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An Economic Analysis of Kinnow Cultivation in Sirsa District of Haryana

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A B S T R A C T

The study was based on both primary as well as secondary data. Primary data related to cost and returns of Kinnow cultivation were collected from Sirsa district of Haryana. Whereas, secondary data related to area, production and productivity of Kinnow were obtained from department of horticulture, government of Haryana. The CAGR in area, production and productivity of Kinnow in Haryana was found to be 11.69, 17.67 and 5.36 respectively. The NPV, IRR, B:C ration and payback period were estimated to be ₹ 747703.64, 26.24%, 1:3.79 and 7 years respectively. Lack of infrastructure for processing, storage, lack of better marketing facility, post-harvest management some of major constraints faced by Kinnow growers were identified in the study area.Keeping in view the high profitability and constraints, it can be suggested to the government to focus more on infrastructural facilities for post-harvest management, ensure availability of quality planting materials to the farmers and provide better marketing facility in the study so that more income of the farmers' can be ensured.

Introduction

Horticultural sector play a vital role in providing the livelihood security to the farmers under the changing agriculture scenario (Kumar *et al.*, 2017). No doubt green revolution has increased the production of rice and wheat and ultimately farmer's income in Haryana but it has some adverse effects like monoculture, increase in electricity consumption etc. Due to rising per capita income, growing urbanization and globalization, there is a shift in the consumption patterns of both rich as well as poor households in favor of high value crops (Grover *et al.*, 2012). With nature gifted suitable agro-climatic condition, Haryana has a large capacity in terms of production of

fruits and vegetables. In Haryana citrus is the leading fruit crop among all the major fruits grown in Haryana. Kinnowisa hybrid of two citrus cultivars, namely, King (*Citrus nobilis*) and Willow leaf (*Citrus deliciosa*) mandarins originated at Riverside, California (Sharma *et al.,* 2007). Cultivation of Kinnow in Haryana gained momentum among the fruit growers as it has higher profitability and good market value relative to some of the other crops in the state. Keeping in mind all these facts, the study was conducted with specific objectives *viz.,* Toanalyze the trends in area, production and productivity of Kinnow in Haryana, to calculate the costs, returns and economic feasibility of Kinnow and To identify the constraints faced by the Kinnow growers in Sirsa district of Haryana.

Materials and Methods

The study was undertaken in Sirsa district of Haryana. Further, thirty Kinnow growers were interviewed thought pretested interview schedule from the selected district randomly. Secondary data regarding area, production and productivity of Kinnow in Haryana were collected from Departments of Horticulture, Government of Haryana from 2005-06 to 2017-18. The CGR was then calculated to show the trends in area, production and productivity. The growth rates were estimated using exponential growth functional form as under:

$Y= AB^tU_t,$

Taking log i.e., Log Y= log A + t log B+ log U_t

i.e. $y=a+b^t+ut$

Where, Y= area or production or yield,
A= constant,
B= regression coefficient,
U_t= disturbance term And
t= time in years starting from the base year 2005-06.

The compound growth rate (Antilog of b-1)* 100 was used to calculate the growth rates in area, production and productivity of fruit crops at state levels for a period of 13 years.

Cost and returns from Kinnow cultivation

To analyse the economics of Kinnow cultivation, it is essential to study the cost in two parts viz., establishment costs and operational costs. For analysis of data, various economic tools like net present value (NPV), benefit cost ratio (B:C), internal rate of returns (IRR), paybackperiod were used.

Depreciation and interest rate of Kinnow cultivation

For estimating the annual cost, the depreciation has been worked out @ 4 per cent per annum of the fixed investment (*i.e.* establishment cost) by applying straight line method or direct method, assuming the productive life of Kinnow. Further rate the interest has been taken @ 12 per cent per annum on operational cost.

Amortization of fixed cost

The annual amortization of fixed cost was computed from the investment made on establishment of Kinnow, assuming the rate of interest 12 per cent per annum and the expected life 25 years for Kinnow. Thus, annual amortization was worked out by using the compounding cost formula.

$$I = B \frac{i}{1-(1+i)^{-n}}$$

Where,
I = Annual cost,
B = Present fixed cost,

i = Interest rate (12 % per annum), and
n = Economic life of the orchard (in years).

