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An economic comparison of organic and conventional guava cultivation in Hisar district of Haryana

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Abstract
An investigation was undertaken to compare the economics of guava grown under organic and inorganic farming systems in Hisar district, Haryana. Data were collected from different villages under both farming systems. Results indicated that, per hectare production of organic guava was 198 quintals and conventional guava was 259 quintals in 7th year. The per hectare total cost of guava production was Rs.176349 and Rs.193668 under organic and conventional farming respectively. Per hectare total net returns of on organic guava (Rs.272121) as compared to conventional guava (Rs. 215034) were found to be higher in organic farming. Benefit: cost ratio was observed to be higher in organic farming. Hence, organic guava production was beneficial than conventional guava production.

Keywords: Economics, organic farming, B:C ratio and net returns

Introduction
The continuous adoption of modern technologies with increased use of chemical fertilizers and plant protection chemicals has resulted into various negative effects like deterioration of soil health, heavy infestation of weeds, severe incidence of insect-pests and diseases, depletion and contamination of ground water etc. The wide spread of improved agricultural practices coupled with the extensive usage of chemical synthetic materials caused negative impact on agricultural production and human health. In this context, organic farming is one of the options to avoid or largely exclude the use of synthetically manufactured fertilizers, pesticides, growth regulators and relies on green manure, crop rotations, crop residues, animal manures, bio-fertilizers, bio-pesticides etc. for improving soil heath and sustaining crop productivity**.** Organic farming is a system which avoids or largely excludes the use of synthetic inputs (such as fertilizers, pesticides, hormones, feed additives etc.) and to the maximum extent feasible rely upon crop rotations, crop residues, animal manures, off-farm organic waste, mineral grade rock additives and biological system of nutrient mobilization and plant protection (USDA). Organic farming is cost-effective for farmers due to the lack of usage of chemicals (due to its high price), turning to inexpensive methods, such as biological resources rather than chemical fertilizers and pesticides. India has the largest number of organic producers in the world, with 1,093,288 certified organic producers, it is home to more than 35.11 per cent of total number of organic producers (3.10 million) in the world (APEDA, 2019) However, when it relates to area under certified organic cultivation, India contributes only 2.54 per cent (1.80 million ha) of the total (69.80 million ha) coverage at global level. India is one leading country for export of organic products to various destinations in world. The major organic products exported from India are tea, pulses, sugar, basmati rice, oilseeds (sesame and soybean) spices, cotton, medicinal plants and herbs, processed foods and dry fruits. Awareness about organic farming is also increasing in Haryana and a number of farmers have converted and started organic farming.

Materials and methods
The study pertains to Hisar district of Haryana. The survey was conducted during agricultural year 2018-19. From the above selected district, total 3 blocks were selected based on highest number of organic farmers. Though organic farming is much beyond the use of chemicals, the farmers who were not using chemical fertilizers and chemical pesticides/weedicides for the last three years constantly were considered as the organic growers in the present study. From the selected blocks, 30 farmers cultivating organically and 40 farmers cultivating inorganically from each block were interviewed to extract relevant information pertaining to inputs used,

output, prices of inputs and output in organic and inorganic cultivation of crops and the constraints in adoption of organic farming etc.

Analytical tools and techniques

The various statistical tools like average, percentage, Benefit-Cost ratio (B-C ratio), Compound Annual Growth Rate (CAGR) etc. were employed to draw valid inferences from the study. Tabular analysis was adopted to analyse the general economic characteristics of the sampled farmers, determine the cost structure, returns, net profits and opinions of the farmers regarding the organic as well as inorganic cultivation of the guava.

Economic viability

To examine the economic feasibility of orchard while studying the economics of guava cultivation, four indicators were used viz., net present value (NPV), internal rate of return (IRR), cost benefit ratio and payback period. The detailed method used to find out these indicators are given below.

Net present value

Future net returns were discounted to their net present value by using the following formula:

$$N.P.V. = \frac{R_1}{(1+r)^1} + \frac{R_2}{(1+r)^2} + \ldots\ldots + \frac{R_{n-1}}{(1+r)^{n-1}} + \frac{R_n}{(1+r)^n}$$

Where,

R_1, R_2 ……. R_n are the net returns in the period 1, 2, ……. n respectively, 'n' is the life span in years of the investment in the orchard, 'r' is the discount rate (prevailing interest rate) and N.P.V. is net present value of returns R_1, R_2, R_3 ……...R_n.

