

# **MANUAL ON HORTICULTURE STATISTICS**

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# PREFACE

1. One of the mandates of the Central Statistical Organization (CSO) is that of laying down norms and standards and evolving concepts, definitions, methodology and classification in relation to Official Statistics. Even though the CSO has been performing this mandate in many fields of statistics, the absence of proper documentation in this regard had, some time back, led to a decision to prepare, to start with, statistical manuals in respect of identified subjects dealing inter alia with concepts, definitions, classification procedures, compilation of data, estimation procedures, dissemination and other relevant explanatory notes, including methodological framework in respect of the statistical indicators to make these manuals comprehensive and useful reference books comparable to the manuals produced by the UNSD from time to time.
2. A Steering Committee for preparation of Manuals on various Statistical Indicators/Statistics has been set up under the chairmanship of the Director General, formerly Central Statistical Organisation and presently known as the Central Statistics Office (CSO) for directing, guiding, monitoring and reviewing the work of the preparation of Manuals. The revised draft of this Manual viz. *Manual on Horticulture Statistics* was deliberated upon in detail on February 15, 2011 and accorded the requisite approval by the aforesaid Steering Committee.
3. The basic purpose of this manual, like those of all others in the series, is to provide the users of data/information on *Horticulture* with a ready-to-use reference guide on methodological aspects of the subject (metadata) that can inter-alia facilitate international comparison. Another purpose of this manual is to provide the statistical offices, both at the national and state levels, with guidelines regarding the subject covered by this manual.
4. The manual is primarily meant for the easy understanding and operational use by the relevant staff/Statistical functionaries working with the various Ministries/Departments/Organisations at the National, State and Sub-State Levels. At the same time, the manual is also meant to serve as a comprehensive reference material on the subject of "*Horticulture Statistics* " in the form of metadata, for the understanding and use of researchers, academicians and students of academic Institutions, besides Industry and Trade Associations/Chambers etc.

5. The details included in this manual are expected to bring about inter-alia harmonization in concepts, definitions and methodology of compilation of **Data/Information on Horticulture**. The adoption of the methodologies suggested in this manual, it is expected, can go a long way in facilitating data aggregation and data comparison, both at intra-regional and inter-regional levels, besides international comparisons.
6. The original draft of this manual was earlier prepared by Dr.H.V.L.Bathla and Dr.G.K.Jha, former Faculty Members of the Indian Agricultural Statistics Research Institute, in the capacity of a consultant, under the overall directions and guidance of the Steering Committee for Preparation of Manuals on Statistical Indicators/Statistics functioning under Chairmanship of the Director General, CSO. I take this opportunity to place on record the invaluable support extended to this endeavour in reviewing the Draft Manual by Mr. Selvan M.T., Directorate of Areca Nut and Spices Development and Dr V.K.G. Unnithan, Retired Professor (Agriculture Statistics), The Kerala Agriculture University in terms of suitably revising the hitherto existing version of the draft manual on the subject. I would like to heartily thank and record my deep sense of appreciation for the invaluable and timely technical support extended to the process of review of the Manual by the Training Division of CSO under the able stewardship of Shri A.K.Mehra, Additional Director General. I take this opportunity to also place on record my deep and heartfelt appreciation to the team of Officers of the Social Statistics Division of the CSO commendably led by Ms. S.Jeyalakshmi, Additional Director General and ably supported by Shri T.V. Raman and Shri Inderjeet Singh, Deputy Directors General, Dr. Niyati Joshi and Shri M.P.Diwakar, Assistant Directors and to Shri M.C.Sharma, PA for his Secretarial Assistance.
7. I hope that this manual will serve as a useful reference document on the subject. Any comments/suggestions towards improving the scope, contents, lay out etc. of this manual from the readers/users of this manual would be welcome and deeply appreciated.

**New Delhi**  
**Dated: 18.02.2011**

**-sd-**  
**(S.K. Das)**  
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## **CHAPTER - I**

### **INTRODUCTION**

#### **Introduction:**

Agriculture plays a vital role in the Indian economy. Over 70 percent of the rural households depend on agriculture as their principal means of livelihood. Agriculture alongwith fisheries and forestry accounts for one-third of the nation's Gross Domestic Product (GDP) and is its single largest contributor. Agricultural exports constitute one fifth of the total exports of the country.

Horticulture, which has gained commercial tone in the recent years, is an important component of Agriculture, having very significant share in the economy of the country. India has the advantage of diverse agro-climatic conditions which enables it to produce a wide range of horticultural crops round the year. The horticulture crops also provide better alternative for diversification of Indian agriculture in view of higher return. It plays an important role in country's nutritional security as well, including poverty alleviation and employment generation.

The horticultural scenario of the country has been changing fast, both in terms of production and productivity. India has emerged as a leading horticultural country of the world with a total annual production of 144.4 million tonnes of horticultural crops during 2002-03. The focussed attention and high priority accorded to the development of horticulture in the country has led to increases in production and productivity and opened new vistas for export of fresh and processed horticulture products. India is now the second largest producer of fruits and vegetables in the world and is the leader in several horticultural crops, namely mango, banana, papaya, cashewnut, arecanut, potato and okra.

The changed economic order in the context of globalization and liberalization of world trade in agriculture has opened up new vistas of growth. Spices sector is one of the key areas in which India has an inherent strength to dominate the global markets. Spices constitute an important group of agricultural commodities which are virtually indispensable in the culinary art. They can be primarily defined as farm products used in various forms viz; fresh, ripe, dried, broken, powdered etc. which contributes aroma, taste, flavour, colour and pungency to food, rather than a lone food seasoning factor. Spices may be either bark, buds, flowers, fruits, leaves, rhizomes, roots, seeds, stigmas and styles or the entire plant tops. They are well known as appetizers or

preservatives and many of them have rich medicinal properties and are used in pharmaceutical, perfumery, cosmetic products, religious rituals etc.

India, known as “Land of Spices”, is the largest producer, consumer and exporter of variety of spices in the world. The area covered under various spices in the country is estimated to be 25 lakhs ha with an annual production of 30.23 lakh tonnes (1999-2000). More than 90% of the spices produced in the country are used for domestic consumption and the rest exported as raw as well as value added products.

Coconut tree in botanical terminology is known as ‘Cocosnucifera’. Each and every part of the Coconut tree is useful in one way or the other. For instance, raw nut and edible copra are important items of food and indispensable items for divine ablution. Oil extracted from copra is used in cooking, manufacturing of soap and other cosmetics. The tender coconut water is one of the refreshing drinks and considered to be the un-adulterated one. The husk is used in the manufacture of coir products. Matured trunks are used in construction of houses. The coconut shell is burnt and often converted into charcoal. Spoons and ladles are made out of shells. Coconut leaves both green and dry are used for making baskets and thatches for houses. Coconut shells and husks are also used in the manufacture of handicraft articles in our cottage industry. On account of these utilization and desirable features, the coconut tree is aptly called as ‘Kalpavriksha’- the Tree of Heaven.

‘Arecanut Crop’ is known ‘Areaca catechu’ in botanical terminology. This crop thrives on a wide variety of soils throughout the year and can only be grown in areas of heavy rainfall or where abundant irrigation facility is available. This factor makes it a highly localized crop and limits its possibility of any huge extension.

**1.1 Measurement Needs of the Sector:** In view of the commercial importance, it has become imperative to have proper planning for enhancing the productivity of these 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 (Tehsil, District, State). 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.

Though India has emerged as a major producer of horticultural crops and the share of horticulture in Gross Domestic Product (GDP) of Agriculture Sector has increased, yet the database in this regard is weak, lacks authentic information. It is therefore, does not provide suitable support for strategies to its development.

One of the biggest constraints for prospective planning in the field of horticulture and spices is the scarcity of reliable data, particularly relating to areas under cultivation, as also the productivity and marketing of produce.

The production of fruits, vegetables and spices has attained significant importance in the recent past. Although, India has emerged as a leading producer of these crops in the world, yet the official estimates on large number of fruits, vegetables and flowers are not available. This is one of the major data gaps in the Agricultural Statistical System in India. 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 these crops is essential.

**1.2 Development of statistical system of the sector:** The problems involved in estimation of area under fruits were first considered by the Technical Committee on Coordination of Agricultural Statistics (TCCAS) in 1949 which observed that “it is not possible to include area under scattered trees in the estimates of cropped area given in Agricultural Statistics in India, as the land on which such trees stand is also covered by one or the other land use classification”. Realizing the difficulties in the collection of data relating to area and yield of different fruit crops, the Indian Agricultural Statistics Research Institute (IASRI), New Delhi conducted a series of pilot investigations in typical districts of selected states with a view to evolve a suitable sampling methodology for estimating the extent of cultivation, yield rates and production of fruit crops as well as to collect reliable data on the cultivation practices adopted.

Also, at the instance of the Ministry of Food and Agriculture, the IASRI initiated a series of pilot sampling investigations on important fresh fruit crops with a view to evolve a suitable sampling methodology for conduct of such surveys. These investigations were carried out in three phases. In the first phase, surveys were conducted on a single fruit crop grown in a district. In the second phase, the surveys covered a group of fruit crops grown in a compact region and in the third phase, integrated surveys were carried out covering all the important fruit crops grown in a State.



Fruit(s) and area covered in various surveys conducted by the Institute under different phases are given below:

Phase	Name of the fruit	Area	Year of the survey
<b>I</b>	1. Mango	Shaharanpur District (U.P.)	1958-59
	2. Mango	Varanasi District (U.P.)	1960-61
	3. Orange	Vidarbha Region (Maharashtra)	1959-62
	4. Guava	Allahabad District (U.P.)	1959-62
	5. Banana	Malaba District (Kerala)	1960-64
	6. Lime	Nellore District (A.P.)	1961-64
<b>II</b>	1. Apple and other temperate fruits	Nainital region (U.P.)	1963-67
	2. -do-	Mahasu and Kulu region (H.P.)	1966-69
	3. Mango and Litchi	Muzzafarpur district (Bihar)	1966-69
<b>III</b>	1. Banana, Mango, Citrus, Grapes	Andhra Pradesh	1965-67
	2. -do-	Tamil Nadu	1971-73

Also, a pilot study as below was undertaken each for Pepper and Ginger.

Name of the Spice	Area	Year of the survey
Pepper	Kodagu District (Karnataka), Sindhudurg District (Maharashtra), Nilgiri and Comboitore District (Tamil Nadu)	1991-94
Ginger	East Garo Hills of Meghalaya	1997-98

Coconut and Arecanut palms are grown in gardens or as stray palms on the bunds of tanks, fields, road sides, house sites, etc. At the village level the area under these crops is recorded by the Village Administrative Officers (Patwaris) and aggregated at different levels to secure the corresponding area figures. Information regarding the number of palms, proportion of bearing palms, average yield per palm etc. is not recorded by them.

Besides, there is ample scope for enhancing the production of coconut by bringing more area under the crop. Information regarding the area and yield of coconut is essential for formulating developmental plans to increase the production of coconut in suitable areas. Thorough

knowledge of the prevailing agricultural practices is also required while preparing schemes for the improvement of coconut crop.

Considering the inadequacy of the data on area, yield, etc. and the importance of crops, a scheme for the estimation of area and yield of coconut and arecanut was launched in the year 1959-60 and is being continued since then.

Originally, the scheme was introduced to cater to the needs of the Central Coconut Committee and the Indian Central Arecanut Committee upto the year 1963-64 and the expenditure towards this scheme was shared by the above two bodies on 50:50 basis. Subsequently, upto the end of the Third Five Year Plan, the expenditure under the scheme was borne by the Government of India and the State Government on 50:50 basis. Afterwards, the expenditure towards the scheme is fully borne by the State Government and it has become regular scheme of the State Government.

**1.3 Purpose of the manual:** The manual will serve as a ready reckoner for all the user organizations and help them in following uniform definitions, data collection procedures and methodology for the analysis of data. It is hoped that this manual will also be useful to administrators, planners and researchers for evolving new policies and programmes for augmenting the production of horticultural crops in the country.

**1.4 Contents and Organization:** The manual consists of four chapters and appendices. Chapter I highlights the significance of the sector, need for statistical standards and development of statistical system of the sector. Concepts and definitions are placed in Chapter II. Chapter III presents sources of data and details of methodology being adopted for generating these data. Chapter IV conveys the suggestion for ensuring quality standards. Lastly, appendices include estimation methods, survey schedules and lists of fruits, vegetables and spices etc.

## **1.5 Food and Agriculture Organization (FAO): Definitions, Classifications And Specific Recommendations**

### ***1.5.1 Fruits and Berries***

- (i) Definition: Fruit crops are those yielding fruits and berries which generally are characterized by their sweet taste and their high content of organic acid and pectin.

Apart from strawberries, all fruits and berries are permanent crops, mainly trees, bushes and shrubs, but also vines and palms. Fruits and berries are generally found in great numbers attached to the branches or stalks or trunks of the plants, in most cases singly, in other cases grouped in bunches and clusters (e.g. bananas and grapes). Commercial crops are cultivated in well ordered orchards and compact plantations, but significant quantities are also collected from scattered plants, either cultivated or growing spontaneously.

Bananas, plantains, grapes, dates and carobs are considered fruit crops by FAO, while nuts, olives, coconuts, melons and water melons are not considered fruit crops.

- (ii) Classification: Fruits are broadly classified as either sub-tropical/tropical fruits, or fruits of the temperate zones. These at times are classified into pome fruits (with seeds/pips contained in rather light endocarp, e.g. apples and pears) and stone fruits (with seed/kernel enclosed in hard woody shells surrounded by the pulp or mesocarp, e.g. peaches and plums). Grapes, dates, figs and some other fruit crops do not enter into any sub-group, while berries and citrus comprise independent groups.

In principle, fruit crops should be classified according to the genus and species to which they pertain with related data reported separately. In certain cases, a further distinction by varieties of the same species may be very useful.

- (iii) Recommendations: With particular application to fruit crops, it is recommended that countries report separately area figures for commercial orchards or compact plantations and for interplanted crops, as well as the number of scattered trees in instances when it is not possible to arrive to a single total area figure in terms of pure stand equivalent.

It is further recommended that separate data on area and number of trees in new plantings should be an integral part of current statistics on fruits. It is considered desirable that countries report the density or planting space of various fruit crops in commercial orchards. It is also suggested that fruit crops be classified by variety.

It is worth emphasizing that fruit crops are grown outside agricultural holdings and commercial orchards to a greater degree than are other crops. It is necessary, therefore, to evaluate periodically how much of the production comes from non-commercial crops.

With regard to bananas specifically, production should be reported in terms of weight, not in terms of numbers of bunches. The weight should include the weight of single bananas or the weight of banana hands, excluding, therefore, the weight of the central stalk of the bunches.

Finally, the gathering of wild plants, particularly berries, should be recorded apart from the production of cultivated crops.

### **1.5.2 Nuts**

- (i) Definition: Nuts are tree crops yielding dry fruits or kernels. They are characterized by their woody shells or hard husks which are generally covered by a thick, fleshy/fibrous outer husk which is removed at harvesting time. The weight of the shells or husks ranges from as little as 20 percent for chestnuts to as much as 70 percent in the case of cashew nuts of the total weight of unshelled/unhusked nuts.
- (ii) Classification: In the FAO classification, only those nuts used mainly as dessert or as table nuts are included. Nuts used for flavouring beverages are excluded, as are masticatory and stimulant nuts and nuts used for the extraction of oil or butter. Also excluded are areca/betel nuts, cola nuts, illipe nuts, karite nuts, coconuts, tung nuts, oil palm nuts, etc.
- (iii) Recommendations: Production data should relate to the weight of the nuts in the shell, or in the husk, without counting the weight of the outer husks.

Gathering of wild plants, particularly chestnuts, walnuts and hazelnuts, should be recorded separately from the production of cultivated crops.

### **1.5.3 Oil-bearing Crops (Permanent only)**

- (i) Definition: Permanent oil-bearing crops are perennial plants whose seeds (kapok), fruits or mesocarp (olives) and nuts (coconuts) are used mainly for extraction of culinary or industrial oils and fats. Consequently, dessert or table nuts, such as walnuts, are excluded because although they are high in oil content, they are not used mainly for extraction of oil.
- (ii) Classification: The oil palm produces bunches containing a large number of fruits or nuts having a fleshy mesocarp or pulp enclosing a kernel covered by a hard shell. As regards coconuts, the primary product is the nut, including the woody shell, the meat and the water or milk, but excluding the fibrous outer husk (coir), which represents about one third of the total weight of mature unhusked coconut.
- (iii) Recommendations: Production data should be reported in terms of dry mature products as they are usually marketed. Olive crops should be classified according to the main use, i.e. olives for oil or table olives.

#### ***1.5.4 Spices, Condiments and Aromatic herbs***

Spices are plants which, in one or the other of their components (rhizome, bark, fruits, berries, seeds, etc.), contain strongly flavoured and aromatic substances, and for that reason are used mainly as condiments. Most of them are perennial.

Spices are rich in essential oils which, in addition to be used in the food industry, are also used in cosmetic and medicinal preparations. The nutritive value of spices is insignificant, but their commercial value is high.

Production data of spices should be reported in terms of ripe, dried or powdered products in order to make them roughly comparable with trade figures.

A partial listing of some of the main spices includes peppers, pimento, vanilla, cinnamon, canella, cloves, nutmeg, mace and cardamons, ginger and anise, badian and fennel.

#### ***1.5.5 Other Permanent Crops***

- (i) Coffee: A tropical shrub or small tree yielding two-seeded fruits or cherries which are processed to free the seeds or "beans" from the pulp fruit and then from the mucilage and silver skin covering the beans.

By weight, the mature but still fresh cherries consist of 45-55 percent pulp, mucilage and skin, and 45-55 percent beans. The dried/clean/cured beans are generally called "green coffee"; or "clean coffee". At this stage, coffee is considered a "primary crop". It contains very little in the way of nutritive elements, apart from some fat. For this reason coffee is classified among the edible but "non-food" crops. Because it contains caffeine, an alkaloid, it is also counted with "stimulant" crops.

The coffee with mucilage and skin not removed is called parchment coffee.

- (ii) Cocoa: Cocoa is a tropical rain-forest tree cultivated for its beans which are contained in large numbers in ovoid pods growing directly on the trunk and on the large branches.

The beans and the white mucilage or pulp covering them represent about one third of the total weight of the pods. Beans and mucilage are taken out of the pods and fermented. The fermented and dried beans are considered a "primary crop", from which various processed products may be derived, including roasted beans (in the shell), and nibs (fragments of roasted/shelled/crushed beans). The nibs are ground to give cocoa mass, from which cocoa fat or butter is extracted by pressing. The resulting cake is then pulverized into cocoa powder.

Cocoa beans contain carbohydrates, protein and particularly fat. As such, it is considered a "food" crop. Since they also contain alkaloids, caffeine and theobromine, they are considered a "stimulant" crop as well.

