Economic analysis of commercial tomato nurseries

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ABSTRACT

The present study attempts to estimate the demand potential of tomato seedlings in Karnataka and economic viability of establishing commercial nurseries in poly-house condition. To accomplish these objectives, 10 nurseries each were selected from Southern Transitional Zone, Northern Transitional Zone and Central Dry zone of Karnataka. The study indicated the existence of annual demand of 62.10 crores of tomato seedlings in Karnataka. To meet this demand, establishment of commercial nursery is inevitable. In this regard, investigation on capital investment and its profitability was assessed employing capital budgeting techniques. The result indicated that entrepreneurs have invested Rs. 10,66,705 towards setting up of nursery in an area of 1000m² poly-house. The economic analysis revealed that entrepreneurs have realized gross returns of Rs. 1,65,528 and net returns of Rs. 50,438 per time. In a year, tomato nursery was raised for eight times considering demand for seedlings and the associated gross returns and net returns were Rs. 13, 24,224 and Rs. 4, 03,504, respectively. The capital investment on commercial nursery was found to be economically viable in terms of positive Net Present Worth (Rs. 2121346), Discounted Benefit Cost Ratio of more than unity (1.22) and Internal Rate of Return of 103 per cent.

Tomato is an important vegetable crop mainly propagated by seeds. It plays vital role in up-liftment of farming community through its prolific yield potential. Farmers in the state mainly depend on this crop for cash income. Tomato production involves two stages *viz.,* nursery and main field. The nursery is a pre-requisite for quality seedling production. Traditionally the tomato seedlings used to be produced on raised bed nursery. Farmers discontinued this method of nursery due to expensive seed material, high incidence of pests and diseases, high rate of mortality and non-uniform growth of seedlings. Nowadays, due to government intervention, technological support by public and private organizations, nurseries are picking up on an entrepreneurial mode. These nurseries are raised in protected structures due to easy monitoring, uniform growth of seedlings, fewer incidence of pests and diseases and lower rate of mortality. Of late, majority of farmers rely on commercial nurseries for tomato seedlings. Their reliance on commercial nursery advances tomato cultivation by 21 days and avoids risk of managing nursery. Since, commercial nurseries for tomato are fewer in number, their establishment in tomato growing regions will not only help prospective tomato growers to avail healthy seedlings but also promote entrepreneurial ability among tomato growers as well as nursery men. Besides, commercial nurseries could supply quality seedlings of different varieties as desired by the farmers. Hence, the present study is an attempt to estimate the demand potential of tomato seedlings in major tomato growing regions and also to examine economic feasibility of establishing commercial nurseries of tomato.

MATERIALS AND METHODS

The present study was taken up in Karnataka state having an area of 0.64 lakh hectares with annual production of 20.31lakh tons (Ramappa and Manjunatha. 2016). Tomato is cultivated in Kolar, Davangere, Belgaum, Haveri, Mandya and Mysore districts of Karnataka accounting for about 55 per cent of the total area in the state. Demand for tomato seedlings in the above mentioned districts and state as a whole was estimated considering annual growth rate in area under tomato in respective districts and per hectare requirement of seedlings as recommended in package of practice. The compound annual growth rate (CAGR) in area was worked out using exponential model. The district wise secondary data on area under tomato from 2004 to 2014 was obtained from Directorate of Economics and Statistics, Bangalore. The details of exponential model and calculation of CAGR is detailed below (Sathyendra Kumar and Chandrashekar, 2015),

$$Y_1 = \beta_0 \beta_1^t e^{U_1}$$

Y_t = Area under tomato in hectares during 't' time period in major districts and state

β_0 = Intercept

β_1 = Slope coefficient

t = Time in years (2004-2014)

u_t = Stochastic term

The estimable form of the model was obtained by natural logarithmic transformation. The parameters of

the model were estimated using ordinary least squares *i.e.,* Ln = $Y_t = \ln\beta_0 + t\,in\beta_1 + U_t$

The compound annual growth rate (CAGR) in area was obtained from the expression given as CAGR = (antilog $(\ln\beta_1) - 1) * 100$

The growth in area under tomato for the subsequent year was determined by adding actual area under tomato in the previous year with actual area times compound annual growth rate *i.e.,* Area under tomato in 2015-16= Area under tomato in 2014-15 + CAGR X Area under tomato in 2014-15. For instance, the CAGR in area under tomato for Davangere district was 15.15 percent and the area during preceding year was 5587 hectares. The growth in area for the succeeding year will be 5587 x 0.1515= 846 hectares. Hence, the total area under tomato in the succeeding year will be 5587+846 = 6433 hectares. The demand for seedlings is estimated by considering total area in succeeding year and seedlings requirement per hectare as recommended in the package of practice, IIHR, Bangalore (9289 seedlings hectare⁻¹ at spacing of 1.2 x 0.9 m).

