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Area and seedlings forecast of tomato and economic analysis of nursery in Karnataka

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Abstract
Tomato is one of the important vegetable crops cultivated in India. Karnataka is one of the leading producers with 64250 hectare area during 2018-19. The cultivable area of tomato is heavily influenced by the market price prevailing in the previous year. In this connection, the current study taken up to estimate the area under tomato cultivation and to estimate the demand for the seedlings for the year 2019-20 with the help of Compound Annual Growth Rate (CAGR) analysis. The cost and returns pattern of tomato seedling production also worked out. Both secondary and primary data were collected to fulfill the objectives of the study. The results indicated that, Karnataka state as a whole requires 161.13 crores of tomato seedlings for an estimated area of 65259.04 hectare for the next year 2019-20. Production of seedlings under shade net house is a profitable venture as each seedling earns ₹ 0.22 net-profit. Investing in tomato nursery is economically feasible and financially viable as reflected by magnitude of different project evaluation techniques. Huge competition among the nurseries and lack of credit facilities are identified as major constraints in raising tomato seedlings.

Keywords: Area, estimates, demand, nursery and profit

Introduction
Horticulture plays an important role in nutritional security for the consumers and it's a source of livelihood to the millions of the famers. India serves as the home of various kinds of vegetables, fruits and holds a vital position in the field of production of fruits and vegetables amidst different countries of the world. The vegetables are the main sources of nutrition and are being consumed by the all class of people *viz.*, poor to rich class of people. Karnataka is one of the leading state in India in production of vegetables. During 2017-18, the area under total horticultural crops was 21.09 lakh ha and production was 213.90 tonnes whereas vegetable crop occupies an area of 4.83 lakh ha with a production of 83.94 tonnes in Karnataka. The vegetable area occupies 23.92 per cent to the total horticultural area in the state whereas production accounts 39.39 per cent to the total horticultural production (http://nhb.gov.in) [9]. Tomato is an important vegetable crop mainly propagated by seeds. It plays important role in upliftment of farmers in socio-economic status. Production of tomato consists of two steps. The first step is to raise healthy seedlings under nursery and secondly transplanting in to the main field. Raising healthy seedlings under good nursery management is an important part of successful vegetable production, especially for tomato, pepper, eggplant and other crops that are commonly transplanted Lin *et al.* (2015) [1]. The nursery is pre-requisite for good quality seedling production. Bharati and Ravishankar (2018) [2] defined as a vegetable nursery is a place or an establishment for raising or handling of young vegetable seedlings until they are ready for more permanent planting. Traditionally earlier these seedlings were produced on the raised beds under open condition; farmers discontinued this method of nursery due to high incidence of pest and diseases, high mortality and non-uniform growth of seedlings. Seedlings have to be protected from adverse temperature, heavy rains, drought and wind along with pest and diseases. Nowadays due to quality assurance, many nurseries are picking up on an entrepreneurial mode. These nurseries are raised in protected structures due to easy monitoring, uniform growth of seedlings, minimum incidence of pests and diseases and lower rate of mortality by Patil *et al.* (2017) [3]. Hence, majority of the farmers who are cultivating tomato are depends on nurseries for quality seedlings. The establishment of these modern nurseries in vegetable growing regions will not only help growers to avail healthy seedlings but also promote agripreneurial ability among growers as well as nursery men. The area under tomato cultivation is highly volatile due to many reasons. Hence, the present study is an attempt to estimate the demand potential of tomato seedlings in

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Major growing regions and also to examine economic feasibility of establishing nurseries under shade net condition.

Methodology
The present study was taken up in the state of Karnataka as Karnataka is one of the leading tomato producing state. Tomato is being cultivated in all most all districts of Karnataka. The demand for theses seedlings in major growing districts and state as a whole was estimated using Compound Annual Growth Rate (CAGR) in area under these crops and per hectare requirement of seedlings on the basis of spacing recommended in package of practice suggested by Anonymous (2014) [8]. The CAGR in area was calculated with exponential model. The secondary data on area with respect to major tomato growing districts was collected from Directorate of Economics and Statistics, Bengaluru from 2010-11 to 2018-19 (http://des.kar.nic.in/)[10]. The method of exponential model and computation of CAGR is detailed below by Sathyendra Kumar and Chandrashekar (2015) [4]. The primary data on investment pattern, cost-returns structure and constraints faced in raising tomato seedlings was collected with the help of pre-tested questionnaire. The primary data was collected by 30 owners of sample nurseries consisting 10 from each district *viz.*, Belagavi, Koppal and Kolar in Karnataka as these districts comprises major area of tomato cultivation.