- (iii) Tea: A shrub or small tree of the Camellia family that is cultivated in sub-tropical and tropical regions, mainly the Far East and China, for the tender leaves which prepared by different processes give the so-called "made" tea. There are two main varieties: assamica and chinese. FAO defines the "primary" crop as the tender leaves, withered, rolled, fermented and dried (black tea). Green tea is black tea not fermented. As tea leaves contain no nutrients but do contain various alkaloids, caffeine and theine or theophylline, they are classified among the "non-food" and "stimulant" crops. Green tea leaves may be consumed fresh as vegetables, while oil may be extracted from the seeds.
- (iv) Natural rubber: The Para rubber or caoutchouc tree is indigenous to Brazil but now is cultivated mainly in the Far East. The natural rubber is the milky fluid latex which exudes when the tree is cut (tapped), and coagulates on exposure to air. The dried latex is treated with sulphur at high temperatures in a process known as vulcanization to increase the more desirable properties of the final product, such as elasticity, strength and stability.

It is hoped that some or all of the recommendations outlined here will be taken up by the countries and that the task of making international comparisons becomes easier.

## CHAPTER - II

### CONCEPTS AND DEFINITIONS

1. **Agricultural year:** Agricultural year is defined as the period of 12 months from 1<sup>st</sup> July to 30<sup>th</sup> June.
2. **Annual crops:** Banana, sugarcane, plantain, pineapple and betel leaves are to be considered as annual crops for the purpose of the survey.
3. **Garden:** For the purpose of the survey a coconut/arecanut garden is to be taken as a distinct patch or portion of land growing 25 and above, 3 rows with minimum of 25 coconut/arecanut palms which is demarcated on all sides by means of a bund or a channel of a narrow strip of uncultivated land or by means of a crop different from coconut/arecanut. Generally coconut or arecanut palms are grown in gardens alongwith other perennial crops like mango, guava, etc. In certain villages crops like paddy, groundnut are raised in the space between the palms in coconut/arecanut gardens. When the coconut/arecanut palms are grown in gardens along-with perennial crops, gardens should be classified as pure or mixed.
  - a) **Pure Garden:** A coconut/arecanut garden is considered as a pure garden if 90% or more of the garden is grown with coconut/arecanut palms. If the crops like groundnut, paddy, etc. are growing between coconut/arecanut palms in a garden, that garden should be treated as a pure garden.
  - b) **Mixed Garden:** A coconut/arecanut garden is considered as mixed if more than 10% of the garden is grown with other perennial crops.
4. **Investigator zone:** The area allotted to one Investigator will be treated as an Investigator zone. It can be one or more panchayats.
5. **Perennial crops:** Crops, which are standing for more than one year, are treated as perennial crops. Most of the perennial crops are tree crops.
6. **Plot:** A plot is defined as a patch or piece of land, which has separate survey sub-division number in the basic tax register.

- 7. Season:** Agricultural year is divided into three non-overlapping seasons of four months duration each.

These are:- a) Autumn - July to October

b) Winter - November to February

c) Summer - March to June

- 8. Seasonal crops:** Crops which are harvested during the period of four months in the season are defined as the seasonal crops of the respective season. Thus, paddy, pulses tapioca, etc. which are harvested during different periods of the year will be classified as Autumn paddy, autumn pulses, etc. according to the period of harvest. The seasonal crops for which the major period of harvest in that village falls within July to October will be autumn crops, November to February winter crops and March to June summer crops.
- 9. Unit of observation:** A unit of observation is defined as the area identified separately for area enumeration. It can be a plot or a group of plots (in the case of a survey sub-division number as in Litho map) or the land in possession of one cultivator.

## A. FRUITS

### 1. Area under orchards of a given fruit crop

In a tract or a region, the sum-total of areas under all orchards in which a minimum number of 12 trees of a given fruit crop are planted or those orchards having area more than  $1/10^{\text{th}}$  of an hectare will be regarded as area under orchards of a given fruit crop in the tract. It may be remarked here that this area will include all such area occupied by vacant spaces in the orchards, mixed crops other than the given fruit crop grown in the orchard, wells, huts and bunds etc.

### 2. Average yield per bearing tree

The average yield per bearing tree is the average yield obtained from trees of bearing age which have borne fruit during the season/year under survey in terms of weight as well as count of fruits.

### 3. Average yield per tree of bearing age

The average yield per tree of bearing age is defined as the average yield per tree of bearing age as specified in (1) in terms of weight as well as count of fruits.



#### **4. Bearing tree**

A bearing tree is regarded as the one which has attained the bearing age as specified under and has also borne fruits during the season/year under survey.

#### **5. Extent of cultivation of fruits:**

Extent of cultivation of fruits includes:

- total number of fruit trees categorized as bearing, non-bearing and young.
- number of orchards categorized as bearing and young and
- area under orchards.

#### **6. Net area under a given fruit crop**

Net area under a given fruit crop is defined as the area occupied by trees of a given fruit crop alone excluding all such areas occupied by vacant spaces, wells, huts and area under mixed crops including area occupied by fruit crops other than the given fruit crop planted in the orchards for given fruit crop. This area could be obtained by estimating the number of fruit trees planted in the region and average area occupied by a single tree as estimated from average spacing between the trees planted systematically in rows and multiplying these two estimates i.e. the estimate of number of trees of a given fruit crop by the estimate of average area occupied by a single tree of that crop.

#### **7. Non-bearing tree**

A tree of bearing age which fails to bear fruits during the season/year under survey due to any reasons such as disease, old age, withering of flowers etc. is regarded as non-bearing tree.

#### **8. Orchard**

A compact piece of land which is at least  $1/10^{\text{th}}$  of an hectare area in size or is having at least 12 trees planted on it, may be regarded as an orchard.

It may be clarified that in case of such fruit trees where distance between the trees is quite large say more than six meters as in the case of mangoes, the orchard will be defined according to the minimum number of 12 trees planted in it while, in such cases where the distance is less than six meters as in the case of bananas, papayas, grape vines etc., the orchard will be defined on the basis of the minimum area of  $1/10^{\text{th}}$  of an hectare.

## 9. Reporting or non-reporting villages

A “reporting” village for a given fruit is one in which some area under the fruit is reported according to the latest information available with the revenue agency. The villages not reporting any area under the fruit are classified as “non-reporting” villages for that fruit.

## 10. Stray or scattered trees

Trees not planted in orchards, those planted in clusters of less than 12 trees or those in a piece of land less than 1/10<sup>th</sup> of an hectare as well as those planted in back-yard of houses, along the roads, river banks etc. are defined as stray or scattered trees.

## 11. Tree of bearing age

A tree of bearing age may be regarded as a tree which has attained the age at which 95 percent of the trees are normally expected to bear fruits, irrespective of the fact whether or not the tree bears fruit during the particular year /season.

The bearing age for different fruit crops may be taken as follows:

(i)	Guava, plum, apricot, peach, sapota, lime and other citrus fruits	4 years
(ii)	Mango and litchi	5 years
(iii)	Grape vine	3 years
(iv)	Papaya	18 months
(v)	Apple	7 years
(vi)	Pear	6 years
(vii)	Walnut	10 years

It may be noted that the bearing age for different fruits as given above are only indicative. The States may suitably modify these ages according to the agro-climatic conditions and varieties prevailing in the State.

## 12. Young tree

A young tree is defined as a tree which has not attained the specified bearing age of the fruit.

## 13. Young and bearing orchard

A young orchard is defined as the one in which at least 90% of the trees planted have not attained the bearing age during the year under survey, otherwise it will be regarded as a bearing orchard.

## B. VEGETABLES

### 1. Area under a given vegetable crop

The area under a given vegetable crop in a tract is the total of areas of fields sown under that vegetable. The areas under such fields in which the given vegetable is sown in a mixed form will be regarded as inter-crop as if the entire area were under that crop.

### 2. Area under vegetables

Area under vegetables may be measured as **net area** or **cropped area**.

- (i) **Net area** under vegetables is the area under cultivation of vegetables during the given agricultural year excluding area sown more than once.
- (ii) **Gross cropped area** under vegetables is the total area under all the vegetables sown during the year including area sown more than once during the year as well as area under mixed crop counted as many number of times as the number of mixed crops sown in the field. Alternatively, cropped area may be defined as total of areas under different vegetable crops grown in the agricultural year.

### 3. Crop-cutting plot

For the purpose of estimating the production of vegetables, the random plot having a size of 5×5 sq. metres will be regarded as a crop-cutting plot. However, for conducting surveys in hill areas where cultivation of vegetables is done on terraces, the size of such plot may be smaller suiting the condition of the crop.

### 4. Inter-crop/support-crop:

Inter or support-crop is the one which is sown alongwith certain other field or horticultural crop in a systematic form e.g. vegetables sown in the vacant spaces in a mango orchard or those sown as support crops in a young orchard. Vegetables which are sown in a mixed form such that when harvesting of one is more or less completed, the harvesting of second crop commences will also be regarded as inter-crops. When sown along with certain field crops, the area will be accounted for vegetables only when the plant ratio of vegetables is at least 25%.

### **5. Mixed vegetable field:**

When two or more vegetable crops are sown in a field in such way that it is difficult to apportion the area under each crop and also, when percentage of any single crop does not exceed 90% of the total number of plants in the field then, such field will be regarded as mixed vegetable field. Vegetables sown in mixed form are harvested more or less during the same period.

### **6. Period of harvesting:**

Period of harvesting of any vegetable crop will be regarded as total period between the first picking and the last picking when, either the crop is completely harvested or the vegetable field is ploughed for sowing the next crop.

### **7. Pure vegetable field:**

A pure vegetable field is the one in which either a single vegetable crop is sown at a time or the number of plants of the main vegetable crop is more than 90 percent.

### **8. Sowing date**

Sowing date of any vegetable crop will be week and month during which the vegetable seeds are sown in the field or transplantation of seedlings takes place.

### **9. Vegetable:**

Vegetable is an agricultural product which is used for human consumption and eaten as raw or in cooked form along with cereals. We may broadly classify different vegetable crops in the following categories:

- (i) fresh vegetables
- (ii) root crops
- (iii) peas and beans

NOTE: Onions and green spice crops are excluded from this definition.

The fresh vegetables may be categorized as:

- (a) leafy vegetables include fenugreek (methi), palak, chulai etc.
- (b) gourds include bottle gourd, bitter gourds, skuash melon and sponge-gourd etc.
- (c) other vegetables such as lady finger, cabbage, brinjal, tomato, cauliflower, etc.

Root crops may include potato, arvi, zimikand etc.

Beans may include green peas, french beans etc.

**10. Vegetable field:**

A vegetable field is a compact piece of land in which vegetables are grown either as pure or in mixed form or as intercrops. For the purpose of survey the minimum size of such field in plains should be 0.05 hectare and in hilly areas it should be 0.02 hectare.

**11. Vegetable season:**

Different vegetables are sown during different periods. In fact, for some of the vegetables, the total sowing and harvesting period may be less than 80 days. It is rather difficult to define the season for each and every vegetable. Sometime, the harvesting and sowing of vegetables in different fields goes on simultaneously. We may broadly divide the year into three seasons viz. winter season starting from October to February, summer from March to June and rainy from July to October. In order to collect reliable data on the extent of cultivation of vegetables it is necessary to completely survey the selected villages during each of the three seasons. For a given vegetable, its season will be the one in which majority of the crop is harvested.

## **CHAPTER - III**

### **SOURCES AND SYSTEMS**

There are two main sources that generate statistics of production of horticultural crops. The first source is the Directorate of Economics and Statistics, Ministry of Agriculture (DESMOA), which operates a centrally sponsored scheme “Crop estimation Survey on Fruits and Vegetables” for estimating area and production. So far this scheme is in operation only in 11 states and covers only seven fruits and seven vegetables. The eleven states are Andhra Pradesh, Gujarat, Haryana, Himachal Pradesh, Karnataka, Maharashtra, Orissa, Punjab, Rajasthan, TamilNadu and Uttar Pradesh. The fruit crops covered are mango, banana, apple, citrus, grapes, pineapple and guava. The vegetable and spice crops are potato, onion, tomato, cabbage, cauliflower, ginger and turmeric. The sampling methodology for the centrally sponsored scheme was provided by IASRI and details of the methodology are given in Section 3.1 and 3.2. The results of the DESMOA survey are published in its publication entitled, “Report and Database of pilot Scheme on Major Fruits and Vegetables”.

The second source of horticultural statistics is the National Horticultural Board (NHB), which compiles and publishes estimates of area, production and prices of all important fruit and vegetable crops based on reports finalised by state Directorates of Horticulture and Agriculture. The methodology followed by NHB for estimating area and production has not been clearly spelt out. These estimates are apparently based on assessment made by local level officials dealing with horticulture and the reports of market arrivals in the major wholesale fruit and vegetable markets. NHB publishes this information through its annual publication “Indian Horticulture Database”.

#### **3.1 FRUITS**

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

- As against seasonal nature of field crops, fruits are perennial crops.
- Fruit trees, besides being grown in regular orchards, are also extensively grown on canal banks, field bunds, road sides, back yard of houses as stray trees.
- Different fruits are frequently grown in the same orchard.
- Fruit trees take quite a few years before they start bearing fruit.

- All the trees in an orchard may not be of the same age i.e. an orchard may contain both bearing and young trees.
- Harvesting of fruit trees is done in a number of pickings extending over several weeks.
- Several fruits like citrus, guava etc. have two harvesting seasons in a year.

All these features need 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 of 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.

### **3.1.1 ESTIMATION OF EXTENT OF CULTIVATION AND PRODUCTION OF A SINGLE FRUIT CROP – DISTRICT LEVEL ESTIMATES**

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.

#### **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, 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 primary stage units and selection of allocated or the desired number of villages may be done by probability proportional to size 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 simple random sampling without replacement. 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 trees. 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 simple random sampling without replacement to record information regarding cultivation practices such as irrigation, manuring, intercropping and other practices followed by the farmers 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.

### **Sample size**

A total of 150-200 reporting villages (primary stage units) 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 probability proportional to size 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 of about 5% and the area and total production with a standard error 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 variability and accordingly the number of villages and orchards selected may be modified to achieve the desired degree of precision. The procedure adopted for estimating the extent of cultivation and production of a single fruit crops in a district is given in Appendix-A.1.



### **3.1.2 ESTIMATION OF EXTENT OF CULTIVATION AND PRODUCTION OF MORE THAN ONE FRUIT CROP – STATE LEVEL ESTIMATES**

The important fruit crops whose production is to be estimated should be first identified. Normally, the previous years' area figures under different fruit crops are available at the tensile/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 only in 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 sub-divisions 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 here 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 a broad 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.

#### **Sampling design**

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 faulty reporting is not uncommon and, therefore, adequate representation may be given to non-reporting group also. 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 with simple random sampling without replacement. From the villages in category (ii) where no cultivation of fruits is reported, a sample of two villages may be selected with simple random sampling without replacement. 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 fruits. However, exceptions to this procedure may be made for certain crops like banana and grapes.

In case of banana, the clusters are selected in the form of rows. For grapes, two plots are selected randomly in each grape orchard. Generally, grape vines are sown in strips with every alternate row of vine stands having a row of vines planted in the middle. Firstly, strips having grape vines are counted and two strips are selected at random. For demarcation of two random plots the number of stands in the selected strip are counted and one vine stand is selected within each selected strip of stands and thus two key stands in each selected grape orchard are selected for demarcation of two random plots for observing the yield of grapes. The other three corners of the plots are determined by three stands nearest to the key stand and forming a rectangle with the key stand. Therefore, the size of random plots for grapes may vary according to distance between the stands. A uniform approach in this regard is essential for comparability as well as pooling of estimates over different areas. The procedure adopted for estimation of extent of cultivation and production of more than one fruit crop in a state is given in Appendix-A.2.

## **3.2 VEGETABLES**

### **METHODOLOGY FOR ESTIMATION OF AREA AND PRODUCTION OF VEGETABLE CROPS**

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

- The vegetables are short duration crops and their duration varies considerably from one vegetable to another.
- Harvesting of vegetables involves a number of pickings.
- 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.
- Vegetables are highly sensitive crops and this normally adds to the variability in the yield rates of these 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 through different surveys conducted so far in various states.

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

#### **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 from 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. 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 maturing 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 obtained from the chosen plot during the period. 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 of 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. The procedure adopted for estimation of area and production of vegetable crops at the district level is given in Appendix-A.3.

### **3.3 SPICES**

There are 109 spices listed in the International Organization for Standardization (ISO) as given in Appendix-C.1. In India, 52 spices are identified as commercially important, considering their domestic requirement, export demand and substantial coverage in area and production (Appendix-C.2). Among them only the following seven spices are included in the National Crop Forecasting System of the Directorate of Economics and Statistics (DES), New Delhi for the annual release of statewise area and production statistics.

- 1) Cardamoms (Small and large), 2) Black Pepper, 3) Chilli, 4) Ginger, 5) Turmeric,
- 6) Garlic and 7) Coriander

In the present system, all India estimates on area and production of the above selected crops are generated by the DES, based on the estimations made by the State Departments of Economics and Statistics. The State Departments of Economics and Statistics generally make estimates of few among the remaining spices like Cumin, Fennel, Ajwain, Tamarind, Tejpat, Nutmeg, Clove, Cinnamon etc. but these estimates are not included in the data released by the DES, New Delhi. Further, no efforts have so far been made for generation of data on spices like Saffron, Vanilla, Aniseed, Celery, Dill seeds etc., database on which are also required in view of the appreciable area & production and commercial importance of these spices.

### **Grouping of spices having similar features for conducting survey**

Reliable data on all the important spices crops having commercial importance are required periodically for the formulation of various development programmes in order to assess their availability in the internal market to meet the domestic requirement as well as export demand. Therefore, it is necessary that the important spices having potential for cultivation in the country and fairly good demand in the domestic market be included in the forecasting system of DES. For the sake of convenience in formulating a methodology for collection and compilation of data, these crops can be grouped as perennials and annuals considering not only the crop duration but also their similarity in various features related to production.

#### ***Perennial Spices***

- 1) Cardamoms (Small and large) 2) Pepper 3) Nutmeg 4) Clove 5) Tejpat 6) Cassia
- 7) Cinnamon 8) Tamarind 9) Curry leaf 10) All spice 11) Cambodge/ Garcinia 12) Vanilla

#### ***Annual Spices***

- 1) Chilli 2) Ginger 3) Turmeric 4) Coriander 5) Cumin 6) Fennel 7) Fenugreek 8) Celery
- 9) Aniseed 10) Ajwan seed 11) Caraway 12) Dill 13) Garlic 14) Saffron 15) Star Anise

### **Methodology Followed At Present For Data Collection**

The Directorate of Economics and Statistics (DES) under Ministry of Agriculture, Government of India is the official agency for compilation and release of crop estimates. The methodology used by DES for crop estimation may be unified at national level and further refined to generate realistic figures within the minimum possible time.

Directorate of Arecanut and Spices Development, Calicut generally collects statistics on the crops concerned by it from all the available sources viz. DES, New Delhi, State Departments of Economics & Statistics/Agriculture/Horticulture, Commodity Boards etc. and acts as a secondary source for ‘Database on Spices and Arecanut’. These data are compiled and released through the various periodical publications of the Directorate. A publication entitled “Arecanut and Spices Database” containing data on area, production and productivity for Arecanut and Spices which include Black pepper, Chillies, Ginger, Turmeric, Garlic, Cardamom, Seed spices, Tree spices and other spices is brought out annually by the Directorate of Arecanut and Spices Development, Calicut.

