Available online at www.isas.org.in/jisas
JOURNAL OF THE INDIAN SOCIETY OF AGRICULTURAL STATISTICS 63(3) 2009 259-265

Methodology for Estimation of Production of Flowers on the Basis of Market Arrivals

A.K. Gupta*, H.V.L. Bathla, U.C. Sud and K.K. Tyagi
Indian Agricultural Statistics Research Institute, New Delhi

(Received: January 2009, Revised: June 2009, Accepted: August 2009)

SUMMARY

Appropriate methodology has been developed for estimation of production of important flowers in Delhi on the basis of market arrivals data in flower mandis. The estimated market arrivals figures were in agreement with the estimated figures obtained through village survey.

Key words : Flower mandi, Market arrivals, Village survey approach.

1. INTRODUCTION

India has a vide range of climate and soil conditions which enable cultivation of an array of horticulture crops such as fruits, vegetables, floriculture plants, plantation crops etc. Among these, floriculture is a fast expanding dynamic industry which has gained momentum with the liberization of economic and industrial trade policies. The Government of India has identified floriculture as a major thrust area for export because floriculture industry in India has made significant progress in the recent years. Flowers, of all kind, besides being a source of essential oils are in great demand for decoration and various other purposes. Floriculture is now a remunerable venture for unemployed youth and women, yielding higher returns and generating employment opportunities for rural people in the villages. With varied agro-climatic conditions available in the country, it is possible to grow almost all the major flower crops of the world, either from tropical, sub-tropical or temperate region.

Following the Green Revolution in Agriculture, flowers are considered to be one of the best alternatives for diversification.

Currently, no scientific methodology is available for reporting area and production of flowers in the country. The existing crop-cutting experiments approach being followed for estimation of production of food crops may not be appropriate in case of flowers when seen from the point of view of cost and time involved. This is due to the fact that the production of flowers involves multiple pickings. The enumerator is thus required to make multiple visits for recording the production of flowers. Recording the produce of every picking may turn out to be very cumbersome.

With the specific objective of strengthening the existing database pertaining to flowers, the National Statistical Commission recommended that a cost-effective suitable sampling methodology be developed for estimation of production of important flowers on the basis of market arrivals. Accordingly, a pilot study funded by Central Statistical Organization, Ministry of Statistics and Programme Implementation, Government of India, entitled "Pilot sample survey to develop sampling methodology for estimation of area, production and productivity of important flowers on the basis of market arrivals", was planned and conducted in Delhi State during September 2003 to August 2004 in which estimates of production of flowers were developed by considering two approaches namely, (i) on the basis of market arrivals of flowers and (ii) on the basis of village survey.

* *Corresponding author* : A.K. Gupta
E-mail address : akgupta@iasri.res.in

2. MATERIALS AND METHODS

(i) Market Survey Approach

There are three flower mandis in Delhi namely, Hanuman Mandir Mandi, Khari Baoli Mandi and Mehrauli Mandi. Cut flowers of Rose, Gladiolus, Chrysanthemum, Tube-rose and Carnation etc. are mainly traded in the Hanuman Mandir Mandi while trading of loose flowers of Marigold, Rose, Margaret and Jaffrey etc. is carried out in Khari Baoli and Mehrauli Mandi by the commission agents and self-selling farmers. The commission agents and self-selling farmers were selected as per the following sampling design adopted for collection of data on varieties of flowers sold in the three mandis.

Sampling Design: A stratified random sampling design was followed in each flower mandi. Commission agents comprise the first stratum while the self-selling farmers the second stratum. Within the first stratum, seven random groups of commission agents were formed to cover all the commission agents trading in both Hanuman Mandir Mandi and Khari Baoli Mandi. The survey work was carried out from September 2003 - August 2004. The entire one year survey work was divided into three periods viz. Period-1: September - December 2003, Period-2: January - April 2004 and Period-3: May - August 2004. One random group of commission agents was randomly selected and observed for a fortnight in one period for data collection purpose. The remaining six random groups were observed in a similar manner. All the seven groups were observed in seven fortnights in one period. This process was repeated in the other two periods also. All the commission agents of Mehrauli mandi were observed for 8 days in each period. A suitable number of self-selling farmers were selected to collect inquiry based data on flowers sold. A self-selling farmer once chosen was not repeated in the particular period of inquiry.

