International Journal of Agricultural Sciences ☞DOI:10.15740/HAS/IJAS/17.2/239-244
Volume 17 | Issue 2 | June, 2021 | 239-244 ■ ISSN : 0973-130X Visit us : *www.researchjournal.co.in*

RESEARCH PAPER

Resource use and economic potential of pigeonpea cultivation in Haryana

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Abstract : Pigeonpea is one of the protein-rich legumes of the semi-arid tropics grown throughout the tropical and subtropical regions of the world.India is the largest producer of pigeonpea sharing for 66 percent of total production and the other major pigeonpea producing countries are Myanmar, Malawi, Kenya and Tanzania. The crop is cultivated on marginal land by resource-poor farmers, who commonly grow traditional medium and long-duration landraces. Conventionally, the use of inputs such as chemical fertilizers, irrigation and pesticides is minimal as cultivated in rainfed areas. Greater attention is being given to raise productivity to meet growing demand in India. The data pertains to various aspects of pigeonpea cultivation was collected from 60 cultivators of Haryana during 2019-20. Simple budgeting technique was employed to draw practical implications and Cobb-Douglas production function was used for measure the extent of resourceuse in pigeonpea cultivation for taking policy decisions to encourage its cultivation in Haryana. The positive growth rate of area, production and yield of pigeonpea was estimated in India during last two decades (1998-2018). But negative growth of area and production of pigeonpea was observed in Haryana in same period owing large replacement of area towards cotton, sugarcane and pushing cultivation on marginal land.The gross and net returns of pigeonpea cultivation in Haryana worked out were Rs. 54487 ha^{-1} and Rs. 7073 ha^{-1}. The MVP of human labour, machine hour, seed, chemical fertilizers, plant protection chemicals and irrigation was greater than unity revealing the lower utilization of these resources.

Key Words : Compound growth rate, Production, Gross return, MVP

View Point Article : Pawar, Neeraj, Bishnoi, Nirmal and Malik, D.P. (2021). Resource use and economic potential of pigeonpea cultivation in Haryana. *Internat. J. agric. Sci.*, **17** (2) : 239-244, **DOI:10.15740/HAS/IJAS/17.2/239-244.** Copyright@2021: Hind Agri-Horticultural Society.

Article History : Received : 22.02.2021**; Accepted :** 14.03.2021

INTRODUCTION

Pigeonpea (*Cajanuscajan* (L.) Millsp.) is one of the protein-rich legumes of the semi-arid tropics grown throughout the tropical and subtropical regions of the world. In India, its major area is lying between 14° and 28°N latitude, where the majority of the world's pigeonpea is produced (Pramod *et al.,* 2010). Pigeonpea is grownon about 5.62 million ha with a production and productivity of 4.43 million tonnes and 788.1 kg/ha in the world, respectively. India is the largest producer of pigeonpea partaking for 66 percent of total global production. The other major pigeonpea producing countries in the world are Myanmar (17.09%), Malawi (6.15%), Kenya (4.36%), and Tanzania (5.29%). Pigeonpea ranked second after chickpea among all the pulses in the India

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and largely cultivated during kharif season. In India, it occupies an area of 4.55 million ha with aproduction and productivity of 3.32 million tonnes and 728.7 kg/ha, respectively (FAOSTAT, 2019). Pigeonpea is the most preferable crop of rainfed areas because of its well developed tap root system as well as lateral root system, its ability to extract moisture from deeper soil layers. The cultivation of short duration pigeonpea varieties is a preferable option even in moisture stress conditions which might be the credible reason for increase in area cultivated under pigeonpea. Pigeonpea is an important crop of central, western and southern regions of India however; Karnataka is contributing around 32.55 percent and 28.58 percent to total area and production in 2018-19, respectively (GoI). In northern states like Punjab and Haryana, cultivation of short duration pigeonpea varieties is getting momentum in recent years as it can be adopted as substitute of water guzzling crop like paddy and also pesticides intensive crop (cotton). Keeping in view, an attempt was made to work out costs and returns as well as efficacy of various resources and constraints in cultivation of pigeonpea.