Internal rate of return

In estimating the internal rate of return, the investment cost and incremental gross returns for each year in the life of orchard were calculated. The internal rate of return was calculated at the different rate of discount until it satisfies the relationship B – C = 0 where 'B' is the sum of discounted stream of positive value (returns) and 'C' is taken as the sum of discounted stream of negative values (costs).

$$IRR = \begin{pmatrix}\text{Lower}\\ \text{discount}\\ \text{rate}\end{pmatrix} + \begin{pmatrix}\text{Difference}\\ \text{between two}\\ \text{discount rates}\end{pmatrix} \times \frac{\text{(Present worth of the cash flow at lower discount rate)}}{\text{(Absolute difference between the present worth of the cash flow at two discount rates)}}$$

Benefit: Cost ratio

The benefit cost ratio is the ratio between the sum of discounted gross benefits of returns (R) and the sum of discounted cost (K), i.e. B = R/K. If this ratio is greater than 1.00 then the investment in fruits orchard is considered to be economically viable.

Payback period

It is the period within which the cost of the orchard is fully recovered from its own returns. In other words, it indicates the number of years by which the net returns (R) equal, to the cost of orchard (K). For this condition the following relationship must be satisfied.

$$\sum_{i=1}^{n} Ri = K$$

Where,

i = 1, 2, 3 ……. n year,
R = Indicates the return over a number of year,
K = Indicate the cost of orchard.

Results and discussion

Establishment cost of organic and inorganic guava orchard

Guava cultivation is a long term capital intensive farm enterprise. The initial cost of establishment of a guava orchard consists of the preparation of land and layout, digging and filling of pits, irrigation, plant, replacement plant, manures and fertilizer, transportation including labour, plantation, permanent fencing, equipments and miscellaneous expenses. The results presented in Table 1, indicated the average total establishment cost of organic and inorganic guava orchard in Hisar district of Haryana. It was estimated Rs.69695 ha^{-1} in case of organic whereas the average total establishment cost of inorganic guava orchard worked out was Rs.71711 ha^{-1}.

Table 1: Establishment cost of guava orchard in Haryana (Rs./ha.)

Particulars	Hisar	
	Inorganic	Organic
Preparation of land and layout	6324 (8.82)	6227 (8.93)
Digging and filling of pits	9751 (13.60)	9743 (13.98)
Cost of irrigation	2592 (3.61)	2615 (3.75)
Cost of plant	7763 (10.83)	7898 (11.33)
Cost of replacement plant	1367 (1.91)	1374 (1.97)
Manures and fertilizer	7235 (10.09)	-
FYM+Organic fertilizer	-	6347 (9.11)
Transportation of plant	5963 (8.32)	5765 (8.27)
Plantation cost	6284 (8.76)	5873 (8.43)
Intercultural operation	2986 (4.16)	2835 (4.07)
Permanent fencing	12457 (17.37)	12032 (17.26)
Cost of equipments	6021 (8.40)	6126 (8.79)
Miscellaneous	2968 (4.14)	2860 (4.10)
Total cost	71711 (100.00)	69695(100.00)

Operational cost of organic and inorganic guava orchard

It is clear from the data in the Table 2. that the per hectare operating cost in organic guava cultivation increased over years because of higher expenses incurred on various inputs and hike in picking cost. This increase may be attributed to the direct relationship between the physical input requirement and age of the plants. The annual operating cost of organic guava orchard ranges from Rs. 36289 ha^{-1} in the first year to Rs. 72588 ha^{-1}in 7th year. The operational cost keeps on increasing up to seventh year of the establishment of an orchard and thereafter it becomes more or less stabilized. The operational cost of organic guava cultivation per annum from first to seventh years was found to be higher Rs. 9012 ha^{-1} on irrigation (16.14%) followed by Rs. 8835 ha^{-1} on intercultural and hoeing (15.83%), Rs. 844468 ha^{-1} on plant protection (15.17%), Rs. 8011 ha^{-1} on manure and organic fertilizer