Economic viability

To examine the economic feasibility of orchard while studying the economics of Kinnow cultivation, four indicators were used viz., net present value (NPV), internal rate of returns (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:

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

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 returns

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 returns were 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=

(lower discount rate) + (difference between two discount rates) x (Present worth of the cash flow at lower discount rate) / (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 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 Kinnow 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 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.

Identification of constraints

Sixty farmers from the Sirsa district were surveyed with the pre tested schedules and their opinions were considered. For identifying the production and marketing constraints faced by the farmers Henry Garrett ranking technique was used. The respondents were asked to rank the given constraints. The order of merit thus given by the respondents was converted in to ranks using the following formula

$$\text{Percentage position} = \frac{100 - (R_{ij} - 0.5)}{N_j}$$

Where,
R_{ij} = Rank given for ith item j^{th} individual
N_j= Number of items ranked by j^{th} individual

Results and Discussion

Compound growth rate in area, production and productivity of Kinnow in Haryana

It is evident from the Table 1 that in the period (2005-2017) the area, production and productivity of Kinnow showed increase by 313.13, 382.29 and 16.86 per cent, respectively in the year 2017-18 over the area, production and productivity under Kinnow in the year 2005-06 in Haryana. The compound growth rate in area, production and productivity of Kinnow in Haryana were recorded as 11.69, 17.67 and 5.36 per cent, respectively. During the last 13 years the average area, production and productivity of Kinnow were 11.69 thousand hectares, 17.67 thousand tonnes and 5.36 tonnes per hectare, respectively. The area and production of Kinnow showed increasing trend over the time period 2005-18. However the productivity has not shown any specific trend.

Economics of Kinnow orchard in Sirsa, Haryana

Sirsa district shares 49.51 per cent of the total area under Kinnow cultivation in Haryana. Therefore 60 farmers from this district were randomly selected to analyse the economics of Kinnow orchard in Haryana**.**

Establishment cost of Kinnow orchard in Haryana

The per hectare average total establishment cost of Kinnow orchard in Sirsa district of Haryana was found to be ₹ 122460. The construction of pond (35.59 %), installation of drip irrigation (19.23%), Permanent fencing (10.24%), preparation of land and layout (5.71%), cost of plants (5.19%) cost of equipment (4.80%), manures and fertilizers (3.87%), transportation of plants (3.80%) were found be major component of the average establishment cost of kinnow orchard. These results are in conformity with the findings of Gangwar *et al.*, (2005) and Bhat *et al.*, (2011) (Table 2).

Operational cost of Kinnow orchard in Haryana

Per hectare operational costs increased over the years due to higher expenses involved on various inputs, rise in cost of staking and watch and ward which may be attributed to the direct relationship between input requirements and age of the plant. It was clearly evident from the results that the per hectare average annual operational cost of Kinnow orchard ranges from ₹ 29376 in the first year to ₹ 75625 in the seventh year after seventh year it becomes more or less stabilised. The per hectare average annual operational cost from the first year to the seventh year were found to be ₹ 13091.57 on plant protection insecticides and pesticides (23.10%), ₹ 7419.29 on intercultural operation and hoeing (13.09%), ₹ 7132.57 on pruning and cutting (12.58%) and ₹ 7011.43 on watch and ward (12.37%), ₹ 5485.86 on manures and fertilizers (9.68%) respectively in Kinnow cultivation (Table 3).

Costs and returns from Kinnow orchard in Haryana

Cost and returns from Kinnow orchard are presented in Table 4. Per hectare cost and return from Kinnow orchard from the year of establishment to the potential year of fruiting (7^{th} year). For the first 3 years there is lean

period and production is near to negligible. Thereafter the production started increasing like 43 quintals in the 4th year, 79 quintals in the 5th year, 207 quintals in the 6th year and 311 quintals in the 7th year. However, after 7th year of age the production remains static. So the gross returns per hectare increase up to 7th year of orchard age. In the full bearing stage that is in the 7th year, the gross returns were found to be ₹ 421405 per hectare which is expected to remain same up to 25 years of orchard life. The net returns from Kinnow orchard were calculated after taking into consideration various cost variable viz; rental value of the land, amortized fixed cost, operational cost of orchard, expected depreciation on fixed cost investment and interest on operational cost. After considering the returns from intercropping the net returns were found to be positive in the 6th year (₹ 108817 per hectare). The net returns were estimated to increase to ₹ 257397 in the 7th years and after that it remain more or less same up to 25 years of orchard life. The net returns from Kinnow orchard up to 7th year is presented in the figure 1.

