

**PRODUCTION, POST HARVEST LOSSES AND CONSUMPTION  
PATTERN OF FRUITS AND VEGETABLES IN SELECTED  
FARM HOUSEHOLDS OF COIMBATORE DISTRICT AND  
IMPACT OF TRAINING**

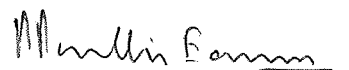
BY  
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A Thesis submitted to the Avinashilingam Institute for Home Science  
and Higher Education for Women (Deemed University) Coimbatore - 641 043  
in partial fulfilment of the requirements for the Degree of  
**Doctor of Philosophy**

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### CERTIFICATE

This is to certify that the Dissertation entitled "Production, Post Harvest Losses and Consumption Pattern of Fruits and Vegetables in Selected Farm Households of Coimbatore District and Impact of Training" submitted to the Avinashilingam Institute for Home Science and Higher Education for Women (Deemed University), Coimbatore, for the award of the Degree of Doctor of Philosophy in Food Science and Nutrition, is a record of original research work done by Miss. MEENA, K. during the period of her study in the Department of Food Science and Nutrition, Avinashilingam Institute for Home Science and Higher Education for Women (Deemed University), Coimbatore, under my supervision and guidance and the thesis has not formed the basis for the award of any Degree/ Diploma/ Associateship/ Fellowship or other similar title to any candidate of any other University.



Signature of the Guide

## DECLARATION

I hereby declare that the matter embodied in this thesis is the result of investigation carried out by me in the Department of Food Science and Nutrition, Avinashilingam Institute for Home Science and Higher Education for Women (Deemed University), Coimbatore, under the supervision and guidance of Dr.(Tmt.) P.PARVATHI EASWARAN, M.Sc. (Columbia)., Ph.D. (Madras), Professor and Head, Department of Food Service Management and Dietetics, and that it has not been submitted for the award of any Degree/ Diploma/ Associateship/ Fellowship or other similar title of any candidate of any other University or Institute.

*Meenale*  
Signature of the Candidate

*Parvathi Easwaran*  
Signature of the Guide



**Dedicated to my  
Beloved Parents**

# Acknowledgement

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# Introduction

## INTRODUCTION

India, as a result of its agro-climatic diversities, is one of the few countries in the world, capable of growing various kinds of fruits and vegetables - temperate, sub-tropical and tropical the year round. The production of fruits and vegetable products in the country, as Economic and Commercial News (1990) points out, has registered a five fold increase during the last 20 years from 0.52 million tonnes in 1970 to 2.4 million tonnes in 1989. India is the third largest producer of fruits after Brazil and USA and the second largest producer of vegetables after China contributing about the world's 60 per cent of mangoes, 13 per cent of bananas and 12 per cent of onions. Its share to the world fruit production in 1989 was about 7 per cent and that of vegetables was about 11 per cent (FAO, 1991).

Fruit and vegetable crops as Mohideen, (1991) points out, assure the farmers a steady flow of income while their exports fetch the exchequer a sizable foreign exchange. They also provide ample scope for employment generation for the rural people as these crops require more labour input for cultivation as compared to other crops.

India's area under horticultural produce is very low. As Chadha, (1991) points out the area under fruit production is 2.94 million hectares (ha) and the annual production of

fruits is 26.5 million tonnes while the area under vegetables is only 4.3 million hectares with an annual production of about 48.5 million tonnes. Although horticulture covers only 6.7 per cent of the total cultivable land in India, horticultural produce contributes more than 18 per cent of the gross value of the agricultural output and 52 per cent of the export earnings from agricultural produce (Kisan World, 1991).

According to Chadha (1990) in India, the total fruit produce comprises of 39-40 per cent mangoes, 17-19 per cent bananas, 8-9 per cent citrus, 6-7 per cent guava, 11-15 per cent grapes and 17-18 per cent other fruits. The average yield of citrus is about 9-10 tonnes/ha in India, as compared to 13-20 tonnes in Spain, Italy and Japan (Farm Progress, 1991). Despite the 50 different varieties of vegetables grown in India, the productivity averages to only about 9.5 tonnes/ha. The average yield of tomato is about 9.57 tonnes/ha in contrast to 53.8 tonnes/ha in Japan and 57.64 tonnes in France. For onion the average yield is about 8-9 tonnes in India as compared to 15.4 tonnes/ha in Japan, China, France and USA (Farm Progress, 1991a).

Katoti and Kasbekar (1992) attribute the low productivity to poor quality seed material, poor orchard efficiency, weak extension linkage between research and

farmers which implies under utilization and under exploitation of technology.

In most countries of the world, fruit and vegetable industry occupy top slot in order of priority as it is considered vital for national development, thus providing impetus both at commercial and home scale strata (Sharma and Joshi, 1990). In contrast to the extensive processing of horticultural produce of 70 per cent in Brazil and USA, 78 per cent in Philippines, 83 per cent in Malaysia and 30 per cent in Thailand, (an almost insignificant per cent of 0.5 is processed in India.) The Export scenario is also pathetic (0.5 per cent) despite India being one of the largest producers (Joshi and Attri, 1990; Selvaraj and Shanmugam, 1991 and Chandra, 1992). The reflection in the processing causes colossal annual loss of 30 per cent amounting to Rs.3000 - 4000 crores which is a drain on a developing nation like ours with an explosive population growth rate (Kaushal, 1992 and Jain, 1992).

In spite of the high potential for increased crop yields under existing agro-climatic conditions, pests and diseases and other agents compete against humans in their struggle to achieve higher outputs. Food losses of fruits and vegetables are more critical in developing countries than in developed nations. Similar losses were experienced

by the developed nations and the existing transformation could be attributed to the technological advancement in terms of yield, processing and storage. In most developed nations widespread mechanisation has replaced human labour with concomitant advances in storage technology and post harvest handling operations. In wide contrast such technologies are practically non-existent, in developing countries like India, eventually contributing to the colossal losses of food.

(Horticultural crops differ from food crops like cereals with respect to certain natural characteristics like moisture content 70-95 per cent, as against 10-20 in cereals, texture-softness as against hardness in the case of cereals and unit size - 5 g to 5 kg as against less than 1g in the case of cereals. These characteristics make them highly perishable resulting in huge post harvest losses (Subrahmanyam, 1986). The special features in the production of fruits and vegetables are intensive labour requirement, bulky nature of the products, seasonal production, perishability and lag between investment and returns which are considerably high in case of some fruits like mango (Mangifera Indica) and sapota (Achras sapota) (Vigneswara, 1986).

The Green Revolution has been a boon to horticultural

production, although it has not penetrated to the grass-root levels. Most of the horticultural producers are facing marketing problems like intermediaries, non availability of market price slab, other market information, absence of grading and standardisation (Vigneswara, 1991). Lack of storage facilities, limited knowledge of horticultural practices and lack of transport facilities are some of the problems faced by the farmers in disposing their produce.

Most post harvest losses in fruits and vegetables result from pre and post harvest infections and from inherent physiological activity. Lack of utilization of horticultural crops result in considerable post harvest losses which have been estimated to be as high as 40 per cent. It has been evaluated by different scientists and committees like Parpia (1976) and Swaminathan (1981) that one third of the perishable produce is lost at different stages in post harvest management which is to the tune of about Rs. 3000 crores annually (Kaushal and Chauhan, 1991).

The principal causes of post harvest losses and poor quality in the order of importance are; mechanical injuries, wilting, water loss, shrivelling, bruising, improper curing, over ripening, sprouting and rooting, high respiration rate, chilling injury and decay. These losses account towards poor return to the growers and increase the cost of raw materials

which ultimately affect the consumer at large.)

The facilities for transport in and outside the country are inadequate. There are not enough refrigerated lorries, wagons and cargo space. The poor condition of road surface and speedy driving on bumpy roads are the two major factors which result in much mechanical damage caused to the produce consigned by road (Roy, 1989). The packaging industry is still in its infancy in India. The existing practices of packaging of fruits and vegetables in gunny bags, woven baskets and traditional wooden crates result in excessive mechanical damage.

Fruits and vegetables are rich sources of micro nutrients essential for the prevention and rectification of a number of micro nutrient diseases associated with malnutrition. Fruits and vegetables in recent years have acquired focus and importance due to the presence of dietary fibre which plays a multifactorial role in diseases and metabolic disorders like diabetes and cardio-vascular diseases. Bakhru, (1991) states that fruits and vegetables have a multifaceted effect viz., hydrating, diuretic, alkalinising, mineralising and laxative.

The percapita consumption of horticultural produce in the last few decades falls far below the recommended

allowances which is a reflection of the percaput availability for a rapidly growing populace. Ramphal and Gill (1990) and Venkataraman (1992) have estimated the percaput availability of vegetables and fruits to be 135 and 40 g as against 285 and 60 g recommended by the Indian Council of Medical Research (ICMR). If the Recommended Dietary Allowances are to be met, India needs 36.77 million tonnes of fruits and 81.76 million tonnes of vegetables. Low consumption of fruits and vegetables in Indian diet is directly associated with low productivity and efforts are needed to harvest maximum produce per unit time. (A transformation) in production of horticultural produce (can be effected only by (the adoption of scientific methods from the initial stage of seeding.) There exists a dearth of technological know-how at the farming level, which demands a sustaining and effective government policy.) The policy should also extend to the marketing sector whereby the producer is not exploited by the middlemen. Total commitment by the government is the ultimate factor that will determine the complete eradication of shortage of fruits and vegetables. As more fruits and vegetables are needed to supply the growing population, as more produce is transported to non producing areas, and as more commodities are stored longer to obtain a year round supply (measures on

post harvest loss prevention technology are of paramount importance.)

(The post harvest losses obviously have an impact both at micro and macro levels of economy. They will result not only in physical loss of the produce for the nation but also affect the marketing cost which will finally affect (the consumer's price and their consumption) Hence there is a need to study them. The present study, 'Production, Post Harvest Losses and Consumption Pattern of Fruits and Vegetables in Selected Farm Households of Coimbatore District and Impact of Training' was undertaken with the following specific objectives:

- A. Survey the existing production figures and cultivation practices of fruits and vegetables followed by the selected farmers in the target area.
- B. Assess the post harvest losses of fruits and vegetables and identify the causative factors.
- C. Study the pattern of marketing of fruits and vegetables in the target area.
- D. Study the consumption pattern of fruits and vegetables in selected gardeners' and non gardeners' households.
- E. Impart training on cultivation techniques and measures to minimise post harvest losses of fruits

and vegetables to the farmers and desirable methods of storage, cooking and preservation of fruits and vegetables to the housewives and

- F. Evaluate the impact of training in terms of reduction in post harvest losses and improvement in pattern of consumption of fruits and vegetables.

# Review of Literature

## II REVIEW OF LITERATURE

Literature pertaining to the present research topic is discussed under the following heads.

- A. Fruits and Vegetables - Store house of nutrients
- B. Production pattern, per capita availability and consumption pattern of fruits and vegetables
- C. Causes of post harvest losses and loss reduction techniques
- D. Constraints in marketing of fruits and vegetables and
- E. Role of training to overcome post harvest losses and improve the consumption pattern

### A. Fruits and Vegetables - Store house of nutrients

Fruits and vegetables are the major dietary sources of vitamins A and C as well as some minerals. They are low in protein and fat, and generally have only small amounts of B vitamins. They are good sources of fibre especially if the whole fruit is consumed. A variety of fruits and vegetables is more likely to yield a wider intake of nutrients (Gates, 1987).

Roots and tuber crops, plantains and bananas are rich sources of carbohydrates. They constitute a basic component of the diet for millions of people in the temperate zone and in vast areas of the tropics and sub-tropics (FAO, 1988).

Fruits and vegetables are excellent sources of minerals, vitamins and enzymes. They are easily digested and exercise a cleaning effect on the blood and digestive tract. The main physiological actions of fruits are hydrating, diuretic, alkalinising, mineralising and laxative (Bakhru, 1991).

Leafy vegetables provide significant amounts of vitamin A, C, fibre and minerals (ICMR, 1989 and Paul, 1992).

Components of dietary fibre vary from food to food. High levels of cellulose are found in root and leafy vegetables and some fruits such as pears and apples. Lignin content is highest in fruits, particularly strawberries and peaches, whereas pectin levels are highest in citrus fruits and apples (Selvendran, 1984 and Lanza and Butrum, 1986).

Fruits and vegetables may influence coronary heart disease through their role in reducing cholesterol and influencing blood platelet function. Platelets are specialised blood cells which influence clotting. Vegetables and fruits have been shown to be fairly rich in pectin which has cholesterol lowering effect (Wolthuis et al., 1980).

Gormley et al., (1977) showed that two apples per day, in addition to the normal diet, reduced serum cholesterol by 8 per cent (mean value) and raised the high density

lipoprotein cholesterol fraction (HDL) from 18 to 24 per cent in 80 human volunteers.

A study conducted by Brigham and Women's Hospital and Harvard Medical School (Health and Nutrition, 1992) revealed that in women who ate large amounts of beta-carotene (orange-yellow vegetables) risk of heart attack was lowered by 22 per cent and the risk of stroke was lowered by 40 per cent, as compared to those who took little beta-carotene.

The incidence of nutritional blindness, anaemia and angular stomatitis could be reduced by the consumption of fruits and vegetables (Mukherjee, 1989).

WHO study group (WHO, 1990) reported that a diet low in total and saturated fat, high in plant foods especially green, yellow vegetables and citrus fruits and low in alcohol, salt-pickle, smoked and salt preserved foods was consistent with a low risk of many of the current major cancers including cancers of the colon, prostate, breast, stomach, lung and oesophagus. Vegetables like cabbage, cauliflower, brussels sprouts, radish, sweet potato, grapes and oranges had protective factors against carcinogen (Polasa, 1989 and Zheng et al., 1992).

**B. Production pattern, per capita availability and consumption pattern of fruits and vegetables**

In terms of production, India is the third largest producer of fruits after Brazil and USA and the second largest producer of vegetables after China. India increased its fruit production from 20.3 million tonnes in 1980 to 27.8 million tonnes in 1990 and in vegetable production from 40.5 million tonnes to 50.9 million tonnes (FAO, 1991). India's fruit and vegetable production during 1980-90, its share in world's and Asia's production during 1980-90 is given in Table I.

TABLE I

PRODUCTION TREND OF FRUITS AND VEGETABLES IN INDIA						
Name of the fruit/ vegetable	Production in '000 tonnes		Share in Asia's production (%)		Share in World's production (%)	
	1980	1990	1980	1990	1980	1990
<b>Fruits</b>	20358	27839	24.60	24.80	6.88	8.10
Banana	360	280	26.70	18.60	13.70	6.30
Mango	8365	9500	78.06	79.16	61.50	60.50
Grapes	195	380	2.74	4.20	0.29	0.60
Pineapple	548	602	9.50	10.50	5.91	6.20
<b>Vegetables</b>	40585	50999	21.48	20.50	11.50	11.50
Tomato	743	806	6.10	4.60	1.40	1.20
Onion	2551	3550	25.40	25.90	12.00	12.70

Source : FAO, 1991.

In India, horticultural crops occupy only 6.7 per cent of the gross cropped area, however their contribution to the gross agricultural output is 18.8 per cent. The present per capita availability of fruits and vegetables is far below the requirement of the rapidly growing population which is a reflection of the poor productivity.

The analysis of consumption pattern is a pre requisite of a planned economy so as to enable the planners to have a precise knowledge of the future demands of different commodities and to match supply with changing pattern of demand (Prasher et al., 1990).

Consumption of fruits and vegetables in India is very meagre and the consumption pattern differ in different income groups (Ramachander et al., 1986). The balanced menus recommended by Indian Council of Medical Research prescribe 280 g of vegetables per capita per day, while Indian consumption stands at 120 g (Kisan World, 1991).

The report of National Nutrition Monitoring Bureau (NNMB) 1980-81 indicates that the average intake of roots and tubers was maximum in Gujarat (445 g) as against the minimum of 21 g in Andhra Pradesh. The intake of fruits was found to be maximum in Orissa (47 g) and minimum in Karnataka (3 g). Survey data of NNMB points out that the

average intake of green leafy vegetables, roots and tubers, other vegetables and fruits in Tamil Nadu was found to be 6,71,44 and 16 g respectively.

Seasonal variations, environmental conditions, food availability, food prices and labour demands were found to have considerable impact on consumption in many rural areas of developing countries (Behrman and Deolalikar, 1986).

Lalchand Singh et al., (1976) have reported that consumption of fruits was much higher in higher income groups. According to Ramachander et al., (1986) the daily per capita consumption of fruits among the salaried classes averaged 101 g and varied from 58 to 172 g in the four regions of India and from 43 to 226 g among various income groups.

According to Chandra Prabha et al., (1990) the dietary pattern among Harijan households in rural Karnataka was poorly balanced and predominated by cereal and millets with low intake of protective foods such as leafy vegetables, roots and tubers and fruits, the consumption of these being as low as 2, 10 and 11 g respectively.

As per Narasinga Rao et al., (1989) the survey results of NNMB over the past decade in 10 different states of the country, have brought out the clear picture of average

consumption of fruits in rural, urban and slums and was found to be 15, 66 and 26 g as against 58, 110 and 51 g for vegetables.

A study conducted by Puspamma et al., (1984) revealed that availability was found to be one of the deciding factors of the consumption pattern of fruits and vegetables.

The agro climatic and socio-economic conditions as per Srinivasan et al., (1991) affect the income, consumption pattern and nutritional status of the rural households. Kaur et al., (1982) reporting the consumption pattern of expectant mothers in suburbs of Hissar indicates negligible consumption of green leafy vegetables, attributing it to their non availability during the season in which the study was conducted. In suburbs the consumption of all food stuffs except green leafy vegetables by expectant mothers increased with rise in their income level.

For the farm households, changes in cropping system influenced the amounts and kinds of food produced and fluctuation in food availability during the year was much more important than changes in price (Guyer, 1980). Francis (1987) pointed out that the lack of adequate purchasing power with the low income group constrained them to consume more. Among the non farm households there was a shift from

consumption of cereals to consumption of pulses, vegetables, fruits and milk and milk products (Sangwan et al., 1987).

**C. Causes of post harvest losses and loss reduction techniques**

**1. Causes of Post harvest losses of fruits and vegetables**

There are so many causes for losses (Fig. 1) and is classified into two groups viz., primary and secondary.

**a. Primary causes of loss**

Primary causes of loss are those causes that directly affect the food. This kind of loss can be classified into the following sub groups.

**i. Biological**

Consumption of fruits and vegetables by rodents, birds, monkeys and other animals cause direct disappearance of fruits and vegetables. Annual losses of horticultural produce due to rodents account to 15-20 per cent in India (Kumar, 1987) and in Bhutan, it accounted to 15-20 per cent of the total production (Dukpa, 1992). A study on rodent damage in vegetable crops by Malhi (1992) revealed that the extent of damage ranged between 9.5 and 21.7 per cent in tomato, summer squash and melon.

Insect, pests, mites and nematodes are responsible for substantial losses of fruits and vegetables. Cole crops like

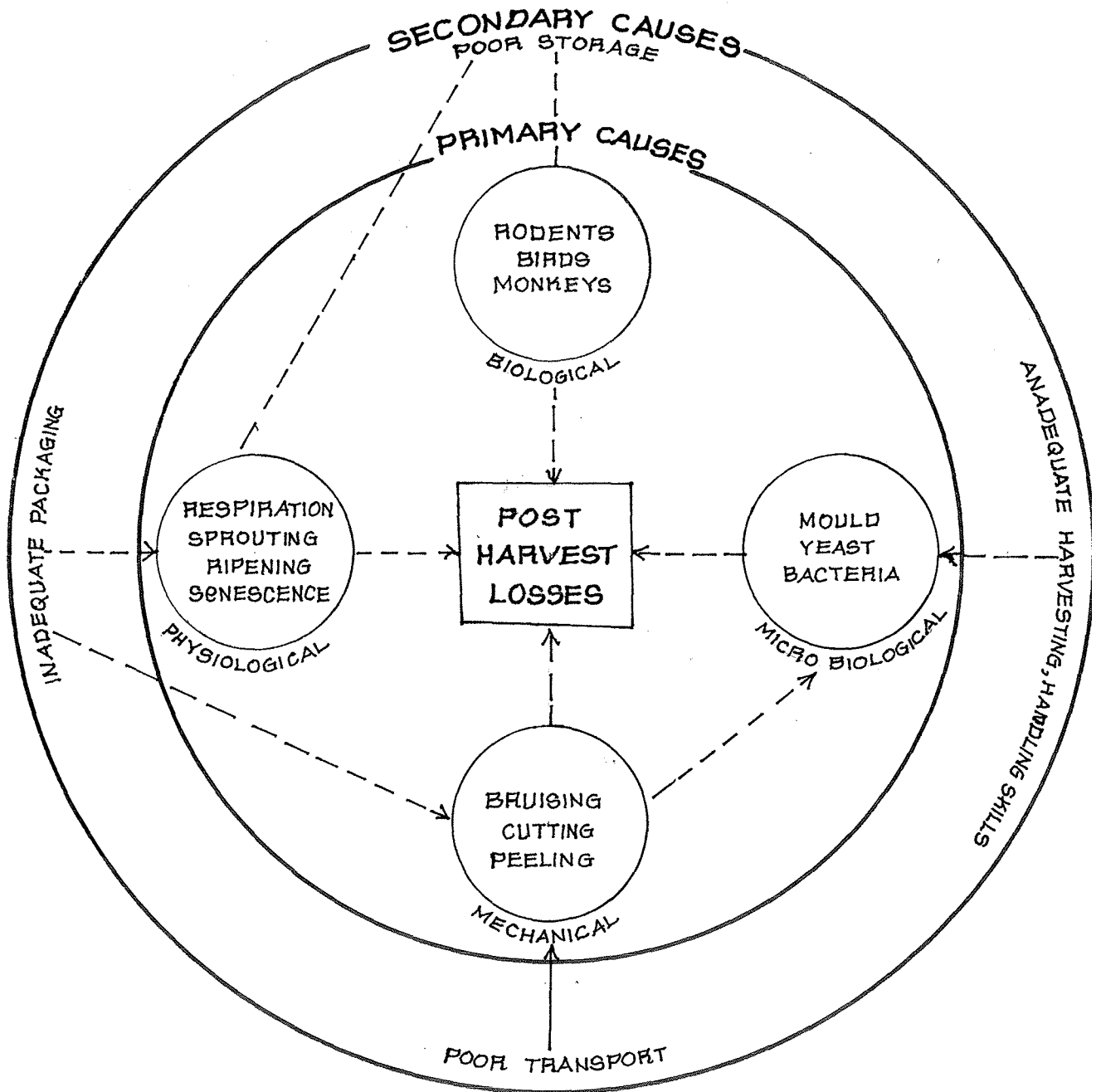


Fig.1. CAUSES OF POST HARVEST LOSSES OF FRUITS AND VEGETABLES

cabbage and cauliflower are attacked by diamond back moth and cabbage butterfly. Aphids are the main pests on roots and cole vegetables. Spotted boll worm and jassids are serious pests of Okra (Lady's finger). Root knot nematodes seriously affect most vegetables particularly in light soils and cause considerable damage (Kirthi Singh and Chadha, 1990).

Reported losses of fruits and vegetables due to insects and pests ranged from 5 to 100 per cent and is presented in Table II.

TABLE II

REPORTED LOSSES OF FRUITS AND VEGETABLES DUE TO INSECTS AND PESTS

Community	Causative agent <sup>*</sup>	Per Cent loss	Source
Okra	Fruit borer	49 - 74.2	Krishnaiah (1980)
Chilli	Bud borer	15 - 50	Ukey <i>et al.</i> (1991)
Tomato	Fruit borer	40 - 80	The Hindu (1992)
Brinjal	Fruit borer	28.6 - 85	Dhamdhare and Bhonsle (1992)
Cabbage	Diamond back moth	43 - 53	Krishnaiah (1980)
Pea	Aphids	20.1	Krishnaiah (1980)
Colocasia	Aphids	21.5	Palanisamy and Pillai (1989)
Sweet Potato	Weevil	25 - 54	Pillai and Prasa (1983)
Yam	Termites	70	Johnson and Wood (1979)
Cassava	Termites	40	Lal and Pillai (1981)
Papaya	Fruit fly	12	Belgica Geronimo and Mendoza (1988)
Sweet orange	Thrips	30 - 46	Pholan <i>et al.</i> , 1984
	Mites	28 - 40	Pholan <i>et al.</i> , 1984
Mango	Mango hopper	20 - 100	Thilak Subbaiah, (1990)
	Fruit fly	3.6 - 56.6	Singh (1991)
Banana	Burrowing nematode	30 - 60	Blake (1972)
Grapes	Flea beetle	31	Trehan <i>et al.</i> , (1947)
	Mealy bug	90	Azam and Ramesh Babu (1989)
	Mealy bug	8.8	Tondon and Dhara Jothi (1991)
	Thrips	23.5	Tondon and Dhara Jothi (1991)
Guava	Tea mosquito bug	45	Ragumoorthi <i>et al.</i> , (1992)

\* Scientific names given in Appendix A.

## ii. Microbiological

Moulds, yeasts and bacteria not only affect the flavour, colour and texture of the fruits and vegetables but render them unmarketable. Common pathogens causing loss in harvested fruits and vegetables are fungi such as Alternaria, Botrytis and Penicillium and bacteria such as Ervinia and Pseudomonas. Toxic substances elaborated by moulds such as aflatoxin (A liver carcinogen) and patulin cause some food to be condemned and hence lost.

Studies by Mir and Kotha (1986) revealed that Penicillium expansum was the predominant organism in apple causing 43.9 and 27.5 per cent spoilage during transit to Jammu and Delhi markets respectively. Other pathogens included were Alternaria, Glomerulla and Monilinia species.

In surveys of markets, stores, godowns and canning centres in various parts of the state Himachal Pradesh, the cumulative incidence of brown rot in harvested apple was 5-15.2 per cent (Sharma and Kaul, 1989). Gerini (1988) observed that there was a 5 per cent weight loss in bananas during transit due to fungal disease.

Ceponis and Butter field (1979) found that parasitic diseases were main causes of losses namely 6.7 and 7.9 per cent respectively at retail and consumer levels in fresh tomatoes marketed in Greater New York. More than 60 per cent

of the losses at the retail level and 80 per cent at the consumer level resulted from diseases principally gray mold rot and bacteria soft rot.

Nikolaeva (1983) reported that in damaged vegetables losses due to moulds were 5-11 times higher in carrots, 1.5-1.8 times in cabbage and 2-4 times in onions than the respective undamaged vegetables. Adhikaram (1988) surveyed 35 fruit and vegetable stalls in the central province of Sri Lanka and reported 5-25 per cent losses in most of the commodities. Singh et al., (1988) reported that yellow vein mosaic of okra (Lady's finger) could cause a damage of 50-90 per cent.

Prasad et al., (1989) reported 24.6 per cent losses in potato of the markets of Bihar and attributed this to post harvest fungal diseases. Of this eight per cent was due to Rhizopus arrhizus and the remainder to Fusarium, Phythium, Aspergillus and Penicillium species.

### iii. Mechanical/Physical injury

Because of their characteristic shape, structure and high water content, fruits and vegetables are more susceptible to physical or mechanical injury due to rough handling, inadequate packaging and poor transportation and storage condition. Bruising, cutting, excessive peeling or

trimming of horticultural products, puncture, abrasions, scars, crushing are causes of loss. Mechanical injury takes many forms and arises at all stages from pre harvest operations, harvesting, handling, grading, packaging, transporting and storage, to exposure in the market and finally at the hands of the consumer (Coursey, 1983).

Mechanical damage occurred mainly during transport from field to wholesalers and from wholesalers to retailers. Rail transport resulted in greater damage than road. Losses were mainly due to spoilage and quality deterioration for fruits and vegetables (Zu neuen, 1984).

