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To study the production cost and return structure of kinnow orchard in North-Western region of Kangra district of Himachal Pradesh

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Abstract
The present study entitled, "An economic analysis of production and marketing of kinnow in Kangra district of Himachal Pradesh" was conducted during the agricultural year 2017-18. A sample of 100 kinnow growers was selected using multistage sampling technique. The sample farms were further categorized into small (up to 300 plants), medium (300-700 plants) and large (> 700 plants) based on number of plants. The primary data were collected through survey method by interviewing the kinnow growers directly through a well-designed pre-tested schedule. Initial cost of kinnow plantation per hundred plants was calculated as Rs. 7960.76 at overall level and was practically found almost same in all categories of farmers. The maintenance cost of non-bearing plants was Rs. 6970.74, Rs. 7702.84 and Rs. 8431.03 per hundred plants in the second to fourth year of age, respectively. Maintenance cost during bearing stage was estimated to Rs. 18706.04, Rs. 19292.84, Rs. 19437.39 and Rs. 18202.73 per hundred plants in the age groups of 5-8, 9-12, 13-16 and 17-20 years, respectively which showed an increasing trend up to 13-16 years of age group and then gradually decreased in the age group of 17-20 years. The payback period worked out to be of eight years among all farm categories with overall benefit-cost ratio of 1.45, internal rate of return (IRR) 17.48 per cent and net present value of Rs. 112369.90. These measures clearly indicated that kinnow cultivation is profitable in the study area.

Keywords: Kinnow production, economic analysis of kinnow, Kangra region

Introduction
Agriculture plays a vital role in India's economy. About 55 per cent of the rural households depend on agriculture as their principal means of livelihood. The share of agriculture and allied sectors is about 16 per cent to the country's GDP (Anonymous, 2017-18a) [6]. Fruits and vegetables account for nearly 90% of the total horticultural production in the country. India is the world's second largest producer of fruits with its projected value touching 98 million tonnes by the year 2020-2021 (Bhat *et al.*, 2011) [11]. In India, fruits are grown on an area of about 6.30 million hectares with an annual production of 92.84 million tonnes (Anonymous, 2017) [5]. Among different fruit crops, Citrus is the third largest fruit industry in India after Mango and Banana in terms of area under cultivation. After Mexico, India is the leading producer of citrus fruits with an area of about 1.06 million hectares and production of about 12.75 million tonnes annually (Anonymous, 2017) [5]. India alone has contributed 24% of the total world production of citrus fruits in the world (Anonymous, 2016) [4]. In Kangra district of Himachal Pradesh kinnow/orange are grown on an area of about 5736 hectares with annual production of about 10430 metric tonnes (Anonymous, 2016-17) [3]. Progressive farmers prefer to grow kinnow because of its high yielding characteristics and its attractive quality that possesses the potential to give the lucrative return in the form of profit. The extent of profitability of an enterprise also depends upon the efficiency of the marketing system. The expansion in the area and production alone in not an indicator of enhanced income, but its efficient marketing management is equally important to ensure better returns from the produce. It thus, becomes pertinent to review and analyze this farm activity in totality i.e. studying both production and marketing processes simultaneously, because they are partners of a progressive system. Therefore, efforts must be made to boost area, production and efficient marketing of the produce, which is possible only when a detailed cost & returns and marketing analysis is carried out systematically. Keeping in view the above facts, the present study was conducted to evaluate the costs & returns of kinnow cultivation in Kangra district of Himachal Pradesh.

Data and Methodology

A multistage sampling technique was adopted to select the ultimate sample of the respondents. At the first stage of sampling, out of total 15 blocks falling in the Kangra district, two blocks namely Indora and Nurpur were selected purposively as these are major kinnow growing blocks of the Kangra district. At the second stage, a list of villages growing kinnow in each selected block was prepared and ten villages from each block were selected randomly. At the third stage, list of farmers growing kinnow was prepared and a sample of five kinnow growers from each selected village was selected randomly to constitute a sample size of 100 farmers in total. For the analysis of data, the selected farmers were further categorized into three categories according to the number of plants, viz., small (<300 plants) medium (300-700 plants) and large (> 700 plants) through cumulative cube root frequency method. Thus, the total sample of 100 farmers consisted of 46 small farmers, 39 medium farmers and 15 large farmers.