**Sources of data compiled by Directorate of Arecanut and Spices Development, Calicut**

Data	Source
Statewise Area and Production of arecanut, black pepper, ginger, chilli, turmeric, coriander, cardamom, garlic	Directorate of Economics and Statistics, New Delhi
Statewise Area and Production of seed spices and tree spices	Compiled from the concerned State Departments of E&S / Horticulture
Districtwise Area and Production of arecanut and spices	State Departments of Economics and Statistics
Area and Production of medicinal and aromatic plants	State Departments of E&S/ Horticulture/ Agriculture
Export and import of Arecanut	Directorate General of Commercial Intelligence and Statistics, Kolkata
Export of spices	Spices Board, Kochi
Import of spices	Directorate General of Commercial Intelligence and Statistics, Kolkata
Export and Import of Medicinal and Aromatic Plants	Directorate General of Commercial Intelligence and Statistics, Kolkata
Market prices of arecanut and spices	1. Regional / Taluk Statistical Offices under State Dept. of E&S 2. India Pepper and Spice Trade Association, Kochi. 3. Agricultural Produce Marketing Committees in different market centers 4. Department of Marketing, Andhra Pradesh 5. Spices Board, Kochi
Cost of cultivation of arecanut and spices	State Agricultural Universities/ ICAR Institutes

## **International Status in terms of methodology and statistics**

As regards the international statistics, each country has its own methodology for crop estimation, and the international agencies like Food and Agriculture Organization (FAO), International Pepper Community (IPC), International Trade Centre (ITC) compile statistics available in the country reports or data received from the Government sources.

### **3.3.1 Estimation of crop assessment of Cardamom (Small) in Kerala, Karnataka & Tamil Nadu**

Small Cardamom botanically known as ‘Elettaria Cardamomum Maton’ is cultivated in India in the hilly tracts of the three Southern States of Kerala, Karnataka and Tamilnadu. Crop assessment of area and production of Cardamom (Small) in the three states of Kerala, Karnataka and Tamil Nadu is done in three stages viz. preliminary, mid-term and final by the Spices Board, Kochi with the following guidelines for each stage. Proforma used for collection of the details are given as Appendix-B.3.

#### **Preliminary**

- 2% of the total holdings in each field unit subject to a maximum of 30 holdings are sampled.
- Samples are selected at random including marginal, small and large holdings
- Sampled holdings may include utilized high yielding planting materials and enjoyed benefits under various development schemes of the Spices Board like replanting, irrigation etc.
- Influences of climatic conditions on the crop production are taken into account.
- Area assessment in respect of yielding and non-yielding in respect of village/taluk/field unit are arrived at.

### **Mid-term**

- The sample estate covered for preliminary assessment are visited again for mid-term assessment and growers are also consulted to assess the actual quantity harvested and expected quantity left for harvest. The views of Cardamom Planters' Associations/Auctioneers etc. are also taken into account while arriving at the crop assessment.
- Late crop, if any, anticipated from each location are ascertained based on the present climatic conditions.
- Cardamom sold outside auction centres are assessed in consultation with marketing officers/auctioneers/planters' associations

### **Final**

- The sample estate covered for preliminary and mid-term assessments are visited again for final assessment and growers are also consulted to assess the actual quantity harvested during the year.
- The views of Cardamom Planters' Associations/Auctioneers etc. are obtained before arriving at the final estimate.
- Cardamom sold through auctions and sold outside auction centres are assessed in consultation with concerned marketing officers/auctioneers/planters' associations etc.
- The final estimates are prepared with details such as total area, yielding area, average yield per ha., and production in respect of each village or part of the village (specify taluk and district also) (in the case of Karnataka, taluk and district only).

## **3.4 CASHEWNUT**

In the absence of any basic statistical information and in view of its importance, the Indian Agricultural Statistics Research Institute, New Delhi took initiative in early sixties to conduct pilot sample surveys to estimate area and production of cashew in a few selected important cashew growing states in the country. One round of survey was conducted in Kerala in 1960-61 and two rounds of survey were conducted in Karnataka in the year 1959-60 and 1960-61. On the basis of the survey, it was estimated that Kerala produced 21,582 MT of raw cashewnuts from an area of 125,101 hectares. The production was estimated at 9300 MT in Karnataka in 1959-60.



The area and production of Cashew in Karnataka were 11,583 hectares and 5,315 MT in the year 1960-61. Based on the experience gained in Kerala and Karnataka surveys, the IASRI subsequently undertook area and production surveys in Andhra Pradesh in 1966-67 and 1967-68 and in Maharashtra in 1967-68 and 1968-69. The survey brought out that Andhra Pradesh had 10,141 hectares with a production of 9,122 MT of raw cashewnut in the year 1967-68 and Maharashtra produced 3,508 MT of raw cashewnut in the year 1968-69. Since then, no regular survey has been undertaken either by IASRI or by the State Governments concerned.

The Directorate of Cashewnut Development made efforts to collect the area and production statistics of cashewnut from different sources in different cashew growing states for the period from 1955-56 to 1979-80. The district-wise figures were also collected from different states from the year 1974-75 onwards. The production figures furnished by the state authorities in Kerala, Karnataka, Andhra Pradesh and Maharashtra do not tally with the figures as revealed by the survey in the concerned years. The production figures estimated on the basis of the survey seem to be much lower than the actual production in Kerala in the year 1960-61 as much more quantities of rawnuts were reported to have been procured from Kerala by the processing units in the year 1960-61. The results of the survey in Karnataka also seem to be erratic, that the estimated production of raw cashewnut in the year 1960-61 was only a little over half of the production of the previous year. The production in the year 1959-60 seems to have been over estimated. In the case of Andhra Pradesh also, production in 1967-68 seems to have been over estimated. According to the survey, the average yield per tree in the year 1967-68 works out to 8.33 kgs. which seems to be on a very high side for Andhra Pradesh. The Bureau of Economics and Statistics, Kerala conducted three rounds of survey during the year 1971-72 to 1973-74. A brief account of the survey as published by them is given below.

### **Objective of the survey**

The objectives of the survey are (i) to estimate the acreage and yield rate of cashewnut and (ii) to collect information on practices followed by the cultivators.

### **Coverage**

Out of the 57 taluks in the state of Kerala 38 taluks were covered for the first round of the survey while in the second and third rounds survey was conducted only in 35 taluks. The taluks selected for the survey cover about 95 percent of the area under the crop in the state.

## **Sampling design**

The design adopted for selecting sample units was one of the multi-stage stratified random sampling. Cashew is cultivated only in the low land and mid-land regions of the state. During the first round of the survey, the 14 taluks in the low land region which were important for cashew cultivation were grouped together to form one stratum and the remaining 24 taluks which belonged to the midland region were grouped into three strata according to intensity of cashew cultivation. Thus there were four strata in all for the first round. Within the stratum census village was the primary unit of sampling. Equal allocation of sample villages was made among the different strata. Accordingly, for estimation of the number of trees, 40 census villages were selected at random from each stratum (total 160 villages for the state) during the first round of the survey. In each selected village, plot to plot enumeration of cashewnut trees was carried out by visiting all the survey numbers in the village. Collection of data on yield and cultivation practices was confined to 30 villages selected at random from among the villages already selected for enumeration. A sample of two randomly selected orchards was covered in each selected village for collecting detailed information on various cultivation practices of the crop. The actual harvested yield was obtained from two clusters of three adjacent trees each selected at random in each of the orchards so selected. Since cashewnut crop was harvested a number of times and at frequent intervals in the season, the enumerator was directed to visit each selected orchard once in every three or four days to observe and record data on harvested yield of each of the selected trees on the day of visit by actual weighment. The owner of the selected plot had also been requested to store the produce separately for each of the selected trees collected between two consecutive visits of the investigator for making appropriate records at his next visit. In the second and third rounds the sampling design adopted during the first round was slightly modified with a view to get district estimates. The district was taken as the stratum and the survey was conducted in 35 taluks which are important for cashew cultivation. Census villages were allocated among the taluks considering the distribution of area under cashew in them. In all, 240 census villages were selected separately for each round throughout the state for enumeration and 60 villages for collection of data on yield and cultivation practices. Other details remained the same as in case of the first round.

Based on the above sample survey and regression studies, the Directorate of Cashewnut & Cocoa Development finalized the estimation of 1979-80 as the firm base to which the incrementals in

area coverage that has taken place thereafter were added year after year/plan after plan. The detailed estimation procedure is given in Appendix-A.4. The schedules used by the Directorate of Cashewnut & Cocoa Development for production forecast are included in Appendix B.5.

### **3.5 COCONUT and ARECANUT**

The sampling design being adopted for estimating the extent of cultivation and production of these crops may be broadly defined as stratified simple random sampling technique. The villages in the state are stratified into the following three strata:

- i) Villages reported to be growing coconut only.
- ii) Villages reported to be growing both coconut and arecanut.
- iii) Villages reported to be growing arecanut only.

The sample size for each stratum is fixed at the rate of one village from each block of the state in which either coconut or areca nut or both are cultivated. Out of these selected villages arecanut survey is also carried out along with coconut survey wherever the crop is available. Of these selected villages, 40% of the villages are randomly retained from the villages selected from the previous year. The rest of the 60% of the villages are randomly selected at the rate of one village per block in the remaining blocks.

#### **Area Enumeration:**

For area enumeration, 50% of the geographical area of each one of the selected villages growing coconut/ arecanut, constitute the sampling unit in respect of the first two strata. If the village is selected afresh, the first 50% of the geographical area of the village is covered. If the village is retained one, the second 50% of the area of the village is covered for the survey. From the year 1998-99, onwards it has been decided by the Department to conduct the survey only on garden palms. Area enumeration is done in two selected gardens and the area estimated from the survey is used only for yield estimation (per hectare). For the purpose of estimation of production of nuts the area reported in the secondary source like 'Season and Crop Report of Tamil Nadu' is used.

#### **Yield Estimation:**

The sampling design for yield estimation is simple random sampling. In the village selected for yield estimation, 2 coconut/ arecanut gardens are selected. The selected gardens have a minimum of 25 trees with 3 rows. The total number of bearing trees and their yield are taken for

estimation. The field enumerators are instructed to be present at the time of harvest and record the yield from each coconut palm of the selected garden.

The detailed estimation procedure is given in Appendix-A.5.

### 3.6 REPORTING OF DATA ON FRUIT CROPS BY DIFFERENT COUNTRIES

Different countries report their annual crops in different ways, many of them being unable to conform with FAO. This can be seen in case of the countries presented below. This information was gathered by FAO from annual country publications of recent years, available in the Statistics Division Library at FAO.

- a) **United States.** Bearing area and production of fruit crops, by kinds. Commercial crops only.
- b) **China.** All fruit crops area (presumably planted) and corresponding production in one single figure. Both area and production data also available for the most important individual crops.
- c) **Russian Federation.** Planted and bearing area of fruit crops (all together) and grapes, and related production.
- d) **Brazil.** Bearing area and production of fruit crops, by kind. Production reported in number of fruits rather than weight.
- e) **Indonesia.** Bearing area and occasionally number of bearing trees for most individual fruit crops and related production.
- f) **India.** Irregularly, production of main fruit crops and total fruit production. Occasionally, unspecified area figures for some of them.
- g) **Morocco.** Unspecified area and production of fruit crops, by kind.
- h) **Philippines.** Unspecified area and production of fruit crops. Separate figures for some kinds of fruits; all other together.
- i) **Germany.** Commercial production of fruits, by kind, and related area (for apples and grapes only), or number of bearing trees (for all other crops). Estimates of non-commercial production (very important), are also shown, as well as related yields per tree for the former Federal Republic of Germany.
- j) **Spain.** Planted and bearing area for fruit crops, by kind, grown in regular plantations. Number of scattered trees. Total production, including that from scattered trees.
- k) **France.** Non-bearing and bearing area of fruit crops , by kind, including pure and interplanted stands in compact plantations. Total production, including production of scattered trees.

- l) **Italy**. Planted and bearing area of fruit crops, by kind, and related production (both biological and harvested).
- m) **Poland**. Number of bearing trees and corresponding production of fruit crops, by kind. For some berries, area and production.
- n) **Greece**. Unspecified area and number of trees in compact plantations. Number of scattered trees. Production from both. All by kind of fruit.
- o) **Turkey**. Number of non-bearing and bearing fruit trees and related production. By kind.
- p) **Syria**. Planted area and production of fruit crops. Number of trees; bearing and total. All by kinds.
- q) **Paraguay**. Planted area and total number of trees in compact plantations. Number of bearing trees including scattered trees and related production. All by kinds.
- r) **Algeria**. Planted and bearing area of fruit crops, by kinds, and corresponding production. Mixed cropping included.
- s) **Austria**. Intensive cultivation: Bearing area and production. Extensive cultivation: Number of bearing trees and production. Total production. All by kinds.
- t) **Switzerland**. For important fruit crops, area and production in compact plantations and number of scattered trees and related production. For all other fruit crops, area and production by kinds. Family gardens production, excluded.
- u) **Czech Republic**. Number of trees, presumably bearing, and production, by kinds.
- v) **Romania**. Planted area and production of fruit crops in one figure. Only production available by kinds.
- w) **Yugoslavia (Federal Republic)**. Planted area of fruit crops all together. By kinds: bearing and total trees and related production.
- x) **Hungary**. Planted and productive area of fruit crops, all together. Production shown by kinds. Occasionally, yields per hectare shown.
- y) **Norway**. Harvested area and production of various kinds of fruits in commercial orchards. Very low coverage.
- z) **Non-reporting countries**. Quite a long list. Mainly developing countries.

## APPENDICES

### Estimation Procedures

#### Appendix A.1

#### Estimation of the extent of cultivation and production of a single fruit crop in a district

##### (a) Estimation of extent of cultivation

Define the following notations

$L$  = Total number of strata

$N_{h(R)}$  = Total number of reporting villages in the  $h^{\text{th}}$  stratum

$n_{h(R)}$  = Total number of reporting villages selected from the  $h^{\text{th}}$  stratum

$P_{hi}$  = Probability of selecting  $i^{\text{th}}$  village from the  $h^{\text{th}}$  stratum

$N_{h(NR)}$  = Total number of non reporting villages in the  $h^{\text{th}}$  stratum

$n_{h(NR)}$  = Total number of non reporting villages selected from the  $h^{\text{th}}$  stratum

$p$  = Number of orchards selected ( $p=5$  in the present case) in a village for conducting yield study.

$x_{hi(R)}$  = Value of the character under study e.g. number of trees bearing or young or total, number of orchards, area under orchards etc. recorded on the basis of complete enumeration of trees in the  $i^{\text{th}}$  village selected with probability  $P_i$  in the  $h^{\text{th}}$  stratum from the reporting group of villages.

$x_{hi(NR)}$  = Value of the character under study e.g. number of trees bearing or young or total, number of orchards, area under orchards etc. recorded on the basis of complete enumeration of trees in the  $i^{\text{th}}$  village selected with equal probability in the  $h^{\text{th}}$  stratum from the non reporting group of villages.

An estimate of total for the character  $x$  in the reporting group for the  $h^{\text{th}}$  stratum is obtained as,

$$\hat{X}_{h(R)} = \frac{1}{n_{h(R)}} \sum_i^{n_{h(R)}} \frac{x_{hi(R)}}{P_{hi}}$$

An estimate of total for the character  $x$  in the non-reporting group for the  $h^{\text{th}}$  stratum is obtained as,

$$\hat{X}_{h(NR)} = \frac{N_{h(NR)}}{n_{h(NR)}} \sum_i^{n_{h(NR)}} x_{hi(NR)}$$

The total of the  $h^{\text{th}}$  stratum as estimated on the basis of samples selected (reporting as well as non reporting ) is given by,

$$\hat{X}_h = \hat{X}_{h(R)} + \hat{X}_{h(NR)}$$

### Pooling of strata estimates to get district level estimate

The estimates of all the strata in a district are added to get the estimates of the district

$$\hat{X} = \sum_{h=1}^L \hat{X}_h$$

### Estimation of variance

An estimate of variance for the reporting group in the  $h^{\text{th}}$  stratum is given by,

$$\hat{V}(\hat{X}_{h(R)}) = \frac{1}{n_{h(R)}(n_{h(R)} - 1)} \left\{ \sum_i^{n_{h(R)}} \frac{X_{hi(R)}^2}{P_{hi}^2} - n_{h(R)} \hat{X}_{h(R)}^2 \right\}$$

An estimate of variance for the non reporting group in the  $h^{\text{th}}$  stratum is given by,

$$\hat{V}(\hat{X}_{h(NR)}) = \frac{N_{h(NR)}(N_{h(NR)} - n_{h(NR)})}{n_{h(NR)}(n_{h(NR)} - 1)} \sum_i^{n_{h(NR)}} (X_{hi(NR)} - \frac{1}{n_{h(NR)}} \sum_i^{n_{h(NR)}} X_{hi(NR)})^2$$

The variance of  $\hat{X}$  in the  $h^{\text{th}}$  stratum is obtained as

$$\hat{V}(\hat{X}_h) = \hat{V}(\hat{X}_{h(R)}) + \hat{V}(\hat{X}_{h(NR)})$$

Estimate of variance for the district is the sum of estimates of variances of all the strata

$$\hat{V}(\hat{X}) = \sum_{h=1}^L \hat{V}(\hat{X}_h)$$

Percentage standard error of  $\hat{X}$  is given by,

$$\% \text{S.E.}(\hat{X}) = \frac{\sqrt{\hat{V}(\hat{X})}}{\hat{X}} \times 100$$

### (b) Estimation of overall average yield per tree

As mentioned in the sampling plan the villages are selected with probability proportional to area under the fruit. It is reasonable to assume that the area under a particular fruit is proportional to

the number of bearing trees of that fruit.

Define the following notations:

$y_{ij}$  = Average yield per tree in the  $j^{\text{th}}$  orchard of the  $i^{\text{th}}$  village.

$\bar{y}_{hi}$  = Average yield per tree in the  $i^{\text{th}}$  village of the  $h^{\text{th}}$  stratum.

$B_h$  = Total number of bearing trees of the  $h^{\text{th}}$  stratum.

$B$  = Total number of bearing trees of the district.

$\bar{y}_{hij}$  = Average yield per bearing tree obtained from 12 bearing trees harvested in the  $j^{\text{th}}$  orchard of the  $i^{\text{th}}$  village in the  $h^{\text{th}}$  stratum.

$B_{hi}$  = Number of bearing trees of the  $i^{\text{th}}$  village in the  $h^{\text{th}}$  stratum.

