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POST – HARVEST MANAGEMENT OF FRESH FRUITS AND VEGETABLES – A STUDY IN KARNATAKA, INDIA

Dr. H. M. CHANDRASHEKAR
Associate Professor of Agribusiness Management,
Institute of Development Studies, University of Mysore,
Manasagangotri, Mysore, 570 006

Abstract

India produces a large variety of food crops including cereals, pulses and oilseeds. Diversified agriculture is the priority of the Central Government, and technical and financial support is being extended to farmers to encourage diversification especially in the areas of horticulture, floriculture, medicinal and aromatic plants, apiculture (pee-keeping) and sericulture. The government is continuously working towards the development of the agribusiness sector through considerable emphasis on infrastructure and food processing. However, there still is scope for further development and up gradation of technology and agri-infrastructure to attain world-class standards. The main emphasis is on quality enhancement, infrastructure development and the use of modern technology. Even though India is a major producer of fruits and vegetables less than 2% of the total output is being processed. The contribution of processing industry in the country is pathetically low as compared to other developing countries. The dismal performance of the processing industry and the factors that hinder the growth of the processing industry in the country can be attributed to lack of adequate and proper post harvest management practices and infrastructure. The State of Karnataka is no exception to this. In India, the total losses on account of wastage & spoilage are estimated to be around 25 % of total production of fruits and vegetables. Considering the economy of the country, this wastage is enormous and efforts have to be geared up immediately to arrest it. The fruits and Vegetables sector in India is marked by extensive inefficiency with high level of wastage and value distortion (Mc Kinsey & Co report – 1997). The paper highlights the Post – Harvest Management of Horticultural crops the special consternation given in this paper is for Fresh Fruits and Vegetables. The two fruits such as Mango and Grapes and two vegetables like Onion and potato were selected for the study. The SPSS was adopted in the study to know the fruits and vegetables producers opinion on post harvest infrastructure and management aspects in Karnataka.

Keywords: *Post – Harvest, Management, Fruits and Vegetables, Grading and Packaging*

INTRODUCTION

Fruits and vegetables are an important part of a healthy balanced diet. They provide us with essential vitamin. They are a rich source of protein and they are also aesthetically pleasing to the eye and our olfactory senses, however, unlike most other food commodities, fruits and vegetables have living organisms, even after harvest. As a result of their biological nature, they are subject to physical, chemical and microbiological spoilage from the time they are harvested until consumption. Physical spoilage

includes bruising, softening and moisture loss, the latter resulting in shriveling of products. Fruits and vegetables also continue to respire after harvest. These biochemical changes result in a breakdown of carbo-hydrate and build up of CO_2 and CH_4, resulting in senescence and change in the colour and odour of many fruits and vegetables. In addition, enzymatic activity, e.g., pectinases and result in softening of fruit. Micro-biological spoilage, due to the growth of molds, yeasts and bacteria on a product's surface or internally, result in changes in the colour, odour and texture of products. All of these changes can occur alone or in conjunction with one another. While good manufacturing practices and proper temperature/humidity control can reduce physical, chemical and micro-biological spoilage, proper packaging can also play an important role in maintaining the quality and shelf life of fresh produce throughout the distribution chain.

Many fruits and vegetables undergo further processing, e.g., thermal processing, freezing or drying to inhibit/delay the enzymatic and microbial spoilage and to extend product shelf life. The success or failure of any processing operation is to develop the correct choice of packing container. For example, if dried fruits are packed in a material that has too low a moisture barrier, the product will pick up moisture from the external atmosphere to a level conducive to mold spoilage. In other instances, the packaging container is an integral part of the food process operation and ensures the quality and safety of the processed product, e. g., canned fruits and vegetables. There is a multitude of packaging materials in today's market place, each designed with specific properties. The correct choice of packaging is not only dependent on a knowledge of the physical, chemical, and micro-biological characteristics of fruits and vegetables, but also on the functional properties of the packaging materials available for a particular product or preservation technology.

In the past three decades, there has been a tremendous growth in pre-packaged fruits and vegetables on supermarket shelves and new food processing/packaging technologies, such as aseptic processing and controlled/modified atmosphere packaging, for shelf life extension of these products. The growth of packaging, for both short and long term preservation of fruits and vegetables is due to a number of interrelated factors. The success of any packaging technology as a means of extending shelf life of food depends on the permeability characteristics of packaging materials surrounding a product. Developments in polymer chemistry have resulted in the production of packaging films, such as Low –Density polyethylene (LDPE): polystyrene (PS): polyvinyl chloride (PVC): polyvinylidene chloride (PVDC), commonly known as Saran: and Ethylene Vinyl Alcohol(EVOH). These films have a range of water vapor, gas barrier, and heat-sealable characteristics to enable them to be used alone or to be tailor-made to give laminated structures with the desired permeability characteristics for shelf life extension of products. In addition development in high-speed continuous and thermoforming packaging equipment, compatible with the machinability characteristics of these films, have also promoted the growth of packaging of fruit and vegetable products.