Economic viability of Kinnow plantation

To evaluate the economic feasibility of investment in kinnow cultivation, economic indicators, viz., net present value, benefit cost ratio, annuity, internal rate of return and pay-back period have been worked out using following formulae:

a) Net Present Value: Net present value of an investment has been defined as the discounted value of all cash inflows, net of all cash outflows of the project during its life span and estimated by this formula:

$$NPV = \sum_{t=1}^{n} \frac{B_t - C_t}{(1+r)^t}$$

b) Benefit-Cost Ratio: The benefit-cost ratio of an investment is ratio of the discounted value of all cash inflows to the discounted value of all cash outflows during the life of the project, can be computed as:

$$B: C \text{ Ratio} = \frac{\sum_{t=1}^{n} \frac{B_t}{(1+r)^t}}{\sum_{t=1}^{n} \frac{C_t}{(1+r)^t}}$$

c) Annuity: Annuity value of the project is the annual expected income from the project. It was computed as follows:

$$A = \frac{NPV \times i \times (1+i)^t}{(1+i)^t - 1}$$

d) Internal rate of return: It is used to evaluate the overall feasibility of kinnow plantations in the study area. The internal rate of return is that discount rate at which the NPV is Zero. Derivation of the IRR is analogous to solving for 'rate of interest' in the equation given as under:

$$IRR = LDR + (\text{Difference between two discount rates}) \times \frac{\text{NPV of LDR}}{\text{Absolute difference between NPV of two discount rates}}$$

Where,
LDR = Lower discount rate

Pay-Back period: Pay-back period is the length of time required to recover the original investment on the project, through cash flow earned. Symbolically, the pay- back period equals t*, where t* is the lowest value of t for which the following inequality holds: $\sum_{t=1}^{t^*} C_t / (1+r)^t < \sum_{t=1}^{t^*} B_t / (1+r$

Costs and Returns of Kinnow Cultivation: The analysis of economics of production of Kinnow in the study area has been discussed under establishment cost which includes initial cost of plantation plus the cost of maintaining the kinnow plantation during non-bearing stage and expenditure incurred during bearing stage. The costs and returns were worked out on hundred plant basis under small, medium, large and for overall farm categories. For estimating the cost and returns estimates for kinnow, it has been assumed that: Total economic life of kinnow plantation is 20 years. First bearing start from 5th year onward. The major operation and input requirement remains same in the groups 5-8, 9-12, 13-16 and 17-20 year old plants. The mentioned groups are based on the physiological growth and productivity pattern of the plant.

Cost of Plantation: The item wise plantation cost of kinnow incurred in the initial year is presented in Table 1. It is imperative to examine the resource position of the growers before deciding to establish an orchard. It is clear from the table that, kinnow orchardists in study area incurred on an average, a total cost of Rs. 7960.76 per hundred plants, at the initial stage. The variable cost and fixed cost was found to be 62.45 and 37.55 per cent of total cost for all farms. In small, medium and large categories, the initial cost was Rs. 7748.35, Rs. 8071.30 and Rs. 8319.78, respectively. The variable & fixed costs accounted for 61.84 & 38.16 per cent, 62.71 & 37.29 per cent and 63.02 & 36.98 per cent in small, medium and large categories, respectively. In total variable cost, expenditure on planting material was highest and rental value of land was highest in total fixed cost.

Table 1: Initial costs of kinnow orchard on sample farms (Rupees/ 100 plants)

Sr. No.	Particulars	Establishment cost			
		Small	Medium	Large	Overall
1.	**Variable cost**				
i)	Family labour	1412.38	1378.85	1226.38	1388.62
ii)	Hired labour	64.95	305.53	537.38	229.64
iii)	Filling of pits (Soil & FYM)	738.92	753.20	782.23	741.84
iv)	Planting material cost	1921.12	1911.02	1919.81	1917.93
v)	Interest on working capital	109.00	118.79	129.58	115.58
vi)	Risk margin	272.50	296.98	323.94	288.94
vii)	Managerial cost	272.50	296.98	323.94	288.94
A.	Total variable cost	4791.37(61.84)	5061.35 (62.71)	5243.26 (63.02)	4971.49(62.45)
2.	**Fixed cost**				
i)	Land revenue	1.20	1.20	1.20	1.20
ii)	Annual depreciation	151.80	177.30	230.38	167.37
iii)	Interest on fixed capital	88.98	116.45	129.94	105.70
iv)	Rental value of land	2715.00	2715.00	2715.00	2715.00

B.	Total fixed cost	2956.98 (38.16)	3009.95 (37.29)	3076.52 (36.98)	2989.27 (37.55)
	Total cost (A+B)	7748.35 (100.00)	8071.30 (100.00)	8319.78 (100.00)	7960.76 (100.00)

Figures in parenthesis are percentages to total cost.