Economic feasibility of Kinnow orchard in Haryana

To analyse the economic feasibility of Kinnow orchard four indicators like Net Present Value(NPV), Internal Rate of Returns(IRR), Benefit Cost (B:C) ratio, Payback period were computed which are discussed as below.

Net present value of kinnow orchard in Haryana

The data related to cost and returns in the table 4is not sufficient to act as a guiding tool in making decision to go for Kinnow orchard because the cost and returns from Kinnow orchard are obtained over times which are not compared with the cost and returns of annual crops. The data from the table 5 shows that the per hectare net present value of Kinnow orchard was found to be ₹ 747703.64 up to the age of 25 years which indicated that Kinnow orchard is highly profitable as the net present value is greater than zero and a higher positive value.

Internal rate of return of Kinnow orchard in Haryana

Internal rate of return is that discounting rate which makes the net present value zero or a minimum one. In the present study various discounting rates were taken to obtain the net present value zero or a minimum one. Finally, the internal rates of returns were found to be a higher value of 26.24 per annum. It means the Kinnow orchard is a highly profitable enterprise as the internal rate of return is higher than the prevailing interest rate that is 12 per cent per annum (Table 6).

Benefit Cost ratio of Kinnow orchard in Haryana

At the prevailing interest rate of 12 per cent the Benefit Cost ratio of Kinnow orchard were obtained 1:3.79. As this ratio is greater than one it implies that Kinnow orchard is a highly profitable enterprise. The Benefit cost ratio 1:3.79 means that at the prevailing interest rate of 12 per cent an investment of ₹ 1.00 will fetch a return of ₹ 3.79.

Payback period of Kinnow orchard in Haryana

From the table 4 it was clear that the net cost incurred during the first five years of orchard was ₹ 364673 per hectare. This cost was more than the net returns from the seventh year which was ₹ 366214 per hectare. This means the costs were recovered in the seventh year of establishment of Kinnow orchard. Hence the payback period of Kinnow orchard was found to be seven years.

Table.1 Trends in area, production and productivity of Kinnow in Haryana

Years	Area ('000ha)	Production ('000T)	Productivity (tonnes/ha)
2005-06	5.04	69.56	13.80
2006-07	6.42	77.43	12.06
2007-08	8.21	66.84	8.14
2008-09	11.22	63.16	5.63
2009-10	13.84	98.33	7.11
2010-11	17.15	130.00	7.58
2011-12	17.66	214.17	12.12
2012-13	18.78	225.05	11.99
2013-14	19.38	235.35	12.14
2014-15	19.50	302.07	15.49
2015-16	19.65	301.76	15.36
2016-17	20.05	323.92	16.15
2017-18	20.83	335.82	16.13
Average	15.21	187.96	11.82
Percentage change over 2005-06	313.13	382.29	16.86
CGR (% p.a.)	**11.69**	**17.67**	**5.36**

(Source: Department of Horticulture, Govt. of Haryana)

Table.2 Establishment cost of Kinnow orchard in Haryana

Sr. No.	Particulars	Value ((₹)/ hectare)	Percentage
1	Preparation of land and lay out	6987	5.71
2	Digging and filling of pits	5343	4.36
3	Cost of irrigation	1051	0.86
4	Cost of plant	6358	5.19
5	Cost of replacement plant	965	0.79
6	Manures and fertilizer	4737	3.87
7	Transportation of plant	4659	3.80
8	Plantation cost	2963	2.42
9	Intercultural operation	1469	1.20
10	Construction of pond	43578	35.59
11	Drip irrigation	23546	19.23
12	Permanent fencing	12543	10.24
13	Cost of equipment	5874	4.80
14	Miscellaneous	2387	1.95
	Total	122460	100.00

Table.3 Operational cost of Kinnow orchard in Haryana Value (₹ /hectare)

