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Comparative Economics Analysis of Capsicum Cultivation under Protected and Open Field Conditions in Himachal Pradesh

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A B S T R A C T

An attempt was made to study the comparative economics of capsicum cultivation under protected and open field conditions in Himachal Pradesh. Solan district was selected purposively on the basis of predominance of capsicum cultivation both under polyhouse and open field conditions. The primary data were collected by personal interviews of the selected farmers with the help of a specially designed schedule. Simple statistical tools like averages and percentages were used for processing the data. The overall findings of the study revealed the cost of production of capsicum under open conditions was Rs. 113878.48 per hectare at overall basis, varied between Rs. 118695.63 to Rs. 128959.10 per hectare among different farm categories. The cost of production of capsicum under protected conditions was Rs. 23570.64 and Rs. 40393.32 in 250 m^2 and 500 m^2 polyhouse respectively. Comparative economics analysis revealed that the cost of cultivation of capsicum under polyhouses were higher as compared to open field conditions by Rs. 20755.63/250 m^2, Rs. 34769.90/500 m^2. The net retunes from capsicum under protected conditions, were higher as compared to open field conditions Rs. 246.94 /250 m^2, Rs. 15792.38/500 m^2. The results of the study revealed that the vegetable cultivation under polyhouses have contributed to the yield significantly.

Introduction

Capsicum (*Capsicum annuum* L. var. grossum Sendt) popularly known as Shmila Mirch belongs to the family Solanaceae. It is a popular vegetable in India. It is relatively a new entrant into our country and is native of Mexico with secondary centre of origin is Guatemala (Heiser and Smith, 1953). It is a high value vegetable crop which was brought to India by British people in 19th century. In India, it is mainly cultivated in Himachal Pradesh, U.P., J & K, parts of West Bengal, Maharashtra and Karnataka (Chadha, 2005). It grows well in summer season in hills and cooler season in the plains. Capsicum is looked upon as luxury vegetable as its consumption is greater in and around the cities. The high market price is attributed to the heavy demand from urban consumers.

In India, Capsicum is grown in an area 30 thousand hectares with annual production of 172 thousand metric tonnes having

productivity of 5.73 tonnes per hectare (NHB, 2016). Himachal Pradesh is a leading supplier of capsicum to the plains during summer and rainy season. The annual production of capsicum in Himachal Pradesh is 39.50 metric tonnes from an area of 2.24 thousand ha (NHB, 2016). The produce becomes off-season to the plains and fetches higher price to the vegetable growers (Joshi and Shukla, 1997). It is mainly grown in mid-hills (800-1500 amsl.) of Solan, Sirmour, Bilaspur, Mandi and lower areas of district Shimla. However, productivity and quality of produce is low because of fluctuating environment prevalent during its cultivation in open. In addition, round-the year and off-season production of capsicum is not possible as it cannot be grown during winter months in open condition.

Capsicum, besides being a cash crop is also an important vegetarian food because of its high nutritional value particularly vitamin A (870 IU) and C (175 mg) per 100 g of edible portion. It also contains appreciable quantity of protein, calcium, thiamine, riboflavin and niacin (Mac Gillivary, 1961). It is believed to be used for the treatment of dropsy, colic, toothache, and cholera (Peirce, 1987).

Sweet pepper consumption in India is increasing now-adays due to increasing demand by urban consumers. There is a good demand for export too. The export market needs fruits with longer shelf life, medium size, tetra lobed fruits with an attractive dark colour, mild pungency and good taste. But, the supply is inadequate due to low productivity of the crop. There is a need to studies on economic aspects of capsicum production. Keeping in view of these aspects, the present study was a modest attempt to analyze the economics of capsicum production in Solan district of Himachal Pradesh.