The estimate of number of bearing trees of the  $h^{\text{th}}$  stratum is given by,

$$\hat{B}_h = \frac{1}{n_h} \sum_i^{n_h} \frac{B_{hi}}{P_{hi}}$$

The estimate of number of bearing trees of the district is given by,

$$\hat{B} = \sum_{h=1}^L \hat{B}_h$$

The estimate of average yield per tree in the  $i^{\text{th}}$  village of the  $h^{\text{th}}$  stratum is given by,

$$\bar{y}_{hi} = \frac{1}{p} \sum_{j=1}^p y_{ij}$$

The estimate of average yield/tree of the  $h^{\text{th}}$  stratum is given by,

$$\bar{y}_h = \left( \sum_i^{nR} \frac{B_{hi} \bar{y}_{hi}}{P_{hi}} \right) / \left( \sum_i^{nR} \frac{B_{hi}}{P_{hi}} \right)$$

The estimate of average yield/tree of the district is given by,

$$\bar{y}_{(\text{pooledover all strata})} = \sum_{h=1}^L \frac{\hat{B}_h}{\left( \sum_{h=1}^L \hat{B}_h \right)} \bar{y}_h$$



### Estimation of variance for average yield

The estimate of variance for average yield is given by,

$$\hat{V}(\bar{y}_h) = \frac{1}{n_h(n_h - 1)(\hat{B}_h)^2} \sum \frac{\hat{B}_{hi}^2}{P_{hi}^2} (\bar{y}_{hi} - \bar{y}_h)^2$$

The estimate of variance for district is given by,

$$\hat{V}\left(\bar{y}_{\substack{\text{(pooledover)} \\ \text{all strata}}}\right) = \sum_{h=1}^L \left( \frac{\hat{B}_h}{\sum_{h=1}^L \hat{B}_h} \right)^2 \hat{V}(\bar{y}_h)$$

### (c) Estimation of total production

The total production of the fruit is given by,

$$\hat{Y} = \bar{y}_{\substack{\text{(pooledover)} \\ \text{all strata}}} \times \hat{B}$$

The estimate of variance is given by,

$$\hat{V}(\hat{Y}) = (\bar{y})_{pooled}^2 \hat{V}(\hat{B}) + (\hat{B})^2 \hat{V}(\bar{y})_{pooled} - \hat{V}(\hat{B}) \times \hat{V}(\bar{y})_{pooled}$$

where,

$$\hat{V}(\hat{B}) = \sum_{h=1}^L \frac{1}{n_h(n_h - 1)} \left( \sum_{i=1}^{n_h} \frac{B_{hi}^2}{P_{hi}^2} - n_h \hat{B}_h^2 \right)$$

## Appendix A.2

### Estimation of extent of cultivation and production of more than one fruit crops in a state

#### Estimation procedure for working out estimates of number of trees, area, average yield and total production of each fruit

Consistent with the sampling plan, the estimates of the number of trees/area under a given fruit crop in a given stratum can be obtained as follows:

Define the following notations:

Let

$N$  = Number of primary sampling units (psu's) - villages in the case of those taluks which were taken strata as such and taluks in the case of remaining strata.

$n$  = Number of psu's selected in the given stratum.

$P_i$  = Probability of selecting  $i^{\text{th}}$  taluk in a given stratum in which the taluks were taken as psu's.

$M_{if(R)}$  = Number of villages reported to be growing  $f^{\text{th}}$  fruit crop (either banana, mango, citrus or grapes or any other fruit) in the  $i^{\text{th}}$  taluk.

$m'_{if(R)}$  = Number of villages selected from reporting group for the  $f^{\text{th}}$  fruit crop in the  $i^{\text{th}}$  taluk i.e. number of villages selected from  $M_{if(R)}$ .

$m_{if(R)}$  = Number of villages selected for yield study for the  $f^{\text{th}}$  fruit from  $i^{\text{th}}$  taluk.

$M_{if(NR)}$  = Number of villages not growing  $f^{\text{th}}$  fruit crop in a given stratum.

$m_{if(NR)}$  = Number of villages selected out of  $M_{if(NR)}$  in a given stratum.

$p$  = Number of orchards selected in a village for conducting yield study ( $p = 5$  in the present case) of a particular fruit.

$y_{ijl}$  = Average yield per bearing tree obtained from 12 bearing trees harvested in  $l^{\text{th}}$  orchard of  $j^{\text{th}}$  village in the  $i^{\text{th}}$  taluk.

$P_{ijf}$  = Probability of selecting the  $f^{\text{th}}$  fruit crop (banana, mango, citrus or grapes or any other fruit) in  $j^{\text{th}}$  village of the  $i^{\text{th}}$  taluk.

$x_{ijf(R)}$  = Value of the character under study e.g. number of trees, bearing or young or total, number of orchards etc. recorded on the basis of complete enumeration of  $j^{\text{th}}$  village selected with probability  $P_{ijf}$  in the  $i^{\text{th}}$  taluk from the reporting group.

$x_{ijf(NR)}$  = Value of the character under study e.g. number of trees, bearing or young or total, number of orchards etc. recorded on the basis of complete enumeration of  $j^{\text{th}}$  village selected with equal probability in the  $i^{\text{th}}$  taluk from the non reporting group.

$M_{i(NA)}$  = Number of villages not growing any fruit in the  $i^{\text{th}}$  taluk.

$m_{i(NA)}$  = Number of villages selected out of  $M_{i(NA)}$  in the  $i^{\text{th}}$  taluk.

$x_{ij(NA)}$  = Value of the character under study based on complete enumeration in  $j^{\text{th}}$  village selected from the non reporting group for all the fruits from the  $i^{\text{th}}$  taluk.

An estimate of total for the character  $x$  (briefly we call it total unless otherwise stated) in the reporting group for the  $f^{\text{th}}$  fruit in the  $i^{\text{th}}$  taluk is given by,

$$\hat{X}_{if(R)} = \left( \frac{1}{m'_{if(R)}} \right) \sum_{j=1}^{m'_{if(R)}} x_{ijf(R)} / P_{ijf}$$

An estimate of total in the non-reporting group for  $f^{\text{th}}$  fruit in the  $i^{\text{th}}$  taluk is,

$$\hat{X}_{if(NR)} = \left( \frac{M_{if(NR)}}{m_{if(NR)}} \right) \sum_{j=1}^{m_{if(NR)}} x_{ijf(NR)}$$

The total of the  $i^{\text{th}}$  taluk for  $f^{\text{th}}$  fruit  $\hat{X}_{if} = \hat{X}_{if(R)} + \hat{X}_{if(NR)}$

An estimate of total in the group which is non-reporting for all the fruits is given by,

$$\hat{X}_{i(NA)} = \left( \frac{M_{i(NA)}}{m_{i(NA)}} \right) \sum_{j=1}^{m_{i(NA)}} x_{ij(NA)}$$

An estimate of total on the basis of samples selected for all the fruits  $Q(f=1,2,3,4)$  in the  $i^{\text{th}}$  taluk is given by,

$$\hat{X}_i = \frac{1}{4} \sum_{f=1}^4 \hat{X}_{if} + \hat{X}_{i(NA)}$$

The estimate of total in the strata where taluks are taken as psu's is given by,

$$\begin{aligned} \hat{X} &= (N/n) \sum_{i=1}^n \hat{X}_i \text{ if taluks are selected with equal probabilities without replacement} \\ &= \frac{1}{n} \sum_{i=1}^n \hat{X}_i / P_i \text{ if taluks are selected by probabilities } P_i \text{'s with replacement} \end{aligned}$$

The total in the entire state is estimated by adding  $\hat{X}$  over all the strata.

### Estimation of variance

An estimate of variance of  $\hat{X}$  in those strata where taluks are taken as psu's is given by,

$$\hat{V}(\hat{X}) = (N(N-n)/n(n-1)) \left[ \sum_i^n \hat{X}_i^2 - \frac{1}{n} \left( \sum_i^n \hat{X}_i \right)^2 \right]$$

when psu's are selected with equal probabilities. In this case the variance components due to ssu's have been ignored due to their insignificant contribution towards the total variance,

$$= \left( \sum_{i=1}^n \frac{\hat{X}_i^2}{P_i^2} - n\hat{X}^2 \right) / n(n-1)$$

when psu's are selected with pps with replacement. An estimate of variance of  $\hat{X}$  in the taluks where taluks are taken as strata is given by,

$$\hat{V}(\hat{X}) = \frac{1}{16} \sum_{f=1}^4 \hat{V}(\hat{X}_{if}) + \hat{V}(\hat{X}_{i(NA)})$$

$$\text{where, } \hat{V}(\hat{X}_{if}) = \hat{V}(\hat{X}_{if(R)}) + \hat{V}(\hat{X}_{if(NR)})$$

$$\hat{V}(\hat{X}_{if(R)}) = \frac{1}{m'_{if(R)}(m'_{if(R)} - 1)} \left[ \sum_{i=1}^{m'_{if(R)}} \frac{x_{ijf(R)}^2}{P_{ij}} - m'_{if(R)} \hat{X}_{if(R)}^2 \right]$$

$$\hat{V}(\hat{X}_{if(NR)}) = \frac{M_{if(NR)}(M_{if(NR)} - m_{if(NR)})}{m_{if(NR)}(m_{if(NR)} - 1)} \sum_j \left( x_{ijf(NR)} - \frac{1}{m_{if(NR)}} \sum x_{ijf(NR)} \right)^2$$

Therefore,

$$\hat{V}(\hat{X}_{i(NA)}) = \frac{M_{i(NA)}(M_{i(NA)} - m_{i(NA)})}{m_{i(NA)}(m_{i(NA)} - 1)} \sum_{j=1}^{m_{i(NA)}} \left( x_{ij(NA)} - \frac{1}{m_{i(NA)}} \sum x_{ij(NA)} \right)^2$$

The variance of the estimate of total in the entire state is estimated as the sum of the estimated variances of  $\hat{X}$  's in all the strata.

### Estimation of overall average yield per tree of a given fruit crop

As mentioned in the sampling plan the villages are selected with probability proportional to area under the respective fruits. It is reasonable to assume that the area under a particular fruit is proportional to the number of bearing trees of that fruit. Under this assumption the estimate of average yield of the  $f^{\text{th}}$  fruit in the  $i^{\text{th}}$  taluk is given by

$$\bar{y}_{if} = \frac{1}{m_{if(R)}} \sum_{j=1}^{m_{if(R)}} \bar{y}_{ijf}$$

where,

$$\bar{y}_{ijf} = \frac{1}{p} \sum_{l=1}^p y_{ijl}$$

An estimate of average yield of  $f^{\text{th}}$  fruit in a given stratum is given by,

$$\bar{y}_f = \left( \sum_{i=1}^n \hat{B}_{if} \bar{y}_{if} \middle| P_i \right) / \left( \sum \hat{B}_{if} \middle| P_i \right)$$

where  $\hat{B}_{if}$  is the estimate of number of bearing trees of  $f^{\text{th}}$  fruit in  $i^{\text{th}}$  taluk. An estimate of overall average yield per tree of  $f^{\text{th}}$  fruit is given by,

$$(\bar{y})_{\text{pooled}} = \sum_h \left( \hat{B}_{fh} / \hat{B}_f \right) \bar{y}_{fh}$$

where  $\hat{B}_{fh}$  and  $\hat{B}_f$  are estimates of number of bearing trees of  $f^{\text{th}}$  fruit in  $h^{\text{th}}$  stratum and an estimate of total number of bearing trees and pooled over those strata which have been observed for yield study respectively and  $\bar{y}_{fh}$  is an estimate of average yield of  $f^{\text{th}}$  fruit in the  $h^{\text{th}}$  stratum.

An estimate of variance of  $(\bar{y}_f)_{\text{pooled}}$  is given by,

$$\hat{V}(\bar{y}_f)_{\text{pooled}} = \sum_h \left( \hat{B}_{fh} / \hat{B}_f \right)^2 \hat{V}(\bar{y}_{fh})$$

$$\text{where } \hat{V}(\bar{y}_{fh}) = \frac{1}{n(n-1)(\hat{B}_{fh})^2} \sum_{i=1}^n \frac{\hat{B}_{ifh}^2}{P_i^2} (\bar{y}_{ifh} - \bar{y}_{fh})^2$$

the suffix  $h$  stands for  $h$ -th stratum.

### Estimation of total production of a given fruit crop

An estimate of total production of  $f^{\text{th}}$  fruit is given by,

$$\hat{Y}_f = (\bar{y}_f)_{\text{pooled}} \times (\hat{B}_f)_{\text{pooled}}$$

where  $(\bar{y}_f)_{\text{pooled}}$  is the estimate of overall average yield for  $f^{\text{th}}$  fruit and  $(\hat{B}_f)_{\text{pooled}}$  is an estimate of total number of bearing trees of  $f^{\text{th}}$  fruit in the entire state. With the assumption the average yield and total production of bearing trees are independent, an estimate of variance is given by,

$$\hat{V}(\hat{Y}_f) = (\bar{y}_f)_{\text{pooled}}^2 \times \hat{V}(\hat{B}_f)_{\text{pooled}} + (\hat{B}_f)_{\text{pooled}}^2 \times \hat{V}(\bar{y}_f)_{\text{pooled}} - \hat{V}(\hat{B}_f)_{\text{pooled}} \times \hat{V}(\bar{y}_f)_{\text{pooled}}$$

### APPENDIX A.3

#### Estimation of area and production of vegetable crops in a district

The following notations will be used in explaining the formulae applied for obtaining the estimates and their variances:

$N$  = Total number of primary sampling units (psu's) .

$N_h$  = Total number of psu's in the  $h^{\text{th}}$  stratum.

$A^t$  = Area under  $t^{\text{th}}$  vegetable crop in the tract.

$A_h^t$  = Area under  $t^{\text{th}}$  vegetable crop in the  $h^{\text{th}}$  stratum.

$A_{h,i}^t$  = Area under  $t^{\text{th}}$  vegetable crop in  $i^{\text{th}}$  psu of  $h^{\text{th}}$  stratum.

$A_{h,i}^{t,p}$  = Area under  $t^{\text{th}}$  vegetable crop in  $i^{\text{th}}$  psu of  $h^{\text{th}}$  stratum to be harvested during  $p^{\text{th}}$  period.

$n$  = Number of psu's selected in the survey.

$n_h$  = Number of psu's selected from  $h^{\text{th}}$  stratum.

$y_{h,i,j}^{t,p}$  = Yield harvested from  $j^{\text{th}}$  plot of standard size having  $t^{\text{th}}$  vegetable crop in  $i^{\text{th}}$  psu of the  $h^{\text{th}}$  stratum during  $p^{\text{th}}$  period.

$\bar{y}_{h,i}^{t,p} = \frac{1}{m} \sum_{j=1}^m y_{h,i,j}^{t,p}$  = average yield of  $t^{\text{th}}$  vegetable crop in  $i^{\text{th}}$  psu in  $p^{\text{th}}$  period, where  $m$  is the number of fields selected for each vegetable crop in a psu.

#### Estimate of area and its estimate of variance

The estimate of area under  $t^{\text{th}}$  crop in  $h^{\text{th}}$  stratum is given by,

$$\hat{A}_h^t = \frac{N_h}{n_h} \sum_{i=1}^{n_h} A_{h,i}^t = N_h \bar{A}_h^t$$

Estimate of variance of  $A_h^t$  is given by,

$$v(\hat{A}_h^t) = \frac{N_h(N_h - n_h)}{n_h(n_h - 1)} \sum_{i=1}^{n_h} (A_{h,i}^t - \bar{A}_h^t)^2$$

**Estimates of total production and average yield per hectare with their estimates of variance for  $t^{\text{th}}$  crop in  $h^{\text{th}}$  stratum**

- (i) Total production in  $i^{\text{th}}$  village during  $p^{\text{th}}$  period

$$= 400 \times \bar{y}_{h,i}^{t,p} \times A_{h,i}^{t,p} \quad (\text{Since size of the plot is } 5\text{m} \times 5\text{m})$$

- (ii) Total production in  $i^{\text{th}}$  village during the year,

$$\hat{Y}_{h,i}^t = 400 \times \sum_{p=1}^6 \bar{y}_{h,i}^{t,p} \times A_{h,i}^{t,p}$$

Total production estimated for  $t^{\text{th}}$  crop in  $h^{\text{th}}$  stratum is given by,

$$\hat{Y}_h^t = \frac{N_h}{n_h} \sum_{i=1}^{n_h} \hat{Y}_{h,i}^t$$

- (iii) An estimate of variance of  $\hat{Y}_h^t$  is approximately is given by,

$$\hat{V}(\hat{Y}_h^t) = \frac{N_h(N_h - n_h)}{n_h(n_h - 1)} \sum_{i=1}^{n_h} \left( \hat{Y}_{h,i}^t - \frac{\hat{Y}_h^t}{N_h} \right)^2$$

assuming that second component in the variance estimate due to variation between fields within is negligible.

Average yield of  $t^{\text{th}}$  crop in  $h^{\text{th}}$  stratum is given by,

$$\hat{\bar{y}}_h^t = \frac{\sum_{i=1}^{n_h} \hat{Y}_{h,i}^t}{\sum_{i=1}^{n_h} A_{h,i}^t}$$

An approximate estimate of variance of  $\hat{\bar{y}}_h^t$  is given by,

$$\hat{V}(\hat{\bar{y}}_h^t) = \frac{N_h(N_h - n_h)}{(n_h - 1)n_h(\hat{A}_h^t)^2} \times \left[ \sum_{i=1}^{n_h} (\hat{Y}_{h,i}^t)^2 - 2\hat{\bar{y}}_h^t \sum_{i=1}^{n_h} \hat{Y}_{h,i}^t \times A_{h,i}^t + (\hat{\bar{y}}_h^t)^2 \sum_{i=1}^{n_h} (A_{h,i}^t)^2 \right]$$

The estimates of total production and area for each vegetable crop for the entire region under survey could be obtained by taking summation over all the strata. Similarly, an estimate of variance could be obtained by taking summation of the corresponding estimates of variances over all the strata.



The estimate of average yield  $(\bar{y}^t)$  of  $t^{\text{th}}$  crop pooled over all the strata will be given by,

$$\bar{y}^t = \frac{\sum_{h=1}^k \hat{Y}_h^t}{\sum_{h=1}^k \hat{A}_h^t}$$

where  $k$  is the number of strata into which the population has been divided. Also, an approximate of variance of  $\bar{y}^t$  can be obtained by a formula of variance of combined ratio estimate.

$$\hat{V}(\bar{y}^t) = \frac{1}{\left( \sum_{h=1}^k \hat{A}_h^t \right)^2} \sum_{h=1}^k \left[ v(\hat{Y}_h^t) - 2\bar{y}^t \text{cov}(\hat{y}_h^t, \hat{A}_h^t) + (\bar{y}^t)^2 v(\hat{A}_h^t) \right]$$

where  $\text{Cov}(\hat{Y}_h^t, \hat{A}_h^t)$  denotes covariance between  $\hat{Y}_h^t$  and  $\hat{A}_h^t$  and is given by,

$$\text{Cov}(\hat{Y}_h^t, \hat{A}_h^t) = \frac{N_h(N_h - n_h)}{n_h(n_h - 1)} \sum_{i=1}^{n_h} (\hat{Y}_{h,i}^t - \hat{Y}_h^t/N_h) \hat{A}_{h,i}^t$$

## APPENDIX A.4

### Estimation of the acreage and yield rate of cashewnut

#### 1. Number of cashew trees

The number of bearing, non-bearing and total number of cashew trees were separately estimated for each stratum. First, the estimates were made for each selected villages and the average stand per acre in each stratum calculated by the weighted average method using the areas of the selected villages as weights. Multiplying this average stand per acre by the dry land area of the stratum, the estimate for the stratum were arrived at. The number of bearing cashew trees in the  $i^{\text{th}}$  stratum was estimated as,

$$\hat{P}_i = \frac{A_i}{\sum_{j=1}^{n_i} a_{ij}} \sum_{j=1}^{n_i} P_{ij}$$

where  $P_{ij}$  = number of bearing trees in the  $j^{\text{th}}$  selected village of  $i^{\text{th}}$  stratum

$a_{ij}$  = the dry land area of the  $j^{\text{th}}$  village of the  $i^{\text{th}}$  stratum and

$A_i$  = Total dry land area of all villages in the  $i^{\text{th}}$  stratum

The total number of bearing trees for all the strata is given by,

$$\hat{P} = \sum_{i=1}^L \hat{P}_i \quad \text{where } L \text{ is the total number of strata.}$$

The variance of the number of bearing trees for all the strata together was estimated as

$$\hat{V}(\hat{P}) = \sum_{i=1}^L \frac{N_i(N_i - n_i)}{n_i(n_i - 1)} \sum_{j=1}^{n_i} (p_{ij} - R_{ni}a_{ij})^2 \quad \text{where}$$

$$R_{ni} = \frac{\sum_{j=1}^{n_i} p_{ij}}{\sum_{j=1}^{n_i} a_{ij}},$$

$N_i$  = No. of villages in the  $i^{\text{th}}$  stratum

$n_i$  = No. of villages selected for enumeration in the  $i^{\text{th}}$  stratum.

