Estimation of Area and Production of Fruits and Vegetables in Maharashtra State

Tauqueer Ahmad, H.V.L. Bathla, Anil Rai and Prachi Misra Sahoo

Abstract--- *Production of fruits and vegetables has attained significant importance in the recent past. Fruits and vegetables account for nearly ninety percent of total horticulture production in the country. One of the basic requirements for proper planning for increasing the production of these crops in the country is the availability of reliable statistics about their area and production at various levels. At present, the estimates of area and production of important fruits and vegetables are being obtained under the scheme "Crop Estimation Survey on Fruits and Vegetables (CES-F&V)" only for eleven states. Ahmad et al. (2011) developed an alternative methodology for estimation of area and production of different horticultural crops. In this paper, the estimates of area, production and productivity of important fruits and vegetables have been obtained for Maharashtra State using the alternative methodology.*

Keywords--- *Fruits, Vegetables, Bearing Trees, Alternative Methodology, Horticulture Statistics*

I.   INTRODUCTION

INDIA is endowed with diverse agro-climatic conditions, rich soils and plentiful water, making it suitable for growing almost all type of temperate, sub-tropical and tropical fruits, vegetables and flowers. Rapidly growing demand for horticulture commodities and products especially burgeoning market for processed fruits and vegetables as well as booming floriculture market is an evidence of the phenomenon that is expected to accelerate horticulture growth in the country. Consequently, horticulture is set to assume a greater role and importance within the agriculture sector and eventually in the national economy.

In addition, there are tremendous opportunities to augment exports of horticulture commodities and products especially fruits and vegetables-both raw and processed-by way of strengthening existing markets as well as exploring fresh markets. Due to enormous potential of horticulture-both on domestic as well as international front - as evident from burgeoning demand of horticulture commodities and products, it could become a key driver in stimulating agricultural growth that has been rather sluggish in the recent past.

In view of the commercial importance, it has become imperative to have proper planning for enhancing the productivity of horticultural crops. One of the basic requirements for proper planning for increasing the production of these crops in the country is the availability of reliable statistics about their area and production at various levels. No realistic targets for production of these crops can be fixed in the absence of reliable statistics about the area and yield rates. Even a proper evaluation of the various developmental programmes taken in this direction is not possible in the absence of reliable statistics.

Indian Agricultural Statistics Research Institute (IASRI) carried a series of surveys in typical districts of selected states during 1958 to 1973 on important fresh fruit crops with a view to evolve a sampling methodology for estimating the extent of cultivation, yield rates and production of fruit crops. A study on vegetables was conducted in rural areas of Delhi by Sukhatme *et al.* (1969). Singh *et al.* (1976) conducted a study on fresh fruits in Tamil Nadu State and on vegetables in Bangalore district of Karnataka State. Problems and issues related to statistics of horticultural crops were discussed in detail in the symposium organized during Indian Society of Agricultural Statistics (ISAS) Conference in 2001.

Presently, the estimates of area and production of important fruits and vegetables are being obtained under the scheme "Crop Estimation Survey on Fruits and Vegetables (CES-F&V)" only for eleven states. On the other hand, the estimates furnished by the National Horticulture Board (NHB) relate to the entire country but are essentially based on subjective reports received from the ground level staff which is not scientifically sound. Moreover, the survey procedures in the scheme "CES-F&V" are complex, time consuming and not cost effective.

Therefore, Ahmad *et al.* (2011) developed an alternative methodology for estimation of area and production of different horticultural crops which is cost effective and less time consuming and in which the survey procedures have been simplified. The alternative methodology provides estimates for more than one fruit/vegetable at district level. Hence, in this paper, an attempt has been made to obtain estimates of area, production, yield rates, number of trees categorized as bearing, non-bearing, young and total number of trees as well as number of stray trees categorized as bearing, non-bearing, young and total number of stray

Tauqueer Ahmad, Indian Agricultural Statistics Research Institute, New Delhi.
H.V.L. Bathla, Indian Agricultural Statistics Research Institute, New Delhi.
Anil Rai, Indian Agricultural Statistics Research Institute, New Delhi.
Prachi Misra Sahoo, Indian Agricultural Statistics Research Institute, New Delhi.

trees for major fruits and area, production and yield rates of major vegetables for Maharashtra State using the alternative methodology.

