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An economic evaluation of *kinnow* cultivation in north western India

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ABSTRACT

The present study analysed the primary data collected from 180 randomly selected *kinnow* growing farmers of three districts of Haryana and Punjab during the year 2016–17. It was revealed that *kinnow* cultivation in north western India has advantage over the traditional wheat-cotton farming; yielding 121.33% higher net return per ha. *Kinnow* cultivation involved lesser investment on irrigation, fertilizer and plant protection chemicals, but generated 12.78% higher employment than that of wheat-cotton farming system. *Kinnow* cultivation has proved out to be a viable enterprise. This is, therefore, empirically proven that it is a suitable option to diversify from the prevailing rice-wheat cropping system in certain parts of north western India.

Key words: *Kinnow* farming, Marketing channels, Marketing efficiency, Profitability

Climate change, deteriorating soil health and depleting groundwater in the north western India has posed stiff challenges to sustain crop production and farm income. The stagnation in productivity of irrigated crops in the region has forced the farmers to look for alternate cropping systems. Diversification towards fruit crops can be a vital strategy to reduce the soil fatigue, created by rice–wheat crop rotation system. Further, fruit crops have been identified as a major avenue for diversification in agriculture for improving sustainability, creation of employment opportunities, maintaining ecological balance, providing enormous export potential and above all achieving nutritional security in the long run (Hall *et al.* 2003, Gangawar *et al.* 2005, Bhat *et al.* 2011, Romana and Sachdeva 2015). India is the second largest producer of fruits in the world accounting for 10.9 % of world fruit production in the year 2016 (Government of India 2016). *Kinnow*, a hybrid of king and willow leaf mandarin (*Citrus nobilis* × *Citrus deliciosa*) was introduced in North India during 1947. It is more convenient to grow *kinnow* in frost prone, dry and arid areas, with less irrigation, as compared to sweet orange. India earns sizeable amount of foreign exchange by exporting *kinnow* to other countries of the world like Iran, Bahrain, Singapore, Nepal, Switzerland, Kuwait, Sri Lanka, Qatar etc. (Pal 2016). In view of umpteen importance associated with the crop, the study was undertaken to evaluate the profitability and comparative advantage of *kinnow* crop in order to suggest ways to improve profitability and to analyse the marketing channels.

MATERIALS AND METHODS

In north western India, three districts namely Fazilka and Bhatinda of Punjab, and Sirsa district of Haryana were purposively selected on account of these having highest area under *kinnow* cultivation. Further, one block having highest area under *kinnow* was selected purposively from each of the selected districts. Finally, 30 farmers were selected from each of the two cluster of villages (comprising of three villages) within each sample blocks. Thus, a total of 180 sample farmers were selected for this study. The field survey was done in the year 2016–17.

Various components of cost were computed under the two major categories, i.e. variable costs and fixed costs. The cost and return were calculated after classifying the sample *kinnow* orchards into various age groups, i.e. 1, 2, 3, 4-5, 6-8, and 9-25 years as suggested by Sidhu *et al.* (2012), Kaur and Singla (2016). For estimating annual cost, the depreciation has been worked out @4% per annum of the fixed investment (i.e. establishment cost) by applying straight line method or direct method, assuming the productive life of orchard as 25 years. The annual amortised cost was computed for the investment made on establishment of *kinnow* orchard, assuming the rate of interest at 12% per

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annum as suggested by Varkey and Kumar (2013).

$$I = B \frac{r}{1-(1+r)^t}$$

where, I, Annual cost (in ₹); B, Fixed cost (in ₹); r, Interest rate (12 % per annum) and t, Economic life of *kinnow* orchard (in years).

The marketing efficiency of different marketing channels have been computed by following Acharya's method (Acharya and Agarwal 2005) and is given by the formula:

$$\text{Marketing efficiency} \frac{FP}{MC + MM}$$

where, FP, Net price received by farmer; MC, Total marketing cost of all intermediaries; MM, Total marketing margin of all intermediaries

The growth and instability of area, production and productivity of *kinnow* was analysed for two periods, i.e 2004–10 as period I and 2010–15 as period II. Instability index of area, production and productivity of *kinnow* was computed using Cuddy-Della Valle Index which is given by the formula:

$$CDVI = CV^* \sqrt{(1-\overline{R}^2)}$$

where, CDVI, Instability index in percent; CV, Coefficient of variation; $\overline{R}^2$, Coefficient of determination from a time trend regression adjusted for the number of degrees of freedom.

RESULTS AND DISCUSSION

Status of kinnow in Punjab: In Punjab, the area under *Kinnow* crop has increased from 0.25 lakh ha in 2007–08 Triennium ending (TE) to 0.47 lakh ha in 2014–15 TE; recording a very high growth of 9.3% per annum. The production of *kinnow* also increased from 0.44 million tonnes to 1.03 million tonnes during the same period recording a growth of 12.7% per annum. The result shows that area and production grew substantially due to higher adoption of *kinnow* mandarin in Punjab.

