisers (NPK)	871.62	874.66	590.05	460.04	699.09
(g)	Plant protection chemicals	394.23	343.04	92.78	36.09	216.54
(h)	Interest on working capital	426.64	391.84	368.59	377.73	391.20
(i)	Depreciation charges	621.39	579.10	128.50	43.35	343.09
	Total cost- A_1	6325.56	5982.14	4996.11	5220.98	6142.42
2.	**Cost-A_2**					
(a)	Cost-A_1	6325.56	5982.14	4996.11	5220.98	6142.42
(b)	Rent paid for leased-in land	0.00	0.00	0.00	0.00	0.00
	Total cost- A_2	6325.56	5982.14	4996.11	5220.98	6142.42
3.	**Cost- B_1**					
(a)	Cost A_1	6325.56	5982.14	4996.11	5220.98	6142.42
(b)	Interest on fixed capital (excluding land)	338.68	329.59	180.15	105.24	238.41
	Total cost- B_1	6664.24	6311.73	5176.26	5326.22	6380.83

4.	Cost- B$_2$					
(a)	Cost B$_1$	6664.24	6311.73	5176.26	5326.22	6380.83
(b)	Land Revenue	0.00	0.00	0.00	0.00	0.00
(c)	Estimated rental value	2200.91	2167.47	1372.73	833.62	1643.68
	Total cost-B$_2$	8865.15	8479.20	6548.99	6159.84	8024.51
5.	**Cost -C$_1$**					
(a)	Cost B$_1$	6664.24	6311.73	5176.26	5326.22	6380.83
(b)	Imputed value of family labour	817.36	586.45	766.59	596.25	691.66
	Total cost- C$_1$	7481.60	6898.18	5942.85	5922.47	7072.49
6.	**Cost-C$_2$**					
(a)	Cost B$_2$	8865.15	8479.20	6548.99	6159.84	8024.51
(b)	Imputed value of family labour	817.36	586.45	766.59	596.25	691.66
	Total cost- C$_2$	9682.51	9065.65	7315.58	6756.09	8716.17
7.	**Cost- C$_3$**					
	Cost of management (10% of Cost-C$_2$)	968.25	906.57	731.56	675.61	871.62
	Total cost- C$_3$	10650.76	9972.22	8047.14	7431.70	9587.79

Table 4: Cost and returns of wheat crop under rainfed conditions in four districts (rainfed) (₹/acre.)

Sl. No.	Particulars	Jammu	Kathua	Udhampur	Rajouri	Overall average
Cost						
(a)	Total variable cost	6521.53	5989.49	5634.20	5773.88	6490.98
(b)	Total fixed cost	3160.98	3076.16	1681.38	982.21	2225.18
(c)	Total cost (C$_2$)	9682.51	9065.65	7315.58	6756.09	8716.17
Returns						
(a)	Gross returns	16470.87	15290.89	11320.47	10826.84	13477.27
(b)	Net returns	6788.36	6225.24	4004.89	4070.75	4761.10
(c)	Family labour income	7605.72	6811.69	4771.48	4667.00	5452.76
(d)	Farm business income	7944.40	7141.28	4951.63	4772.24	5691.17
(e)	Cost-Benefit Ratio	1:1.70	1:1.69	1:1.54	1:1.60	1:1.63

shows that, the result for the regression coefficients turned out to be positive and significant (at 5 per cent level) for the human labour, machine labour and plant protection chemicals. It means that, one unit increase in the cost of human labour, machine labour and plant protection chemicals, would lead to the enhancement in returns by 0.06 percent, 0.34 per cent and 0.34 percent, respectively. Therefore, these three variables were found out to be of considerable importance. Whereas, the regression coefficients for the seed, manure and fertiliser were found to be positive but non-significant. The idea about the over-utilisation and the under-utilization of the resources has been revealed by the concept of MVP. The MVP of seed, human labour, machine labour, manure, fertiliser and plant protection chemicals were found to be 1.58, 0.53, 4.33, 0.26, 3.09 and 10.12. It reveals that variables like human labour and manure are overutilized and therefore needs to be reduced and variables like seed,

machine labour and fertilisers are under-utilised and are required to be enhanced, so as to increase the overall returns from the cultivation of wheat crop in the Jammu district.

In case of Kathua, the sum of elasticities was revealed to be 1.01, thereby, reflecting the constant returns to scale. Further, the R^2 turned out to be 98.93, thereby, shows that 98.93 per cent of variability in output is shown by the six explanatory (regressor) variables. Further, the value of coefficients for human labour, machine labour, fertiliser and plant protection chemicals turned out to be positive and significant and for that of seed turned out to be non- significant but negative. The value of coefficient for the manure was positive but non-significant. One unit increase in cost of human labour, machine labour, fertiliser and plant protection chemicals would lead to an increase in the returns by 0.46 percent, 0.18 per cent, 0.31 percent and 0.07 percent, respectively. MVP for seed came out to be negative and it came out to be

Table 5: Production pattern of wheat crop cultivation under rainfed conditions (per acre)