(14.35%), Rs. 6986 ha^{-1} on watch and ward (12.51%), Rs. 5701 ha^{-1} on picking (10.64%), followed by Rs. 3672 ha^{-1} on pruning and cutting (6.58%). These items were the major constituents of operational cost of organic guava orchard. In case of inorganic guava cultivation, operational cost has increased over years (Table 2). The annual operating cost of organic guava orchard ranges from Rs. 41894 ha^{-1} in the first year to Rs. 85829 ha^{-1} in the seventh year. The operational cost showed increasing trend up to seventh year of the establishment of an orchard and thereafter it becomes more or less stabilized. The operational cost in inorganic guava cultivation per annum from first to seventh years were found to be higher Rs. 12558 ha^{-1} on plant protection (19.85%), Rs. 10471 ha^{-1} on manure and fertilizer (16.55%), Rs. 8969 ha^{-1} on irrigation (14.17%) followed by Rs. 8948 ha^{-1} on intercultural and hoeing (14.14%), Rs. 8454 ha^{-1} on picking (13.36%), Rs. 6942 on watch and ward (10.97%) followed by Rs. 3918 ha^{-1} on pruning and cutting (6.19%). These items were the major constituents of operational cost of inorganic guava orchard.

Cost and returns from organic and inorganic guava orchard

Data presented in Table 3 reveals the cost and returns per hectare of organic guava orchard at different ages i.e. from the year of establishment to seventh-year age of orchard. It was observed that there was no production of guava up to the age of three years as the bearing of fruits usually starts after attaining three years of age. The per hectare production of fruits starts increasing gradually from nearly 43 quintals in fourth year to about 198 quintals in seventh year orchard age.

Table 2: Operational cost of guava orchard in Hisar district of Haryana (Rs./ha.)

Organic guava orchard											
Sr. No.	**Particulars**	**Years**									
		1	**2**	**3**	**4**	**5**	**6**	**7**	**Total cost**	**Avg cost/annum**	**%age**
1	Manure +Organic fertilizer	7123	7429	7653	8125	8347	8634	8769	56080	8011	14.35
2	Plant protection	7309	7746	8120	8652	8963	9148	9342	59280	8468	15.17
3	Pruning and cutting	0	0	4459	4937	5207	5432	5674	25709	3672	6.58
4	Intercultural and hoeing	7562	8387	8746	8965	9105	9430	9653	61848	8835	15.83
5	Irrigation cost	6438	8450	9123	9564	9732	9803	9978	63088	9012	16.14
6	Replacement and causality	742	803	890	988	1071	1287	1506	7287	1041	1.86
7	Watch and ward	6109	6402	6654	7128	7309	7547	7756	48905	6986	12.51
8	Plucking cost	0	0	0	3139	6694	12632	17443	39908	5701	10.64
9	Miscellaneous	1006	1486	1675	1845	2001	2234	2467	12714	1816	3.39
10	Total operational cost	36289	40703	47320	53343	58429	66147	72588	374819	53545	100
Inorganic guava orchard											
1.	Manure and chemical fertilizer	9142	9468	9985	10256	11125	11526	11799	73301	10471.57	(16.55)
2.	Plant protection	11025	11549	12354	12478	13001	13547	13958	87912	12558.86	(19.85)
3.	Pruning and cutting	0	0	4657	4956	5468	6021	6324	27426	3918.00	(6.19)
4.	Intercultural and hoeing	7453	8124	8365	9135	9654	9875	10031	62637	8948.14	(14.14)
5.	Irrigation cost	6532	8245	9011	9265	9758	9951	10024	62786	8969.43	(14.17)
6.	Replacement and causality	698	709	801	986	1001	1152	1403	6750	964.29	(1.52)
7.	Watch and ward	5987	6423	6742	7023	7125	7443	7853	48596	6942.29	(10.97)
8.	Plucking cost	0	0	0	6031	12547	19147	21456	59181	8454.43	(13.36)
9.	Miscellaneous	1057	1564	1759	1869	2354	2802	2981	14386	2055.14	(3.25)
10.	Total operational cost	41894	46082	53674	61999	72033	81464	85829	442975	63282	100

