Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
www.phytojournal.com
JPP 2020; 9(2): 1449-1452
Received: 01-01-2020
Accepted: 03-02-2020

Neeraj Pawar
Asstt. Scientist, Deptt. ofAgril. Economics, CCS Haryana Agricultural University Hisar, Haryana, India

Vinay Mehla
District Extension Specialist, Deptt. ofAgril. Economics, CCS Haryana Agricultural University Hisar, Haryana, India

Monika Devi
Asstt. Scientist, Deptt. ofAgril. Economics, CCS Haryana Agricultural University Hisar, Haryana, India

DP Malik
Professor & Head, Deptt. Of Agril. Economics, CCS Haryana Agricultural University Hisar, Haryana, India

Sumit
Asstt. Professor, Deptt. ofAgril. Economics, CCS Haryana Agricultural University Hisar, Haryana, India

Corresponding Author:
Neeraj Pawar
Asstt. Scientist, Deptt. ofAgril. Economics, CCS Haryana Agricultural University Hisar, Haryana, India

Economic dimensions and resource use efficiency of mustard crop under sprinkler irrigation in Southern Haryana

Neeraj Pawar, Vinay Mehla, Monika Devi, DP Malik and Sumit

Abstract
The study was conducted in Southern Haryana. The study used farm level data collected from 60 randomly selected farmers using sprinkler irrigation in mustard crop from two selected districts namely Mahendergarh and Bhiwani. From each selected district two blocks from each district were selected i.e. Mahendergarh and Kanina blocks from district Mahendergarh, and Kairu and Bahal blocks were selected from district Bhiwani. From each block, one villagewas selected randomly. Further, 15 farmers were selected randomly.The overall variable and total cost incurred for cultivation of mustard accounted for Rs. 31583and Rs. 60625, respectively. The B:C ratio over total cost in Mahendregarh, bhiwani and overall were 1.47, 1.35 and 1.41, respectively. The results of Cobb-Douglas production function indicated thatMVP ofinputs whose regression coefficients were found statistically significant in mustard production function was compared with their respective unit price. Irregular supply of electricity is the most important constraint in sprinkler irrigation, reportedby the farmers with total weighted score of 264.Heavy initial investment, less efficiency of the sprinkler due to high wind velocity and declining water table were the II, III and IV ranks of the constraints, respectively.

Keywords: Economic dimensions, resource, efficiency, mustard crop, under sprinkler irrigation

Introduction
India is third largest rapeseed-mustard producer in the world after china and Canada with 12 percent of world's production (2006-07) and the oilseed sector occupies an important position in the country's economy. Rapeseed-mustard is the major source of income especially even to the marginal and small farmers in rainfed areas. The domestic demand for vegetable oils and fats has been rising rapidly, at the rate of 6 percent per annum, but our domestic output has been increasing at just about 2 percent per annum. In India, the average yield of rapeseed-mustard is compared to world average.India occupies 2 per cent of the world land area, represent 16 per cent of the world population and 15 percent of livestock, whereas it has only 4 per cent of the water resources of the world. The agricultural sector (irrigation), which currently consumes over 80 per cent of the available water in India, Continues to be the major water consuming sector due to the intensification of agriculture. Though India has the largest irrigated area in the world, the coverage of irrigation is only about 40 per cent of the gross cropped area as of today. One of the main reason for the low coverage of irrigation is the pre-dominant use of flood (conventional) method of irrigation, where water use efficiency is very low due to various reasons. Available estimates indicates that water use efficiency under flood method of irrigation is only about 35 to 40 percent because of huge conveyance and distribution losses (Rosegrant, 1997, INCID, 1994) Irrigation development (MI) benefiting the farmers and to increase the employment opportunities and wage rate of the agricultural land less laborers, both of which are essential to reduce the poverty among the land less labor households, (Saleth, 2004, Narayanamoorthy, 2001). However, water is becoming increasingly scarce worldwide due to various reasons (Rosegrant, *et al*., 2002) with the fast decline of irrigation water potential and continued expansion of population and other economic activities in the countries. The problem of water scarcity is expected to be aggravated further (Rosegrant, *et a1*., 2002). Therefore, it is to be used judiciously and efficiently to sustain the agriculture production. One of the demand management strategies to control water consumption in Indian agriculture is micro irrigation, which includes mainly drip and sprinkler irrigation method. Under micro-irrigation, unlike flood method of irrigation (FMI), water is supplied at a required interval and quantity using pipe network, emitters and nozzles. Therefore, the conveyance and distribution losses are reduced completely which result in higher water use efficiency under M.I. The water efficacy can be attained up to 82 per cent by the system and 31-46 per cent additional cropped area may be brought under irrigation by