In the past, production of food was a major task for the majority of the population. With the industrial revolution, rural population decreased as people moved into cities to be close to their workplace. Most urbanized nations depend on a food supply chain that extends all the way from the farm gate which may be thousands of miles away to the urban meal table. The food processing/ packaging industry provides an essential chain in this long link by

ensuring that consumers have a constant supply of a variety of fresh and processed fruits and vegetables that are nutritious and safe to eat.

HARVESTING

Care in harvesting and handling is necessary to preserve subsequent quality of fruits. Faulty harvesting and rough handling at farms directly affects market quality of the produce. Different kinds of fruits require different methods of harvesting. Harvesting by hands is used for fruits, which can be easily plucked by pulling or twisting. However, there is always a possibility of tearing off a piece of flesh or rind.Manual harvesting includes the use of hand tools like sickle, knife, clippers etc. Which can aid the harvesting of fruits, especially if fruits are to be harvested with stalks, without causing undesired injury to fruits and trees. Use of picking platforms and pickup machines of raised platforms on the back of a tractor etc. facilitates easy accessibility to fruits as in case of tall trees. Trolleys and conveyer belts can be used to facilitate conveying harvested fruits from point of harvesting to point of collection. In mechanical harvesting, generally there are three types of commercial mechanical harvesters used for fruits.

HARVESTING OF FRUITS

Harvesting of fruits in India is carried out either by hand or with help of certain hand tools such as knives, cutters etc. These fruits are then collected in cloth/gunny bags, bamboo baskets etc. Harvesting techniques for the major fruits in India are discussed in the following paragraphs.

MANGO

Owing to the delicate nature of the fruit, harvesting is done by hand to the extent possible. The fruit is twisted sharply sidewise or upwards. Fruit borne on high branches are gathered by a mango picker which consists of a long bamboo ring. A sharp iron blade is fixed to the inner side of the ring. This hook is surrounded by a canvas or net bag to hold the fruits as they are cut. The picker may either climb the tree or remain on the ground. If he is on top of a tree, he places the fruits in a collecting basket or bucket, which once refilled, is lowered to the ground with a rope. The mechanical harvesting may not feasible on existing trees due to their large spread. However, the use of dwarf stocks for mangoes will produce compact and short trees within reach of a mechanical harvester. But , Israel is using this technique.

GRAPE

Bunches of grapes are snipped off from the vine with a pair of scissors or a sharp knife and gently transferred into baskets or trays and arranged in 2 to 3 layers. Grapes meant for table use or exports are generally hand-picked and carefully sorted to remove any defective and damaged fruits from the bunch. As mentioned above, harvesting in India is done manually. Where as the developed nations have mechanized harvesting operations to a considerable extent.

HARVESTING OF VEGETABLES

Harvesting of vegetables in India is by and large done manually, where as semi – mechanized means is being used for potato and onion. Manual harvesting requires use of tolls such as knives and clippers and digging tools for root crops.

Internationally, echanized harvesting has made tremendous strides; however, the degree of mechanization varies with area and crop. Factors such as climate, cultivators, cultural practices, machine development, labor supply, landholding and the extent to which the crop is grown for processing influence the status of mechanization. Although machine harvesting of vegetables is growing rapidly, certain bio-engineering limitations must be met before machine outputs are acceptable to processors. This is because each crop is perishable to a different degree and engineers, post-harvest physiologists and bacteriologists have to work together to determine the

effects of damage on ultimate vegetable quality. There are various stages involved in the mechanization of harvesting vegetable crops. The first stage is mechanization of hand thinning of vegetables, which was once a tedious job requiring high labor input. Later, machine thinning was developed for many crops, and now precision seeders may eliminate the thinning operation entirely. Internationally, harvesters have been developed for each of the major vegetables. The most important reason for development of mechanical harvesters is rapidly increasing labor costs. Mechanically harvested vegetables have lesser handling costs associated with them specifically if the production is to be sent for further processing. For example, vegetables for canning ordinarily require a far greater number of man-hours per unit monetary value of output than the other segments of agriculture such as food grains and cereals and are already highly mechanized. Harvest mechanization has brought about drastic changes in the crop-growing system. In the past, later-maturing, large-vined cultivators were planted in wide-spaced rows and hand-harvested several times; whereas, now a days many early maturing, dwarf cultivars in close-spaced rows are grown for a single destructive harvest. Closely related to the change in row spacing and plant size is evolution of harvesting methods. The usual stages proceed from hand harvesting to mechanical aids for hand harvest, to destructive machine harvest following hand harvest, to a single destructive harvest. The most advanced state is the single destructive machine harvest. World over, there is an emphasis on an integrated approach to mechanization. Cultivars, fertilization, precision seeding, weed, insect, and disease control, plant spacing, scheduled plantings irrigation, mechanical harvesting and mechanized post-harvest handling should all be considered simultaneously if the most efficient system is to evolve. Mechanical harvesters have been developed for each type of vegetable crop and is harvested by using a unique harvester; the principle of working of harvesters used for harvesting important vegetable crops is briefly discussed below.

