1. INTRODUCTION

In recent years, Horticulture sector has emerged as an important component of the Indian Economy. This sector of agriculture contributes about one-fifth share in the economy of agriculture and allied sectors. Hence, the statistics of horticultural crops has become one of the priority programmes for the planning commission. Horticulture development is being given high priority in the Five Year Plans. For preparation of various developmental programmes and for policy formulations etc., the availability of adequate, reliable and timely statistics on area, yield and production estimates of horticultural crops is essential. At present, a scheme namely "Crop Estimation Survey on Fruits and Vegetables" is being implemented under Directorate of Economics & Statistics (DES), Ministry of Agriculture. This scheme has so far been implemented only in 11 States namely Andhra Pradesh, Gujarat, Haryana, Himachal Pradesh, Karnataka, Maharashtra, Orissa, Punjab, Rajasthan, Tamil Nadu and Uttar Pradesh and covers only 7 fruits and 7 vegetables namely, Mango, Apple, Banana, Grapes, Guava, Citrus, Pineapple, Cauliflower, Potato, Onion, Tomato, Cabbage, Ginger and Turmeric. For estimation of area and production of fruit and vegetable crops, methodology developed by Indian Agricultural Statistics Research Institute (IASRI) is being used in these States. In this paper, present method of generation of data, existing methodology being used and an alternative methodology for estimation of area and production of different horticultural crops have been discussed in brief.

IASRI carried a series of surveys to evolve a sampling methodology for estimating area and yields of fruits and vegetables. 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 and on vegetables in Bangalore district of Karnataka. Problems and issues related to Statistics of Horticultural Crops were discussed in detail in the Symposium organized during ISAS Conference in 2001. Details of the sampling methodology for
estimation of extent of cultivation and production of fruit and vegetable crops are given below:

2. SAMPLING METHODOLOGY FOR ESTIMATION OF EXTENT OF CULTIVATION AND PRODUCTION OF FRUIT AND VEGETABLE CROPS

2.1 FRUIT CROPS

In view of the special features of fruit crops, estimation of extent of cultivation and production of fruit crops is somewhat different than other annual crops. Some of the features are:

i. As against seasonal nature of field crops, fruits are perennial crops.
ii. Fruit trees, besides being grown in regular orchards, are also extensively grown on canal banks, field bunds, road sides, back yard of houses and even as stray trees.
iii. Different fruits are frequently grown in the same orchard.
iv. Fruit trees take quite a few years before they start bearing fruit.
v. All the trees in an orchard may not be of the same age i.e. an orchard may contain both bearing and young trees.
vi. Harvesting of fruits trees is done in a number of pickings extending over several weeks.
vii. Several fruits like citrus, guava etc. have two harvesting seasons in a year.

All these features are to be carefully considered while planning a sample survey to estimate the extent of cultivation and yield of fruits.

Unlike other crops, extent of cultivation of a fruit may be measured in terms of area under the crop or by the number of trees both bearing as well as young. However, only bearing trees contribute towards the production of the fruit. The number of young trees on the other hand provide an idea about the extent of cultivation of the crops in the future.

The choice of sampling design would depend upon whether only one fruit is of interest or more than one fruits are being studied. Normally, the survey may be planned to cover all important fruit crops simultaneously at the State level. However, if single fruit is to be covered for some specified area, say the district level, on the basis of importance of the
crops, the sampling design for such surveys may be used. Accordingly, the sampling design for single fruit in a district and for several fruit crops at the State level are separately described below:

2.1.1 Sampling Plan for Surveys to Estimate the Extent of Cultivation and Production of a Single Fruit Crop in a District

Each village in the district may be identified as “reporting or “Non-reporting” for the crops on the basis whether the fruit is grown in the village or not. A list of “reporting” as well as “non-reporting” villages may be prepared along with area under the fruit. This information may be obtained from revenue records or from past years data.

2.1.1.1 Sampling design

The sampling design may be broadly defined as stratified three stage random sampling. The tehsils/taluks/blocks or groups thereof in the district may be taken as strata, villages as primary sampling units (psu’s), orchards as second stage units and clusters of trees as the ultimate units of sampling. The sample size of villages i.e. the number of villages to be selected in the district may be allocated to different strata in proportion to the area under the fruit in the strata. The “reporting” villages in a stratum may be regarded as p.s.u.’s and selection of allocated or the desired number of villages may be done by probability proportional to size (pps) with replacement, taking area under the fruit as the size measure. Orchards in the selected villages and cluster of trees in the orchards are then selected with SRSWOR. Also since there may be errors in the reporting/recording of fruit cultivation or some fruit cultivation may be taken up in the “non-reporting” villages, a sample of villages may also be selected from the “non-reporting” groups of villages in each stratum. For determining the extent of cultivation, the selected villages may be completely enumerated to obtain information on the area under fruit orchards and the number of trees both in the orchards as well as stray tree. The trees may also be enumerated with respect to the varieties as well as status about bearing or non-bearing fruits. Apart from estimation of extent of cultivation of fruit complete enumeration would also provide a frame of orchards for further selection of orchards and trees for estimation of yield. For estimation of yield of fruit, five orchards may be selected by SRSWOR to record information regarding cultivation practices such as irrigation, manuring, inter-
cropping and other practices followed by the cultivators throughout the year. From each of the selected orchards, three clusters of four trees each of bearing age may be selected at random for recording data on yield of a fruit throughout the harvesting season.

