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Demand and Supply of Cut Flowers Production in Krishnagiri District of Tamil Nadu- An Approach by Data Envelopment Analysis

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ABSTRACT

Background: India has been bestowed with wide range of climate and physio-geographical conditions making it suitable for growing various kinds of horticultural crops. Out of which the awareness on usage of cut flowers for various occasions has raised the demand for cut flowers in the market, especially Tamil Nadu. The overall objective of the study is to estimate the demand and supply of cut flowers in Tamil Nadu.

Methods: Hosur block in Krishnagiri district of Tamil Nadu was purposively selected as it is the leader in area and production of rose flowers. A two-stage random sampling method was adopted to select the sample farms with a total sample size of 120. Simple percentage analysis and Data Envelopment Analysis were used to discuss the results.

Result: The important period of demand for cut flowers in Hosur block are events like Navratri, Christmas, New Year, Valentine Day, Therthiruvizha, Ramjan and Bakrith. There were 164 days in a year which would be auspicious. On an average 450 bunches of rose, 320 bunches of gerberas and 150 bunches of carnations are used in an event in addition to some other flowers. The technical efficiency measures for Roses indicated that most farmers belonged to the least efficient category (<90 per cent) with a proportion of 62.50 per cent to total.

Key words: Cut flowers, Demand and supply, Date envelopment analysis, Technical efficiency.

INTRODUCTION

India has been bestowed with a wide range of climate and physio-geographical conditions and as such is most suitable for growing various kinds of horticultural crops such as fruits, vegetables, flowers, nuts, spices and plantation crops. Floriculture products mainly consist of cut flowers, pot plants, cut foliage, seeds bulbs, tubers, rooted cuttings and dried flowers or leaves (APEDA, 2016). The important floricultural crops in the international cut flower trade are rose, carnation, chrysanthemum, gerbera, gladiolus, gypsophila, liatris, nerine, orchids, archilea, anthurium, tulip and lilies. Floriculture crops like gerberas, carnation, *etc*. are grown in greenhouses. The open field crops are chrysanthemum, roses, gaillardia, lily marigold, aster, tuberose *etc*. (APEDA, 2017). Nowadays improved communication facilities have increased their availability in every part of the country. Usman *et al*., 2015 in his study pointed that about 305,105 ha area is under flower production in different countries of the world, of which the total area in Europe is 44,444 ha, followed by North America (22,388 ha), Asia and Pacific (215,386 ha), the Middle East and Africa (2,282 ha) and Central and South Africa (17,605 ha). Flowers are also grown under protected greenhouses in different countries around the world (46,008 ha). India has the maximum area under ornamental crops (88,600 ha) followed by China (59,527 ha), Indonesia (34,000 ha), Japan (21,218 ha), USA (16400 ha), Brazil (10285 ha), Taiwan (9.661 ha), The Netherlands (8,017 ha), Italy (7.654 ha), the United Kingdom (6,804 ha), Germany (6,621 ha) and Colombia (4,757 ha). Globally more than 145 countries are involved in the cultivation of ornamental crops and the area under these crops has been increasing steadily. Production of flowers are estimated to be 1659 thousand tons loose flowers and 484 thousand tons cut flowers in 2016-17. The country has exported 20703.46 MT of floriculture products to the world for the worth of Rs. 507.31 crores/ 78.73 USD Millions in 2017-18 (APEDA, 2017). Major Export destinations are USA, Netherland, UK, Germany and United Arab Emirates were major importing countries of Indian floriculture during the same period.

The awareness on usage of cut flowers for various occasions has raised the demand for cut flowers in the

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market. It is expected to grow at a CAGR of 3.9% during 2020-2027 (Dublin, 2020). The production of cut flowers went up to 6,902 million stems during 2011 from 2,071 million stems in 2017 and this was due to the improvement in the standard of living and quality of life which ultimately increased the growth of domestic and export markets. Tamil Nadu holds potential scope for promotion and demand for cut flowers.

Objectives of the study

The overall of objective is to study the production and marketing of major cut flower crops and the specific objective of this paper is to

1. To estimate the demand and supply of cut flowers in Krishnagiri.
2. To estimate the annual income of the cut flower farmers.
3. To find out technical efficiency of cut flower production.