(ii) Village Survey Approach

Sampling Design: The sampling design adopted for estimation of area under floriculture in flower growing villages of Delhi was one of stratified uni-stage random sampling with villages as the sampling units. For estimating production of important flowers on the basis of village survey, the sampling design was stratified two stage random sampling with villages as first stage sampling units and flower growing farmers as the second stage sampling units. All the flower growing villages of Delhi were divided, in each period, into three strata as follows; Stratum I: villages having area up to 5 ha under flower, Stratum II: villages having area more than 5 ha and less than 10 ha, and Stratum III: villages having area more than 10 ha under floriculture. Out of 92 flower growing villages in Delhi, a simple random sample of 15 flower growing villages was selected. This sample of 15 flower growing villages was allocated among the three strata using proportional allocation according to area under flowers in each village in each of the three Periods. Accordingly, among each of the three strata, 3, 7 and 5 villages were selected in Period-1; 5, 4 and 6 villages in Period-2; and 5, 3 and 7 villages in Period-3 respectively. The area estimates were obtained by complete enumeration of all the flower growing farmers in each of the selected villages. Villages having 15 or less than 15 flower growing farmers were completely enumerated for compilation of production figures. The production estimates for villages having more than 15 flower growing farmers were made on the basis of a random sample of 15 flower growing farmers selected in such a way that each kind of flower grown by the farmers got properly represented. The sampling units at both the stages were selected by simple random sampling without replacement.

3. ESTIMATION PROCEDURE

(i) Market Survey Approach

Estimation of total market arrivals in Delhi for a particular kind of flower in the i^{th} period

The entire survey period of one year (366 days) was divided into 3 periods viz. Period-1 of 122 days, Period-2 of 121 days and Period-3 of 123 days. Two strata viz. stratum-1 of Commission Agents/Mashakhors and stratum-2 of self-selling farmers and seven groups (each group comprising of suitable number of commission agents/mashakhors from first stratum and self-selling farmers from the second stratum) were formed.

Let y_{ighad} be the quantity of market arrivals of the flower for i^{th} period, g^{th} group, h^{th} stratum, a^{th} commission agent/ self-selling farmer on d^{th} day. Mean market arrivals per day for i^{th} period, g^{th} group, h^{th} stratum, a^{th} commission agent/self-selling farmer is given by

$$\bar{y}_{igha.} = \frac{1}{m_{igha}} \sum_{d}^{m_{igha}} y_{ighad}$$

where m_{igha} is the number of days for which a^{th} commission agent/self-selling farmer was observed for i^{th} period, g^{th} group, h^{th} stratum.

Estimated mean market arrivals per day per commission agent/self-selling farmer in the i^{th} period, g^{th} group, h^{th} stratum is given by

$$\bar{y}_{igh..} = \frac{1}{n_{igh}} \sum_{a}^{n_{igh}} \bar{y}_{igha.}$$

where n_{igh} is the number of commission agents observed in the i^{th} period, g^{th} group, h^{th} stratum.

The variance of $\bar{y}_{igh..}$ is given by

$$V(\bar{y}_{igh..}) = \left(\frac{1}{n_{igh}} - \frac{1}{N_{igh}} \right) \frac{1}{(N_{igh} - 1)} \sum_{a}^{N_{igh}} \left(\bar{y}_{igha.} - \bar{Y}_{igh..} \right)^2$$

where $\bar{Y}_{igh..} = \frac{1}{N_{igh}} \sum_{a}^{N_{igh}} \bar{y}_{igha.}$

The estimator of $V(\bar{y}_{igh..})$ is given by

$$\hat{V}(\bar{y}_{igh..}) = \left(\frac{1}{n_{igh}} - \frac{1}{N_{igh}} \right) \frac{1}{(n_{igh} - 1)} \sum_{a}^{n_{igh}} \left(\bar{y}_{igha.} - \bar{y}_{igh..} \right)^2$$

where N_{igh} is the total number of commission agents pertaining to the i^{th} period, g^{th} group, h^{th} stratum.