Maintenance cost during non-bearing stage of kinnow orchard

Kinnow growers have to incur expenditure on maintenance of the crop every year. The cost incurred after initial cost of plantation in first year up to bearing of fruit is categorised as maintenance cost during non-bearing stage of kinnow orchard. During this gestation period (up to 4 years) the orchardist does not get any return from the tree in the form of fruits. The maintenance cost of the kinnow tree per annum varies due to factors like age of the tree, insect and pest intensity, variety of the tree, canopy of the tree, source of irrigation, distance from the market etc. The item wise maintenance cost per hundred plants during non-bearing stage of kinnow orchard for small, medium, large and overall farms has been presented in Tables 1 to 5. The total maintenance cost of non-bearing kinnow plants has shown positive relationship with age of the plants and on small farms, it was estimated to be Rs. 6808.68, Rs. 7593.47 and Rs. 8304.82 for second, third and fourth year, respectively (Table 1). The total variable & fixed costs accounted for 50.88 and 49.12 per cent, 51.47 and 48.53 per cent and 51.06 and 48.94 per cent of total cost in second, third and fourth year, respectively, for small farms.

In case of medium category, maintenance cost during non-bearing stage for second to fourth year was estimated to be Rs. 7139.23, Rs. 7773.18 and Rs. 8516.73, respectively and total variable & fixed costs accounted for 52.19 & 47.81 per cent, 51.49 & 48.51 per cent and 51.17 & 48.83 per cent of total cost in respective years (Table 1). In large farms, maintenance cost was estimated to be Rs. 7156.33, Rs. 7800.69 and Rs. 8503.70 in second, third and fourth year, respectively (Table 1). In case of large farms, the variable & fixed costs accounted for 51.20 & 48.80 per cent, 50.64 & 49.36 per cent and 50.14 & 49.86 per cent of total cost in second, third and fourth year, respectively. In case of overall farms, maintenance cost during non-bearing stage was estimated to be Rs. 6970.74, Rs. 7702.84 and Rs. 8431.03 for second to fourth year, respectively and total variable & fixed costs accounted for 51.41 & 48.59 per cent, 51.50 & 48.50 per cent and 51.12 & 48.88 per cent of total cost in respective years.

The material cost of critical inputs like hired labour, FYM, fertilizer and chemicals for plant protection increased with the age of plants. Interest on working capital, risk margin, managerial cost, interest on past establishment cost was found to have positive relationship with the age during non-bearing stage of kinnow plantation. Family labour and FYM were the main components of total variable cost, while, rental value of land and interest on past establishment cost were the main components responsible for highest per cent share of fixed cost in the total cost. The same trend was observed among the various categories. Table

Maintenance cost during bearing stage of kinnow orchard

The grower has to invest on the maintenance of the kinnow orchards every year from the first bearing year to the last year of the life of the tree. Maintenance cost of the kinnow tree per annum varies due to factors like age of the tree, insect and pest intensity, canopy of the tree etc. To work out the maintenance cost during bearing stage of kinnow orchard in different farm categories the productive life of kinnow plants has been divided in four age groups with respect to relatively homogeneous productivity and input use etc., viz. 5-8 year, 9-12 year, 13-16 year and 17-20 year. Detailed analysis of maintenance cost per hundred plants of kinnow during bearing stage for small, medium, large and overall category farms has been carried out and presented in Tables 1 to 5.

The data in the Table 1 revealed that in case of small category of famers, maintenance cost per hundred plants was estimated to be Rs. 18511.31, Rs. 18858.57, Rs. 18986.51 and Rs. 18244.26 in bearing age groups of 5-8 year, 9-12 year, 13-16 year and 17-20 year, respectively. It was found that the total cost increased in age groups 5-8 year, 9-12 year and 13-16 year, respectively and then gradually decreased in age group 17-20 years of plantation. In case of medium farmers (Table 1) total cost varied between Rs. 18175.49 to Rs. 19729.27, while in case of large farmers (Table 1) it varied between Rs. 18158.73 to Rs. 20131.27 and at overall level (Table 1) it was worked out to be Rs. 18706.04, Rs. 19292.84, Rs. 19437.39 and Rs. 18202.73 in age groups 5-8 year, 9-12 year, 13-16 year and 17-20 year, respectively. The costs were found decreasing in the age group of 17-20 years in all the categories of farms. It may be due to the reason that the labour and material inputs were increasing with the growth of the plants up to the maturity in the age group of 13-16 years, after which the productivity of kinnow plants start decreasing and also use of material inputs also decreases.

