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Analysing Growth Trend, Profitability and Resource Use Efficiency of Summer Mungbean in Eastern Haryana

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ABSTRACT

Background: Mungbean [*Vigna radiata* (L.) Wilczek] is the most extensively sown crop among commonly produced Asiatic Vignas, *viz*., urdbean, mungbean, mothbean, ricebean and azukibean. In Haryana, the crop covered 28.5 thousand ha area with annual production of 19.6 thousand tonnes having productivity of 688 kg ha^{-1} in 2020-21. To prevent the perils of mono-cropping (paddy-wheat system) in the state, there is a need for deep transformation through inclusion of pulses like summer mungbean, in the existing cropping system. Hence, the present investigation critically examines the growth trends, economics and efficiency of resource use in summer mungbean cultivation in eastern zone of the state.

Methods: This study uses both primary and secondary source of data. The primary data was collated from 80 summer mungbean growers using multi-stage random sampling technique. The secondary data was retrieved from various published and unpublished sources for a period of 30 years from 1991-92 to 2020-21. For measuring the growth trends and instability in the area, production and productivity of mungbean, compound annual growth rate (CAGR) and Cuddy-Della Valle index (CDVI) were computed. Simple budgeting technique was employed for calculating the economics of summer mungbean. For resource use efficiency, Cobb-Douglas production function was used.

Result: The results show a positively significant growth rate in mungbean area, production and productivity but with irregular trends. The instability in mungbean production is more pronounced in Haryana than India and is mainly attributed to area instability, while it is because of productivity instability at the country level. The mungbean is a profitable enterprise in summer season as the net returns realized to the tune of ₹ 26024 ha^{-1} with benefit-cost ratio of 1.43 in the study area. Further, the efficiency of resourceuse in summer mungbean exhibits increasing returns to scale. Hence, the inclusion of mungbean cultivation in summer season is profitable.

Key words: Instability, Mungbean, Net returns, Production function, Returns to scale.

INTRODUCTION

Pulses play a pivotal role in agriculture as well as human diet by providing nutritional security (Kumar and Malik, 2022). They are an excellent source of protein laden with dietary fiber, energy, minerals and possess low glycemic index. Pulses, which contribute about 10 per cent of the daily protein intake and 5 per cent of the daily energy intake, are of the utmost significance for food security in low-income countries such as India, where a substantial portion of the population is vegetarian (Malik *et al.,* 2021). India is the top most producer, consumer and importer of pulses worldwide (Verma *et al.,* 2023a), which accounts for 23.62 per cent of world's total pulses production in 2019-20 (PIB, 2021). The total pulses production in India has increased from 11.81 million tonnes in 1970-71 to 25.46 million tonnes in 2020-21 showing phenomenal achievement. However, there is still import dependency, which calls for major technological break-through and utilization of fallow lands of summer period for growing pulses like mungbean.

Mungbean [*Vigna radiata* (L.) Wilczek], popularly called as green gram or moong, is a vital food and economic crop in the South and Southeast Asian paddy-based agricultural systems (Nair and Schreinemachers, 2020). It is one of the most important pulse crops supplementing the cereal-based diets of the impoverished in Asia (Shanmugasundaram *et al.,* 2010) and the most extensively sown crop among commonly produced Asiatic Vignas, *viz*. urdbean, mothbean, mungbean, ricebean and azukibean. It is cultivated in all seasons *viz. Kharif, Rabi* and summer season in India. The maximum area of mungbean is under *Kharif season* (3.82 million ha) followed by *Rabi season* (1.30 million ha) and least under summer season in India. The crop covered 5.13 million ha area with total production

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of 3.08 million tonnes in 2020-21. It contributed about 18 per cent to total pulses area and 12 per cent to total pulses production in the country. Mungbean is largely used in *dahl* making, sprouts, soup, curry, sweets and snacks preparation (Jadhav *et al.,* 2023).

