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A study on different farming systems for improving sustainable barley production in Rajasthan

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Abstract
The present investigation was undertaken with a view to studying the effect of different farming systems on the production of barley in the state of Rajasthan. Indian agriculture policy reforms for some time one of the issues it faces is the lack of viability of smallholdings and lack of international competitiveness of its produce. Based on these issues new initiatives are reorganizing the production systems. In now a days agricultural lands are being allowed to be bought or leased by corporate agribusiness houses and in some area farmers are make a clusters produce their products and send to the market. This paper profiles cases of different farming practices and examine the rationale for allowing those farming systems in the context of its agriculture and rural sector. It point out that rationale which farming systems is weak and which one is better to continue for further period. Based on the above issues paper will discuss about out of different farming systems which farming system is making better use of resources for barley production.

Keywords: contract farming, collective farming, peasant farming, barley, production, smallholdings, corporate agribusiness

1. Introduction

Barley (Hordeum vulgare L.) is the world's fourth most important cereal crop after wheat, rice and maize. Its flour is used in preparing chapaties and sattu (a kind of drink made of flour of roasted barley grains mixed with sugar and water). Pearled barley, the round kernel pellets prepared by removing the husk of the kernels, is used as baby food and also as food for patients. The major use of barley is in brewing industries for manufacturing malt, which is used to make bear, industrial alcohol, whisky, malt syrups, brandy, malted milk, vinegar and yeast. Barley grains are also used as concentrates for feeding livestock and poultry. Its straw and husk serve as good quality roughage for cattle and are used for preparing compost, litter bedding and papers in paper industry. Barley grains contain about 12.5 per cent moisture, 11.5per cent protein, 69.6 per cent carbohydrate, 1.3 per cent fat, 3.9 per cent crude fiber, 1.2per cent mineral matter, 0.026 per cent calcium and 0.21 per cent phosphorous.

In India, barley is cultivated in an area of 7.06 lakh ha with an annual production of 16.89 lakh tonnes of grains with an average productivity of 2392 kg/ha. It is cultivated mainly in the states of Uttar Pradesh, Rajasthan, Madhya Pradesh, Bihar, Haryana and Punjab. In Rajasthan, the crop occupies an area of 3.28 lakh ha producing 9.35 lakh tonnes with an average productivity of 2851 kg/ha.

Examination of costs and returns in agriculture play a significant role in making the farm sector economically viable and feasible under the pressure of continuous rise in input prices. The level of input use and their prices affect the profitability of the crop enterprise. This mechanism needs to be critically examined for formulating effective policies in relation to costs and output prices for understanding the income path in the farm sector. As such there is a need to study the costs of and returns on different system of farming Systems.

Productivity in agriculture can be increased through adoption of improved technology. Seeds, manures, plant protection measures, fertilizers, irrigation, human labour and tractor power are the most important crucial inputs for increasing agricultural production on India. Judicious use of resources coupled with proper technology plays an important role in stepping up agricultural production. It is generally noticed that the farmers are not using recommended level of crop production technology. This results in to a gap between the potential and actual yield. As such there is a need to evaluate the resource use efficiency on different system of farming Systems.

The basic challenge every farmer in agriculture faces is to increase output and minimize the cost. For this, one must know how efficiently the farmers are using currently the inputs, identify the inputs that are inefficiently used, and then measures can be suggested to efficiently use such inputs to increase production and also to minimize cost. In order to identify the efficient use of inputs, production function analysis is the relevant technique.

Goni *et al*. (2013) [4] explored the efficiency of resource use in the production of dry season vegetables including cucumber in Nigeria. Vegetable output was significantly affected by herbicide ($p<0.10$), seed ($p<0.01$), pesticide ($p<0.01$) and land ($p<0.01$). Farmers were found inefcient in the utilization of all resources because of under-utilization (seed, pesticide and land) and over-utilization (fertilizer, herbicide and labour). They mentioned an increase in vegetable output by 114.58, 322.64 and 568.72 kg ha-1 due to increase the accessibility of seed, pesticide and land, respectively.