ONION

Onion are mechanically dug and deposited on top of the bed. Huge hydraulically-operated bulkers pick up the onion and convey them to a moving grading and cleaning table. Clean, graded and inspected onions are then elevated and deposited into semi trailer trucks that travel alongside. There onions are transported directly from the field to the processing plant.

POTATO:

The potato harvester digs potatoes up and separates much of the soil while elevating the roots and remaining soil to a grading table. This table conveys everything past six to twelve grader-packers, which snap the roots from the stem and place them in baskets or crates.

MECHANISED HARVESTING IN INDIA

The design of the mechanical harvester depends on various factors such as crop characteristics, layout of plantation etc. Thus, the crop has to be grown very scientifically to ensure efficiency and effectiveness of mechanical harvesting. However, in India fruits and vegetables are generally grown on small pieces of land and are not cultivated on scientific patterns. This may render the use of automated mechanical harvesters impractical. The economics of mechanical harvesting in Indian conditions needs to be evaluated taking into consideration the following factors:

- The size of landholding in India, even in large farms, is very small by international standards;
- Cost of labor in India is low;
- The yields in India are low for most of the fruits and vegetables.

The spoilage during mechanized harvesting is higher than during manual harvesting. The produce that is harvested mechanically sustains minor injuries and bruises. Therefore, it can be used for processing only. However, in India most of the fruits and vegetables are consumed fresh and less than 3% of total production goes to processing. Even in countries like Brazil, fruits and vegetables for table consumption are picked manually.

Indian economy being labor-intensive a technology like mechanical harvesting may be seen as reducing employment opportunities, may not be an ideal one for Indian conditions. However, a certain degree of mechanization such as use of picking machines and raised platforms can assist in raising harvesting efficiency.

Objectives of the study

To study the Post – Harvest Management of Fresh Fruits and Vegetables

Methodology

The study mainly depends on primary data. The primary data was collected from the fruits and vegetables producers. The primary data was collected by administering the questionnaire by personal interview.

Sample Design

The multi random sampling technique was adopted in sampling to arrive at a representative sample for the study. The districts having highest share in (a). Area under production and (b). Production of selected fruits like mango and grapes and vegetable such as onion and potato were chosen for each commodity 50 producers were consulted personally in the selected districts. Thus, the sample size constituted 50 for each crop totally 200 for the study, to comprehend the post harvest facilities and problems their off with the producers in the state. The statistical tools and techniques are used to draw a definite and precise conclusion on the proposed study. In addition to these statistical techniques, the tables graphs and charts, which are generated from the analysis of both primary and secondary data collected from various sources has been used to draw appropriate inferences. The SPSS is adopted in the study to draw the results.

Results and Discussions

The following table depicts the harvesting season of selected fruits and vegetable in Karnataka.

Harvesting Season of selected fruits and Vegetables in Karnataka

Sl. No.	Commodities	Harvesting Season		
		Beginning	Peak	End
Fruits				
01	Mango	March	May	July
02	Grapes	January	February – March	April-May
Vegetables				
01	Potato	August March	September-October, April – May	November June

Source: Department of Horticulture, GOK, Bangalore

POST – HARVEST TREATMENTS

Post-harvest treatment prevents losses in the harvested produce by delaying the natural senescence and inhabits microbial attack. Post-harvest treatments for Mango and Grapes are given in the following table.

Post Harvest treatments of Selected Fruits in India

Treatment	Commodities treated	Point of Application	Function
1.Degreening (Etheral treatment)	Grape	After washing	Improve appearance
2. Hot water immersion	Mango	After washing	Disease controls stimulation of ripening
3.Fumigation	Grapes, fruits for exports	After harvest and	Controls decay and

		during storage	infestation
4.Vapour heat	Mango	Before or after shipping	Controls decay and infestation
5. Ripening	Mango	Ripening rooms in wholesale markets	Converts fruit to edible condition

Source: TIFAC, New Delhi

Technologies for use of above mentioned post-harvest treatments are available in the country, but the extent to which they are used commercially is difficult to ascertain due to the presence of a large, unorganized sector within. However, a judicious mix of such technologies is essential to reduce harvesting losses and to extend storage life.

PRE-COOLING

Pre-cooling is perhaps the most important of all the field operations for increasing the shelf life of fresh fruits and vegetables. It involves removal of field heat from the harvested produce, since this heat accelerates their senescence. Further, it is very important to remove the field heat as early as possible since every hour saved from the moment of harvest to removal of field heat can add a day to the useful shelf life of the fruit/vegetable.