II.   MATERIALS AND METHODS

In view of National Statistical Commission (NSC) – 2001 recommendations, a project entitled "Pilot study to develop an alternative methodology for estimation of area and production of horticultural crops" funded by Central Statistics Office (CSO), Ministry of Statistics and Programme Implementation was undertaken by IASRI. This paper considers the study conducted in Maharashtra State under the project covering important fruits and vegetables.

A total of ten districts out of a total number of thirty four districts from Maharashtra were selected for carrying out field survey on the basis of previous year's area figures under fruits and vegetables. The ten selected districts of Maharashtra are Ahmadnagar, Amravati, Jalgaon, Nagpur, Nasik, Pune, Ratnagiri, Satara, Sindhudurg and Solapur. The fruits and vegetables covered under the study are Mango, Guava, Grape, Banana, Sapota (Chikku), Citrus, Onion, Tomato, Potato, Cauliflower, Cabbage, Ladyfinger, Brinjal and Peas.

2.1 Sampling Design and Sample Size

First of all, important districts were identified for conducting survey on the basis of district-wise area figures under fruits and vegetables of the State. As a broad guideline, the important districts are those which taken together cover 70-80% of the total area under fruits and vegetables in the entire State. The sampling design which was adopted for the survey may be described as stratified multistage random sampling. Taluk-wise area figures under fruits and vegetables were used for stratifying the taluks of the selected districts into two groups viz. high productive taluks and low productive taluks. High productive taluks are those which constitute 60-70 percent of the total area under fruits and vegetables of the district and rest of the taluks will fall under low productive taluks. A sample of two taluks was selected by simple random sampling without replacement (SRSWOR) from both the groups after rejecting taluks contributing less than 5% of total area under fruits and vegetables of the district.

From each of the four selected taluks, a sample of five villages was selected by SRSWOR. The selected villages were completely enumerated so as to record number of orchards under different fruits and cropping pattern with respect to vegetables. An orchard for selection process should have minimum of twelve fruit trees of bearing age of a single fruit crop. For fruits survey, a sample of five orchards was selected from each selected village by SRSWOR. In case, there are more than one fruit crop available in the village then orchards were selected in proportion to the number of orchards for two major fruit crops in each of the village with a minimum of two orchards for each fruit crop. Major fruit crops were decided on the basis of number of orchards of different fruits available in the village. From each selected orchard, a sample of three clusters each consisting of four trees of bearing age was selected randomly out of the total number of trees of bearing age. The yield of selected trees was collected through enquiry and yield of any four trees was collected through physical observation.

For vegetable survey, a sample of ten vegetable growers was selected out of qualified vegetable growers of a village. For this, after complete enumeration of selected village, a list of qualified vegetable growers was prepared. Qualified growers are those vegetable growers who have 0.1 ha and above gross cropped area under vegetables. Ranking of qualified vegetable growers was done as per gross cropped area and then qualified vegetable growers were divided into two groups after ranking. If number of growers is odd, the first group will have one more grower than the second group. A total of six vegetable growers were selected from the first group and rest four from the second group. In case total number of qualified vegetable growers in any village is less than or equal to ten, all the growers were selected for detailed survey enquiry. The produce of all the vegetables crops grown by the selected vegetable grower was recorded through enquiry and physical observation was taken on the day of visit. The Field Investigator must get in touch with the grower of the selected field from time to time and ascertain the date of harvest. He must be present on the day of harvest. He must locate the experimental plot of specified size (5mx5m) before the cultivator starts harvesting the field. In each selected field, the experimental plot of the specified size must be located at random beginning with South-West corner of the selected field.

2.2 Technical Programme

The major steps followed for the successful completion of the study are as under:

1. Primary data collection work was done in ten districts of Maharashtra State during the year 2006-2007 in two phases i.e. complete enumeration for three months and detailed survey for one year with the help of Commissionerate of Agriculture, Pune. Seventeen (17) Field Investigators (FIs) were hired with the help of respective State Govt.
2. Schedules along with instruction manual were prepared for data collection. Training for data collection was provided to the hired FIs in the State in two phases.
3. Supervision of data collection was done by the IASRI officials at regular intervals and all necessary support for this purpose was provided by the State Govt.
4. The data was coded and entered. The entered data was scrutinized.
5. Estimation procedures developed under alternative methodology by Ahmad *et al.* (2011) for obtaining estimates of area,

production and yield rates of fruits as well as vegetables were used.

6. Data analysis was done and estimates of area, production and yield rates of important fruits and vegetables were obtained for surveyed districts of the State.