Estimated total market arrivals per day for the mandi on the basis of g^{th} group is given by

$$\hat{Y}_{ig...} = \sum_{h=1}^{2} N_{igh} \bar{y}_{igh..}$$

The variance of $\hat{Y}_{ig...}$ is given by

$$V(\hat{Y}_{ig...}) = \sum_{h=1}^{2} N_{igh}^2 V(\bar{y}_{igh..})$$

and the corresponding variance estimator by

$$\hat{V}(\hat{Y}_{ig...}) = \sum_{h=1}^{2} N_{igh}^2 \hat{V}(\bar{y}_{igh..})$$

Estimated total market arrivals per day for the mandi averaged over all the groups for the i^{th} period is

$$\hat{Y}_{i....} = \frac{1}{g} \sum_{g=1}^{7} \hat{Y}_{ig...}$$

The variance of $\hat{Y}_{i....}$ is given by

$$V\left(\hat{Y}_{i....}\right) = \frac{1}{g^2} \sum_{g=1}^{7} V\left(\hat{Y}_{ig...}\right)$$

and the estimator of $V\left(\hat{Y}_{i....}\right)$ is given by

$$\hat{V}\left(\hat{Y}_{i....}\right) = \frac{1}{g^2} \sum_{g=1}^{7} \hat{V}\left(\hat{Y}_{ig...}\right)$$

Estimator of total market arrivals for the entire year (366 days) for a specified kind of flower is given by

$$\hat{Y}..... = 122\ \hat{Y}_{1....} + 121\ \hat{Y}_{2....} + 123\ \hat{Y}_{3....}$$

The variance of $\hat{Y}.....$ is given by

$$V(\hat{Y}_{.....}) = (122)^2 V(\hat{Y}_{1....}) + (121)^2\ V(\hat{Y}_{2....}) + (123)^2 V(\hat{Y}_{3....})$$

and the estimator of variance of the estimate of total market arrivals for the entire year is given by

$$\hat{V}(\hat{Y}_{.....}) = (122)^2 \hat{V}(\hat{Y}_{1....}) + (121)^2\ \hat{V}(\hat{Y}_{2....}) + (123)^2 \hat{V}(\hat{Y}_{3....})$$

Estimates of all kind of flowers grown in Delhi on the basis of market arrivals have been obtained on the similar lines.

(ii) Village Survey Approach

Estimation of total production for a particular kind of flower for a period in the villages of Delhi

Let y_{hij} be the production of a particular kind of flower for the j^{th} flower growing farmer of the i^{th} flower growing village in the h^{th} stratum (j = 1, 2, …, M_{hi} ; i = 1, 2, …, N_h ; h = 1, 2, 3), M_{hi} being the number of

flower growing farmers in the i^{th} village of the h^{th} stratum and N_h, the total number of flower growing villages in the h^{th} stratum. The average production of a particular kind of flower in the i^{th} village of the h^{th} stratum is given by

$$\bar{y}_{hi} = \frac{1}{m_{hi}} \sum_{j=1}^{m_{hi}} y_{hij}$$

where m_{hi} is the number of selected flower growing farmers in the i^{th} village of h^{th} stratum.

Total production per village of a particular kind of flower in the h^{th} stratum is given by

$$\bar{y}_h = \frac{1}{n_h} \sum_{i=1}^{n_h} M_{hi} \bar{y}_{hi}$$

where n_h denotes the number of selected villages in the h^{th} stratum.

Let y'_{1i} is the production of a particular kind of flower reported from i^{th} village in the 1^{st} stratum. Hence

$\bar{y}'_1 = \frac{1}{n_1} \sum_{i=1}^{n_1} y'_{1i}$ is the estimate of average production of a particular kind of flower in 1^{st} stratum. Again

$\bar{y}'_h = \frac{1}{n_h} \sum_{i}^{n_h} M_{hi} \bar{y}_{hi}$ is the estimate of average production of a particular kind of flower in h^{th} stratum (h = 2, 3).