The various technologies of pre cooling

Forced draught air-cooling
Hydro cooling
Vacuum cooling

GRADING

The following table gives the various quality parameters, which can be used for sorting/grading of fruits and vegetables.

Table 1
Quality parameters for sorting/grading of fruits and vegetables

Factors	Component Parameters
Appearance	Size: Dimensions, Weight, Volume Shape and form: Diameter/depth ratio, smoothness, compactness Colour: Uniformity, intensity, Gloss: Wax Defects: External, Internal 1. Morphological (sprouting, rooting, floret opening) 2. Physical and mechanical (shriveling, bruising) 3. Entomological
Texture (Feel)	Firmness hardness, softness Crispness, Succulence, Juiciness Mealiness/grittiness,Toughness /fibrousness
Flavour (Taste & / Smell)	Sweetness, Sourness (acidity), Astringency, Bitterness Aroma (volatile compounds) Off-flavours and off-odours
Nutritive value	Carbohydrates (including dietary fibre) Proteins Lipids Vitamins Minerals
Safety	Naturally occurring toxicants Contaminants (chemical residues, heavy metals, etc.) Mycotoxins Microbial contamination

Source: Advances in Horticulture, edited by Dr. K. L Chandha

The various methods of grading fruits and vegetables are:

1. Manual grading
2. Specific gravity grading
3. Grading according to diameter
4. Mechanical grading.

Internationally, only mechanical grading has been adopted on a commercial scale. For mechanical grading, volume-fill graders, rotary bin graders. Smaller or junior systems, avocado grading systems and

composite graders are commercially available.

GRADING OF SELECTED FRUITS AND VEGETABLES IN KARNATAKA

The farmers in Karnataka sort the fruits and vegetables by the size, colour, variety, freshness etc which is done by manual grading. No farmer in the state go by Mechanical grading or scientific methods of grading the commodities. The grading methods used by the farmers are give in the following table.

Grading of selected fruits and vegetables

(In Percentage)

Fruits	Percentage Producers grade the Commodity	Basis of Grading						
		Quality	Size	Color	Maturity	Variety	Freshness	Diseases Free products
Fruits								
Mango	48	20	15	6	30	10	40	40
Grapes	90	23	10	5	28	8	41	37
Vegetables								
Onion	88	14	55	4	35	20	5	38
Potato	82	20	23		11	9	48	48

Source: Primary Survey

The table reveals that only 48 per cent; of the mango producers grade the commodity, where as in case of grapes as much as 90 per cent of the producers grade the fruits. The most determinants of the grades are freshness of the commodity (40%) and disease free fruits. The other prominent factors for grading are maturity of the fruit (30%) quality and size of the product. The farmers normally sort their products based on quality size, colour and freshness of the fruits at the farm level. The package is done on the basis the grade. The table also reveals that more than 80 per cent of farmers are into sorting/grading the vegetables. 88 percent of the onion producers and 82 per cent of the potato producers grade the commodities. In case of onion size, disease free and variety are the important determinants for grading, where as in case of potato freshness, disease free and size are the criteria for grading.

PACKAGING

The self life of packaged fruits and vegetables is controlled by the properties of the product (including water activity, susceptibility to enzymic or microbiological deterioration, mechanism of spoilage, and the requirement for or sensitivity to oxygen, light, carbon dioxide, and moisture) and the properties of the package material. Moisture loss or uptake is one of the most important factors that controls the shelf life of fruits and vegetables. Fruits and vegetables are high in moisture content ranging form 75-95%. Loss of moisture under normal storage conditions causes wilting and shriveling of product, however, proper packaging is able to extend storage life of fresh products by keeping moisture loss during storage to 10% or less, thereby preventing wilting. The rate of moisture loss varies on each product's respiration rate and the water vapour permeability of the packaging film. The use of small perforations in some films to ensure a constant supply of oxygen has no appreciable effect on moisture loss. Fruits and vegetables are living organisms, and even after harvest, they continue to respire and transpire. Respiration involves the uptake of oxygen and breakdown of organic matter into water and carbon dioxide. If there is not enough oxygen, fermentation occurs, and small amounts of alcohol are produced. This results in the production of off-

flavors and off-odors and spoilage of the commodity therefore, packaging materials for fruits and vegetables should note be too high a barrier to oxygen. The thermal properties of the packaging material should also be taken into consideration, to minimize temperature fluctuations. Maturation can be slowed down by storage at refrigeration temperatures, because this reduces the respiration and the synthesis of ethylene, which causes maturation. However, too low a temperature may cause chilling damage to the products. Therefore, proper packaging can endure temperature distribution within the package and prevent chilling injury. Some packages are required to withstand processing conditions.