However, after attaining the age of seven years, it remains almost static with advance in age of the plants. Hence, the gross returns per hectare from organic guava orchard increase up to seventh year age of the plants. The gross returns per hectare worked out to be Rs. 448470 in the seventh year that was full bearing stage and was expected to be more or less same rate of returns up to age of 25 years. Taking into account the rental value of land, amortized fixed cost, operational cost, expected depreciation on fixed investment and interest on operational cost, the net returns per hectare have been worked out over time. The total cost varied from Rs. 114292 ha^{-1} in the first year to Rs.178589 ha^{-1}in the seventh year. The net returns from inter-crops ranged from Rs. 37654 to Rs. 16346 ha^{-1} during the first year to fifth year of the organic guava orchard. Even after taking the returns from intercropping in the orchard, the orchardist has to bear a loss of Rs. 76638, Rs. 89253, Rs. 107655 and Rs. 62239 ha^{-1}in first, second, third and fourth year, respectively. During the fifth year, the net returns become positive and worked out to be Rs. 29424 ha^{-1}. The net returns scale up to seventh year i.e. Rs. 269881 ha^{-1}and after that it become more or less stable up to the age of 25 years. The net returns were negative in first four initial years and then were found to be positive from the fifth year to seventh year and onwards. In the seventh year, the cost and returns were almost stable as the orchard was fully matured. In case of inorganic guava orchard, the cost and returns per hectare of inorganic guava orchard at different ages i.e. from the year of establishment to seventh-year age of orchard was presented in Table 3. It was observed that there was no production of guava up to the age of three years as the bearing of fruits usually starts after attaining three years of age. The per hectare production of fruits starts increasing gradually from nearly 51 quintals in fourth year to about 259 quintals in seventh year orchard age. However, after attaining the age of seven years, it remained almost static with advance in age of the plants. Hence, the gross returns per hectare from inorganic guava orchard increase up to seventh year age of the plants. The gross returns worked out to be Rs. 408702 ha^{-1} in the seventh year that was full bearing stage. This rate of return was expected to be more or less same up to age of 25 years.

Table 3: Cost and return of guava orchard in Hisar district of Haryana (Rs./ha.)

Sr. No.	Particulars	Years						
		1	2	3	4	5	6	7
Organic								
1	Rental value of land	62053	67503	72397	78432	81230	82345	83456
2	Amortized Fixed Cost	8826	8826	8826	8826	8826	8826	8826
3	Operational Cost	36289	40703	47320	53343	58429	66147	72588
4	Expected depreciation on Fixed Cost investment @4%	2768.88	2768.88	2768.88	2768.88	2768.88	2768.88	2768.88
5	Interest on operational cost @12% PA	4354.68	4884.36	5678.4	6401.16	7011.48	7937.64	8710.56
6	Total Cost (1-5)	114292	124685	136990	149771	158265	168024	176349
7	Production (qtls)	0	0	0	43	101	147	198
8	Price (qtls)	0	0	0	1568	1763	1834	2265
9	Gross returns	0	0	0	67424	178063	269598	448470
10	Net returns	-114292	-124685	-136990	-82347	19798	101573	272121
11	Return from inter crops	37654	35432	29335	23468	16346	0	0
	Total net returns	-76638	-89253	-107655	-58879	36144	101573	272121
Inorganic								
1	Rental value of land	63489	68745	71548	75412	82001	83214	85478
2	Amortized Fixed Cost	9181	9181	9181	9181	9181	9181	9181
3	Operational Cost	41894	46082	53674	61999	72033	81464	85829
4	Expected depreciation on Fixed Cost investment @4%	2880	2880	2880	2880	2880	2880	2880
5	Interest on operational cost @12% PA	5027	5530	6441	7440	8644	9776	10299
6	Total Cost (1-5)	122472	132418	143724	156912	174739	186515	193668
7	Production (qtls)	0	0	0	51	113	183	259
8	Price (qtls)	0	0	0	1321	1405	1518	1578
9	Gross returns	0	0	0	67371	158765	277794	408702
10	Net returns	-122472	-132418	-143724	-89541	-15974	91279	215034
11	Return from inter crops	38149	36548	29487	24535	17568	0	0
	Total net returns	-84323	-95870	-114237	-65006	1594	91279	215034