Accordingly, an estimator of the total production of a particular kind of flower in Delhi is given by

$$\hat{Y} = \frac{N_1}{n_1} \sum_{i=1}^{n_1} y'_{1i} + \sum_{h=2}^{3} N_h \bar{y}'_h$$
$$= \hat{Y}_1 + \hat{Y}_2$$

where $\hat{Y}_1 = \frac{N_1}{n_1} \sum_{i=1}^{n_1} y'_{1i}$ and $\hat{Y}_2 = \sum_{h=2}^{3} N_h \bar{y}'_h$

The variance of $\hat{Y}$ is given by

$$V(\hat{Y}) = N_1^2 \left(\frac{1}{n_1} - \frac{1}{N_1}\right) S_{b1}^2 + \sum_{h=2}^{3} N_h^2 \left(\frac{1}{n_h} - \frac{1}{N_h}\right) S_{bh}^2 + \sum_{h=2}^{3} \frac{N_h}{n_h} \sum_{i=1}^{N_h} M_{hi}^2 \left(\frac{1}{m_{hi}} - \frac{1}{M_{hi}}\right) S_{hi}^2$$

where

$$S_{b1}^2 = \frac{1}{(N_1 - 1)} \sum_{i=1}^{N_1} (y'_{1i} - \bar{Y}_1)^2$$

$$S_{bh}^2 = \frac{1}{(N_h - 1)} \sum_{i=1}^{N_h} \left(M_{hi} \bar{Y}_{hi} - \bar{Y}_h\right)^2$$

$$S_{hi}^2 = \frac{1}{(M_{hi} - 1)} \sum_{j=1}^{M_{hi}} (y_{hij} - \bar{Y}_{hi})^2$$

$$\bar{Y}_1 = \frac{1}{N_1} \sum_{i}^{N_1} y'_{1i}$$

$$\bar{Y}_{hi} = \frac{1}{M_{hi}} \sum_{j}^{M_{hi}} y_{hij}$$

and $\bar{Y}_h = \frac{1}{N_h} \sum_{i}^{N_h} M_{hi} \bar{Y}_{hi}$

An estimator of $V(\hat{Y})$ is given by

$$\hat{V}(\hat{Y}) = N_1^2 \left(\frac{1}{n_1} - \frac{1}{N_1}\right) s_{b1}^2 + \sum_{h=2}^{3} N_h^2 \left(\frac{1}{n_h} - \frac{1}{N_h}\right) s_{bh}^2 + \sum_{h=2}^{3} \frac{N_h}{n_h} \sum_{i=1}^{n_h} M_{hi}^2 \left(\frac{1}{m_{hi}} - \frac{1}{M_{hi}}\right) s_{hi}^2$$

where

$$s_{b1}^2 = \frac{1}{(n_1 - 1)} \sum_{i=1}^{n_1} (y'_{1i} - \bar{y}'_1)^2$$

$$s_{bh}^2 = \frac{1}{(n_h - 1)} \sum_{i=1}^{n_h} (M_{hi} \bar{y}_{hi} - \bar{y}'_h)^2$$

and $s_{hi}^2 = \frac{1}{(m_{hi} - 1)} \sum_{j=1}^{m_{hi}} (y_{hij} - \bar{y}_{hi})^2$

Combined estimate for the three periods has been obtained by adding the estimates of different kind of flowers to get an estimate for the entire duration of one year.

Estimation of area for a particular kind of flower for *i*th period on the basis of village survey

Let $a_{h'j}$ be the area under a particular kind of flower in the j^{th} village of h'^{th} stratum of the i^{th} period and $\bar{a}_{h'}$ be the corresponding average area per village in the h'^{th} stratum.

We define $\bar{a}_{h'} = \sum_{j}^{n_{h'}} \frac{a_{h'j}}{n_h}$, where $n_{h'}$ is the number of sampled flower growing villages in the h'^{th} stratum.

Let $\hat{A}_{h'}$ be the estimated total area under flower cultivation in the h'^{th} stratum.

Therefore,

$$\hat{A}_{h'} = N_{h'} \times \bar{a}_{h'}$$

An estimator of variance for $\hat{A}_{h'}$ is given by

$$\hat{V}(\hat{A}_{h'}) = N_{h'}^2 \left(\frac{1}{n_{h'}} - \frac{1}{N_{h'}} \right) s_{ah'}^2$$

where $$s_{ah'}^2 = \frac{\sum_{j=1}^{n_{h'}} (a_{h'j} - \bar{a}_{h'})^2}{n_{h'} - 1}$$

Estimated total area in Delhi State for a particular kind of flower in the i^{th} period is given by

$$\hat{A} = \sum_{h'=1}^{3} N_{h'} \bar{a}_{h'}$$

and the variance estimator is given by

$$\hat{V}(\hat{A}) = \sum_{h'=1}^{3} N_{h'}^2 \left(\frac{1}{n_{h'}} - \frac{1}{N_{h'}} \right) s_{ah'}^2$$

Estimates of area for all kind of flowers grown in Delhi for the other periods have been obtained on similar lines. The estimates for the three periods are added to get an estimate for the entire period.