MATERIALS AND METHODS

In Tamil Nadu Hosur is a leading area and production of rose flowers in the country (Mathivanan 2013). Hosur block in Krishnagiri district was purposely selected as the universe of the study, since the area under cut flower crops in this block was found to be the highest with 325.57 hectares among all the blocks present in Krishnagiri district. Hosur block consists of 30 revenue villages. A two-stage random sampling method was adopted to select the sample farms. At the first stage, twelve revenue villages were selected at random. At the second stage, all the farmers in each of the selected revenue villages were arranged and 10 farmers were selected at random from each of the selected twelve revenue villages, thus constituting a total sample size of 120 farmers. The households were post-stratified into three groups based on the income level. Households with annual income of below Rs.25 lakhs were categorized as low-income group, households with annual income between Rs.25 lakhs and Rs.50 lakhs were included under middle income group and those with annual income exceeding Rs.50 lakhs were included under high income group.

Tools of analysis

1. Simple percentage analysis
3. Data envelopment analysis

Data envelopment analysis

The DEA method is a frontier method that does not require specification of a functional or distributional form and can accommodate scale issues. This approach was used by Forsund (2007) as a piecewise linear convex hull approach to frontier estimation.

Data envelopment analysis

Empirical model

$$Min\ \theta, \lambda\ \theta$$

$$\text{Subject to} \quad -y_i + Y\lambda \geq 0$$
$$\theta x_i - X\lambda \geq 0$$
$$\lambda \geq 0 \qquad \text{.....(1)}$$

Where,

yi is a vector (m x 1) of output of the i^{th} crop producing farms,

xi is vector (k x1) of inputs of the i^{th} crop producing farms,

Y is an output matrix (n x m) for n crop producing farms,

X is the input matrix (n x k) crop producing farms,

θ is the efficiency score, a scalar whose value will be the efficiency measure for the i^{th} crop producing farms. If $\theta = 1$, crop producing farms will be efficient, otherwise, it will be inefficient and

λ is a vector (n x 1) whose values are calculated to obtain the optimum solution.

For an inefficient crop producing farms y values will be weights used in the linear combination of other, efficient crop producing farms, which influenced the projection of the inefficient crop producing farms on calculated the frontier.

The specification of constant returns is only suitable when the firms work at the optimum scale. Otherwise, the measures of technical efficiency can be mistaken for scale efficiency, which considers all the types of returns to production, *i.e.*, increasing, constant and decreasing. The measure of technical efficiency obtained in the model with variable return is also named as “pure technical efficiency”, as it is free of scale effects. The following linear programming model estimated is:

$$Min\ \theta, \lambda\ \theta$$

$$\text{Subject to} \quad -y_i + Y\lambda \geq 0$$
$$\theta x_i - X\lambda \geq 0$$
$$N1\ \lambda = 1$$
$$\lambda \geq 0 \qquad \text{.....(2)}$$

Where,

N_1 is a vector (n x 1) of ones.

Tyteca (1996) adapted Färe *et al*. (1989) to derive environmental efficiency scores by measuring the degree to which the pollution variable could be reduced given the fixed levels of inputs and desirable outputs. The scale efficiency values for each analyzed unit can be obtained by the ratio between the scores for technical efficiency with constant and variable returns as follows:

$$\theta s = \theta CRS\ (XK, YK) / \theta VRS\ (XK, YK) \qquad \text{.....(3)}$$

Where,

θCRS (XK, YK) = Technical efficiency for the model with constant returns,

θVRS (XK, YK) = Technical efficiency for the model with variable returns and

θs = Scale efficiency.

It was pointed out that model (2) makes no distinction as to whether crop producing forms is operating in the range of increasing or decreasing returns (2005). The only information one has is that if the value obtained by calculating the scale efficiency in equation (3) is equal to one, the crop producing farms will be operating with constant returns to scale. However, when θs is smaller than one, increasing or decreasing return can occur. Therefore, to understand the nature of scale inefficiency, it is necessary to consider another problem of linear programming, *i.e.* the

convexity constraint of model (2), N1 $\lambda = 1$, is replaced by N1 $\lambda \leq 1$ for the case of non-increasing returns, or by N1 $\lambda \geq 1$ for the model with non-decreasing returns. Therefore, in this work, the following models were also used for measuring the nature of efficiency.