MATERIAL AND METHODS

The present study is based on information collated from 60 pigeonpea cultivators of two districts namely, Rohtak and Jhajjar of Haryana state during 2019-2020. The information was extracted from identified cultivators using well-structured interview schedule through survey method. Growth rates for data collected for area, production and yield of pigeonpea in India and Haryana for period 2000-2018 were computed. Cobb-Douglas function was employed with five exogenous variables i.e. human labour (X_1), machine labour (X_2), seed (X_3), chemical fertilizers (X_4), plant protection chemicals (X_5) and irrigation (X_6) in monetary term. The model adopted was as follows :

$$\ln Y = \ln a + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + b_4 \ln X_4 + \ln \mu$$

Y = Returns (per hectare in Rs.)
a = Intercept
X_1 = Human labour
X_2 = Machine labour
X_3 = Seed
X_4 = chemical fertilizers
X_5 = Plant protection chemicals
X_6 = Irrigation
b_1 to b_6 = Respective elasticity co-efficients

Returns to scale (RTS) was calculated by summing production elasticities of all the inputs (Σbi). If, Σbi: = 1, Σbi : > 1 and Σbi : < 1 it indicates constant, increasing and decreasing returns to scale.

Marginal value productivity (MVP) indicates the expected increase in gross returns forthcoming from the use of an additional unit of pertinent input, while the level of other inputs remaining unchanged.

A resource or input factor is considered to be used most efficiently if its marginal value product (MVP) is just sufficient to offset its input marginal cost (IMC). Equality of MVP to factor cost is the basic condition that must be satisfied for efficient use of farm resource. If the ratio of MVP to IMC is less than one, it indicates that excess use of the particular resource is being used under the existing price conditions and vice versa. Resource-use efficiency is worked out by computing the difference of MVP to opportunity cost.

RESULTS AND DISCUSSION

The area, production and yield of pigeonpea in India increased over years owing price escalation in market as result of increased demand. The increase in area from 3.44 to 4.55 million ha, production from 2.23 to 3.91 million tonnes and yield from 649.33 to 842.00 kg/ha during 2000-2018. The yield of pigeonpea augmented over 20 years due to evolution of promising varieties suitable for diverse agro-climatic conditions and adoption of improved production technologies. The overall trend in area, production and yield was fluctuating over years as pigeonpea cultivation is mainly depends upon precipitation.The growth rates of area, production and yield of pigeonpea unveiled positive signs and were estimated to be 5.32, 10.25 and 4.49 per cent during 2000-03 to 2015-18, respectively. The linear growth rate also indicated increase in area, production and yield over the years.

Pigeonpea is cultivated in only kharif season in Haryana. The sharp decline in area of pigeonpea was noticed as it reduced from 22.67 to 7.77 thousand ha from 2000-03 to 2015-18 triennium ending periods. The main reasons for decline in area was non- suitability of long duration varieties, low productivity and inadequate procurement arrangement of produce by government agencies at MSP. The triennium growth rates of area and production of pigeonpea were negative and the decline in area and production. The CGR of pigeonpea yield indicated positive sign as yield increased in initial years due to cultivation on fertile land and adoption of

quality seeds and better production technologies. The production of pigeon pea decreased over the year sowing to sharp decline in area due to less profitability even with improved productivity (Table 1).

Cost and Returns Structure of Pigeon pea cultivation:

Pigeon pea is long standing kharif crop planted in month of July and harvested upto first week of December in Haryana.Harvesting and threshing were the major components of total variable expenses incurred in cultivation of pigeonpea sharing about one fourth (25%) of total cost in Jhajjar and Rohtak districts of Haryana (Table 2). This might be as harvesting was mainly done by manual labour and threshing was done by hiring machine. The other components of total expenses incurred in cultivation of pigeonpea in Haryana were field preparation & sowing (12.09%) and plant protection (3.23%).

The share of seed cost to total cost was only 2.51 percent while cost of chemical fertilizers and irrigation were Rs. 852 ha^{-1} and Rs. 898 ha^{-1}. The rental value of land shared about two-fifth (40.34%) of the total cost as land rent increased owing to higher value of land and

Table 1: Production scenario of pigeon pea in India and Haryana

Sr. No.	Triennium ending Year	India			Haryana		
		Area	Production	Productivity	Area	Production	Productivity
1.	2000-03	3439.67	2231.00	649.33	22.67	18.00	803.00
2.	2003-06	3538.67	2480.33	700.67	29.00	31.67	1100.33
3.	2006-09	3555.33	2552.00	715.67	30.67	34.00	1109.67
4.	2009-12	3946.67	2660.00	676.00	21.67	23.33	1078.67
5.	2012-15	3883.67	3001.33	772.67	10.20	11.37	1120.00
6.	2015-18	4579.67	3908.00	842.00	7.77	7.50	1004.00
	CAGR (%)	5.32	10.25	4.49	-22.31	-20.04	3.32
	LGR (%)	0.05	0.10	0.04	-0.20	-0.17	0.03