Mechanical damage to potato tubers during harvesting, transporting and sorting was analysed by Francak and Biros (1990) and was found to be 85 per cent in Rosa and Radka varieties. Field studies were carried by Peruzzi and Di Ciolo (1990) in Tuscany, Italy on the mechanical harvesting and grading of French beans and the losses were 12-19 per cent during harvesting while at sorting it was 18-28 per cent.

#### **iv. Physiological**

Natural respiratory losses which occur in all living organisms account for a significant level of the weight loss and moreover the process generates heat. Changes which occur during ripening, senescence, including wilting and

termination of dormancy (eg. sprouting) may increase the susceptibility of the commodity to mechanical damage or infection by pathogens. A reduction in nutritional level and consumer acceptance may also arise with these changes.

In the case of apple, losses amounted to 25-26 per cent due to physiological damage (Genchen, 1982). Among citrus fruits like loose and tight skinned oranges, limes and lemons, the pre harvest losses due to physiological disorder were found to be 1.4 per cent (Dalal, 1988). Potatoes recorded 50 per cent loss due to sprouting after storage for three months in pits. Tubers stored under ordinary conditions (18-20°C) started sprouting after two months and were unusable after 3-4 months of storage (Khurana et al., 1986).

**b. Secondary causes of loss**

Secondary causes of losses are those that lead to conditions that encourage a primary cause of loss.

**i. Inadequate harvesting and handling skills**

Fruits harvested at an immature stage may never ripen properly and may consequently constitute a post harvest loss and are rejected at retail or consumer levels. Fruits and vegetables harvested at an over mature stage may not survive the handling to which it is subjected during marketing and usually goes as a loss (Jatindukumar and Beniwal, 1981).

The losses in tomatoes harvested at green and immature stage were heavy and 40 per cent of them never changed colour to pink or red and further shrivel up during the course of storage becoming susceptible to microbial infection (Dalal, 1988).

Handling of fruits and vegetables after harvesting involves several steps before reaching the consumer. Improper handling of the produce results in losses of 25 to 40 per cent depending on the type of fruit or vegetable (Kader, 1980).

Sharma and Kachru (1986) noted a ten per cent loss on potato damage caused by conventional harvesting method. A study conducted by Associates Agricultural Development Foundation (1986) showed that 45 to 50 per cent of the onion got damaged during handling, transportation and storage.

#### **ii. Inadequate packaging**

The existing practices of packaging of fruits and vegetables in gunny bags, woven baskets and traditional wooden crates result in excessive mechanical damage resulting in heavy mechanical losses (Sethi and Maini, 1989). Approximately thirty per cent fruits and vegetables goes waste every year due to inadequate packaging, transport and mishandling (Chakravorty, 1980).

Joshi et al., (1988) studied the effect of different packing cases on the transportability and marketing quality of apple. The lowest fruit loss (3.35 per cent) and least spoilage occurred in the corrugated cartons and the greatest losses (10 per cent) and damage occurred in wooden boxes.

The traditional method of packing cauliflower in gunny bags registered 5 per cent loss due to rough handling. The losses on account of packing peas in gunny bags were nearly 59 per cent due to blemishes on the pods. Carrots and radishes packed in gunny sacks under went all sorts of bruises during handling to the extent of 10 per cent. Packing tomatoes, oranges in wooden pilfer proof with little ventilation cause 50 per cent loss during transportation and storage. The unventilated crates produce favourable environment for physiological disorders in produce (Dalal, 1988).

Apple trays in corrugated fibre board cartons suffered bruising losses of 5 per cent as against 30-40 in conventional wooden boxes. The superiority of corrugated fibre board box over conventional wooden box for packing of plums, mango and other fruits for transport and storage has already been proved at various places in India (Maini, 1983 and Gopalakrishna Rao and Krishnamurthy, 1983).

### **iii. Inadequate transport**

In India damages caused by rail wagon due to respiratory heat and solar radiation is quite high (Sethi and Maini, 1989). Controlled temperature transport is necessary to preserve the quality of fresh fruits and vegetables (Bennahmiah, 1990).

Studies conducted by Directorate of Marketing and Inspection (DMI) showed transit losses in oranges at 8-28 per cent depending upon the mode of transport (DMI, 1982). To protect fruits and vegetables from bruising, vibration and weight of other stacked containers during transportation, adequate packaging is required (Kaushal and Chauhan, 1991).

Investigation was carried out with existing containers such as corrugated fibre board (CFB) box, date palm box, bamboo basket and mud pot for packaging and transportation of grapes. Thompson seedless and Anab-E-Shahi packed in CFB containers indicated good results. Bamboo basket, date palm box and mud pot were found to be inconvenient for stacking because of uneven external structure causing more crushing and bruising (Sankaraiah and Roy, 1991).

Spoilage in the case of grapes brought by rail cum road ranged between 5-25 per cent. The extent of spoilage was greatly influenced by the type of containers used, nature of

padding material and lining provided, duration of journey, mode of conveyance, stage of ripening, season of supply and weather conditions (Industrial Development Services, 1972).

Containers used for food should facilitate the transport of the product, prevent its contamination or loss and prevent it against damage or degradation (Essuman, 1990).

Studies conducted by Sinaga (1986) revealed that there was more loss (38 per cent) in bamboo baskets compared to wooden crates (6 per cent) which were used for transporting fresh cauliflowers to market.

#### **iv. Inadequate storage facilities**

Against the total production of 80 million tonnes of fruits and vegetables the cold storage capacity, however is around 5.7 million tonnes and over 90 per cent of the capacity is only for potatoes. Establishment of cold storage plants is highly capital intensive and the returns are non commensurate with investment. Non availability of uninterrupted power is another constraint (Grover, 1991).

Survey conducted by Bhatnagar et al., (1989) revealed that farmers usually sold onions immediately after harvest because of the possible deterioration of onions as well as expenditure incurred on storage of the produce.

## 2. Loss reduction Techniques

Post harvest losses can be reduced to a great extent by breeding of fruits and vegetables for longer shelf-life, improvement of pre harvest factors and harvesting techniques, proper method of handling, marketing, packaging, transport and storage.

### a. Harvesting at correct time

Right time of harvesting depends upon the varieties of fruits and vegetables, climate and cultural operations (Khurdiya, 1985). The harvesting indices of important individual fruits and vegetables have been discussed by Pantastico et al., (1975) and Ranganna (1986). Harvesting of fruits and vegetables should be carried out during the cooler part of the day i.e., in the early morning to avoid higher level of field heat leading to rapid deterioration. Picking and catching methods and hand harvesting caused less damage than mechanical methods (International Food Convention, 1988).

The treatment which the produce receives after harvesting is a major factor contributing to its deterioration in quality. Produce should be collected from the field in suitable containers and not allowed to be exposed to sun, rain and wind (Coursey, 1983).

## b. Curing

With starch root crops and onion a curing process immediately after harvesting can substantially reduce post harvest loss and prolong shelf-life. The term 'curing' implies a wound healing process brought about by a few days exposure to high relative humidities and temperature (Booth, 1974 and Proctor et al., 1981). The drying of onion, although a different process, has a somewhat similar effect. According to Proctor et al., (1981) it is a treatment given for fast healing of mechanical injury, lowering the moisture content and decreasing the rotting and fungal growth on surface. Similarly curing in onion and garlic brings down the moisture content and thereby enhances the shelf-life. High temperature and relative humidity is favourable for fast healing in potato and sweet potato. Properly cured onion (Atwa et al., 1974) and potatoes (Maini, 1989) had longer shelf-life than uncured one. Mango before transportation or storage prior to marketing is often dipped in hot water at 51-55°C for 2-3 minutes for uniform ripening and to reduce the fungal growth.

Mbonomo and Brecht, (1990) studied the effect of curing, on xanthosoma cormels. Curing at 30 or 35°C and 95-100 per cent relative humidity for 7 days reduced weight loss and decay due to Ervinia carotovora during storage

under simulated ambient conditions of 25°C and 75 per cent relative humidity compared with not curing.

### c. Degreening

In citrus, banana, mango and sometimes in tomato, degreening is practised to give characteristic colour to the fruit preferred by consumers. The treatment may vary with the kind of fruit and its condition of harvest (Kaushal, 1987).

Fully green kagze lime (Citrus aurantifolia) washed, dipped in ethrel at 2000 ppm, dried in the shade and stored in perforated polyethylene bags at 17 - 35°C and 65-70 per cent relative humidity resulted in 100 per cent yellow fruits after 5 days of storage (Rath and Pattnaik, 1989).

### d. Precooling

This helps in removing field heat, reduces the rate of respiration, transpiration and the refrigeration required during storage and transport. Temperate fruits like apple and peaches were cooled to 4.4°C or less whereas the tropical and sub tropical fruits which were susceptible to chilling injury were cooled to 10-12°C (Wills et al., 1981). Pre cooling is achieved by use of coolants such as air, iced water and vacuum.

#### e. Grading

Grading includes removal of splits, punctures, deformed fruits and incipient rots and size grading. This may be done manually or mechanically (Ramana et al., 1981). Culled fruits may be used for processing and the graded fruits transported to packing sections for further storage and marketing.

#### f. Control of ripening and spoilage

Ripening can be retarded by skin coating of wax along with proper packing or by the use of growth retardants or by storing at low temperature.

A discontinuous thin layer of wax on the surface of fruits controls the transpiration and respiration which results in increasing shelf-life. Gibberellic acid ( $GA_3$ ) is known to delay ripening in fruits such as apple (Wills and Scott, 1974), citrus (Aworh et al., 1991), tomato (IIHR, 1988) and Kinnow (Sandhu et al., 1983). In mango post harvest treatment with  $GA_3$  could extend the shelf-life by 2-3 days (Krishnamurthy et al., 1983 and Khader et al., 1988) and 6 days of storage under ambient temperature between  $36 \pm 3^\circ C$  (Khader, 1991).

Habibunnisa et al., (1988) extended the storage life of apples and oranges by fungicidal waxol dip treatment under evaporative cooling storage conditions. Evaporative

cooling storage gave 6 times longer storage life for apples and 4 times longer storage life for mandarins than at ambient conditions. Shelf life was extended in guava for 10 days when treated with wax emulsions and stored at room temperature (Khedkar et al., 1982).

Efficacy of post harvest treatment with fungicides like benlate, thiabendazole, captan, rovril at 500 ppm showed that benlate was the best to control the spoilage from 30 per cent to 10 per cent during ripening of Alphonso and Pairi mangoes. This treatment also retarded ripening. In mandarin, benlate reduced spoilage by 50 per cent (i.e., from 40 to 20 per cent) during 10 days storage period at ambient condition (ICAR, 1986 and Bhuller et al., 1986).

Treatment of sultana grapes with 5000 ppm acetaldehyde vapours for 24 hrs reduced decay by 92 per cent compared with the control fruits (Avisar et al., 1988).

Ladiniya et al., (1990) studied the effect of growth retardants in controlling storage rots of grapes. Chlormeguat at 2000 ppm applied at the second rapid growth stage of berry development, controlled storage rot of CV Perlette, associated with Aspergillus niger, A. Flavus and Pencillium species.

Pre harvest spray with maleic hydroxide 2000-3000 mg/litre or 40 per cent ethrel resulted in lowest percentage of rotting in onion bulbs after 4 months (0.9 and 0.3 per cent respectively) of storage (Ray et al., 1991).

#### **g. Packaging**

Improved packaging plays an important role in protecting the quality as well as quantity of the commodity and thereby extending the marketing potentials of fruits and vegetables to the advantage of growers. Freshly harvested green peas pre packed in 200 gauge low density polyethylene bags with ventilation stored at room temperature (13-30°C) had a shelf-life upto 6 days (Kalra et al., 1989).

Okra (Lady's finger) treated in water-mustard oil emulsion and packed in 400 gauge thickness polyethylene bags showed the minimum weight loss and remained in good condition upto ten days of storage at 42°C and 77.5 per cent relative humidity (Sembhi and Randhawa, 1983).

Risse (1989) found that individual film wrapping reduced the weight loss, colour development and chilling injury in cucumber tomatoes, capsicum, grape fruits, lemons and mangoes under optimum storage conditions.

Dipping lemons in 2500 ppm ethrel and packing in polyethylene film have also been reported to improve the

quality and marketability of fruits (Josan et al., 1981). Individual citrus fruits wrapped in 0.15 mm high density polyethylene (HDPE) film inhibited fruit softening and spreading of scars (Colomb et al., 1984). The chilling injury of grape fruit and lemon could be inhibited by seal packaging with 0.1mm thick HDPE film (Ben-Yohoshua et al., 1981).

The storage life of lettuce heads was only one day when kept unwrapped one whereas it was 7 and 6 days in those wrapped in 100 gauge polyethylene bags without vents and with 0.2 per cent ventilation respectively (Chikkasubbanna et al., 1991). When it is packed in HDPE bags and stored at 0-1°C the shelf-life was increased to 40 days compared with 8-10 days for unpacked lettuce (Jeong et al., 1990).

Grapes var. pachadraksha stored at 8-10°C and wrapped in a 100 gauge polyethylene sheet had minimum yield losses (10-52 per cent) after 50 days and no disease was recorded (Reddy et al., 1989).

#### **h. Transport facilities**

Traditionally bamboo and wood have been the choice of packing material in India to withstand crude transportation, to resist high humid climate and to offer excellent stacking strength but there is a lot of physical damage such as bruising and moreover wood consumption towards package

material is elevated at about 5 million cubic metres per annum. Therefore less wood consumption package such as CFB box and wire bound box have great scope for long distance transportation and storing in different storage conditions (Sankaraiah and Roy, 1991).

Bruising, ripening, spoilage, shrivelling in transport and storage were less when mango fruits were packed in corrugated fibre board boxes (ICAR, 1988). Studies conducted by Pathak et al., (1989) during transport by bus for 20 hrs and by rail for 31 hrs Aonla (Phyllanthus emblica, L) fruits packed in wooden crates with polyethylene liner showed minimum damage, physiological loss in weight and bruising compared to fruits packed in gunny bags. Packaging studies on Benshan mangoes during transportation from Hyderabad to Delhi showed that the use of high molecular high density polyethylene (20 UM thickness) film wrap created a modified atmosphere around the fruits and helped in extending its storage life (IARI, 1990).

#### **i. Storage**

Under ambient conditions of storage, especially in the tropical climate, the rate of ripening is faster, and the fruits shrivel rapidly due to wide variations in the temperature and relative humidity and become susceptible to microbial spoilage leading to heavy losses. Low temperature

and high humidity in storage reduces the rate of physical activities and thereby the shelf-life of the fruits and vegetables is increased. Lowering of the temperature could be accomplished in the following ways.

**i. Evaporative cool storage**

Several studies have shown the possibility of extending the storage life of fresh fruits and vegetables in evaporative cool storages, where the temperature is lower than the outside air.

Indian Agricultural Research Institute (IARI) has developed a zero energy cool chamber for retaining the freshness of fruits and vegetables during storage for a short period. This is based on evaporative cooling system where capital cost of equipment as well as running cost are much less than mechanical refrigeration system (Sethi and Maini, 1989).

Cool chamber storage was helpful in prolonging the freshness, firmness and nutritive qualities of mango, apple, guava and green tomato but was not found suitable for potato (ICAR, 1988). Ripe mangoes when stored in cool chamber had 9 days shelf-life as compared to 6 days under ambient conditions (Roy and Pal, 1991).

**ii. Low temperature storage**

This is extensively used to store the perishable fruits and vegetables, employing the principle of maintaining low temperature around the commodity. This reduces the rate of respiration, growth of organisms which cause decays and delays ripening.

Mud storage devices are effective to extend the shelf-life of fruits and vegetables as compared to traditional storage methods. A study conducted by Rajalakshmi and Antoinette (1985) points out that vegetables like carrot, beet root, bitter gourd, brinjal, lady's finger, green chillies, beans and tomato had an extended storage life of 5-7 days in mud pots compared to that of 3-4 days by other traditional methods.

**iii. Controlled/modified atmosphere (CA/MA) storage**

In controlled/modified atmosphere storage, the commodity is stored under increased  $\text{CO}_2$  and decreased  $\text{O}_2$  and high  $\text{N}_2$  levels compared to normal atmosphere. Keeping fruits and vegetables in very low oxygen and or very high  $\text{CO}_2$  atmospheres may have beneficial effects such as reducing respiration rate, inhibiting ethylene production and action, retarding colour change and softening, maintaining composition and nutritional value, reducing the incidence of some physiological disorders and inhibiting decay. The

specific beneficial effect observed depend on the commodity, maturity, stage, storage, temperature, atmosphere composition and exposure time (Ke and Kader, 1992). For most commodities decreasing O<sub>2</sub> level to 1 per cent or below and or enhancing CO<sub>2</sub> level to 50 per cent or above greatly inhibits ethylene production and action (Ke et al., 1990, 1991 and 1991a).

Controlled atmospheric storage combined with refrigeration markedly extends the storage life of commodities. Exposure of banana bunches (Ramana et al., 1983 and 1989), carrot (Aida, 1983), bell pepper (Padmini, 1987), green chillies (Selvarajah, 1987), tomatoes and spinach (Casas et al., 1990) and mango (Gonzalez et al., 1990 and Malkawa, 1990) to modified atmosphere storage extended their shelf-life significantly.

Ethylene free atmosphere extends storage life of banana (Solunkhe and Desai, 1984) and guava (Ramana et al., 1989).

Modified Atmosphere storage on green asparagus revealed that precooling before storage reduced more than 20 per cent loss retaining colour, fresh appearance and firmer texture (Gairepy et al., 1991).

Marangoni and Stanley (1991) studied the long term storage of mature, green tomato. Field grown mature, green

tomato fruit stored at 12°C under modified atmosphere could only be stored between 10 and 30 days due to heavy fungal infection whereas green house grown fruit could be stored for atleast 30 days with no detectable changes in quality.

#### **iv. Storage structure of onion**

For proper storage, onions need to be kept at low temperature and low humidity. Gupta and Shukla (1992) suggested that onion could be stored in air ventilated storage structure with 7 per cent losses and in forced ventilated structure with 4 per cent losses for about four months.

Losses in onion could be reduced from 35 to 20 per cent when the rural oriented storage structures were ventilated through perforated bamboo pipes (ICAR, 1987).

#### **D. Constraints in marketing of fruits and vegetables**

Agricultural marketing in India is by and large inefficient (Prasad 1991). Its inefficiency arises from poor transport, storage and processing facilities, poor market information systems, lack of standardization of weights and measures and inadequately and poorly administered banking and credit facilities. Marketing of fruits and vegetables needs quick transportation and storage facilities. The marketing of these commodities involves a large number of

intermediaries for performing different activities which take away margins from the price paid by the consumers (Nawadkar et al., 1991).

Vegetable growers who sold directly to the consumer got eighty (Bhupal, 1989) to hundred (Sharma and Sharma, 1981) per cent of the consumers rupee. The consumers also got vegetables of much cheaper rates than through any other channel.

Marketing of fruits and vegetables pose peculiar problems not commonly met with other commodities, because of their special characteristic such as highly perishable nature, high moisture content, seasonality, bulkiness and easy susceptibility for damage due to rough handling (Narayanasamy and Reddy, 1988).

Grover (1991) pointed out that the trade practices in most of the markets which were largely unregulated are advantageous to the middle men. In the absence of sufficient marketing credit, producers were unable to get better prices for their produce and the trader takes advantage of the situation.

The problems began with grading and packing of perishables. The labour and materials are not available in time at desired place and at reasonable price (Mehta, 1982

and Sikha and Swarup, 1989). There was a wide gap (34.29 per cent) between the price paid by the consumer and price received by the producers (Kalyankar and Rajmane, 1987).

Preharvest contractors play an important role in the marketing of fruits. They may sell directly to retailers but more often through commission agents in the distribution market (Rana, 1984).

Subrahmanyam (1986) opined that the need for money seems to be the major reason for selling to pre harvest contractors in case of small and medium size group of mango orchardists whereas lack of interest and time seems to be the major reason in the case of large size group of orchardists. Hugar et al., (1983) studied the costs and margins in marketing of brinjals. It was found that wholesaler price was higher when the lots sold through co-operative society.

To provide fruits to the consumer at reasonable prices, and to increase the fruit growers profit, regulated markets should be introduced for selling fruits (ICAR, 1987).

#### **E. Role of training to overcome post harvest losses and improve the consumption pattern**

To introduce agricultural and household innovations, farm women are equally important as those of farmers to be

educated to bring out desirable change in their behaviour to be effective in the social and economic well being of the family. Studies revealed that the main economic constraints in adoption of farm technologies were scattered small size of holdings, limited resources to purchase inputs, unavailability of labour to carry out work, insufficient irrigation, non availability of loan at proper time and costly outputs. The social problems which the farmer face in adoption of agricultural technology are caste, custom, tradition and religious beliefs, non availability of technical knowledge and information on various topics (Sharma, 1992). Grewal and Johl (1991) observed that people were not quite aware of the new advances in technology due to poor extension support and communications and lack of credit and marketing support.

According to Bhople and Alkapatki (1992) effective training and guidance is required by the farm women for effective performance of farm operations and minimising post harvest operations.

Through training and disseminating post harvest technologies to rural women, advantage to themselves and to an overall rural economy can be brought about (Alam and Sekhon, 1988). Verma and Jain (1988) found that approach with training was effective in imparting knowledge and

skills even to illiterate or semi literate rural women. The training when it was need based helped in creating interest and a favourable attitude.

Prevention of colossal waste of food starting from field level losses before and during harvest till the period of storage, calls for greater attention of all concerned and need to be prevented by combined efforts of farmers, governmental and non governmental agencies which promote agricultural production (Devadas, 1981).

Comprehensive instruction on ways to minimise post harvest food loss is needed at every level, from public officials who make policy to administrators, technicians, extension specialists, the producer at the farm level and the consumer at the home level. Education and training programme must be locally designed and conducted and the most important point is it should be adopted to local needs. National Academy of Sciences (1978) rightly points out that personal training facilitates the integration of activities at the village level, that improve communication between farmers and representative of governments and educational agencies and planning organizations.

Minimising the post harvest losses save the produce which increase the per capita availability of fruits and vegetables. The role of mothers in combating malnutrition

through changing the socio-cultural barriers for good nutrition is vital and unique. The mothers are responsible for the methods adopted for the preparation and serving of food. They play a major part in influencing dietary habits of their husbands, children and other family members. The nutritional status of family members are greatly influenced by the sound knowledge, attitude, beliefs and values passed by the mother (Veenakumar et al., 1989).

Fruits and vegetables are highly perishable and seasonal. They are produced in large quantities in the rural areas, where they go waste due to lack of facility for storage and improper processing. Rural people need the know-how of simple preservation methods to avoid the wastage of seasonal produce. More feasible forms of preservation training is needed. For rural background the processing methods should be simplified with the available facilities (Devadas, 1981).

Food fads and faulty food habits are widely prevalent among the common man in all the countries of the world. There is a need to impart to mothers the correct knowledge of nutrition and point out the dangers of faulty notion regarding nutritive value of foods and ill effects caused by the deficiencies of various nutrients in the diet (Devadas and Easwaran, 1986). Specially trained staff should be

engaged for conducting demonstration in every village and they should be taught the know-how of preserving food stuff.

Home gardening has a vast potential for addressing the food, health and income needs of the people. Household gardens represent a direct cost effective and ecologically sound strategy for tackling the socio-economic and nutritional needs of the poor. To overcome the problems of tribals a self help programme of setting up nutrition garden was initiated by Patil (1988). As a result, the diets of the the tribal families which hither to was of cereals, contained fruits and vegetables.

# Methodology

### III METHODOLOGY

The present study was designed to assess the production, post harvest losses and consumption pattern of fruits and vegetables in the target area and to study the impact of training in reducing the losses and improving the consumption pattern of fruits and vegetables of the target group. The research study was conducted in selected villages of Coimbatore district in the calendar year 1991 and 1993 and the procedure adopted for the study is presented below.

#### A. Preliminary Phase

Steps involved in this phase were

1. Developing the sampling design and rationale for the selection of area and target group
2. Formulation of the tools of data collection and selection of the techniques
3. Survey of production, post harvest losses and consumption pattern of fruits and vegetables

#### B. The Training Phase included

1. Formulation of the training module
2. Imparting the training

#### C. Evaluation Phase included the impact of study in terms of

1. Extent of adoption of improved practices of cultivation

2. Reduction in post harvest losses
3. Improvement in the consumption of fruits and vegetables

#### **A. Preliminary Phase**

##### **1. Developing the sampling design and rationale for the selection of area and target group**

Post harvest losses are of great magnitude in almost every part of the country. All concerted efforts are needed to minimise the post harvest losses at the various stages. Coimbatore district was selected for the study because it has diversified cropping pattern. In addition, the department of horticulture utilizing the available facilities of Tamil Nadu Agricultural University, is working towards the improvement on the production of fruits and vegetables.

##### **a. Selection of the target area**

Coimbatore district consists of 26 blocks. Of these five were urban blocks and one was hill station where there was not any area under production of fruits and vegetables. Hence these six blocks were excluded from the purview of the study. Of the remaining twenty blocks, four were omitted due to their diminutive production of horticultural crops. In consultation with the District Assistant Director of Horticulture, three blocks namely, Anaimalai, Thondamuthur

and Udumalpet were selected as target area because the area under fruits and vegetables cultivation was more in these blocks. Four villages in each block were chosen at random with the help of the Block Development Officer (BDO). Thus selection of the blocks and villages were based on their production of fruits and vegetables. Figure 2 shows the locale of the study area.

**b. Selection of respondents**

The success of any study depends on the selection of sample. Sample design is a definite plan determined before any data is collected for obtaining a sample from a given population (Kothari, 1990). In the present study proportionate stratified random sampling procedure was followed for the selection of respondents, since it ensures that the sample has the same percentage of elements from each stratum as the percentage existing in the population (Glashapp and Poggio, 1985).