Non-increasing returns:

$$\begin{aligned} &Min\ \theta, \lambda\ \theta \\ &\text{Subject to} \quad -y\,i + Y\,\lambda \geq 0 \\ &\qquad\qquad \theta\,x\,i - X\,\lambda \geq 0 \\ &\qquad\qquad N1\ \lambda \leq 1 \\ &\qquad\qquad \lambda \geq 0 \end{aligned} \qquad \text{.....(4)}$$

Non-decreasing returns:

$$\begin{aligned} &Min\ \theta, \lambda\ \theta \\ &\text{Subject to} \quad -y\,i + Y\,\lambda \geq 0 \\ &\qquad\qquad \theta\,x\,i - X\,\lambda \geq 0 \\ &\qquad\qquad N1\ \lambda \geq 1 \\ &\qquad\qquad \lambda \geq 0 \end{aligned} \qquad \text{.....(5)}$$

It is to be stated that all the above model should be solved n times, *i.e.* the model is solved for each crop producing farms in the sample.

Production was used as an output (Y) in the present case and seeds/planting materials, farmyard manure (tones/ha), chemical fertilizer (Kg/ha), human labour (man days/ha), machine labour (hrs/ha) and plant protection chemicals (lit/ha) as inputs.

RESULTS AND DISCUSSION

Average productivity of major crops

The measure of productivity is defined as a total output per hectare. Productivity of cut flowers is furnished in Table 1. It could be seen from the table that the productivity of Gerbera was highest with 556 thousand bunches per hectare followed by Carnation with 296 thousand bunches per hectare and lastly Rose with 237 thousand bunches per hectare, respectively.

Table 1: Productivity of cut flowers. (In'000 bunches per ha.)

Cut flowers	Productivity
Rose	237
Gerbera	556
Carnation	296

Demand and supply of cut flower production

Demand assessment in Hosur

The flower market of Hosur exhibits strong seasonality in demand. The marriage season is the most important influencing factor of demand for flowers throughout the year. The other important period of demand are festivals like Navratri, Christmas, New Year, Valentine Day, Therthiruvizha, Ramzan and Bakrid *etc.*, Because of this, price at consumer level generally increases from December onwards till March and then starts declining and is lower during the monsoon period of June-August. Hence an attempt is made to assess the demand in Hosur, for the cut flowers especially Rose, Gerbera and Carnation.

The important consumption points of cut flowers are decoration of the venue of functions, hotel decorations, bouquet and garland making and house decorations. Of all the consumption points, the first category of activity occupied the major share of the total requirement in the Hosur. The event under this category depends on the auspicious days according to the calendar events. It is assessed that the number of events that occur on a very auspicious day may even exceed 800 in the city.

The estimated domestic demand of Rose, Gerbera and Carnation cut flowers in Hosur is presented in Table 2. It is clear from the table that, on conservative side, there could be on an average about 350 events happening in the city on any auspicious day. In addition to this there are major festival events happening around the year and it was also noted from the calendar that about 164 days in a year were auspicious or during which some event or function or celebration happened in the city.

Based on the interaction with traders, it was ascertained that in the study area (Hosur) on an average, 450 bunches of Roses, 320 bunches of Gerberas and 150 bunches of Carnations were used in an event in addition to some other flowers. Based on these assumptions the total demand was worked out for the three cut flowers. Accordingly, the demand for Rose was 258 lakh bunches, the demand for Gerbera was 183 lakh bunches and the demand for Carnation was 86 lakh bunches and the combined demand was 527 lakh bunches.

Present supply in Hosur

Currently there are around 350 green houses in and around Hosur. The standard size of each greenhouse adopted by

Table 2: Demand estimation of Rose, Gerbera and Carnation.

Domestic Demand Estimation of Rose, Gerbera and Carnation cut flowers in Hosur				
Particulars	Units	Total estimated demand		
		Rose	Gerbera	Carnation
Number of auspicious days per year during which maximum functions take place	164			
Average number of events happening in the city on each of the auspicious days	350			
Average consumption of flowers per event	Number of bunches of twenty stems each	450 lakhs	320 lakhs	150 lakhs
Total demand	Number of bunches of twenty stems each	258 lakhs	183 lakhs	86 lakhs
Combined demand		527 lakhs		

farmers is 1000 sq.mts. Among all the cut flowers, the major flowers grown in this area are Rose, Gerbera and Carnations because of the favourable climate and geographical conditions. Among these, Rose is cultivated in the majority of the green houses followed by Gerbera and Carnations. As seen from the table, there was huge demand - supply gap and presently it was met by neighbouring states like Karnataka. The said gap was highest in Rose with 244 lakh bunches followed by Gerbera with 174 lakh bunches and lastly with 81 lakh bunches of Carnation. The combined demand - supply gap was 499 lakh bunches of cut flowers in Hosur (Table 3).