Bulk Packaging of Fresh Fruits and Vegetables

The primary functions of bulk packaging of fruits an vegetables are to provide a means of shipping a suitable quantity of product in one marketing unit and to protect the products during loading, transport, unloading, and marketing distribution from physical injury and spoilage. Therefore, to meet these requirements, bulk packaging containers should be able to :

1. Protect products from physical injury
2. Provide adequate temperature control throughout distribution and storage
3. Protect from water loss to prevent shriveling or wilting
4. Facilitate certain treatments, e.g., fumigation, ethylene treatment to enhance or delay ripening.
5. Be compatible with handling systems e.g., palletization
6. Be adaptable to handling/storage requirements, e.g., high relative humidity, ice packing, controlled atmosphere storage.

The different types of packing materials used to pack fresh produce are as follows.

Traditional Materials:
Wooden Crates
Cardboard or Fibre – Board Containers
PLASTICS
Polypropylene boxes:
Moulded expanded polystyrene boxes:
Rigid plastic crates:
Plastic nets:
Plastic films:
Plastic Bags:
Stretch film:
Shrink wrapping:
Natural and synthetic fibres:

Paper Sacks:

The following table gives the extent of use of various packaging materials for Mango and Grapes

Usage of different packaging materials for fruits

Fruit	Packaging Type
Mango	Loose CFB PE wrappings
Grapes	Wooden Boxes Bamboo boxes CFB

Source: Techno-market survey report on packaging, TIFAC, Dec. 1991

Usage of different packaging materials for vegetables

Vegetables	Packaging Type
Potato	Jute Bags Paper Bags Plastic Films
Onion	Jute Bags Bamboo Baskets Plastic Packs

Source: Techno-market survey report on packaging, TIFAC, Dec. 1991

As shown above, in India the most common type of packaging are bamboo baskets and wooden cartons which are used for majority of fruits and vegetables including mango, banana, citrus fruits, guava, apples, pears, potato, onion, tomato and garlic. These boxes are

cushioned with paddy straw to reduce mechanical injury. Corrugated fiber board (CFB) is generally used for packaging of grapes. These boxes are perforated to provide ventilation. At present the use of CFB boxes and plastic films is very limited and generally used for export purposes. However, the use of these packaging materials is expected to increase rapidly. These materials are used extensively for packaging of fruits and vegetables in all developed countries. Plastic films with perforations have also developed to enable respiration in the packaged products. Field preparation and packaging is possible only for a limited number of fruits and vegetables. After the harvest fruits and vegetables must be cleaned, sorted, graded, sized and packaged. Usually, these processes takes place in a packaging house and most of the operations are carried out manually. As against this, most advanced nations have fully automated packaging houses with automated facilities for cleaning, grading, sorting and packaging.

Packaging by the farmers in the study area

An attempt is made to analyze the different packaging material used by the producers to protect the produce from physical injury, protect from water loss, provide adequate temperature control, handle carefully and facilitate certain fumigation treatments. The following table gives the various packaging materials used by the farmers in the study area. The table is prepared on the basis of field survey conducted all over the state.

Packaging materials used for Mango and Grapes

Commodity	Bamboo Bowl	Carton Box	Plastic Crates	Wooden Box	Gunny /Jute Bags	Others	Total
Mango	**12**	**36**	**16**	**24**	**4**	**8**	**100**
Grapes	**48**	**32**	**8**	**8**	**-**	**4**	**100**

Source: Primary Data

The above table and graph reveals that, the most common packaging material used for mango are carton and wooden box which account for 36 and 24 per cent respectively. The other important packaging materials used in the study area are plastic crates (16%) followed by Bamboo bowl (12%), gunny bags (94%) and other materials (8%) like plastic bags etc. But, incase of Grapes bamboo bowl and Carton box are most commonly used by the farmers which account for 48 and 32 per cent respectively. Plastic and wooden boxes are also used by the farmers.

Table 2

Packaging materials used by Onion and Potato producers.

Commodity	Bamboo Bowl	Plastic Crates	Carton Box	Wooden Box	Gunny/Jute Bags	Others	Total
Onion	**-**	**-**	**-**		**92**	**8**	**100**
Potato		**4**		**4**	**80**	**12**	**100**

Source: Primary Data

The above table reveals that, the most common packaging material used by the farmers all over the state for onion is gunny/jute bag (92 %) and only few farmers use other types (8%) of packing material. Similarly, the most common packaging materials used for potato is same as onion i.e., gunny /jute bags (86 %) followed by others 2 per cent, wooden box 2 pr cent and plastic crates 2 per cent. It is evident from the above, packaging materials play an important role in marketing of fruits and vegetables since, they are perishable in nature. Still the producers of fruits and vegetables practiced the traditional methods of packaging. By adopting modern technologies in packaging of fruits and vegetables post harvest loss may be avoided. From the primary survey it is evident that the fruits and vegetables are packed by producers in various forms,

unless sold at the farm or at a nearby place. A gunny bag is the commonly used packaging material for onion and potato. However, fruits like mango and grapes wooden box is used to prevent damage to the skin of fruits. Farmers opined that gunny bags, wooden case and bamboo bowl are easy to handle and required by the purchaser.