4. RESULTS AND DISCUSSION

(i) Market Survey Approach

Estimates of the total market arrivals of loose flowers in Metric Tonnes (MT) as well as of cut flowers in lakh numbers along with their percentage standard errors in the three flower mandis of Delhi are presented in Table 1. A close perusal of Table 1 reveals that the estimate of the total market arrivals of loose flowers from the villages of Delhi in the flower mandis was 14570.91 MT with 2.51% standard error (SE). The corresponding figure for cut flowers was 670.69 lakhs with 1.53% SE.

Table 1. Estimate of total market arrivals of different kind of flowers in Delhi on the basis of market arrivals

Flowers	Loose (MT) Estimate		Cut (Lakh Nos.) Estimate	
Rose	1896.55	(1.02)	571.46	(1.74)
Marigold	1727.17	(3.62)		–
Guldawari	33.65	(*)	26.94	(7.75)
Rajnigandha	13.52	(*)	10.82	(6.11)
Jaffrey	8897.82	(3.85)	–	
Margaret (White/Yellow)	1899.03	(5.69)	–	
Gladiolus	–		14.05	(3.77)
Gerbera	–		–	
Orchid	–		–	
Carnation	–		–	
Tube Rose (Double)	–		2.76	(*)
Others	103.16	(2.61)	44.65	(2.63)
Total production	14570.91	(2.51)	670.69	(1.53)

Note: Figures within parentheses indicate corresponding percent standard errors.

* Estimates are based on small number of observations.

(ii) Village Survey Approach

Table 2 provides period-wise as well as stratum-wise estimated area (ha) of loose and cut flowers separately in the villages of Delhi. The area under loose flowers was estimated to be 2583.28 ha and that under cut flowers was 442.59 ha. Thus, during the survey period, 3025.87 ha area was estimated to be under floriculture in the flower growing villages of Delhi. Out of this, 85.37% area was under loose flowers while 14.63% was under cut flowers. However, the percentage standard errors of the estimates were on the higher side as these were based on small number of observations.

Period-wise and stratum-wise estimates of production of loose and cut flowers are presented in Table 3. A close perusal of Table 3 reveals that estimated production of loose flowers was to the tune of 1359.10 MT with 7.03% SE in Period-2 of stratum I; 668.50 MT with 7.30% SE in Period-1 of stratum II and 8277.30 MT with 4.31% SE in Period-2 of stratum III. Pooled over all the periods, these figures were

Table 2. Area (ha) under important flowers in the villages of Delhi

Period	Stratum I			Stratum II			Stratum III			Total		
	Loose	Cut	Total	Loose	Cut	Total	Loose	Cut	Total	Loose	Cut	Total
1	130.08	0	130.08	61.72	23.60	85.32	627.90	98.95	726.85	819.70	122.55	942.25
	(32.42)		(32.42)	(31.66)	(*)	(26.21)	(*)	(*)	(*)	(35.16)	(*)	(32.15)
2	123.05	0	123.05	34.16	75.43	109.59	796.74	85.26	882.00	953.95	160.69	1114.64
	(30.30)		(30.30)	(*)	(30.32)	(31.03)	(33.82)	(*)	(31.83)	(28.64)	(*)	(25.59)
3	136.01	0	136.01	0	84.47	84.47	673.62	74.88	748.50	809.63	159.35	968.98
	(31.98)		(31.98)		(8.94)	(8.94)	(34.60)	(*)	(32.45)	(29.28)	(*)	(25.48)
Total	389.14	0	389.14	95.88	183.50	279.38	2098.26	259.09	2357.35	2583.28	442.59	3025.87
	(18.28)		(18.28)	(33.24)	(14.40)	(14.82)	(21.72)	(*)	(20.23)	(17.90)	(32.13)	(15.99)