III.   RESULTS AND DISCUSSIONS

The district level estimates were obtained for all major fruit and vegetable crops in the State using the estimation procedure developed under alternative methodology.

3.1 Extent of Cultivation of Major Fruits

The district-wise estimates of area under major fruit crops, number of trees categorized as bearing tree(BT), non-bearing tree(NBT), young tree(YT) and total number of trees as well as number of stray trees categorized as bearing, non-bearing, young and total number of stray trees were obtained using the estimation procedure developed under alternative methodology. The district-wise estimates of area under major fruit crops are presented in Table 1.

Table 1: District-Wise Estimates of Area (In Ha) Under Major Fruit Crops

Districts → Fruits ↓	Ahmad-nagar	Amravati	Jalgaon	Nagpur	Nasik	Pune	Ratnagiri	Sindhudurg	Solapur
Mango	8561.22 (3.46)	-	-	-	-	5859.08 10.43)	36304.59 (17.44)	15074.11 (9.29)	-
Lime	-	-	363.56 (8.00)	-	-	758.09 (2.62)	-	-	-
Mosambi	320.96 (1.60)	1796.8064 (3.83)	-	2778.80 (10.15)	-	645.85 (4.03)	-	-	-
Orange	-	40415.89 (19.18)	-	22962.84 (4.28)	-	195.63 (1.85)	-	-	-
Guava	1658.55 (2.30)	-	-	-	-	2018.22 (1.99)	-	-	213.84 (6.80)
Grape	520.22 (11.71)	-	-	-	16225.67 (16.27)	1032.92 (8.19)	-	-	2405.18 (5.72)
Banana	-	680.95 (5.72)	62752.41 (18.94)	-	-	948.26 (20.01)	-	191.36 (2.70)	-
Pomegranate	532.64 (1.30)	-	-	-	6726.75 (15.51)	2952.07 (12.23)	-	-	7366.856 (13.50)
Sapota	1107.66 (2.00)	-	-	-	-	1106.09 (1.39)	-	-	-

Figures in brackets represent percentage standard errors.

It can be observed from the Table 1 that the estimates of total production of important fruit crops such as mango, lime, mosambi (sweet orange), orange, guava, grape, banana, Pomegranate and sapota were obtained with percentage standard errors ranging from 1.30 to 20.01.

The district-wise estimates of number of trees categorized as bearing, non-bearing, young and total number of trees under major fruit crops are presented in Table 2.

Table 2: District-Wise Estimates of Number of Trees under Major Fruit Crops

Districts → Fruits ↓	Ahmadnagar				Amravati				Jalgaon			
	BT	NBT	YT	TOTAL	BT	NBT	YT	TOTAL	BT	NBT	YT	TOTAL
Mango	98305	1920	21785	122010	-	-	-	-	-	-	-	-
Lime	-	-	-	-	-	-	-	-	120098	452	3645	124195
Mosambi	11190		10062	21252	-	-	-	-	185826		119808	305634
Orange	-	-	-	-	7764598	380398	1261294	9406290	-	-	-	-
Guava	100689		99491	200180	-	-	-	-	-	-	-	-
Banana	-	-	-	-	5519170	54329	2365814	7939313	209778167	56921	6984218	216819306
Sapota	64079	1049	81029	146157	-	-	-	-	-	-	-	-

Districts / Fruits	Nagpur				Nasik				Pune			
	BT	NBT	YT	TOTAL	BT	NBT	YT	TOTAL	BT	NBT	YT	TOTAL
Mango	-	-	-	-	-	-	-	-	181487	2752	98056	282295
Lime	58377	1723	10532	70632	-	-	-	-	10935	3180	10578	24693
Mosambi	18406	48555	75125	142086	-	-	-	-	-	-	-	-
Orange	3274989	407263	2458126	6140378	-	-	-	-	417058	9280	617700	1044038
Guava	-	-	-	-	-	-	-	-	400370	101	181164	581635
Grape	-	-	-	-	-	-	-	-	-	-	-	-
Banana	-	-	-	-	-	-	-	-	22586		69493	92079
Sapota	-	-	-	-	-	-	-	-	33352	571	129419	163342

Districts / Fruits	Ratnagiri				Sindhudurg				Solapur			
	BT	NBT	YT	TOTAL	BT	NBT	YT	TOTAL	BT	NBT	YT	TOTAL
Mango	1513146	615763	219336	2348245	793243	4192	74829	872264	-	-	-	-
Guava	-	-	-	-	-	-	-	-	-	-	-	-
Grape	-	-	-	-	-	-	-	-	-	-	-	-
Banana	-	-	-	-	55649	6487	18951	81087	-	-	-	-
Sapota	-	-	-	-	-	-	-	-	-	-	-	-

The district-wise estimates of number of stray trees categorized as bearing, non-bearing, young and total number of stray trees under major fruit crops are presented in Table 3.