Taking into account the rental value of land, amortized fixed cost, operational cost, expected depreciation on fixed investment and interest on operational cost, the net returns per hectare have been worked out over time. The total cost varied from Rs. 122472 ha^{-1}in the first year to Rs. 193668 ha^{-1}in the seventh year. The net returns from cultivation of crops in the guava orchard varied from Rs. 38149 to Rs. 17568 ha^{-1}during the first year to fifth year of the organic guava orchard. Even after taking the returns from inter-crops in the orchard, the orchardist has to bear a loss of Rs. 84323, Rs. 95870, Rs. 114237 and Rs. 65006 ha^{-1}in first, second, third and fourth year, respectively as expenditure incurred was higher than returns attained. During the fifth year, the net returns become positive and worked out to be Rs. 1594. The net returns scale up to seventh year i.e. Rs. 215034 ha^{-1} and after that it become more or less stable up to the age of 25 years. The net returns were negative in first four initial years and then were found to be positive from the fifth year to seventh year and onwards. In the seventh year the cost and returns were almost stable as the orchard was fully matured.

Economic viability of guava orchard in Hisar district

To examine the economic feasibility of guava orchard, four indicators were used viz., net present value (NPV), and internal rate of returns (IRR) and benefit-cost ratio which are discussed as below:

Net present value (NPV) of guava orchard in Hisar district of Haryana

Costs and returns data presented in previous tables not serve as true guide for making choice to go for guava orchard vis-à-vis other annual crops. This was due to the fact that cost incurred and returns gained from guava orchard over time are not comparable with annual crops grown in the area. Returns from investment in annual crops can be obtained within a year, while minimum three to four year period must be lapsed after planting before any returns are obtained over operational costs from guava orchards. Hence, it is necessary to estimate the net present value of future returns which can be determined by discounting both the costs as well as returns at the prevailing rate of interest. In the present study the prevailing interest rate of 12 per cent per annum was taken as discount rate of the costs and returns to determine NPV of the guava orchard.

The net present value thus computed is showed in Table 4. The figure given in this table showed that net present values (NPVs) for one ha organic guava orchard was Rs.833817.71 and for inorganic guava orchard was Rs.575251.75 for the entire life (25 years) of the orchard. The positive NPV of organic and inorganic guava cultivation is a profitable crop enterprise in the Hisar district of the state. At discount rate of 12 per cent, on an average the benefit cost ratio obtained was equal to 1:4.29 for organic guava and 1:3.10 for inorganic guava in Hisar district. It indicates that at the prevailing rate of interest at 12 per cent per annum on investment of Re. 1.00 would fetch a return of Rs.4.29 for organic and Rs.3.10 for inorganic guava orchard. Since this ratio was greater than unity, it shows that the investment in guava orchard is considered to be economically viable.

Table 4: Per hectare net present value of organic guava orchard in Hisar district of Haryana (r=12%)

Year	Negative returns (Rs.)	Positive returns (Rs.)	Discount coefficient 1/(1+r)n	Present value	
				Cost (Rs.)	Net returns (Rs)
1	-76637.6	-	0.8929	-68426.4	-
2	-89253.2	-	0.7972	-71152.1	-
3	-107655	-	0.7118	-76626.7	-
4	-58879	-	0.6355	-37418.7	-

5		36143.64	0.5674	-	20508.87
6	-	101573.5	0.5066	-	51460.3
7≥	-	272120.6	3.7317	-	1015472
up to 30 years)					
Total	-332425	409838	-	-253624	1087442

Net present value (NPV) = 1087441.61-253623.90 = 833817.71 B:C = 4.29

Table 5: Per hectare net present value of inorganic guava orchard in Hisar district of Haryana

Year	Negative returns (Rs.)	Positive returns (Rs.)	Discount coefficient 1/(1+r)n	Present value	
				Cost (Rs.)	Net returns (Rs)
1	-84323	-	0.8929	-75288.1	-
2	-95870	-	0.7972	-76427.2	-
3	-114237	-	0.7118	-81311.9	-
4	-65006	-	0.6355	-41312.7	-
5		1594	0.5674	-	904.25
6	-	91279	0.5066	-	46244.72
7.(and onward	-	215034	3.7317	-	802442.7
up to 30 years)					
Total	-359437	307907	-	-274340	849591.7

Net present value (NPV) = 849591.65-274339.90 = 575251.75
B:C = 3.10

Internal rate of return (IRR) of guava orchard in Hisar district of Haryana

In estimating the internal rate of return, the investment cost, gross returns from first to seventh year and the life of guava orchard have been depicted in previous tables. The net cash flow was obtained by using these single values which may have negative and positive signs according to quantum of costs and benefits or returns in every year.