TRANSPORTATION

A significant proportion of fruits and vegetables are lost due to lack of cold chains, which can control the storage conditions of produce. An important constituent of the cold chain is the means of transportation of fruit and vegetables from the point of production to consumption centers. If the fruits and vegetables are to be avoided from serious post-harvest losses, the system should provide suitable transport at the right time and at the right place.

Mode of Transport prevailing in the study area

The mode of transport used by the farmers in moving their produce from production centers to the market centers areas are Cart, Tractor, Tempo, Truck .and Others (Bus, Cycle) etc., The study reveals that the farmers use different sources for transport such as personal contact with transport operators, through commission agents, transport agents, through public transport. The different categories of farmers use their own link for the transport and the same is given below.

Transport facility used by different categories of farmers for fruits and vegetables in the State

(In Percentage)

Type of Farmer	Personal Contact with operators	Commission Agent	Transport Agent	Own Transport	Public Transportation, Bus etc.
Marginal farmer	**6**	**4**	**-**	**-**	**20**
Small Farmer	**3**	**12**	**-**	**3**	**3**
Big Farmer	**13**	**18**	**2**	**16**	**-**
Total	**22**	**34**	**2**	**19**	**23**

Source: Primary Data

The table reveals that 34 per cent of the farmers approach commission agents for transport facility, 23 percent use public transport, 22 per cent approach the transport operators directly and 19 per cent of the farmers use their own transport for fruits and vegetables in the study area.

REASONS FOR USING THE PRESENT TRANSPORT SYSTEM

There are several reasons for using the existing transport system and each farmer has his own reasons.

Reasons for using the existing mode of transportation in the state

Types of Farmer	Qty. is less	Bulkiness of Qty.	Cheaper	No other cheap alternative	Own transport	Others
Marginal	**12**	**2**	**5**	**18**	**-**	**8**
Small	**-**	**7**	**2**	**7**	**-**	**1**
Big	**-**	**15**	**1**	**2**	**17**	**3**
Total	**12**	**24**	**8**	**27**	**17**	**12**

Source: Primary Data

The table above reveals that, 27 per cent of farmers expressed the opinion that due to non availability of other cheap transport they are forced to use the present transport facility where as 24 per cent opined that it is because of the bulkiness of the produce, but only 8 per cent of the farmers expressed that present system of transport is cheaper and convenient.

Distance by Mode of Transport

The following table gives the details on the various modes of transport used by the farmers by distance.

Mode of Transport for Mango and Grapes by distance

Distance in Kms	Lorry	Truck/ Tempo	Tractor	Carts	Others	Total
< 20	-	2	4	4	4	14
20-40	8	4	6	-	2	20
40-60	16	8	4	-	-	28
60 & above	24	14	-	-		38
Total	48	28	14	4	6	100

Source: Primary Data

The above table and the graphs shows that as their distance increase, the farmers use Lorry as a major transport (48%) followed by the Tractor/Tempo (28%). Only 14 per cent of the farmers use Tractor with the distance ranging from 0-60 KM. Further, it also reveals that lorry is the common mode of transport for Mango and Grapes accounted 48 per cent followed by trucks 28 percent, tractor 14 percent, others 6 per cent and by carts 4 percent. Most of the farmers opined that the cost of transport is lesser for the longer distance. Most of the fruits are highly perishable in nature so, they should take care of them while transporting from producing centers to consuming center. Transport play an important role in post harvest infrastructure for fruits and vegetables, without good transportation facilities, the commodities can not be moved from one place to another place safely.

The following table shows the mode of transport by distance for vegetables

Mode of Transport for Onion and Potato by distance.

(In Percent)

Distance	Lorry	Truck/Tempo	Tractor	Carts	Others	Total
< 20	-	6	2	4	4	16
20-40	4	10	4	2	6	26
40-60	16	22	2	-	-	40
60 & above	12	6	-	-	-	18
Total Percentage	32	44	8	6	10	100

Source: Primary Data

The table and graphs shows that, as the distance increases the farmers tend to use Lorry as a major transport (32%) followed by Truck/Tempo (44%). Only 8% and 6% of the farmers use Tractor and Carts respectively with the distance ranging from 0-60 Km.

Cost of Transport

The cost of transportation varies according to the mode of transport and distance. The average transportation cost was also significantly influenced by the weight and volume of the fruits and vegetables. The problems in transportation of fruits and vegetable are serious because of peculiar factors associated with them such as perishability of produce, bulkiness, the small quantity of marketed surplus etc. The important problems in transportation are to poor roads, non-availability of desired means of transport and loss in transit which is relatively high. The response of producers in this regard revealed that over loading, poor packaging, poor transport facilities, poor road and weather and improper loading and unloading facilities are responsible for loss in transit. It is therefore, there is a need to provide efficient and good transport systems in the producing centers. Therefore also reported by the producers, that the transport operators charge high cost of transport for fruits and vegetables. They opined that the cost of transport alone

comes to 20 to 25% of the total marketing cost.