Materials and Methods

The study was conducted in Solan district of Himachal Pradesh. This area was selected because of its significant contribution with respect to area and production of vegetable crops in the state and simultaneously providing fruitful employment to the families involved in vegetable cultivation. Multistage random sampling was adopted to select the ultimate sample of the respondents. There are 5 blocks in Solan district, among these 5 blocks Kandaghat and Solan were randomly selected. Ten villages from selected block were randomly selected. A total of 100 farmers (10 farmers from each village) were randomly taken as sample. A pre-tested structured interview schedule was prepared. Data was collected by personal interview method.

For the analysis of data the total vegetable growers were divided into four classes according to the size of their land holdings, *viz.*, marginal (<1 ha), small (1-2 ha), medium (2-4 ha) and large farmers (>4 ha). The distribution of the sampled vegetable growers under protected and open conditions according to their holding size.

Analytical Tools

Cost of cultivation

The cost of cultivation of vegetables crops was worked out by using various cost concepts defined below:

Cost A_1

Cost A_1 includes;

Cost of hired human labour
Cost of owned machinery
Cost of hired machinery
Cost of fertilizer

Cost of manure
Cost of seed (owned / purchased)
Cost of plant protection chemicals
Land revenue
Depreciation of farm machinery, equipments and farm buildings
Interest on owned working capital

Cost A_2 = Cost A_1 + Rent paid for leased in land

Cost B_1 = Cost A_1 + Interest on owned fixed capital assets excluding land

Cost B_2 = Cost B_1 + Rental value of own land (net of land revenue) + Rent paid for leased in land

Cost C_1 = Cost B_1 + Imputed value of family labour

Cost C_2 = Cost B_2 + Imputed value of family labour

Cost C_3 = Cost C_2 +10 percent of cost C_2 on account of managerial function performed by the farmer.

Income measures

For working out profitability of vegetable cultivation in the study areas following income measures were worked out:

Family labour income (FLI)

It is the return to family labour (including management).

$$F.L.I. = Gross\ income - Cost\ B_2$$

Net income (NI)

It is the net profit after deducting all cost items *i.e., variable and fixed costs from gross income.*

NI = Gross income – Total cost (Cost C_3)

Farm business income (FBI)

It is the disposal income out of the enterprise and is defined as:

FBI = Gross income – Cost A_1 (cost A_2 in case of tenant operated land)

Farm Investment Income (FII)

FII = Farm Business Income – Family Labour wages

Break-even analysis

The point at which the two curves, i.e., total cost curve and total revenue curve intersect is called the break-even point (BEP) which indicates the level of production at no profit no loss.

$$BEP = \frac{F}{P - V}$$

Where,

F   =   Fixed costs in Rs. per farm sizes
P   =   Price per Kg
V   =   Variable costs per Kg

Margin of safety

Margin of safety is used in break-even analysis to indicate the amount of revenue/production that is above the break-even point. Margin of safety indicates the amount of revenue/production that can be dropped before losses begin to be incurred. Higher margin of safety implies low risk.

$$Margin\ of\ safety = Total\ Revenue\ at\ Output - Revenue\ at\ Break\ even\ point$$

$$Margin\ of\ safety\ (\%) = \frac{Revenue\ at\ Break\ even\ point}{Total\ Revenue\ at\ Output} \times 100$$

Results and Discussion

Cost and return structure of capsicum under protected and open conditions

Cost analysis play an important role in farm decision making, producers are concerned

about the cost of production as it reflects the level of farm activity or an enterprise. Thus cost analysis helps in planning and implementing farm investment decisions. An attempt has been made in this section to analyse the cost and returns for different vegetable crops grown under protected and open conditions. Mainly capsicum was grown by the vegetable growers under protected and open conditions.

Economics of Capsicum Production under Open Field Conditions

Cost of production

Farm category wise cost of capsicum crop was estimated and results have been presented in Table 1.

The overall cost of cultivation of capsicum was estimated to be Rs. 113878.48 per hectare. Out of which cost A1, A2, B1, B2, C1, C2, and C3 were Rs. 60221.78, Rs. 60221.78, Rs. 61123.19, Rs. 73509.23, Rs. 91139.86, Rs. 103525.89, Rs. 103525.89 and Rs. 113878.48 respectively.

