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Economic Analysis and Resource use Efficiency of Sunflower Cultivation in Haryana

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Abstract: The present study was conducted during spring season of 2020-21 for determining the cost and returns of sunflower and its resource use efficiency in Kurukshetra district of Haryana. Multi-stage random sampling technique was employed for selection of 80 sunflower growers. The relevant primary data was mined from selected farmers through survey method. The total cost incurred in sunflower cultivation was ₹ 76297/ha and gross returns were ₹ 91526/ha thus reflecting net returns of ₹ 15229/ha. Moreover, the B-C ratio of 1.20 was realized which reflected the profitability of sunflower. Further, the Cobb-Douglas production function analysis revealed that value of R^2 was 0.76 and efficiency of resource use in sunflower exhibited increasing returns to scale which indicated under-utilization of the farm resources for sunflower cultivation. Seed exhibited the highest resource use efficiency while machine labour was found to be least efficient input.

Keywords: B-C ratio, Net returns, Production function, Resource use efficiency, Sunflower

India is one of the world's leading producers of oilseeds (Lokesh and Dandoti 2017), producing a wide variety of crops such as soybean, rapeseed-mustard, groundnut, sesame, sunflower, castor, etc. The oilseed sector contributed significantly to the agricultural economy of the country providing a source of income for millions of farmers and supporting various downstream sectors (Narayan 2016, Sharma 2018, Satishkumar et al 2022). The total oilseeds production in India has increased from 18 to 35.90 million tonnes in last three decades reflecting the doubling of production. This increment in production is due to rise in both acreage (19.50%) and productivity (61.73%) during the same time period. Furthermore, this sector accounted for a considerable share of India's agricultural exports worth ₹ 83.10 billion in 2020-21. Even though India produces substantial quantities of oilseeds, it imports a significant amount of edible oils to meet domestic demand. India imported 14.2 million tonnes of edible oils worth ₹ 1415.32 billion in 2020-21 (RBI 2022).

Sunflower (*Helianthus annuus* L.) is an essential oilseed crop (Sunandini and Devi 2020) which plays a pivotal role in meeting out the demand of edibles oils in India (Ramamurthy et al 2022). The crop's prominence has increased due to the national emphasis on vegetable oil production and Technology mission on oilseeds launched in 1986 which subsequently restructured as Integrated Scheme of OilSeeds, Pulses, Oilpalm and Maize (ISOPOM) in 2004 (Reddy 2009, Reddy and Bantilan 2012). In India, the area under sunflower cultivation increased from 117 t ha in 1970-71 to 2668 t ha) in 1993-94, fluctuated until 2009-10, and thereafter declined significantly. In Haryana, the crop occupies an area of 12.29 t ha with total production of 24.63 thousand tonnes in 2020-21 (GoH 2022). Keeping in view the importance of crop, the present study was undertaken in order to figure out the returns and resource use efficiency of sunflower in the study area.

MATERIAL AND METHODS

Study area and design: The present study was conducted in Kurukshetra district of Haryana during 2020-21. The district is having assured irrigation facilities and various cropping systems like paddy-wheat, paddy-potato-sunflower, sugarcane-ratoon, etc. Multi-stage random sampling technique was employed for selection of the sampled farmers. Kurukshetra district was selected purposively at first stage of sampling based on area under sunflower cultivation in the state. At the second stage of sampling, two blocks i.e. Ladwa block and Shahbad block, were selected randomly. The random selection of two villages from each block was third stage of sampling. At last stage of sampling, 20 farmers from each village were selected randomly. Finally, 80 farmers were interacted through face-to-face approach in order to extract the pertinent information for addressing objectives of the study.

Data collection and analysis: The present investigation was based on primary data. Self-prepared and pre-tested interview schedule was used for the collection of relevant information from sunflower growers related to their demographic characteristics, inputs used in sunflower cultivation, input-output prices, yield, returns etc. Simple descriptive analysis and budgeting techniques were used for drawing practical inferences.

Resource use efficiency: For determining the efficiency of resources used in the cultivation of sunflower, following Chand and Anoop (2022) and Guleria et al (2022), the Cobb-Douglas type of production function was used considering six explanatory variables in monetary terms and the following functional form was used:

$$Y = aX_1^{b1}X_2^{b2}X_3^{b3}X_4^{b4}X_5^{b5}X_6^{b6}u$$

This above functional form was analyzed using ordinary least square method after transforming into logarithmic form:

$$\log Y = \log a + b_1\log X_1 + b_2\log X_2 + b_3\log X_3 + b_4\log X_4 + b_5\log X_5 + b_6\log X_6 + u$$

Where, Y = Output value (₹/ha), a = Constant, X_1 = Seed (₹/ha), X_2 = Chemical fertilizers (₹/ha), X_3 = Plant protection chemicals (₹/ha), X_4 = Human labour (₹/ha), X_5 = Machine labour (₹/ha), X_6 = Irrigation (₹/ha), b_1, b_2 … b_6 = Regression coefficient of respective input X_i and u = Random error term

Statistical significance of the regression coefficients were tested using 't' test.