STORAGE

Proper storage of fruits and vegetables is necessary to extend their shelf life, especially if the distance between production and consumption centers or the time between production and consumption is large. In temperate regions, storage plays an important role in improving the off-season availability of fruits and vegetables. The basic aim of any storage is to prevent the exposure of produce to excessive temperature and dry weather, both of which accelerate senescence. At the same time, very low temperature leads to chilling injury. Thus a careful evaluation of optimum storage conditions is necessary for designing proper storage facilities. The important types of storages issues in fruits and vegetables storage are discussed in the following paragraphs.

VENTILATED STORAGES

These are ambient air storages, which make use of controlled ventilation for cooling. It protects the product from solar heating and allows cooling by ambient air at night. There are different types of ventilated storages such as barnstorms, earth banks, cellars and fully insulated above ground buildings with vent controls. Though these storages are widely used in developing countries including India, they are not suitable for fruits, which have a rapid ripening rate. Further, these storages should be used when

a. Produce is being stored for short periods and meant for local use
b. Produce has relatively long natural storage life,
c. There is significant difference between day and night temperature,
d. Regular inspections are possible to remove spoilage.

Other types of storages have replaced the ventilated storages in most developed countries.

Low temperature storages:

These are extensively used all over the world to store fruits and vegetables for a long period and employ the principle of maintaining a low temperature which reduces the rate of respiration and thus delays the ripening. Further, they also reduce the growth of organisms which cause decay. The optimum storage conditions, the storage life and the expected storage losses under conditions for various fruits and vegetables are given below.

Optimum storage conditions for selected fruits and vegetables

Fruit/Vegetable	Storage Temperature (°C)	Relative Humidity (%)	Storage Life (days)
Fruits			
Mango	**7 - 12**	**90**	**21 – 49**
Grapes	**-1 – 0**	**90 – 95**	**30 – 120**
Vegetable			
Onion	**0**	**65 – 70**	**180 – 250**
Potato	**4 – 6**	**90 – 95**	**120 - 250**

Source: Directorate of Horticulture.

HARVEST LOSSES

Harvesting Losses in fruits Improper pre-harvest treatments

As discussed earlier, pre-harvest treatments such as fungicides protect the fruits from microbial attack. Similarly use of growth regulators can help in extending the shelf-life of product. Although, technologies for pre-harvest treatments are available in India, they are not being used properly because of the lack of education among the farmers. Further, the spraying of fungicides etc. can be effective only if they are adopted by all farmers in a given area and spraying schedules are observed properly.

Improper determination of fruit maturity

Harvesting of fruits at the correct stage of maturity is very important since it influences the shelf-life and quality of ripe fruits. Maturity for harvest in

traditional practice is determined by the size, shape and surface colour of the fruit. Harvest maturity criteria such as total soluble solid, (TSS) starch content, starch to acid ratio, brix level and 'Heat Unit Concept' have been suggested for various fruits. The general parameters for determining maturity of mango and grape are given below.

Harvesting criteria for Mango and grapes

Sl. No.	Fruits	Criteria for harvesting fruits	
		Physical	Chemical
01	Mango	Olive green colour with clear lenticulas, shoulder development, size, sp. gr., days from fruit set	Starch content, flesh colour
02	Grapes	Peel colour, easy separation of berries, characteristic aroma	TSS

Source: Advances in horticulture, edited by K. L. chandha)

Further, maturity of fruits at the time of harvesting also depends upon type of consumption they are meant for:

1. Fruits which are consumed as fresh fruits in domestic markets, have to be ripened before consumption;
2. For trade, harvesting should be done before harvesting for local consumption as this prolongs the shelf life;
3. For fruits used in processing, maturity depends on distance between orchard and processing plant, type of fruit and the final product.

In India, however, most of the advanced techniques for determination of fruit maturity are confined to lab scale. Generally, the Indian farmer relies on visual inspection only. Moreover, in the absence of proper infrastructure for transportation and storage, the farmers are generally forced to either advance or delay the harvesting (than as required by proper maturity indices) to avoid a glut in the market.

Improper handling of fruits during harvesting

Extreme caution is needed to prevent damage to fruits during harvesting. Some of the harvesting practices to prevent such injuries are noted below:

1. Mangoes should generally be clipped leaving a stalk end of about one centimeter attached to fruit.
2. The harvesting of fruit should be generally not carried out during the daytime since high temperature accelerates the aging of the fruits. To overcome this, developed countries have installed precooling facilities at the farms. However, the above precautions are generally not being observed by producers in India. Further, the precooling facilities in India are generally limited to natural shade or mud houses.

Improper post-harvest treatments

As discussed earlier, various post-harvest treatments may be required by different fruits to delay the natural senescence of fruits. These include treatments like fumigation, surface coatings, hot water immersion etc. However, due to lack of awareness these are practiced on a limited scale only.