Similarly, the other estimates were also worked out.

#### 2. Estimates of the average yield of rawnuts per bearing tree

From each village selected for crop cutting 2 plots each having at least 6 bearing trees were selected and from each plot 2 clusters of 3 trees each were selected for crop cutting surveys. The variance of the average yield for the state and variance of total production were also calculated using the number of bearing trees as weights. The average yield per bearing tree in the  $i^{\text{th}}$  stratum was estimated as,

$$\hat{\bar{Y}}_i = \frac{\sum_{j=1}^{n_i} B_{ij} \bar{Y}_{ij}}{\sum_{j=1}^{n_i} B_{ij}}$$

where  $\bar{Y}_{ij}$  = Average yield of nuts from  $j^{\text{th}}$  village of the  $i^{\text{th}}$  stratum.

$B_{ij}$  = No. of bearing trees in the  $j^{\text{th}}$  village selected for crop cutting in the  $i^{\text{th}}$  stratum.

The average yield per bearing tree for all the strata was also estimated using the same method of procedure as,

$$\hat{\bar{Y}} = \frac{\sum_{i=1}^L B_i \hat{\bar{Y}}_i}{\sum_{i=1}^L B_i} \quad \text{where } B_i = \sum_{j=1}^{n_i} B_{ij}$$

The estimate of variance of  $\bar{Y}_i$  is given by,

$$\hat{V}(\hat{\bar{Y}}_i) = \frac{(N_i - n_i)}{N_i n_i (n_i - 1)} \times \frac{1}{\left[ \frac{\sum_{j=1}^{n_i} B_{ij}}{n_i} \right]^2} \times \sum_{j=1}^{n_i} (T_{ij} - Q_{ni} B_{ij})^2$$

$$\text{where } T_{ij} = B_{ij} \times \bar{Y}_{ij} \quad \text{and} \quad Q_{ni} = \frac{\sum_{j=1}^{n_i} T_{ij}}{\sum_{j=1}^{n_i} B_{ij}}$$

The estimate of variance of the average yield per bearing tree for all the strata is calculated as,

$$\hat{V}(\hat{\bar{Y}}) = \frac{\sum_{i=1}^L \hat{B}_i^2}{\left( \sum_{i=1}^L \hat{B}_i \right)^2} V(\hat{\bar{Y}}_i)$$

The total production of nuts is given by

$$\hat{T} = \sum_{i=1}^L \hat{T}_i \text{ where } \hat{T}_i = \hat{B}_i \times \hat{Y}_i$$

The estimate of variance of  $\hat{T}_i$  is given by,

$$\hat{V}(\hat{T}_i) = \hat{Y}_i^2 \hat{V}(\hat{B}_i) + (\hat{B}_i)^2 \hat{V}(\hat{Y}_i)$$

and the variance of the total production of nuts is estimated as,

$$\hat{V}(\hat{T}) = \sum_{i=1}^L \hat{V}(\hat{T}_i)$$

## APPENDIX A.5

### B. COCONUT/ARECANUT

#### Estimation Procedure

The ratio estimate is adopted for estimating the number of Coconut palms for both fresh and retained villages and added up using regression estimate. The estimate of average yield per bearing palms is also done to work out the production. The estimation procedure is given below:

- $N_i$  Total number of villages in  $i^{\text{th}}$  stratum growing the crop.  
 $n_i$  Number of villages selected for palm enumeration in  $i^{\text{th}}$  stratum.  
 $p_i$  Number of retained villages of previous round in  $i^{\text{th}}$  stratum.  
 $(n_i - p_i)$  Number of villages selected afresh for the current round in  $i^{\text{th}}$  stratum.  
 $A_i$  Total area under the crop in  $i^{\text{th}}$  stratum as per 'g' return.  
 $a_{ij}$  Area under the crop in  $j^{\text{th}}$  village of  $i^{\text{th}}$  stratum.  
 $t_{ij}$  Number of trees enumerated during previous year in  $j^{\text{th}}$  retained village of  $i^{\text{th}}$  stratum.  
 $t'_{ij}$  Number of trees enumerated during current year in  $j^{\text{th}}$  retained village of  $i^{\text{th}}$  stratum.  
 $c$  current year of the survey.  
 $i$  Number of strata considered.  
 $r_i$  Correlation coefficient between the number of palms in previous year and current year of the retained villages.  
 $b_i$  Regression coefficient of the number of palms of retained villages in current and the number of palms in previous year.

#### ESTIMATION OF TOTAL NUMBER OF PALMS

$$X = \left[ \frac{\sum_{j=1}^{n_i} t'_{ij}}{\sum_{j=1}^{n_i} a_{ij}} \right] \times A_i$$

is the ratio of the number of palms for  $i^{\text{th}}$  stratum based on the palms enumerated during current year in all the selected villages.

$$X_i(p_i) = \frac{\sum_{j=1}^{p_i} t_{ij}}{\sum_{j=1}^{p_i} a_{ij}} \times A_i$$

is the ratio estimate of the number of palms for  $i^{\text{th}}$  stratum based on the palms enumerated during the previous year in the retained villages.

$$Y_i(p_i) = \frac{\sum_{j=1}^{p_i} t_{ij}}{\sum_{j=1}^{p_i} a_{ij}} \times A_i = R_{ni} \times A_i$$

is the ratio estimate of the number of palms for  $i^{\text{th}}$  stratum based on the palms enumerated during current year in the retained villages.

Therefore, regression estimate of the total number of palms for  $i^{\text{th}}$  stratum on the basis of both fresh and retained villages is,

$$T_i(c-1, c) = Y_i(p_i) + b_i[X_i - X_i(p_i)] \quad \dots\dots\dots(1)$$

Sampling variance of this estimate is,

$$V[T_i(c-1, c)] = [N_i(n_i - p_i)S_{yi}^2(c-1, c)] \times \left[ \frac{1 - r_i^2}{p_i} \left( 1 + \frac{1}{p_i - 3} \right) + \frac{r_i^2}{n_i} \right]$$

$$\text{where } S_{yi}^2(c-1, c) = \frac{1}{p_i - 1} \sum_{j=1}^{p_i} (t_{ij} - R_{ni}a_{ij})^2$$

Ratio estimate of the number of palms for  $i^{\text{th}}$  stratum on the basis of fresh villages is,

$$\hat{T}_i(c) = \frac{\sum_{j=1}^{n_i - p_i} t_{ij}}{\sum_{j=1}^{n_i - p_i} a_{ij}} \times A_i = R_{ni} \times A_i \quad \dots\dots\dots(2)$$

An estimate of variance of this estimate is,

$$\hat{V}[\hat{T}_i(c)] = \frac{[N_i(N_i(n_i - p_i))S_{yi}^2(c)]}{n_i - p_i}$$

where  $S_{yi}^2(c) = \frac{1}{n_i - p_i - 1} \sum_{j=1}^{n_i - p_i} (t_{ij} - R_{ni} - a_{ij})^2$

Final estimate of the total number of palms for  $i^{\text{th}}$  stratum based on the estimate (1) & (2) is,

$$\hat{T}_i = a T_i(c-1, c) + b T_i(c)$$

where  $a = \frac{V(T_i(c))}{V(T_i(c-1, c)) + V(T_i(c))}$

$$b = \frac{V(T_i(c-1, c))}{V(T_i(c-1, c)) + V(T_i(c))}$$

The estimate of variance is given by,

$$\hat{V}(\hat{T}_i) = a V(T_i(c-1, c)) + b^2 V(T_i(c))$$

Estimate of the total number of palms in all strata is,

$$\hat{T} = \sum_{i=1}^L T_i$$

Its estimate of variance is  $\hat{V}(\hat{T}) = \sum_{i=1}^L \hat{V}(T_i)$

**ESTIMATION OF AVERAGE YIELD PER BEARING PALM**

$N_i$  Number of villages in the  $i^{\text{th}}$  stratum.

$r_{ni}$  Number of villages selected for yield estimation in the  $i^{\text{th}}$  stratum.

$k_{ij}$  Number of bearing palms selected for yield estimation in  $j^{\text{th}}$  villages of  $i^{\text{th}}$  stratum.

$B_{ij}$  Total number of bearing palms in  $j^{\text{th}}$  village of  $i^{\text{th}}$  stratum.

$T_{ij}$  Total yield of all the selected palms of  $j^{\text{th}}$  village in  $i^{\text{th}}$  stratum.

Average yield per bearing palm for  $j^{\text{th}}$  village of  $i^{\text{th}}$  stratum is,

$$\bar{Y}_{ij} = \frac{T_{ij}}{k_{ij}}$$

Total production of nuts for  $j^{\text{th}}$  village of  $i^{\text{th}}$  stratum is,

$$Y_{ij} = \bar{Y}_{ij} \times B_{ij}$$

Therefore, an estimate of average yield per bearing palm for  $i^{\text{th}}$  stratum is,

$$\hat{\bar{Y}}_i = \frac{\sum_{j=1}^{r_{ni}} Y_{ij}}{\sum_{j=1}^{r_{ni}} B_{ij}} = R_{ni}$$

The estimate of variance is given by,

$$\hat{V}(\hat{\bar{Y}}_i) = \frac{N_i - r_{ni}}{N_i \times r_{ni}} \frac{1}{\left( \sum_{j=1}^{r_{ni}} B_{ij} \right)^2} \times \frac{1}{r_{ni} - 1} \left[ \sum_{j=1}^{r_{ni}} (Y_{ij} - R_{ni} B_{ij})^2 \right]$$

Estimate of average yield per bearing palm for all the strata is,

$$\hat{\bar{Y}} = \frac{\sum_{i=1}^L \sum_{j=1}^{r_{ni}} Y_{ij}}{\sum_{i=1}^L \sum_{j=1}^{r_{ni}} B_{ij}}$$



An estimate of variance of this estimate is

$$\hat{V}(\hat{\bar{Y}}) = \frac{\sum_{i=1}^L V(\hat{Y}_i) B_i^2}{\left( \sum_{i=1}^L B_i \right)^2}$$

### ESTIMATION OF TOTAL PRODUCTION

$\hat{B}_i$  = Estimated number of bearing palms for  $i^{\text{th}}$  stratum

Estimate of production of nuts for  $i^{\text{th}}$  stratum is,

$$\hat{P}_i = \hat{\bar{Y}}_i \times \hat{B}_i$$

Its estimate of variance is

$$\hat{V}(\hat{P}_i) = \hat{V}(\hat{B}_i) \hat{\bar{Y}}_i^2 \times \hat{V}(\hat{\bar{Y}}_i) \hat{B}_i^2$$

Estimate of total production of nuts for all the strata is,

$$\hat{P} = \sum_{i=1}^L \hat{P}_i$$

An estimate of variance for this estimate is

$$\hat{V}(\hat{P}) = \sum_{i=1}^L \hat{V}(\hat{P}_i)$$

**APPENDIX B.1****MODEL SURVEY SCHEDULES****PROFORMA USED FOR THE FRUITS SURVEY****Institute of Agricultural Research Statistics (I.C.A.R.)**

Pilot sample survey for the study of yield and cultivation practices of fresh fruits in

Tamil Nadu

**Form - 1**

General information regarding the selected village/cluster

Code

Code

1. State

3. District

2. Year

4. Taluk

5. Village/Cluster

1.	Information as recorded in revenue records	Acres	Cents
	(i) Total area of the village		
	(ii) Total cultivated area		
	(iii) Area Under fresh fruits		
	(1) Banana		
	(2) Mango		
	(3) Grapes		
	(4) Sweet Orange		
	(5) Lime		
	(6) Total Citrus		
	(7) Other fresh fruits with name		
	(i)		
	(ii)		
	(iii)		
2.	Soil types in the village		Code
3.	Sources of irrigation		
4.	Average rainfall		
5.	Maximum temperature during the year		
6.	Minimum temperature during the year		
7.	Name of the nearest (i) Railway station (ii) Bus stop		
8.	Distance in kilometers from the above (i) Railway station (ii) Bus stop		

Signature of the Supervising Officer

Date:

Signature of the enumerator

Date:

**Form - 2**

Enumeration of fruit orchards in the selected villages/cluster

Code

Code

1. State
2. Year

3. District
4. Taluk
5. Village/Cluster

Date of enumeration	Survey No. of the orchard	Name of the owner or lessee	Sl. No. of the orchard	Area of the orchard as recorded in Revenue Record		Approximate area as observed on the spot		Total number of fruit trees/Grape Vines in the orchard (all type other than the banana, if Banana plants, there write 'B' also	Names of the fruit crops grown in the orchards	Code	Max. age	Min. age	How old is the orchard i.e. max. & Min. age of trees in the orchard (For banana, give date of planting)	Any crop other than fruit trees grown in the orchard	Serial No. of Bearing orchard having more than 12 trees of Bearing age of				Serial No. of purely young orchard of			Remarks, if any
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)		(11)	(12)		(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)

**Form - 3**

Enumeration of bearing trees of different fruits in the selected orchard of a village

Code

Code

1. State

3. District

2. Year

4. Taluk

5. Village/Cluster

Sl. No. of the orchards as given in form 2	Area under Banana		Total No. of bearing trees of major fruits							Total (columns 4,5 & 10)	Total No. of bearing trees of minor fruits			Total of column 12, 13, 14	Grand total column 11 and 15	Remarks, if any
	Acres	Cents	Mango	Grapes	Citrus				Total (Col. 6 to 9)		Sapota (chiku)	Guava	Other (specify)			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)

**Form - 4**

Enumeration of young trees of different fruits in selected village

Code

Code

1. State

3. District

2. Year

4. Taluk

5. Village/Cluster

S. No. of the orchards as given in Form 2	Total No. of young trees of major fruits							Total of columns 2,3 & 8	Total No. of young trees of minor fruits			Total of column 10 to 12	Grand total column 9 and 13	Remarks, if any
	Mango	Grapes	Citrus						Sapota (chiku)	Guava	Other (specify)			
			Mandarin	Lime	Sathgudi (Mosambi)	Others	Total of Col. 4 to 7							
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)

**Form - 5**

Enumeration of stray trees in the selected village

Code

Code

1. State

3. District

2. Year

4. Taluk

5. Village/Cluster

Date of enumeration	Survey No. or some other identity of the plot having stray trees	No. of bearing trees							Total of column 3 to 9	No. of young trees						Total of column 11 to 16	Others		Grand total of column 10+17+18	Remarks, if any				
		Banana	Mango	Citrus				Grapes		Mango	Citrus				Grapes		No.	Type						
				Mandarin	Lime	Sathgudi (Mosambi)	Other				Mandarin	Lime	Sathgudi (Mosambi)	Others										
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)		(19)	(20)				

**Form - 6**

Particulars of random selection of the bearing orchards

Code

Code

1. State

4. Taluk

2. Year

5. Village/Cluster

3. District

6. Name of the fruit

S. No. of selected orchards		1	2	3	4	5
1.	Column number of the random number list					
2.	Starting row number of the random number list					
3.	Random number rejected between					
4.	Finally selected random number					
5.	Serial number of the selected orchards as given in column 4 of form-2					
6.	Survey number of the selected orchards					
7.	Name of the owner					
8.	If given on lease, name of the lessee					
9.	If given on contract: (a) Amount in Rupees of the contract (b) Period of contract					

**Form - 7(a)**

## Layout plan and other details of the selected orchards

Code

Code

1. State

2. Year

3. District

4. Taluk

5. Village/Cluster

6. Survey No. of the orchard

7. S. No. of the orchard as given in Form-2

8. Name of the owner or the lessee

9. Name of the fruit

1. Area of the orchard as given in revenue records					Acres	Cents
2. Area of the orchard as actually measured						
Code	(1)	(2)	(3)	(4)	(5)	(6)
3. Topography of the orchard	Level	Slopy	Riverside	Hillside	-	-
4. Soil type of the orchard	Loam	Clay	Sandy	Clay Loam	Sandy loam	Any other (mention)
5. Colour of the soil	Red	Black	Brown	Any other (mention)	-	-
6. Depth of the soil	Deep above 10"	Medium 6"-10"	Shallow below 6"	-	-	-
7. System of planting	Square	Hezathonal	Diagonal	Contour	Any other (specify)	-
8. Source of irrigation	Well	Tube well	Canal	revulet	Tank	Any other (mention)
9. Mode of lifting water	Mohte	Persian wheel	Oil engine	Electrical engine	Any other (mention)	-
10. Layout plan (Give sketch with measurement of all sides and diagonals in meters and cms.)						
Sketch						



**Form - 7(b)**

Detailed information about all the trees in the selected orchard of .....(Name of the fruit)  
 Code Code

- |                    |   |
|--------------------|---|
| 1. State           | 6. Survey No. of the orchard                  |
| 2. Year            | 7. S. No. of the orchard (as given in Form-2) |
| 3. District        | 8. Name of the owner or tenant                |
| 4. Taluk           | 9. Date of enumeration                        |
| 5. Village/Cluster |   |

Serial No. of the tree	Type of fruit	Whether bearing fruit (B), Non-bearing fruit (N.B.) or young (Y)	Age in year	Variety	Whether the tree is graft/layer or seedling
(1)	(2)	(3)	(4)	(5)	(6)
	Code	Code	Code	Code	

**Form - 7(c)**

Detailed information about all the trees in the selected rows of Banana orchards  
 Code Code

- |                    |  |
|--------------------|--|
| 1. State           | 6. Survey No. of the orchard                     |
| 2. Year            | 7. S. No. of the orchard (as given in Form-2)    |
| 3. District        | 8. Number of rows of Banana trees in the orchard |
| 4. Taluk           | 9. Date of enumeration                           |
| 5. Village/Cluster |  |

Part "A"

Serial number of Banana rows	(1)	(2)	(3)	(4)	(5)
Column No. of the random number list					
Row No. of the random number list					
Random number rejected					
Finally selected number					

Part "B"

Serial number of Banana row	Banana row no.	No. of Banana plants	Whether bearing fruit (B) or non-bearing fruit (N.B.)	Date of plantation	Variety	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)

**Form – 8 (a)**

Particulars of random selection of the clusters of trees in the selected orchards for the study of yield

Code

Code

1. State

4. Taluk

2. Year

5. Village/Cluster

3. District

6. Name of the fruit

	(1)	(2)	(3)	(4)	(5)
1. Serial No. of the orchard					
2. Serial No. of the orchard as given in Form2					
3. No. of bearing trees in the orchard					
4. Serial No. of the cluster	1   2   3	1   2   3	1   2   3	1   2   3	1   2   3
5. Column No. of the random No. list					
6. Row No. of the random No. list					
7. Random Nos. rejected					
8. Finally selected No.					
9. Serial No. of the tree in the cluster as in Form 7(b)					
1.					
2.					
3.					
4.					