In Haryana, mungbean occupied 28.5 thousand ha area with annual production of 19.6 thousand tonnes having productivity of 688 kg ha^{-1} in 2020-21 (GoH, 2023). Traditionally, the crop is sown in *Kharif* season in rain-fed areas and restricted to marginal lands in Haryana but in the past few years, mungbean cultivation is spreading to non-traditional eastern areas of the state as the crop fits well in paddy-wheat cropping system. Undoubtedly, the paddy-wheat system produces greater farm profits, but it also poses serious risks to soil health, groundwater table depletion, development of resistance against *Phalaris minor* in wheat and other environmental pollutions. These problems call for a sustainable alteration of existing system, which can be achieved through inclusion of legumes (particularly pulses) in food production system (Milou *et al.,* 2023). However, during summer season, the fields remain vacant after the harvest of *Rabi* crops (wheat, potato, gram, mustard, *etc*.) thus providing space for cultivation of short-duration recommended varieties of mungbean. Hence, the present study critically examines the growth trend, economics and efficiency of resource use in summer mungbean cultivation in eastern zone of the state.

MATERIALS AND METHODS

The study was undertaken at Chaudhary Charan Singh Haryana Agricultural University of Hisar, Haryana during 2020 and 2021. The current investigation was executed in Karnal and Kurukshetra districts which lie in eastern zone of Haryana. Summer mungbean growers were selected using a multistage random sampling technique. From each district, two blocks were randomly selectedand from every single block, two villages. Finally, 10 summer mungbean farmers were chosen at random from each randomly selected village thus making a final sample of 80 farmers, which were interacted personally in order to extract the pertinent information for addressing targeted objectives.

The present study was based on both primary and secondary data. A self-prepared and pre-tested interview schedule was employed for acquiring primary information from summer mungbean growers regarding inputs used, input-output prices, yield, returns *etc*. Descriptive statistical tools such as mean, percentage, *etc.* were applied for tabular analysis in order to determine the cost and return structure of summer mungbean.

The secondary data were retrieved from various published and unpublished sources such as government websites, annual reports and other publications of Department of Agriculture and Farmers Welfare, Government of Haryana. Year wise time series data pertaining to area, production and productivity of mungbean in Haryana and India were collected for a period of 30 years from 1991-92 to 2020-21. For measuring the growth trends of area, production and productivity of summer mungbean crop, compound annual growth rate (CAGR) was calculated by fitting to the time-series data in exponential function of the following form:

$$Y = ab^t \quad \ldots(1)$$

Where:
Y = Area/Production/Productivity as dependent variable.
a = Intercept.
b = Regression coefficient.
t = Time (year) as independent variable.

Equation (1) can be expressed in logarithmic form *i.e.*

$$\log Y = \log a + t \log b \quad \ldots(2)$$

Further, equation (2) can be re-written as:

$$\log Y = b_0 + b_1 t \quad \ldots(3)$$

Where:
b_0 = log a.
b_1 = log b.

The compound annual growth rate (CAGR) was computed as:

$$CAGR(\%) = (\text{Antilog of } b_1 - 1) \times 100 \quad \ldots(4)$$

Instability analysis in the area, production and productivity of mungbean was done using Cuddy-Della Valle index (CDVI) formula (Cuddy and Valle, 1978). The ranges of CDVI (Sihmar, 2014) are between 0 and 15 for low instability, greater than 15 but lower than 30 as moderate instability and above 30 represent higher instability.

$$CDVI = CV \times \sqrt{1-\bar{R}^2} \quad \ldots(5)$$

Where,
CV = Coefficient of variation.
$\bar{R}^2$ = Adjusted coefficient of multiple determination.

In order to figure out how well the resources were used in summer mungbean cultivation, the Cobb-Douglas production function was exercised with six explanatory variables in monetary values. The following functional form was employed:

$$Y = A\prod_{i=1}^{n} X_i^{bi} e^u$$

i.e. $Y = A.X_1^{b1}.X_2^{b2}.X_3^{b3}.X_4^{b4}.X_5^{b5}.X_6^{b6}.u \quad \ldots(6)$

The non-linear equation (6) was linearized into logarithmic form and the parameters were analyzed using ordinary least square method. So, the new equation is:

$$\log Y = \log A + b_1 \log X_1 + b_2 \log X_2 + b_3 \log X_3 + b_4 \log X_4 + b_5 \log X_5 + b_6 \log X_6 + u \quad \ldots(7)$$

Where,
Y = Output value (₹ ha^{-1}).
A = Constant.
X_1 = Seed (₹ ha^{-1}) .
X_2 = Chemical fertilizers (₹ ha^{-1}).
X_3 = Plant protection chemicals (₹ ha^{-1}).
X_4 = Human labour (₹ ha^{-1}).