The resource use efficiency was computed by finding the difference between marginal value product (MVP) and marginal factor cost (MFC) for each input. MFC or P_i is the price of additional unit of input and MVP is calculated as:

$$\text{MVP of } X_i = b_i\,(\overline{Y}/\overline{X})\,Pi$$

Where, b_i = regression coefficient of i^{th} input, $\overline{Y}$ = Geometric mean of output Y, $\overline{X}$ = Geometric mean of input X_i, P_i = Price of input X_i

The decision rules under MVP-MFC method are as follows: if MVP-MFC > 0 then it represents underutilization of farm resources; if MVP-MFC = 0 then it represents efficient utilization of farm resources; if MVP-MFC < 0 then it represents over utilization of farm resources.

RESULTS AND DISCUSSION

Demographic characteristics of the sample farmers: The demographic characteristics such as age composition, family size, farming experience and educational status, is shown in Table 1.

Cost and return structure of sunflower: The pertinent information with regard to various inputs used, output obtained and their prevailing market prices during 2020-21 was collected from sampled farmers of Kurukshetra district of Haryana in order to compute the cost and returns of sunflower (Table 2). The total cost incurred in cultivating sunflower was ₹ 76297/ha in the study area, out of which,

Table 1. Demographic characteristics of the sample farmers

Particulars	No. of respondents (N=80)	Per cent
Age (Year)		
Young (up to 35 years)	6	7.50
Middle (36 to 55 years)	60	75.00
Old (above 55 years)	14	17.50
Total	80	100.00
Family size (Member)		
Small (3-5)	26	32.50
Medium (6-8)	34	42.50
Large (Above 8)	20	25.00
Total	80	100.00
Farming experience (Year)		
Up to 10 years	8	10.00
11-20 years	62	77.50
Above 20 years	10	12.50
Total	80	100.00
Education		
Illiterate	20	25.00
Below matric	32	40.00
Matric / Sr. Secondary	24	30.00
Graduate / above	4	5.00
Total	80	100.00

Table 2. Cost of cultivation of sunflower in Kurukshetra district of Haryana (₹/ha)

Particulars	Quantity	Value	Percentage
Preparatory operation (No.)	5	9639	(12.64)
Sowing		2583	(3.38)
Seed (Kg)	4.22	2436	(3.19)
Chemical fertilizers (kg)	331.03	3832	(5.02)
Irrigation (No.)	7	2138	(2.81)
Inter-cultural operation (No.)	3	4828	(6.33)
Plant protection chemical		2038	(2.67)
Harvesting operation		12186	(15.97)
Miscellaneous		171	(0.22)
Interest on working capital @ 7% p.a		916	(1.20)
(A) Total variable cost		40767	(53.43)
Transportation cost		1834	(2.41)
Rental value of land		25542	(33.48)
Management charges @ 10%		4077	(5.34)
Risk charges @ 10%		4077	(5.34)
(B) Total fixed cost		35530	(46.57)
Total cost (A+B)		76297	(100.00)

Figures within parentheses indicates percentage to total cost

53.43 per cent was variable cost (₹ 40767/ha) and 46.57 per cent was fixed cost (₹ 35530/ha). The variable cost constituted highest share in total cost because operations like harvesting operation (₹ 12186/ha), preparatory operation (₹ 9639/ha), inter-cultural operation (₹ 4828/ha), etc. carried out in sunflower cultivation were costly and labour-intensive. In addition to this, chemical fertilizers, which costs near about ₹ 3832/ha further augmented the total variable cost. Among the fixed cost, rental value of land alone share a segment of 33.48 per cent (₹ 25542/ha) of total cost of cultivation due to high fertility of land along with assured irrigation water availability in the study area. The cost and returns obtained from sunflower cultivation in the study area exposed that the yield achieved from its cultivation was 17.63 quintals/ha with monetary values of ₹ 91526/ha (Table 3). As the total cost incurred in cultivating sunflower was ₹ 76297/ha, the net returns realized were ₹ 15229/ha. Moreover, the value of B-C ratio (1.20) indicated the economic viability of sunflower cultivation in the study area. Similar results of sunflower profitability were obtained by Suneetha and Illuru (2014) and Sonawane et al (2019). Further, similar findings were also described by Das and Rout (2018) on economic analysis of sunflower enterprise in western Odisha.