Table 3: District-Wise Estimates of Number of Stray Trees under Major Fruit Crops

Districts / Fruits	Ahmadnagar				Amravati				Jalgaon				Nasik			
	BT	NBT	YT	TOTAL	BT	NBT	YT	TOTAL	BT	NBT	YT	TOTAL	BT	NBT	YT	TOTAL
Lime	-	-	-	-	-	-	-	-	4163	-	1110	5273	-	-	-	-

Districts / Fruits	Nagpur				Pune				Ratnagiri				Sindhudurg			
	BT	NBT	YT	TOTAL	BT	NBT	YT	TOTAL	BT	NBT	YT	TOTAL	BT	NBT	YT	TOTAL
Mango	229	-	-	229	4365	101	24291	28757	2880	0	9900	12780	322	-	-	322
Lime	14025	675	1013	15713	1438	-	-	1438	-	-	-	-	-	-	-	-
Guava	-	-	-	-	404	-	-	404	-	-	-	-	-	-	-	-
Banana	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sapota	-	-	-	-	-	-	202	202	-	-	-	-	-	-	-	-

3.2 Estimates of Yield Rates of Major Fruits

The district-wise estimates of yield rates of major fruit crops were obtained using the estimation procedure developed under alternative methodology. The district-wise estimates of yield rates (kg/tree) of major fruit crops are presented in Table 4.

Table 4: District-Wise Estimates of Yield Rates (Kg/Tree) of Major Fruit Crops

Districts → Fruits ↓	Ahmad-nagar	Amravati	Jalgaon	Nagpur	Nasik	Pune	Ratnagiri	Sindhu-durg	Solapur
Mango	105.27 (10.03)	-	-	-	-	30.00 (6.81)	38.64 (9.34)	40.10 (11.79)	-
Lime	-	-	14.31 (19.29)	13.93 (16.83)	-	8.57 (18.69)	-	-	-
Mosambi	-	-	72.25 (10.01)	55.15 (9.47)	-	-	-	-	-
Orange	-	26.12 (8.80)	-	43.45 (12.33)	-	30.26 (18.31)	-	-	-
Guava	13.97 (13.59)	-	-	-	-	16.16 (9.41)	-	-	-
Grape*	237.75 (12.39)	-	-	-	382.11 (9.86)	369.43 (17.24)	-	-	202.79 (14.61)
Banana	-	19.83 (17.91)	24.36 (13.54)	-	-	27.70 (10.23)	-	14.18 (15.50)	-
Sapota	10.93 (10.19)	-	-	-	-	19.81 (17.09)	-	-	-

Figures in brackets represent percentage standard errors.   *Yield rates in Qtls./ha.

It can be observed from the Table 4 that the estimates of yield rates of important fruit crops such as mango, lime, mosambi, orange, guava, grape, banana and sapota, were obtained with percentage standard errors ranging from 6.81 to 19.29.

3.3 Estimates of Total Production of Major Fruit Crops

The district-wise estimates of production of major fruit crops were obtained using the estimation procedure developed under alternative methodology. The district-wise estimates of production of major fruit crops are presented in Table 5.

Table 5: District-Wise Estimates of Total Production (in m.t.) of major Fruit Crops

Districts → Fruits ↓	Ahmad-nagar	Amravati	Jalgaon	Nagpur	Nasik	Pune	Ratnagiri	Sindhu-durg	Solapur
Mango	10348.58 (16.14)	-	-	-	-	5575.57 (11.57)	58579.25 (13.14)	31821.94 (8.12)	-
Lime	-	-	1778.18 (15.71)	1008.56 (19.17)	-	106.04 (12.45)	-	-	-
Mosambi	-	-	13425.91 (13.35)	1015.09 (8.58)	-	-	-	-	-
Orange	-	202811.30 (16.53)	-	142298.26 (13.84)	-	12620.18 (4.19)	-	-	-
Guava	1406.62 (10.83)	-	-	-	-	6476.50 (20.00)	-	-	-
Grape	12368.23 (15.01)	-	-	-	-	38156.12 (9.27)	-	-	48777.06 (17.19)
Banana	-	109445.14 (19.21)	5110196.14 (10.56)	-	-	625.62 (9.20)	-	789.10 (9.30)	-
Sapota	700.38 (18.32)	-	-	-	-	660.71 (11.32)	-	-	-

Figures in brackets represent percentage standard errors.