utilizing same quantity of available irrigation water. It is a scientific tool for judicious use of irrigation water promoting water conservation technology. By adopting this system, cultivation of water intensive remunerative crops can be extended to a larger area for higher yield. Farmers also maintain moisture and temperature to protect crops from severe cold/frost in winter season by applying light irrigation to crops. Moreover, this technology helps in removal of insect eggs and dust materials from plants, which helps in keeping insect population below threshold level and increases photosynthesis activity.

Materials and Methods

The present study was confined to two districts (Mahendergarh and Bhiwani) from southernzone of Haryana. Two blocks from each district were selected i.e. Mahendergarh and Kanina blocks from district Mahendergarh, and Kairu and Bahal blocks were selected from district Bhiwani.From each block, one villagewas selected randomly. Further, 15 cultivators were selected randomly from each selected village from the list of mustard growers incentivized by Krishi Vigyan Kendras (KVKs) of CCS Haryana Agricultural University. The relevant information pertaining to various resources like seed, farm machinery, human labour, farm operationsetc was extracted from mustard cultivators under sprinkler irrigation through personal interaction. Simple budgeting techniques and descriptive analysis were employed to draw valid inferences from the information collated.The Cobb-Douglas function / log linear production was fitted with six independent variables namely Human labour (X_1), machine labour (X_2), seed cost (X_3) fertilizer cost (X_4), plant protection chemicals (X_5) and irrigation (X_6) The model adopted was as follows.

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

Y = Returns per hectare in rupees

a = Intercept

X_1 = Human labour charges in rupees

X_2 = Machine labour charges in rupees

X_3 = Seed cost in rupees

X_4 = Fertilizers charges in rupees

X_5= Plant protection chemicals in rupees

X_6= Irrigation charge in rupees

b_1 to b_6 = Respective elasticity co-efficients

For testing the regression co-efficients or production elasticities't' value was calculated using the formula.

$$t = \frac{bi}{S.E \text{ of } bi}$$

Where

bi = Regression co-efficient or production elasticity of input xi

S.E of bi = Standard error of bi

Returns to scale was calculated by summing production elasticities of all the inputs (∑bi).

If, ∑ bi: = 1, ∑bi : > 1 and ∑bi : < 1 it indicates constant, increasing and decreasing returns to scale

Marginal value productivity indicates the expected increase in gross returns forthcoming from the use of an additional unit of relevant 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 is just sufficient to affect its cost. Equality of marginal value product to factor cost is the basic condition that must be satisfied to obtain efficient resource use. In Cobb Douglas production function, marginal value product (MVP) of Xi, the i^{th} input factor is given by the following formula.

MVP of Yi = $Y / Xi * bi$

Where,

$\bar{Y}$ = Geometric mean of output Y

$\bar{X}$ = Geometric mean of output X

Bi = Regression co-efficient of Xj

After computation of marginal value product of a variable, it is to be compared with its acquisition cost or opportunity cost. If the variable in the production function is taken in rupee terms, then the acquisition cost of unit of that input will be one rupee. When the input is expressed in physical units, then the marginal value product must be compared with the actual acquisition cost of one physical unit of that input.

Resource-use efficiency is worked out by computing the difference of marginal value product to opportunity cost. If the difference is less than one, it indicates that too much of the particular resource is being used under the existing price conditions and vice versa.