Table 6: Internal rate of return from one ha of organic guava orchard in Hisar district of Haryana (Rs./ha)

Year	Discounted cash Flow	Present value coefficient	Corresponding Present value (Rs.)	Present value coefficient	Corresponding Present value (Rs.)
		r= 28% (1/(1+r)n		r= 29% (1/(1+r)n	
1	-76638	0.7813	-59873.1	0.7752	-59409
2	-89253	0.6104	-54475.8	0.6009	-53634.5
3	-107655	0.4768	-51333.9	0.4658	-50149.3
4	-58879	0.3725	-21934.1	0.3611	-21261.9
5	36144	0.291	10519.18	0.2799	10117.74
6	101574	0.2274	23095.14	0.217	22041.55
7-30	272121	0.1776	48338.33	0.1682	45775.54
Total	-	-	-105664	-	-106520

IRR = 28+1 (105664.3)/(105664.3+106519.88) = 28+0.50 = 28.50 per cent

Table 7: Internal rate of return from one ha of inorganic guava orchard in Hisar district of Haryana (Rs./ha)

Year	Net cash flow	Present value coefficient	Corresponding Present value (Rs.)	Present value coefficient	Corresponding Present value (Rs.)
		r= 28% (1/(1+r)n		r= 29% (1/(1+r)n	
1	-84323	0.7937	-66922.8	0.8333	-70268.9
2	-95870	0.6299	-60386.9	0.6944	-66576.6
3	-114237	0.4999	-57107.9	0.5787	-66109.6
4	-65006	0.3968	-25791.3	0.4823	-31349.5
5	1594	0.3149	501.8	0.4019	640.43
6	91279	0.2499	22811.14	0.3349	5 30569.11
7-30	215034	0.1983	42649.45	0.2791	60012.07
Total	-	-	-144247	-	-143083

IRR = 26+1 (144246.6)/(144246.6+143082.97) = 26+0.50 = 26.50 per cent

To find out the present value, the discounted rate was estimated by different discount rate at random until the difference between the sum of discounted streams of positive and negative values is reduced either to zero or to a lowest minimum value. Thus, computed values of internal rate of returns are shown in Tables 6 and 7. The data presented in this Table indicates a very high internal rate of return of 28.50 per cent per annum in case of organic guava and 26.50 per cent per annum in case of inorganic guava indicating that investment on guava orchards is highly profitable and internal rate of return is comparatively more than the present market interest rate i.e. 12 per cent per annum.

Conclusion

There is need for proper socio-cultural environment for promotion of organic farming in the state which have not been given due attention. Therefore, an attempt has been made to study economics of organic farming *vis-à-vis* inorganic farming. In general, organic farming is a production system which has low productivity levels, needs more labor, require low energy inputs and has a changing net income levels along with selling prices. Overall, results concluded that the unit

cost of production is lower in organic guava as compared to inorganic. The average total establishment cost was estimated Rs.69695 ha^{-1} in case of organic guava orchard whereas the average total establishment cost of inorganic guava orchard worked out was Rs.71711 ha. The annual operating cost of organic guava orchard ranged from Rs. 36289 ha^{-1} in the first year to Rs. 72588 ha^{-1}in 7^{th} year. In case of inorganic guava cultivation, annual operating cost of ranges from Rs. 41894 ha^{-1} in the first year to Rs. 85829 ha^{-1} in the seventh year. Results indicated that, per hectare production of organic cotton was 12.33 quintal and conventional cotton was 11.78 quintal. The gross returns per hectare from organic guava orchard worked out to be Rs. 448470 in the 7th year that was full bearing stage while in case of inorganic guava orchard, the gross returns worked out to be Rs. 408702 ha^{-1} in the seventh year.

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