Technical efficiency in rose, gerbera and carnation farms

It could be observed from the Table 4 that the level of technical efficiency for Rose farm ranged from 48.70 to 100.00 with mean efficiency of 85.10 per cent in constant return to scale. The mean level of technical efficiency indicated that 14.90 per cent of Rose farmers are falling short of the maximum possible level of technology. Scale of efficiency ranged from 70.60 to 100.00 with mean efficiency of 92.90 per cent. For Gerbera, the level of technical efficiency for Gerbera farm ranged from 60.30 to 100.00 with mean efficiency of 83.70 per cent. The mean level of technical efficiency indicated that 16.30 per cent of Gerbera farmers are falling short of the maximum possible level of technology. Scale of efficiency ranged from 55.40 to 100.00 with mean efficiency of 87.10 per cent.

For Carnation, the level of technical efficiency ranged from 56.00 to 100.00 with mean efficiency of 79.20 per cent. The mean level of technical efficiency indicated that 20.80 per cent of Carnation farmers are falling short of the maximum possible level of technology. Scale efficiency ranged from 63.00 to 100.00 with mean efficiency of 90.70 per cent.

The frequency distribution of technical and scale efficiency measures for Rose, Gerbera and Carnation is furnished in Table 5. The technical efficiency measures for Roses indicated that most farmers belonged to the least efficient category (<90 per cent) with a proportion of 62.50 per cent to total followed by high efficient category (>98 per cent) with a proportion of 20.00 per cent Rose farmers. The rest 17.50 per cent of Rose farmers belonged to the medium efficient category (90-98 per cent). The scale efficiency measures indicated the farmers belonging to the highly efficient category and medium efficient category occupied the highest proportion of 35.00 per cent and 35.00 per cent respectively followed by Rose farmers belonging to least efficient category with a proportion 30.00 per cent.

The technical efficiency measures for Gerbera indicated that most farmers belonged to the least efficient category (<90 per cent) with a proportion of 65.00 per cent to total followed by high efficient category (>98 per cent) with a proportion of 20.00 per cent Gerbera farmers. The rest 15.00 per cent of Gerbera farmers belonged to the medium efficient category (90-98 per cent) of constant return to scale. The scale efficiency measures indicated the same distribution

Table 3: Demand and supply gap estimation of Rose, Gerbera and Carnation.

Demand and supply gap estimation of Rose, Gerbera and Carnation cut flowers in Hosur city				
Particulars	Units	Total estimated demand		
		Rose	Gerbera	Carnation
Number of green houses around Hosur	1000 Sq.m	145	120	85
Production in an year	Number of bunches of twenty stems each	9425	7800	5525
Total production	Number of bunches of twenty stems each	14 lakhs	9 lakhs	5 lakhs
Total demand	Number of bunches of twenty stems each	258 lakhs	183 lakhs	86 lakhs
Demand supply gap	Number of bunches of twenty stems each	244 lakhs	174 lakhs	81 lakhs

Table 4: Technical efficiency of major cut flowers in Hosur.

Particulars	Rose		Gerbera		Carnation	
	TE	SE	TE	SE	TE	SE
Mean	85.10	92.90	83.70	87.10	79.20	90.70
Standard deviation	0.13	0.07	0.13	0.10	0.18	0.09
Minimum	0.487	0.706	0.603	0.554	0.560	0.632
Maximum	1.00	1.00	1.00	1.00	1.00	1.00

Table 5: Frequency distribution of major cut flowers based on technical efficiency.