In order to meet the total requirement of seedlings, commercial nurseries employing modern techniques of raising seedlings are essential. In this regard, an attempt was made to examine whether investment on commercial nurseries is economically rewarding or not using budgeting technique. In order to accomplish this objective, sample of 10 nurseries from each of the zone *viz.,* Southern Transitional Zone, Central Dry Zone and Northern Transitional Zone in Karnataka were selected. The feasibility of investment on tomato seedling production under poly-house condition was ascertained by employing discounted and undiscounted cash flow measures (Murthy *et al.,* 2009). The discount rate of 12 per cent was considered in the present study since it is close to opportunity cost of capital in India.

Discounted cash flow measures

Net Present Worth (NPW) :

$$\sum_{t=1}^{15} \frac{B_t}{(1+r)^t} - \sum_{t=1}^{15} \frac{C_t}{(1+r)^t}$$

Discounted Benefit Cost Ratio (DBCR):

$$\frac{\sum_{t=1}^{15} \dfrac{B_t}{(1+r)^t}}{\sum_{t=1}^{15} \dfrac{C_t}{(1+r)^t}}$$

where,

B_t is the benefit stream of the project in 't' period
C_t is the cost stream of the project in 't' period,
r is the discount rate assumed as 12 per cent (opportunity cost of capital),
t is the life span of the project (15 years),
Internal Rate of Return (IRR): LDR + (HDR-LDR)*

$$\left(\frac{\text{NPW at LDR}}{\text{NPW at LDR} + \text{NPW at HDR}} \right)$$

LDR: lower discount rate is the discount rate which leaves positive NPW, HDR: Higher discount rate is the discount rate which leaves negative NPW

Profitability index :

$$\frac{\text{NPW at O C of capital (12\%)}}{\text{Initial investment}}$$

Undiscounted cash flow measures

Pay Back Period (years) :

$$\frac{\text{Initial investment}}{\text{Annual net cash revenue}}$$

Proceeds per rupee of outlay :

$$\frac{\text{Total proceeds from the project}}{\text{Total amount of investment on the project}}$$

Average proceeds of rupee outlay:

$$\frac{\text{Average proceeds per year}}{\text{Initial investment on the project}}$$

RESULTS AND DISCUSION

The growth rate in area of tomato in major districts of Karnataka is depicted in table 1. There was a positive and significant growth rate in area under tomato in all the districts except Kolar, which has registered negative growth rate (-2.08%).

Table 1: Estimated demand for tomato seedlings in Karnataka

Districts	Area under tomato in 2014-15 (ha)	CAGR in area (%)	Increase / Decrease in area during 2015-16 (ha)	Estimated area in 2015-16 (ha)	Estimated demand for tomato seedlings (crores)
Kolar	10086	-2.08	-210	9876	9.14
Belgaum	6340	3.82	242	6582	6.09
Davangere	5587	15.15	846	6433	5.96
Haveri	5192	4.93	256	5448	5.04
Mandya	3917	4.39	172	4089	3.79
Mysore	3504	3.02	106	3610	3.34
Karnataka	64325	4.27	2747	67072	62.1

Incidentally this is the district where tomato crop is extensively cultivated. Farmers of this district are innovative and entrepreneurial and cultivate tomato in large quantities. The excess production led to decline in the prices. This phenomenon is more or less regular every year putting the tomato growers to hardship. The volatile price situation has prompted the farmers of Kolar district to reduce area under tomato. The positive growth was observed in other districts such as Davangere (15.15%), Haveri (4.93%), Mandya (4.39%), Belgaum (3.82%), Mysore (3.02%) and state as a whole (4.27%) (Sathyendra kumar and Chandrashekar, 2015). Based on the estimates of growth rate in area under tomato, increased/ decreased area under tomato in the subsequent year (2015-16) was estimated for major tomato growing districts and state as a whole. Increased area under tomato was observed in all the districts except Kolar. The magnitude of increase in area under tomato in the state was 2747 hectares. The increased area under tomato in major districts ranged from 106 hectares in Mysore to 846 hectares in Davangere whereas, Kolar district registered decrease in area (210 hectares). Incremental increase/ decrease in area during subsequent year (2015-16) was added to the area in preceding year (2014-15) to obtain expected area under tomato in 2015-16. Using this estimate, potential demand for tomato seedlings in major districts and state was estimated considering per hectare seedling requirement as recommended in package of practice (Anon., 2014). Accordingly, seedling requirement in Karnataka for an area of 67072 hectares was 62.10 crores. The estimated demand for tomato seedlings was the highest in Kolar district (9.14 crores) followed by Belgaum (6.09 crores), Davangere (5.96 crores), Haveri (5.04 crores), Mandya (3.79 crores) and Mysore (3.34 crores). In order to meet this massive demand, establishment of commercial nurseries is imminent to facilitate scientific cultivation of tomato. Hence, there is a vast potential for entrepreneurship in tomato nursery.