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

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 (2010-11 to 2018-19)
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

$$\text{i.e., Ln} = Y_t = \ln\beta_0 + t\ln\beta_1 + U_t$$

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 these vegetables in the previous year with actual area times compound annual growth rate i.e., Area under tomato in 2019-20=Area under tomato in 2018-19 + CAGR × Area under tomato in 2018-19 by Patil et al (2017) [3]. For instance, the CAGR in area under tomato for Karnataka state was 1.57 percent and the area during preceding year was 64,250 hectares. The growth in area for the succeeding year will be 64,250 × 0.0157= 1009 hectares. Hence, the total area under tomato in the succeeding year will be 64,250 +1009 = 65,259 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 suggested by Anonymous (2014) (24,691 seedlings hectare[-1] at spacing of 0.9×0.45 m).
In order to meet the total demand of seedlings, nurserymen are employing modern techniques of raising seedlings. In this regard, an attempt was made to examine whether investment on enterprise is economically feasible or not using project evaluation technique. In order to fulfill this objective, sample of 10 nurseries from each of the disticts viz., Belagavi, Koppal and Kolar in Karnataka were selected. The feasibility of investment on tomato seedling production under shade-net house was determined by using discounted and undiscounted cash flow techniques by Murthy *et al*. (2009) [5]. The discount rate of 12 per cent was considered in the present study, since it is close to opportunity cost of capital in India. The research was based on both primary and secondary data. The primary data was collected from the owners of the selected nursery entrepreneurs for the agricultural year 2019-20. The secondary data were collected from Directorate of Economics and Statistics, Bengaluru.

Discounted cash flow measures

$$\text{Net Present Worth (NPW)} = \sum_{t=1}^{15} \frac{B_t}{(1+r)^t} - \sum_{t=1}^{15} \frac{C_t}{(1+r)^t}$$

$$\text{Benefit Cost Ratio (DBCR)} = \frac{\sum_{t=1}^{15} \frac{B_t}{(1+r)^t}}{\sum_{t=1}^{15} \frac{C_t}{(1+r)^t}}$$

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)

$$\text{Internal Rate of Return (IRR)} = \text{LDR} + (\text{HDR-LDR}) \times \left(\frac{\text{NPW at LDR}}{\text{NPW at LDR + NPW at HDR}} \right)$$

LDR is lower discount rate is the discount rate which leaves positive NPW and HDR is Higher discount rate is the discount rate which leaves negative NPW.

Undiscounted cash flow measures

$$\text{Pay Back Period (years)} = \frac{\text{Initial investment}}{\text{Annual net cash revenue}}$$

Results and Discussion
Estimation of area under tomato and seedlings demand in Karnataka
The growth rate in area of tomato in major growing districts of Karnataka is shown in Table 1. There was a positive and significant growth rate (1.57 per cent per annum) in area of tomato in Karnataka state as a whole even though few major growing districts shown negative growth rate i.e., -4.13 per cent for Belagavi, -0.24 per cent for Kolar and -1.59 per cent for Haveri. Bidar and Chikkaballapura districts witnessed significant and positive growth rate to the tune of 7.71 per cent and 0.89 per cent per annum during the study period 2010-11 to 2018-19. Increased tomato production in Karnataka state in recent past led to decline in the prices especially in Belagavi, Kolar and Haveri districts. The farmers of these districts were technically sound and had entrepreneurial qualities to cultivate tomatoes in large quantities. High fluctuation in the tomato price is more or less common in the market. The price volatility of tomatoes led the farmers to reduce the area under tomato cultivation. Increase or decrease in area under tomato crop in the

subsequent year 2019-20 was estimated for major growing districts and state as a whole based on the estimates of growth rate of the study period. Increased area under tomato was observed in Karnataka state as a whole during the year 2019-20 to the tune of 1009 hectare. The increased area under tomatoes in major growing districts ranged from 36.95 hectare in Chikkaballapura to 448 hectare in Bidar district. Contrary to this, Belagavi, Kaolar and Haveri districts have registered decline in the area to the tune of 326 hectare, 326 hectare and 14 hectare respectively.

Incremental increase or decrease in the area under tomato for the next year (2019-20) was added to the area of preceding area (2018-19). Using this estimated area for the year 2019-20, the potential demand for tomato seedling were estimated in major growing districts and in the state as well. Considering per hectare seedling requirement as per the spacing recommended in the package of practice suggested by Anonymous (2014). Accordingly, seedling required for the year 2019-20 for the state of Karnataka for an area of 65,259 hectare was 161.13 crores. The estimated demand for tomato seedlings was highest in Belagavi district (18.69 crores) followed by Bidar (15.48 crores), Kolar (14.42 crores), Chikkaballapura (10.37 crores) and Haveri (9.69 crores).