Technical efficiency classes (per cent)	Rose		Gerbera		Carnation	
	TE	SE	TE	SE	TE	SE
<90	25(62.50)	12(30.00)	26(65.00)	24(60.00)	28(70.00)	16(40.00)
90-98	7(17.50)	14(35.00)	6(15.00)	5(12.50)	3(7.50)	10(25.00)
>98	8(20.00)	14(35.00)	8(20.00)	11(27.50)	9(22.50)	14(35.00)
Total	40(100.00)	40(100.00)	40(100.00)	40(100.00)	40(100.00)	40(100.00)
Mean technical efficiency	85.10	92.90	83.70	87.10	79.20	90.70

Table 6: Annual income of sample farmers in Hosur. (in lakh ` /farm)

Annual income (`)	Rose	Gerbera	Carnation
Below 25 lakhs	7(17.50)	4(10.00)	5(12.50)
25 lakhs to 50 lakhs	17(42.50)	31(77.50)	23(57.50)
More than 50 lakhs	16(40.00)	5(12.50)	12(30.00)
Total	40(100.00)	40(100.00)	40(100.00)
Average annual income	**44.33**	**36.86**	**42.09**

(Figures in parentheses indicate percentage to total).

pattern as under technical efficiency with farmers belonging to the least efficient category with a highest proportion of 60.00 per cent followed by Gerbera farmers belonging to high efficient category with a proportion of 27.50 per cent and lastly the medium efficient farmers with a proportion of 12.50 per cent.

The technical efficiency measures for Carnation indicated that most farmers belonged to the least efficient category (<90 per cent) with a proportion of 70.00 per cent to total followed by high efficient category (>98 per cent) with a proportion of 22.50 per cent Gerbera farmers. The rest 7.50 per cent of Carnation farmers belonged to the medium efficient category (90-98 per cent). The scale of efficiency measures indicated the same distribution pattern as under technical efficiency with farmers belonging to the least efficient category with a highest proportion of 40.00 per cent followed by Carnation farmers belonging to high efficient category with a proportion of 35.00 per cent and lastly the medium efficient farmers with a proportion of 25.00 per cent. The results showed that most farmers of Rose, Gerbera and Carnation belonged to the least efficient category despite their high mean technical efficiency. Regarding scale efficiency also, majority of Gerbera and Carnation farmers belonged to the least efficient category.

Annual income of sample farmers from the sales of cut flowers

Details regarding the distribution of households in three different income groups and their percentage share to the total number of sample households are furnished in Table 6.

It could be observed from Table 6 that in Rose, Gerbera and Carnation, most farmers were of the middle-income group with a proportion of 42.50 per cent, 77.50 per cent and 57.50 per cent, respectively. High income groups of farmers formed the next category with a proportion of 40.00 per cent, 12.50 per cent and 30.00 per cent in Rose, Gerbera and Carnation, respectively. Low-income group farmers formed the last category with 17.50 per cent in Rose, 10.00 per cent Gerbera and 12.50 per cent in Carnation, respectively. Thus, it could be concluded from the above table that most of the farmers of Rose, Gerbera and Carnation belonged to the middle-income category and they earn Rs.25 to 50 lakhs per annum.

CONCLUSION

Production and marketing of cut flowers have unique problems as observed in the case of perishables like fruits and vegetables. The demand for flowers is not also uniform. It has little relationship to the supply of flowers. Religious festive occasions may also interrupt the demand supply relationship, posing uncertainty in the marketing of flowers. Irrespective of demand, the supply of flowers remains constant, which makes the price fluctuate wildly. It could be observed from the study that the important period of demand for cut flowers in Hosur block are events and festivals like Navratri, Christmas, New Year, Valentine Day, Therthiruvizha, Ramzan and Bakrid, There were 164 days in a year which would be auspicious or during which some event or function or celebration occur in the city. An average 450 bunches of rose, 320 bunches of gerberas and 150 bunches of carnations are used in an event in addition to some other flowers. There is a huge demand supply gap and presently it is being met by supply of cut flowers from Karnataka. The said gap was highest in rose with 244 lakh bunches followed by gerbera with 174 lakh bunches and lastly with 81 lakh bunches of carnation. The combined demand supply gap was 499 lakh bunches of cut flowers. Higher price fluctuation was the major constraint in the Rose, Gerbera and Carnation marketing. The technical efficiency measures for Roses indicated that most farmers belonged to the least efficient category (<90 per cent) with a proportion of 62.50 per cent to total followed by high efficient category (>98 per cent) with a proportion of 20.00 per cent Rose farmers. Forming marketing co-operatives of flower growers may facilitate direct marketing to fill the demand and supply gap.

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