The Table 5 reveals that the estimates of total production of important fruit crops such as mango, lime, mosambi, orange, guava, grape, banana and sapota were obtained with percentage standard errors ranging from 4.19 to 20.00.

3.4 Estimates of Area under Major Vegetable Crops

The district-wise estimates of area under major vegetable crops were obtained using the estimation procedure developed under alternative methodology. The district-wise estimates of area under major vegetable crops are presented in Table 6.

Table 6: District-Wise Estimates of Area (in ha.) under Major Vegetable Crops

Districts → Vegetables ↓	Ahmad-nagar	Amravati	Jalgaon	Nagpur	Nasik	Pune	Solapur
Potato	-	797.98 (8.24)	-	-	-	15839.75 (17.23)	-
Tomato	416.11 (29.94)	25.49 (10.22)	-	12330.3 (21.76)	28838.46 (14.84)	10038.90 (21.46)	1676.40 (10.10)
Cauliflower	-	-	-	517.75 (27.05)	272.8 (15.55)	15111.78 (24.36)	-
Cabbage	-	-	-	-	95.93 (20.71)	17403.91 (23.71)	-
Peas	-	-	-	-	-	123.95 (10.12)	-
Onion	21116.73 (19.13)	1629.33 (27.86)	62.51 (23.94)	1026.93 (21.13)	62306.35 (14.37)	17432.34 (4.97)	1190.71 (20.11)
Lady finger	267.62 (29.87)	-	354.34 (16.83)	465.23 (15.84)	-	14485.86 (19.21)	-
Brinjal	756.48 (21.10)	93.04 (8.49)	519.9 (4.36)	3761.12 (28.21)	439.94 (25.41)	8096.31 (15.60)	-

Figures in brackets represent percentage standard errors.

It can be observed from the Table 6 that the estimates of area under vegetable crops such as potato, tomato, cauliflower, cabbage, peas, onion, ladyfinger and brinjal were obtained with percentage standard errors ranging from 4.36 to 29.94.

3.5 Estimates of Total Production of Major Vegetable Crops

The district-wise estimates of total production of major vegetable crops were obtained using the estimation procedure developed under alternative methodology. The district-wise estimates of production of major vegetable crops are presented in Table 7.

Table 7: District-Wise Estimates of Total Production (in M.T.) of Major Vegetable Crops

Districts → Vegetables ↓	Ahmad-nagar	Amravati	Jalgaon	Nasik	Pune	Solapur
Potato	-	10476.41 (25.00)	-	-	214818.54 (18.49)	-
Tomato	11184.41 (25.00)	538.37 (27.08)	-	531311.07 (22.54)	323946.20 (20.01)	51675.73 (10.01)
Cauliflower	-	-	-	3163.20 (14.91)	615834.74 (19.86)	-
Cabbage	-	-	-	2392.44 (3.40)	429190.08 (16.01)	-
Peas	-	-	-	-	847.87 (24.82)	-
Onion	133759.38 (23.64)	13332.25 (9.33)	401.23 (13.34)	689266.67 (11.58)	247032.92 (10.26)	1749.05 (9.65)
Ladyfinger	-	-	3007.00 (27.32)	-	70992.30 (28.84)	1113.60 (18.57)
Brinjal	9887.32 (18.76)	1216.16 (29.34)	-	4478.72 (8.16)	131541.69 (8.88)	1160.00 (15.92)

Figures in brackets represent percentage standard errors.

The Table 7 reveals that estimates of total production of vegetable crops such as potato, tomato, cauliflower, cabbage, peas, onion, ladyfinger and brinjal were obtained with percentage standard errors ranging from 3.40 to 29.34.

3.6 Estimates of Yield Rates of Major Vegetable Crops

The district-wise estimates of yield rates of major vegetable crops were obtained using the estimation procedure developed under alternative methodology. The district-wise estimates of yield rates of major vegetable crops are presented in Table 8.