X_5 = Machine labour (₹ ha^{-1}).
X_6 = Irrigation (₹ ha^{-1}).
b_1, b_2 … b_6 = Regression coefficient of respective input Xi.
u = Random error term.

To test the significance of regression coefficients, t-test was used.

For analysing resource use efficiency, the difference between marginal value product (MVP) and marginal factor cost (MFC) was worked out and significance test were applied. The marginal value product (MVP) of ith input is:

$$MVP \text{ of } X_i = b_i\left(\frac{\bar{Y}}{\bar{X}}\right) P_i \quad \ldots(8)$$

Where:
b_i = Regression coefficient of ith input.
Y_i = Geometric mean of output Y.
$\bar{X}_i$ = Geometric mean of input X_i.
$\bar{P}_i$ = Price of input X_i.

The decision criterion under MVP-MFC method is that: 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

Mungbean scenario in India vis-à-vis Haryana

The trend in area, production and productivity of mungbean in India remained slightly consistent till 2006-07 and thereafter, showed a rising trend (Fig 1). This increase could be attributed to the initiatives undertaken by the government in the form of National Food Security Mission (NFSM) and Accelerated Pulses Production Programme (A3P). The analysis revealed that the mungbean area (5130 thousand ha), production (3085 thousand tonnes) and productivity (601 kg/ha) was maximum in 2020-21. Khine *et al.* (2021) also observed similar kind of results in their study. On the other hand, the performance of mungbean in Haryana exhibited a slight positive bias till 2003-04 and thereafter, showed an irregular trend in area and production but an increasing trend in the productivity (Fig 2). From 1999-00 to 2002-03, the production in the state plummeted due to decline in area and productivity, increased until 2007-08 and thereafter fluctuated significantly.

Growth and instability of mungbean in India vis-à-vis Haryana

The compound annual growth rate (CAGR), adjusted coefficient of multiple determination ($\bar{R}^2$), coefficient of variation (CV) and Cuddy-Della Valle index (CDVI) of instability in area, production and productivity of mungbean for the period of 30 years (1991-92 to 2020-21) for India as well as Haryana is given in Table 1. The findings revealed positive as well as significant growth rate of mungbean area, production and productivity for both India and Haryana. The CAGR of mungbean area (1.35%), production (2.53%) and productivity (1.17%) was positive and significant at 1 per cent during the overall period in India owing to timely government interventions in a mission mode through various initiatives like NFSM, A3P programme, crop diversification schemes, *etc.* In a similar way, the growth rate of area (2.40%), production (4.57%) and productivity (1.89%) of mungbean in Haryana was also positively significant and much higher than India. This might be due to active implementation of NFSM-Pulses programme, inter-cropping of mungbean with sugarcane and maize, sowing of mungbean in fallow land area of paddy-wheat system. The positive growth rate of summer mungbean area and production in Haryana was also reported by Malik *et al.* (2021).

Both CV and CDVI are the indicators used for measuring instability, however, the latter is the most widely used instability index as it can be applied to all types of time series data such as linear, exponential, non-trended, *etc*. (Cuddy and Valle, 1978). In India, the instability in mungbean area (13.43) was lower when compared to production (30.08 representing high instability) and productivity (18.54 representing moderate instability) (Table 1).