Results and Discussion

The cost of cultivation of mustard under sprinkler irrigation is presented in table 1. The overall variable and total cost incurred for cultivation of mustard accounted for Rs. 31583and Rs. 60625, respectively. Overall operational cost of mustard cultivation under sprinkler irrigation reveals that harvesting and field preparation accounted for 13.09 and 11.48 per cent of the total cost, respectively. Both operations accounted for about one-fourth of total cost incurred in raising mustard crop under sprinkler irrigation. The other variable items of total cost of mustard cultivation were irrigation (7.68%), hoeing/weeding (7.27%) and fertilizer investment (7.23%) while in case of fixed expenses, rental value of land accounted 35.75 percent followed by management and risk charges (10.42%) and transportation charges (1.73%), respectively. The share of rental value of land in total cost may be due to cultivation of crop on fertile land. Similar findings were also observed by Sahu *et al*., 2018 [17].

Table 1: Cost of cultivation of mustard under sprinkler irrigation in Haryana (₹/ha)

S. No.	Particulars	Mahendergarh	Bhiwani	Overall
1.	Field preparation	6780 (11.09)	7135 (11.87)	6957.50 (11. 48)
2.	Seed cost	870 (1.42)	845 (1.41)	857.50 (1.41)
3.	Fertilize Investment	4463 (7.30)	4305 (7.16)	4384.00 (7.23)
4.	Irrigation	4825 (7.89)	4490 (7.47)	4657.50 (7.68)
5.	Hoeing/weeding	4686 (7.67)	4130 (6.87)	4408.00 (7.27)
6.	Plant protection	605 (0.99)	485 (0.81)	545.00 (0.90)
7.	Harvesting & Threshing	8190 (13.40)	7680 (12.77)	7935.00 (13.09)
8.	Misc.	1869 (3.06)	1808 (3.01)	1838.50 (3.03)
9.	Variable cost	32288 (52.83)	30878 (51.35)	31583.00 (52.10)
10.	Mgt and risk charges	6458 (10.57)	6176 (10.27)	6317.00 (10.42)
11.	Rental value of land	21250 (34.77)	22100 (36.75)	21675 (35.75)
12.	Transportation	1120 (1.83)	980 (1.63)	1050.00 (1.73)
13.	Total Cost	61116 (100.00)	60134 (100.00)	60625.00 (100.00)

Figure in parentheses indicate the percentage of total cost

As regards to the returns structure from mustard cultivation under sprinkler irrigation was concerned in the study area it is

observed from the table 2 that the gross and net return for Mahendergarh, Bhiwani and overall was Rs. 89693, 81107 and 85400 and Rs. 28577, 20973 and Rs. 24775 respectively. The B:C ratio over total cost in Mahendregarh, bhiwani and overall were 1.47, 1.35 and 1.41, respectively. Similar findings were also observed by Verma, *et al*., 2015 [19].

Table 2: Returns from cultivation of mustard under sprinkler irrigation in Haryana (₹/ha)

S. No.	Particulars	Mahendergarh	Bhiwani	Overall
1.	Production (main)	85893	78057	81975.00
2.	By-product	3800	3050	3425.00
3.	Gross Return	89693	81107	85400.00
4.	Cost of Production (Rs./qtl.)	2913	3182	3047.50
5.	Return over variable cost	57405	50229	53817.00
6.	Net Return	28577	20973	24775.00
7.	B:C over variable cost	2.78	2.63	2.71
8.	B:C over total cost	1.47	1.35	1.41

Marginal value of productivities (MVPs)

Resource use efficiency: In order to examine the resource use efficiency in mustard production, the marginal value productivity (MVP) of inputs whose regression coefficients were found statistically significant in mustard production function were compared with their respective unit price. To test the significance of deviation of MVP of an input from its unit price, t-statistics was used. A significant higher MVP of an input from its unit price implies that more of that input can be used to increase the mustard productivity, while a significant lower MVP of an input from its unit price implies that the input is used in excess and needs curtailment.

The present study revealed that the difference between MVP of fertilizer cost and plant protection and its unit was found positive and significant in Mahendergarh, Bhiwani as well as in overall result of both the districts. While, human labour found to be negatively significant in Mahendergarh, Bhiwani as well as in overall result of both the districts (Table 3). Result agrees with the findings of Dhakal *et al*, 2015 [8].