The percentage share of variable costs in the total maintenance cost during bearing stage among different categories of farms and at overall level also showed an increasing trend up to the age group of 13-16 years and thereafter it declined in the age group of 17-20 years of plantation. However, fixed cost in percentage term to total cost exhibited declining trend up to the age group of 13-16 years and then increased in 17-20 years age group of plantation. Interest on working capital, risk margin, managerial cost was found to have positive relationship up to 13-16 year age group of kinnow plantation and thereafter, it decreased in age group of 17-20 years during bearing stage of kinnow plantation. Rental value of land and prorated establishment cost were the main components responsible for highest per cent share of fixed cost in the total cost. The same trend was observed among the various categories.

Returns from Kinnow cultivation

From the Table 1, it was observed that the average production per hundred plants was recorded highest in medium farm category (36.12 Qtls) followed by large farms (35.02 Qtls) and small farm category (34.96 Qtls). In case of overall farms, the average production was estimated to be 35.24 quintals. Among different age group and farm categories, the average production varies between 21.82 quintals in case of 5-8 year age group of large farm category to 42.63 quintals in age group of 13-16 year in case of small farm category. On overall basis, the average production showed direct relationship with the age of plant up to 13-16 year age group of plantation and after that it showed decreasing trend. This is because the kinnow plant attains maturity in the age group of 13-16 years of plantation and after that the yield diminishes as shown by age group of 17-20 years of plantation.

Table 2: Average production from different age groups of kinnow plants (Quintals/100 plants)

Farm categories	Age group				Average Production
	5-8 year	9-12 year	13-16 year	17-20 year	
Small	22.04	36.04	42.63	39.14	34.96
Medium	22.68	38.86	42.57	40.35	36.12
Large	21.82	38.21	41.32	38.74	35.02
Overall	22.05	37.35	42.28	39.29	35.24

The average gross returns in terms of money value (Table 2) were highest in case of medium farms category i.e. Rs. 87408.07 followed by large farms (Rs. 38525.10) and small farms (Rs. 38459.10). The overall average gross returns of kinnow were worked out to be Rs. 38767.10. On overall basis, the gross returns in different age groups also showed positive relationship with the age of plant up to 13-16 year age group and after that returns decreased as shown by 17-20 age group of plantation.

Table 3: Average gross returns from different age groups of kinnow plants (Rupees/ 100 plants)

Farm categories	Age group				Average Gross Returns
	5-8 year	9-12 year	13-16 year	17-20 year	
Small	24244.22	39644.36	46893.43	43054.39	38459.10
Medium	24948.23	42746.39	46827.43	44385.40	39726.86
Large	24002.22	42031.38	45452.41	42614.39	38525.10
Overall	24255.22	41085.37	46508.42	43219.39	38767.10

The results related to net returns per hundred plants (Table 3) revealed that average net returns were highest in case of medium farm category (Rs. 20652.21) followed by small farms (Rs. 19808.94) and large farms (Rs. 19309.46). The overall average net returns were worked out to be Rs. 19857.35. Among different age groups, for overall farms, the net returns were highest in 13-16 year age group and in 17-20 year of age group the net returns decreased due to decrease in production as shown in Table 3.

Table 4: Average net returns from different age groups of kinnow plants (Rupees/ 100 plants)

Farm categories	Age group				Average Net Returns
	5-8 year	9-12 year	13-16 year	17-20 year	
Small	5732.91	20785.79	27906.92	24810.13	19808.94
Medium	6232.60	23068.15	27098.16	26209.91	20652.21
Large	5030.38	22430.67	25321.14	24455.66	19309.46
Overall	5549.18	21792.53	27071.03	25016.66	19857.35

Economic viability of kinnow orchards

The principal objective of any plantation programme is to increase the productivity of land, to meet the basic requirements of rural population, to create employment opportunities in general and to promote socio-economic prosperity. Kinnow cultivation requires high capital investment for the establishment and maintenance of orchards. This high investment calls for the need to quantify the benefits and also evaluate the economic viability of such investment. The economic viability test of the kinnow orchard was designed to aid the decision-maker in deciding whether or not the economic benefits that occur from an investment were at least as high as the cost involved in the investment. Unlike, seasonal crops, in which returns are obtained within a year, the returns in kinnow start after a gestation period of four years. This indicates the need to estimate the value of returns by discounting future returns.