The cost of cultivation of capsicum in case of marginal farms was higher (Rs. 128959.10) as compared to large farms (Rs. 101657.19). It was Rs. 111533.48 on medium farms and Rs. 118695.63 on small farms.

Among different input operation on overall level, the per hectare cost was observed highest for FYM (Rs. 27233.33) followed by plant protection (Rs. 10814.44), hired labour (Rs. 9091.67), fertilizer (Rs. 3243.50), seed (Rs. 960.85), owned machinery (Rs. 1112.73) and hired machinery (Rs. 895.83).

The cost of owed human labour is the major contributor to the cost of cultivation of capsicum. Owed human labour on overall level was Rs. 30016.67. Owed human labour in case of marginal farms was highest (Rs.

46282.89) as compared to large farms (Rs. 19258.24), medium farms (Rs. 26388.89) and small farms (Rs. 36428.57).

The cost A1 in case of large farms was highest (59.22 %) as compared to marginal farms (44.74 %), small farms (48.59 %) and medium farms (55.28 %). There is no cost A2 because farmers used their owed land for cultivation of capsicum. Similar trend was found in cost B1 and cost B2 as in cost A1.The cost C1 in case of marginal farms was found highest (81.30 %) as compared to large farms (78.72 %), medium farms (79.80 %), and small farms (80.47 %). The cost C3 in case of marginal farms was higher (Rs. 128959.10) as compared to large farms (Rs. 101657.19), medium farms (Rs. 111533.48) and small farms (Rs. 118695.63).

Returns from capsicum under open field conditions

The information regarding the returns from capsicum per hectare basis is given in the table 2. The results revealed that on an overall basis, yield of capsicum was 166.94 quintals per hectare. The yield was highest (181.91 qtls.) on marginal farms followed by small farms (169.84 qtls.), large farms (161.72 qtls.) and medium farms (156.06 qtls.) which indicated that gross return were found higher in marginal farms as compared to small, medium and large farms. It may due to better management practices and efficient use of resources by marginal farmers. The overall gross returns were Rs. 300500 per hectare.

The table revealed that farm business income which represents returns over cost A2, varied between Rs.345967.45 to Rs. 389592.86 with Rs. 374156.57 at overall basis. Family labour income which represents returns over cost B2, varied between Rs. 205903.90 to Rs. 256481.56 with Rs. 240278.22 at overall basis. Farm income (net income) varied between Rs. 169375.61 to Rs. 198475.11 with

Rs. 186621.52 at overall basis. Farm investment income varied between Rs. 192862.50 to Rs. 223456.60 with Rs. 210261.55 at overall basis.

Economics of Capsicum Production under Protected Conditions

Cost of production

Polyhouse size wise cost of capsicum crop was estimated and results have been presented in Table 3. The major constituents of total cost were fixed cost with included depreciation on polyhouse equipments and interest on fixed capital. The cost of cultivation of capsicum was estimated to be Rs. 23570.64 in 250 m^2 polyhouse. Out of which cost A1, A2, B1, B2, C1, C2, and C3 were Rs. 16581.01, Rs. 16581.01, Rs. 16603.20, Rs. 16912.85, Rs. 21118.20, Rs. 21427.85 and Rs. 23570.64 in 250 m^2 polyhouse of capsicum cultivation. The cost of cultivation of capsicum was Rs. 40393.32 in 500 m^2 polyhouse and cost A1, A2, B1, B2, C1, C2, and C3 were Rs. 31161.09, Rs. 31161.09, Rs. 31205.47, Rs. 31824.78, Rs. 36101.90, Rs. 36721.20 and Rs. 40393.32. The cost of production has positive relation with the size of polyhouse. It can further be concluded from the analysis that polyhouse cultivation is capital intensive farming.