The capital investment on commercial tomato nursery under protected condition includes investment on poly-house structure, cladding material, construction charges, irrigation facilities and other minor assets (Table 2). The total capital investment on commercial nursery of 1000 m^2 capable of keeping 2200 protrays (98 seedlings tray^{-1}) was Rs. 10,66,705. Poly-house structure alone accounted for 45.28 per cent of the total investment (4,82,990). Next in the order were construction charges sharing 22.80 per cent of total investment. Investment on polysheet/cladding material was another important item which worked out to Rs. 1,30,900 (12.27%) meant for roofing the structure. Land

area of 1000 m^2 was essential for establishing nursery with an investment of Rs. 1,25,000 (11.72%). Investment on irrigation infrastructure came to Rs. 78,010 accounting for 7.31 per cent of total investment. It is essential for continuous supply of water during nursery management. The investment on other accessories accounts to Rs. 6565 (0.62%).Thus, the investment on poly-house structure inclusive of irrigation infrastructure was Rs. 9,35,140. The Government provides 50 per cent subsidy which accounts to Rs. 4,67,570. Hence, the net investment made by the farmer in establishing commercial nursery was Rs. 5,99,135.

Table 2: Capital Investment on commercial tomato nursery in poly-house condition

#	Particulars	Quantity (No.)	Rate (Rs.)	Value (Rs.)	Share (%)
1	Land			125000	11.72
2	Borewell			45480	4.26
3	Irrigation pumpset			32530	3.05
4	Polyhouse structure			482990	45.28
5	Cladding material			130900	12.27
6	Construction charges			243240	22.80
7	Irrigation cans	2	300	600	0.06
8	Knapsack sprayer	1	2565	2565	0.24
9	Baskets	5	250	1250	0.12
10	Spades	3	250	750	0.07
11	Pickaxes	4	200	800	0.07
12	Sickles	4	150	600	0.06
	Total investment			1066705	100.00
	Subsidized investment			467570	
	Net investment (Total investment -Subsidized investment)			599135	

Economics of commercial nursery of tomato under protected condition is given in the table 3. The polyhouse structure erected on 1000 m^2 land could accommodate 2200 trays. Each tray accommodates 98 seeds. The total cost of raising nursery on 1000 m^2 area came to Rs. 1,15,090. The variable cost constituted 80.54 per cent and rest was accounted for by fixed cost (19.46%). The major variable costs were cost of trays (Rs. 26400), followed by labour cost (Rs. 24225), seed material (Rs.21000) and enriched cocopit (Rs. 16500). About 80.75 mandays of labour were required to raise nursery on 1000 m^2 area. Labours were required to perform operations such as preparation of pot mixture (cocopit + culture of *Trichoderma* and *Pseudomonas*), filling of trays with pot-mixture, sowing of seeds, irrigation, weeding and application of plant protection

chemicals. Filling of trays with pot mixture, sowing and irrigation were the labour intensive operations. Cocopit of 1650 kgs valued at Rs. 16500 @ Rs. 10 per kg and 700 g of seed worth at Rs. 21000 @ Rs.30g^{-1} was used to raise nursery on 1000 m^2 area. If farmers purchase seeds of private company then the expenditure could have been two- three times higher than the existing one. Sterilized and enriched cocopit was used as a media as it is less prone to soil borne diseases, has better water retention capacity and is environment friendly. Among fixed costs, depreciation on polyhouse structure, polysheet, borewell and pumpset was Rs. 9514 (8.27%). Interest at the rate of 12 per cent per annum on net investment made by farmers on commercial nursery *ie*., Rs. 5,99,135 was Rs. 7112 (6.18%). Rental value of land was accounted at its opportunity cost which came to Rs. 5750 (5%). The total number of seedlings available for marketing after accounting for 5 per cent mortality was 2,06,910. The average cost per seedling worked out to Rs. 0.56. The gross returns from commercial nursery estimated at Rs. 165528 @ Rs. 0.80 per seedling. The net returns per seedling came to

Rs.0.24. Farmer could raise tomato nursery for eight times per year considering demand for seedlings and realize gross returns of Rs. 13,24,224 and net returns of Rs. 4,03,504.