The growth in area (20.14% per annum), production (30.18% per annum) and productivity (8.95% per annum) was high in the first half of the study period, i.e. 2004–10. During 2010–11 to 2014–15, the per annum growth rate in area, production and productivity was 4.17, 6.03 and 1.88%, respectively. It is the area growth which has been the main driver of production growth. The instability index shows that the productivity of *kinnow* has higher instability compared to that of production and area. The instability in productivity was high during the first half (5.23%) of the study period of 2004–10 but was much lower in later period (2.31%). This may be because of the rapid expansion in area under *kinnow* and most of the orchard were new and had not reached the stable yield phase. However, the low instability in area, production and yield during the overall period (2.57%) reflects low risk associated with the crop which could be one of the reasons for its widespread adoption in north western region of India especially in Punjab state.

Profitability of kinnow orchard: Kinnow cultivation is a capital-intensive farming involving investment cost of ₹ 70476 per ha. The major expenditure is on cost of fencing and planting materials which accounts for 49.7 % and 19.8 % of total cost, respectively. Cost of digging and filling (9.3 %), land preparation and layout (8.6 %) and filling material (4.64 %) were other major components of the establishment cost. The amortised establishment cost was estimated to be ₹ 8854.The *kinnow* involves investment on maintenance of the orchards throughout its economic life which depends on age of the orchard. There is significant increase in operational cost during initial years and reaches its peak from 9th year onwards after which the crop attains stability in yield. The age wise maintenance costs of average *kinnow* orchard are indicated in Table 1 and reveals that among different components of operational costs, pruning and cutting constituted the major share in *kinnow* cultivation. Total amount spent on pruning and cutting charges on average farm varied from 703 ₹/ha in 1st year to 8886 ₹/ha for the age group of 9-25 years.

Cost of watch and ward ranged from 4962 ₹/ha for 4 year old orchard to 7432 ₹/ha for 9 year old *kinnow* orchard. Irrigation expenses varied from 1137 ₹/ha to 3275 ₹/ha for 1st and 9-25 years age group of orchard. The operational cost varied from 5137 ₹/ha for one year old orchard to 52678 ₹/ha for 9-25 years old orchard. It is, thus, revealed that *kinnow* cultivation is an input intensive enterprise.

The net income for the first five years of plantation is negative and turned positive afterwards and has reached the highest for 9-25 years old orchard (Table 2). The per ha average annual gross cost, annual gross income and net annual income (returns) during the stable yield phase of

Table 1 Operational cost of kinnow orchard (% to total cost)

Particular	Age group kinnow orchard (Years)					
	1st	2nd	3rd	4-5th	6-8th	9-25th
Manure and fertilizers	22.72	21.67	21.07	17.32	15.35	12.52
Intercultural operation*	13.0	13.6	12.0	7.4	11.8	12.9
Irrigation	19.91	21.50	20.86	10.40	8.12	5.59
Pruning and cutting*	13.7	13.3	17.3	11.9	14.6	16.9
Plant protection ch micals (PPC)	8.57	10.55	11.56	8.08	10.19	10.31
Replacement	6.58	3.89	1.94	0.44	-	-
Watch and ward*	-	-	-	25.2	20.7	14.1
Staking*	-	-	-	-	-	2.9
Picking*	-	-	-	6.1	6.4	12.5
Labour cost towards fertilizer, irrigation, PPC & replacement	6.42	6.38	6.15	4.03	3.74	3.16
Interest on working capital	9.1	9.1	9.1	9.1	9.1	9.1
Total cost (₹/ha)	5137	5874	7621	19662	31241	52678

* indicates labour intensive activities.

Table 2 Cost and returns of kinnow orchard (₹/ha)

Particular	Age group kinnow orchard (year)					
	1	2	3	4-5	6-8	9-25
Rental value of land	50000	50000	50000	50000	50000	50000
Depreciation	1572	1572	1572	1572	1572	1572
Amortized cost	8854	8854	8854	8854	8854	8854
Fixed cost	60426	60426	60426	60426	60426	60426
Operational	5137	5874	7621	19662	31241	52678
Total cost	65563	66300	68047	80088	91667	113104
Yield of kinnow (q/ha)				70	177	274
Return from kinnow				69300	175230	271260
Return from intercrop	52393	45176	33226			
Gross return	52393	45176	33226	69300	175230	271260
Net return	-13170	-21124	-34821	-10788	83563	158156
B:C ratio						2.39

orchard (9-25 years) was ₹ 113104, ₹ 271260 and ₹ 158156, respectively with a B:C ratio of 2.39.

Comparative economics of alternate cropping system: wheat-cotton system: The operational cost of cotton-wheat system was 122530 ₹/ha (Table 3). The major component of operational cost was labour which accounted for 42% of total cost, followed by plant protection chemicals (12%). The net return from the cotton-wheat system was 71455 ₹/ha. The feasibility of cotton-wheat system as assessed through B:C ratio was 1.58. However, the *kinnow* crop was observed to give 121.33% higher net return per annum over cotton-wheat cropping system. This clearly indicates that *kinnow* cultivation is more profitable than existing cotton-wheat cropping pattern.