Area ('000' ha), Production ('000' tonnes) and Yield (kg/ha)

Table 2: Cost and returns of pigeonpea cultivation in Haryana **(Rs.ha^{-1})**

Sr. No.	Items	Jhajjar	Rohtak	Overall
Variable expenses				
1.	Field preparation and sowing	5650 (11.96)	5810 (12.21)	5730 (12.09)
2.	Seed cost	1178 (2.49)	1205 (2.53)	1191.5 (2.51)
3.	Fertilizer investment	835 (1.77)	868 (1.82)	852 (1.80)
4.	Irrigation	965 (2.04)	830 (1.74)	898 (1.89)
5.	Plant protection	1590 (3.36)	1475 (3.10)	1533 (3.23)
6.	Harvesting and threshing	11840 (25.06)	11560 (24.30)	11700 (24.68)
7.	Interest + miscellaneous	1257 (2.66)	1239 (2.60)	1248 (2.63)
8.	Sub-Total	23315 (49.34)	22987 (48.32)	23151 (48.83)
Fixed cost				
9.	Management and Risk charges	4663 (9.87)	4597.4 (9.66)	4630 (9.77)
10.	Rental value of land	18750 (39.68)	19500 (40.99)	19125 (40.34)
11.	Transportation	525 (1.11)	490 (1.03)	508 (1.07)
12.	Sub-Total	23938 (50.66)	24587 (1.03)	24263 (51.17)
Total cost (A+B)		47253 (100.00)	47574 (100.00)	47414 (100.00)
Gross returns				
13.	A) Main product*	46763 (10.75)	45835 (10.3)	46299 (10.53)
	B) By-product	8250	8125	8188
14.	Gross returns	55013	53960	54487
15.	R.O.V.C.	31698	30973	31336
16.	Net returns	7760	6386	7073
17.	B: C (ROVC)	2.36	2.35	2.35
18.	B: C (TC)	1.16	1.13	1.15

Note: Figure in parenthesis indicates the percentage to total cost, * Figures in bracket denote yield in terms of quintals

income accrued from competing crops like paddy, cotton and sugarcane in the study area. The average yield of pigeonpea was 10.53 quintals ha^{-1} with gross returns of Rs 54487 ha^{-1} and net returns of Rs. 7073 ha^{-1}. The value of B: C ratio was found more than one indicates profitability of pigeonpea cultivation in the study area. Similar results were also observed by Pal *et al.,* 2016 in their study led on pigeonpea in Gulbarga district of Karnataka.

Resource Use Efficiency in Pigeonpea cultivation:

The resources like seed, human labour, machine hour, chemical fertilizers, plant protectionchemicals and irrigation were identified as major contributing exogenous variables in cultivation of pigeonpea. The Cobb Douglas production function fitted for resource use in pigeonpea cultivation reveals that the regression co-efficient of human labour, machine hour, seed, chemical fertilizers, plant protection chemicals and irrigation water resources were established positive in study area (Table 3). In Jhajjar and Rohtak districts as well as overall basis, the coefficients of all these variables were found to be statistically significant (5% level). The estimated co-efficient of multiple determinations (R^2) exposed that selected inputs (human labour, machine hour, chemical fertilizers, seed cost plant protection chemicals and irrigation) were capable of explaining 63.00, 29.00 and 42.00 per cent variation in pigeonpea cultivation in study area. The MVP of resources used like human labour, machine hour, seed, chemical fertilizers, plant protection chemicals and irrigation for both districts was greater than unity. It indicates that all these inputs were underutilized. Hence, there is needed to be upsurge the use of inputs to attain optimum level of crop productivity. The increased use of underutilized resources in the cultivation of pigeonpea may cause higher yieldwhich