2.1.1.2 Sample size

A total of 150-200 reporting villages (psu’s) may be selected in the district. As described above, this number may be allocated to different strata (tehsils) in proportion to area under orchards and the allocated number of villages in a stratum may be selected with pps with replacement. At the second stage of sampling 5 orchards may be selected at random and from each selected orchard, three clusters of 4 bearing trees may be selected at the ultimate stage of sampling. Earlier surveys have shown that with this type of design and sample size, the average yield at the district level is likely to be estimated with a Standard Error(S.E.) of about 5% and the area and total production with a S.E. between 5 to 10%. However, the efficiencies of various estimators would depend upon the amount of variability in different characters. Surveys conducted during initial years will provide an idea about these variabilities and accordingly the number of villages and orchards selected may be modified to achieve the desired degree of precision.

2.1.2 Sampling Plan for Estimation of Extent of Cultivation and Production of More Than One Fruit Crops in a State:

The important fruit crops whose production is to be estimated should be identified first. Normally, the previous years’ area figures under different fruit crops are available at the tehsil/taluk level and these may be used to determine the important fruits in the State. Since the cultivation of fruits is usually not so evenly spread and may in fact be concentrated in a few districts/regions, the first step in the planning of fruit survey is to identify and delimit the important fruit growing regions or areas for different fruits. A district is considered too large a unit of area for this purpose. However, taluks or subdivisions or equivalent areas in a district may be considered appropriate. Thus taluks which are important at least for one of the fruit crops, may be identified as important fruit growing taluks. It may be mentioned that importance of a taluk with respect to a fruit is determined on the basis of area under that fruit and thus a taluk important for a given fruit may not be important for other fruits. As abroad guideline, for a given fruit, the important
taluks are those which taken together cover 40-50% of the total area under that fruit in the entire State.

2.1.2.1 Sampling design and sample size

All taluks/sub-divisions, considered important fruit growing areas as described above, may be taken as strata. The remaining area or taluks may be further classified or grouped into 4 to 5 strata with respect to importance of individual fruit crops taking into account the geographical contiguity. In these strata, taluks may be considered as primary sampling units. Thus survey would then cover all important fruit growing taluks i.e. taluks in which fruit cultivation is concentrated as well as the selected taluks out of the rest.

In the selected taluks also, all the villages may not be growing all the fruits. A frame of villages growing different fruit in a stratum is, therefore, prepared. Accordingly, villages in a stratum may be classified into two categories (i) growing at least one fruit and (ii) growing no fruit at all. In category (i) on the basis of village-wise area under fruits, villages may be identified as ‘reporting’ or “non-reporting” for individual fruits. If the reported areas are considered as reliable, efforts may be concentrated only in the reporting villages for each fruit. However, experience shows that faculty reporting is not uncommon and therefore, adequate representation may be given to non-reporting group.

From the reporting group of villages for a given fruit crop four villages may be selected with replacement and with probability proportional to area reported under the fruit crop. From the non-reporting group of villages (in which other fruits are grown), a sample of two villages may be selected in each stratum by SRSWOR. From the villages in category (ii) where no cultivation of fruits is reported, a sample of two villages may be selected by SRSWOR. The selected villages may be completely enumerated for the extent of cultivation and number of trees in orchards and also the stray trees.

For yield estimation, a sub sample of two villages out of four reporting villages may be retained in all the major fruit growing taluks/strata and from each village 5 orchards and 3 clusters of 4 trees each of bearing age may be selected for this purpose. The selected clusters of trees may be observed for entire harvest period both with respect to weight as well as number of fruit. However, exceptions to this procedure may be made for certain
crops like banana and grapes. A uniform approach in this regard is essential for comparability as well as pooling of estimates over different areas.

2.2 VEGETABLE CROPS

The survey approach for estimation of area and production of vegetable crops is somewhat more complex due to special feature of cultivation of these crops. Some of these features are as follows:

i. The vegetables are short duration crops and their duration varies considerably from one vegetable to the other.

ii. Harvesting of vegetables involves a number of pickings

iii. Vegetable cultivation is more or less a continuous process with various operations like sowing, harvesting, etc. being done simultaneously in different fields of a village.

iv. Vegetables are highly sensitive crops and this normally adds to the variability in the yield rates of the crops.

It is also realized that due to perishable nature of the vegetable crops, production depends on availability of marketing facilities in the area. This is why cultivation of vegetables is normally concentrated around bigger town and cities. Accordingly, the methodology for estimation of area and production of vegetable crops has been developed at the district level in different surveys conducted so far in various States.