The study aims for the calculation of resource use efficiency and return to scale in Barley production. Return to scale is an important indicator to check the increase in output by increasing the level of inputs. The attempt is also made to know whether the farmers present levels of resource use is efficient or not.

Materials and Methods

Primary data were collected by purposive sampling from barley farmers in both contract and cooperative farming systems In Jaipur, SriGanganager and Sikar District will be purposively selected. From each district three blocks will be selected on the basis of area and production of Barley crop. From the selected districts, selection of farmers will be done by ensuring minimum representation of main farming models in the study area (totally 270 farmers) will be selected using purposive technique for the study.

Model Specifcation

The Cobb-Douglas production function will be used to explain the relationship between various inputs and the yield. The Cobb-Douglas form of production function is specified as follows:

$$Y = a\, X_1^{b1} . X_2^{b2} . X_3^{b3} . X_4^{b4} . X_5^{b5.} X_6^{b6.} X_7^{b7} . X_8^{b8} . X_9^{b9} U$$

Where,

Y	=	Yield of Barley (quintals /ha.)
X1	=	Farm yard manure (tonnes/ha)
X2	=	Quantity of Nitrogenous fertilizer (kg./ha.)
X3	=	Quantity of Phosphorus fertilizer (kg./ha)
X4	=	Quantity of Potassium fertilizer (kg./ha)
X5	=	Seed (grams/ha)
X6	=	Expenditure on plant protection chemicals (Rs/ha)
X7	=	Machine power (tractor hours/ha)
X8	=	No. of irrigation
X9	=	Human labour (man days/ha)
U	=	Error term

Estimation procedure

The Ordinary Least Square (OLS) method will be used for estimating the parameters associated with different independent variables. The estimable form of the Cobb-Douglas production function is formally expressed as follows.

$\ln Y = \ln a + \beta 1 \ln X1 + \beta 2 \ln X2 + \beta 3 \ln X3 + \beta 4 \ln X4 + \beta 5 \ln X5 + \beta 6 \ln X6 + \beta 7 \ln X7 + \beta 8 \ln X8 + \beta 9 \ln X9 + U$

The resource use efficency could be worked out based on the marginal value productivity (MVP), which indicates the increase in the gross return from the use of an additional unit of a given input while keeping the level of other inputs constant.

Resource use efficiency = MVP / MFC

The marginal value product (MVP) of the i-th input factor will be measured by using the formula:

$$MVP_j = \beta_j \frac{\bar{Y}}{\bar{X}_j} P_y$$

Where,

MVPj	-Marginal value product of 'jth product
Y	- Geometric mean level of output
Xj	- Geometric mean of input 'j'
βj	- Estimated co-efficient of elasticities for jth input
Py	- Price of Barley (Rs /tonnes).

Decision Rules

The decision about the under utilization, over utilization and efficient utilization of a particular input resource is taken by using following rule:

When r = 1 or MVP=MFC, it indicates efficient utilization.

When r <1 or MVP<MFC, it indicate over utilization. When r > 1 or MVP>MFC, it indicate under utilization.

Adjustment in inputs is required when the value of "r" is greater or less than 1. The decision about return to scale is taken as:

If ∑ Ep = 1 than it shows constant return to scale If ∑ Ep <1 than it shows decreasing return to scale If ∑ Ep > 1 than it shows increasing return to scale

Results and Discussion

Estimated Cobb-Douglas production function for Contract farming system.