**Form - 8(b)**

Particulars of random selection of the cluster of trees in the selected banana orchards for the study of yield

Code

Code

1. State

4. Taluk

2. Year

5. Village/Cluster

3. District

	(1)			(2)			(3)			(4)			(5)		
1. Serial No. of the orchard															
2. Serial No. of the orchard as given in Form2															
3. Serial No. of the Banana row															
4. Number of bearing trees in the selected Banana row	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
5. Column number of the random number list															
6. Row number of the random number list															
7. Random numbers rejected															
8. Finally selected numbers															
9. Serial number of the tree in the Banana orchard as in Form-7(c)															
1.															
2.															
3.															
4.															

**Form - 8(c)**

Particulars of random selection of plots in the selected grape orchards for the study of the yield

Code

Code

1. State

4. Taluk

2. Year

5. Village/Cluster

3. District

1. Orchard number	(1)	(2)	(3)	(4)	(5)
2. Survey number of the orchard					
3. Serial number of the orchard as given in Form-2					
4. Length of the orchard in meters					
5. Breadth of the orchard in meters					
6. Number of grapes planted strips in the orchard					
7. Number of columns of pillars in the orchard					
8. Random strip number selected for					
(i) Plot 1					
(ii) Plot 2					
9. Random column number of pillar selected for					
(i) Plot 1					
(ii) Plot 2					

**Form - 9(a)**

## Cultivation practices in the selected bearing orchards

Code

Code

1. State

6. Name of the fruit for which selected

2. Year

7. Survey number of the orchard

3. District

8. Serial number of the orchard

4. Taluk

9. Number of trees of each fruit crop

5. Village/Cluster

Period	January to March (code)	April to June (code)	July to September (code)	October to December (code)
1. Irrigation (i) Source of irrigation (ii) Frequency of irrigation (iii) Depth of water level (in meters)				
2. Cultural operations, frequency of (i) Ploughing (ii) Digging (iii) Pruning (iv) Root exposure (v) Weeding (vi) Thinning (vii) Any other (specify)				
3. Manuring If manure was applied state: (i) Name of the manure (ii) Number of trees manures (iii) Rate of application per tree (in Kgs)				
4. Fertilizer application. If any fertilizer was applied state (i) Name of fertilizer (ii) Number of trees benefited (iii) Rate of application (in Kgs) per tree				
5. Green manuring: Any green manure was used, its name				

Table (contd..)

6. Crops grown during the period				
7. Intercultural operations: (i) Type of operation (ii) Implements used				
8. Incidence of diseases: (i) Name of the diseases (ii) Nature of damage done (iii) Severity of damage (iv) Number of trees affected (v) Control measure taken				
9. Incidence of pests: (i) Name of pests (ii) Nature of damage done (iii) Severity of damage (iv) Number of trees affected (v) Control measures taken				
10. Damage due to natural causes (i) Cause of damage (ii) Nature of damage (iii) Severity of damage (iv) Number of trees affected				

**Form - 9(b)**

Cultivation practices of young orchards of..... (Name of the fruit)

Code

1. State

6. Total number young orchards .....in the village

2. Year

3. District

4. Taluk

5. Village/Cluster

1. Particular of random selection of young orchard
(i) Row and column of the random number list used for selection (ii) Finally selected random number (iii) Survey number of the selected orchard (iv) Area of the orchard (v) Serial number of the selected orchard (vi) Total number of the trees planted
2. Name of the fruit trees planted in the orchard 3. Sources of planting material 4. Root stock (for citrus only) 5. Scion (for citrus only) 6. Date/s of planting (month, number & year) 7. Dimension of pit (L×B×D) in cms. 8. Method of filling the pit. (i) For how many days pits were exposed to sun (ii) Were the pits filled with soil from sources like tank, river, silt etc. (iii) Whether any fertilizer or manure was used while filling the pit. If yes, mention (iv) Type of manure/ fertilizer used (v) Rate of application (Kg/tree)
9. Irrigation: (i) Source (ii) Total number of irrigations given in a year

Table (contd..)

<p>10. Cultural operations frequency of:</p> <p>(i) Ploughing</p> <p>(ii) Digging</p> <p>(iii) Pruning</p> <p>(iv) Weeding</p> <p>(v) Any other (specify)</p>
<p>11. Manuring:</p> <p>(i) Name of manure used</p> <p>(ii) Rate of application per tree (Kgs/tree)</p> <p>(iii) Number of trees manured</p>
<p>12. Fertilizers:</p> <p>(i) Name of fertilizer used</p> <p>(ii) Rate of application per tree (Kgs/tree)</p> <p>(iii) Number of trees fertilized</p>
<p>13. Inter crops grown during each year of planting</p> <p>14. Incidence of diseases:</p> <p>(i) Names of diseases</p> <p>(ii) Nature of damage done</p> <p>(iii) Severity of damage</p> <p>(iv) Number of trees affected</p> <p>(v) Control measures taken</p>
<p>15. Incidence of pests:</p> <p>(i) Name/s of pest/s</p> <p>(ii) Nature of damage done</p> <p>(iii) Severity of damage</p> <p>(iv) Number of trees affected</p> <p>(v) Control measures taken</p>
<p>16. Damage due to natural causes</p> <p>(i) Cause of damage</p> <p>(ii) Nature of damage</p> <p>(iii) Severity of damage</p> <p>(iv) Number of trees affected</p>



**Form -10**

General information about the selected trees

Code

Code

1. State

6. Name of the fruit crop

2. Year

7. Survey number of the orchard

3. District

8. Serial no. of the orchard (as given in Form-2)

4. Taluk

5. Village/Cluster

1. Serial number of the cluster/rows	(1)				(2)				(3)			
	1	2	3	4	1	2	3	4	1	2	3	4
2. Serial number of trees												
3. Variety												
4. Age of the tree												
5. Root stock												
6. Scion												
7. Source of planting material												
8. Extent of pruning done during the last season												
9. Distance between: (i) Adjacent trees in the same row (ii) Two rows												
10. If manure was applied, state: (i) Type of manure applied (ii) Time of application (mention month)												
11. If fertilizer was applied, state: (i) Type of fertilizer applied (ii) Time of application (Month) (iii) Rate of application												
12. Expected yield (eye estimate) (i) Number of fruits (ii) Wt. in (Kgs)												

**Form -11(a)**

Yield in weight (Kgs) and number of fruits of all the selected trees in different pickings

Code

Code

1. State

6. Serial number of the orchard

2. Year

7. Survey number of the orchard

3. District

8. Name of the fruit crop

4. Taluk

5. Village/Cluster

Serial No. of the picking	Sl. No. of cluster	I								II								III								No. of fruits damaged	No. of fruits dropped	Remarks
	Sl. No. of trees	1	2		3		4		1	2		3		4		1	2		3		4							
	Date of picking	Number Wt. in Kg. & Gm.	Number Wt. in Kg. & Gm.	Number Wt. in Kg. & Gm.	Number Wt. in Kg. & Gm.	Number Wt. in Kg. & Gm.	Number Wt. in Kg. & Gm.	Number Wt. in Kg. & Gm.	Number Wt. in Kg. & Gm.	Number Wt. in Kg. & Gm.	Number Wt. in Kg. & Gm.	Number Wt. in Kg. & Gm.	Number Wt. in Kg. & Gm.	Number Wt. in Kg. & Gm.	Number Wt. in Kg. & Gm.	Number Wt. in Kg. & Gm.	Number Wt. in Kg. & Gm.	Number Wt. in Kg. & Gm.	Number Wt. in Kg. & Gm.	Number Wt. in Kg. & Gm.	Number Wt. in Kg. & Gm.							
											</																	

**Form - 11(b)**

No. of Banana fruits of all the selected plants harvested

Code

Code

1. State

4. Taluk

2. Year

5. Village/Cluster

3. District

Survey No. of the selected orchard	Sl. No. of the plant	First row			Second row			Third row		
		Date	No. of hands	No. of fingers in hand	Date	No. of hands	No. of fingers in hand	Date	No. of hands	No. of fingers in hand
1	2	3	4	5	6	7	8	9	10	11
1	1 2 3 4									
2	1 2 3 4									
.	.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.	.
5	1 2 3 4									

**Form - 11(c)**

Yield in weight (Kg. and gms.) and number of bunches in the selected plots of grape orchard

Code

1. State
2. Year
3. District
4. Taluk
5. Village/Cluster

1. Orchard No.					
2. Survey No. of the selected orchard					
3. Plot No.		1	2		
4. Number of vines in the plot selected					
5. Variety					
6. Rough sketch of the plot selected with measurements of four sides and diagonal					
7. Serial no. of picking	Dates of picking	No. of bunches	Wt. in (Kg. and Gms.)	No. of bunches	Wt. in (Kg. and Gms.)
1					
2					
3					
4					
5					
6					
7					
8					
9					

**Form - 12**

## Marketing of the crops for the selected village

Code

Code

1. State

4. Taluk

2. Year

5. Village/Cluster

3. District

1.	Name of the nearest market/s where the fruit is sold	
2.	Distance of market/s from the village	
3.	Name of fruit grower interviewed	
4.	Number of trees harvested during the year	
5.	Total produce obtained during the year (in units)	
6.	Total quantity of fruit sold at orchard site	
7.	Total quantity of fruit marketed	
8.	Type of packing used for marketing	
9.	Size of packing	
10.	Whether any chemical or other treatment given before packing If yes, mention (i) Type of treatment (ii) Method	
11.	Mode of transport to the market	
12.	Whether storage facility exists at the orchard site? If yes, mention extent of facility	
13.	Variety wise prices obtained (a) By sale on the site (i) In the beginning of the season (ii) During the peak season (iii) End of season (b) By sale in the market (i) In the beginning of the season (ii) During the peak season (iii) End of season	

**APPENDIX B.2****PROFORMA USED FOR THE VEGETABLES SURVEY**

Pilot Scheme for the study of yield and cultivation practicals of vegetable crop in Mysore State 1970-73

**FORM I**

Village..... Taluka..... District.....

**GENERAL INFORMATION REGARDING THE SELECTED VILLAGE**

(a) Information record in revenue Records

1. Geographical area of the village
2. Net area sown during the last year
3. Total cropped area during the last year
4. Area & number of fields under vegetable crops as recorded by Patwari during the last three years.

(b) Distance from the Pucca road

(c) Distance from the nearest Railway Station

(d) Distance of the village from the mamlatdars office.

Name of the vegetable crops	Recorded					
	1970-71		1971-72		1972-73	
	Area (in acres and cents)	No. of fields	Area (in acres and cents)	No. of fields	Area (in acres and cents)	No. of fields

**FORM II (a)**

Survey of fields growing vegetable in selected village

Village.....

Taluka.....

District.....

Date of visit	S.No. of the vegetable field	Name of the cultivator	Whether own land or hired	S. No. of the vegetable field	Name & variety of the vegetable		Area of the field under vegetable		Date of sowing/ planting	Probable date of harvesting		Name of the previous crop grown	Name of the mixed crop & its proportion	Area of the holding	Size of the holding
					Name	Variety & Source	Acre	Gunta		First harvest- ing	Last harvest- ing				
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

**FORM II (b)**

List of fields being harvested during the period from .....to.....

Village.....

Taluka.....

District.....

S. No.	Crops	List of vegetable crops being harvested with its Sl. No. from form II (a)			Grand Total
1	2	3	4	5	6



**FORM III (a)**

Village.....

Taluka.....

District.....

## Particulars of Random selection of fields

Name of the vegetable crops observed during the period	Total number of vegetable fields growing each crop	Finally selected random Nos.	Rows Col. Numbers of the Random Number list used for selection of fields		Sl. No. of finally selected fields (As given in form – II a)	Survey no. of the selected fields (As given in form – II a)	Measurement of the field & its sketch
			Col. No.	Row No.			
1	2	3	4	5	6	7	8

**FORM III (b)**

Particulars of Random selection of plots for yield study

Village.....

Taluka.....

District.....

S. No.	Name of the vegetable field	S. No. and S. No. of the vegetable field	Area of the field under vegetable		Length of the field (in metres)	Breadth of the field (in metres)	Random pair selected		Row and Col. Number of the Random No.				Remarks
			Acre	Cents					Length		Breadth		
							For length	For breadth	Row No.	Col. No.	Row No.	Col. No.	
1	2	3	4	5	6	7	8	9	10	11	12	13	14

**FORM IV**

Cultivation practices of the vegetables grown in selected fields

Code

Code

Code

Village.....

Name of the vegetable grown.....

Period.....

Taluka.....

Name of the cultivator.....

Survey No. of selected field as per form II (a).....

District.....

Area under vegetable.....

Date of enquiry	Size of Nursery	Probable Area to be covered by the seedling sown	(A) Cultivation practices in the Nursery Bed								
			Preparatory cultivation		Manures or Fertilizers used			Date of sowing		Quantity of seeds used	Source of Seed
			Type of operation	Date	Kind	Code	Quantity	Code	Code		
			Code	Code							
1	2	3	4	5	6	7	8	9	10	11	12

(B) Cultivation practices in the field											
Date of transplanting	Preparatory cultivation	Frequency	Date	Type of plough used whether Iron/wooden		Method of planting	Quantity of seeds or seedling used per acre	No. of plants sown in each row of the located plot			
				Code			No. of seedling retained	No. of rows	Length in metres of each row	No. of plants	
Code	Code		Code	Iron	Wooden						
13	14	15	16	17		18	19	20	21	22	23

**FORM IV (CONTD...)**

				Manures and Fertilizers used including Basal						Irrigation			
Name of the crop mixed with vegetable		Seed rate per acre		Type	Code	Quantity	Method of application	Date Code	Date of application	Source of water	Code	Method of lifting water	Code
Name of the mixed crop	Method of sowing in separate rows/mixture	In terms of Guntha per acre	In terms of seedling (kilo)			Cost in Rs.							
24	25	26	27	28	29	30	31		32	33		34	

Irrigation				Interculturing					(C) Incidence of pests and diseases and Protective measures						
State	Code	Intensity	Code	Frequency		Type of operation	Code	Date	Diseases /pest observed	Code	Period of incidence	Type of protective measures	Code	Cost involved	Dates of picking
				How many times	Dates										
35		36		37	38	39		40	41		42	43		44	45

**FORM IV (A)**

Engagement of labour and bullocks in the selected fields

Year:

Period:

District:

Crop:

F: stands for family labour

H: stands for hired labour

Date of enquiry	Taluk	Cluster No.	Village	Name of cultivator	S.No. of field as in form IIA	No. of labourers engaged on						
						Raising of nursery	Ploughing	Digging	Leveling or Planking	Sowing or transplanting	Irrigation	Hoeing
1	2	3	4	5	6	7	8	9	10	11	12	13
						F H	F H	F H	F H	F H	F H	F H

												Rates of wages per day	
Weeding	Application of manure & fertilizer	Plant protection measurement	Harvesting	Watch and Ward	Market -ing	Total	Engagement of		No. of pair of bullocks			Per labour	Per pair of labour
							Names of operations						
14	15	16	17	18	19	20	21	22	23	24	25	26	27
F      H	F      H	F      H	F      H	F      H	F      H	F      H	F      H	F      H	F      H	F      H	F      H		

**FORM V**

Village.....

Taluka.....

Period.....

District.....

CROP	(A) Yield of the selected pure vegetable crop				
	1 code	2 code	3 code	4 code	5 code
Survey no. of the selected field as given in Form II (a)					
Name of the vegetable crop					
Name of the vegetable sown					
Condition if the crop (good, normal, poor)					

S.No.	Survey No.	S.No. of the picking	Date and Time of picking		Weight and count of the vegetable produce								Next date of picking	Remarks
			Date	Time	Crop 1		Crop 2		Crop 3		Crop 4			
					Count	Weight	Count	Weight	Count	Weight	Count	Weight		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

Signature of the Supervisor and  
Date:

Signature of the Field Assistant and  
Date:

**FORM VI**

Village..... Taluka..... Period..... District.....

Name of the Selected cultivator:

Total area under vegetables sown by him during the period		Crop	Code	Crop	Code	Crop	Code	Crop	Code
Acre	Cents	1		2		3		4	
1. Name of the vegetable crop grown during the period									
2. Area under each vegetable									
3. Total quantity of vegetable produced during the period									
4. Disposal of each vegetable crop during the period									
(a) Total quantity sold									
1. On the farm									
2. In the market									
(b) Total quantity stored									
(c) Total quantity consumed									
5. Mode of transport									
6. Whether the transport is owned or hired									
7. If hired total amount paid as transport charges									
8. Name of the market where produce was sold									
9. Distance of each market from the village (in kilometers)									
10. Agency to whom the vegetable was sold									
11. Prices received during the period per unit									
12. Commission or other charges paid									

**INFORMATION REGARDING VEGETABLES SOLD DURING THE PERIOD**

Survey No.	Date of sale	Crop1		Crop2		Crop3		Crop4		Crop5	
		Weight	Price	Weight	Price	Weight	Price	Weight	Price	Weight	Price

Signature of the Supervisor and  
Date:

Signature of the Field Assistant and  
Date:

## Sample survey for Estimation of area, yield and cultivation practices of vegetable crop in Mysore State 1973

**FORM VI A**

Information on marketing margin and prices of vegetable crops about the selected cultivator

Year.....Period.....District.....Taluk.....Cluster No. of the village.....

Name of the cultivator..... S.No. of the cultivator.....Holding Size.....

Total area under vegetable.....

Date	Name of the vegetable crop	Whether the transport is owned/ hired	Name of the market where the produce was sold	Distance of market from the village	Total quantity of vegetable sold (in kgs.)	Price at which produce was sold		Mode of transport
						Rate	Amount	



**FORM VI A (contd..)**

Transport charges		Commission charges		Storage charges (in Rs.)	Octrai charges		Labour charges (in Rs.)	Any other charges (in Rs.)	Net Amount of sale (in Rs.)	Remarks
If hired, amount paid (in Rs.)	If owned, imputed charges (in Rs.)	Rate	Amount		Rate	Amount				

Signature of the Supervisor and  
Date:

Signature of the Field Assistant and  
Date:

Sample survey for Estimation of area, yield and cultivation practices of vegetable crop in Mysore  
State 1974

**FORM VII**

**A. Particulars of the market**

1. Name of the market
2. Distance from district headquarters (in km.)
3. Whether regulated or managed by municipality
4. (a) Number of storages/godowns available in the market  
(b) Total capacity of these storages/ godowns (in )
5. Method of sale of vegetables
  - (a) Open auction
  - (b) Under cover of cloth
  - (c) Tenders
  - (d) Negotiations
  - (e) Any other (specify)
6. Percentage of arrivals (all vegetables taken together) in the season brought by
  - (a) Producers
  - (b) Contractors
  - (c) Other agencies (specify)
7. Type of containers used and their capacities
8. Market charges                      Payable by their producer                      Payable by the purchaser
  - (a) Commission
  - (b) Octrai
  - (c) Brokerage
  - (d) Loading and unloading
  - (e) Any other (specify)

Contd...