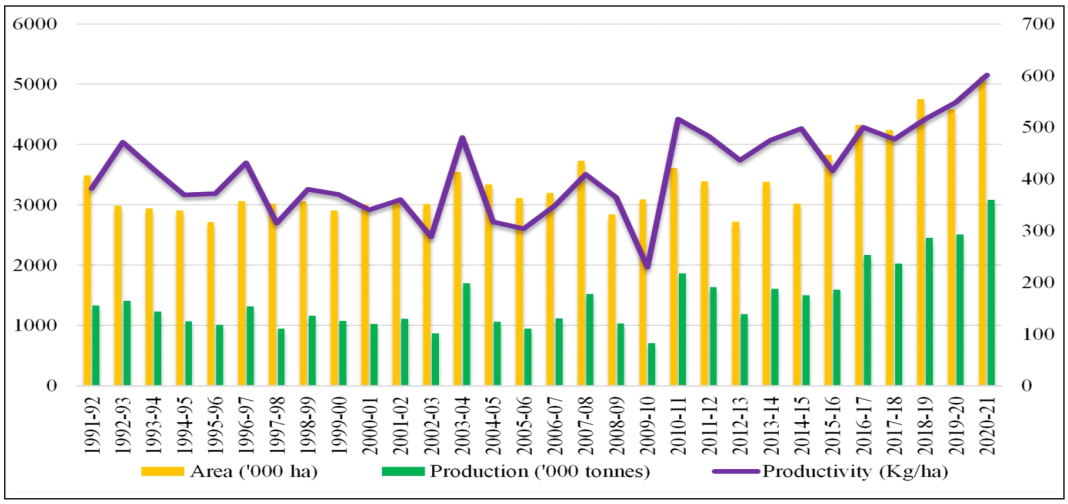

Fig 1: Trend in area, production and productivity of mungbean in India.

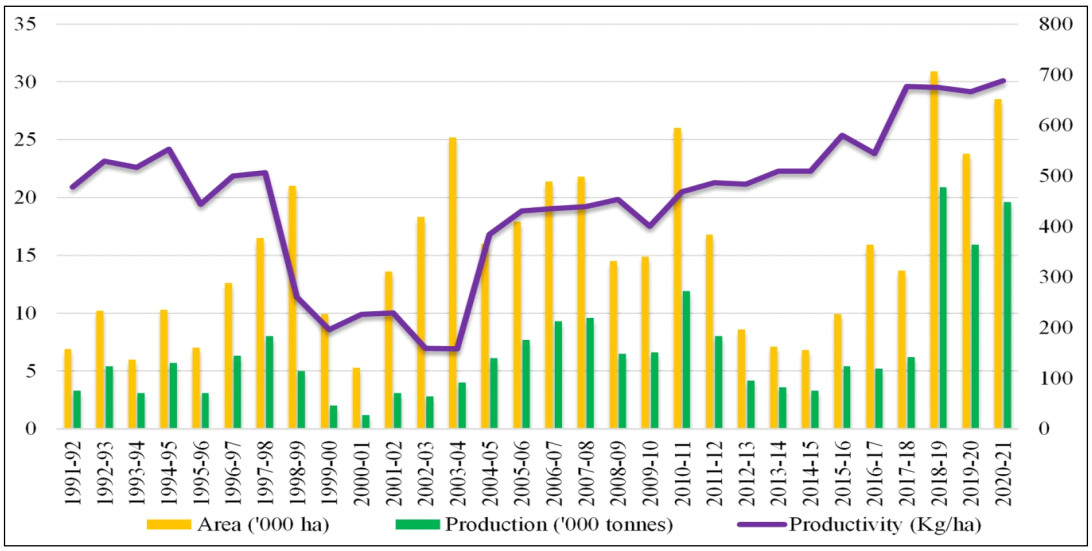

Fig 2: Trend in area, production and productivity of mungbean in Haryana.

Table 1: Growth and instability in area, production and productivity of mungbean in India vis-à-vis Haryana (1991-92 to 2020-21).

Particulars	India				Haryana			
	CAGR (%)	$\bar{R}^2$	CV (%)	CDVI	CAGR (%)	$\bar{R}^2$	CV (%)	CDVI
Area ('000 ha)	1.35***	0.47	18.45	13.43	2.40**	0.15	46.67	43.03
Production ('000 tonnes)	2.53***	0.38	38.20	30.08	4.57***	0.26	99.07	85.22
Productivity (Kg/ha)	1.17***	0.20	20.73	18.54	1.89**	0.13	32.96	30.74

***Significant at 1% level, **Significant at 5% level.

These results were in conformity with the findings of Khine *et al.* (2021). On the other hand, the analysis revealed high instability in mungbean area (43.03), production (85.22) and productivity (30.74) of Haryana for overall period. This high instability might be due to its cultivation on marginal lands which is now shifting to irrigated and fertile areas of the state, consideration of mungbean as a minor crop but now including mungbean in cropping pattern as a catch crop, development of input responsive short duration varieties, *etc*. Similar results of high instability were obtained by Sihmar (2014) while examining the growth and instability in agricultural production in Haryana.