To select the sample for the study on production and post harvest losses of fruits and vegetables, a list of farmers cultivating fruits and vegetables was prepared with the help Village Administrative Officer (VAO) in all the selected villages. Based on land holding, farmers were categorised into marginal (0-1 ha), small (1-2 ha), semi-medium (2-4 ha), medium (4-10 ha) and large ( > 10 ha)

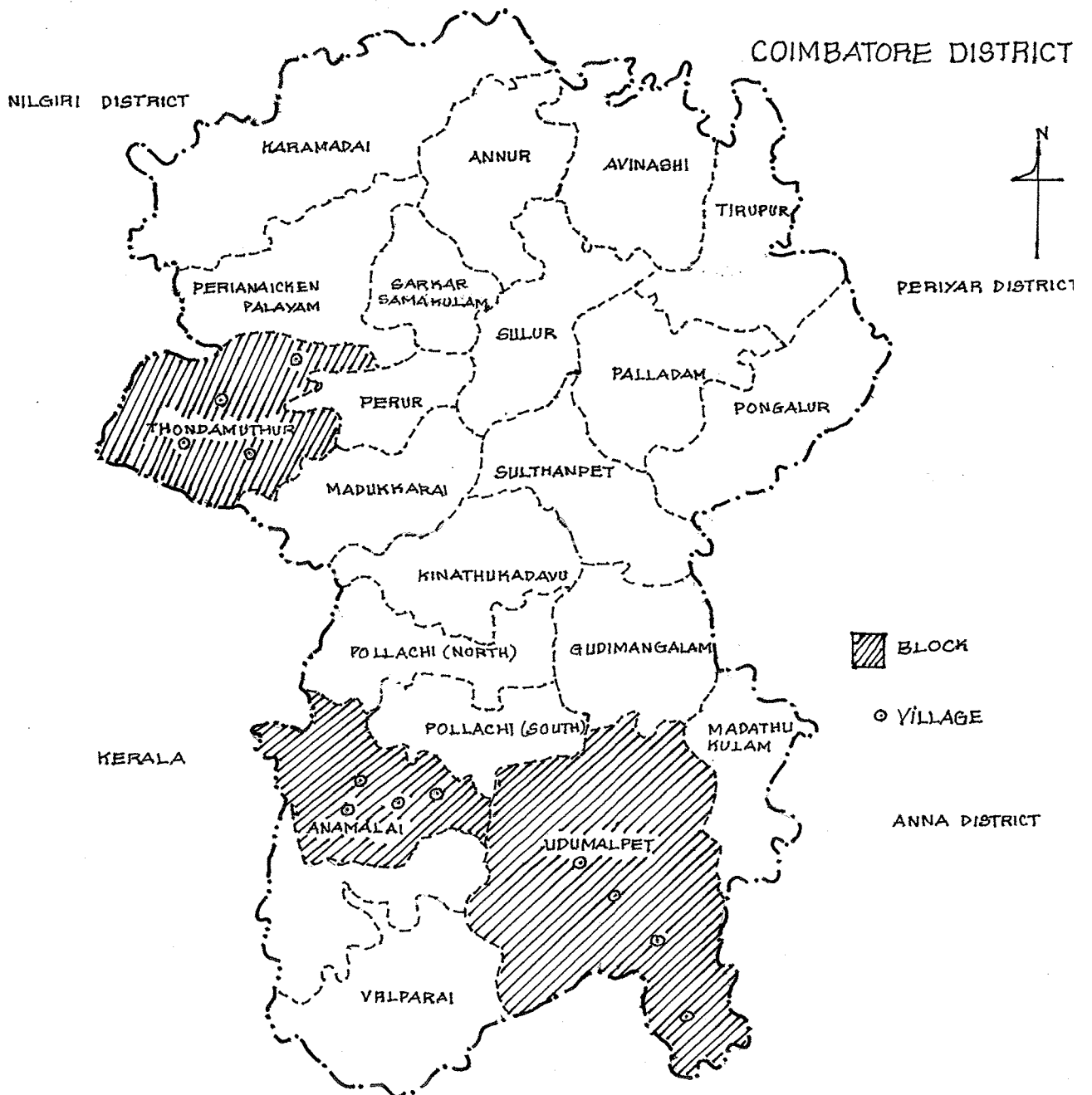
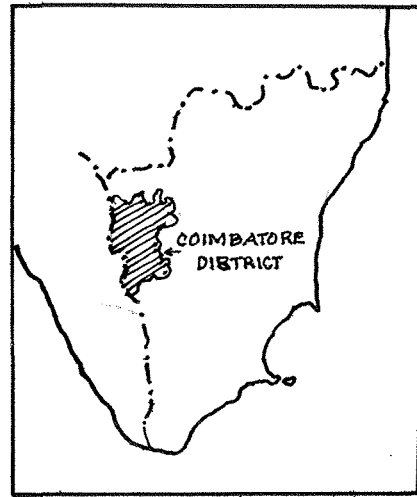
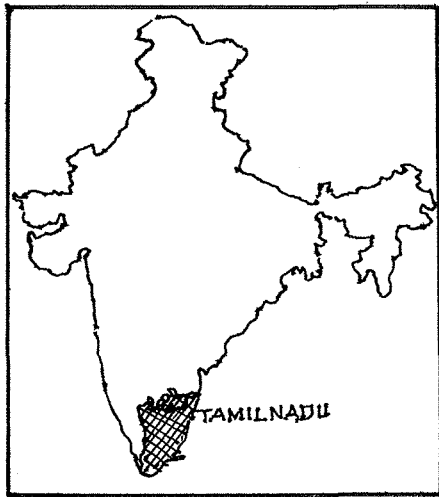


Fig. 2 LOCALE OF THE STUDY

farmers (Government of India, 1988). Thirty per cent of the farmers which amounted to 365 were selected by stratified random sampling method from the universe. These 365 farmers belonged to the various land holding as follows.

marginal - 36	medium - 108
small - 90	large - 40
semi-medium - 91	

The list of villages selected in each block and the numbers of farmers selected in each village is appended (Appendix B).

To study the consumption pattern of fruits and vegetables, two groups of farm households were selected. The first group consisted of the similar group of 365 farmers who were studied for production figures and post harvest losses. These were the gardeners households producing fruits and vegetables. The second group consisted of 365 farm households from the selected 12 villages who did not cultivate fruits and vegetables constituting the non gardeners households. The consumption pattern of fruits and vegetables was studied in these two groups of gardeners and non gardeners who were classified based on family monthly income level as low (< Rs. 2,000), lower-middle (Rs. 2001-5000), upper-middle (Rs. 5001-10,000) and high (Rs. > 10,000) income groups (Subramanian, 1990).

## 2. Formulation of the tools of data collection and selection of the techniques

Surveys are the basic techniques in research for the purpose of obtaining more information on the specific problems within the community (ICMR, 1991). Survey technique was selected for data collection for which two types of interview schedules were constructed by the investigator. To collect first hand information related to production, post harvest losses and consumption pattern of fruits and vegetables, a personal contact with the respondents is required. Hence through the personal interview method, the investigator collected data by using the pre structured interview schedules. The personal interview method permits establishment of greater rapport and stimulates the respondent to give more complete and valid responses (Palanisamy and Manoharan, 1990).

The interview schedule on production and post harvest losses of fruits and vegetables included information on socio-economic profile, land holding and cropping pattern, production figures, post harvest losses and marketing pattern.

Another interview schedule framed to study the consumption pattern of fruits and vegetables comprised of socio-economic profile and consumption pattern of fruits and

vegetables - frequency of consumption, place of purchase, methods of cooking, storage and preservation.

The mean daily intake of fruits and vegetables was determined on a subsample of 20 per cent of the households each from the four income categories. Thus 80 gardeners households and 80 non gardeners households formed the subsample to study the consumption pattern. A 24 hour recall method was followed to assess the fruits and vegetables consumption.

### **3. Survey on production, post harvest losses and consumption pattern of fruits and vegetables**

Survey on the production and post harvest losses of the target families was conducted for five months between December and May, 1991. The field work was carried out in only one village at a time. When the field work was over the investigator moved from one village to the other and one block to the other at a time. Person to person interviewing was done by the investigator using the pre structured interview schedule with the farmers. The interview was conducted at a time which suited the target household and lasted between 30 minutes and one hour per household. Farmers and housewives were contacted for interview generally in the forenoon between 8 A.M. to 2 P.M. In about 80 per cent of the cases the interview was completed by one

sitting, in the rest there were two or three sittings. An average 3-4 farmers were interviewed per day by the investigator.

Survey on consumption pattern of fruits and vegetables of the target households was conducted between June to October 1991. Background information in terms of socio-economic profile, food expenditure pattern, consumption pattern of fruits and vegetables, methods of storage, cooking and preservation followed, place of procurement of fruits and vegetables and knowledge on the role of fruits and vegetables in the day's diet was elicited from the 730 target households through a personal interview method using the pre structured interview schedule. To estimate the mean day's intake of fruits and vegetables, a 24 hour recall method was used requesting the housewives to recollect the quantities of vegetables and fruits used in the family menu for the day (Plate 1).

## **B. Training Phase**

### **1. Formulation of the training module**

Based on the results of the survey and needs of the farmers and housewives, a training module was developed by the investigator with the help of the experts in the fields of Agriculture, Horticulture and Extension.

The aim of the training was to impart simple appropriate technologies to encourage the target group, adopt and sustain them to ensure high production of fruits and vegetables, conserve them and improve their consumption pattern. Table III shows the training module prepared by the investigator. Plate 2 shows the training activities carried out by the investigator.

**TABLE III**  
**TRAINING MODULE**

Venue of training	Day	Salient features	Method	Training staff
<b>Target group - Farmers</b>				
Office of the BDO	1st Day Fore noon	Sharing the personal experience of farmers on the extent and causes of post harvest losses in specific fruits and vegetables		Investigator/
	After noon	Importance of conserving fruits and vegetables after harvest - Methods adopted by the farmers to minimise the losses	Participatory discussion	Agricultural Officer/ Extension Officer
Village	2nd day Fore noon	Sharing the cultivation practices of fruits and vegetables. Guidelines of improved cultivation practices	Lecture with chart, posters Distribution of pamphlets on cultivation aspects of fruits and vegetables	Agricultural Officer Horticultural Officer Investigator
	After noon	Seed treatment	Lecture with field demonstration	- -
	3rd day Fore noon	Plant protection measures to minimise the yield loss due to pests, insects and microbes	Models of diseases and disorders of fruits and vegetables	Horticultural Officer/ Village level worker Investigator
	After noon	Demonstration of methods of using plant protection chemicals	Field visit identifying the diseases and disorders of fruits and vegetables methods to control them	
Village	4th day Fore noon	Problems encountered in cultivation of fruits and vegetables suggestions	Participatory discussion	
	After Noon	Methods of reducing post harvest losses. Time and method of harvesting. Importance of sorting/grading - Method of packing	Lecture, Participatory discussion	Investigator Agricultural Officer Extension Officer

**Target group - Housewives**

Village	1st Day Fore noon	Importance of fruits and vegetables in a day's diet - view points of the housewives	Lecture with posters and charts and exhibit- ing desirable quantities of fruits and vegetables in a days diet	Investigator
	After Noon	Sharing the personal experience of housewives on their consumptions pattern of fruits and vegetables - Deficits, Methods to fill up the gap	Participatory discussion	Investigator
	2nd day Fore noon	Desirable methods of cooking vegetables - guidelines, nutrient content of cooked vegetables	Lecture with demonstration	Investigator
	After noon	Need for nutrition garden in home, school and community	Tips for model kitchen garden, Distribution of seeds and pamphlet	Investigator
	3rd day Fore noon	Need for extending shelf life of fruits and vegetables methods adopted - sharing experience with housewives housewives.	Participatory Discussion	Investigator
			Mud storage device and zero energy cool chamber	Demonstration
	After noon	Preparation of jam squash and pickle	Demonstration Distribution of pamphlet	Investigator

---



Lecture cum Discussion



Lecture cum Discussion



Demonstration

## **2. Imparting the training**

The timings of the training were fixed to suit the convenience of the farmers and housewives. The response from the farmers was encouraging and they ensured great interest in learning the skills through their effective participation both at the block and village levels. However, increased production of fruits and vegetables alone does not ensure increase in the consumption pattern. Hence the housewives of both gardeners and non gardeners families were imparted knowledge and skill on the importance of fruits and vegetables on a day's diet, methods of cooking, storage and preservation of fruits and vegetables. The training was conducted in selected blocks in the following order viz., Thondamuthur, Anaimalai and Udumalpet.

Block Development Office and farm formed the venue for the block level and village level training to the farmers while the conveners of the women's working group ('Mahila Mandals') helped the investigator for conducting the training in a home, school or temple. Materials distributed to the farmers and housewives are given in Appendix E.

## **C. Evaluation Phase**

Evaluation is defined as the process by which information relevant to decision making can be obtained from a programme, analysed and interpreted (Kurien, 1991). The

impact of the training was evaluated using the following pointers after six months of training.

1. Extent of adoption - number of farmers adopting the techniques given by the training such as recommended varieties, seed treatment, plant protection measures using the interview schedule.
2. Reduction in post harvest losses of fruits and vegetables - using the same interview schedule.
3. Nutritional knowledge of housewives on importance of fruits and vegetables in a day's diet. Schedule used for prior training was used again.
4. Daily intake of fruits and vegetables after the training by 24 hour recall method.

# Results and Discussion

## IV RESULTS AND DISCUSSION

Horticultural crops are highly perishable and therefore losses occur at different stages of crop growth and post harvest handling. It is therefore important to provide proper support system and infra structural facilities to the farmers both during pre and post harvest operations. Reducing losses during harvesting and post harvest processing of fruits and vegetables is a very effective way of increasing their availability to population groups. The results obtained from the present study are presented, analysed and discussed in this chapter under the following headings:

### A. Data obtained on base line survey

1. Socio-economic profile of the selected farmers
2. Pattern of land holding and cropping
3. Production figures and post harvest losses of fruits and vegetables
4. Marketing pattern of fruits and vegetables
5. Pattern of consumption of fruits and vegetables by the selected households

### B. Impact of training in terms of

1. Extent of adoption of cultivation practices
2. Improvement in production
3. Reduction in post harvest losses
4. Improvement in consumption pattern of fruits and vegetables

### A. Base line survey

Results obtained by the base line survey is discussed as follows

#### 1. Socio-economic profile of the selected farmers

##### a. Size of land holding

Table IV shows the distribution of selected farmers according to their land holdings.

TABLE IV  
DISTRIBUTION OF FARMERS ACCORDING TO THEIR LANDHOLDINGS

Farmer's Category *	Thondamuthur Block	Anaimalai Block	Udumalpet Block	Total
No. of farmers				
Marginal (0-1 ha)	20	4	12	36 (9.36)
Small (1-2 ha)	41	26	23	90 (24.65)
Semi-medium (2-4 ha)	33	23	35	91 (24.93)
Medium (4-10 ha)	24	45	39	108 (29.58)
Large (> 10 ha)	8	18	14	40 (10.95)
<b>Total</b>	<b>126</b>	<b>116</b>	<b>123</b>	<b>365</b> <b>(100.0)</b>

ha - hectares

percentage in parenthesis

\* - Based on Government of India (1988)

Among the 365 farmers surveyed, the marginal and large farmers were 9.4 and 10.9 per cent respectively. The maximum percentage (29.58) of farmers were under the group of medium land holdings. The size of holding influenced to a great degree the production and marketing decisions of the farmers. The average land holding size of the target group was found to be 4.1 hectare as compared to the average land holding size of Tamil Nadu State and Coimbatore district where it was 1.1 and 2.2 hectare respectively (Government of Tamil Nadu, 1991).

**b. Educational and economic status**

Data on educational and economic status of the selected farmers is presented in Table V. Figure 3 illustrates the educational status of the selected farmers.

TABLE V

## EDUCATIONAL AND ECONOMIC STATUS OF THE TARGET GROUP

Educational and Economic status	Farmer's category					Total n=365
	Marginal n=36	Small n=90	Semi medium n=91	Medium n=108	Large n=40	
<b>Educational status</b>						
Illiterate	19 (52.8)	13 (14.4)	15 (16.5)	18 (16.7)	2 (5.0)	67 (18.3)
Elementary	10 (27.81)	36 (40.0)	28 (30.7)	27 (25.0)	4 (10.0)	105 (25.8)
High school	3 (8.3)	11 (12.2)	24 (26.4)	36 (33.3)	9 (22.5)	83 (22.7)
Higher secondary & College	4 (11.1)	30 (33.3)	24 (26.4)	27 (25.0)	25 (62.5)	110 (30.1)
Educational status Vs land holding <sup>2</sup> = 71.0**						
<b>Economic status @</b>						
Low income ( < Rs. 2000)	34 (94.5)	77 (85.5)	14 (15.4)	-	-	125 (34.2)
Lower-middle (Rs. 2001-5000)	2 (5.5)	13 (14.5)	62 (68.1)	50 (46.3)	5 (12.5)	132 (36.2)
Upper-middle (Rs. 5001-10,000)	-	-	15 (16.5)	49 (45.4)	20 (50.0)	84 (23.0)
High-income ( > Rs. 10,000)	-	-	-	19 (8.3)	15 (37.5)	24 (6.6)

@ Classification based on Subramanian (1990)  
 Figures in parenthesis indicate percentage

\*\* Significant at 1 per cent



The educational status of the farmers plays an important role in productivity aspects. Farmers' education is found to positively affect the adoption of new farm technologies, a finding which is consistent with numerous other studies (Strauss et al., 1991). Duraisamy (1992) rightly points out that education has a positive and significant effect on single and multiple crop production.

Illiteracy was higher to the tune of 52.8 per cent among the marginal farmers followed by medium and semi-medium whereas only five per cent of the large farmers were found to be illiterate. It is encouraging to note that 62 per cent of the large farmers were graduates or post graduates. The results of chi-square test indicated that the relationship between land holding and educational status was found to be significant at one per cent level.

In the agrarian societies, land holdings and crops grown provide a measure of people's economic status which inturn is known to influence their health and nutritional status (Gowrinath Sastry et al., 1988). According to the family monthly income the farmers were categorised into low, lower-middle, upper-middle and high income groups based on the classification of Subramanian (1990). Majority of the marginal (94.5%) and small farmers (85.5%) belonged to the low income group and only a 5.5 and 14.5 per cent were in

lower middle group. Forty-five per cent of the medium farmers belonged to the lower middle and upper middle each and only 8.3 per cent belonged to high income group. Half of the large farmers belonged to upper middle income group followed by high income. Landholding had a positive influence on the economic status of the farmers.

### **C. Occupational status**

Analysis of the main occupational composition of the selected farmers revealed that for 92.6 per cent of the selected farmers, cultivation was the main occupation and the remaining were mainly engaged in non-agricultural and agricultural labour, business and service. With regard to subsidiary occupation, of the 365 farmers surveyed 86 per cent farmers had no subsidiary occupation at all. For marginal and small cultivators, the income from farming, which is a traditional occupation for them was meagre and hence they had secondary occupation such as non-agricultural labour and petty shops.

## **2. Pattern of land holding and cropping**

### **a. Land kept uncultivated and reasons**

The observations recorded in Table VI provide information about the percentage of land kept uncultivated by the farmers.

TABLE VI  
AREA KEPT UNCULTIVATED BY THE FARMERS AND REASONS

Area kept uncultivated (% of total area)	Farmer's Category				
	Marginal n=36	Small n=90	Semi- medium n=91	Medium n=108	Large n=40
0-15	2	7	14	8	2
16-30	3	7	6	16	2
31-45	11	2	5	13	5
46-60	-	2	4	7	-
<b>Reasons</b>					
Water scarcity	16	10	18	20	-
Labour scarcity	-	6	7	12	4
Not profitable	-	-	3	4	5
Engaged in other work	-	2	1	8	-

Relatively a higher percentage of marginal farmers (44.4 per cent) surveyed, kept their land as uncultivated than the farmers belonging to the other categories. Water scarcity was the main reason for the land being kept uncultivated for the majority of the farmers followed by labour scarcity, low profit and being engaged in other work. Since more than half of the cultivable land depends on the mercy of monsoon for irrigation, failure of monsoon affected

the area under cropping and the productivity of the crops too. Figures of Government of Tamil Nadu (1992) point out that the state cultivable waste is 24 per cent to the net area sown mainly due to deficient rain fall.

#### D. Area under Horticultural crops

The percentage of the area under the cultivation of horticultural crops of the total cultivating area based on different land holding is shown in Table VII.

TABLE VII  
AREA UNDER HORTICULTURAL CROPS

Area of Horti- cultural crops (percentage of cropped area)	Marginal n=36	Small n=90	Semi- medium n=91	Medium n=108	Large n=40
No. of farmers					
0-25	8	31	43	60	22
26-50	16	39	35	35	13
51-75	5	9	8	5	-
76-100	7	11	5	8	5

Area under horticultural crops of the total cultivable land was higher among the marginal farmers. One third of the marginal farmers raised horticultural crops on more than 50 per cent of the cultivable land as against 12.5 per cent of large farmers. Marginal and small farmers raised

horticultural crops like tomato and brinjal only for their home needs as these vegetables could be cultivated throughout the year and needed very less maintenance cost. High cost of production, perishable nature of the produce, high fluctuations in the prices and substantial labour requirement have made farmers not to grow these crops on large scale which is reflected by the area under cultivation.

### C. Cropping pattern

Cropping pattern indicates the area under different crops as sown/cultivated by the farmers. Cropping pattern is influenced by factors such as soil, size of land holdings, climate, rainfall, sunshine, availability of agricultural resources and income. Only the crops which suited the natural conditions of that area were raised.

Paddy (Oriza sativa) was the principal crop grown in the target area, in the river belts and wherever water resources were in abundance with the high yielding varieties, since the climatic condition and soils of Coimbatore are congenial for growth of paddy. Other cereals cultivated were jowar (Sorghum vulgare), ragi (Eleusine coracana), bajra (Pennisetum typhoideum) and maize (Zea mays). Thenai (Setaria italica) and samai (Panicum miliare) were cultivated in a meagre area.

In pulses, green gram (Phaseolus aureus), red gram (Cajanus cajan) and black gram (Phaseolus mungo) and groundnut (Arachis hypogaea) were cultivated as dry land crops.

The fruits and vegetables grown in the target area, variety used and their sowing and harvesting season are given in Table VIII.

TABLE VIII

## FRUITS AND VEGETABLES GROWN IN THE TARGET AREA

Common Name	Scientific Name	Varieties grown	Season	
			Sowing	Harvesting
Acid lime	Citrus aurantifolia	PKM I	June-Dec	June-Sep
Banana	Musa paradisiaca	Rasthali, Poovan Robusta, Nadan Sambarani	June-July	Nov-Dec
Grapes	Vitis Vinefera	Paneer, Seedless	Jan-Mar	July-Feb
Guava	Psidium guajava	Banarasi Seedless, Lucknow 49	Jan-Dec	Aug-Jan
Mango	Mongifera indica	Neelam, Bangalora	June-Dec	Apr-June
Sapota	Archas sapota	Cricket ball, Banarasi	June-Dec	Apr-June
Brinjal	Solanum melongena	Co <sub>1</sub> , Co <sub>2</sub> , PKM <sub>1</sub>	Apr-Sep	June-Nov
Cabbage	Brassica oleracea,	Maharani, Ganesh	Aug-Oct	Nov-Jan
Cauliflower	Brassica oleracea,	Double cross	Aug-Oct	Nov-Jan
Lady's finger	Abelmoschus esculentus	Pusavani, Co <sub>32</sub> , Pusa <sub>7</sub>	Mar-May	May-July
Onion	Allium cepa	Co <sub>1</sub> , Co <sub>2</sub> , Bellari	Apr-May	July-Sep
Snake gourd	Trichosanthes anguina	Co <sub>1</sub> , Co <sub>2</sub> , PKM <sub>1</sub>	Dec-Jan	Feb-Mar
Tomato	Lycopersicum esculentum	Col, Co <sub>2</sub> Pusaruby	Apr-Sep	June-Nov

Among the above mentioned fruits and vegetables, fruits namely banana, grapes, guava and mango and vegetables, such as brinjal, lady's finger, tomato and onion were selected to study the production and post harvest losses as they were commonly cultivated by most of the selected farmers in the target area and the area under them were larger compared with the remaining. Area under cultivation of these fruits and vegetables in the target area and by the group is given in Appendix - F.

Area under the cultivation of selected fruits and vegetables by the different land holding categories and the number of farmers cultivating each fruit and vegetables is presented in Table IX.

TABLE IX  
AREA (ACRE) UNDER SELECTED FRUITS AND VEGETABLES

Name of the fruit/ vegetable	Farmer's category					Total
	Marginal	Small	Semi-medium	Medium	Large	
Area in acre						
Banana	1.0 (2)	7.5 (8)	10.3 (7)	21.9 (14)	32.0 (4)	72.7 (35)
Grapes	0.3 (1)	14.0 (10)	27.5 (12)	63.5 (22)	24.5 (9)	129.8 (54)
Guava	0.5 (1)	4.0 (3)	3.2 (4)	8.3 (9)	23.7 (5)	39.7 (22)
Mango	0.8 (4)	2.3 (12)	7.3 (22)	43.5 (41)	104.5 (22)	158.4 (101)
Brinjal	0.5 (1)	5.0 (8)	7.3 (7)	14.5 (10)	13.5 (7)	40.8 (33)
Lady's finger	3.2 (6)	7.9 (15)	6.0 (9)	8.7 (9)	9.0 (7)	34.8 (46)
Onion	10.3 (9)	30.7 (19)	41.0 (19)	54.1 (14)	41.5 (8)	177.6 (69)
Tomato	9.9 (15)	32.8 (40)	44.3 (36)	55.7 (38)	29.5 (14)	172.2 (143)

Figures in parentheses indicate number of farmers cultivating.

Area under cultivation of mango and grapes was found to be higher compared to banana and guava. Since growing grapes is highly capital intensive, farmers with adequate financial resources cultivated it. Fragmentation of land holding, long

duration of fruit crops and capital intensive nature of their management had made marginal and small farmers not to grow mango, banana and guava, whereas being of short duration, vegetable crops allowed them enough scope for increasing the intensity of cropping.

In Tamil Nadu area under the cultivation of banana, mango, guava and grapes occupied 43.5, 39.8, 3.6 and 1.4 per cent of the total area under fruits cultivation. Among vegetables area under cultivation of tapioca was found to be the highest (50 per cent) followed by onion, brinjal and tomato respectively of 15.0, 4.8 and 10.9 per cent (Government of Tamil Nadu, 1992).

Medium and large farmers felt that fruits have the capacity to yield more per unit area, pay quickly and the net return obtained was high as compared to many cereal crops.

### **3. Production Figures and Post Harvest Losses of Selected Fruits and Vegetables**

#### **a. Production of selected fruits and vegetables**

The average production of selected fruits and vegetables in tonnes per acre is given in Table X and Figure 4 and 5.