Table 3: Estimation of allocative efficiency of pigeonpea farming in Haryana

Items	Coefficients	Geometric mean	MVP	MFC	MVP/MFC	R
Jhajjar district						
Human labour	0.56**	7194.50	1.45	1.00	1.45	Under utilized
Machine hour	0.07	2413.54	1.52	1.00	1.52	Under utilized
Seed	0.25**	388.96	12.23	1.00	12.23	Under utilized
Chemical Fertilizers	0.06**	372.80	2.91	1.00	2.91	Under utilized
Plant protection chemicals	0.11	277.87	7.48	1.00	7.48	Under utilized
Irrigation	0.08	329.96	4.77	1.00	4.77	Under utilized
R-square value:	0.63					
RTS = Σbi		1.79 Increasing return to scale, (under-utilization of resources)				
Rohtak district						
Human labour	0.21**	7291.73	1.53	1.00	1.53	Under utilized
Machine hour	0.20**	2522.26	1.42	1.00	1.42	Under utilized
Seed	0.15	382.18	7.32	1.00	7.32	Under utilized
Chemical Fertilizers	0.07	369.61	3.29	1.00	3.29	Under utilized
Plant protection chemicals	0.12**	284.30	7.54	1.00	7.54	Under utilized
Irrigation	0.04**	375.55	2.08	1.00	2.08	Under utilized
R-square value:	0.29					
RTS = Σbi		1.54 Increasing return to scale, (under-utilization of resources)				
Overall						
Human labour	0.34**	7242.95	1.87	1.00	1.87	Under utilized
Machine hour	0.08**	2467.30	1.58	1.00	1.58	Under utilized
Seed	0.08**	385.56	3.83	1.00	3.83	Under utilized
Chemical Fertilizers	0.033	371.20	1.64	1.00	1.64	Under utilized
Plant protection chemicals	0.006	281.07	2.39	1.00	2.39	Under utilized
Irrigation	0.013	352.02	1.68	1.00	1.68	Under utilized
R-square value:	0.42					
RTS = Σbi		1.45 Increasing return to scale, (under-utilization of resources)				

Table 4: Constraints faced by pigeonpea growers

Sr. No.	Items	Jhajjar (N=30)	Rohtak (N=30)	Overall (N=60)	Overall rank
1.	Price realizationless than MSP	28 (93.33)	29 (96.67)	57 (95.00)	1st
2.	Delayed planting of succeeding crop (wheat)	28 (93.33)	28 (93.33)	56 (93.33)	2nd
3.	Difficulty in spraying pesticides in later stage of crop	27 (90.00)	28 (93.33)	55 (91.67)	3rd
4.	Non-adoption of package of practice/agronomic practices	28 (93.33)	27 (90.00)	55 (91.67)	3rd
5.	Watch and ward to protect the crop from blue bulls	27 (90.00)	26 (86.67)	53 (88.33)	4th
6.	Non-synchronous maturity of crop	25 (83.33)	26 (86.67)	51 (85.00)	5th
7.	Poor quality of ground water and low soil fertility status	22 (73.33)	24 (80.00)	46 (76.67)	6th

ultimately stemmed into higher profitability and better returns to cultivators. The similar finding also highlighted by Asmatoddin *et al,* 2011 in their study on pigeonpea conducted in Maharashtra.

Constraints Faced in Pigeonpea cultivation:

About, 93, 96 and 95 per cent of pigeonpea cultivators reported harvesting price of pigeonpea realized was not as par with MSP and it was more profound constraint in the study area. The other important constraints faced by majority (93.33%) of pigeonpea cultivators was long duration of varieties cultivated causing delay in planting of succeeding crop (wheat). More than 90 percent of respondents expressed the opinion of difficultyin spraying insecticides at later stage of crop andnon-adoption of agronomic practices in pigeonpea cultivation. The problems like watch and ward required to protect the crop from blue bulls, non-synchronous maturity, poor quality of underground water, low soil fertility as reported by more than third fourth (75%) of cultivators in the study area (Table 4). Similar observations in cultivation of pigeonpea were also witnessed by Singh *et al.,* 2007 in their study conducted in Uttar Pradesh.

Conclusion:

The compound growth rate of area (5.32%), production (10.25%) and productivity (4.49%) of pigeonpea crop was found encouraging during 2000-2018 in India owing to evolution of improved varieties and adoption of better production technologies. However, in Haryana compound growth of area (-22.31%) and production (-20.04%) of pigeonpea exhibited negative sign even with positive sign in productivity (3.32%). This might be as pigeonpea cultivation shifted to low fertility land and large area was captured by cotton and sugarcane. The gross and net returns estimated were Rs. 54487 ha^{-1} and Rs. 7073 ha^{-1} in study area. The value of B:C ratio over total cost was found more than one indicates profitability of pigeonpea cultivation in Haryana. The value of MVP for human labour, machine hour, seed cost, chemical fertilizers, plant protection chemicals and irrigation recognized greater than unity indicating underutilization of these resources. Hence, increased use of these inputs is required to harness optimum level of crop productivity. The constraints confronted by pigeonpea cultivators were low realization of post-harvest price, use of long duration varieties seed, delayed planting of succeeding crop, difficulty in spraying of insecticides at later stage of crop, menace of blue bulls etc.

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