Table 3. Estimates of production of important flowers in the villages of Delhi

Period	Stratum I		Stratum II		Stratum III		Total	
	Loose (MT)	Cut (Lakh)	Loose (MT)	Cut (Lakh)	Loose (MT)	Cut (Lakh)	Loose (MT)	Cut (Lakh)
1	1325.38	0	668.55	36.82	4278.51	322.29	6272.447	359.12
	(13.74)		(7.30)	(6.10)	(17.28)	(*)	(7.47)	(1.98)
2	1359.09	0	527.33	91.42	8277.33	165.96	10163.747	257.38
	(7.03)		(*)	(15.22)	(4.31)	(*)	(3.73)	(5.84)
3	307.65	0	0	72.16	984.83	44.76	1292.49	116.92
	(17.32)			(30.54)	(3.79)	(*)	(10.62)	(17.97)
Total	2992.126	0	1159.88	200.39	13540.67	533.02	17728.68	733.41
	(6.80)		(4.95)	(9.19)	(8.18)	(*)	(4.09)	(3.54)

Note: Figures within parentheses indicate the corresponding percent standard errors (Table 2 & Table 3).

* Estimates are based on very few observations (Table 2 & Table 3).

2992.10 MT with 6.80% SE, 1159.80 MT with 4.95% SE and the highest 13540.70 MT with 8.18% SE for the three strata respectively. The pooled estimate of production of loose flowers was significantly higher in Period-2 i.e. of the order of 10163.70 MT with 3.73% SE followed by 6272.40 MT with 7.47% SE in Period-1 and 1292.50 MT with 10.62% SE in Period-3. The overall estimated production of loose flowers in the villages of Delhi was to the tune of 17728.70 MT with 4.09% SE. The period-wise estimated production of cut flowers were 359.11 lakhs with 1.98% SE, 257.38 lakhs with 5.84% SE and 116.92 lakhs with 17.97% SE respectively. The overall estimated production of cut flowers was 733.41 lakhs with 3.54% SE.

(iii) Comparative Study of both the approaches

A comparative study of the estimates of production of loose and cut flowers from the market arrivals survey approach and village survey approach is presented in Table 4. The results reveal that a maximum 91.4% of loose flowers produced in the flower growing villages of Delhi arrived for trading in the flower mandis of Delhi in Period-2 (peak period of flowers production) while 98.7% cut flowers produced in the villages of Delhi arrived for trading in the flower mandis of Delhi in Period-1. When pooled over the three periods, the percentage arrivals were to the tune of 82.2% and 91.5% respectively.

5. CONCLUSION

The study demonstrates the feasibility of estimating the production of flowers with a reasonable degree of precision. The methodology developed for estimating production of important flowers on the basis of market arrivals needs to be tested in some other representative areas before it can be recommended for large scale adoption.

Table 4. Estimates of production of important flowers based on Market Arrivals Survey Approach and Village Survey Approach

Period	Loose (MT)		Cut (Lakh Numbers)	
	Market Arrivals Survey Approach	Village Survey Approach	Market Arrivals Survey Approach	Village Survey Approach
1	4393.15 (70.0%)	6272.45	354.35 (98.7%)	359.11
2	9290.06 (91.4%)	10163.75	231.60 (90.0%)	257.38
3	887.67 (68.7%)	1292.49	84.74 (72.5%)	116.91
Total	14570.91 (82.2%)	17728.68	670.69 (91.5%)	733.41

Note: Figures within parentheses indicate the percentage of estimated flower production of flowers based on market arrivals approach to the estimated production of flowers based on village survey approach.

REFERENCES

Gupta, A.K., Jain, V.K., Narang, M.S., Tyagi, K.K. and Sud, U.C. (2004). Pilot sample survey to develop sampling methodology for estimation of area, production and productivity of important flowers on the basis of market arrivals. Project Report published by IASRI, New Delhi and funded by CSO, Ministry of Statistics & Programme Implementation, Government of India.

Murthy, M.N. (1977). *Sampling Theory and Methods*. Statistical Publishing Society, Calcutta.

Report of the National Statistical Commission (2001). National Statistical Commission, Government of India, Volume 1, 66-67.

Sukhatme, P.V., Sukhatme, B.V., Sukhatme, S. and Asok, C. (1984). *Sampling Theory of Surveys with Applications*. Iowa State University Press, AMES, Iowa, U.S.A. and Indian Society of Agricultural Statistics, New Delhi, India.