Table 1: Estimated demand for tomato seedlings in Karnataka

Districts	Area under Tomato in 2018-19 (ha)	CAGR (%) in area from 2010-11 to 2018-19	Increase / Decrease in area during 2019-20 (ha)	Estimated area in 2019-20 (ha)	Estimated demand for Tomato seedlings (Crores)
Belagavi	7897	-4.13	-326.51	7570.49	18.69
Kolar	5854	-0.24	-14.10	5839.90	14.42
Haveri	3987	-1.59	-63.41	3923.59	9.69
Bidar	5821	7.71	448.79	6269.79	15.48
Chikballapura	4161	0.89	36.95	4197.95	10.37
Karnataka total	64250	1.57	1009.04	65259.04	161.13

Establishment cost of shade net house

The initial investment on commercial nursery of tomato under low-cost protected condition (shade net) given in Table 2. This whole structure includes investment on shade net house, irrigation pump set, digging bore well & motor, construction charges, irrigation facilities and other minor assets. The total capital requirement on profitable tomato nursery activity of 1000 m^2 capable of raising 3965 portrays (98 celled seedlings in a portray) was ₹ 5,18,099. Shade net structure alone constituted 59 per cent (₹ 3,05,678) of the total investment followed by construction charges sharing 24.51 per cent (₹ 1,26,988) of total investment. Investment on irrigation facilities was ₹ 45,568 accounting 8.80 per cent of total investment. It is necessary to supply water to portrays daily during nursery rising. The investment on other miscellaneous accounted around ₹ 12,020 (2.32%). Thus total investment on establishment of tomato nursery under shade net house was ₹ 5,18,100. The Dept. of Horticulture, Government of Karnataka provides 50 per cent subsidy which accounts to ₹ 2,59,050. Hence, the net investment made by entrepreneur in establishing profitable nursery was ₹ 2,59,050.

Table 2: Investment structure on tomato nursery in shade net condition (1000 m^2/annum)

Sl. No.	Particulars	Quantity (No.)	Rate (Rs.)	Value (Rs.)	Share (%)
1	Bore well			27845	5.37
2	Irrigation pump set			45568	8.80
3	Shade net structure			305678	59.00
4	Construction charges			126988	24.51
5	Rose cans/ hose pipe	5	420	2100	0.41
6	Knapsack sprayers	2	2760	5520	1.07
7	Baskets	5	350	1750	0.34
8	Spade	3	300	900	0.17
9	Pickaxes	3	250	750	0.14
10	Sickles	5	200	1000	0.19
11	Total Investment			518099	100.00
12	Subsidized amount			259050	
13	Net Investment			259050	

Costs and returns structure for raising tomato seedlings under shade net house

The economics of marketable nursery of tomato under shade net condition is depicted in table 3. The shade net structure installed on 1000 m^2 land could accommodate 3965 protrays. The total cost of raising nursery seedling on 1000 m^2 worked out to ₹ 2,29,860. The variable cost constituted ₹ 1,54,303 (67.19 %) and rest was accounted for fixed cost i.e., 32.87 per cent (₹ 75,557). The major variable cost was cost of portrays (₹ 37,668), followed by seed (₹ 29,750), labour cost for both men and women (₹ 40,000) and coco peat (₹ 12,888). Among fixed costs, depreciation on tank, pipe, pump set, pump house, sprayer, including shade net etc was accounted ₹ 32,381 and interest on fixed capital was worked out at the rate of 12 per cent on investment made by the entrepreneur commercial nurseries i.e., ₹ 8,095. The rental value of land was accounted 5 per cent of total fixed cost (₹ 35,000 per year). The gross returns from sale of 3965 trays of tomato seedlings at the rate of ₹ 80 per tray was accounted ₹ 3,17,200. The net returns worked out was ₹ 87,340. The average cost per seedling worked out to be ₹ 0.59 and net returns per seedling came to ₹ 0.22. Linganagouda and Mahajanasetti (2016) [6] reported similar results from seedling production under hi-tech condition. Depending on the demand from farming community, nursery entrepreneur can raise the seedling eight to nine times in a year.

Table 3: Cost & returns of tomato seedling production under shade net condition (1000 m²/annum)

Sl. No.	Particulars	Quantity (No.)	Rate /unit (Rs.)	Value (Rs.)	Share (%)
	I. Variable cost (A)				
1	Tomato seed (kg)	850 gm	35/gm	29750	19.28
4	Protrays with 98 cells (no.)	3965	9.5 / tray	37668	24.41
5	Coco peat (kg)	2148	6	12888	8.35
6	Fertilizers (kg)	25	245	6125	3.97
7	PPCs (kg)	29	567	16443	10.66
8	Men labour	80	250	20000	12.96
9	Women labour	100	200	20000	12.96
10	Interest on working capital (8%) (Rs.)			11429.88	7.41
11	Total variable cost (A)			154303	100.00
	II. Fixed cost (B)				
12	Rental value of land (Rs.)		35000	35000	46.32
13	Land revenue (Rs.)		80	80	0.11
14	Depreciation on tank, pipe, pump set, pump house, sprayer, including shade net etc			32381	42.86
15	Interest on FC (12 %) (Rs.)			8095	10.71
16	Total fixed cost (B)			75557	100.00
17	Total cost (A+B) =C			229860	
	Returns				
18	Tomato seedlings trays (no.)	3965	80	317200	100.00
21	Gross Income (D)			317200	100.00
22	Net income = D-C (Rs.)			87340	
23	Cost per seedling (Rs.)			0.59	
24	Profit per seedling (Rs.)			0.22	