The sampling design for surveys for estimation of area and production of vegetables is described below:

2.2.1 Sampling Design

The sampling design is a stratified multistage random sampling. Taluks or equivalent areas may be taken as main strata. Further, since area under vegetables may vary considerably from one village to another in a taluk, sub-stratification may be done on the basis of village-wise area under vegetables. For this purpose 3 to 4 substrata with equal area under vegetables may be formed. The data figures may be available in revenue records. If not available, then a preliminary survey may be conducted to obtain village
wise area under vegetables. Within the strata, clusters of three villages may be taken as primary sampling units. For determining the extent of cultivation, a sampling fraction of about 20% may be used for selection of clusters of villages. The allocation of clusters of villages to different strata may be done in proportion to area under vegetables. The allocated number of clusters in different strata may be selected with simple random sampling without replacement (SRSWOR). For yield study, 50% of the clusters selected for area may be retained and fields growing vegetables may be selected in these clusters. The selected clusters of villages may be completely enumerated for area under vegetables. Vegetables being short duration crops, one time enumeration in a year may not be meaningful. To account for the short duration of crops and early and late varieties, a year may be divided into four periods of three months each. The area enumeration may be done in the beginning of each period. This will also provide a frame of vegetable fields for estimation of yield rates. For estimation of production, 6 to 8 fields of each important vegetables may be selected in each of the clusters selected for yield study. In each of the selected fields, a randomly located plot of 5m x 5m may be demarcated and observed for all the pickings in the respective periods. The yield of a vegetable for a selected field is obtained as the aggregate of all pickings in the period obtained from the c.c. plot. The average yield of the vegetable for the village is obtained as a simple mean of field wise yield and when multiplied by the area under vegetable in the village gives the vegetable production in the village. In this way the production for each period may be estimated separately. The average yield is then obtained from the estimated production and the area under a vegetable.

This sampling design is likely to provide estimates of average yield with less than 5% standard error and the area and production with less than 10% standard error for important vegetable crops at the district level.

3. PRESENT STATUS

Country level estimates are developed only for important fruit and vegetable crops under central scheme "Crop Estimation Survey on Fruits and Vegetables". Although this scheme is in operation for the last several years, coverage in terms of fruits and vegetables as well as in terms of geographical coverage of the country, it is grossly
inadequate. Since DES releases the estimates for only eleven States, users are depending on other sources of statistics. National Horticulture Board (NHB) of the Ministry of Agriculture is bringing out the publication entitled "Indian Horticulture Database". This publication contains recent data on area, production and prices of various horticultural produce. NHB data is relatively more comprehensive by way of covering data for most of the States, and is generally used for the purpose of GDP estimates etc. The estimates released by NHB are not based on sound statistical methodology and need to be examined.

It is evident from the above that reliable and timely estimates of area and production at all India level for these crops are not available from any source. Moreover, there are problems in the implementation of the pilot scheme on fruits and vegetables because of various reasons.

4. RECOMMENDATIONS OF NATIONAL STATISTICAL COMMISSION (NSC)

National Statistical Commission (NSC) - 2001 in its recommendation (refer 4.5.7 on page 122) has suggested that:

- “The methodology adopted in the pilot scheme of Crop Estimation Survey on Fruits and Vegetables should be reviewed and an alternative methodology for estimating the production of horticultural crops should be developed taking into account information flowing from all sources including market arrivals, exports and growers associations.

- Special studies required to establish the feasibility of such a methodology should be taken up by a team comprising representatives from Indian Agricultural Statistics Research Institute (IASRI), Directorate of Economics and Statistics, Ministry of Agriculture (DESMOA), Field Operations Division of National Sample Survey Organization (NSSO (FOD)) and from one or two major States growing horticultural crops.

- The alternative methodology should be tried out on a pilot basis before actually implementing it on a large scale”.

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5. ALTERNATIVE METHODOLOGY

In view of NSC recommendation, a Brainstorming Session on "Alternative Methodology for Estimation of Production of Horticultural Crops" was held on 24th November 2003 at Indian Agricultural Statistics Research Institute, New Delhi under the Chairmanship of Economic and Statistical Advisor to discuss the issues regarding strengthening of horticulture database. Accordingly, a project proposal entitled “Pilot Study to Develop an Alternative Methodology for Estimation of Area and Production of Horticultural Crops" after incorporating the suggestions made during the brainstorming session was submitted by IASRI to DES, MOA for funding. The project was finally funded by Ministry of Statistics and Programme Implementation and is in operation at IASRI. This study is being conducted in two States namely Maharashtra and Himachal Pradesh covering important fruits and vegetables.

5.1 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 12 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 10 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 in case of Maharashtra and 0.01 ha and above in case of Himachal Pradesh. 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 FI 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.

6. CONCLUDING REMARKS

It is worth mentioning that under the present study the sample size has been decreased drastically i.e. from 150-200 villages per district to 20 villages per district. The sampling design being adopted is simple both for fruits and vegetables. Attempts are being made to use the market arrival data available from different sources. The methodology being
developed shall make use of primary data as well as market arrival data. This study will bridge the data gaps in official statistics related to horticultural crops. Once the methodology is developed, the greater commitment and willingness of all concerned to strictly comply with prescribed procedures and time schedules will bring about remarkable improvements in the system.
REFERENCES