Table 8: District-Wise Estimates of Yield Rates (In Kg/Ha) of Major Vegetable Crops

Districts → Vegetables ↓	Ahmadnagar	Amravati	Jalgaon	Nasik	Pune	Solapur
Potato	-	13128.74 (13.26)	-	-	13561.99 (19.89)	-
Tomato	26878.45 (13.29)	21118.30 (22.15)	-	18423.70 (17.24)	32269.08 (5.05)	30825.41 (10.14)
Cauliflower	-	-	-	11595.31 (27.47)	40751.97 (15.90)	-
Cabbage	-	-	-	24939.99 (20.71)	24660.55 (14.67)	-
Peas	-	-	-	-	6840.20 (24.82)	-
Onion	6334.28 (24.04)	8182.68 (23.30)	6418.35 (4.34)	11062.54 (17.87)	14170.96 (13.65)	17536.44 (11.81)
Ladyfinger	-	-	8486.26 (16.46)	-	4900.80 (10.43)	-
Brinjal	13070.39 (19.07)	13071.55 (19.34)	-	10180.40 (13.20)	16247.12 (15.67)	-

Figures in brackets represent percentage standard errors.

It can be seen from the Table 8 that the estimates of yield rates of vegetable crops such as potato, tomato, cauliflower, cabbage, peas, onion, ladyfinger and brinjal were obtained with percentage standard errors ranging from 4.34 to 27.47.

It may be indicated here that the above estimated total production of fruits and vegetables using the alternative methodology in the State are in agreement with the estimates obtained by the respective State Govt. for the year 2006-2007 using the existing methodology. It can be observed from the above tables that the percentage standard errors of the estimates obtained for fruits are between 4 to 20 and for vegetables are between 2 to 30 percent at district level. Since, only 20 villages per district were selected for the integrated survey and hence for the individual crops the effective sample size i.e. number of villages per district comes out to be less than 20 which results in high percentage standard errors of the estimates at district level. In general, the desirable percentage standard errors of the estimates of the individual crops at district level should be around 10. But due to special features of fruit and vegetable crops, survey approach is somewhat more complex and estimation procedures are somewhat different than other annual crops. Therefore, to obtain 10 percent standard error in case of fruits and 15 percent standard error in case of vegetables at district level, the required sample size i.e. number of villages to be selected per district was also estimated.

It was found that at district level, the total production of important fruits can be estimated with less than or equal to 10 percent standard error and the total production of important vegetables can be estimated with less than 15 percent standard error at 95 percent confidence interval, if 80 villages are selected from each selected district.

IV.   CONCLUSION

The estimates obtained using the estimation procedure developed under alternative methodology is in agreement with the estimates obtained by the State Govt. using the existing methodology. The estimates of number of stray trees have also been obtained and used in finding out estimates of total production of fruit crops. The percentage standard errors of the estimates obtained for fruits are between 4 to 20 and for vegetables are between 2 to 30 percent at district level. It is expected that at district level, the total production of important fruits can be estimated with less than 10 percent standard error and the total production of important vegetables can be estimated with less than 15 percent standard error at 95 percent confidence interval, if 80 villages are selected from each selected district. The study has revealed very encouraging results as shown above and demonstrated the feasibility of estimating the production of fruits and vegetables with much smaller sample size.

REFERENCES

[1] Agricultural Research Data Book (2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011): IASRI publication.
[2] Ahmad, T., Bathla, H.V.L., Rai, A., Mathur, D.C. and Sood, R.M. (2011): An alternative methodology for estimation of area and production of horticultural crops. Model Assist. Statist. Appl., 6(4), 325-336.

[3] Cochran, W.G. (1977): Sampling Techniques. 3rd Ed., Wiley Eastern Limited, New Delhi.

[4] Indian Horticulture Database (2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011): National Horticulture Board, Gurgaon, Ministry of Agriculture publication.

[5] Proceedings of the Symposium on "Statistics of Horticultural Crops: Problems and Issues (2001): Jour. Ind. Soc. Agril. Statist., 54(1), 119-138.

[6] Report of the National Statistical Commission (2001): Ministry of Statistics and Programme Implementation publication.

[7] Singh, D., Manwani, A.H. and Srivastava, A.K. (1976): Survey on fresh fruits in Tamil Nadu, IASRI publication.

[8] Singh, D., Srivastava, A.K., Padam Singh and Satya Pal (1976): Survey on vegetables in Banglore district of Karnataka State, IASRI publication.

[9] Sukhatme, B.V., Manwani, A.H. and Bapat, S.R. (1969): Survey on vegetables in rural areas of Delhi, IASRI publication.