Economic viability of investment on tomato nursery in protected condition: Scientific tomato seedling production required huge investment of Rs.10.66 lakhs. Whether the investment on commercial nursery is rewarding or not was examined employing discounted and undiscounted cash flow measures. Discounted measures used were net present worth (NPW), benefit cost ratio (BCR) and internal rate of returns (IRR) and undiscounted measures were pay-back period (PBP), proceeds per rupee of outlay and average proceeds per rupee of outlay (Anon. 2012). The details pertaining to these measures are presented in table 4. As indicated by NPW, the investment on tomato seedling production under poly-house condition generated wealth of Rs. 21,21,346 over its life period duly accounting for inflation. Positive NPW indicated the economic viability of investment on commercial nursery. Another measure used to judge the viability of investment on

Table 3: Economics of commercial tomato nursery in poly-house condition

	Particulars	Quantity (No.)	Rate (Rs.)	Value (Rs.)	Share (%)
1	Labour cost				
a	Preperation of pot culture (Cocopit+*Trichoderma*+*Pseudomonas*)	7.5 mds	300	2250	1.95
b	Filling of trays with pot culture	42 mds	300	12600	10.95
c	Irrigation	26.25 mds	300	7875	6.84
d	Application of plant protection chemicals	2.5	300	750	0.65
e	Weeding	2.5	300	750	0.65
2	Seeds	700 g	30 g^{-1}	21000	18.25
3	Cocopit	1650 kgs	10kg^{-1}	16500	14.34
4	Pseudomonas culture	5 kgs	100kg^{-1}	500	0.43
5	Trichoderma culture	20 kgs	150kg^{-1}	3000	2.61
6	Trays	2200	12 tray^{-1}	26400	22.94
7	Plant protection chemicals			265	0.23
8	Interest on working capital @ 7% per annum apportioned per crop			804	0.70
9	Total variable cost			92694	80.54
10	Depreciation			9514	8.27
11	Land revenue			20	0.02
12	Land rent			5750	5.00
13	Interest on fixed capital @12% per annum apportioned per crop			7112	6.18
14	Total fixed cost			22396	19.46
15	Total cost			115090	100.00
16	Cost per seedling			0.56	
17	Total number of seedlings sold			206910	
18	Selling price per seedling			0.8	
19	Total returns			165528	
20	Net returns			50438	
21	Profit per seedling			0.24	

project was BCR which was 1.22 indicating that project generates returns of Rs. 1.22 for every rupee of investment. The IRR was another DCF provides the earning capacity of money invested in the project. The IRR was 103 per cent indicating that project generates returns of 103 per cent on its investment over its life period. IRR was much higher than the opportunity cost of capital justifying economic worthiness of investment on commercial tomato nursery. The farmers/ entrepreneurs willing to invest on commercial nurseries can borrow credit from commercial banks/cooperatives/ RRBs at opportunity cost of 12 per cent and invest on commercial nursery to earn returns at the rate of 103 per cent. Further pay- back period was estimated to be 2.64 years indicating that the initial investment on nursery could be recovered with in a period of 2.64 years. The other undiscounted measures such as proceeds per rupee of outlay and average proceeds per rupee of outlay were estimated to be 1.23 and 1.76, respectively. The profitability index was also estimated and it worked out to 1.99.

Marketing of tomato seedlings: Organized marketing system for tomato seedlings is lacking. The only marketing channel existing for marketing of seedlings is nursery man → tomato grower. The farmers procure required seedlings from nursery and transport it to their main field for transplanting. Farmers buy seedling at Rs. 0.80 and incur Rs. 0.05 per seedling towards transportation and mortality. The farmers have to travel longer distances to procure seedlings as there are no commercial nurseries in the vicinity.

Table 4: Economic feasibility of investment on commercial tomato nursery in poly-house condition

Discounted and undiscounted cash flow measures	Magni-tude
Net Present Worth (NPW) @ 12%	2121346
Discounted Benefit Cost Ratio (DBCR)	1.22
Internal Rate of Returns (IRR)	103%
Profitability index	1.99
Pay Back Period (PBP) in years	2.64
Proceeds per rupee of outlay	1.23
Average proceeds per rupee of outlay	1.76

The study was undertaken in Southern Transitional, Northern Transitional and Central Dry Zone of Karnataka to examine the economic feasibility of establishing commercial tomato nurseries. The economics of tomato nursery was worked out using budgeting technique. The economic analysis has showed that the per seedling cost worked out to Rs.0.56. The gross returns and net returns per seedling worked out to Rs. 0.8 and Rs.0.24, respectively. The seedling production in poly-house condition was economically viable as evident from discounted and undiscounted measures of cash flow. Thus, seedling production under protected structure was found to be profitable venture drawing the attention of prospective entrepreneurial farmers to go in for this and make fortunes.

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