Cost and returns from summer mungbean cultivation

In the study area *i.e*. Karnal and Kurukshetra districts of Haryana, SML-668 and MH-421 varieties of summer mungbean were sown in the month of March-April and was harvested in the months of May-June. In order to calculate the costs and returns of summer mungbean, the sampled farmers were questioned about the inputs used, yield obtainedand the market prices that prevailed during 2020-21. The distribution of cost of cultivation in the study area is depicted in Table 2. The table reflects that total cost incurred in cultivating summer mungbean was ₹ 59914 ha^{-1} in Karnal, out of which, 44.02 per cent was variable cost (₹ 26372 ha^{-1}) and 55.98 per cent was fixed cost (₹ 33542 ha^{-1}). The distribution pattern of variable cost showed that the field preparation work accounted for maximum expenditure (11.93%) followed by harvesting operation (10.25%) and inter-cultural operation (8.34%). Among the fixed cost, rental value of land alone constituted 42.27 per cent (₹ 25326 ha^{-1}) of the total cost of cultivation in Karnal district. On the other hand, the total cost incurred in cultivating summer mungbean in Kurukshetra district was found to be ₹ 59527 ha^{-1}, out of which, 44.20 per cent was variable cost (₹ 26313 ha^{-1}) and 55.80 per cent was fixed cost (₹ 33214 ha^{-1}). Among variable cost, highest expenses were incurred in preparatory operation (11.98%) tracked by harvesting operation (10.37%) and inter-cultural operation (8.40%). Among the fixed cost, rental value of land alone constituted 42.59 per cent (₹ 25354 ha^{-1}) of the total cost of cultivation in Kurukshetra district. Furthermore, the overall average total cost incurred in cultivation of summer mungbean in the study area came out to be ₹ 59721 ha^{-1} of which 44.11 per cent was variable cost and 55.89 per cent was fixed cost. The fixed cost constituted highest share in total cost because rental value of land alone accounted for maximum share (42.43%) of the total cost of cultivation due to its greater demand, high fertility and assured irrigation water availability in the study area.

The gross returns obtained from summer mungbean cultivation in Karnal and Kurukshetra districts were found to be ₹ 84291 ha^{-1} and ₹ 87198 ha^{-1}, respectively (Table 3).

Table 2: Cost of cultivation of summer mungbean in the study area. (₹ ha^{-1})

Particulars	Karnal		Kurukshetra		Overall	
	No./Qty.	Value	No./Qty.	Value	No./Qty.	Value
Preparatory operation	4.56	7149(11.93)	4.4	7129(11.98)	4.48	7139(11.95)
Sowing		1561(2.61)		1541(2.59)		1551(2.60)
Seed (kg)	19.76	1519(2.54)	21.48	1502(2.52)	20.62	1510(2.53)
Chemical fertilizers	54.63	843(1.41)	44.71	785(1.32)	49.67	814(1.36)
Irrigation	2.75	1722(2.87)	2.65	1741(2.92)	2.7	1731(2.90)
Inter-cultural operation	0.75	4994(8.34)	0.7	4999(8.40)	0.72	4997(8.37)
Plant protection chemical		1729(2.89)		1734(2.91)		1732(2.90)
Harvesting operation		6147(10.25)		6169(10.37)		6158(10.31)
Miscellaneous		115(0.19)		122(0.20)		119(0.20)
Total (1 to 9)		25779(43.03)		25722(43.21)		25751(43.12)
Interest on working capital @ 7% p.a		593(0.99)		591(0.99)		592(0.99)
Total variable cost (A)		26372(44.02)		26313(44.20)		26343(44.11)
Transportation cost		2942(4.91)		2598(4.37)		2770(4.64)
Rental value of land		25326(42.27)		25354(42.59)		25340(42.43)
Management charges @ 10%		2637(4.40)		2631(4.42)		2634(4.41)
Risk charges @ 10%		2637(4.40)		2631(4.42)		2634(4.41)
Total fixed cost (B)		33542(55.98)		33214(55.80)		33378(55.89)
Total cost (A+B)		59914(100.00)		59527(100.00)		59721(100.00)

Table 3: Cost and returns from summer mungbean in the study area. (₹ ha^{-1})