## B. WEEKLY ARRIVALS (IN QUINTALS)

Total Quantity Arrived During Weeks Ending Friday

S.No.	Name of the vegetable	Date		Date		Date		Date	
		From	To	From	To	From	To	From	To
		Qtls.		Qtls.		Qtls.		Qtls.	
1.	Tomato								
2.	Potato								
3.	Brinjal								
4.	Ladies finger								
5.	Carrot								
6.	Beetroot								
7.	Radish								
8.	Onion								
9.	Garlics								
10.	Ginger								
11.	Peas								
12.	Beans								
13.	Chillies (green)								
14.	Capsicum								
15.	Suvarnagadde								
16.	Sweet potato								
17.	Ridge gourd								
18.	Bitter gourd								
19.	Cluster beans								
20.	Karimanikalu								
21.	Lab-Lab								
22.	Dalicas Lab-Lab (Havare)	Per 100 small bundles		Per 100 small bundles		Per 100 small bundles		Per 100 small bundles	
23.	Dantu (greens)								
24.	Harve "								
25.	Chilkarve "								
26.	Chakotha "								
27.	Subseege "								
28.	Menthe "								
29.	Caryender "								
30.	Curry leaf "								
31.	Pudeena "	Per 100 Nos.		Per 100 Nos.		Per 100 Nos.		Per 100 Nos.	
32.	Banana bunches								
33.	Knol-Khol								
34.	Cabbage								
35.	Cauliflower								
36.	Chow-Chow								
37.	Ash gourd								

38.	Bottle gourd				
39.	Pumpkin				
40.	Cucumber				
41.	Snake gourd				
42.	Drumstick				

Signature of the Supervisor

Signature of the Horticultural Assistant

## C. WEEKLY WHOLESALE PRICES (IN QUINTALS)

S.No.	Name of the vegetable	Date		Date		Date		Date	
		From	To	From	To	From	To	From	To
		Rs. P.	Rs. P.	Rs. P.	Rs. P.	Rs. P.	Rs. P.	Rs. P.	Rs. P.
1.	Tomato								
2.	Potato								
3.	Brinjal								
4.	Ladies finger								
5.	Carrot								
6.	Beetroot								
7.	Radish								
8.	Onion								
9.	Garlics								
10.	Ginger								
11.	Peas								
12.	Beans								
13.	Chillies (green)								
14.	Capsicum								
15.	Suvarnagadde								
16.	Sweet potato								
17.	Ridge gourd								
18.	Bitter gourd								
19.	Cluster beans								
20.	Karimanikalu								
21.	Lab-Lab								
22.	Dalicas Lab-Lab (Havare)								
23.	Dantu (greens)								
24.	Harve "								
25.	Chilkarve "								
26.	Chakotha "								
27.	Subseege "								
28.	Menthe "								
29.	Caryender "								
30.	Curry leaf "								
31.	Pudeena "								
32.	Banana bunches								
33.	Knol-Khol								
34.	Cabbage								
35.	Cauliflower								
36.	Chow-Chow								
37.	Ash gourd								
38.	Bottle gourd								

39.	Pumpkin				
40.	Cucumber				
41.	Snake gourd				
42.	Drumstick				

## APPENDIX B.3

## SPICES BOARD

PROFORMA FOR PRELIMINARY FIELD ESTIMATION OF SMALL CARDAMOM  
BASED ON TYPICAL SAMPLES SELECTED FOR THE STUDY

1)	Name of the unit	:	.....		
2)	Name and address of the planter	:	.....		
3)	Name of the estate	:	.....		
4)	Total area of estate	:	.....		
5)	Registration No. and registered area of the estate	:	.....		
6)	Actual area under cardamom	:	Yielding area .....Hect.		
			Non yielding area .....		
			Non-yielding immature area.....		
7)	Is the estate covered under the developmental schemes	:	Yes/No		
8)	If yes, specify the area details		Mature area	Immature area	Total area
	1. Irrigation	:			
	2. Re-plantation	:			
	3. Irrigation and Re-plantation	:			
9)	Age-wise break-up of plants		Area		
	Less than 3 years	:	.....		
	3 to less than 8 years	:	.....		
	8 to less than 12 years	:	.....		
	12 years and above	:	.....		
	Total	:	.....		
10)	Approx. no. of plants	:	.....hect		
11)	Average spacing adopted	:	.....		
12)	Elevation of the area	:	.....		

- 13) a. No. of panicles per plant  
b. No. of capsules per panicle

14) No. of capsules per plant(13a\*13b)

15) Green weight of the capsules ( 2500 green capsules form 1 Kg. In Kerala and T. Nadu and 3000 in Karnataka)

16) Dry weight of cardamom (the ratio of green to dry is 5:1)

Preliminary estimate

Estimated production for 1995-96 dried (kgs)	Yield per Hect. Dried (kgs)
--	--------------------------------

-----

-----

-----

17) Percentage increase/ decrease in production compared to last year

-----% \_

-----% +

18) Reason for increase/ decrease in production

19) Plants and crop affected by disease in 1996-97 (if any)

Plant loss

Crop loss

1. Azhukal

-----%

-----%

2. Any other

-----%

-----%

20) Any other information

-----

-----

-----

Place:

Date:

Signature of the reporting officer



## APPENDIX B.4

### PROFORMA FOR FIELD ENUMERATION SURVEY TO FIND OUT ACTUAL AREA UNDER CARDAMOM CULTIVATION IN INDIA

1.	Name of the Estate Owner and Estate Address.	.....
	(In the case of partnership and Companies, name of Managing Partner/ Director may be given)	.....
2.	Postal Address of the owner (Indicate Post office and pincode)	.....
		.....
3.	Location of the estate	
	(a) Revenue Village	.....
	(b) Taluk	.....
	(c) State	.....
4.	Total area planted with Cardamom (as on date)	.....Acres
5.	Area under immature plants	
	(a) 1 year old	.....
	(b) 2 years old	.....
	(c) 3 years old	.....
	Total (a+b+c)	.....
6.	Area under yielding plants	
	(a) 4 to 12 years old	.....
	(b) 12 to 20 years old	.....
	(c) Above 20 years old	.....
	Total (a+b+c)	.....
7.	Area under old and senile plants/ neglected condition	.....Acres

8. No. of plants per acre .....

9. Area under other spices

(a) Pepper .....Acres

(b) Others (specify) .....Acres

Name of the Investigating Officer .....

Signature..... Date.....

Name of first level counter checking Officer .....

Signature..... Date.....

Name of the second level counter checking Officer .....

Signature..... Date.....

## APPENDIX B.5

### (A) DIRECTORATE OF CASHEWNUT & COCOA DEVELOPMENT PRODUCTION FORECAST OF CASHEW – 2001 SEASON

#### PROFORMA FOR DATA COLLECTION

Survey No.	1 <sup>st</sup> <input style="width: 60px;" type="text"/>	2 <sup>nd</sup> <input style="width: 60px;" type="text"/>	(√)	Form No. :	
				Date:	
I. Serial No.	:	<input style="width: 100px;" type="text"/>			
II. Name of Enumerator	:	<input style="width: 200px;" type="text"/>			
Address	:	<div style="border: 1px solid black; height: 70px; width: 300px;"></div>			
III. General Information:					
STATE	DISTRICT	VILLAGE/PANCHAYAT			
<input style="width: 150px;" type="text"/>	<input style="width: 150px;" type="text"/>	<input style="width: 200px;" type="text"/>			
Name of farmer	<input style="width: 150px;" type="text"/>	Address	<div style="border: 1px solid black; height: 70px; width: 250px;"></div>		
Holding (Ha) (Give √ mark)	< Ha <input style="width: 40px;" type="text"/>	1-2 Ha <input style="width: 40px;" type="text"/>	>2 Ha <input style="width: 40px;" type="text"/>		

## IV. Enumerative aspects:

(i) Total cashew area/holding  
under the farmer (Ha)

No. of trees

(ii) Canopy coverage (in metres)  
(Diameter)

	Tree No. 1	Tree No. 2	Tree No. 3	Tree No. 4	Tree No. 5
North-South					
East-West					

(iii) Flushing, flowering, nut yield and insect damages per tree observations  
(Tree Nos. – T1, T2, T3, T4, T5) (sq.m – Square meter)

Parameters	a) Eastern Side					b) Northern Side				
	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
No. of flushes/ sq. m										
No. of panicles/ sq. m										
No. of nuts/ sq. m										
Tea mosquito damage (No. of flushes affected per sq. m)										

Parameters	c) Western Side					d) Southern Side				
	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
No. of flushes/ sq. m										
No. of panicles/ sq. m										
No. of nuts/ sq. m										
Tea mosquito damage (No. of flushes affected per sq. m)										

(iv) Expected yield per tree based on farmers experience – (Kg/tree)

Yield	T1	T2	T3	T4	T5

Signature (Enumerator)

Signature (Farmer)

Date

Date

Name of Scientist i/c

Signature (Farmer)

Date

Address

**(B) STATISTICAL INFORMATION IN SUPPORT FOR PRODUCTION FORECAST  
OF CASHEW -2001 SEASON**

- a. Climate parameters (During flushing, flowering fruiting seasons)  
(Use one sheet for one district. All districts covered under enumeration should be provided with these details)

1. District      1       2       3       4       (✓)

2. Name of District

Month	Temperature ( <sup>0</sup> C)		Relative Humidity		Rainfall (mm)		
	Min.	Max.	Min.	Max.	No. of rainy days	Min. Rainfall	Max. Rainfall
August							
September							
October							
November							
December							
January							
February							
March							

Name, designation and address of  
Scientist i/c with signature and date

**B. Statistical information on Area in each panchayat/village of districts covered under enumeration**

(Use one sheet for two districts. All districts information should be provided in consultation with concerned development agency of the States)

1. District      1       2       3       4       (✓)

2. Name of District

No. of Taluks/Blocks in the district

3. No. of Panchayat/Village  
Per district/block/taluk

Per district

Per taluk/block

Districts 1 & 3		Districts 2 & 4	
Name of Panchayat or Taluk in the district	Cashew (Area-Ha)	Name of Panchayat or Taluk in the district	Cashew (Area-Ha)
1		1	
2		2	
3		3	
4		4	
5		5	
6		6	
7		7	
8		8	
9		9	
10		10	
11		11	
12		12	
13		13	
14		14	
15		15	

## APPENDIX C.1

### List of fruits (as provided by DES)

1. Mango
2. Banana
3. Apple
4. Orange
5. Santra
6. Lime and Lemon
7. Guava
8. Grapes
9. Sapota
10. Papaya
11. Pomegrenate
12. Coconut
13. Cashewnut
14. Tamarind
15. Lichi
16. Pineapple
17. Ber
18. Walnut
19. Pears
20. Ambla
21. Arecanut
22. Oil Palm
23. Dates
24. Jack fruit



## APPENDIX C.2

### List of vegetables (as provided by DES)

1. Potato
2. Onion
3. Tomato
4. Cabbage
5. Cauliflower
6. Brinjal
7.
  - i) Chillies (Green)
  - ii) Chillies (Red)
8. Okra
9. Carrot
10. Radish
11. Turmeric
12. Beans
13. Ginger
14. Garlic
15. Peas
16. Black Pepper
17. Parwal
18. Water melon
19. Musk melon
20. Pumpkin
21. Cucumber
22. Bitter gourd
23. Turnip
24. Sweet Potato

### APPENDIX C.3

#### List of spices as per ISO (International Organization for Standardization) 676:1995

No.	Botanical Name of the Plant	Family	Common Name of the Spice in English	Name of the Part of the Plant Used as Spice
1.	<i>Acorus calamus</i> L	Araceae	Sweet flag, myrite flag calamus, flag root	Rhizome
2.	<i>Aframomum angustifolium</i> (sonn.) Schumann	Zingiberaceae	Madagascar cardamom	Fruit, seed
3.	<i>Aframomum hanburyi</i> Schumann	Zingiberaceae	Cameroon cardamom	Fruit, seed
4.	<i>Aframomum Korarima</i> (Peroira) Engl.	Zingiberaceae	Korarima cardamom	Fruit, seed
5.	<i>Aframomum melegueta</i> (Roscoe) Schumann	Zingiberaceae	Grain of paradise, Guinea grains	Fruit, seed
6.	<i>Allium ascalonicum</i> L	Liliaceae (Alliaceae)	Shallot	Bulb
7*.	<i>Allium cepa</i> L	Liliaceae (Alliaceae)	Onion	Bulb
8.	<i>Allium cepa</i> var. <i>aggregatum</i>	Liliaceae (Alliaceae)	Potato onion	Bulb
9*.	<i>Allium tuberosum</i> Rottler ex. Sprengel	Liliaceae (Alliaceae)	Indian leek, Chinese chive	Bulb, leaf
10*.	<i>Allium fistulosum</i> L	Liliaceae (Alliaceae)	Stony leek, Welsh onion, Japanese bunching onion	Leaf and bulb
11.	<i>Allium porrum</i> L	Liliaceae (Alliaceae)	Leek, winter leek	Leaf and bulb
12*.	<i>Allium sativum</i>	Liliaceae (Alliaceae)	Garlic	Bulb
13*.	<i>Allium schoenoprasum</i> L	Liliaceae (Alliaceae)	Chive	Leaf
14.	<i>Alpinia galanga</i> (L) wild	Zingiberaceae	Greater galangal longwas, Siamese ginger	Rhizome
15.	<i>Alpinia officinarum</i> Hance	Zingiberaceae	Lesser galangal	Rhizome
16.	<i>Amomum aromaticum</i> Roxb.	Zingiberaceae	Bengal cardamom	Fruit, seed

17.	<i>Amomum kepulaga</i> Sprague et Burk. Syn. <i>Amomum campactum</i> Sol. Ex. Maton	Zingiberaceae	Round cardamom, Chester cardamom, Siamese cardamom, Indonesian cardamom	Fruit, seed
18.	<i>Amomum krevanh</i> PierreEx. Gagnepain	Zingiberaceae	Cambodian cardamom	Fruit, seed
19.	<i>Amomum subulatum</i> Roxb.	Zingiberaceae	Greater Indian cardamom, Large cardamom, Nepalese cardamom	Fruit, seed
20.	<i>Amomum tsao-ko</i> Crevost Et Lemaire	Zingiberaceae	Tsao-ko cardamom	Fruit, seed
21*.	<i>Anethum graveolens</i> L	Apiaceae (Umbelliferae)	Dill	Fruit, leaf, top
22.	<i>Anethum sowa</i> Kurz	Apiaceae (Umbelliferae)	Indian Dill	Fruit
23.	<i>Angelica archangelica</i> L	Apiaceae (Umbelliferae)	Garden angelica	Fruit, petiole, root
24.	<i>Anthriscuscereifolium</i> (I.) Hoffm	Apiaceae (Umbelliferae)	Chervil	Leaf
25.	<i>Apium graveolens</i> L. var <i>dulce</i> (Miller) Pers.	Apiaceae (Umbelliferae)	Celery, garden celery	Fruit, root, leaf
26.	<i>Apium graveolens</i> L. var <i>rapaceum</i> (Miller) Gaudich	Apiaceae (Umbelliferae)	Celeriac	Fruit, root, leaf
27*.	<i>Armoracia rusticana</i> P. Gaertn. B. Meyer et Scherb	Brassicaceae (Cruciferae)	Horseradish	Root
28*.	<i>Artemisia dracunculus</i> L	Astraceae (Compositae)	Terragon, estragon	Leaf
29*.	<i>Averrhoa bilimbi</i> L	Averrhoaceae (Oxalidaceae)	Belimbing bilimbi cucumber tree	Fruit
30.	<i>Averrhoa carambola</i> L	Averrhoaceae (Oxalidaceae)	Carambola, caramba	Fruit
31*.	<i>Brassica juncea</i> (L) Czernj.et Cosson	Brassicaceae (Cruciferae)	Indian mustard	Seed
32*.	<i>Brassica nigra</i> (I) Koch	Brassicaceae (Cruciferae)	Black mustard	Seed
33.	<i>Bunium persicum</i> (Boiss) B.Fedtsch	Apiaceae (Umbelliferae)	Black caraway	Seed, tuber

34.	<i>Capparis spinosa</i> L	Capparidaceae	Caper, common caper, caper bush	Floral bud
35.	<i>Casicum annum</i> L <sup>1)</sup>	Solanaceae	Capsicum, chillies, paprika	Fruit
36.	<i>Capsicum frutescens</i> L <sup>1)</sup>	Solanaceae	Chillies, bird eye chilli	Fruit
37.	<i>Carum bulbocastanum</i> L	Apiaceae (Umbelliferae)	Black caraway	Fruit, bulb
38.	<i>Crum carvi</i> L	Apiaceae (Umbelliferae)	Caraway, blond caraway	Fruit
39.	<i>Cinnamomum aromaticum</i> Nees. Syn. <i>Cinnamomum cassia</i> Nees ex. Blume	Lauraceae	Cassia, Chinese cassia	Bark
40*.	<i>Cinnamomum burmanii</i> (Nees et T. Nees) Blume	Lauraceae	Indonesian cassia	Bark
41*.	<i>Cinnamomum loureirii</i> Nees	Lauraceae	Vietnamese cassia	Bark
42.	<i>Cinnamomum tamala</i> Nees	Lauraceae	Tejpat, Indian cassia	Bark
43*.	<i>Cinnamomum zeylanicum</i> Blume	Lauraceae	Sri Lankan cinnamon, Indian cinnamon	Bark
44*.	<i>Coriandrum sativum</i> L	Apiaceae (Umbelliferae)	Coriander	Leaf, Fruit
45*.	<i>Crocus sativus</i> L	Iridaceae	Saffron	Stigma
46*.	<i>Cuminum cyminum</i> L	Apiaceae (Umbelliferae)	Cumin	Fruit
47*.	<i>Curcuma longa</i> L	Zingiberaceae	Turmeric	Rhizome, Leaf
48*.	<i>Cymbopogon citratus</i> (DC.) Stapl.	Poaceae (Gramineae)	West Indian lemon grass	Leaf
49.	<i>Cymbopogon nardus</i> L. Randle	Poaceae (Gramineae)	Sri Lankan citronella	Leaf
50.	<i>Elettaria cardamomum</i> (L) Maton var. <i>minucula</i> . Burk	Zingiberaceae	Small cardamom	Fruit, seed
51.	<i>Elettaria cardamomum</i> (L) Maton var. <i>major</i> . Thwaites	Zingiberaceae	Sri Lankan cardamom	Fruit, seed