In order to assess the capital productivity for kinnow orchards, different techniques were used for finding comparative economic viability of kinnow cultivation. Further the comparative viability of kinnow orchards was analysed by working out benefits cost ratio, pay-back period, net present value (NPV), uniform annual returns and internal rate of returns. A discount rate of 10 per cent was used to estimate the present worth of the future income. These formulae provide the sound base for information to decision makers, whether to invest or not to invest. The results of the analysis have been presented in Table 4.

Table 5: Measures of investment worth per 100 plants of kinnow

Measures of investment worth	Farm categories			
	Small	Medium	Large	Overall
Benefit-cost ratio	1.46	1.47	1.42	1.45
Net present value (Rs.)	113814.95	115401.29	105375.78	112369.90
Uniform annual returns (Rs.)	9132.81	9260.10	8455.63	9016.85
Internal rate of return (%)	17.52	17.58	16.91	17.48
Payback period (years)	8	8	8	8

The results in the Table 5 revealed that pay-back period for kinnow plantation was estimated at 8th year for all the farm categories. The pay-back period of kinnow was found to be high in the study area because the production of kinnow was found to be lower in the beginning of the years. At overall level, NPV was estimated to be Rs. 112369.90 per hundred plants and across various farm categories NPV was found to be highest in medium farms (Rs. 115401.29) followed by small farms (1, 13, 814.95) and lowest in large farms (Rs. 105375.78). The internal rate of returns were estimated to be

17.48 per cent on overall farms indicates that investing in kinnow is financially desirable as long as the rate of interest on loan doesn't exceed 17 per cent. The results related to benefit cost ratio (B: C ratio) revealed that B: C ratio was found to be maximum in case of medium farm category (1.47) followed by small farm (1.46) and large farm category (1.42) and on overall farms, it was found to be 1.45. These results indicated that for all the categories of farms, B: C ratio was more than one which suggest that kinnow cultivation is economically profitable in the study area and each rupee spent on kinnow cultivation would yield return of Rs. 1.46, Rs. 1.47 and Rs. 1.42 in case of small, medium and large farms, respectively. On overall farm, it indicated that each rupee spent on kinnow cultivation would yield return of Rs. 1.45.

Conclusion and Discussion

- The analysis of cost and returns of kinnow in the study area revealed that initial cost of kinnow plantation per hundred plants was found Rs. 7960.76 at overall level. Total variable cost and total fixed cost was estimated at 62.45 per cent and 37.55 per cent of total cost, respectively. In total variable cost, expenditure on planting material was major component and rental value of land was highest in total fixed cost.
- The total maintenance cost during non-bearing stage of kinnow plants showed positive relationship with the age of plants, at overall level. The share of FYM was found highest followed by family labour cost in total variable cost while rental value of owned land contributed more in total fixed cost followed by interest on past establishment cost. Similar trend was observed among medium and large categories while in small category the share of family labour was more than FYM in total variable cost.
- Maintenance cost per hundred plants during bearing stage at overall level showed an increase in cost up to 13-16 years of plant age and thereafter, it start decreasing which is due to the decrease in production which lead to lesser labour requirement. The proportion of variable cost in total cost ranged from 69.88 to 71.80 per cent in different years. The per cent share of fixed cost in total cost varied from 28.20 per cent to 30.12 per cent in different age groups of plantation. Pro-rated establishment cost accounted for the maximum share in fixed cost and family labour accounted for maximum share in total variable cost.
- The yield at overall level was found to vary across age groups from 22.05 to 42.28 quintals per hundred plants. The gross returns on an average were ranged between Rs. 24255.22 to Rs. 46508.42 in different age groups of plants. The net returns varied between Rs. 5549.18 to Rs. 27071.03 among different categories of farm.
- Per hectare gross returns for overall farm category varied between Rs. 121276.10 to Rs. 232542.11 among different age groups of kinnow orchard. It was also found that net income per hectare of kinnow orchard becomes positive from 5-8 years of age group.
- The payback period worked out to be of 8 years among all the categories with overall benefit-cost ratio of 1.45, internal rate of return (IRR) of 17.48 per cent and net present value of Rs. 112369.90. These measures clearly indicated that kinnow cultivation in the study area is a profitable venture. In small, medium and large category, benefit-cost ratio was worked out be 1.46, 1.47 and 1.42, respectively.

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