Among different input operation in 250 m^2 polyhouse, the cost was observed highest for hired labour (Rs. 2292.86) followed by FYM (Rs. 1228.57), plant protection (Rs. 720.29), fertilizer (Rs. 289.96), seed (Rs. 53.75). Similar trend was found in case of 500 m^2 polyhouse.

The cost of owed human labour is the major contributor to the cost of cultivation of capsicum under protected conditions. Owed human labour was Rs. 4515.00 and Rs. 4896.43 in 250 m^2 and 500 m^2 polyhouse respectively. Hired labour was found Rs. 1260.00 and Rs. 2292.86 in 250 m^2 and 500 m^2 polyhouse respectively.

Returns from Capsicum under Protected Conditions

The returns from capsicum production under different sizes of polyhouses were calculated and results have been presented in table 4.

The results revealed that yield of capsicum were 14.20 quintals and 32.68 quintals in 250 m^2 and 500 m^2 polyhouse respectively. Gross returns were found Rs. 28400 and Rs. 65357.14 in 250 m^2 and 500 m^2 polyhouse respectively.

Farm business income which represents returns over cost A2, was Rs. 11818.99 in 250 m^2 polyhouse while in 500 m^2 polyhouse, it was found Rs. 34196.05. Family labour income which represents returns over cost B2, was Rs. 11487.15 and Rs. 33532.37 in 250 m^2 and 500 m^2 polyhouse respectively. Farm income (net income) was Rs. 4829.36 and Rs. 24963.82 in 250 m^2 and 500 m^2 polyhouse respectively. Farm investment income was Rs. 7303.99 and Rs. 29299.62 in 250 m^2 and 500 m^2 polyhouse respectively.

Comparative economics of capsicum production under protected and open field conditions

The finding obtained from comparative economic analysis of capsicum cultivation under protected and open field conditions are discussed here. Cost and returns of capsicum production under protected and open field conditions in 250 m^2 and 500 m^2 area, are elaborated and presented in table 5.

In case of 250 m^2, the cost of cultivation of capsicum under protected conditions was much higher (Rs. 23570.64) than open conditions (Rs. 2815.01).

Table.1 Farm Category wise Cost of Capsicum under Open Field Conditions in Sampled Vegetable Growers (Rs./ha.)

S.No.	Particulars	Marginal	Small	Medium	Large	Overall
Cost A1						
	Human hired labour	5674.34	7142.86	8939.39	12142.86	9091.67
	Owned machinery labour	337.17	1164.02	1245.79	1319.44	1112.73
	Hired machinery labour	2878.29	628.31	505.05	366.30	895.83
	Seed/plants	992.43	946.30	939.81	937.50	960.85
	FYM	27565.79	25608.47	28653.20	25531.14	27233.33
	Fertilizer	4331.91	3646.30	2565.49	2965.57	3243.50
	Plant protection	8444.08	8891.53	11609.43	12164.84	10814.44
	Depreciation	6334.67	8562.18	5968.23	3516.06	5663.00
	Land Revenue	6.00	6.00	6.00	6.00	6.00
	Interest on working capital	1130.04	1080.63	1225.31	1247.12	1200.43
	Sub-total	**57694.72**	**57676.58**	**61657.71**	**60196.83**	**60221.78**
		(44.74)	(48.59)	(55.28)	(59.22)	(52.88)
Cost A2						
	Cost A1	57694.72	57676.58	61657.71	60196.83	60221.78
	Rental value of leased -in land	0.00	0.00	0.00	0.00	0.00
	Sub-total	**57694.72**	**57676.58**	**61657.71**	**60196.83**	**60221.78**
		(44.74)	(48.59)	(55.28)	(59.22)	(52.88)
Cost B1						
	Cost A1	57694.72	57676.58	61657.71	60196.83	60221.78
	Interest on Fixed capital	871.89	1413.93	961.45	574.53	901.41
	Sub-total	**58566.61**	**59090.51**	**62619.15**	**60771.35**	**61123.19**
		(45.41)	(49.78)	(56.14)	(59.78)	(53.67)
Cost B2						
	Cost B1	58566.61	59090.51	62619.15	60771.35	61123.19
	Rental value of land	12386.03	12386.03	12386.03	12386.03	12386.03
	Rental value of leased -in land	0.00	0.00	0.00	0.00	0.00
	Sub-total	**70952.65**	**71476.55**	**75005.19**	**73157.39**	**73509.23**
		(55.02)	(60.22)	(67.25)	(71.96)	(64.55)
Cost C1						
	Cost B1	58566.61	59090.51	62619.15	60771.35	61123.19
	Imputed value of family labour	46282.89	36428.57	26388.89	19258.24	30016.67
	Sub-total	**104849.51**	**95519.09**	**89008.04**	**80029.59**	**91139.86**
		(81.30)	(80.47)	(79.80)	(78.72)	(80.03)
Cost C2						
	Cost B2	70952.65	71476.55	75005.19	73157.39	73509.23
	Imputed value of family labour	46282.89	36428.57	26388.89	19258.24	30016.67
	Sub-total	**117235.54**	**107905.12**	**101394.08**	**92415.63**	**103525.89**
		(90.91)	(90.91)	(90.91)	(90.91)	(90.91)
Cost C3						
	Cost C2	117235.54	107905.12	101394.08	92415.63	103525.89
	Value of management input(10% of cost C2)	11723.55	10790.51	10139.41	9241.56	10352.59
	Sub-total	**128959.10**	**118695.63**	**111533.48**	**101657.19**	**113878.48**
		(100.00)	(100.00)	(100.00)	(100.00)	(100.00)