Sl. No.	Particulars	Jammu	Kathua	Udhampur	Rajouri	Overall average
	Main product					
a)	Quantity (quintals)	6.48	6.40	5.80	5.00	5.92
b)	Average Price per quintal	1887	1865	1650	1625	1756.75
	Total amount (A)	12227.76	11936.00	9570.00	8125.00	10464.69
	By- product					
a)	Quantity (quintals)	9.43	7.21	4.30	6.75	6.92
b)	Average Price per quintal	450	465	406.95	400	430.49
	Total amount (B)	4243.11	3354.89	1750.47	2700	3011.51
	Total (A+B)	**16470.87**	**15290.89**	**11320.47**	**10826.84**	**13477.27**

Table 6: Resource-use efficiency of wheat crop

Variables	Jammu		Kathua		Udhampur		Rajouri	
	Coefficients	MVP	Coefficients	MVP	Coefficients	MVP	Coefficients	MVP
Constant or intercept	2.782 (0.171)		2.632 (0.062)		2.782 (0.476)		2.567 (0.203)	
X_1 Seed	0.113 (0.101)	1.582	-0.073 (0.043)	-0.961	-0.427* (0.201)	-4.817	0.074 (0.062)	0.862
X_2 Human labour	0.062* (0.032)	0.532	0.461* (0.072)	4.510	1.229* (0.217)	10.501	0.256 (0.147)	1.963
X_3 Machine labour	0.342* (0.091)	4.332	0.184* (0.081)	2.422	-0.273* (0.091)	-2.930	0.532* (0.102)	4.935
X_4 Manure	0.01 (0.021)	0.261	0.041 (0.031)	1.702	0.327* (0.022)	12.80	0.033 (0.021)	0.862
X_5 Fertiliser	0.186 (0.101)	3.094	0.310* (0.060)	5.451	0.048 (0.88)	0.837	0.014 (0.053)	0.291
X_6 Plant protection chemicals	0.342* (0.11)	10.122	0.072* (0.031)	3.191	0.088 (0.179)	10.912	0.101* (0.063)	31.022
R^2 %	99.68		98.93		99.68		99.89	
$\sum b_i$	1.03		1.01		0.99		1.06	

Significant at 5 per cent level of significance; (Figures in parentheses show standard error).

positive for the rest of the variables. It connotes the fact that, seed needs to be reduced so as to enhance the returns of the farmers. Further, all the rest of the variables reflected the under-utilization of resources, and therefore, there is high scope of increasing the usage of these resources in Kathua district.

The sum of elasticities in case of Udhampur district, were found out to be 0.993, representing the decreasing returns to scale. Further, the value of R^2 was 99.68 i.e., 99.68 of the variability is explained by the explanatory variables (regressors) in the independent variable (regressand). Further, the value of regression coefficients revealed out to be negative and significant (at 5 per cent level) in case of seed and machine labour, whereas, it came out to be positive in case of the rest of the variables. Therefore, the cost in case of seed as well as machine labour needs to be decreased. The value of coefficients of human labour, manure, fertiliser and plant protection chemicals came out to be 1.229, 0.327, 0.048 and 0.088, thereby, reflecting the fact that, with one unit increase in the cost of these inputs there will be increase in the returns for the farmers by 1.22 per cent (for human labour), 0.32 per cent (for manure), 0.05 per cent (for fertilisers)

and 0.09 per cent (for plant protection chemicals), respectively.

Finally, in case of Rajouri district, the sum of elasticities was revealed to be 1.06 per cent, respectively, which revealed the constant returns to scale and the value of R^2 came out to be 99.89. Thus, 99.89 of regressors representing the variation in the regressand. The value of regression coefficients was found to be significant (at 5 per cent level) and positive in case of two variables i.e., machine labour (0.53) and plant protection chemicals (0.1). One unit increase in cost of machine labour and plant protection chemicals would lead to increase in returns for farmers by 0.53 per cent and 0.1 pe cent, respectively. In addition, the value of coefficients for seed, human labour, manure and fertiliser were revealed out to be 0.07, 0.26, 0.03 and 0.01, respectively. The analysis at the geometric level showed that the variables like seed, manure and fertiliser were over-utilised and therefore, needed to be reduced and the variables like human labour, machine labour and plant protection chemicals were under-utilised and therefore, should be enhanced accordingly, so as to increase the returns for the farmers.

CONCLUSION

The total cost of production of wheat crop in case of Jammu and Kathua districts was found to be high in comparison to that of two districts of Udhampur and Rajouri, respectively. With the gross returns of ₹ 16470.87 per acre and ₹ 15290 .89 per acre, Jammu and Kathua districts yielded cost-benefit ratio of 1:1.70 and 1:1.69, respectively. As far as the production per acre was concerned, it was found out to be 5. 92 quintals per acre, on an average, in the rainfed regions of the four districts. The highest was found out to be in case of Jammu district i.e., 6.48 quintals per acre.

Resource-use efficiency of wheat crop delineates the fact that there was positive significant relationship in the human labour, machine labour and plant protection chemicals in the Jammu district. Also, there found the significant positive relationship in human labour, machine labour, fertiliser and in plant protection chemicals. Positive significant relationship was also being found in the human labour and manure in district Udhampur and in the variables of machine labour and plant protection chemicals in Rajouri district. This showed the importance of increasing the application of these variables for their respective districts. At the same time, negative significant relationship was found in seed in Kathua district, seed and machine labour in Udhampur district, respectively. This shows the reduction in these inputs so as to enhance the income and returns for the farmer. Almost all the districts experienced constant returns to scale.

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