Table 3: Resource use efficiency of mustard crop in Haryana

Resources	GM	B	MVP	MFC	Difference
Mahendergarh (N=30)					
Human labour	12432.99	-0.29	-1.68	1.00	-2.68*
Machine labour	6204.08	0.19	2.23	1.00	1.23
Seed cost	1749.65	0.04	1.65	1.00	0.65
Fertilizer cost	2879.73	0.15	3.76	1.00	2.76*
Plant protection	159.63	0.02	9.04	1.00	8.04*
Irrigation	2279.67	0.07	2.22	1.00	1.22
Bhiwani(N=30)					
Human labour	12779	-0.15	-0.95	1.00	-1.95**
Machine labour	6334	0.17	2.18	1.00	1.18
Seed cost	1773	0.03	1.37	1.00	0.37
Fertilizer cost	3478	0.14	3.25	1.00	2.25*
Plant protection	288	0.03	8.41	1.00	7.41*
Irrigation	2085	0.06	2.33	1.00	1.33***
Overall of both the districts (N=60)					
Human labour	12604.63	-0.31	-1.88	1.00	-2.88*
Machine labour	6268.49	0.18	2.21	1.00	1.21
Seed cost	1761.33	0.04	1.73	1.00	0.73
Fertilizer cost	3164.73	0.14	3.38	1.00	2.38**
Plant protection	214.59	0.03	10.68	1.00	9.68*
Irrigation	2180.10	0.06	2.10	1.00	1.10

*Significance at 1% level, **Significance at 5% level, ***Significance at 10% level

Constraints faced by respondents

Ranking of constraints based on total score as per their relative importance in adoption of sprinkler irrigation as per farmers perception is given in Table 4.Irregular supply of electricity in the area ranked the most important constraint in sprinkler irrigation system by the farmers with total weighted score of 264. Heavy initial investment, less efficiency of the sprinkler due to high wind velocity and declining water table were the II, III and IV ranks of the constraints, respectively. Due to high temperature more water loss in irrigation system, Presence of salty water, Unavailability of spare parts at proper time in the village market and fewer subsidies as compared to investment were the constraints with total weighted score 231, 224, 224 and 203, respectively. Bahire *et al*. (2015) [5] the major problems expressed by the farmers of Maharashtra were higher initial cost of investment, high cost of drip repairing and higher cost of liquid fertilizers as compared to other fertilizer.

Table 4: Constraints faced by the respondents

(N =60)

S. N.	Particulars	Total Weighted Score	Weighted Mean Score	Rank Order
1	Irregular supply of electricity in the area	**264**	**4.40**	**I**
2	Heavy initial investment.	245	4.08	II
3	Less efficiency of the sprinkler due to high wind velocity.	243	4.05	III
4	Declining water table	242	4.03	IV
5	Due to high temperature more water loss in irrigation system.	231	3.85	V
6	Presence of salty water.	224	3.73	VI
7	Unavailability of spare parts at proper time in the village market.	224	3.73	VI
8	Fewer subsidies as compared to investment.	203	3.38	VII

Conclusion and Policy Implications

The sprinkler irrigation was found efficient irrigation system as increased the irrigation efficiency, covers higher area as compared to flood irrigation. The per hectare Return over variable cost and net returns from mustard crop was found Rs. 53817 and Rs. 24775 respectively with B:C ratio, over variable cost and total cost is 2.71 and 1.41 respectively. The results also revealed that the difference between MVP of fertilizer cost and plant protection and its unit price was found positive and significant which indicates that these inputs were underutilized, while human labour found to be negative significant. The major constraints reported by the farmers were heavy investment, less efficiency due to high temperature and high wind velocity, salinity water and erratic supply of electricity. Farmers of other districts will be able to adopt this technology more easily if government take steps to reduce initial cost by giving more subsidy and by managing erratic supply of electricity.