Table.2 Farm Category wise Return from Capsicum under Open Field Conditions
in Sampled Vegetable Growers (Rs/ha.)

Particulars	Marginal	Small	Medium	Large	Overall
Yield of Capsicum (qtls)	181.91	169.84	156.06	161.72	166.94
Gross Return	327434.21	305714.29	280909.09	291098.90	300500.00
Farm Business Income (Gross return - Cost A1)	269739.49	248037.70	219251.38	230902.07	240278.22
Family Labour income (Gross return - Cost B2)	256481.56	234237.74	205903.90	217941.51	226990.77
Farm Income (net income) (Gross return - Cost C3)	198475.11	187018.65	169375.61	189441.71	186621.52
Farm Investment Income (Farm Business Income - Family Labour wages)	223456.60	211609.13	192862.50	211643.83	210261.55

Table.3 Polyhouse Size wise Cost of Capsicum under Protected Conditions in Sampled
Vegetable Growers (Rs.)

Sr. No.	Particulars	250 m^2	500 m^2
Cost A1			
	Human hired labour	1260.00	2292.86
	Owned machinery labour	0.00	82.14
	Hired machinery labour	0.00	142.86
	Seed/plants	24.50	53.75
	FYM	570.00	1228.57
	Fertilizer	146.72	289.96
	Plant protection	212.70	720.29
	Depreciation	139.41	278.81
	Depreciation on polyhouse	14146.97	25903.51
	Land Revenue	6.00	6.00
	Interest on working capital	74.72	162.35
	Sub-total	**16581.01**	**31161.09**
		(70.35)	(77.14)
Cost A2	Cost A1	16581.01	31161.09
	Rental value of leased -in land	0.00	0.00
	Sub-total	**16581.01**	**31161.09**
		(70.35)	(77.14)
Cost B1	Cost A1	16581.01	31161.09
	Interest on Fixed capital	22.19	44.38
	Sub-total	**16603.20**	**31205.47**
		(70.44)	(77.25)
Cost B2	Cost B1	16603.20	31205.47
	Rental value of land	309.65	619.30