HARVESTING LOSSES IN VEGETABLES

ONION

Of the total production, nearly 15 – 30% never reaches the consumer, resulting in substantial economic loss to the country. The factors responsible for such heavy losses are:

1. High moisture content and poor load bearing capacity of onions resulting in problems during harvest, handling, transportation and storage.
2. The rough handling of the bulbs at the time of harvest, collection and packing leading to heavy damage which may be due to injury, cuts and decay

resulting in undesirable softening of the damaged tissues and shattering or separation of the protective dry scales, thus enhancing the loss of weight and chances of post-harvest decay. Immediately after harvesting, onion is dried and cured under sun. during this process of drying and curing, nearly 3 – 5% of the harvested produce is lost.

Normally, sorted and graded onions are packed in used gunny bags with varying thickness. Sacks are thrown rather than lifted on account of their weight (more than 50Kg capacity). The stocking pattern in transport trucks accommodates more bags rather than allowing sufficient ventilation. Due to non-availability of ventilated wagons, onions are transported in closed wagons, with open doors or tops, which causes decomposition of 10 to 20% of stock, sprouting losses amounted to 15%.

STORAGE LOSSES

The reasons for storage losses are:

Limited infrastructure: as discussed earlier, the storage infrastructure in India is very limited. The total cold store capacity is about 8 million MT., of which about 90% is used for storing potato. Further, most of the cold storages are restricted to urban centers and with a few government organizations such as NAFED, State Agro Marketing Federations etc.

LOSSES DURING TRANSIT:

The main reasons for losses during transport are as follows:

1. Poor road conditions: The general condition of roads in India is very poor which leads to high physical injury to fruits and vegetables during transportation.
2. Absence of cold chains: Post-harvest losses during transportation can be minimized if the produce is kept at optimal temperature conditions during transport. However, this would require an organized cold chain right from farm to retail level. Although such cold chains have been established in Maharashtra, Gujarat, Andhara Pradesh etc., the infrastructure is very limited and these are being used generally for export purposes only. Thus, growers in India are forced to use ordinary trucks, rail wagons etc. for transporting horticultural products.However, be emphasized that infrastructure for cold chains is quite expensive not only in terms of capital costs, but also in terms of operating and maintenance costs due to high temperatures which exist in India. Therefore, alternative means of transportation suited to Indian conditions need to be studied and developed.It is evident that there is an urgent to conserve post-harvest losses in fruits and vegetables. Most of the losses can be reduced by educating farmers about better farm management practices. Further, there is a need to develop proper infrastructure in terms of precooling facilities, road conditions, storage and transportation facilities and the overall marketing setup.

POST – HARVEST LOSSES

As stated earlier, a significant proportion of the fruits and vegetables in India is lost due to spoilage at various post-harvest stages. Several studies have been conducted in India to estimate the level of these losses. Table below gives the estimated post harvest losses for fruits and vegetables in India.

Post-harvest losses in Selected fruits and vegetables

Sl. No.	Commodity	Post harvest losses as a percentage of production
	Fruits	
01	**Mango**	**17 - 37**
02	**Grapes**	**23 - 30**
	Vegetables	
01	**Onion**	**15 – 30**
02	**Potato**	**15 - 20**

Source: Figures based on the study done under Indo-Us Aid Project for estimation of post-harvest losses in fruits and vegetable (1986-90) as reported in ‘ Advances in Horticulture’ edited by K. L. Chandha, 1993).

The indicative level of wastage for mango fruit losses at various stages in Post-harvest handling

The post harvest losses of fruits and vegetables in the study area is estimated on the basis of the farmer's experience in handling during transport and storage etc. The following table gives storage such details

Estimated post harvest loss of selected fruits and vegetable

Category	Handling	Transportation	Storage	Others
Fruits				
Mango	3	8	15	
Grapes	4	10	18	
Vegetables				
Potato	1	2	16	4
Onion		4	11	2

Primary Data

The above table reveal that the post harvest loss during handling, transport and storage of mango, grapes, onion and potato. It is evident from the above table that the major loss of 15 per cent is during storage followed by 8 per cent during transport and 3 per cent during handling. This is because of lack of road facilities at the production centers to consumption centers and also absent of mechanical handling of the produce. The major loss incurred during storage is because of pests, insects, rodents and lack of cold storage in the state are the major bottlenecks which account for loss during storage.

Conclusion

Proper post-harvest management is utmost important to maintain the standard of quality products in export markets. The fruits and vegetables produced are very good taste and nutritional value and would help in meeting export obligations, once an export niche is established. To harvest the export potential of fruits and vegetables, diversified efforts can be focused for horticultural products, a systematic formation of an effective package of production and marketing strategies is important. The export potential should be enhanced further through improved productivity and quality, better technology, improving standards to meet international quality specification etc.

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