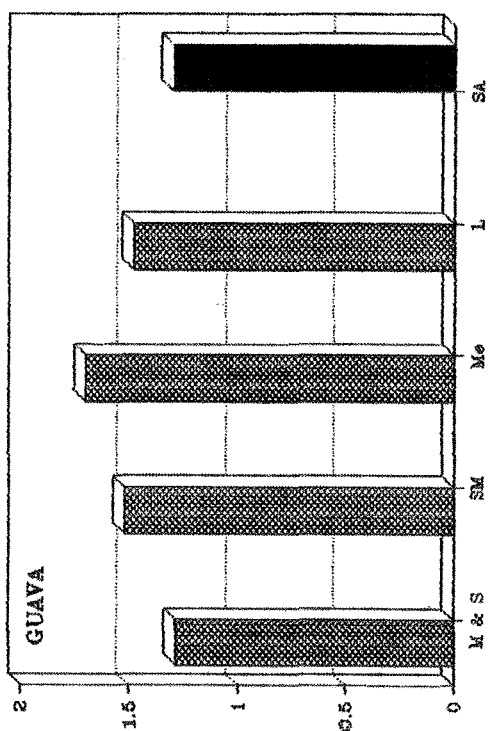
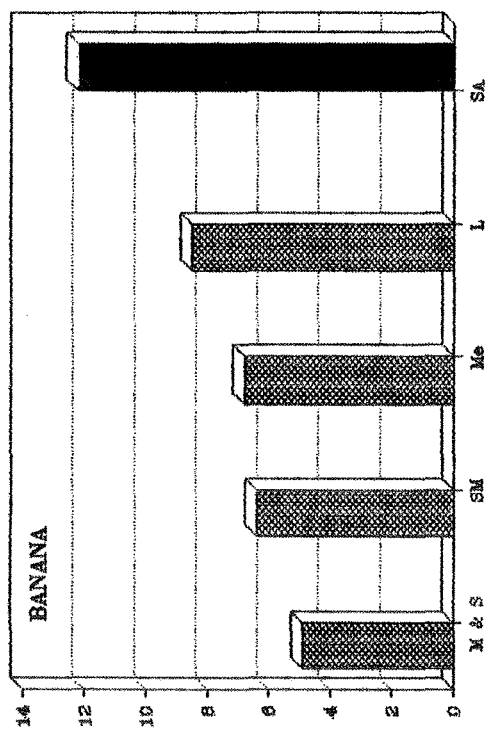
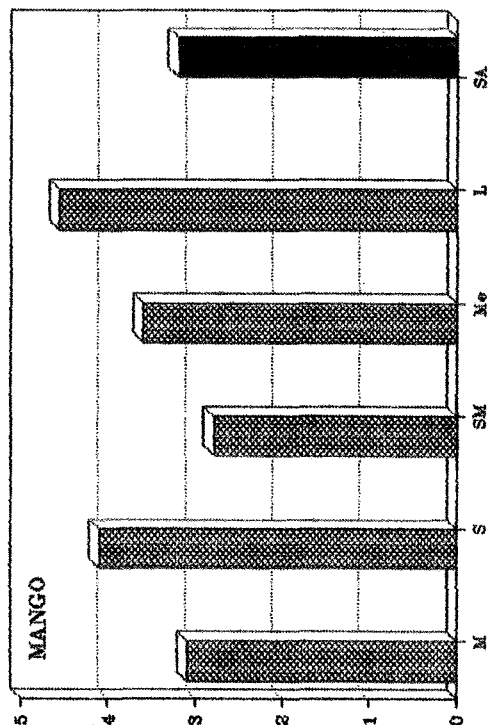
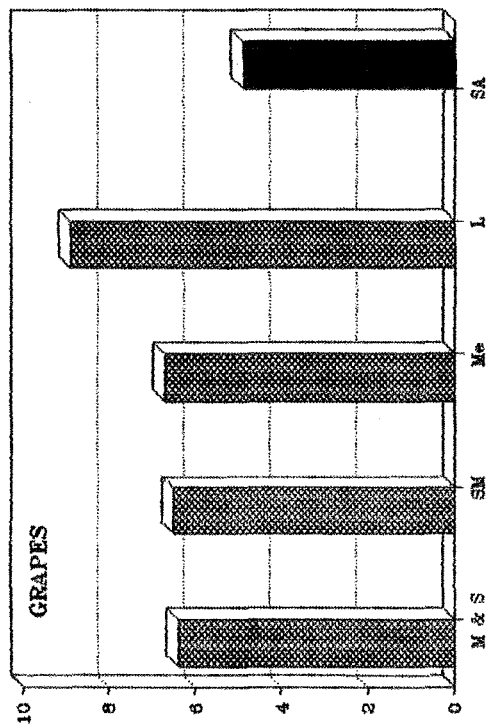
TABLE X  
AVERAGE PRODUCTION RATE OF FRUITS AND VEGETABLES AMONG THE TARGET  
GROUP

Farmer's Category	Banana	Grapes	Guava	Mango	Brinjal	Lady's finger	Onion	Tomato	Target
Marginal	-	-	-	3.10	-	1.62	5.82	2.03	
Small	4.91	6.34	1.29	4.07	2.47	1.18	6.30	2.06	
Semi-medium	6.37	6.50	1.52	2.88	2.75	1.57	6.48	2.18	
Medium	6.82	6.72	1.72	3.66	2.47	1.37	5.67	2.20	
Large	8.45	8.16	1.48	4.56	2.85	1.59	6.14	2.29	
Average production rate of Tamil Nadu	12.17	4.91	1.32	3.23	3.67	3.46	5.45	3.36	
'F' value	6.44**	3.42*	0.42 NS	6.41**	1.39 NS	0.49 NS	0.99 NS	0.31 NS	

\*@ Government of Tamil Nadu (1991) NS - Not Significant

\* Significant at 5 % level

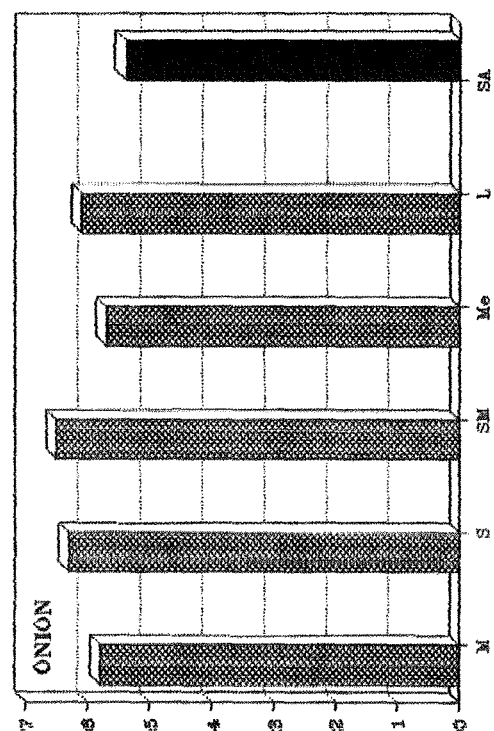
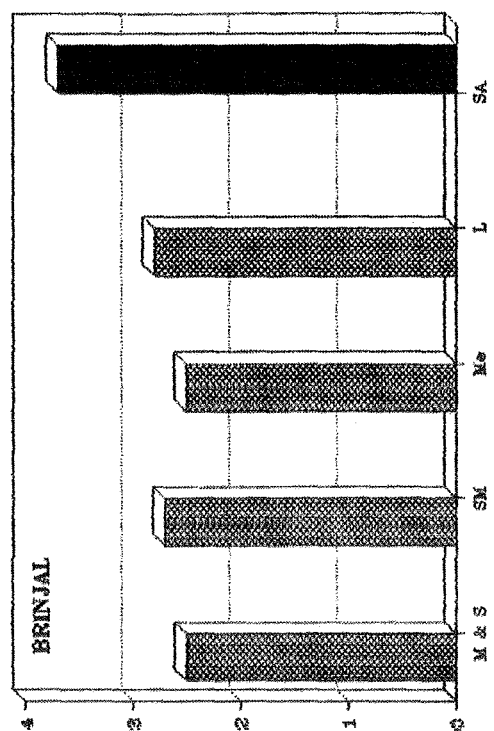
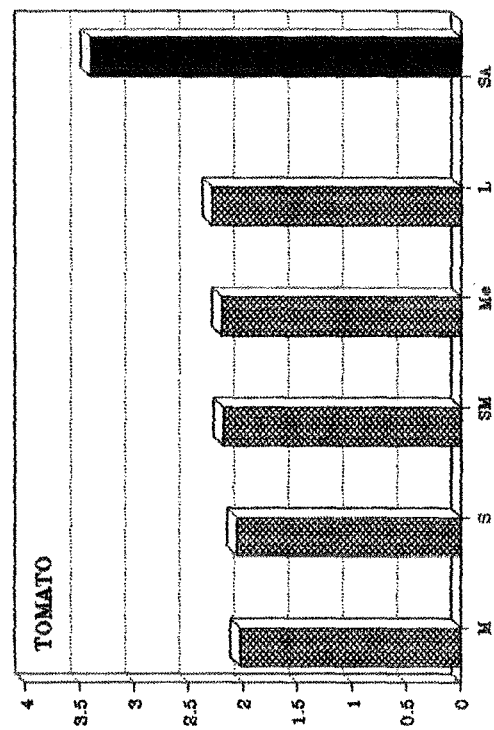
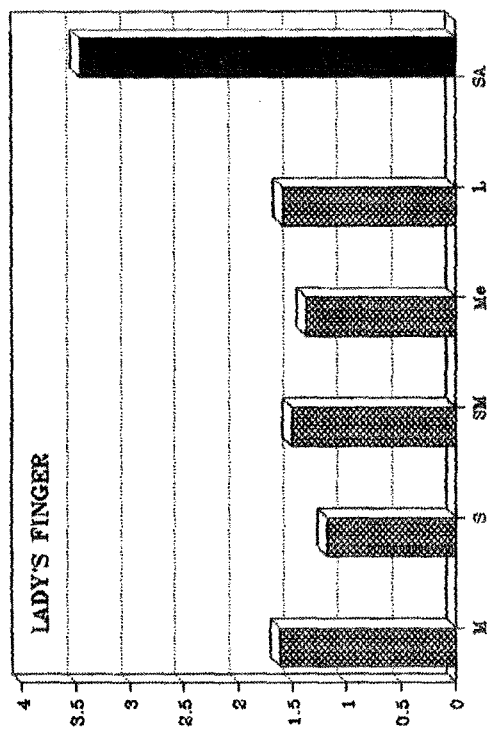
\*\* Significant at 1 % level



PRODUCTION IN TONS PER ACRE

M-Marginal S-Small SM-Semi-Medium Me-Medium L-Large SA-State average

Figure 4 PRODUCTION RATE OF SELECTED FRUITS



PRODUCTION IN TONNES

PER ACRE

M-Marginal S-Small SM-Semi-Medium Me-Medium L-Large SA-State average

Figure 5 PRODUCTION RATE OF SELECTED VEGETABLES

The average productivity of grapes, guava and mango of the target farmers was higher when compared with the state average productivity. In vegetables, the mean productivity was found to be lesser than the state average yield except onion.

Since the number of marginal farmers growing banana, grapes, guava and brinjal were either one or two, while analysing the data statistically, the categories of marginal and small farmers were grouped together.

Statistical appraisal indicated that land holding size significantly affected the production of fruits except guava. Because of limited resources at their command, marginal and small farmers were not in a position to make use of new technologies such as hybrid varieties and plant protection methods. On the other hand, they stick on to growing traditional cultivars with low yields.

Medium and large group progressive farmers, on the other hand adopted the latest technologies for modernizing their production with improved varieties and recommended fertilizers, pesticides and insecticides. This enabled them to enhance the production rate.

In vegetables, statistically there was no significant difference between the different land holdings and

production. The reasons attributed to low productivity were inadequate irrigation facilities, less reliable irrigation, high price of fertilizers, plant protection chemicals, and quality seeds. Farmers with tiny land holdings were not in a position to bear even production costs of traditional techniques.

In view of the above facts, the target group was trained on improved cultivation techniques, such as suitable varieties for each crop, seed treatment, spacing, use of manures and recommended fertilizers to improve the productivity.

To study the relationship between education, income and years of experience of farmers in cultivation of horticultural crops on productivity, correlation analysis was carried out and the results are presented in Table XI.

TABLE XI

COEFFICIENT CORRELATION BETWEEN PRODUCTION OF SELECTED FRUITS AND VEGETABLES AND EDUCATION, INCOME AND YEARS OF EXPERIENCE OF THE FARMERS

Co-efficient correlation (r) values for								
Variables	Banana	Grapes	Guava	Mango	Brinjal	Lady's finger	Onion	Tomato
Production Vs Education	0.51	0.13	0.36	0.23	0.92	0.29	0.04	0.36
Production Vs Percapita income	0.26	0.49	0.22	0.43	0.52	0.40	0.40	0.32
Production Vs Years of experience	0.54	0.08	0.23	0.12	-0.07	0.07	0.07	0.43

The results obtained from the correlation analysis show that the educational status, per capita income and the years of experience of the farmers were positively related with the production of banana, grapes, guava and mango. Duraisamy (1992) had observed similar trends that education has a positive and significant effect on single and multiple crop production.

Productivity of brinjal, tomato and onion was positively related with the educational status and per capita income of the farmers whereas the years of experience of the farmers were correlated negatively. Bhaskar (1993) indicates that poverty and illiteracy along with the traditional outlook of farmers are the two important factors leading to low productivity. Economic status, educational status, family size and farm size were found to correlate with adoption of modern technologies as per Murthy (1981).

Selected marginal and small farmers considered the new technologies as input intensive, management intensive and risk prone and hence they shy away from it. Hence in the training curriculum particular efforts were taken to enlighten them on taking advantage of the subsidy rate hybrid seeds, fertilizers and pesticides. The farmers were motivated to practise the new technologies to improve the productivity of fruits and vegetables.

The average annual production of selected fruits and vegetables is given in Table XII.

TABLE XII  
AVERAGE ANNUAL PRODUCTION (TONNES) OF THE SELECTED  
FRUITS AND VEGETABLES

Fruit/ Vegetables	Marginal (0-1 ha)	Small (1-2 ha)	Semi- medium (2-4 ha)	Medium (4-10 ha)	Large (>10 ha)
Banana	5.00	36.00	63.61	141.36	270.4
Grapes	5.40	178.64	532.25	1280.16	599.76
Guava	1.60	7.04	8.45	25.89	74.42
Mango	2.48	9.36	21.02	159.21	476.52
Brinjal	1.40	13.05	40.15	71.63	76.95
Lady's finger	5.18	9.32	18.84	23.84	28.62
Onion	59.95	193.41	265.68	306.75	254.81
Tomato	20.10	67.56	224.32	245.08	135.11

The production of guava was found to be lower compared to other fruits because area under cultivation of guava was low. Except grapes and guava other fruits were harvested yearly once in the target area. Grapes were harvested yearly twice or thrice by the selected farmers. Guava was harvested twice a year by all the guava growers.

In vegetables, the production of brinjal was the lowest. Marginal and small farmers raised the vegetable crops yearly once due to water shortage, and thus their production was low. On the other hand, medium and large farmers raised vegetable crops yearly twice and obtained the maximum production.

**b. Post harvest losses of selected fruits and vegetables**

Pre harvest factors such as cultivar selection and fertilizer application play a significant role in the post harvest losses of fruits and vegetables. Post harvest losses occurred due to improper handling, transport, storage and marketing of fruits and vegetables. Principal causes of losses were mechanical injuries, wilting, water loss, shrivelling, bruising, improper curing, over ripening, over maturity sprouting, rooting and decay.

The mean percentage of post harvest losses of the selected fruits and vegetables is given in Table XIII.

TABLE XIII  
 MEAN POST HARVEST LOSSES (%) OF SELECTED FRUITS AND VEGETABLES

Farmer's Category	Per cent post harvest losses							
	Banana	Grapes	Guava	Mango	Brinjal	Lady's finger	Onion	Tomato
Marginal	-	-	-	14.25	-	14.83	15.33	16.53
Small	19.60	15.22	18.75	10.81	15.20	10.33	13.10	13.72
Semi-medium	13.28	13.57	12.50	6.59	13.57	9.22	8.89	13.27
Medium	11.86	9.10	10.00	5.95	9.10	7.33	7.64	10.50
Large	7.25	9.71	8.40	5.18	9.71	5.43	9.13	10.36
'F' value	7.12 <sup>**</sup>	1.38	7.45 <sup>**</sup>	17.15 <sup>**</sup>	4.07 <sup>*</sup>	5.10 <sup>**</sup>	9.99 <sup>**</sup>	11.30 <sup>**</sup>
				NS				

\* Significant at 5 % level

\*\* Significant at 1 % level

NS - Not Significant

Post harvest losses were significantly higher among marginal and small farmers as against other categories in all the fruits and vegetables selected. Marginal and small farmers were found to hardly use pesticides and weedicides on their farms due to economic constraints and the untimely supply of pesticides. As a result of low diffusion of plant protection measures farmers endured heavy crop losses. These findings confirm with findings of Pandya (1981). Since most of the small and medium farmers lived in a cycle of poverty, they did not have much capital for heavy investment in better management.

Table XIV shows the causes and extent of losses in fruits and vegetables.

TABLE XIV

CAUSES OF POST HARVEST LOSSES

Causes	Ranking of causes by the Farmers			Extent of Losses in Percentage
	Marginal	Semi-medium	Large	
1. Improper Harvesting	VI	V	VII	2-5
2. Rough handling	VII	V	VI	2-5
3. Pests and insects	I	II	IV	5-20
4. Crop Disease	III	I	V	5-10
5. Improper packing	V	VI	III	5-10
6. Poor transport	IV	VII	II	2-10
7. Climatic condition	II	III	I	5-10

Losses in fresh produce are on account of several factors or a combination of natural as well as man made factors. Improper harvesting and handling led to losses which ranged between zero and ten per cent. Hence the farmers were trained with proper time of harvesting and method of handling fruits and vegetables. Losses in the selected fruits and vegetables due to insects, pests and diseases were found to the extent of 0-20 per cent. Present finding is in conformity with the results reported by Chadha (1985) and Ukey et al., (1991). Reduction of such losses results in increased production per unit area. Plant protection schedules to control the major pests and diseases of fruits and vegetables have been worked out in terms of the concentration of plant protection chemical to be used, frequency of spraying and prophylactic measures have been recommended to minimise the losses.

Fruits and vegetables being highly perishable, are much prone to losses after harvest. Adverse environmental conditions prevalent in the garden such as strong wind/untimely rains/mist resulted in losses of 10-20 per cent. Packing brinjal and lady's finger in gunny bags and bamboo baskets registered 0-10 per cent loss. Similar results were observed by Dalal (1988).

Improper harvesting and packaging led to considerable damage during transportation of the produce. Hence the

farmers were trained to introduce proper harvesting, handling, grading, packing and transportation to minimise the losses.

#### **4. Marketing pattern of fruits and Vegetables**

##### **Marketing Pattern**

All the selected fruits and vegetables except onion were sold to the market immediately after harvesting, retaining a portion for home needs. The marginal and small farmers generally received Rs. 1.00 to 1.50 less per kg of the produce when compared to the other categories because of their financial commitments resulting in forced and early sales, rendering it uneconomical to transport to distant markets. Advantages of this fact is taken by local businessmen to buy all the produce from marginal and small farmers and send them to the distant markets where they can profit. Plate 3 shows the marketing practices of the target group.

##### **Banana**

Harvested bunches of bananas were transported by lorries, tempos and handcarts with or without protective padding of banana leaves if the fruits is to be marketed at far off cities or towns. Out of 35 banana growers only three large farmers possessed smoke rooms where they kept the banana bunches for ripening for two days and then they sent



Grading



Packing



Hauling

them to the markets. When the farmers sold it in the local market they faced severe intermediaries who purchased it for a lower price and thereby the margin of the grower reduced. In open auction sale the growers faced stiff competition from others and thereby the price fluctuated. This is in conformity with the finding of Vigneshwara (1986).

#### **Guava**

The harvested fruits assembled in the field and the rotten and diseased fruits were separated. The rest were packed in bamboo baskets and marketed. It was observed that grading according to size was not done by the farmers because the farmers marketing as such would fetch the profit.

#### **Grapes**

In the study region normally three harvestings per year were made and the fruits were harvested in stages with an interval of 4-7 days. The produce were assembled in the orchard itself and the rotten and injured fruits were removed. The fruit bunches were packed in bamboo baskets. The size of baskets varied from eight to twenty kg depending upon the distance and mode of transport. The transport cost varied depending upon the distance of the market places. The loading and unloading charges were met by the farmers themselves except in Udumalpet Block where the charges were equally shared by the farmers and the commission agents. In

Thondamuthur Block the pre harvest contractors from Kerala come during harvesting time and collect the produce from the field itself.

### **Tomato**

The stage of harvesting depended upon the place of marketing and the quantity produced. If the tomatoes were to be sold in the local markets and produced in smaller quantities they were harvested in the pink stage. If they were to be sold in the distant markets in large quantities they were harvested in the hard green stage. Because of the seasonal production and perishable nature, the whole sale market of tomatoes was highly imperfect and concentrated in the hands of a few large buyers who set the tone of the market as studied by Ramamoorthy et al., (1984).

### **Mango**

After harvest, all the injured, deformed and diseased fruits were separated. The fruits were then graded according to their size. For long distance supply, the fruits were packed in wooden crates while bamboo baskets were used for short distance supply. Medium and large farmers auctioned their orchards to the pre harvest contractors. These contracts were made at the time of flowering and setting of fruits. The packing, transport and handling charges were borne by the purchasing parties. The contractors were

obliged to dispose their fruits at higher price. The rest of the farmers marketed their produce through commission agents.

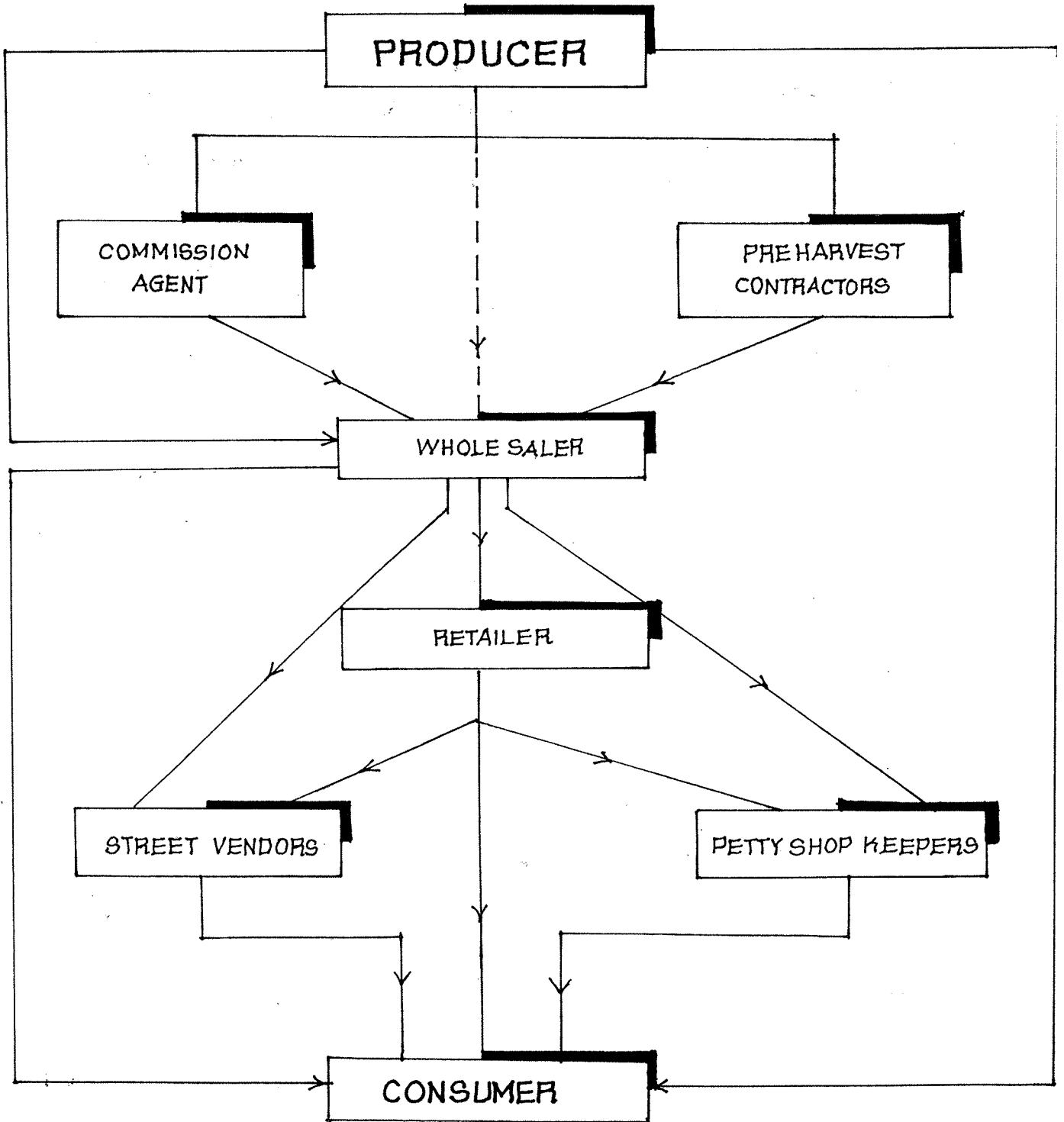
#### **Lady's finger and Brinjal**

Lady's finger and brinjal were packed immediately after harvesting in gunny bags, and in bamboo baskets and sold to the villages/city markets without any grading through commission agents. The produce were also sold directly to the local consumers and the village vegetable vendors. A few farmers sold to the contractors who used to come during the season and made direct contract with the farmers.

The channel of marketing of fruits and vegetables were identified in the study area and is schematically represented in Figure 6.

#### **b. Producer's share in marketing of fruits and vegetables**

Producer's share means how much the farmer gets for his produce from the price paid by the consumer. The general observation made was that the greater the distance covered by the produce, higher will be the price while lesser will be the share of the farmers. It is because the produce passes through two to three agencies and each agency needs its share. The farmer got hundred per cent share when the produce was directly sold to the consumer as he did not invest anything on handling, transport, labour and



AND  
Fig.6 MARKETING CHANNEL OF FRUITS VEGETABLES

marketing. In practical situation this was not possible because the local consumer could not utilize the bulk produce. This is on line with the findings of Sharma and Sharma (1981) and Bhupal (1989). Studies by Nawadkar et al., (1991) showed that the profit of intermediaries margin accounted for quite a large proportion of the price paid by the consumer's in markets of both of Pune and Bombay, Maharashtra.

Table XV shows the mean farmer's share (in percentage) in consumer rupees of selected fruits and vegetables.

TABLE XV  
MEAN PERCENTAGE OF PRODUCER'S SHARE IN CONSUMER RUPEES

Name of the Fruit/ Vegetable	Producer's share in per cent				'F'
	Marginal	Small	Semi-medium	Medium Large	
Banana	46.3 + 4.2 -	53.4 + 2.4 -	47.2 + 4.6 -	55.0 + 3.5 -	7.26**
Grapes	51.1 + 7.0 -	56.8 + 5.5 -	56.5 + 6.2 -	49.7 + 5.5 -	3.93*
Guava	56.3 + 4.1 -	53.7 + 7.4 -	48.6 + 15.9 -	53.0 + 5.1 -	0.43 NS
Mango	48.3 + 4.2 -	52.8 + 4.1 -	51.7 + 6.0 -	53.9 + 4.0 -	0.80 NS
Brinjal	46.8 + 5.7 -	45.1 + 3.1 -	54.8 + 7.7 -	54.3 + 4.2 -	5.5**
Lady's finger	45.6 + 5.3 -	44.9 + 4.3 -	54.2 + 5.5 -	58.7 + 4.9 -	6.1**
Onion	46.9 + 5.9 -	43.5 + 15.1 -	48.3 + 5.2 -	53.7 + 4.1 -	1.63 NS
Tomato	38.4 + 6.7 -	37.2 + 6.1 -	48.3 + 9.4 -	53.6 + 8.0 -	14.83**

\* Significant at 5 % level

\*\* Significant at 1 % level

NS - Not Significant

The farmers namely the producer's share in consumer rupee was found to range from 35 to 60 per cent as against the observations of Jaganatha Rao et al., (1987) where the producers share ranged from 40 to 50 per cent of the consumers price. The study of the Indian Institute of Horticultural Research's in Karnataka showed that 50.5 per cent of over all retail price of vegetables formed part of the commission and 37.6 per cent was used up for transportation charges (Farm Progress, 1991).

The crucial problems faced by the farmers during marketing their produce were unhelpful attitude of commission agents, ignorance of market prices, lack of organisation among the cultivators and the long chain of middle men.

Statistical appraisal indicated significant relationship between land holding and producer's share except for guava, mango and onion. The medium and large farmers had the advantage of the bulk produce which attracted the commission agents. In the case of mango, the pattern of producers' share remained the same for all categories of farmers because the mango orchards were given as pre harvest contracts. The small and marginal farmers marketed guava to the local consumers and markets, this gaining greater percentage of producer's share compared to the other categories of farmers.

**c. Problems of Marketing fruits and vegetables**

The study has revealed that more than 90 per cent respondents sold their horticultural produce immediately after harvesting and did not wait to get higher price in future. Similar observations were recorded by Renuka et al., (1991) in their region in Telangana region on horticultural produce.

An effort has been made to find out the reasons for disposing off the produce. Out of the 365 farmers surveyed, marginal and small farmers expressed that they had to sell their produce immediately after harvesting either due to meet their expenditure or to clear off loans. Whereas medium and large farmers expressed their view that they had to sell their produce to mobilise the working capital for the next year.

The crucial problems faced by the selected farmers while marketing of their produce are listed in Table XVI.

TABLE XVI

PROBLEMS ENCOUNTERED DURING MARKETING OF FRUITS AND  
VEGETABLES

Problems	Marginal	Small	Semi- medium	Medium	Large
	n=36	n=90	n=91	n=108	n=40
No. of Farmers					
1. High commission charges	19	45	48	68	8
2. Too many intermediaries	4	30	25	26	12
3. Absence of storage facilities	2	17	15	39	14
4. Poor transport facilities	12	43	36	20	5
5. Prohibitive Transport cost	14	28	14	56	8
6. Ignorance of market prices	5	16	25	60	24

The problem of high commission charges was found to be faced by all categories of farmers with large numbers mentioning about it. Poor transport facility was the crucial problem faced by the marginal, small and semi-medium farmers.

Studies by Sadasivam et al., (1972) Narayanasamy and Reddy (1988), Sikka and Swarup (1989) and Renuka et al., (1991) have reported the problems found in marketing fruits and vegetables as high commission charges, lack of storage

and transport facilities, lack of market information in time and non availability of inputs or credits. In addition to this, farmers have to pay market fees, hauling charges, terminal tax and others in the market as reported by Vigneswara (1988).