	Rental value of leased -in land	0.00	0.00
	Sub-total	**16912.85**	**31824.78**
		(71.75)	(78.79)
Cost C1	Cost B1	16603.20	31205.47
	Imputed value of family labour	4515.00	4896.43
	Sub-total	**21118.20**	**36101.90**
		(89.60)	(89.38)
Cost C2	Cost B2	16912.85	31824.78
	Imputed value of family labour	4515.00	4896.43
	Sub-total	**21427.85**	**36721.20**
		(90.91)	(90.91)
Cost C3	Cost C2	21427.85	36721.20
	Value of management input(10% of cost C2)	2142.79	3672.12
	Sub-total	**23570.64**	**40393.32**
		(100.00)	(100.00)

Table.4 Polyhouse Size wise Return from Capsicum under Protected Conditions in Sampled Vegetable Growers (Rs.)

Particulars	250 m^2	500 m^2
Yield of Capsicum (qtls.)	14.20	32.68
Gross Return	28400.00	65357.14
Farm Business Income	11818.99	34196.05
(Gross return - Cost A1)		
Family Labour income	11487.15	33532.37
(Gross return - Cost B2)		
Farm Income (net income)	4829.36	24963.82
(Gross return - Cost C3)		
Farm Investment Income	7303.99	29299.62
(Farm Business Income - Family Labour wages)		

Table.5 Comparative Cost and Return Analysis of Capsicum under Protected and Open Field Conditions in Sampled Vegetable Growers (Rs.)

Particulars	250 m^2		500 m^2	
	Protected	**Open**	**Protected**	**Open**
Cost of cultivation	23570.64	2815.01	40393.32	5623.42
Gross return	28400.00	7397.43	65357.14	14794.86
Net Return	4829.36	4582.42	24963.82	9171.44
Break-even point	21349.68	1989.22	33869.39	3965.99
Margin of safety	7050.32	5408.21	31487.75	10828.87
Margin of safety (%)	75.17	26.89	51.82	26.81

Fig.1 Comparative economics of capsicum production under protected and open field conditions in 250 m^2 area
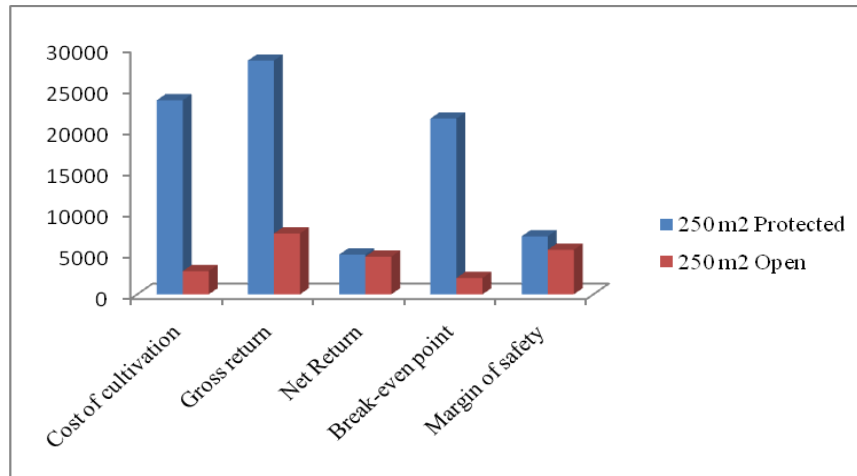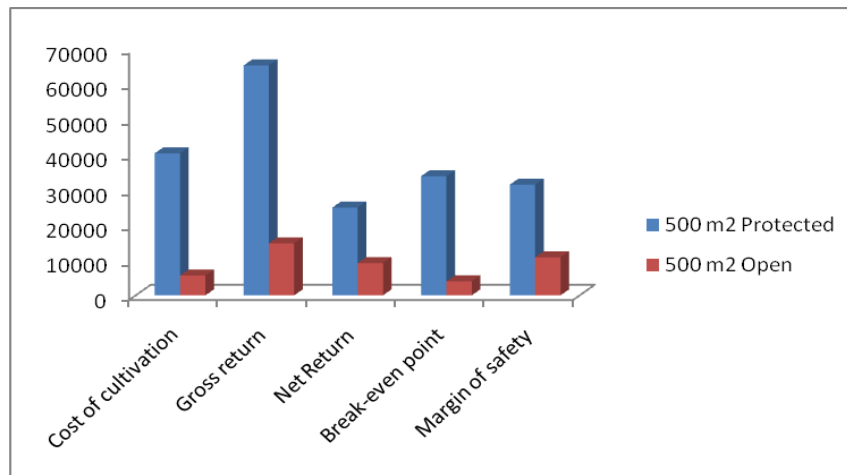