Sr. No.	Particulars	Years							Total Cost	Average cost per Annum	Percentage
		1	2	3	4	5	6	7th and onwards			
1	Manure and fertilizer	3127	3758	4523	5568	6894	7164	7367	38401	5485.86	9.68
2	Plant protection insecticides, pesticides	8756	11503	12654	13569	14568	15102	15489	91641	13091.57	23.10
3	Pruning and cutting		3781	6873	9245	9741	9964	10324	49928	7132.57	12.58
4	Intercultural and hoeing	4847	5468	6631	7863	8521	9253	9352	51935	7419.29	13.09
5	Irrigation cost	4498	5120	5961	7546	8276	8791	8967	49159	7022.71	12.39
6	Replacement and casualty	1437	1654	2145	2754	3124	3396	3758	18268	2609.71	4.60
7	Watch and ward	4987	5489	6124	6717	7813	8703	9247	49080	7011.43	12.37
8	Staking	0	0	0	7500	7800	8192	8175	31667	4523.86	7.98
9	Miscellaneous	1724	1923	2149	2465	2563	2785	2946	16555	2365.00	4.17
	Total operational cost	**29376**	**38696**	**47060**	**63227**	**69300**	**73350**	**75625**	**396634**	**56662.00**	100

Table.4 Costs and returns from Kinnow orchard in Haryana Value (₹ / hectare)

Sr. No.	Particulars	Years						
		1	**2**	**3**	**4**	**5**	**6**	**7th and onwards**
1	Rental value of land	44256	47234	48563	49671	52874	55963	58796
2	Amortized fixed cost	15614	15614	15614	15614	15614	15614	15614
3	Operational cost	29376	38696	47060	63227	69300	73350	75625
4	Expected depreciation on Fixed Cost investment @4%	4898	4898	4898	4898	4898	4898	4898
5	Interest on operational cost @12% PA	3525	4644	5647	7587	8316	8802	9075
6	Total Cost(1-5)	97670	111086	121782	140997	151002	158627	164008
7	Production (qtls)	0	0	0	43	79	207	311
8	Price (₹) per qtls	0	0	0	1043	1148	1292	1355
9	Gross returns	0	0	0	44849	90692	267444	421405
10	Net returns	97670	-111086	-121782	-96148	-60310	108817	257397
11	Return from inter cropping	28974	25463	24151	24080	19654	0	0
	Total net returns	-68696	-85623	-97631	-72068	-40656	108817	257397

Table.5 Net Present Value of Kinnow orchard in Haryana

Year	Negative returns (₹)	Positive returns (₹)	Discounting factor $1/(1+i)^n$	Present value	
				Negative returns (₹)	Positive Returns (₹)
1	68696		0.8929	61335.29	
2	85623		0.7972	68257.75	
3	97631		0.7118	69491.96	
4	72068		0.6355	45800.52	
5	40656		0.5674	23069.31	
6		108817	0.5066		55130.08
7 to 25		257397	3.7317		960528.38
Total	**364673**	**366214**		**267954.82**	**1015658.46**