Table 1: reveals the coefficient of Cobb-Douglas model in Barley production on contract farming System. Model was good on the basis of coefficient of determination (R2) which was 0.866.It indicates that the model explained 86.6% variations in output due to variations in inputs. F- statistics was also fine (101.734). Coefficient for seed is positive and significant which shows the increase in output (0.121%) for 1% increase in the rate of seed. A quality seed was normally good germination and also helpful to increase the production. Fertilizer played very important role in barley cultivation especially application of nitrogen and its coefficient was positive which indicates (.052%) increase in output due to 1% increase in nitrogen application and in the same case for phosphorus application also plays a major role and its coefficient was positive which indicates (.050%) increase in output due to 5% increase in phosphorus application. Barley cultivation is a water intensive activity and shows a positive (2.978%) impact on output due to 1% increase in water applications. It was in line with (Abid *et al*., 2011; Ashfaq *et al*., 2012; Karthick *et al*., 2013) [1, 3, 5]. The coefficient of labour man days was positive which shows a positive (.362%) increase in output as a result of 1% increase in labour days. Application of FYM shows a positive (.989%) impact on output due to 5% increase in FYM application. The coefficient of machine labour was positive (.617%) increase in output as a result of 5% increase in machine labour. The sum of elasticity coefficients, i.e., returns to scale of production on contract farming system was 5.56 implying increasing returns to scale.

Table 1: Coefficients of Cobb-Douglas model for barley production in Contract farming. Model Summary

Mode l	R	R Square	Adjusted R Square	Std. Error of the Estimate
	.931a	.866	.857	2.804

Source: Primary Data
Predictors: (Constant), NI, PPC, HL, Seed, P, ML, FYM, N

Anova[a]

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression Residual Total	6400.612	8	800.077	101.734	.000b
	990.914	126	7.864		
	7391.526	134			

Source: Primary Data
Dependent Variable: Yield
Predictors: (Constant), NI, PPC, HL, Seed, P, ML, FYM, N

Coefficientsa						
Model	Unstandardized Coefficients	Standardized Coefficients			T	Sig.
	B	Std. Error	Beta			
(Constant)	6.323	6.665			.949	.345
Seed	.121	.048	.097	2.543		.012
FYM	.989	.482	.111	2.053		.042
N	.052	.017	.163	2.988		.003
P	.050	.025	.099	2.010		.047
PPC	-.005	.003	-.052	-1.515		.132
HL	.362	.134	.103	2.707		.008
ML	.617	.270	.121	2.281		.024
NI	2.978	.429	.432	6.948		.000

Source: Primary Data
a. Dependent Variable: Yield

Estimated Cobb-Douglas production function for Cooperative farming system

Table 2: reveals the coefficient of Cobb-Douglas model in Barley production on contract farming System. Model was good on the basis of coefficient of determination (R2) which was 0.954.It indicates that the model explained 95.4% variations in output due to variations in inputs. F- statistics was also fine (327.550). Coefficient for seed is positive and significant which shows the increase in output (.094%) for 5% increase in the rate of seed. A quality seed was normally good germination and also helpful to increase the production. Fertilizer played very important role in barley cultivation especially application of nitrogen and its coefficient was positive which indicates (.030%) increase in output due to 1% increase in nitrogen application and in the same case for phosphorus application also plays a major role and its coefficient was positive which indicates (.046%) increase in output due to 1% increase in phosphorus application. Barley cultivation is a water intensive activity and shows a positive (.658%) impact on output due to 1% increase in water applications. The coefficient of labour man days was positive which shows a positive (.616%) increase in output as a result of 1% increase in labour days. Application of FYM shows a positive (.828%) impact on output due to 1% increase in FYM application. The coefficient of machine labour was positive (.616%) increase in output as a result of 1% increase in machine labour. The sum of elasticity coefficients, i.e., returns to scale of production on contract farming system was 2.71 implying increasing returns to scale.