In order to ensure more and better production, per capita availability of consumption of fruits and vegetables and upliftment of the economy of the fruit and vegetable growers, the farmers have to be assured of remunerative prices. Intervention of the Government is needed for the field conditions, regulation of markets, providing storage facilities both in production and marketing areas, supply of packaging material at subsidised rates, provision of transportation facilities at reasonable cost and reducing a large number of intermediaries who retain quite a large proportion of consumer's rupee.

### **Storage of Onion**

Table XVII provides information on the land holding of respondents who cultivate onion, their trend about sale, storage and reasons for immediate marketing of the produce.

Irrespective of land holdings 20-80 per cent of their total produce was stored by the farmers in the local storage structures called 'Padals' making use of bamboo sticks (Plate 4) which can be extended according to the quantity to be stored for about three months.

TABLE XVII  
 LANDHOLDING OF RESPONDENTS : SALE, STORAGE AND REASONS FOR IMMEDIATE MARKETING OF ONION

Farmer's Category	0-25	26-50	50-80	0-25	26-50	50-80	0-25	26-50	50-80	Immediate funds needed	Lack of storage facility	Higher storage losses	No guarantee of higher market prices
Marginal n:9	-	4	3	-	5	3	3	4	3	-	-	-	-
Small n:19	-	5	8	4	6	4	2	4	4	3	3	3	3
Semi-medium n:19	2	6	7	3	8	7	-	3	5	6	6	6	6
Medium n:14	-	6	4	2	5	6	2	2	3	2	2	2	2
Large n:8	-	2	3	-	4	3	-	-	3	2	3	2	2



Front View



Back View



Full View



'PADAL' - THE STORAGE STRUCTURE OF ONION

PLATE 4.

The produce soon after harvesting was sold by marginal and small farmers and the reasons mentioned were financial commitments and lack of storage facilities. Farmers felt that the storage cost was too high that it made the subsequent sale unprofitable. Semi-medium and medium farmers felt uncertainty in the market prices and higher storage losses made them to sell their produce after harvest. The farmers were concerned about the possible deterioration of the onions, as well as the expenditure incurred on the storage of the produce.

The main causes of losses in onion were rotting, sprouting and weight loss. The extent of losses caused by the stored onion at the farm is given in Table XVIII.

TABLE XVIII  
 EXTENT OF LOSSES IN STORED ONION

Farmer's Category	Losses in Percentage Due to									
	0-5	6-10	11-15	16-20	0-2	3-5	7-5	5-10	11-15	16-20
	Rotting			Sprouting			Drying			
* Marginal n:8	-	3	3	3	4	3	1	5	3	-
Small n:14	5	2	2	5	7	3	4	9	3	2
Semi-medium n:18	3	5	6	4	13	4	1	13	3	2
Medium n:13	2	3	5	3	9	2	2	6	5	2
Large n:8	1	4	3	-	6	2	-	3	5	-

The losses due to decay and weight loss were accounted from five to twenty per cent each as against five per cent due to sprouting. Korde et al., (1981) opined that 30-70 per cent of stored onions were destroyed during the storage period of 2-3 months in Akola district alone. Paul et al., (1980) and Murthy et al., (1988) also reported similar quantum of losses on the stored onion in the conventional structure called 'chals' for 4-5 months in Nashik district. Patil et al. (1988) also reported that the losses due to decay, sprouting and weight loss accounted to 43.0, 10.6 and 32.4 per cent respectively after six months of storage at room temperature. According to Maini et al., (1989) when onion bulbs were stored in gunny bags or gunny bags lined with perforated polyethylene and stored in ambient conditions (28-33°C) for three months, sprouting occurred in only 10 per cent of the sample.

To reduce the losses due to sprouting, farmers were trained on maleic hydroxide treatment. The method of spraying and the period of spraying was explained to them. To reduce the decay, farmers were trained to spray the harvested bulbs with bavistin.

#### **Knowledge and Adoption Index of Cultivation Practices**

Knowledge and adoption index of selected farmers has been ascertained by selecting 10 packages of cultivation/post harvest practices by employing the formulae given by Nikhade et al., (1992).

$$\text{Knowledge Index} = \frac{\text{Sum of knowledge scores obtained by all respondents}}{\text{Sum of obtainable knowledge score by all respondents}} \times 100$$

$$\text{Adoption Index} = \frac{\text{Sum of adoption score obtained by all respondents}}{\text{Sum of obtainable adoption scores by all the respondents}} \times 100$$

The knowledge and Adoption Index of selected farmers is given in Table XIX.

## KNOWLEDGE AND ADOPTION LEVEL OF CULTIVATION AND POST HARVEST PRACTICES

Cultivation/Post harvest Practices	Mean knowledge Index					Mean Adoption Index				
	Ma n:36	S n:90	SM n:91	Me n:108	L n:40	Ma n:36	S n:90	SM n:91	Me n:108	L n:40
1. Use of recommended variety	44.4	30.0	39.6	60.2	75.0	22.2	15.5	5.3	38.9	45.0
2. Proper Seed treatment	55.5	40.0	27.5	52.3	65.0	27.8	13.3	17.6	24.1	45.0
3. Use of recommended doses of fertilizers	16.6	8.9	17.6	19.4	25.0	-	-	2.2	4.6	15.0
4. Application of manures	33.3	28.8	25.3	26.8	27.5	13.9	11.1	7.7	11.1	25.0
5. Plant protection measures	22.2	11.1	15.4	20.4	40.0	-	-	5.5	7.4	25.0
6. Appropriate Time of Harvesting	80.5	94.4	97.8	90.7	92.5	72.2	94.4	93.4	84.3	87.5
7. Right handling of fruits and vegetables	44.4	27.8	30.8	32.4	40.0	13.9	11.1	11.0	12.9	25.0
8. Method of packing	-	17.8	24.2	24.2	37.5	-	4.4	6.6	6.5	10.0
9. Curing procedure in onion	41.66	31.1	60.4	81.5	65.0	-	14.4	30.8	63.0	55.0
10. Method of storage for onion	22.0	28.8	35.2	41.7	62.5	-	7.77	12.1	13.0	62.5
Over all Index	36.0	31.9	37.4	44.9	53.0	15.0	17.2	16.5	26.6	39.5

Ma - Marginal; S - Small; SM - Semi-medium; Me - Medium; L - Large

In the large farmers, knowledge as well as adoption index were the highest which may be attributed to their economic and educational status. The practice of appropriate time of harvesting had the highest knowledge and adoption index in all categories of farmers who might have learnt this by their experiences. Though the knowledge index of the marginal and small farmers was comparable to those of the medium and large farmers in practices such as use of recommended variety and fertilizers and plant protection measures, the adoption index to these practices was very low or nil due to their economic constraint. Special effort should be taken by the Government with reference to department of horticulture to make available hybrid seeds, fertilizers and pesticides to the farmers at subsidy or reasonable prices at the proper time.

**5. Pattern of Consumption of Fruits and Vegetables by the Selected Household**

**a. Background Information of the selected households**

**i. Family size and type**

The Table XX gives details of the selected households' family size and type based on family monthly income.

TABLE XX

FAMILY SIZE AND TYPE

Particulars	Low		Lower middle		Upper middle		High		Total	
	NG	G	NG	G	NG	G	NG	G	NG	G
	n:125	n:125	n:132	n:132	n:84	n:84	n:24	n:24	n:365	n:365
<b>Family size</b>										
Small (1-3)	28	22	27	16	8	10	2	6	65	54
									(17.8)	(14.8)
Medium (4-6)	90	95	92	104	64	70	14	10	260	279
									(71.2)	(76.4)
Large (> 6)	7	8	13	12	12	4	8	8	40	32
									(11.0)	(8.8)
<b>Family Type</b>										
Nuclear	97	112	86	18	65	74	15	18	263	322
									(72.1)	(88.2)
Joint	28	13	46	14	19	10	9	6	102	43
									(27.9)	(11.8)
<b>Dietary pattern</b>										
Vegetarian	15	30	6	7	11	7	2	5	34	49
									(9.3)	(13.4)
Non-Vegetarian	110	95	126	125	73	77	22	19	331	316
									(90.7)	(86.6)
G - Gardeners										
NG - Non gardeners										

Figures in parenthesis indicate percentage

Based on number of the family, target families were classified into small (1-3 members), medium (4-6 members) and large (more than 6 members). Medium size families dominated in both gardeners and non gardeners families followed by small and then large. According to the District Statistical Handbook (1991), the average size of the household in Coimbatore district was 4.2 as against 4.6 in the present study. Education on small family norm in the target group should be strengthened to bring desirable results.

Majority of the selected households (80.1 per cent) was nuclear with lesser proportion of joint family structure due to younger generation moving out of the homes for an independent living.

The majority of the selected gardeners and non gardeners households were found to be non-vegetarians to the tune of 88.6 and 90.7 per cent respectively.

The family size and type did not differ much between the gardeners and non gardeners families.

#### **ii. Educational status of the housewives**

Educational status of women play an important role in the food consumption pattern of the family members which in turn influences the total well being of the family members. The educational status of the housewives of the target households depicts a diverse picture as shown in Table XXI.



It was encouraging to note that the literacy rate among the housewives of the target groups, both gardeners and non gardeners was 77.5 per cent as against the female literacy rate of 29.6 per cent in the district of Coimbatore (District Statistical Hand Book, 1991).

Illiteracy rate was higher in the low income group (35.2 per cent) against an average 23 per cent of illiteracy in all income group. Those who graduated constituted fifteen per cent with large number of graduates from the high income group. Between the gardeners and non gardeners the educational status did not differ much.

While analysing the data based on family monthly income as the income increased the level of education also increased. Statistically there was a significant association between the income and educational status of the housewives in both gardeners and non gardeners families.

### **iii. Expenditure pattern on the selected households**

Monthly household expenditure on food and non-food items is described in Table XXII.

TABLE XXII  
MONTHLY HOUSEHOLD EXPENDITURE ON FOOD AND NON FOOD ITEMS

Particulars	Mean per cent income spent by income group											
	Low		Lower-middle		Upper-middle		High					
	G n:125	NG n:125	G n:132	NG n:132	G n:84	NG n:84	G n:24	NG n:24	G n:24	NG n:24	G n:24	NG n:24
1. Food	63.73	62.15	51.82	49.44	36.32	37.15	25.49	25.66				
2. Clothing	4.95	6.89	7.96	7.22	10.36	9.09	15.55	11.97				
3. Shelter	3.01	3.46	5.93	8.02	6.07	6.82	4.33	4.91				
4. Education	1.33	2.24	2.04	2.04	4.58	3.80	4.24	4.76				
5. Health care	3.32	3.19	2.75	3.13	3.54	2.83	2.25	2.95				
6. Transport	5.99	6.01	6.01	5.36	6.69	6.89	6.53	7.15				
7. Loan/Savings	4.85	3.11	5.03	5.13	6.21	3.29	7.38	6.52				
8. Recreation	2.09	2.99	2.89	3.02	3.72	4.20	3.11	6.03				
9. Miscellaneous	8.05	6.51	9.99	9.02	14.02	13.22	20.05	24.78				

G - Gardeners

NG - Non gardeners

Expenditure pattern reveals the levels of living of people. One's economic status is determined by the magnitude of his expenditure. In the relatively poor classes the propensity to consume is high while in the higher-classes the propensity to save is more. This is evidenced in the present study as food constituted the main item of expenditure taking 62-63 per cent of total family expenditure in low income groups whereas high income spent only 25 per cent on food (Table XXIII).

TABLE XXIII  
PERCENTAGE OF INCOME SPENT ON FOOD

Income group	Per cent Income Spent by	
	Gardeners	Non-gardeners
Low	63.73	62.15
Lower-middle	51.82	49.44
Upper-middle	36.32	37.15
High	25.49	25.66

Source	F	SE (Mean)	C.D. at 5 per cent
Family	0.36 NS	0.87	1.71
Income	173.1**	0.87	1.71
Family x Income	0.57 NS	1.75	3.42

\*\* Significant at 1 % level

NS - Not Significant

Choudhury (1984) found that low income group spent 75 per cent of their total income on food whereas Prasad (1991) observed that almost 80 per cent of total expenditure was on food in both rural and urban sectors.

There was a gradual but significant reduction in the percentage of amount spent on food items as the income increased in both gardeners and non gardeners households. Statistical appraisal indicated a significant difference at one per cent level between income levels.

The gardeners had a tendency to spend more on clothing than non gardeners in all income levels except the high income group. As the income increased the amount spent on health care also increased.

The non gardeners families spent more money on education, an important human resource development activity, than their counterparts and on health care it was vice-versa.

A study by Susheela et al., (1991) and Sinha (1991) revealed that the average monthly household expenditure of large holdings was significantly higher compared to other land holds.

Monthly mean food expenditure pattern of the selected households is depicted in Table XXIV.

TABLE XXIV

## MONTHLY MEAN FOOD EXPENDITURE PATTERN

Income group	Percentage of income spent							
	Low		Lower-middle		Upper-middle		High	
	G n:125	NG n:125	G n:132	NG n:132	G n:84	NG n:84	G n:24	NG n:24
Cereals	42.32	40.65	31.64	31.63	25.95	23.69	24.05	24.65
Pulses	12.66	12.57	12.37	12.93	13.28	12.83	13.09	12.85
Green leafy vegetables	1.46	1.73	1.16	1.15	1.13	1.07	1.04	1.54
Roots & tubers	2.45	2.53	2.31	2.10	2.17	2.64	2.69	2.73
Other vegetables	2.83	2.99	2.43	2.71	2.44	3.37	2.48	2.75
Fruits	2.12	2.66	2.31	2.82	2.93	4.30	2.73	3.86
Flesh food items	5.22	4.61	4.76	5.69	6.34	6.29	5.48	5.83
Milk and milk products	19.21	19.80	19.86	19.85	20.96	19.01	20.48	19.52
Sugar & jaggery	3.11	2.10	3.94	2.61	3.11	3.91	3.32	4.76
Miscellaneous	7.83	7.86	10.78	9.71	13.47	11.62	17.43	18.22

G - Gardeners

NG - Non gardeners

From this data it is clear that the percentage of amount spent on cereals decreased as the income increased, in both the gardeners and non gardeners families. Rice was the staple cereal with other cereals such as ragi and wheat.

Low income gardeners spent 42.3 per cent on cereals and it decreased to 24.1 per cent by high income households. A similar trend was observed among non gardeners households also. Studies by Choudhury (1984) showed that 42-44 per cent of income on food was spent on cereals by low income group and as the income ~~rose~~ budget share on cereal fell.

In pulses there was not much difference between the percentage of amount spent on it among the two groups at all income levels. The non gardeners spent more on leafy vegetables, roots and tubers, other vegetables and fruits than their counterparts. The percentage distribution of expenditure revealed that from the total food expenditure 1-4 per cent only was spent on green leafy vegetables, roots and tubers, other vegetables and fruits each by all the income groups studied. Study by Mohideen (1991) revealed that the household expenditure on fruits and vegetables formed only 11.6 per cent and 10.8 per cent in the total food expenses and the position of low income group was very poor with meagre fruit consumption.

Consumption pattern in rural areas of Assam by Pathak and Goswamy (1989) revealed that expenditure on vegetables

occupied 11 per cent of the total food expenditure and the expenditure on fruit was negligible. Srivastava (1991) and Hashim (1991) noted that per capita consumption expenditure on fruits and vegetables did not exceed ten per cent in both rural and urban India whereas a citizen in a developed country spends 14.2 per cent of his food budget on fruits and vegetables (Mokshapathy, 1988).

**b. Consumption pattern of fruits and vegetables**

Frequency of consuming fruits and vegetables among the target groups is given in Table XXV.

TABLE XXV

## CONSUMPTION PATTERN OF FRUITS AND VEGETABLES AMONG THE TARGET FAMILIES

Frequency	No. of families consuming							
	Green leafy vegetables		Roots & Tubers		Other vegetables		Fruits	
	G	NG	G	NG	G	NG	G	NG
<b>Low Income (n:125)</b>								
Daily	-	-	-	-	22	20	-	-
Weekly thrice	24	17	22	18	2	17	-	-
Weekly twice	54	54	14	9	46	16	11	12
Weekly once	42	54	89	85	45	49	28	22
Once a fortnight	-	-	-	13	10	23	86	91
<b>Lower-middle (n:132)</b>								
Daily	-	-	36	28	10	8	16	-
Weekly thrice	48	32	12	16	26	12	6	14
Weekly twice	16	10	30	24	60	82	46	40
Weekly once	64	72	50	70	36	22	50	42
Once a fortnight	4	18	4	14	-	8	14	36
<b>Upper-middle (n:84)</b>								
Daily	-	-	38	20	46	33	42	32
Weekly thrice	42	38	28	30	18	21	18	16
Weekly twice	14	16	8	20	6	12	12	13
Weekly once	22	26	10	6	14	8	12	23
Once a fortnight	6	4	-	8	-	-	-	-
<b>High Income (n:24)</b>								
Daily	-	-	10	9	18	14	8	6
Weekly thrice	12	16	8	11	6	10	14	10
Weekly twice	8	5	6	4	-	-	2	8
Weekly once	4	3	-	-	-	-	-	-

G - Gardeners; NG - Non-gardeners

Majority of the low income group households consumed greens (43.2 per cent) weekly thrice and fruits (62 per cent) once a fortnight. Availability was found to be the deciding factor of consumption pattern. In high income families greens and tubers were consumed weekly thrice by fifty and forty per cent of the families respectively and 29 per cent families consumed fruits daily. Pushpamma et al., (1984) observed that none of the families studied by them consumed fruits daily.

Low household income, insufficient availability of fruits and vegetables and high prices influenced the pattern of consumption. According to Anderson (1982), cropping system and amount and kind of food produced and fluctuation in fruits and vegetables availability during the year also influenced.

Green leafy vegetables such as drumstick leaves, Amaranth and Araikeerai were consumed commonly by the target group, as they were available easily in the target area. Non leafy vegetables such as brinjal, lady's finger, drumstick, gourds, cluster bean, field bean, cabbage and tomato were consumed. Local availability and taste governed the consumer's preference. Potato, Colocasia, carrot, tapioca and onion were found to be the popularly consumed root vegetables. Green leafy vegetables were cooked and mashed with or without dhal and served as curry, chutney (greens ground with spices) and fry (dry curry using lots of oil).

The most popular recipes made with non leafy vegetables were plain curry, chutney, kootu, poriyal, salt seasonings and fry. Potato was the most frequency used root vegetable, onion was an exception as it was used in all recipes in varying quantities for the purposes of flavouring than as a vegetable. The most commonly made recipes were curry, fry, bajji and kuruma.

Locally and seasonally available fruits such as guava, grapes, banana, mango, sapota were purchased and consumed. The consumption of fruits was found to be based purely on seasonal and local availability.

Quantity of fruits and vegetables consumed by the target group is gives in Table XXVI and Figure 7.

TABLE XXVI

MEAN DAILY PERCAPITA CONSUMPTION OF FRUITS AND VEGETABLES (g) BY THE TARGET FAMILIES

---

Income group (B)	Grams of fruits/vegetable consumed				F value	SE (mean)				CD at 5 per cent	
	Low	Lower middle	Upper middle	High		A	B	A x B	A		B
<b>Food items (A)</b>											
<b>Leafy vegetables</b>											
Gardeners	12.7	11.5	14.5	15.4	4.52**	7.35**	1.2NS	1.52	1.52	1.52	1.52
Non gardeners	13.1	8.2	11.7	14.5							
<b>Other vegetables</b>											
Gardeners	20.2	31.2	41.4	52.1							
Non gardeners	18.8	25.0	36.6	51.2	2.65NS	46.56**	0.41NS	1.99			3.98
<b>Roots &amp; tubers</b>											
Gardeners	18.2	21.2	25.4	26.2							
Non gardeners	15.3	21.4	28.4	27.3	0.05NS	10.57**	0.67NS	1.47			2.94
<b>Fruits</b>											
Gardeners	14.5	25.6	49.2	68.6							
Non gardeners	12.8	25.1	48.7	60.4	1.02NS	73.56**	1.17NS	2.62			5.24

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\* Significant at 1 % level      NS Not Significant

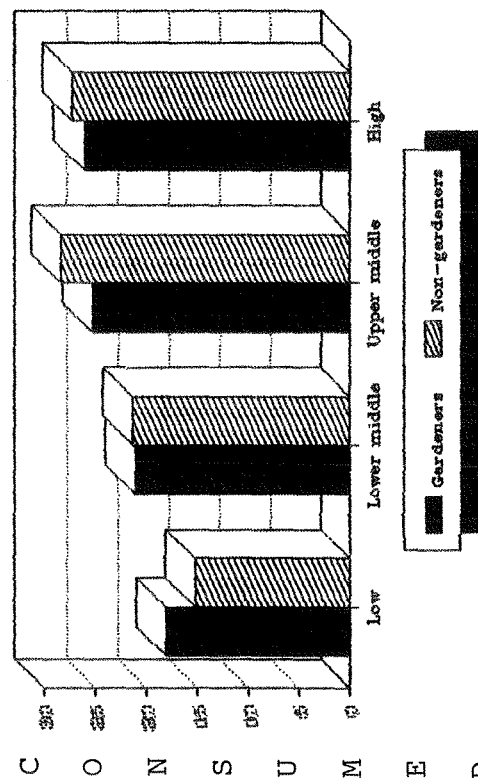
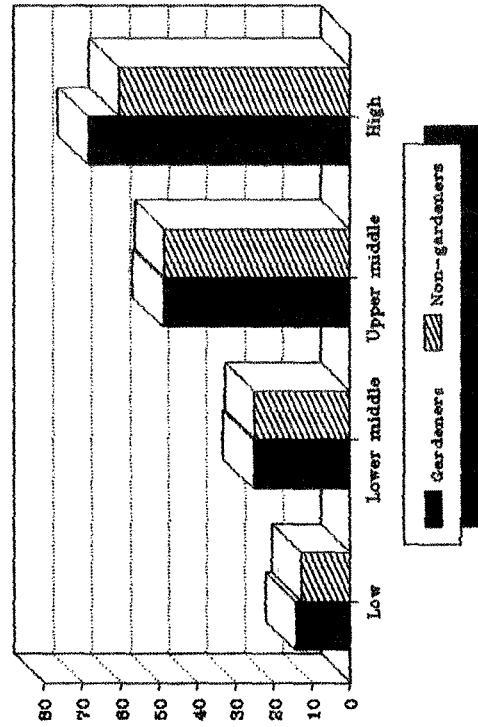
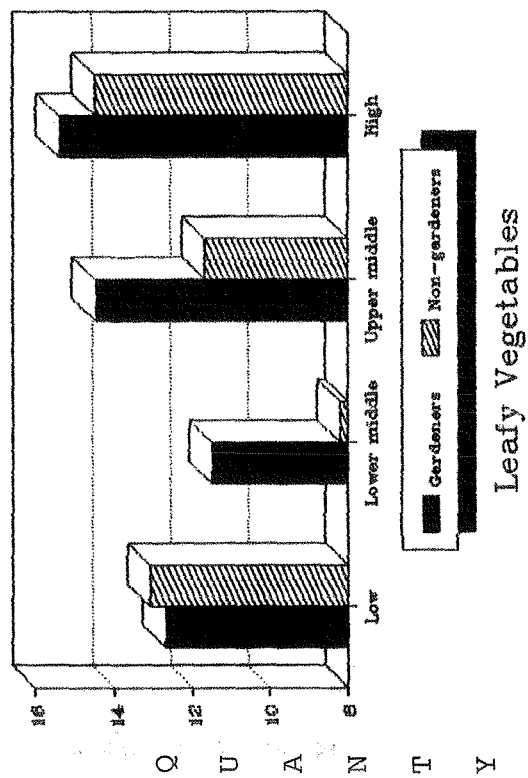
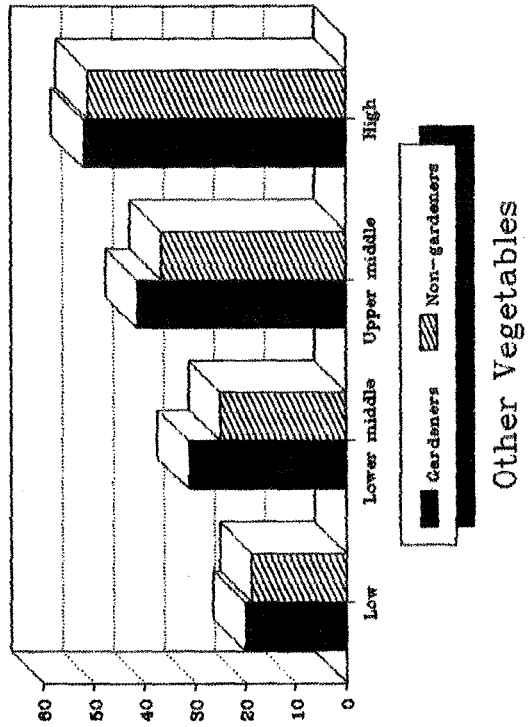


Figure 7 PERCAPITA CONSUMPTION OF FRUITS AND VEGETABLES

(g)

Consumption of fruits and vegetables is directly related to the socio-economic status of the family. Family income, purchasing power of the food items, price, availability and preferences of the family members vitally influence the consumption pattern. In general fruits and vegetables are consumed in meagre amount compared to the ICMR recommended daily intake. The target group consumed 6-12 % of recommended intake of leafy vegetables, 24-70 % of the other vegetables 20-37 % of roots and tubers. In the present study the consumption of vegetables among the various income groups ranged between 50 and 90 g as against national consumption of 50 g (Food talk, 1992). It was surprising to note that even though the upper middle and high income families did not face economic constraint, their intake of vegetables was also found to be lower than the recommended daily intake. Hence during training the importance of fruits and vegetables in a day's diet was stressed and the housewives were motivated to include more locally available and seasonal fruits and vegetables.

In fruits, among the low and lower middle income families the per capita intake was found to be lower than the recommended intake of 30 g/day (ICMR, 1968) whereas it was high among the other two groups.

It is imperative to point out that the latest RDA of ICMR (1989) did not include balanced menus indicating daily need for the various food constituents. The earlier RDA of

1981 (ICMR, 1981) though included the recommendation of food stuffs in balanced menu, had not mentioned about the required daily intake of the one of the important protective foods, fruits.

Lalchand et al., (1976) and Ramachandar et al., (1986) have reported that the higher income groups consumed more than 200 g fruits per day as against the range of 60-68 g in the present study. Report of Government of Tamil Nadu on women and children (1990) showed that the average state intake of green leafy vegetables, other vegetables, roots and tubers and fruits was found to be 13, 38, 42 and 30 g respectively.

According to Kirthi Singh and Chadha (1990) middle and higher income group people were consuming recommended and even higher quantities (200-300 g) of vegetables per capita per day whereas the low income rural people were not able to consume even a few grams of vegetables per week.

The quantity of fruits and vegetables consumed by the gardeners was higher compared with non gardeners though the statistical appraisal did not indicate significant difference except for green leafy vegetables which might be attributed to the fact that the gardeners might have procured them from their own garden.

A direct relationship between income levels and per capita consumption of fruits and vegetables was observed

with a statistically significant difference in consumption among different income groups. The protective food items fruits and vegetables are expensive which the higher income groups could purchase while the lower income groups strived hard to meet the basic need of adequacy in food intake.

#### **Place of Purchase of fruits and vegetables**

The principal channels of fruits and vegetables procurement were farm households, petty shops, daily and weekly markets and from street vendors. Economic condition, quality aspects such as freshness and availability influence the places of procurement.

Low and lower middle income group preferred to buy the fruits and vegetables from farm households for economic reasons. Petty shops were also their source of procurement when they get their day's wages late in the evening. Upper middle and high income group preferred to buy from daily market and street vendors and store the fruits and vegetables in refrigerators. It was encouraging that mud storage devices were also used for storing fruits and vegetables by target households of lower middle income groups. Nimkar and Hatwalne (1976) observed in Nagpur that fruits and vegetables were brought twice a week or even more frequently.