NPV= 1015658.46 – 267954.82= 747703.64

Table.6 Internal rate of return of Kinnow orchard in Haryana

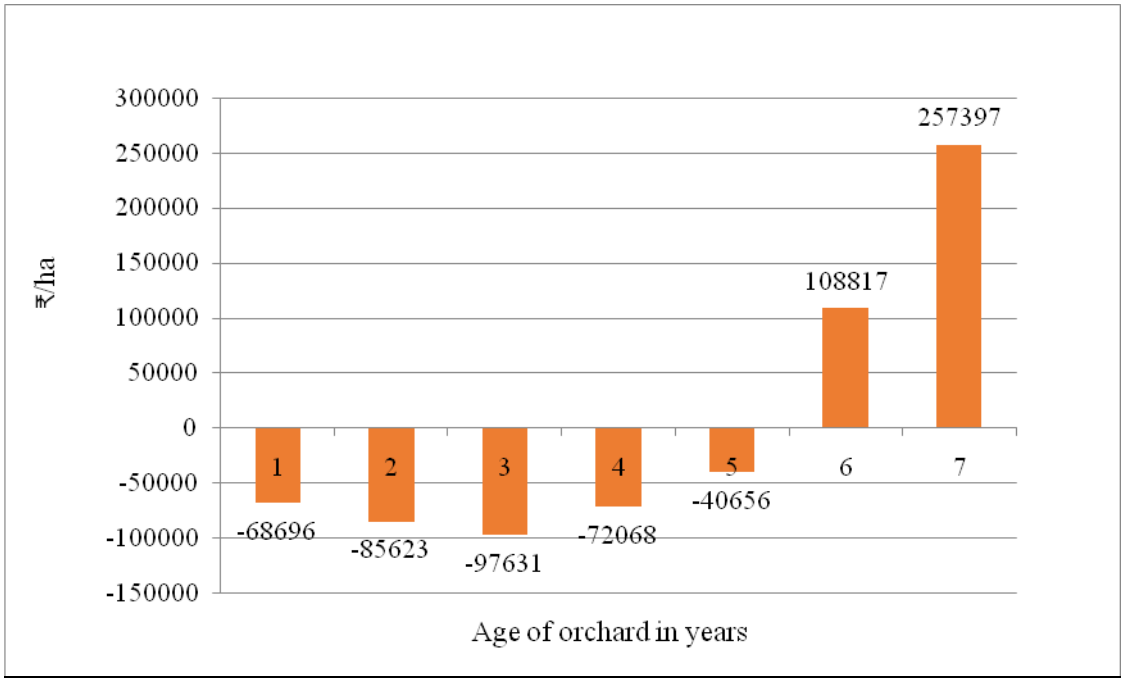
Year	Net cash flow (₹)	Present Value Coefficient r = 26% $[1/(1+r)^n]$	Corresponding Value (₹)	Present Value Coefficient r = 27% $[1/(1+r)^n]$	Corresponding Value (₹)
1	-68696	0.7937	-54520.25	0.8333	-57246.27
2	-85623	0.6299	-53932.05	0.6944	-59460.08
3	-97631	0.4999	-48806.42	0.5787	-56499.54
4	-72068	0.3968	-28593.04	0.4823	-34755.02
5	-40656	0.3149	-12801.83	0.4019	-16338.73
6	108817	0.2499	27194.02	0.3349	36442.59
7 to 25	257397	0.9493	244346.97	1.6221	417523.67
Total			**72887.41**		**229666.63**

IRR= 26+ 1 (72887.41) / (72887.41+229666.63) = 26.24

Table.7 Constraints faced by Kinnow growers in Sirsa district of Haryana

Constraints	Total score	Average score	Rank
Lack of provision of infrastructure like processing and storage	1844	61.47	1
Lack of availability of good quality planting material	1830	61.00	2
Lack of assistance for protected cultivation for nursery	1709	56.97	3
Lack of assistance for integrated post-harvest management	1700	56.67	4
Inadequate assistance for creation of water resources	1519	50.63	5
Inadequate facility for rejuvenation with improved cultivars	1434	47.80	6
Lack of assistance for organic farming	1390	46.33	7
Inadequate scope for horticulture mechanization	1323	44.10	8
Poor marketing facility	1222	40.73	9
Lack of promotion of INM and IPM	1029	34.30	10

Fig.1 Net returns from Kinnow orchard in Haryana



Constraints faced by the Kinnow growers

The response of farmers for various constraints encountered in cultivation of Kinnow were analysed through Garrett ranking technique. Majority of Kinnow growers in Sirsa district of Haryana expressed Lack of provision of infrastructure like processing and storage as major constraint followed by lack of availability of good quality planting material, lack of assistance for protected cultivation for nursery, integrated post-harvest management and inadequate assistance for creation of water resources. Other major constraints identified are inadequate facility for rejuvenation with improved cultivars, inadequate scope for horticulture mechanization, poor marketing facility and lack of promotion of INM and IPM (Table 7).

Conclusions and Policy implications are as follows:

The per hectare establishment cost of Kinnow orchard was found to be ₹ 122460. The average operational cost in the current year was found to be ₹ 75625. The payback period, B:C ratio, NPV, IRR were found to be 7years, 1:3.79, 26.24 % and ₹ 747703.64 respectively. Some major constraints which inhibiting the Kinnow cultivation were identified as lack of infrastructure for processing, storage, lack of better marketing facility, post-harvest management etc. Keeping in view the high profitability and constraints, it can be suggested to the government to focus more on infrastructural facilities for post-harvest management, ensure availability of quality planting materials to the farmers and provide better marketing facility in the study so that more income of the farmers' can be ensured.

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