Table 2: Coefficients of Cobb-Douglas model for barley production in Cooperative farming Model Summary

Mode l	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.977a	.954	.951	1.19599

Source: Primary Data
a. Predictors: (Constant), NI, PPC, N, FYM, HL, P, seed, ML

Anova[a]

Model		Sum of Squares	DF	Mean Square	F	Sig.
1	Regression Residual Total	3748.186	8	468.523	327.550	.000b
		180.229	126	1.430		
		3928.415	134			

Source: Primary Data
Dependent Variable: yield
Predictors: (Constant), NI, PPC, N, FYM, HL, P, seed, ML

Coefficientsa

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant) seed FYM N P PPC HL ML NI	13.239	2.908		4.553	.000
	.094	.044	.111	2.119	.036
	.828	.277	.125	2.984	.003
	.030	.010	.132	3.002	.003
	.046	.012	.192	3.900	.000
	.000	.001	.003	.135	.893
	.446	.125	.164	3.568	.001
	.616	.218	.162	2.830	.005
	.658	.180	.164	3.653	.000

Source: Primary Data (a. Dependent Variable: yield)

Resource use efficiency analysis for Barley production in Contract farming

Table 3 explores the resource use efficiency in barley production under contract farming system. Underutilization of seed was observed and an adjustment is required for barley production growers in the use of good quality seed in a correct seed rate to get more output and revenue. Underutilization was observed in case of fertilizers, irrigation and labour days because they showed greater than 1 value of resource use efficiency. Therefore, a little adjustment is required to increase the level of fertilizer, water application and labour man days for more output. Irrigation coefficient was in line with Abid *et al.,* (2011) [1], Ashfaq *et al.,* (2012) [3] and Karthick *et al.,* (2013) [5]. Labour coefficient was also positive as reported by Abid *et al.,* (2011) [1], Akighir and Shabu (2011) [2], *Ashfaq et al*., (2012) [3] and *Anim et al*., (2015) [3]. Underutilization of fertilizers was also mentioned by *Abid et al.,* (2011) [1] and Ashfaq *et al.,* (2012) [3].

Table 3: Resource use efficiency analysis in Contract farming.

	Mean	MPP	Price	VMP	VMP/MFC
Yield	59.94074074		1800		
Seed	64.82962963	0.11	25	201.94	8.08
N	169.7777778	0.02	7.2	32.97	4.58
HL	24.71111111	0.88	400	1580.83	3.95
NI	5.259259259	33.94	1460	61087.56	41.84

Source: Primary Data

Table 4: Resource use efficiency analysis for Cooperative farming.

	Mean	MPP	Price	VMP	VMP/MFC
Yield	55.76		1600		
FYM	9.01	5.12	343	8197.22	23.90
N	153.19	0.01	7.2	17.23	2.39
P	78.07	0.03	25	52.14	2.09
HL	24.69	1.01	400	1611.40	4.03
NI	5.71	6.42	1404	10278.46	7.32

Source: Primary Data

Conclusion

The present study calculated resource use efficiency and return to scale in barley production in Rajasthan in two different farming system namely Contract farming and Cooperative farming system. Cobb-Douglas model was good on the basis of R2 (86.6%) and f-statistics (101.734). The impact of seed, FYM, fertilizer, irrigation and labour was positive and significant in both the case of contract farming and cooperative farming. Underutilization of resource was observed for seed, fertilizers, irrigation and labour in case of contract farming systems and meanwhile FYM, fertilizers, labour and irrigations were observed underutilization in Cooperative farming system. There exists increasing return to scale both case of contract and cooperative farming system. The only main problem in both the farming system marketing in case of cooperative farming and quality of seed, availability of seed also problem in cooperative farming. In the same case contract farmers are focusing more on chemical fertilizer when compared to FYM and sometimes the seeds procurement was rejected by company because of low quality or otherwise they will get low amount of money for their product.in, both the cases plant protection chemicals were used overutilization for their field, both farming systems are try to control over utilization of chemicals it will be increase the output at the same time increase the farmers revenue. Based on the above issues government will focus to implement comprehensive agricultural policy will be helpful for the promotion of production and prices stability. Government should subsidize the inputs like fertilizers, chemical. Government should ensure the availability of canal water. Improvement in extension services is a pre-requisite for the progress of agriculture sector.

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