Fig.2 Comparative economics of capsicum production under protected and open field conditions in 500 m^2 area

The gross return and net return of capsicum under protected conditions were Rs. 28400.00 and Rs. 4829.36 respectively while in case open conditions, gross return and net return of capsicum were Rs. 7397.43 and Rs. 4582.42 respectively. The break-even point and margin of safety for capsicum under protected conditions were Rs. 21349.68 and Rs. 7050.32 which was comparatively higher than open conditions. Percent margin of safety under protected conditions was 75.17 percent while it was 26.89 percent in open conditions (fig. 1).

In case of 500 m^2, the cost of cultivation of capsicum under protected conditions was also much higher (Rs. 40393.32) than open conditions (Rs. 5623.42). The gross return and net return of capsicum under protected conditions were Rs. 65357.14 and Rs. 24963.82 respectively while in case open conditions, gross return and net return of capsicum were Rs. 14794.86 and Rs. 9171.44 respectively. The break-even point and margin of safety for capsicum under protected conditions were Rs. 33869.39 and Rs. 31487.75 which was comparatively higher

than open conditions (fig. 2). Percent margin of safety under protected conditions was 51.82 percent while in open conditions it was 26.81 percent. It implies protected cultivation has less risk of failure of farm business over open field conditions. Similar findings were also reported by Nagalakshmi *et al.,* (2001) and Sreedhara *et al.,* (2013), Kumar *et al.,* (2016).

In conclusion the present study concluded that the cost of production of capsicum under open conditions was Rs. 113878.48 per hectare at overall level and varied between Rs. 118695.63 to Rs. 128959.10 per hectare among different farm categories. The net returns varied between Rs. 169375.61 to Rs. 198475.11 among different farm categories with an average return of Rs. 186621.52 at overall level. Farm investment income varied between Rs. 192862.50 to Rs. 223456.60 with Rs. 210261.55 at overall level. The cost of production of capsicum under protected conditions was Rs. 23570.64 and Rs. 40393.32 in 250 m^2 and 500 m^2 polyhouse respectively. Net returns were Rs. 4829.36 and Rs. 24963.82 in 250 m^2 and 500 m^2 polyhouse respectively. Farm investment income was Rs. 7303.99 and Rs. 29299.62 in 250 m^2 and 500 m^2 polyhouse respectively. the cost of cultivation in polyhouse cultivation was Rs. 20755.63/250 m^2 and Rs. 34769.90/500 m^2 more than from open field cultivation. The gross returns from polyhouse cultivation worked out Rs. 21002.57/250 m^2 and Rs. 50.562.28/500 m^2 more as compared to open field cultivation and net returns from polyhouse are Rs. 246.94 /250 m^2 and Rs. 15792.38/500 m^2 more than open cultivation of capsicum. The break-even point in polyhouse cultivation was Rs. 21349.68/250 m^2 and Rs. 33869.39/500 m^2 while in open cultivation, it was only Rs. 1989.22/250 m^2 and Rs. 3965.99/500 m^2 and margin of safety was Rs. 1642.11/250 m^2 and Rs. 20658.88/500 m^2 more than open cultivation.

Per cent margin of safety was very high (75.17 & 51.82 in 250 m^2 and 500 m^2 respectively) as compared to open cultivation of capsicum (26.89 & 26.81 in 250 m^2 and 500 m^2 respectively).

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