Resource use efficiency in sunflower cultivation: The production function analysis is a useful tool for allocating farm resources. The Cobb-Douglas type production function, as defined in the methodology, was used to determine the efficiency of each resource namely seed (X_1), chemical fertilizers (X_2), plant protection chemicals (X_3), human labour (X_4), machine labour (X_5) and irrigation (X_6). Table 4 displays the regression coefficient (b_i) of the production function, as well as its standard errors, t-value, coefficient of multiple determination (R^2) and returns to scale. The R^2 was 0.76 which indicated that 76 per cent of the variability in sunflower gross returns was determined by the variables in the model and the remaining unexplained variation (24%) might be ascribed to plethora of factors like sunflower variety/hybrid chosen, time of sowing, cultivation practices and varied agro-climatic conditions. Further, the production function analysis indicated that the regression coefficient of machine labour and human labour were found to be positive and significant at 5 and 10 per cent levels, respectively. This positive significance reflected that increase in machine labour (5%) and human labour (10%) would increase gross returns by 0.77 and 0.57 per cent, respectively thus indicating their contribution in sunflower cultivation. However, seed, chemical fertilizers, plant protection chemicals and irrigation had non-significant impact on sunflower returns. Moreover, the return to scale (1.38) implies increasing returns in the study area. These results were in conformity with the findings of Badar et al (2002), Sonawane et al (2019) and Suneetha and Illuru (2014).

For determining the efficiency of resource use in sunflower cultivation, the difference between marginal value product (MVP) and marginal factor cost (MFC) was calculated and significance test were applied (Table 5). The finding reveals that the difference between MVP and MFC was found to be positive for inputs namely, seed, human labour, machine labour and irrigation thus indicating underutilization of such inputs, which shows that there is enough possibility to increase the profits from cultivating sunflowers by increasing the use of these resources. However, the negative difference was obtained for chemical fertilizers and plant protection chemicals thus indicated that these inputs were over utilized. Further, seed exhibited the highest resource use efficiency as the difference between MVP and MFC for seed being closest to zero while machine labour was found to be least efficient resource. Similar kind of results was reported by Irugu et al (2017) in their study on resource use efficiency of sunflower in Kurnool district of Andhra Pradesh.

Table 3. Cost and returns from sunflower in Kurukshetra district of Haryana (₹/ha)

Particulars	Value
Total variable cost	40767
Total fixed cost	35530
Total cost	76297
Gross returns	91526
(a) Main product (17.63 Qtl.)	91526
Return over variable cost	50759
Net return	15229
Cost of production (₹/Qtl.)	4328
B:C ratio	1.20

Table 4. Regression coefficient and standard error of sunflower production

Variables	Regression coefficient (b_i)	Standard error (SE)	t-value
Intercept	-2.02	5.02	-0.40
Seed	-0.04^{NS}	0.25	0.11
Chemical fertilizers	-0.01^{NS}	0.04	0.31
Plant protection chemicals	0.04^{NS}	0.02	1.62
Human labour	0.57*	0.36	1.85
Machine labour	0.77**	0.35	2.20
Irrigation	0.05^{NS}	0.10	0.51
Returns to scale	1.38		
R^2	0.76		

** Significant at 5% level, * Significant at 10% level, NS: Non-significant

Table 5. Resource use efficiency in sunflower cultivation

Inputs	Seed	Chemical fertilizers	Plant protection chemicals	Human labour	Machine labour	Irrigation
MVP	1.37	0.50	1.92	2.70	7.92*	2.25
MFC or price	1.00	1.00	1.00	1.00	1.00	1.00
Difference	0.37@	-0.50	-0.92	1.70	6.92#	1.25
S.E. of MVP	9.18	1.63	1.18	1.72	3.60	4.39
t-value	0.04	-0.30	0.78	0.99	1.92	0.28

Minus sign in the row 'Difference' shows over utilization and positive value shows under utilization
Least resource use efficiency, @ Highest resource use efficiency, * Significant at 10% level

CONCLUSION

The results of the present study revealed that the socio-economic status of the respondents in the study area was moderate with better education and ample farming experience. The B-C ratio reflected the economic feasibility of sunflower cultivation in the region. The production function analysis indicated that seed was the most efficiently utilized resource whereas machine labour was found to be least efficiently utilized. Moreover, increasing returns to scale has also been observed. So, it can be concluded that sunflower cultivation is a profitable enterprise for fetching greater returns. Thus, its cultivation needs to be prioritised for massive seed production in order to meet out the demand of edible oils. Furthermore, inclusion of sunflower in the cropping system will also provide farmers an option of crop diversification from prevailing field crops and ample scope for sustaining agro-processing enterprises, which generate massive employment opportunities.

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