Pattern of storage of fruits and vegetables in the target area is given in Table XXVII.

TABLE XXVII

## PATTERN OF STORAGE OF FRUITS AND VEGETABLES BY THE TARGET FAMILIES

Storage Period	Gardeners families				Non gardeners families			
	L n:125	LM n:132	UM n:84	H n:24	L n:125	LM n:132	UM n:84	H n:24
<b>Leafy vegetables</b>								
None	115	76	50	16	125	85	69	14
2-3 days	10	56	25	8	-	47	15	7
4-5 days	-	-	9	-	-	-	-	3
<b>Other vegetables</b>								
None	60	30	26	6	58	27	17	12
2-3 days	35	46	17	8	39	49	31	6
4-5 days	18	42	29	10	15	56	25	3
One week	22	14	12	-	13	-	11	3
<b>Roots &amp; Tubers</b>								
None	12	10	12	3	6	2	8	-
2-3 days	10	12	26	2	14	33	26	6
4-5 days	12	29	15	6	79	30	14	5
One week	80	36	10	6	15	21	15	8
Two weeks	6	11	12	2	11	26	11	2
One month	5	34	9	5	-	20	10	3
<b>Fruits</b>								
None	86	86	26	5	77	44	25	12
2-3 days	39	14	14	8	28	56	45	6
4-5 days	-	22	25	10	20	32	12	3
One week	-	-	19	1	-	-	2	3

L - Low; LM - Lower middle; UM - Upper middle; H - High

### **Leafy Vegetables**

These were usually preferred when fresh and consumed on the same day of purchase by the low income group gardeners and non gardeners families. Majority of the families (98.5 per cent) did not store the greens not more than two days. Studies by Pushpamma et al., (1984) also revealed that the storage period did not exceed three days because of the poor storage quality of green leafy vegetables in the tropical climate.

### **Other vegetables**

Out of 730 families surveyed, 236 families consumed it on the day of purchase. Others stored it for a week maximum either keeping it in a plastic basket, bamboo basket, mud storage devices or in refrigerator (Plate 5).

### **Roots and Tubers**

Unlike other vegetables, roots and tubers were stored for longer time by the target groups as the quality is not affected, even in the absence of cold storage facilities. It was observed that during storage, onion was kept in open basket and left in the open air for about a month.

### **Fruits**

Fruits like guava, banana and grapes were purchased and consumed on the same day. Fruits were stored either in



Mud storage device



Plastic baskets

plastic baskets, bamboo, polyethylene bags, mud storage devices or in the refrigerator.

The preservation techniques adopted for fruits and vegetables considerably influence the pattern of consumption. The following table (Table XXVIII) indicates the preservation techniques adopted by the target households.

TABLE XXVIII  
PRESERVATION TECHNIQUES ADOPTED BY THE TARGET HOUSEHOLDS

Form of preserv- ation	Low		Lower- middle		Upper- middle		High		Total	
	G n:125	NG n:125	G n:132	NG n:132	G n:84	NG n:84	G n:24	NG n:24		
1. Vathal	72	26	102	85	29	36	12	10	215	157
2. Pickle	65	56	87	67	65	58	20	19	237	200
3. Thokku	38	28	43	52	36	28	11	12	128	120
4. Juice	-	-	29	36	33	29	18	22	80	87
5. Squash	-	-	-	8	17	23	14	10	31	41
6. Jam	-	-	8	-	12	9	5	6	25	15
G - Gardeners                      NG - Non gardeners										

In glut seasons fruits like mango, tomato, lime, grapes and vegetables like cluster bean, bhendi, brinjal, chillies, bitter gourd and onion were preserved in the form of pickle, vathal, (sun dried product) thokku, jam, juice and squash. Preservation of fruits and vegetables was related to the availability and economic status of the families. As vathal and salted pickle were less expensive, they were made by a majority of the lower middle (71 per cent) and low income groups (39 per cent) whereas oil pickling, juice, jam, squash were more expensive and was found to be higher among the high income group (60 per cent) than the other income groups. Among the two groups studied, number of gardeners families preserving fruits and vegetables was found to be higher than their counterparts.

Table XXIX shows the sources through which the housewives learnt the preservation techniques.

TABLE XXIX

## SOURCES FROM WHERE PRESERVATION TECHNIQUES WERE LEARNT

Sources	Gardeners n:365	Non gardeners n:365	Total N:730
1. Family members and Relatives	150(41.1)	186(51.0)	336(46.0)
2. Friends and neighbours	97(26.6)	78(21.4)	175(24.0)
3. Institutional demonstrations	38(10.4)	49(13.4)	87(12.0)
4. T.V., Radio and magazines	16(4.9)	9(2.8)	25(3.4)

Figures in parenthesis indicate percentage.

Personal sources such as relatives and family members accounted for a large section of housewives i.e., forty six per cent learning preservation technique. The demonstration on food preservation appeared in T.V., the electronic media encouraged learning and acquiring skills, because demonstration helps to convince people quicker than any other method through the triple process of observing, hearing and learning by doing. Hence electronic media should telecast such demonstrations facilitating housewives acquiring the skills and sustain them.

Table XXX shows the number of families possessing kitchen garden. Plate 6 shows the active participation of family members in kitchen gardening.

TABLE XXX

## NUMBER OF FAMILIES POSSESSING KITCHEN GARDEN

Income Group	Gardeners	Non-gardeners
Low (n:125)	45(36.0)	24(19.2)
Lower middle (n:132)	74(59.2)	34(27.2)
Upper middle (n:84)	40(47.6)	28(36.3)
High (n:24)	20(83.3)	16(66.6)
Total	179(49.0)	102(28.0)

Figures in Parenthesis indicate percentage

Home gardening has a vast potential for addressing the food, health and income needs of the family. Kitchen garden represents a direct, cost effective and ecologically sound strategy for tackling the socio-economic and nutritional needs of the poor. Among the 730 families surveyed, 179 (49 per cent) gardeners and 102 (28 per cent) non gardeners families possessed kitchen garden while others reported lack of space and time, shortage of water and maintenance problems as reasons for not having kitchen garden, which is in confirmity of the study conducted by NIN (1991). Fresh and pesticide free produce, economy and availability at all times were reported as the most important advantages of possessing kitchen garden.



PLATE 6. ENTHUSIASTIC PARTICIPATION OF FAMILY MEMBERS  
IN KITCHEN GARDENING

To find out the nutritional knowledge of the housewives ten questions as given in the last section of interview schedule-B (Appendix - E) were administered to the housewives and the mean scores obtained by the target group is given in Table XXXI.

TABLE XXXI  
MEAN NUTRITIONAL KNOWLEDGE SCORES OBTAINED BY THE HOUSEWIVES

Income group	Scores obtained by housewives	
	Gardeners	Non gardeners
Low (n=124)	3.92 ± 1.21	4.66 ± 1.65
Lower middle (n=132)	4.66 ± 1.47	5.14 ± 1.50
Upper middle (n=84)	4.86 ± 1.46	5.12 ± 1.61
High (n=24)	5.52 ± 1.60	5.14 ± 1.09

The mean scores obtained by the housewives ranged between 3.92 and 5.52 out of 10.0 indicating the rather low level of nutrition knowledge of the housewives in both the groups. The income levels did effect the knowledge with better scores of the housewives upper of income levels.

#### **Fads and Fallacies of Fruits and Vegetables**

Food habits of people depended on availability of foods. Food availability is influenced by the climatic, socio-economic and cultural environment. Religious injunction, superstitions and ignorance affected the food habits significantly. Foods like papaya and drumstick leaves

were tabooed for the fear of causing abortion (68.5 per cent) and indigestion (28 per cent) respectively which confirms the observations of Devadas and Easwaran (1986). Fruits like mango, pineapple and papaya were considered as 'hot' (79 per cent) fruit juices were considered 'cold'. These were avoided during certain seasons and illnesses. Study conducted by the government of Tamil Nadu (1990) also reported the same.

Food taboos were studied by Trigo et al., (1989) in Maraba country, Para, Brazil. The most frequently met taboo was that prohibiting the simultaneous intake of milk and fruits and egg and fruits which were considered to be harmful.

Prejudices and taboos have a strong bearing on attitude formation which influence health and nutrition care. To a great extent attitudes are formed based on the knowledge people have regarding the desirable practices.

#### **B. Impact of Training**

The impact of training was evaluated as follows

##### **1. Extent of adoption of cultivation and post harvest practices**

The effect of training on knowledge and extent of adoption of cultivation and post harvest practices is given in Table XXXII.

TABLE XXXII

IMPACT ON TRAINING ON KNOWLEDGE AND ADOPTION LEVEL OF CULTIVATION AND POST HARVEST PRACTICES

Cultivation/ Post harvest Practices	Mean knowledge Index					Mean Adoption Index				
	Ma n:36	S n:90	SM n:91	Me n:108	L n:40	Ma n:36	S n:90	SM n:91	Me n:108	L n:40
1. Use of Recommended variety										
Before	44.4	30.0	39.6	60.2	75.0	22.2	15.5	5.3	38.9	45.0
After	75.0	60.0	70.3	72.2	90.0	38.8	28.9	37.4	51.8	70.0
2. Proper seed treatment										
Before	55.5	40.0	27.5	52.3	65.0	27.8	13.3	17.6	24.1	45.0
After	72.2	48.9	41.8	59.3	80.0	47.2	43.3	25.3	34.3	60.0
3. Use of Recommended dose of fertilizer										
Before	16.6	8.9	17.6	19.4	25.0	Nil	Nil	2.2	4.6	15.0
After	38.9	21.1	26.4	33.3	42.5	5.5	4.44	6.6	10.2	20.0
4. Application of manures										
Before	33.3	28.8	25.3	26.8	27.5	13.9	11.1	7.7	11.1	25.0
After	52.8	42.2	40.6	51.8	60.0	33.3	17.8	15.4	25.0	45.0
5. Plant protection measures										
Before	22.2	11.1	15.4	20.4	40.0	Nil	Nil	5.5	7.4	25.0
After	47.2	13.3	28.6	37.0	60.0	5.5	4.4	8.8	12.0	40.0

Cultivation/ Post harvest Practices	Mean knowledge Index					Mean Adoption Index				
	Ma n:36	S n:90	SM n:91	Me n:108	L n:40	Ma n:36	S n:90	SM n:91	Me n:108	L n:40
6. Appropriate Time of harvest										
Before	80.5	94.4	97.8	90.7	92.5	72.2	94.4	93.4	84.3	87.5
After	91.6	97.7	98.9	96.3	97.5	83.3	97.8	96.7	91.7	92.5
7. Right handling of fruits and vegetables										
Before	44.4	27.8	30.8	32.4	40.0	13.9	11.1	11.0	12.9	25.0
After	66.6	47.8	61.5	62.9	72.5	30.5	15.5	19.8	21.3	30.0
8. Method of packing										
Before	Nil	17.8	24.2	24.2	37.5	Nil	4.4	6.6	6.5	10.0
After	16.7	27.7	26.6	26.8	55.0	5.5	12.2	16.5	12.0	22.5
9. Curing in Onion										
Before	41.66	31.1	60.4	81.5	65.0	Nil	14.4	30.8	63.0	55.0
After	61.1	40.0	71.5	94.4	77.7	22.2	21.1	47.2	71.2	65.0
10. Method of Storage										
Before	22.2	28.8	35.2	41.7	62.5	Nil	7.77	12.1	13.0	62.5
After	47.2	36.7	42.8	50.0	80.0	5.5	16.7	20.9	20.4	72.5
Over all Index										
Before	36.0	31.9	37.4	44.9	53.0	15.0	17.2	16.5	26.6	39.5
After	56.9	43.5	50.9	58.4	68.0	27.7	26.2	29.5	35.0	51.8

Ma - Marginal; S - Small; SM - Semi-marginal; Me - Medium; L - Large

The increase in overall knowledge index was greater in the marginal and small farmers compared to the medium and large farmers which did reflect the impact of training on marginal and small farmers who should be given thrust in such programmes. In terms of knowledge index, on aspects such as use of recommended variety, proper seed treatment, appropriate dose of fertilizers, plant protection measures and curing and storage of onion, the increase was greater in marginal farmers.

As far as the overall adoption index was concerned, the increase was uniform in all categories ranging from 9.0 to 13.0. However the marginal and small farmers could not adopt plant protection measures and improved methods of packaging due to paucity of inputs and economic constraint.

## **2. Improvement of Production**

### **a. Improvement in production of selected fruits**

The impact of training on production rate of selected fruits namely banana, grapes, guava and mango is presented in Table XXXIII.

TABLE XXXIII

EFFECT OF TRAINING ON PRODUCTION OF FRUITS

Farmers Category	Production in tonnes/acre		Production in tonnes/acre	
	n	Before Increase 't'	n	After Increase 't'
<b>BANANA</b>				
Marginal				
Small	10	4.91	5.16	0.25 (5.1)
Semi-medium	7	6.37	6.57	0.20 (3.1)
Medium	14	6.82	7.30	0.48 (7.0)
Large	4	8.45	8.92	0.47 (5.6)
<b>GRAPES</b>				
Marginal				
Small	10	4.27**	11	6.34
Semi-medium	7	31.58**	12	6.5
Medium	14	5.13**	22	6.72
Large	4	32.76**	9	8.16
<b>MANGO</b>				
Marginal				
Small	4	1.29	1.34	0.05 (3.9)
Semi-medium	4	1.52	1.58	0.06 (3.9)
Medium	9	1.72	1.89	0.17 (9.9)
Large	5	1.48	1.72	0.24 (16.2)
<b>GUAVA</b>				
Marginal				
Small	4	0.63NS	12	4.07
Semi-medium	4	1.99NS	22	2.88
Medium	9	4.36**	41	3.66
Large	5	5.72**	22	4.56
<b>GRAPEFRUIT</b>				
Marginal				
Small	4	0.27	3.37	0.27 (8.7)
Semi-medium	4	0.25	3.32	0.25 (6.1)
Medium	9	0.19	3.07	0.19 (6.6)
Large	5	0.12	3.78	0.12 (3.3)
<b>ORANGE</b>				
Marginal				
Small	4	0.28	4.84	0.28 (6.1)
Semi-medium	4	0.28	4.84	0.28 (6.1)
Medium	9	0.28	4.84	0.28 (6.1)
Large	5	0.28	4.84	0.28 (6.1)

Figures in parenthesis indicate percentage

\* Significant at 5 per cent \*\* Significant at 1 per cent NS Not significant

The mean productivity of the selected fruits was increased after training due to the adoption of improved cultivation practices. Small and marginal farmers were greatly benefited by the training and brought remarkable results increasing the production in banana and mango on par with the large farmers. The percentage increase of production ranged between 0.5 and 17.7 among the various categories, the highest being in guava. There was a statistically significant increase in productivity of fruits except in the case of marginal and small farmers cultivating guava and grapes.

The effect of training on productivity of selected vegetables is given in Table XXXIV.

TABLE XXXIV

EFFECT OF TRAINING ON PRODUCTION OF VEGETABLES

Farmers Category	Production in tonnes/acre		Production in tonnes/acre		n	Before	After	Increase 't'	Increase 't'
	n	Before	n	After					
<b>BRINJAL</b>									
Marginal			6	1.62		1.68	0.06	1.78NS	
Small	9	2.47	15	1.18	3.57**	1.30	0.12	3.95**	(3.7)
Semi-medium	7	2.75	9	1.57	1.21NS	1.76	0.19	6.10**	(10.2)
Medium	10	2.47	9	1.37	0.66NS	1.59	0.22	2.92*	(3.6)
Large	7	2.85	7	1.59	4.49**	1.72	0.13	1.69NS	(9.1)
<b>LADY'S FINGER</b>									
<b>ONION</b>									
Marginal	9	5.82	15	2.03	3.55**	2.11	0.08	57.72**	(1.9)
Small	19	6.30	40	2.06	110.17**	2.19	0.134	59.68**	(3.6)
Semi-medium	19	6.48	36	2.18	3.08**	2.37	0.19	67.94**	(5.2)
Medium	14	5.67	38	2.20	16.38**	2.37	0.168	53.1**	(8.1)
Large	8	6.14	14	2.29	20.79**	2.46	0.171	2.24**	(4.1)
<b>TOMATO</b>									

Figures in parenthesis indicate percentage

\* Significant at 5 per cent      \*\* Significant at 1 per cent      NS Not significant

From this table it is clear that the productivity of selected vegetables increased in all the farmers categories reflecting the favourable impact of training. Statistical appraisal indicated a significant difference except in the case of semi-medium, and medium farmers growing brinjal and small and large farmers growing lady's finger.

### **3. Reduction in Post Harvest Losses**

The effect of training on reduction in post harvest losses of selected fruits is depicted in Table XXXV.

TABLE XXXV

## EFFECT OF TRAINING ON PER CENT POST HARVEST LOSSES OF FRUITS

Farmers Category	Post harvest losses in percentage		Post harvest losses in percentage	
	n	Before After Reduction 't'	n	Before After Reduction 't'
<b>BANANA</b>				
Marginal				
Small	10	19.6 14.9	12.5 <sup>**</sup>	11 15.22 13.11 2.09 2.66 <sup>*</sup> (13.4)
Semi- medium	7	13.28 9.99	7.03 <sup>**</sup>	12 13.57 11.07 2.50 7.96 <sup>**</sup> (18.4)
Medium	14	11.86 8.93	6.95 <sup>**</sup>	22 9.10 6.04 3.06 13.95 <sup>**</sup> (24.7)
Large	4	7.25 5.5	43.75 <sup>**</sup>	9 9.71 6.83 2.88 9.33 <sup>**</sup> (24.1)
<b>GUAVA</b>				
Marginal				
Small	4	18.75 13.5	2.92NS	12 10.81 8.85 1.96 6.63 <sup>**</sup> (28.0)
Semi- medium	4	12.5 9.37	4.35 <sup>*</sup>	22 6.59 5.20 1.39 10.27 <sup>**</sup> (25.0)
Medium	9	10.0 6.34	5.66 <sup>**</sup>	41 5.95 4.12 1.83 14.71 <sup>**</sup> (36.6)
Large	5	8.4 5.80	4.33 <sup>**</sup>	22 5.18 3.16 2.02 12.68 <sup>**</sup> (30.9)
<b>MANGO</b>				
Marginal				
Small	4	14.25 11.75	2.50	2.50 3.00NS (17.5)
Semi- medium	4	12.5 9.37	4.35 <sup>*</sup>	22 6.59 5.20 1.39 10.27 <sup>**</sup> (21.1)
Medium	9	10.0 6.34	5.66 <sup>**</sup>	41 5.95 4.12 1.83 14.71 <sup>**</sup> (36.6)
Large	5	8.4 5.80	4.33 <sup>**</sup>	22 5.18 3.16 2.02 12.68 <sup>**</sup> (30.9)

Figures in parenthesis indicate percentage

It is encouraging to note that the percentage of reduction was found to be higher among the marginal and small farmers of banana, guava and mango cultivators.

The statistical appraisal of the data indicated that there was a significant reduction in post harvest losses of all the fruits selected, in all the farmers category except small farmers of mango and guava cultivators.

Marginal and small farmers expressed that they could reduce the post harvest losses by using proper method of handling fruits and vegetables, right time of harvesting, appropriate method of packing and recommended varieties. Whereas medium and large farmers felt that using proper pre harvest measures such as timely application of plant protection chemicals could reduce the post harvest losses significantly.

**b. Reduction in post harvest losses of vegetables**

Table XXXVI presents the impact of training on reduction in post harvest losses of selected vegetables.

TABLE XXXVI

EFFECT OF TRAINING ON PER CENT POST HARVEST LOSSES OF VEGETABLES

Farmers Category	Post harvest losses in percentage		Post harvest losses in percentage	
	n	Before Reduction 't'	n	Before After Reduction 't'
	BRINJAL			
Marginal			6	14.83 12.16 2.67 **
Small	9	15.22 11.15 3.77 (24.8)	15	10.13 8.06 2.07 **
Semi-medium	7	13.57 9.86 3.71 (27.3)	9	9.22 7.39 1.83 (19.8) **
Medium	10	9.10 6.5 2.6 (28.6)	9	7.33 5.00 2.33 (31.8) **
Large	7	9.71 7.14 2.57 (26.7)	7	5.43 3.79 1.64 (30.2) **
	LADY'S FINGER			
			6	14.83 12.16 2.67 **
Small	9	15.22 11.15 3.77 (24.8)	15	10.13 8.06 2.07 **
Semi-medium	7	13.57 9.86 3.71 (27.3)	9	9.22 7.39 1.83 (19.8) **
Medium	10	9.10 6.5 2.6 (28.6)	9	7.33 5.00 2.33 (31.8) **
Large	7	9.71 7.14 2.57 (26.7)	7	5.43 3.79 1.64 (30.2) **
	ONION			
Marginal	9	15.33 12.33 3.00 (19.57)	15	16.53 13.54 2.99 **
Small	19	13.10 10.10 3.00 (22.90)	40	13.72 10.68 3.04 (22.16) **
Semi-medium	19	8.89 6.54 2.35 (26.43)	36	13.27 10.54 2.73 (20.57) **
Medium	14	7.64 5.43 2.21 (28.93)	38	10.50 7.95 2.55 (24.28) **
Large	8	9.13 6.26 2.87 (31.43)	14	10.36 7.47 2.89 (27.89) **
	TOMATO			
Marginal	9	15.33 12.33 3.00 (19.57)	15	16.53 13.54 2.99 **
Small	19	13.10 10.10 3.00 (22.90)	40	13.72 10.68 3.04 (22.16) **
Semi-medium	19	8.89 6.54 2.35 (26.43)	36	13.27 10.54 2.73 (20.57) **
Medium	14	7.64 5.43 2.21 (28.93)	38	10.50 7.95 2.55 (24.28) **
Large	8	9.13 6.26 2.87 (31.43)	14	10.36 7.47 2.89 (27.89) **

Figures in parenthesis indicate percentage

\* Significant at 5 per cent    \*\* Significant at 1 per cent    NS Not significant

From this table it is clear that the reduction in post harvest losses was found to be higher among the marginal and small farmers than the other categories. The percentage reduction however indicated an overall range of 18.0 to 31.4 in all categories.

The statistical results revealed that there was a significant reduction in post harvest losses after training in all the vegetables selected except semi-medium and medium of onion cultivators.

The training thus had a good impact on the farmers bringing about statistically significant reduction in pre-harvest losses. The semi-medium and medium farmers were exceptions to this in terms of post harvest losses in onion.

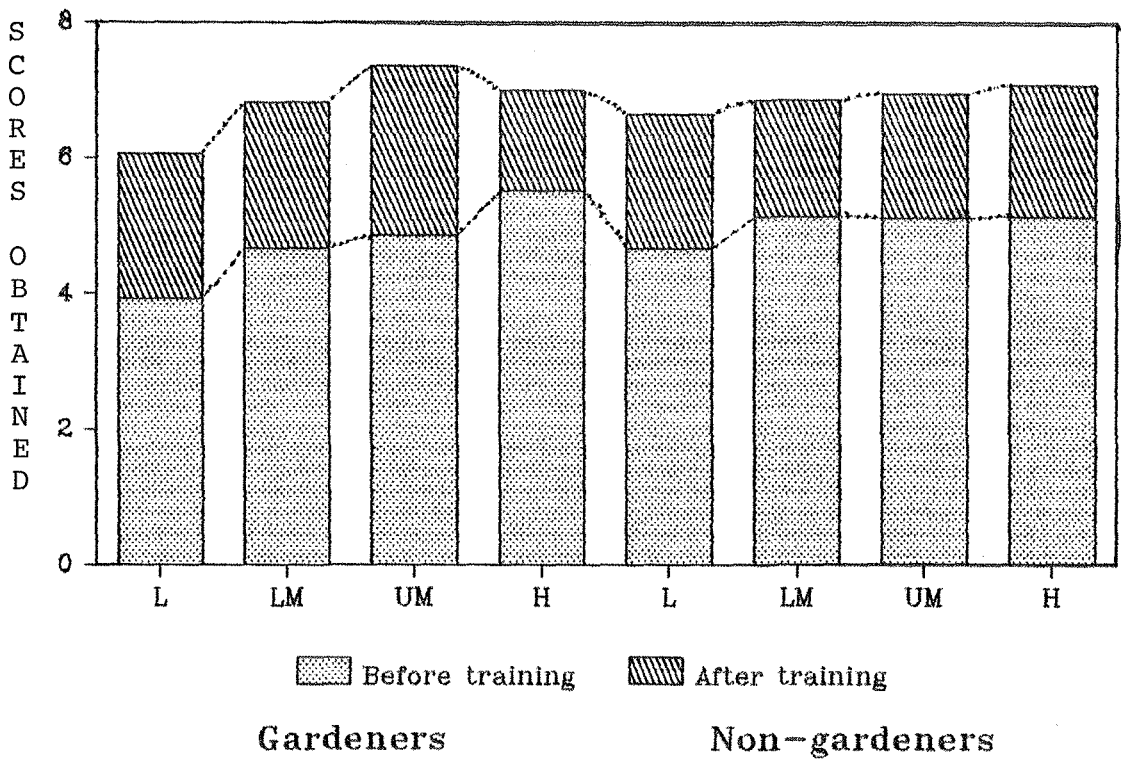
#### **4. Consumption pattern of fruits and vegetables**

The Table XXXVII and Figure 8 shows the impact of training on nutritional knowledge of housewives.

TABLE XXXVII

## IMPACT OF TRAINING ON NUTRITIONAL KNOWLEDGE OF HOUSEWIVES

Income group	Scores obtained by gardeners housewives		Scores obtained by non gardeners housewives	
	Before training	After training	Before training	After training
	Max.Scores 10.0			
Low (n=125)	3.92 <sub>±</sub> 1.21	6.06 <sub>±</sub> 1.36	4.66 <sub>±</sub> 1.65	6.65 <sub>±</sub> 1.57
Lower-middle (n=132)	4.66 <sub>±</sub> 1.47	6.81 <sub>±</sub> 1.47	5.14 <sub>±</sub> 1.50	6.86 <sub>±</sub> 1.61
Upper-middle (n=84)	4.86 <sub>±</sub> 1.46	7.35 <sub>±</sub> 1.44	5.12 <sub>±</sub> 1.61	6.94 <sub>±</sub> 1.44
High (n=24)	5.52 <sub>±</sub> 1.60	7.0 <sub>±</sub> 1.64	5.14 <sub>±</sub> 1.09	7.08 <sub>±</sub> 1.10



L - Low LM-Lower middle UM-Upper middle H-High

Figure 8 IMPACT OF TRAINING ON NUTRITIONAL KNOWLEDGE OF HOUSEWIVES

From this table it is clear that the nutritional knowledge scores of the selected housewives ranged between 3.92 and 5.14 before training and after training it increased from 6.06 to 7.35 out of 10.0. Though the non gardeners housewives before training scored more than their counterparts, after training gardeners housewives, upper middle and high income groups obtained higher scores than their counterparts.

The impact of training on quantity of fruits and vegetables consumed by the target households is given in Table XXXVIII.