References

1. Akanda MAR, Islam MS, Khan BR, Mondal MRI. Response of mustard (*Brassica napus* L.) to irrigation at different stages of growth. Thai J. Agric. Sci. 1996; 29:191-199.
2. Ali MH, Sarkar AA, Rahman MA. Analysis on groundwater-table declination and quest for sustainable water use in the north-western region (Barind area) of Bangladesh. J. Agril. Sci. Applications. 2012; 1:26-32.
3. Ali MH, Abustan I, Rahman MA, Haque AAM. Sustainability of groundwater resources in the north-eastern region of Bangladesh. Water Resource Manage 2011; 26:623-641.
4. Amarasinghe U, Bharat R, Sharma NA, Christopher SV, Smakhtin C, de Fraiture *et al*. Spatial variation in water supply and demand across river basins of India. IWMI Research Report 83, Colombo, Sri Lanka, 2004.
5. Bahire VV, Sidam VN, Kadam AR. Constraints of Drip Irrigation User in Adoption of Banana. Ecology, Environment and Conservation Paper. 2015; 20(2):523-524.
6. Behboudian MH, Singh Z. Water relations and scheduling in grapevine. Hortic. Rev. 2002; 27:189-225.
7. Buttar GS, Thind HS, Aujla MS. Methods of planting and irrigation at various levels of nitrogen affect the seed yield and water use efficiency in transplanted oilseed rape (*Brassica napus* L.). Agric. Water Manage. 2006; 85:253-260.
8. Dhakal SC, Regmi PP, Thapa RB, Sah SK, Khatri-Chhetri DB. Resource Use Efficiency of Mustard Production In Chitwan District of Nepal. International Journal of Applied Sciences and Biotechnol. 2015; 3(4):604-608.
9. Khan GM, Agarwal BK. Water use, water use efficiency and soil moisture extraction pattern of mustard in relation to water stress and sowing methods. Indian J. Agron. 1985; 30:235-243.
10. Kharrou MH, Er-Raki S, Chehbouni A, Duchemin B, Simonneaux V, LePage M *et al*. Water use efficiency and yield of winter wheat under different irrigation regimes in a semiarid region. Agric. Sci. 2011; 2:273-282.
11. Li X, Waddington SR, Dixon J, Joshi AK, de Vincente MC. The relative importance of drought and other water-related constraints for major food crops in south Asian farming systems. Food Secur. 2010; 3:19-33.
12. Liu H, Kang Y. Effect of sprinkler irrigation on microclimate in the winter wheat field in the north China Plain. Agric. Water Manage. 2006; 84: 3-19.
13. Mandal KG, Hati KM, Misra AK, Bandyopadhyay KK. Assessment of irrigation and nutrient effects on growth, yield and water use efficiency of Indian mustard (*Brassica juncea*) in central India. Agric. Water Manage. 2006; 85:279-286.
14. Martinez-Cob A, Playan E, Zapata N, Cavero J, Medina ET, Puig M. Contribution of evapotranspiration reduction during sprinkler irrigation to application efficiency. Journal of Irrigation and Drainage Engineering. 2008; 134:745-756.
15. Michael AM. Sprinkler irrigation. In: Irrigation Theory and Practice, 2nd Edition, Vikas Publishing House, India. 2014b, 578-609.
16. Parthsarthi A, Pandya, dhaval KD. Constraints in Adoption of Drip Irrigation. Advances in Life Sciences. 2016; 5(6):2405-2411.
17. Sahu PK, Kant K, Harendra Pratap, Singh Choudhri HPS, Singh GP. Cost of Cultivation of Mustard crop in Fatehpur District of Uttar Pradesh. International Journal of Current Microbiology and Applied Sciences. 2018; 7(8):3356-3361.
18. Uddin J, Smith RJ, Hancock NH, Foley JP. Evaporation and sapflow dynamics during sprinkler irrigation of cotton. Agric. Water Manage. 2013; 125:35-45.
19. Verma A, Gupta S, Singh IJ, Singh SP, Kumar A. Studythe cost of cultivation and net income of mustard in different farm size groups on the fields, 2015.
20. Yazar A, Sezen SM, Sesveren S. LEPA and trickle irrigation of cotton in the Southeast Anotolia Project area in Turkey. Agric. Water Manage. 2002; 54:189-203.