52.1	Ferula assa-foetida L	Apiaceae (Umbelliferae)	Asafoetida	Rhizome exudate
52.2	Ferula foetida (Binge) Regel			
52.3	Ferula narthex Boiss			
53.	Foeniculum vulgare Miller ssp. Capillaceum Miller var. vulgare	Apiaceae (Umbelliferae)	Bitter fennel	Leaf, twig, fruit
54.	Foeniculum vulgare Miller ssp. capillaceum Miller var. dulce	Apiaceae (Umbelliferae)	Sweet fennel	Leaf, twig, fruit
55.	Garcinia cambogia (Gaertn.) Desr.	Cluciaceae (Guttiferae)	Garcinia, Camboge	Pericarp of the fruit
56.	Garcinia indica (Thouars) choisy	Cluciaceae (Guttiferae)	Garcinia, kokum	Pericarp of the fruit
57.	Hyssopus officinalis L	Lamiaceae (Labiatae)	Hyssop	Leaf
58.	Illicumverum Hook. f	Illiaceae	Star anise, Chinese annise	Fruit
59.	Juniperus communis L	Cupressaceae	Common juniper	Fruit
60.	Kaempferia galanga L	Zingiberaceae	Galangal	Rhizome
61*.	Laurus nobilis L	Lauraceae	Laurel, true laurel, bay leaf, sweet flag	Leaf
62*.	Levisticum officinale Koch	Apiaceae (Umbelliferae)	Garden lovage, lovage	Fruit, leaf
63.1	Lippia graveolens Kunth	Verbanaceae	Mexican oregano	Leaf, terminal shoot
63.2	Lippia berlandieri Schauer			
64*.	Mangifera indica L	Anacardiaceae	Mango	Immature fruit (Rind)
65*.	Melissa officinalis L	Lamiaceae (Labiatae)	Balm, lemon balm, melissa	Leaf, terminal shoot
66*.	Mentha arvensis L	Lamiaceae (Labiatae)	Japanese mint, field mint, corn mint	Leaf, terminal shoot
67.	Mentha citrata L	Lamiaceae (Labiatae)	Bergamol	Leaf, terminal shoot
68*.	Mentha x piperita L	Lamiaceae (Labiatae)	Pepper mint	Leaf, terminal shoot

69*.	<i>Mentha spicata</i> L	Lamiaceae (Labiatae)	Spear mint, garden mint	Leaf, terminal shoot
70.	<i>Murrya koenigii</i> (L)	Rutaceae	Curry leaf	Leaf
71.	<i>Myristica argentea</i> Warb	Myristicaceae	Papuan nutmeg, Papuan mace	Kernel Aril
72*.	<i>Myristica fragrans</i> Houtt	Myristicaceae	Indonesian type nutmeg, Siau type nutmeg Indonesian type mace Siau type mace	Kernel Aril
73.	<i>Nigella damascena</i> L	Ranunculaceae	Damas black cumin, love in a mist	Seed
74*.	<i>Nigella sativa</i> L	Ranunculaceae	Black cumin	Seed
75*.	<i>Ocimum basilicum</i> L	Lamiaceae (Labiatae)	Sweet basil	Leaf, terminal shoot
76*.	<i>Origanum majorana</i> L	Lamiaceae (Labiatae)	Sweet marjoram	Leaf, floral bud
77*.	<i>Origanum vulgare</i> L	Lamiaceae (Labiatae)	Oregano, origan	Leaf, flower
78.	<i>Pandanus amaryllifolius</i> Roxb. Syn. <i>Pandanus latifolius</i> Hassk. Var minor	Pandanaceae	Pandan wangi	Leaf
79*.	<i>Papaver somniferum</i> L var nigrum	Papaveraceae	Poppy, blue maw, maw seed	Seed
80*.	<i>Petroselinum crispum</i> (Miller) Nyman ex. A.W. Hill syn. <i>Petroselinum sativum</i> Hoffm	Apiaceae (Umbelliferae)	Parsely	Leaf, root
81*.	<i>Pimenta dioica</i> (L.) Merr.	Myrtaceae	Pimento allspice, Jamaica Pepper	Immature fruit, leaf
82*.	<i>Pimenta racemosa</i> (Miller) J. Moore	Myrtaceae	West Indian bay	Fruit, leaf
83*.	<i>Pimpinella anisum</i> L	Apiaceae (Umbelliferae)	Aniseed	Fruit
84.	<i>Piper guineense</i> Schumann et Thonn. L	Piperaceae	West African or Benin pepper	Fruit
85*.	<i>Piper longum</i> L	Piperaceae	Long pepper, Indian long pepper	Fruit
86*.	<i>Piper nigrum</i> L	Piperaceae	Black pepper, white pepper, green pepper	Fruit

87*.	<i>Punica granatum</i> L	Punicaceae	Pomegranate	Seed (dried with flesh)
88*.	<i>Rosmarinus officinalis</i> L	Lamiaceae (Labiatae)	Rosemary	Terminal shoot, leaf
89*.	<i>Salvia officinalis</i> L	Lamiaceae (Labiatae)	Garden sage	Terminal shoot, leaf
90*.	<i>Satureja hortensis</i> L	Lamiaceae (Labiatae)	Summer savory	Terminal shoot, leaf
91*.	<i>Satureja montana</i> L	Lamiaceae (Labiatae)	Winter savory	Leaf, twig
92.	<i>Schinus molle</i> L	Anacardiaceae	American pepper, Californian pepper tree	Fruit wall (rind)
93.	<i>Schinus terebenthifolius</i> Radde	Anacardiaceae	“Brazilian pepper”	Fruit
94*.	<i>Sesamum indicum</i> L	Pedaliaceae	Sesame, gingelly	Seed
95*.	<i>Sinapis alba</i> L	Brassicaceae	White mustard, yellow	Seed
96*.	<i>Syzygium aromaticum</i> L. Merr. Et Perry syn. <i>Eugenia caryophyllus</i> (Sprengel) Bullock et S. Harrison	Myrtaceae	Clove	Flower bud
97*.	<i>Tamarindus indica</i> L	Caesalpiniaceae	Tamarind	Fruit
98*.	<i>Thymus serpyllum</i>	Lamiaceae (Labiatae)	Mother of thyme, wild thyme, creeping thyme	Terminal shoot, leaf
99*.	<i>Thymus vulgaris</i> L	Lamiaceae (Labiatae)	Thyme, common thyme	Terminal shoot, leaf
100*.	<i>Trachyspermum ammi</i> (L) Sprague	Apiaceae (Umbelliferae)	Ajowan (Bishop’s weed)	Fruit
101*.	<i>Trigonella foenum-graecum</i> L	Fabaceae (leguminosae)	Fenugreek	Seed, leaf
102.	<i>Vanilla planifolia</i> Andrews syn. <i>Vanilla fragrans</i> (Salisb.) Ames	Orchidaceae	Vanilla	Fruit (pod)
103.	<i>Vanilla tahitensis</i> J. Moore	Orchidaceae	Vanilla	Fruit (pod)
104.	<i>Vanilla pompona</i> Schiede	Orchidaceae	Pompona vanilla	Fruit (pod)
105.	<i>Xylopia aethiopica</i> (Dunal) A. Rich	Annonaceae	Negro pepper, Guinean pepper	Fruit

106.	Zanthoxylum, bungei Planch syn. Zanthoxylum	Rutaceae	Chinese prickly ash pepper Sechuang pepper	Fruit
107.	Zanthoxylum acanthopodium DC	Rutaceae	Chinese pepper	Fruit
108.	Zanthoxylum piperitum DC	Rutaceae	Japanese pepper	Fruit
109*.	Zingiber officinale Roscoe	Zingiberaceae	Ginger	Rhizome

\* Term stabilized by ISTA

<sup>1)</sup> The numerous “species” of the Capsicum genus which have been described are so similar that it is extremely difficult to relate a given cultivator of Capsicum to any particular one of these species. The annual chillies with full herbaceous stem which are cultivated in the temperate and sub tropical regions (“paprika” of Central Europe “red pepper” of Southern Europe, North Africa and N.America) relate to Capsicum annum L.



## APPENDIX C.4

### List of Spices under the Purview of Spices Board

1. Cardamom (Small)

Cardamom (Large)

2. Pepper

3. Chilli Bird Eye

Capsicum

Chilli

Paprika

4. Ginger

6. Turmeric

7. Cumin

8. Fennel

9. Fenugreek

10. Celery

11. Aniseed

12. Bishop's Weed

13. Caraway

14. Dill

15. Cinnamon

16. Cassia

17. Garlic

18. Curry leaf

19. Kokam

20. Mint

21. Mustard

22. Parsley

23. Pomegranate

24. Saffron

25. Vanilla

26. Tejpat

27. Pepper long

28. Star Anise

29. Sweet flag

30. Greater Galanga

31. Horse Radish

32. Caper

33. Clove

34. Asafoetida

35. Cambodege

36. Hyssop

37. Juniper berry

- 38. Bay leaf
- 39. Lovage
- 40. Marjoram
- 41. Nutmeg
- 42. Mace
- 43. Basil
- 44. Poppy seed
- 45. All-spice
- 46. Rosemary
- 47. Sage
- 48. Savory
- 49. Thyme
- 50. Oregano
- 51. Tarragon
- 52. Tamarind

## APPENDIX D.1

### WAY FORWARD

The National Statistical Commission was set up by the Government of India in January 2000 under the Chairmanship of Dr. C. Rangarajan. The two principal terms of reference for the Commission were to examine critically the deficiencies of the present statistical system in terms of timeliness, reliability and adequacy and to recommend measures to correct the deficiencies and revamp the statistical system for the purpose of policy and planning in Government at different levels.

#### 1. FRUITS AND VEGETABLES

With regard to horticultural crops, National Statistical Commission in its recommendation 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 (FOD, NSSO) 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”.

The Commission observed that the production estimates of fruits and vegetables available from the DESMOA pilot survey are based on sound statistical methodology. However, the survey procedures are complex, time consuming and rather difficult to implement in practice. It is observed that the field staff does not always follow the procedures laid down for collection of data. Further, the survey implemented only in 11 States and its extension to the remaining States is taking a long time due to the fact that many of them do not possess the necessary staff resources to carry out the fieldwork. Adoption of this methodology on a nation-wide scale is a remote possibility. The estimates furnished by the National Horticultural Board (NHB) relate to the entire country but reliability is not known as these are essentially based on subjective reports

received from the ground-level staff. There is considerable divergence between the NHB and the DESMOA estimates for the States and also for the crops covered. Neither NHB nor DESMOA provide estimates of production of crops such as mushroom, herbs and floriculture that are of emerging commercial importance.

It is obvious that an alternative and more feasible methodology needs to be developed for estimating production of horticultural crops. Such an approach may consider the possibility of using the flow of data from sources concerned with horticultural crops such as wholesale markets, growers associations, fruit and vegetable processing plants, export trade, etc. in order to develop a suitable model for estimation. Special studies need to be carried out in this connection. Accordingly, the Indian Agricultural Statistics Research Institute (IASRI) has taken up a study entitled, “Pilot study to develop an alternative methodology for estimation of area and production of horticultural crops” which has been funded by the Ministry of Statistics and Programme Implementation, Central Statistical Organization, New Delhi and is being undertaken in two states namely Maharashtra and Himachal Pradesh.

## **2. SPICES**

In case of Spices, no uniform or standard methodology is being followed for estimating the area and production of spices crops. Different methodologies are adopted for a crop in various states leading to different inferences for decision making. Hence, it is suggested that the available methods may be unified for every crop for evolving realistic figures.

The pilot studies for estimation of area and production of black pepper and ginger undertaken by IASRI have shown the feasibility of estimating area and production under these crops with a reasonable degree of precision. However, there is a need to test these methodologies in some more areas before adopting them for a large-scale survey.

In view of the special features of spices like seasonal as well as perennial nature of crops, multiple harvestings, extensively grown in backyard of houses, gestation periods for some spices, short duration crops etc. estimation of extent of cultivation and production of spices is somewhat different than other crops. The survey approach for estimation of area and production of spices is somewhat more complex due to special features of cultivation of these crops. On the basis of cultivation practices of spices, there is a need to group them for evolving suitable sampling methodology for collection of data. There is need to carry out pilot studies with regard

to various spices in different areas to develop and test a methodology based on the techniques of double sampling and partial harvest so that the evolved procedure should be less cumbersome and time consuming. For these a close collaboration with the subject matter Institutes like IASRI and user organization like Directorate of Economics and Statistics (DES), Directorate of Arecanut and Spices Development (DASD), Central Statistical Organization etc is essential.

Pilot studies need to be undertaken for different spices by selecting a suitable region on the basis of available statistics in terms of area and production of the respective crops. The broad approach for carrying out field surveys is given below for different group of spices. These groups have been formed because of peculiar nature of spices like seasonality, nature of crops, cultivation, management and harvesting practices etc. The final methodology for the formulation of spices database will be provided by integrating estimates obtained from the field surveys with the information available from secondary sources viz. consumption data, export data, market arrival etc. Details of these pilot studies can be finalized in collaboration with concerned organizations like Directorate of Arecanut and Spices Development, Spices Board of India, Indian Institute of Spices Research, DES etc. The groups proposed are as below:

**(i) Climbers:** For this group of spices like black pepper, stratified multistage random sampling approach will be followed for selection of sampling units from two frames. The first frame will pertain to households growing these spices; second frame belongs to orchards, and organized/commercial farms. The number of bearing climbers in the study area will be estimated by suitable weighting the estimates obtained from these two frames. The productivity per climber per season will be estimated by selecting a sub sample of climbers from the above sample. For a small sample of climbers observations on production for each picking will be recorded for the development of relationship between production and picking cycles. Based on this relationship the productivity will be estimated on the basis of partial harvest. Finally, the production of spices will be obtained by multiplying productivity per climber per season with the estimated number of bearing climbers.

**(ii) Root and Stem:** The spices like turmeric, ginger, garlic etc. falls under this group. The traditional approach of crop estimation in India involves complete enumeration for estimating crop acreages and sample surveys based on crop cutting experiments for estimating crop yield will be applied in this group of spices. The spice production estimates will be obtained by taking

product of spice acreage and the corresponding yield of the spice crop. The sampling design for yield surveys will be a variant of stratified multistage random sampling design. In each district, tehsils/blocks will form the strata, the villages in a block will form the primary sampling units, the fields under the crop will form second stage unit and at the third stage of sampling a plot of suitable dimensions within a field will be selected for harvesting to determine the crop yield.

**(iii) Fruits and flowers with single harvest:** The spices like coriander, cumin, fennel, fenugreek fall under this group. The approach of spices pertaining to roots and stem will be extended to this group of the spice crop. The main difference of the approach will be in determination of suitable plot size, which is likely to be different from the above category.

**(iv) Fruits and flowers with multiple pickings:** The spices like chilly fall under this group. The sampling design for this group of spices will be a stratified multistage random sampling. Taluks or equivalent areas will be taken as main strata. Further, since area under spices may vary considerably from one village to another in a taluk, sub-stratification will be done on the basis of village-wise area under spices. For this purpose 3 to 4 substrata area will be formed on the basis of area under spices. The data figures may be available from revenue records. If not available, then a preliminary survey will have to be conducted to obtain village wise area under spices. Within the strata, villages will be taken as primary sampling units.

The selected villages will be completely enumerated for area under spices. This will also provide a frame of spices fields for estimation of yield rates. For estimation of production, spices fields will be selected from each village. In each of the selected fields, a randomly located plot of suitable dimension will be demarcated and observed for all the pickings in the respective periods. The above data will be used to develop relationships between production and picking cycles. Based on this relationship the productivity will be estimated on the basis of partial harvest. Finally, the production of spices will be obtained by multiplying productivity with the estimated area for the study region.

The above proposal regarding grouping and the sampling designs need to be tested before adoption.

## **2.1 Some of the current practices need to be rectified in the official statistics published by DES are outlined below:**

### **Black Pepper**

- i) A real picture of area and production of black pepper in the country as a whole is not reflected in the official estimates released by the Directorate of Economics and Statistics, New Delhi particularly in respect of Karnataka and Tamil Nadu. No statistics are also available in respect of Andhra Pradesh, Maharashtra and North-Eastern States as a whole, even though sizeable quantities of black pepper are produced in these states.
- ii) In Karnataka and Tamil Nadu, area estimation is based on the Land records. Since black pepper is generally grown as a mixed crop in Coffee and Arecanut gardens, it is a general practice to under-report or even not to report area and production therefrom. Under-reporting or non-reporting of area is also observed with the intention of growers to avoid taxes.

### **Ginger**

The production data of ginger published by the Directorate of Economics and Statistics are misleading because of adding up of the dry and fresh ginger production figures together. The production data available are on fresh ginger basis for most of States except Kerala where it is recorded on dry ginger basis. This has to be unified by converting the fresh ginger in terms of dry ginger.

### **Chillies**

Similar to ginger adding up of green chilli and red (dry) chilli production figures together is also not realistic and need to be rectified by converting green chilli figures also in terms of red (dry) chilli.

### **Seed Spices**

As per the available figures, seed spices contribute 41% of area and 21% of production of spices in the country. Crops under this group include coriander, cumin, fennel, fenugreek, celery, ajwain etc. Among them only coriander is included in the National Forecasting System. In view of the substantial area coverage and economic importance of other spices in the domestic as well as export markets there is a need to include other spices also in the forecasting system.

## **Tree Spices**

Similarly the area and production of tree spices are also not included in the National Crop Forecasting System. The data on these crops which include mainly Tamarind, Nutmeg, Clove, Cinnamon, Curry leaf, Allspice etc. are also needed for the formulation of development programmes and export-import strategies.

## **Timely Availability of Data**

Annual estimates on area and production of spices are usually released after a period of two years. As such, the available data during 2004 are of 2002. This delay in releasing the data loses their relevance in plan formulation.

In case of Cardamom, there has been no authentic data on the number of holdings and area under cultivation of small cardamom in India. The latest available estimates of area under small cardamom cultivation in India (based on the area registered by State Governments of Kerala, Karnataka and Tamil Nadu) was 1,05,000 hectares comprising 64000 hectares in Kerala, 32000 hectares in Karnataka and 9000 hectares in Tamil Nadu. However, there has been a strong opinion from different quarters that these estimates are outdated. The Spices Board also felt that it is essential to know the actual area under cultivation, age-wise composition of area, effective yielding area and extent of old and senile area in the context of formulation and implementation of various developmental schemes to increase production and productivity of Cardamom in the country.

The Board, therefore, launched an estate to estate enumeration survey in the year 1988-89 to assess the actual area under small cardamom cultivation and the number of holdings in the three producing states of Kerala, Karnataka and Tamil Nadu. The field enumeration was conducted by the field officers of the Spices Board with the guidance and support of the statistical personnel and concerned senior officers of the Board. The survey was initially launched in Idukki district of Kerala and subsequently spread over to other areas in the three states.

The methodology adopted was that of a census survey involving door to door visits by the field officers with a schedule. A copy of the schedule used for the survey is given in Appendix B.4.



Thereafter, area and production assessment of cardamom (small) in the three states of Kerala, Karnataka and Tamil Nadu is done on the basis of typical samples selected for the study.

For cashew, regular survey is not carried out to provide country level estimate for the area and production. The Directorate of Cashewnut and Cocoa Development uses base line survey for obtaining the area and production estimates.

Some of the recent advances like Geographic Information System (GIS), remote sensing and global positioning system (the 3-S technology) and small area estimation techniques can serve as potential and efficient tools for the improvement of statistics related to horticultural crops. The remote sensing technology can be thought of for obtaining estimates of area under horticultural crops at the national and some regional levels. The problem of geographical coverage can be solved with the help of this technique to a great extent.

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