It was found that *kinnow* cultivation involved less investment than prevailing cropping system on irrigation (55.71%), fertilizer (4.52%) and plant protection chemicals (32.27%) and required 12.78 % higher investment on labour. The wheat and cotton are marketed using the administered market price and profitability depends on the production practice and yield, whereas *kinnow* is faced with open market system with price and market risk.

Marketing channel of kinnow: Five types of *kinnow* marketing channels were observed in the study area. Among them the channel I "Producer-pre harvest contractor-wholesaler-retailer-consumer" was the most dominant channel dealing with 70% of the total marketed *kinnow*. Marketing channel V "Producer–modern retail outlet-consumer" is the most innovative marketing channel that has emerged and accounted only 2%. In channel-IV, the farmers directly sell to consumers and it accounts for 5 % of total *kinnow* traded. In channel III, farmers take the produce to the regulated market (APMC) and sell it to the whole seller,

Table 3 Cost of cultivation in wheat and cotton (₹/ha)

Particular	Wheat	Cotton	Total
Operational cost			
Labour cost	6375	22816	29191
Machine cost	5025	1750	6775
Seed	2522	3856	6378
Fertilizer cost	3539	3368	6906
Plant protection chemicals	3506	4509	8016
Irrigation	3175	3481	6656
Interest on working capital	1690	2984	4673
Sub-total	25832	42764	68595
Fixed cost			
Rental value of own land	25000	25000	50000
Depreciation on fixed capital	1164	1063	2227
Interest on fixed capital	905	802	1707
Sub-total	27069	26865	53935
Grand total	52901	69630	122530
Gross returns	70888	123098	193985
Net returns	17987	53469	71455
B:C ratio	1.38	1.77	1.58

which accounts for 10 % of total produce traded.

The price realized by the farmers is highest under marketing channel V (₹ 1426) and is lowest for marketing channel I and II with ₹ 990. It is observed from Table 4 that the producer's share in consumer's rupee is highest in channel V (100 %) followed by channel IV (48.68 %), channel III (41.34 %), channel II (35.61 %) and channel I (31.78 %).

The usefulness of different marketing channels of *kinnow* was analysed through marketing efficiency. The marketing efficiency in channel V was 0.92, due to the absence of intermediaries there was direct contact between producer and consumer and sale price of producer was equal to purchase price of consumer. The marketing efficiency was lowest at 0.32 for channel I. Increase in number of intermediaries in the value chain reduced the producer's share in consumer's rupee and marketing efficiency and vice versa, similar results were reported by Prakash *et al.* (2018). Farmers empowerment through collectivization in the form of SHGs, FPOs, FIGs etc., has immense scope to shift the farmers from less efficient to more efficient marketing channel as less than 10 % of the farmers are disposing the *kinnow* crop through more efficient marketing channels IV and V.

Kinnow has emerged as a profitable enterprise in north-western India and has recorded an impressive growth in area and production. However, the productivity growth has remained moderate. The net income increases consistently from fruit bearing stage and stablizes from the age group of 9 years of plantation. It gave more than double net return over the prevailing cropping system of cotton-wheat of the region. The feasibility of kinnow production system as measured through B:C ratio was also higher than prevailing

Table 4 Price spread of kinnow under different marketing channels in Punjab (₹/quintal)

Market intermediaries	Particulars	Marketing channel				
		I	II	III	IV	V
Farmer	Price received	990	990	1288	1485	1550
	Marketing cost	-	-	155.66	142.27	123.77
	Net price or margin	990	990	1132.34	1342.73	1426.23
Pre harvest contractor	Purchase price	990	990			
	Marketing cost	157.59	155.66			
	Sale price	1660	2780			
	Net margin	512.41	1608.15			
Wholesaler	Purchase price	1660		1288		
	Marketing cost	222.93		189.45		
	Sale price	2335		2335		
	Net margin	1437.07		800.79		
Retailer	Purchase price	2335	2335	2335	1485	
	Marketing cost	96.49	72.95	96.49	80.92	
	Sale price	3115	2780	3115	3050	
	Net margin	683.51	372.05	683.51	1404	
Consumer	Purchase price	3115	2780	3115	3050	1550
Marketing efficeincy measures	Producer share in consumer rupees	31.78	35.61	41.34	48.68	100
	Total marketing cost	477.01	235.38	441.60	223.19	123.77
	Acharya's marketing efficiency	0.32	0.45	0.58	0.83	0.92

cropping system. The marketing efficiency was highest in "Producer–modern retail outlet-consumer" marketing channel in comparision to other four marketing channels due to the absence of intermediaries and higher sale price. The prodcuer's share in consumer's rupee was also the highest in this channel. *Kinnow* cultivation has proved out to be a profitable and viable enterprise. This is, therefore, empirically proven that it is a suitable option to diversify away from the prevailing rice-wheat cropping system in certain parts of north western India. It is suggested that farmers should be educated and enabled to adopt modern marketing channel for better price realization and higher share of consumers' rupee. Therefore, cultivation of *kinnow* should be promoted through contract farming and development of processing infrastructure as an option for horticulture based diversification from rice-wheat cropping system in certain parts of north western India.

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