TABLE XXXVIII

## IMPACT OF TRAINING ON QUANTITY (g) OF FRUITS AND VEGETABLES CONSUMED

Income group	Quantity (g) consumed					
	Gardeners			Non gardeners		
	Before	After	't'	Before	After	't'
<b>Low income (n:125)</b>						
Leafy vegetables	12.7	15.9	2.2 <sup>*</sup>	13.1	16.9	2.05NS
Other vegetables	20.2	25.0	1.6NS	18.8	23.6	0.69NS
Roots and tubers	18.2	22.2	3.05 <sup>**</sup>	15.3	19.6	3.40 <sup>**</sup>
Fruits	14.5 <sup>†</sup>	17.9	3.23 <sup>**</sup>	12.8	16.1	3.65 <sup>**</sup>
<b>Lower middle (n:132)</b>						
Leafy vegetables	11.5	13.1	3.54 <sup>**</sup>	8.2	10.2	1.78NS
Other vegetables	31.2	37.6	2.24 <sup>**</sup>	25.0	30.2	2.31 <sup>*</sup>
Roots and tubers	21.2	25.5	3.82 <sup>**</sup>	21.4	25.4	1.08NS
Fruits	25.6	30.9	1.86NS	25.1	30.7	0.66NS
<b>Upper middle (n:84)</b>						
Leafy vegetables	14.5	18.2	2.6 <sup>*</sup>	11.7	13.7	5.4 <sup>**</sup>
Other vegetables	41.4	50.9	1.22NS	36.6	43.9	1.23NS
Roots and tubers	25.4	31.3	2.0NS	28.4	32.1	2.2 <sup>*</sup>
Fruits	49.2	62.3	0.68NS	48.7	58.8	1.24NS
<b>High Income (n:24)</b>						
Leafy vegetables	15.4	19.6	2.08NS	14.5	17.6	2.05NS
Other vegetables	52.1	64.0	0.38NS	51.2	59.5	0.94NS
Roots and tubers	26.2	33.2	0.88NS	27.3	32.8	1.15NS
Fruits	68.6	84.3	0.29NS	60.4	69.2	0.71NS

\* Significant at 5 per cent

\*\* Significant at 1 per cent

NS Not significant

Training brought an awareness on the importance of including fruits and vegetables in the day's diet which was reflected in an increase in the consumption pattern of both fruits and vegetables in all the target families of gardeners and non gardeners. The highest increase was found in fruits while the lowest was noticed in leafy vegetables.

Statistical appraisal indicated significant increase only in the low and lower-middle income groups of gardeners, while the target households of high income group in both gardeners and non gardeners did not show any significant difference.

# Summary and Conclusion

## V SUMMARY AND CONCLUSION

Fruits and vegetables are store houses of nutrients with particular reference to vitamins and minerals and are indispensable for the human diet. Though India is a large producer of fruits and vegetables, the present production of fruits and vegetables in the country is far below the requirement of rapidly growing population. More than thirty per cent of the total production of fruits and vegetables valued about Rs. 3000 - 4000 crores goes waste annually due to inadequate infrastructure and inputs for post harvest loss reduction. Reduction in post harvest losses is a complementary means of increasing production. The cost of preventing loss in general is less than that of producing. Losses to harvested produce may be of quantity or quality and may occur separately or together. Post harvest losses can be reduced to a great extent by selection of suitable varieties for longer shelf life, improvement of pre harvest factors and harvesting techniques, proper method of handling, marketing, packaging, transport and storage.

In view of the above facts an attempt was made in this research project to assess the production, post harvest losses and consumption pattern of fruits and vegetables in the selected farm households of Coimbatore district.

The methodology followed in the present study consisted of three phases namely preliminary phase, training phase and evaluation phase. Steps involved in the preliminary phase were selection of target area and group, formulating interview schedules and survey of production, post harvest losses and consumption pattern of fruits and vegetables.

(Three stage stratified random sampling technique was adopted to select the target farmers. Three blocks namely Thondamuthur, Anaimalai and Udumalpet were selected based on the area of production of fruits and vegetables. From each block, four villages were selected at random based on production of fruits and vegetables making the total number of 16 villages. From each village 30 per cent of farmers growing fruits and vegetables in each land holding category was selected as the target group.

(Consumption pattern of fruits and vegetables was studied in <sup>730</sup> households of gardeners and non gardeners.) Taking into account of income classes, 730 households were selected distributing equally in both gardeners and non gardeners.

#### **Pr~~e~~liminary Phase**

The results obtained in preliminary phase are summarised as follows:

1. The maximum percentage (29.6) of farmers were under the group of medium size land holdings as against 9.4 per cent in the marginal group. The large farmers constituted only 11 per cent of the target farmers.
2. Illiteracy was the highest among the marginal farmers namely 53 per cent as against five per cent in large farmers. Land holding had a positive influence on the educational and economic status of the farmers.
3. Relatively a higher percentage (44.4) of marginal farmers kept their land as uncultivated due to water scarcity.
4. One third of the marginal farmers raised horticultural crops on more than 50 per cent of the cultivable land as against 12.5 per cent of large farmers.
5. Fruits namely banana, grapes, guava and mango and vegetables viz., brinjal, lady's finger, onion and tomato were cultivated by large number of farmers surveyed and hence they were selected to assess the production and post harvest losses.
6. The average productivity of grapes, guava and mango was higher than the state average. In vegetables the mean productivity was found to be less than the state average yield except onion. Land holding size significantly affected the production of fruits except guava while for vegetables there was no significant difference between production and land holding.

7. Educational status, per capita income and the years of experience of the farmers were positively correlated with the production of banana, grapes, guava and mango. Productivity of brinjal, tomato and onion was positively related with the educational status and per capita income of the farmers while the years of experience of the farmers were correlated negatively.
8. Maximum post harvest losses were found in banana (26.5 per cent) and brinjal (26.0 per cent) and the minimum ✓ in onion and mango to the tune of 15.3 and 14.3 per cent respectively. Post harvest losses were significantly higher among marginal and small farmers as against other categories in all the fruits and vegetables selected.
9. Losses due to insects and pests were found to be the greatest amounting to twenty per cent. Rough handling, improper packing and poor transport were other reasons leading to losses to the extent of 2-10 per cent. Adverse environmental conditions resulted in losses to the tune of 5-10 per cent.
10. All fruits and vegetables cultivated were marketed immediately after harvesting, setting aside a portion for home needs due to lack of storage facilities or to meet the present expenditure incurred or to clear off their debts.

11. The producers' (farmers) share in consumer rupee was found to range between 35 and 60 per cent. It was observed in the field investigation that the crucial problems faced by the farmers were unhelpful attitudes of commission agents, long chain of middle men, irregulated markets, malpractices in the markets, absence of storage and transport facilities, and exhorbitant transport costs.
12. Farmers cultivating onion, stored 20-80 per cent of their produce in 'padals' a storage structure made of bamboo sticks for about three months.
13. The main causes of losses in onion were rotting, sprouting and weight loss. The losses due to decay and weight loss ranged between five and twenty per cent each as against five per cent due to sprouting.
14. In the large farmers, knowledge as well as adoption index were the highest which may be attributed to their economic and education status. Though the knowledge index of the marginal and small farmers was comparable to those of the medium and large farmers, in practices such as use of recommended variety, fertilizer and plant protection measures, the adoption index to those practices was very low or nil due to their economic constraint.

The consumption pattern of fruits and vegetables of the target households indicates that:

1. The selected households were predominantly nuclear (80.1 per cent) with lesser proportion of joint family structure. A majority of the households were found to be non-vegetarians among the gardeners households. Regarding the family size, medium size families dominated in both the groups followed by small and large.
2. There was a significant association between the income and educational status of the housewives in both gardeners and non gardeners families.
3. Food constituted the main item of expenditure taking 62-63 per cent of total family income in low income groups whereas high income families spent only 25 per cent of their income on food. There was a significant reduction in the percentage of amount spent on food items as the income increased.
4. Low income households spent 41.5 per cent on cereals against to 24 per cent by high income group households. In pulses there was not much difference between the percentage of amount spent among the gardeners and non gardeners group at all income levels. Of the total food expenditure 9-11 per cent was spent on vegetables and fruits. Non gardeners spent more on fruits and vegetables than their counterparts.

5. Majority of the low income group households consumed greens (43.2 per cent) weekly thrice, and fruits (62 per cent) once a fortnight. In high income families greens and tubers were consumed weekly thrice by 50 per cent of the families and 29 per cent families consumed fruits daily. The consumption of fruits was found to be based purely on season and local availability.
6. Leafy vegetables were preferred when fresh and consumed on the same day of purchase. None of the families stored the greens for more than 2 days. Roots and tubers and fruits were stored between one and two weeks.
7. Among the 730 families surveyed, 179 gardeners and 102 non gardeners families possessed kitchen garden while others reported lack of space and time, shortage of water and maintenance problems as reasons for not having kitchen garden.
8. Papaya was tabooed among the pregnant women for the fear of causing abortion. Fruits like mango, pineapple and papaya were considered as 'hot' while fruit juices were considered 'cold'.
9. The target group consumed 6-12 per cent of recommended intake of leafy vegetables, 24-70 per cent of other vegetables, 20-37 per cent of roots and tubers. In fruits among the low and lower middle income families

the per capita intake was found to be lower than the recommended intake of 30g/day whereas it was higher among the other two groups.

10. Economic condition, quality aspects such as freshness and availability influenced the places of procurement. Fruits and vegetables were procured weekly once or twice by the high income groups whereas low income group preferred to buy it then and there due to their financial constraint.
11. The mean nutrition knowledge scores obtained by the housewives ranged between 3.92 and 5.52 out of 10.0. Non gardeners housewives scored higher than their counterparts at all income groups except of low income group.

### **Training Phase**

A four day training was given to farmers on improved cultivation practices and methods of reducing post harvest losses to ensure per capita availability of fruits and vegetables. Selected housewives were trained on simple storage practices of fruits and vegetables, desirable method of cooking vegetables, simple home level preservation methods for fruits and vegetables and kitchen gardening. After six months, the impact of training was evaluated in terms of extent of adoption of improved cultivation and post harvest practices, reduction in post harvest losses,

improvement in production, nutritional knowledge and consumption pattern of fruits and vegetables.

### **Evaluation Phase**

The findings of the evaluation phase are presented below.

1. The increase in overall knowledge index was greater in the marginal and small farmers compared to the medium and large farmers which did reflect the impact of training. The increase in adoption index ranging between 9.0 to 13.0 in all categories of farmers was also encouraging. However the marginal and small farmers with paucity of inputs and economic constraint could not adopt plant protection measures and improved methods of packaging in large measures.
2. The mean productivity of the selected fruits and vegetables was increased after training. Small and marginal farmers were greatly benefited by the training and brought remarkable results in increasing the production in banana and mango on par with the large farmers. Statistical appraisal indicated significant increase.
3. There was a significant reduction in post harvest losses of all the fruits and vegetables selected in all the farmers categories except marginal farmers

cultivating mango and small farmers cultivating guava. The marginal and small farmers could bring reduction in post harvest losses of banana and guava after training on par with the large farmers inspite of their limited resources which again indicated that proper training could bring in motivation of farmers to conserve whatever they produce.

4. Training also brought out improvement in the nutritional knowledge of housewives of both gardeners and non gardeners as reflected in the scores obtained by them after training. The scores increased to the tune of 1.5 and 2.5.
5. Training brought an awareness on the importance of including fruits and vegetables in the day's diet which was reflected in an increase in the consumption pattern of both fruits and vegetables in all the target families of gardeners and non gardeners. The highest increase was found in fruits while the lowest was noticed in leafy vegetables. Statistical appraisal indicated significant increase only in the low and lower middle income group of gardeners, while the target households of high income group in both gardeners and non gardeners did not show any significant difference.

### **Limitations of the Study**

As the study was confined to the selected fruits and vegetables in the target area, it was not possible to examine the extent of losses of others fruits and vegetables raised by the farmers. Further the study was conducted in a particular agro-climatic region and hence conclusions drawn are more relevant to the area studied. Hence in making generalisation utmost caution is needed. Despite this limitation best efforts were put forth to make the study as objective as possible.

### **Implications of the Study**

The study indicated an alarmingly low intake of fruits and vegetables by the target households. A detailed examination of the whole production and post harvest system is necessary for individual crops or producer/market situations. Low production was one of the factors and the reasons attributed to this were inadequate and less reliable irrigation facilities, high price of fertilizers, plant protection chemicals and quality seeds.

Fruits and vegetables being highly perishable, losses after harvest were great due to insects, pest, improper harvesting and poor handling, transport and storage and adverse environmental conditions. Marketing of the produce met problems of high commission charges, too may

intermediaries and prohibitive transport cost. Another aggravating problem for the low dietary intake of fruits and vegetables was ignorance of the housewives on the role of these protective food items in the day's diet.

A plan to prevent losses needs to be developed through the use of better varieties, proper handling, packaging and storage facilities. Proper marketing arrangements along with price support are essential to motivate the marginal and small farmers. Awareness programmes on nutrition gardens and kitchen garden and nutrition education need greater emphasis.

A thorough and scientific plan of action is necessary to devise solutions to the above. It should be a comprehensive governmental and non governmental effort. Such a step is imperative so that the vital requirements of the ever increasing population are met at an adequate level.

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# Appendices

APPENDIX A

NAME OF INSECTS <sup>N</sup><sub>AD</sub> PESTS CAUSED LOSSES IN FRUITS AND  
VEGETABLES

Commodity	Common name	Scientific name
Okra	Fruit borer	Earias insulana
Chilli	Bud borer	Euryfoma species
Tomato	Fruit borer	Helicoverpa armigere
Brinjal	Fruit borer	Leucinodes ordonais
Cabbage	<sup>A</sup> <sub>^</sub> Diamond backmoth	Plutella xylostella
Pea	Aphids	Acyrtosiphon pisum
Colocasia	Aphids	Aphids gossypi
Sweet potato	Weevil	Cylas formicarius.F.
Yam	Termites	Odontotermes escherichi
Cassava	Termites	Odontotermes sp.
Sweet orange	Thrips Mites	Paratetranychus citri
Mango	Mango hopper	Amritodus atkisoni
	Fruit fly	Dacur ferrugineus.F. dorsalis.H.
Grapes	Flea beetle	Sulodonta strigicollis
	Mealy bug	Maconellicoccus hirsutus
	Thrips	Phipiphorothrips cruentatus.H.
Guava	Tea mosquito bug	Helopettis antonii

**APPENDIX B**

**LIST OF VILLAGES AND NUMBER OF FARMERS SELECTED FOR THE STUDY**

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Block and Village	Marginal	Small	Semi-medium	Medium	large	Total
<b>THONDAMUTHUR BLOCK</b>						
Thondamuthur	7	17	12	2	-	
Madampatti	6	9	10	15	5	
Vadavalli	3	5	4	3	3	
Pooluvapatti	4	10	7	4	-	
Total	20	41	33	24	8	126
<b>ANAIMALAI BLOCK</b>						
Sethumadai	2	3	4	9	8	
Kaliapuram	2	11	10	11	3	
V.K.pudur	-	6	4	17	6	
Devi patnam	-	6	5	8	1	
Total	4	26	23	45	18	116
<b>UDUMALPET BLOCK</b>						
Jallipatti	2	5	10	12	2	
Elaiyamuthur	4	5	7	10	4	
Dhali	3	7	11	9	3	
Manupatti	3	6	7	8	5	
Total	12	23	35	39	14	123
Total	36	90	91	108	40	365

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**APPENDIX C**

**INTERVIEW SCHEDULE TO ELICIT DETAILS ON PRODUCTION  
AND POST HARVEST LOSSES OF FRUITS AND VEGETABLES**

Date:

District:

Block :

Village :

Hamlet :

Name of the Farmer : Educational Status :

Address :

**I. PARTICULARS OF THE FAMILY BACK GROUND**

Name	Relation to Head	Age	Educational status	Marital status	Occupation	Income per month (Rs.)
------	------------------	-----	--------------------	----------------	------------	------------------------

-----  
Total Income Rs.

Monthly per capita income : Rs.

**II. LAND HOLDINGS AND CULTIVATION**

Type of land	Area (Acres)	Crops cultivated
Wet land		
Dry land		
Garden land		

**III. AREA OF LAND KEPT UNCULTIVATED**

Type of land	Area in acres
Wet land	
Dry land	
Garden land	

**Reasons**

1. Water scarcity
2. Unprofitable
3. Engaged in other work
4. Others (specify)

**IV. CROPPING PATTERN FOR HORTICULTURAL CROPS**

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Name	Variety	Season	Area
------	---------	--------	------

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*Fruits*

- 1.
- 2.
- 3.

*Vegetables*

- 1.
- 2.
- 3.

- 
- Reasons for less area under horticultural crops if noticed :
  - Problems in raising fruits and vegetables in your farm :

**V. PRODUCTION AND UTILIZATION**

---

Name of the fruit and vegetable	Quantity produced	Total production kg/cropping	Methods of use		
			Sale	Personal use	Processing

---

**VI. QUANTITY OF FRUITS AND VEGETABLES LOST DURING POST HARVEST OPERATIONS**

Name of the fruit and vegetable	Losses (kg)/Acre during				
	Harvesting I	Handling II	Storage III	Others	Total Loss

I	II	III
1. Insect	1. Bruising	1. Decay
2. Disease	2. Mechanical injury	2. Shrivelled
3. Small size	3. Grading	3. Sprouted
4. Over matured		4. Others

**VII. STORAGE PRACTICES**

Name of the fruits and vegetables	Type of storage container	Quantity stored (kg)	Duration of storage	Profit	Problems
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List out the fruits and vegetables taken to the market soon after harvesting

If yes,

Fruits :

Vegetables :

If No,

Do you adopt any storage technique?

Fruit/vegetable

Techniques adopted

### VIII. REDUCIBILITY OF LOSSES IN POST HARVEST FOOD SYSTEM

-----  
Operations

Technologically

Economically

-----  
Yes

No

Yes

No  
-----

Harvesting

Grading/Handling

Packaging

Marketing

Storage  
-----

### IX. MARKETING

-----  
1. Distance from village to  
Marketing place :

2. Mode of transport :

3. Price sold :

4. Whether the marketing price  
is on par with direct  
selling :

5. Problems encountered during marketing and suggestions to overcome

Problems

Suggestions



## II. FAMILY MONTHLY EXPENDITURE PATTERN

Particulars	Amount Spent per Month (Rs.)	Percentage of family Monthly Income
Food		
Clothing		
Shelter		
Medicine		
Education		
Transport		
Utensils		
Remittance		
Savings		
Recreation		
Others	i)	
	ii)	

### III. FOOD EXPENDITURE PATTERN

Food Items	Amount Spent (Rs.)	Percentage
Cereals		
Pulses		
Green leafy vegetables		
Roots & Tubers		
Other Vegetables		
Fruits		
Fats and Oils		
Milk & Milk products		
Fleshy foods		
Sugar & Jaggery		
Prepared foods		
Beverages		

### IV. PURCHASING AND CONSUMPTION PATTERN OF FRUITS AND VEGETABLES

1. Frequency of consumption of fruits and vegetables.

Commodity	Daily	Once in 2 days	Twice a week	Once in fortnight
Greens				
Roots & Tubers				
Other Vegetables				
Fruits				

2. From where it is purchased/obtained?

1. Nearby shop/farmhouse
2. Daily Market
3. Weekly sandi
4. Kitchen Garden

3. Purchasing method of fruits and vegetables

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Fruits/Vegetables kg.	Amount purchased (g)	Amount spent (Rs.)	Frequency of purchasing
--------------------------	----------------------------	--------------------------	-------------------------

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**Greens**

1. Araikeerai
2. Amaranth

**Roots and Tubers**

1. Potato
2. Carrot
3. Tapioca
4. Beetroot
5. Yam
6. Knol Khol
7. Turnip

**Other vegetables**

1. Brinjal
2. Lady's Finger
3. Tomato
4. Onion



Other Vegetables

1

2

3

Fruits

1

2

3

---

Reasons for not having kitchen garden

- a. Unawareness
- b. No time
- c. No Experience
- d. Water Scarcity
- e. Difficult to maintain
- f. Any other

Mention the benefits of kitchen garden

- a. Cheaper
- b. Use fresh fruits and vegetables
- c. Variety
- d. Free from chemicals

V. METHODS OF STORAGE AND LOSSES OF FRUITS AND VEGETABLES

Commodity	Methods of Storage I	Shelf life	Kind of Loss II	Amount of Loss (g/100g)	Value Rs.
-----------	-------------------------	------------	--------------------	----------------------------	--------------

Green leafy vegetables

1

2

3

Roots & Tubers

1

2

3

Other vegetables

1

2

3

Fruits

1

2

3

I. Methods of storage

1. Keeping in polythene bags
2. Keeping in Plastic baskets
3. Keeping in bamboo baskets
4. Keeping in Wet cloth
5. Keeping in a Vessel  
Containing water
6. Any others

- a.
- b.
- c.

II. Kind of loss

1. Loss in weight
2. Wilting
3. Rotting
4. Fungal attack

VI. PRESERVATION OF FRUITS AND VEGETABLES

I. Are you preserving fruits and vegetables in glut reason?

Yes \_\_\_\_\_ No \_\_\_\_\_

1-a. If yes, mention the method of preserving

Vegetables/Fruits

Methods

Fruits 1

1. Jam

2

2. Jelly

3

3. Squash

4

4. Pickle

5

5. Vadam

6

6. Vathal

Vegetables

1

2

3

1-b. From where have you learnt the preservation technique?

Nearby home/friends  
T.V/Radio

Demonstrations through institutions  
Others

a.

b.

c.

2. If not what is the reason?

i. No time

ii. Do not know the preservation techniques

iii. Materials required for preservation is not available

iv. Any others

a.

b.

c.

3. Mention the advantages of preservation

i. Long shelf life

ii. We can use during non seasons

iii. Profitable

iv. To prevent losses (Spoilage)

v. Any others

a.

b.

c.

4. Do you have any problem in preserved food items?

Yes \_\_\_\_\_ No \_\_\_\_\_

If yes,

Method	Drawbacks
--------	-----------

Jam	
-----	--

Jelly	
-------	--

Squash	
--------	--

Pickle	
--------	--

---

Vadam	
-------	--

## VII. DIETARY PRACTICES AND COOKING METHODS OF FRUITS AND VEGETABLES

### 1. Methods of Eating

Commodity	Fresh/raw	Cooked
-----------	-----------	--------

#### Greens

1.

2.

3.

#### Roots and Tubers

1.

2.

3.

#### Other Vegetables

1.

2.

3.



6. Fruits and vegetables avoided during special condition

Special condition	Fruits/vegetables avoided	Reason
1. Children		
2. Pregnancy		
3. Lactation		
4. Old age		

7. Do you avoid any fruits and vegetables due to allergy?

Yes \_\_\_\_\_

No \_\_\_\_\_

If yes,

Fruits/Vegetables	Reasons
Vegetables	1.
	2.
	3.
Fruits	1.
	2.
	3.

8. Day's consumption of fruits and vegetables

Food stuff	Amount (g)
Leafy vegetables	
1.	
2.	
3.	

### Other vegetables

- 1.
- 2.
- 3.

### Roots and Tubers

- 1.
- 2.
- 3.

### Fruits

- 1.
  - 2.
  - 3.
- 

### Nutritional Knowledge

1. Why should we include fruits and vegetables in a day's diet?
  - i. Energy giving
  - ii. Body Building
  - iii. Protecting and regulating our body
2. Which is the best method of cooking green leafy vegetables
  - i. Cooking in excess water for long time
  - ii. Cooking in a closed vessel
  - iii. With adequate water for short period

3. Which is the best method of cooking vegetables?
  - i. Cutting into small pieces
  - ii. Cutting into large pieces
  - iii. Cutting into medium size pieces
4. What will happen if you cut the vegetables into small pieces?
  - i. Cook well
  - ii. Mashed
  - iii. Losses of nutrients
5. Mention the foods required for good eye sight
  - i. Rice, Dhal
  - ii. Greens, Papaya, Mango
  - iii. Ground nut, Coconut
6. Mention the foods required for preventing anaemia
  - i. Milk, egg
  - ii. Dhal, rice
  - iii. Greens, Sundaikai
7. a. Bleeding gums is due to what?
  - i. Lack of Iron
  - ii. Lack of Vitamin A
  - iii. Lack of Vitamin C
  - b. Mention the foods rich in Vitamin C
    - i. Apple
    - ii. Banana
    - iii. Amla

8. Is dietary fibre essential for our body?

Yes \_\_\_\_\_

No \_\_\_\_\_

If yes, for what

- i. To eliminate the stools easily/prevent diverticulosis.
- ii. Energy giving
- iii. Body building

9. Is calcium essential for our body?

Yes \_\_\_\_\_

No \_\_\_\_\_

If yes, for what,

- i. Energy giving
- ii. For Teeth & bone
- iii. Body building

10. Mention the foods rich in calcium

APPENDIX E

TRAINING MATERIALS DISTRIBUTED TO THE TARGET GROUP

I CULTIVATION TECHNIQUES

Cultivation practices	MANGO	BANANA	GRAPES	GUAVA
1. Recommended variety	Neelam, Bangalora Rumani, Malgova, Panganapalli, PKMI	Robusta, Poovan Monthan, dwarf, Cavendish, CO1	Anab-E-Shahi, Bangalora, Gulabi, Thompson seedless	Lucknow-46, Lucknow-49, Allahabad
2. Planting season	June - December	June - July	January- March	June- December
3. Spacing	10 x 10 metre	27 x 1.2 metre	3.0 x 1.5 m	6 x 6 m
4. Recommended fertilizer & manures kg/tree				
1st year				
a) Manure (farm yard)	10.000	20/pit	75 kg	30 kg
b) Ammonium sulphate Urea	1.000 or 0.440	55g/plant	1.25	1
c) Super phosphate	1.250	35g/plant	2.0	1.25
d) Muriate of potash	0.500	165g/plant	0.8	0.35
For a well grown tree				
5. Plant protection				
a) Manure	50.000	20/pit	200	50.00
b) Ammonium sulphate or	5.000 2.200	55g/plant	1.0	4.85
c) Super phosphate	6.250	-	1.0	6.25
d) Muriate of potash	2.500	265g/plant	1.0	1.70

5. Plant protection	1. Stem borer: put celphos tablet inside the tunnel and close it with clay-Apply 0.05% emulsion of nuvacron in each hole & plug with mud paste	1. Rhizome weevil BHC 10% - 20g/ plant 2. Banana Aphid Dimecron 250 ml/ha or Rogar 500ml/ha Nuvacron 250ml/ha	1. Thrips metasystox 2 ml/lit 2. Downy Mildew Karathane 7ml/lit	Fruit fly Malathian 1ml/lit Tea mosquitobug Malathian 1ml/lit
6. Special techniques	Hopper management phosphomidal 1ml/lit phesalone 1ml/lit.  Malformed panicle show: spray 5g urea in 1 litre water for flowering  Mango malformation Spray naphthalein Acetic acid at the rate of 200 ppm.	Kottai Vazhi in spray 2,4-D25 ppm within a week after opening of last hand	Spray 1% Urea + 0.5% copper sulphate in March and October	High seed content in the fruit is undesirable feature. The unopened flower buds are sprayed with gibberellic at 100 ppm.

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Cultivation practices	BRINJAL	LADY'S FINGER	ONION	TOMATO
Recommended Variety	CO <sub>1</sub> MDU-12 CO <sub>2</sub> Annamalai	Pusavani, MDU <sub>1</sub> CO <sub>3</sub>	CO <sub>1</sub> , CO <sub>2</sub> , CO <sub>3</sub> , CO <sub>4</sub>	CO <sub>1</sub> , CO <sub>2</sub> PKM <sub>1</sub> Pusa <sub>1</sub> Ruby
Planting Season	May - Oct.	June - Aug.	Oct. & Nov	June - Nov
Spacing	70 x 50 cm	45 x 30 cm	45 x 10 cm	60 x 30 cm
Recommended Fertilizer and manuers /Ac(kg)				
a. Manure(farm yard) (tonnes)	10	10	10	10
b. Ammonium Sulphate	44	18	26	44
c. Super phosphate	120	120	150	125
d. Muriate of potash	32	20	20	20
Urea	After 40 days 44kg	After 30 days 18kg	After 30 days 26kg	After 30 days 44kg
Plant protection	Stem borer & Fruit borer entosulphan 1.5ml/lit cevin 50%	Stem borer entosulphan 35cc 1.5ml/lit Powdery Mildew spray wettable sulphur 2g/lit  Yellow mosaic virus Chlorphiriphos 2.5ml + Neem oil 2ml/lit.	Aphids metasytox 1ml/lit	Fruit borer cevin 50% 2g/lit
6. Special techniques	To increase the yield spray 2 ppm try continol +Boran 4 ppm after 15th day of planting	Mix the seeds with rice porridge, add 0.8kg azospirillum dry it in shade for 30 min.	Spray 200 mg maleic hydr-oxide per lit before 15 days of harvesting to prevent sprouting during storage.	Mix the seeds with rice porridge, add 80g azospirillum dry it in shade for 30 mts.