Particulars	Karnal		Kurukshetra		Overall	
	No./Qty.	Value	No./Qty.	Value	No./Qty.	Value
Total variable cost		26372		26313		26343
Total fixed cost		33542		33214		33378
Total cost		59914		59527		59721
Gross returns		84291		87198		85745
(a) Main product (Qtl.)	12.67	81609	13.09	84430	12.88	83020
(b) By product		2682		2768		2725
Return over variable cost		57919		60885		59402
Net return		24377		27671		26024
Cost of production (₹/Qtl.)		4728		4547		4638
B:C ratio		1.40		1.46		1.43

The yield obtained from main product was 12.67 quintals ha^{-1} and 13.09 quintals ha^{-1} with monetary values of ₹ 81609 ha^{-1} and ₹ 84430 ha^{-1} in both districts, respectively. As the total cost of cultivation was ₹ 59914 ha^{-1} in Karnal and ₹ 59527 ha^{-1} in Kurukshetra, the net returns realized were ₹ 24377 ha^{-1} and ₹ 27671 ha^{-1}, respectively. Further, it was also observed that the value of B-C ratio was higher (>1.0) indicated the profitability of summer mungbean cultivation in the study area. Overall, the average production of summer mungbean was found to be 12.88 quintals ha^{-1} of worth ₹ 83020. Moreover, by-product of worth ₹ 2725 ha^{-1} was also obtained from its cultivation. So, overall gross returns came out to be ₹ 85745 ha^{-1}. As the overall cost of summer mungbean cultivation was ₹ 59721 ha^{-1}, the net returns derived out to be ₹ 26024 ha^{-1} in the study area. Similar results of profitable cultivation of summer mungbean were reported by Sindhu and Dhillon, (2020); Mahendra *et al.* (2020); Singh *et al.* (2018) and Sekhon *et al.* (2007) in their studies.

Resource use efficiency of summer mungbean cultivation

The production function analysis is an effective way to decide how to use limited resources on a farm. The Cobb-Douglas production function, which is explained in the methodology, was used to figure out the resource use efficiency of cultivating summer mungbean. The production elasticity or regression coefficient (bi) of the production function, standard errors, t-value and coefficient of multiple determination (R^2) is shown in Table 4. The result shows that, in Karnal district, R^2 was 0.86 which reflected that 86 per cent of the variability in the gross returns from summer mungbean was expounded by the variables specified in the model. The remaining unexplained variation (14%)

Table 4: Production elasticity of input factors in summer mungbean production.

Variables	Karnal			Kurukshetra		
	Production elasticity (bi)	Standard error (SE)	t-value	Production elasticity (bi)	Standard error (SE)	t-value
Intercept	-0.07	5.36	-0.01	-6.77	5.41	-1.25
Seed	-0.05^{NS}	0.42	-0.13	-0.09^{NS}	0.35	-0.26
Chemical fertilizers	-0.11^{NS}	0.13	-0.88	-0.08^{NS}	0.14	-0.53
Plant protection chemicals	-0.21***	0.06	-3.22	-0.23***	0.06	-3.62
Human labour	1.35*	0.65	2.08	1.76**	0.66	2.66
Machine labour	-0.17^{NS}	0.33	-0.51	0.28^{NS}	0.20	1.38
Irrigation	0.39*	0.19	2.03	-0.27**	0.09	-2.93
Returns to scale	1.20			1.37		
R^2	0.86			0.79		

***Significant at 1% level, **Significant at 5% level, *Significant at 10% level, NS: Non-significant.

Table 5: Resource use efficiency of summer mungbean in the study area.

Inputs	Seed	Chemical fertilizers	Plant protection chemicals	Human labour	Machine labour	Irrigation
Karnal						
MVP	-3.07	-12.67	-10.22***	9.27*	-3.51	9.65*
MFC or price	1.00	1.00	1.00	1.00	1.00	1.00
Difference	-4.07$^{@}$	-13.67$^{\#}$	-11.22	8.27	-4.51	8.65
S.E. of MVP	23.91	14.25	3.17	4.44	6.83	4.70
t-value	-0.17	-0.95	-3.54	1.86	-0.66	1.84
Kurukshetra						
MVP	-5.48	-11.67	-8.34***	12.20**	5.91	-9.69***
MFC or price	1.00	1.00	1.00	1.00	1.00	1.00
Difference	-6.48	-12.67$^{\#}$	-9.34	11.20	4.91$^{@}$	-10.69
S.E. of MVP	20.90	20.42	2.17	4.58	4.27	3.23
t-value	-0.31	-0.62	-4.30	2.44	1.15	-3.31

***Significant at 1% level, **Significant at 5% level, *Significant at 10% level.

$^{\#}$Least resource use efficiency @ Highest resource use efficiency.