Financial feasibility of investment tomato nursery
To evaluate the feasibility of investment in tomato nursery, the criteria such as net present value, benefit cost ratio, payback period and internal rate of return were employed and the results were presented in table 4. Net present worth is the difference between the present value of series of inflow (returns) and outflows (costs) over the economic life period of the nursery enterprise. The net present worth was 2,63,134 for 1000 m² area at the rate of 12 per cent discount rate. Thus it could be concluded that investment in tomato nursery enterprise was economically feasible and financially sound. The higher magnitude of net present value may be attributed to the fact that the initial investment and maintenance costs in tomato nursery enterprise have been lower in relation to returns.

Benefit cost ratio is the criterion indicates the rate of return per rupee invested in tomato nursery enterprise. The benefit cost ratio at 12 per cent discount rate was 1.38 which was more than unity and indicated that investment in tomato nursery enterprise was financially viable. Thus, it could be concluded that investment in tomato nursery enterprise was economically feasible and financially viable. Similar findings were reported by Ashoka *et al* (2017) [7] observed that the benefit-cost ratio for investment in jasmine garden. This could be because of less initial investment for establishment of tomato nursery. The value of IRR generally depends on the magnitude of returns realized in each year over the economic life period and more particularly in the initial years of tomato nursery enterprise. It may be noted here that, the IRR was found to be very high, compared to the opportunity cost of capital or rate of interest paid on borrowed capital. Hence, the investment in nursery enterprise was highly profitable, economically feasible and financially viable. Further, payback period was estimated to be 2.97 years indicating that the initial investment on nursery could be recovered with a period of 2.97 year.

Table 4: Economic feasibility of investment on tomato nursery in shade net condition

Discounted & Undiscounted criterion	Magnitude
Net Present Value @ 12%	263134
Benefit-Cost Ratio	1.38
Internal rate of Returns	96
Pay Back Period	2.97

This clearly indicated that it would take nearly three years to recover the entire investment. However, this criterion neglects the net returns realized by the farmers in the subsequent years which may be more significant in the case of long term enterprise like tomato nursery enterprise. This clearly indicated that a shorter period of less than three year would be required to get back the initial investment. This could be attributed to the fact that the initial investment itself was lower, besides a higher rate of returns.

Marketing of tomato seedlings
Organized marketing mechanism of tomato seedling is lacking. The only one marketing channel existing for marketing of tomato seedling is nursery entrepreneur → tomato farmer.

Problems in raising and marketing of tomato seedling
Opinion survey was conducted about the production and marketing constraints of tomato seedling nursery and the results were presented in table 5. From the table, it could be observed that all the 90 per cent of entrepreneurs have expressed huge competition among other nurseries as major problem. Lack of organized credit facility was the second major problem which was expressed by 83.33 per cent of the entrepreneur. The other problems were lack of availability of labour on continues basis to the tune of 76.67 per cent, mortality of seedling (66.67%), water scarcity (60.00%), pest & disease incidence (53.33%) and sale of seedlings (50.00%) as tomato seedlings have time bound demand. Matured seedlings are rejected by the growers.

Table 5: Problems faced by tomato nursery entrepreneurs

Sl. No.	Particulars	No. of nursery enterpreneurs	percentage
1	Water scarcity	18	60.00
2	Labour availability	23	76.67
3	Mortality of seedling	20	66.67
4	Sale of seedlings	15	50.00
5	Lack of technical guidence	9	30.00
6	Lack of credit facility	25	83.33
7	Competition among nurseries	27	90.00
8	Pest and Disease incidence	16	53.33

Conclusion

The area under tomato cultivation and the demand for tomato seedlings are highly dependent on market price prevailing in the previous year. Recently, tomato farmers prefer the seedling from nurseries rather than rising on their own because of healthy, uniformity and vigor seedling. The time period require to raise the seedling takes 20-25 days. If there is sudden increase in demand for the seedlings, nurseries should be able to raise and supply the required number of seedlings at right time. Seedling raising under shade net house was economically viable as indicated by net profit per seedling (₹ 0.22) and it is also supported by project evaluation techniques i.e., positive net worth, comfortable B:C ratio and more IRR (96%). Thus, tomato seedling production under shade net condition was found to be profitable activity gaining interest of eventual entrepreneurs.

Acknowledgement

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