## II HOME GARDENING

Fruits and vegetables play an important role in providing a balanced diet for human beings through the supply of essential vitamins, minerals, calories, dietary fibre, carbohydrate and protein. They add variety to the daily menu. Household gardens represent a direct, cost effective and ecologically sound strategy for tackling the socio-economic and nutritional needs of the people.

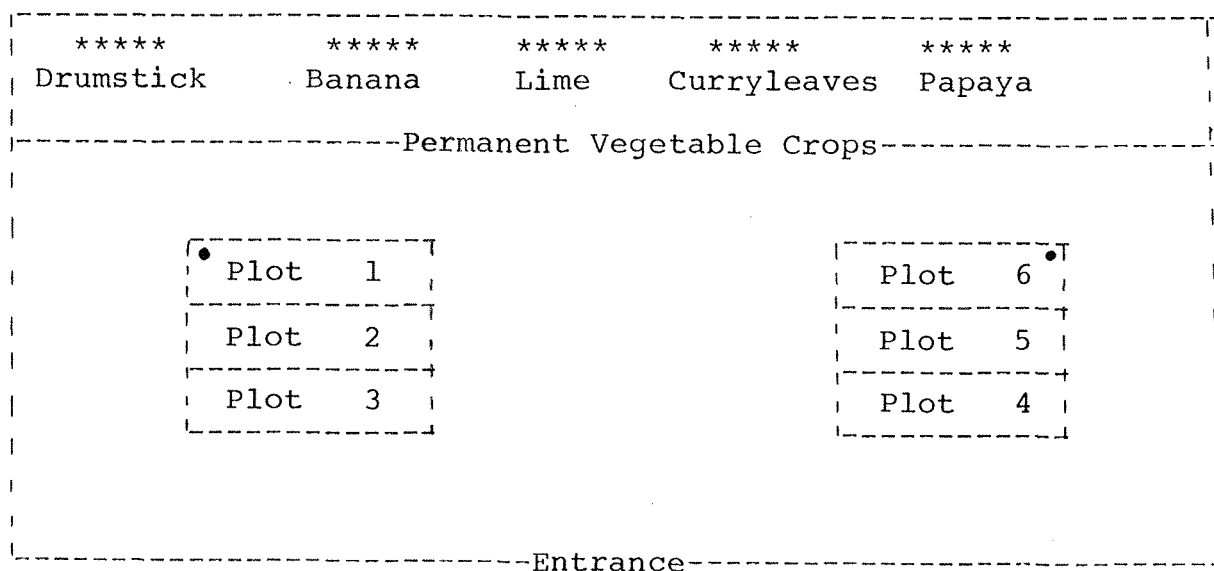
Vegetables like tomato, brinjal, chillies, cabbage, cauli-flower, drumstick, greens and fruits like amla, papaya, acid lime, curry leaves are to be raised in the kitchen garden. The plants need manuring for higher yield. In addition to farm yard manure, give a fertilizer mixture a month after planting. The mixture may contain 100 gms in each of urea, super phosphate and muriate of potash. In addition apply cowdung solution also.

Plants should be watered during evening hours once in 2 or 3 days depending upon moisture content of the soil. Proper plant protection measures also are to be taken. Spray malathion (1 ml/lit of water) against pests. For mites and powdery mildew spray wettable sulphur (2.5 g/lit g water). Spray during early morning or evening with a mask covering the face.

Vegetables and fruits can be grown in kitchen garden during different seasons of year.

Plot	Name of vegetable/ fruit	Season of growing
Plot No.1	Brinjal and radish Lady's finger	June to September February to May
Plot No.2	Tomato or cluster- bean, Amaranthus	June to September January to February
Plot No.3	Lab Lab Brinjal	June to September October to January
Plot No.4	Cauliflower Amaranthus	October to January April to May
Plot No.5	Chillies and Onion Raddish, Brinjal	June to November February to May
Plot No.6	Chillies, cowpea	October to February March to May

#### MODEL KITCHEN GARDEN



Area 5 cent 50 x 44 ft.

• Composit pit

### III SELECTION OF VEGETABLES, FRUITS AND PRESERVATION METHODS

We do not get vegetables and fruits in all seasons, fruits and vegetables provide the vitamins and minerals which are necessary for our body, so it is necessary to include them in our daily diet. If we know to preserve them, we can procure them when they are cheaply available and preserve them which can be used later.

#### Selection methods

- 1) Fresh vegetables and fruits which are unbruised and undamaged.
- 2) Purchase the seasonal vegetables which are locally available.
- 3) Purchase in large amounts from vegetable shops and weakly sandy.
- 4) Purchase in large amounts when seasonally available and preserve.

#### Criteria for selecting fruits and vegetables

- Plantain : Should be of good colour, firm and free from bruises.
- Apple : Firm, good colour and fruits without cuts.
- Grapes : Good healthy bunches, without rots and discoloured once, stems green and pliable.
- Lime : Good yellow coloured, firm and heavy fruits.

Guava : Undamaged, firm fruits.

Pineapple : With good smell, colour from green to yellow the pines should be easily pluckable and the fruit should be heavy.

Orange : Should be green or yellow in colour with new skin, firm, bright and heavy fruits.

Beetroot : Deep red in colour, round in shape.

Brinjal : Should be tender and not affected by the insects.

Cabbage : Solid, fresh with green leaves on the top.

Carrot : Strong, good coloured and green at the top, crisp rather than flabby.

Lady's finger : easily bent, fresh and green without insect infestation.

Onions : Solid, dry and without rots.

Potato : Solid without green coloration, and undamaged.

#### **Desirable Methods Of Cooking Vegetables**

- 1) Pluck the vegetables whenever necessary and use them immediately, when vegetables become dry, the vitamin-C content is reduced.
- 2) Wash the vegetables before cutting, do not soak them in water after cutting.
- 3) The vitamins and minerals are present closer to the skin. So cooking with the skin is better, if necessary they can be trimmed slightly.

- 4) Cut the vegetables into large pieces, when they are cut into small pieces there is a heavy loss of vitamins.
- 5) Add the vegetables to small amount of boiling water and cook them for a short time with closed lid.
- 6) Do not fry or cook for a long time.
- 7) Do not discard the cooked water. 8) do not add soda to the vegetables while cooking.

#### **Why Should the Vegetables and Fruits be Preserved**

- 1) To store the seasonally available fruits and vegetables for a long time.
- 2) To prevent the wastage of fruits and vegetables when they are abundantly available.
- 3) Preserved foods also add variety to our meals.

#### **Methods of Preservation**

- 1) Salting, Pickling.
- 2) Preserving by boiling then drying.
- 3) Canning.
- 4) Squashes.

#### **Jam Varieties**

Common Measures : Mashed fruits - 1 tumbler  
Sugar - 1 tumbler  
Citric Acid - teaspoon

End point : When a small amount of jam is added to water in a plate, it should not spread.

Procedure to clean the bottles: Wash the bottles cleanly and dry them in sun. When hot jam is filled in the bottle, the bottle should be placed on a wooden board.

#### Tomato mango jam

Ripe tomato	- 1/4 kg
Mango	- 1 medium sized
Sugar	-1/4 kg
Citric Acid	- 1teaspoon

#### PROCEDURE

- 1) Wash the tomatoes in water.
- 2) Boil the washed tomatoes for 1 minute, peel off the skin and mash the tomatoes and filter them.
- 3) Peel the skin of the mangoes, cut them into small pieces and mash them well.
- 4) Add sugar and citric acid to the mashed fruit and keep mixing.
- 5) When it comes to the finishing stage, it should be filled in the bottle and stored.

## MIXED FRUIT JAM

### INGREDIENTS:

Papaya	- 1
Banana	- 2
Orange	- 2
Sapota	- 4
Black grapes	- 250 g
Guava	- 4
Sugar	- 1 kg.
Citric acid	- 10 g.

### PROCEDURE:

- 1) Remove the skin of papaya and orange, remove the seeds, cut and then cook.
- 2) Cut the guavas without removing the skin, and cook the grapes in a small amount of water separately and mash.
- 3) Remove the skin and seeds of the sapota and then mash.
- 4) Remove the skin of banana, cut into pieces and cook for 5 minutes with little water.
- 5) Mash the boiled fruits, remove the seeds and filter.
- 6) Measure the fruit pulp and add one part of sugar to one part of the pulp. Boil it in slow fire and stir continuously.

- 7) When it comes to the finishing stage, it is removed and filled in clean bottles.

#### GRAPE SQUASH

Grape juice	1 part
Sugar	2 parts
Water	1 part
Citric acid	1 teaspoon
Sodium benzoate	- little
Tonovin	- required amount

#### PROCEDURE

- 1) Select good fruits, Wash in water and cook with little amount of water.
- 2) Mash the cooked fruits and filter through the muslin cloth.
- 3) Add sugar and water and boil it.
- 4) Cool the sugar syrup and add the extract and tonovin.
- 5) Add a spoon of citric acid and sodium benzoate to a small portion of the extract, mix well until it is dissolved and add to the whole extract and mix thoroughly.
- 6) Fill it in clean bottles.

Method of Use : One tumbler of squash, three tumblers of water can be added and drunk.

Note : Squashes can be prepared with all kinds of fruits in the above said procedure but in the case of other potassium meta bi sulphate should be added instead of sodium benzoate.

#### **MANGO THOKKU**

**Ingredients:**

Mango - 2 large sized  
Dry chillies - 10 - 15  
Asafoetida - small amount  
Mustard - 1 teaspoon  
Fenugreek - 1 tablespoon  
Salt - required amount  
Gingely oil - 100 ml

#### **PROCEDURE**

Heat a small quantity of oil and add half the amount of fenugreek and dry chillies, roast them and powder. Wash the mangoes, remove the skin and grate. Roast the remaining fenugreek and asafoetida with little oil and powder it.

Heat the rest of the oil and add mustard, grated mango and turmeric powder, chilly powder, asafoetida powder, Mustard powder and salt. Mix well.

Remove the mixture from the stove when it does not stick to the vessel. Mix well, fill it in a bottle and keep it protected.

பழப்பயிர் சாகுபடி ஒழிப்புகள்

சாகுபடி விபரங்கள்	வாழை	மா	கொடியா	திராட்சை	
1. இரகங்கள்	புவதி, மொந்தி, கோ.1, ரொபட்டா	நீலம், பெருக்கூரா, பி. கோ. எம். 1	லக்ஷோ + 46, லக்ஷோ - 49, அலகாபாதி	அலாபி, சாகி, பெருக்கூர், புகு, குலாபி, தாய்லக் விதையிலாதது.	
2. நரும் பருவம்	ஜூன் - ஜூலை	ஜூன் - நவம்பர்	ஜூன் - நவம்பர்	ஜனவரி - மார்ச்	
3. இடைவெளி	2.7 1.2 மீட்டர்	10 10 மீட்டர்	6 6 மீட்டர்	3.0 1.5 மீட்டர்	
4. உரங்கள் (மரம் ஒன்றிற்கு) நட்ட முதல் வருடம் (கிலோ)				ஒரு ஏக்கருக்கு	
அ. தொழு உரம்	20.000	10.000	30.000	75.000	
ஆ. அம்மோனியம் சல்பேட் (அ) யூரியா	55 கி/மரம்	1.000	1.000	1.250	
இ. சூப்பர் பாஸ்பேட்	35 கி/மரம்	0.500	0.350	0.800	
ஈ. ஸுரியேட் சூப் பொட்டாஸ்	165 கி/மரம்		0.350	0.800	
நன்கு வளர்ந்த மரம் (கி)					
அ. தொழு உரம்	20/ குழி	50.000	50.000	200.000	
ஆ. அம்மோனியம் சல்பேட் (அ) யூரியா	55 கி/மரம்	5.000	4.850	1.000	
இ. சூப்பர் பாஸ்பேட்		6.250	6.250	1.000	
ஈ. ஸுரியேட் சூப் பொட்டாஸ்	165 கி/மரம்	2.500	1.700	1.000	
5. பயிர்ப் பாக்காப்பு			தக்கைப்புச்சி: பாசலேடு பசுசலோக் 0.05% [1.5 மிலி/லி (அ) பாஸ்டோமாய்டாகி 0.1 மிலி/லி. தலைகு துளைப்பாதி: கார்போபியூராதி 1 கரண்டி துளையில் இட்டு அடைக்கவும்	தேயிலை கொகப்பிச்சி: மாலசியாதி 1 மிலி/லி. பழ ஈ: மாலத்திய யாதி 1 மிலி/லிட்டர்	
6. சிறப்பு கொழித் தட்பங்கள்	கொட்டை வளரை: ஒகக் கொடுப்பாதி மூலம் 2, 4, 8. என்ற களைக் கொல்லி மருந்தை 1 கி/லி என்ற அளவில் கரைத்து தெளிக்க வேண்டும்.	பிச்சு உதிர்தல்: நாப்தலி அசிட்டிக் அமிலம் என்ற வகையில் 1 லிட்டர் நீருக்கு 20 கி வீசும் கரைத்து பிச்சு சிறியதாக இருக்கும்போது இருமுறை தெளிக்க வேண்டும்.	யூரியா 1% அதை நாக சல்பேட் 0.5% கரைசலை மார்ச் மீறம் அக்டோபர் மாதங்களில் தெளிக்கார் மகசூல் கடுகி. விளை அளிகழ்விள ரகங்களில் 100 பிபிஎம் என்ற அளவில் சிப்பரலிக் அமிலத்தை சயாரிசுத மொட்டுக்களில் மேல் தெளிக்கவும்		

**காரிகறி சாகுபடி குறிப்புகள் (ஏக்கருக்கு)**

சாகுபடி விவரங்கள்	தக்காளி	கத்தரி	வெகை	சிறிய வெங்காயம்
1. பருவம்	ஜூன்-நவம்பர் நவம்பர்-ஏப்ரல் ஏப்ரல்-செப்டம்பர்	மே-ஆக்டோபர் டிசம்பர்-மே	ஜூன்-ஆகஸ்டு மார்ச்சு-மே	ஏப்ரல்-மே ஆக்டோபர்-நவம்பர்
2. இரகம்	100-150 நாட்கள் வரை	135-160 நாட்கள்	100 நாட்கள்	65-85 நாட்கள்
3. இடைவெளி	60 30 செ.மீ. 60 45 செ.மீ.	75 50 செ.மீ.	45 30 செ.மீ.	45 10 செ.மீ.
4. அடி உரம்	தொழு உரம் 10டிகி யூரியா 44 கிலோ சூ. பாஸ்பேட் 125 கிலோ மூ. பொட்டாஷ் 20 கிலோ	தொழு உரம் 10டிகி யூரியா 44 கிலோ சூ. பாஸ்பேட் 120 கிலோ மூ. பொட்டாஷ் 32 கிலோ	தொழு உரம் 10 டிகி யூரியா - 18 கிலோ சூ. பாஸ்பேட் 120 கிலோ மூ. பொட்டாஷ் 20 கிலோ	தொழு உரம் 10டிகி யூரியா 26 கிலோ சூ. பாஸ்பேட் 150 கிலோ மூ. பொட்டாஷ் 20 கிலோ
5. பயிர் பாதுகாப்பு	1. இலைகளுக்கிடை வரல்கள் குளோரிபைரிபாஸ் 2.5 மில்லி வேப்பெண்ணெய் 2 மில்லி/லிட்டர் நீரில் 2. காய்ப்புழு: செவிச் 50 சதம் 2 கிராம்/லிட்டர் நீர் அல்லது எண்டோசல்பாஸ் 1.5மில்லி/லிட்டர் நீர்	தண்டுப்புழு: நட்ட மறிமம் 15மி நாளில் காய்ப்புழு: டெமிக் குருணை இட்டு, பிசி 15 நாட்கள் இடைவெளியில் 1 லிட்டர் நீருக்கு 1.5மில்லி எண்டோசல்பாஸ் அருகில் செவிச் 50 சதம் 2 கிராம் 1 லிட்டர் நீர் அளவில் மாறிமாறி தெளிக்கவும்	காய்ப்புழு: எண்டோசல்பாஸ் 35 இசி 1 லிட்டர் நீருக்கு 1.5 மில்லி வீசம் சாய்ப்பி நோமி: நனையுமி கந்தகம் 2 கிலோ/லிட்டர் நீர் வீசம். மஞ்சள் நரம்பு நோமி: குளோரிபைரிபாஸ் 2, 5மில்லி வேப்பெண்ணெய் 2மில்லி/லிட்டர் நீர்	
6. சிறப்புத் தொழில் திட்டங்கள்	விதைகட்டி தேவையான அளவு அரிசிகளில் சேர்த்து பிசி 80 கிராம் அசோஸ் பைரில்தை விதைகளில் மேல் தெளித்து கலக்கி நிறலில் 30 நிமிடம் உலர வைத்து, பிசி நாற்றிக்காவில் விதைக்கவும்.	நட்ட 15-ம் நாளும் மறிமம் பூக்களின் தருகத்தில் ஒருமுறை வரைகாசி வனாள் 2 பிப்ளம் போராஸ் 4 பிப்ளம் தெளித்து மகசூலை அதிகரிக்க கலாம்.	அரிசி கஞ்சியை விதை யுட்கி சேர்த்து நன்கு கலக்கி லிட்டப்பிசி, 0.8 கிலோ அசோல்பைரில்லத்தை டாவி நிறலில் 30 நிமிடம் காய வைக்கவேண்டும். இதனால் 10 கிலோ யூரியா சேமிப்பு செய்வலாம்.	சேமிப்புக்கிடத்தில் விதைகள் முளைக்காமால் இருக்க அளவடை செலி வதற்கு 15 நாட்களில் முடிபு 200 மில்லிகிராம் மெலியிக்ஹைட்ரேசைசைடு மருந்தை 1 லிட்டர் நீரில் கலந்து தெளிக்கவும்

**வீட்டுக் காய்கறித் தோட்டம்**

நமது தினசரி உணவில் காய்கறி, பழங்கள் மிகவும் அவசியமாகும். இவை புரதச்சத்துக்கள், கனிம உப்புக்கள், உயிர்சீ சத்துக்கள் ஆகியவற்றைக் கொடுப்பதோடு நோய் எதிர்ப்புச் சக்தியையும் அளிக்கின்றன. காய்கறி பழங்களின் விலை கூடக் கொண்டே போகின்றது. நம்மிடம் சிறிதளவு நிலமிருந்தாலும் அதில் ஏதேனும் காய்கறி பழங்களை நாமே பயிர் செய்து கொள்வதால் வீட்டுக்குத் தேவையான சத்துமிக்க காய்கறிகள் கிடைப்பதுடன் எஞ்சியதை பொருளிட்ட உதவுவதுடன் ஓய்வு நேரத்தை பயனுள்ள வகையிலும் பயன்படுத்தவும் காய்கறி பயிர்த்தோட்டங்கள் துணை செய்கின்றன.

**பருவத்திற்கேற்ற பலவகைப்பட்ட காய்கறி பயிரிடும் பருவங்கள்**

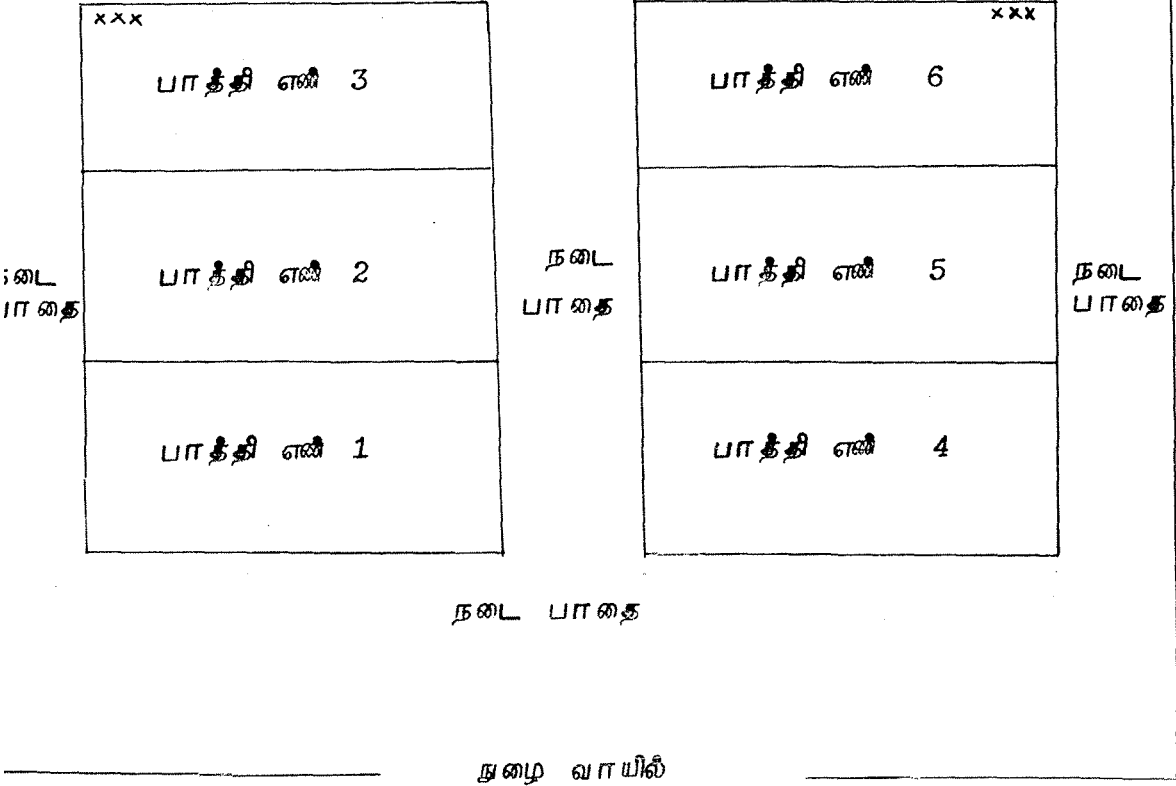
பாத்தி எண்	காய்கறி	பருவம்
1.	கத்தரி முள்ளங்கி முட்டைக்கோஸ் வெண்டை	ஜூன் - செப்டம்பர் அக்டோபர் - ஜனவரி பிப்ரவரி - மே
2.	தக்காளி பீட்டு கீரை	ஜூன் - செப்டம்பர் அக்டோபர் - டிசம்பர் ஜனவரி - பிப்ரவரி
3.	அவரை கத்தரி & டீனிப்	ஜூன் - செப்டம்பர் அக்டோபர் ஜனவரி
4.	வெண்டை காவிப்பளவர் கீரை	ஜூன் - செப்டம்பர் அக்டோபர் - ஜனவரி ஏப்ரல் - மே
5.	மிளகாய் & வெங்காயம் கீரை கத்தரி & முள்ளங்கி	ஜூன் - நவம்பர் டிசம்பர் - ஜனவரி பிப்ரவரி - மே
6.	பெரிய வெங்காயம் மிளகாய்	ஜூன் - செப்டம்பர் அக்டோபர் - பிப்ரவரி

மாதிரி வீட்டுக் காமிகறித் தோட்டம்

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முருங்கை	வாழை	எலமிச்சை	கருவேப்பிலை	பப்பாளி

பரப்பு 5 சென்ட்  
அளவு 50x44  
அடி

நிரந்தர காமிகறி  
பயிர்



# காய்கறி பழங்களை தேர்ந்தெடுக்கும் பதப்படுத்தும் முறைகள்

காய்கறி, பழங்கள் எல்லாக் காலங்களிலும் நமக்குக் கிடைப்பது இல்லை, காய்களிகளில் நம் உடலுக்குத் தேவையான உலோகச் சத்துக்களும் வைட்டமின்களும் அடங்கியுள்ளதால் தினசரி உணவில் அவற்றை நாம் சேர்த்துக் கொள்வது அவசியமாகும். கிடைக்கும் காலத்தில் அவற்றை எவ்விதம் தேர்ந்தெடுக்க வேண்டும். சமைக்க வேண்டும். மற்றும் பதப்படுத்த வேண்டும் என்பது பற்றி நாம் தெரிந்து கொள்வதால் விலை மலிவாக கிடைக்கும் காலத்தில் அதிகமாக வாங்கி பதப்படுத்தி பயன்படுத்தலாம்.

## தேர்ந்தெடுக்கும் முறைகள்

1. புதிய காய்களிகளாக, கீறல்கள், அடிபடாதவைகளாக தேர்ந்தெடுத்தல்
2. பருவ காலங்களில் உள்ளூரிலேயே பயிராகும் காய்கறிகளை வாங்குதல்.
3. வாரச் சந்தை, காய்கறிக் கடைகளில் மொத்தமாக வாங்குதல்.
4. பருவ காலங்களில் மொத்தமாக வாங்கி பதப்படுத்துதல்.

நல்ல காய்கறி பழங்களின் தன்மைகள்

வாழை : நல்ல நிறமுடைய திடமான அடிபடாதவையாக இருத்தல்.

ஆப்பிள் : நல்ல திடமான, நிறமுடைய, வெட்டுக்கள் இல்லாத பழங்கள்

திராட்சை : நல்ல செழுமையான கொத்தாக, அழகாததாக, நிறம் மங்காதது

எலுமிச்சை : நல்ல மஞ்சள் நிறமுடைய, எடையுள்ள, திடமான பழங்கள்.

கொய்யா : அடிபடாத, நன்கு திடமான, குத்தல் இல்லாத பழங்கள்.

அன்னாசி : நல்ல மணமுடைய, பச்சையிலிருந்து மஞ்சள் நிறமுடைய, முட்கள் எளிதில் வரக்கூடிய கனமான பழங்கள்.

ஆரஞ்சு : நல்ல பசுமை அல்லது மஞ்சள் நிறமுடைய, புதிய தோலுடைய திடமான கனமான பழங்கள்.

## காய்கறிகள் :

பீரூட் : ஆழ்ந்த சிவப்பு நிறமுடைய, திடமான, வட்ட வடிவமானவை.

கத்திரி : நல்ல பிஞ்சாக பூச்சி அரிக்காதவை.

முட்டைக்கோசு : திடமான, பசுமையான வெளியிலுள்ள இலைகளும் பசுமையானவை.

**APPENDIX F**

**AREA UNDER CULTIVATION OF FRUITS AND VEGETABLES IN THE TARGET AREA**

Name of the fruit/vegetable	Area(acres)under cultivation of fruits and vegetables in		
	Thondamuthur Block	Anaimalai Block	Udumalpet Block
Banana	145.0(41.5)	33(08.6)	55(22.5)
Grapes	98.0(78.4)	17(35.3)	7(05.4)
Guava	76.0(15.5)	52(10.5)	23(13.7)
Mango	32.0(18.4)	196(79.5)	56(20.4)
Lime	2.0(00.6)	21(8.45)	3(01.2)
Sapota	2.5(00.5)	-	3(00.0)
Orange	10.0(02.5)	19(3.0)	3(01.5)
Watermelon	59.0(17.5)	3(5.6)	25(2.7)
Tomato	369.0(75.6)	85(40.4)	152(56.2)
Okra	37.0(6.6)	30(11.7)	59(15.5)
Brinjal	189.0(42.5)	85(22.1)	59(16.1)
Onion	590.0(96.5)	58(23.0)	155(58.1)
Chillies	38.0(26.7)	19(4.5)	66(19.2)
Tapioca	93.0(15.5)	16(6.6)	2(0.0)
Beetroot	24.0(9.6)	--	10(4.5)
Pumpkin	10.0(4.6)	19(2.7)	2(0.5)
Snake gourd	37.0(7.5)	3(0.7)	3(2.0)

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 Figures in parentheses indicate the area under production of fruits and vegetables by the target group.