Minus sign in the row 'Difference' shows over utilization and positive value shows under utilization.

might be attributed to various factors such as summer mungbean variety chosen, weather conditions, time of sowing and varied fertility gradients of different farms. Further, the production function analysis revealed that the regression coefficients of plant protection chemicals was considered to be negative but significant at 1 per cent level while human labour and irrigation were found to be positive and significant at 10 per cent level of significance, indicating their importance in summer mungbean cultivation. However, seed, chemical fertilizers and machine labour had negative and non-significant impact on returns from summer mungbean. Furthermore, the return to scale was 1.20, implying that added returns were more than added variable inputs. This indicated that the production function exhibited increasing returns to scale in Karnal district.

In case of Kurukshetra district, the value of R^2 (0.79) showed that 79 per cent of the variability in the gross returns was due to the explanatory variables specified in the model. Further, the regression coefficients of plant protection chemicals and irrigation were obtained to be negative and significant at 1 per cent and 5 per cent level, respectively whereas human labour was positive and significant at 5 per cent level of significance. This positive significance reflected that increase in human labour (5%) would increase gross returns by 1.76 per cent thus indicating its contribution in summer mungbean cultivation. However, seed, chemical fertilizers and machine labour had non-significant impact on summer mungbean returns. Furthermore, the return to scale was 1.37 which indicated that the production function exhibited increasing returns. These results were in concurrence with the findings of Angadi and Patil, (2017); Bishnoi *et al.* (2020) and Verma *et al.* (2023b). As far as returns to scale was concerned, Bishnoi *et al.* (2020) reported decreasing returns whereas the present study reported increasing returns. This might be due to number of explanatory variables selected for the study, different management practices adopted, dissimilar mungbean variety chosen, *etc*.

The keen observation of Table 5 reveals that, in Karnal district, the difference between MVP and MFC was found to be positive for inputs namely human labour and irrigation thus indicating under-utilization of such inputs, which reflects that there is an ample scope for increasing the returns from summer mungbean cultivation by enhancing the usage of these inputs. However, the difference was found to be negative for seed, chemical fertilizers, plant protection chemicals and machine labour thus indicated that these resources were over utilized. Further, seed exhibited the highest resource use efficiency while chemical fertilizers were found to be least efficient resource in Karnal. On the other hand, in Kurukshetra district, both human labour and machine labour were underutilized indicating enough scope to attain optimum level of output by utilising such inputs more frequently. Whereas, resources like seed, chemical fertilizers, plant protection chemicals and irrigation were utilized excessively, therefore, it would be better to reduce their usage in order to curtail cultivation cost by optimal use of these resources. Further, machine labour exhibited the highest resource use efficiency while chemical fertilizers was found to be least efficient input because excessive use of fertilizers especially nitrogenous fertilizer caused yield reduction and thereby reducing gross returns. Similar sort of results have also been described by Bishnoi *et al*. (2020) in their study on resource use efficiency of summer mungbean cultivation in paddy-wheat cropping system.

CONCLUSION

The positively significant growth rate of mungbean area, production and productivity in Haryana reflects optimism for cultivation of summer mungbean in paddy-wheat system of the state. In addition to this, the cost of cultivation yields B-C ratio of 1.43 which indicated the profitability of summer mungbean enterprise in the study area. The production function analysis showed that there is room for resource reorganisation so as to optimise their usage and increase returns. Based on the findings, it is suggested that summer mungbean cultivation should be promoted in assured irrigation tract of the state where the crop fits well in prevailing cropping systems. The farmers would be motivated to grow mungbean in summer season for fetching additional income from their farms. Furthermore, inclusion of summer mungbean in the cropping system will help in improving soil health status and ensures sustainability of the production system in the long run. Additionally, there is a lot of potential to increase the productivity of summer mungbean through use of quality seed of short duration cultivars, implementation of improved and novel technology, optimal resource allocation and adoption of better management techniques.

Conflict of interest

The authors declare that no conflict of interest exists.

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