

Review of Literature

The review of literature in the field of fruit processing industry of India and Brazil has revealed several contemporary issues of importance and are discussed in brief here-in-under. They include issues related to growth in the production of fruits, growth with respect to processing of fruits, present availability and future requirement of infrastructure, emergence of wide product range, adoption of emerging new technologies by the firms, management practices (procurement management of raw materials and other inputs, marketing management of finished products and other outputs, production management, etc.) followed by both cultivators and processors, and strategies and policies pursued by all the stake holders involved for the overall growth of this industry.

The Indian fruit processing sector is undoubtedly a potential sector and has a tremendous scope for unparalleled growth prospectus in the coming days. The Government of India has taken a lot of initiatives and policy decisions for commercializing agriculture with specific importance on high tech horticulture and developing the fruit processing, preservation and packaging sectors to its full capacity. The fruit processing sector is rapidly being transformed into a high volume profit making industry. A distinct shift is seen among the consumers for processed, prepared and packed fruit products not only in the so called developed countries but also in the developing countries like India. This has catalyzed the research work in this area leading to publishing of numerous research articles and papers.

Literature discussed in this chapter, which throws light on the contributions made by the prominent researchers in this study area, will set the guidelines for this particular research project and indicate the tremendous scope for the further research in this particular area. Literature available pertaining to subject matter of this research work of both the countries, i.e., India and Brazil are being discussed in brief.

Biodiversity International News of Brazil, (2006), made a remark on EMBRAPA (Brazilian Agency for Agriculture Research and Animal Husbandry), a prime government nodal agency of Brazil, about the announcement that the number of seed samples stored in its Gene Bank had topped 102000, putting the Brazilian gene bank at No. 7 in the world in total number of accessions. More than 500 species were represented in the gene bank, which has restored lost varieties and species of local communities in Brazil. The gene bank will open four new cold storage chambers this month, doubling its capacity to 240000 accessions.

Rocha *et al.*, (2001), studied the efficiency of the starch degradation index for estimating maturity in mango 'Tommy Atkins', a predo-minant variety of mango grown in Brazil, aiming its utilization as an alternative method at field. The efficiency of the method was evaluated through correlation between the index and each of the following traits: starch content, skin color, pulp color, pulp firmness, Ph, titratable acidity, soluble solids, reducing sugar and non reducing sugar. The experiment was completely randomized with five treatments and six replications, and was based on pulp and skin colors. They found a good correlation between the index and each of the traits studied, however pulp color had the best correlation coefficient. And the above correlation analyses indicate that the grower can utilize this method.

NFI Archive Report (2003), reported that the fruits and vegetables that are grown only on 6-7 percent of gross cropped area have contributed more than 18.8 percent of the gross value of agricultural output and 52 percent export earnings out of total agricultural produce. They further opined that during the last few years considerable emphasis has been given to this sector. Accordingly, areas under fruit production has increased by 172 percent from 1961-1993, productivity per hectare was nearly doubled leading to an increase in production to the tune of 320 percent. The average labor requirement for fruit production is 860 man-days per hectare per annum as against 143 man-days for cereals crops. Crops like grapes, bananas, and pineapple generates much larger employment roughly from 1,000 to 2,500 man-days per hectare per annum, the researcher added.

Vinodhari (2003), reported that India is among the world's major producer of food, producing over 600 million tons of food products every year. The researcher further explained that the food processing industry ranks fifth in size in the country representing 6.3 percent of GDP, accounts for 13 percent of the country's export and involves 6 percent of total industrial investment in the country.

Brunini *et. al.*, (2002), in their research work titled '*Quality of Tommy Atkins mango pulp frozen and stored at -18 degree Celsius*' with the aim of evaluating the best preservation methods of Tommy Atkins mango pulp manufactured using two different processing methods namely; ground pulp and sliced pulp frozen and stored at -18 degree Celsius found that ground pulp had reasonable aspects until twenty weeks while sliced pulp had reasonable aspects for eighteen weeks. In general the appearance, texture and flavor were affected by the storage time.

MOFPI (Ministry of Food Processing Industries) Report, (1999), reported that India is the largest producer of fruits (41.5 mmt) and second largest producer of vegetables (67.28 mmt) in the world. The country tops in production of banana, mango, potato, tomato, onion, green peas and coconut. Only 2 percent of the fruits/vegetables produced are being processed at present. The installed capacity of fruits and vegetables processing industries has increased to 21 lakh tons in 1999 with 4589 fruit/ vegetables processing units. Exports during 1998-99 were worth ₹ 678 crores.

Perosa, *et. al.*, (2002), in their article titled "*Post-harvest techniques and expansion of the mango culture in the Sao Paulo state – Brazil*" highlighted that the worldwide demand for mango has been increasing over the last few years and Brazilian mango production for exportation has been showing a great possibility of growth, where the use of floral induction and post-harvest techniques have helped to participate in new market shares while the supply from other countries has been reduced. They noted that in the last decade, the mango production and exportation have been increasing in the Sao Paulo state. They found that adoption of new post-harvest techniques for improving the mango quality required for exportation has a great influence on the production growth. In addition, this activity has shown to be considerably profitable for producers.

TIFAC Report (2003), the task force on Agro food processing of TIFAC on the sub group on fruits and vegetables, has given the technology status and future vision for India. The report states that the total production of fruits in the world is around 370 mmt. India ranks first in the world with an annual output of 32 mmt. TIFAC study has focused on 12 selected vegetables which accounts for about 65 percent of the total production in India. It is estimated that around 20-25 percent of the total vegetables is lost due to poor post harvesting practices. Further while discussing about the future trends, the report highlighted that fruits and vegetables would continue to be harvested manually in the future. While small land holdings and non availability of good quality planting material have been the major issues of concern, it is expected that quality of planting material would improve in the long run

due to right selection, hybridization, proper breeding and adoption of tissue culture.

Junqueira, *et. al.*, (2004), in their research article based on series of experiments conducted on ‘effect of soybean oil in the control of ‘anthracnose’ (a most important post-harvest disease of mango) and on post-harvest conservation of mango’ found that immersing the fruits for five minutes in soybean oil alone or with benomyl or thiabendazol at 22 or 40 degree Celsius increased mango shelf life period and was efficient in the control of anthracnose instead of using the fungicide thiambendazole alone that can leave residues in the fruit. Thus this method will also satisfy the consumers who claim for pesticide free fruits and pollution free environment. US Commercial Services Report (2000), reported that the Indian food processing industry is a high priority sector and is poised for excellent growth in the next century. The government of India has adopted a major policy decision for commercializing agriculture and packaging sectors. Agricultural production and food processing together accounts 30 percent of India’s GDP and employs more than 70 percent of its work force.

Silva, *et. al.*, (2001), in their research work titled “*Effect of earth worm excrements and cattle manure on leaf nutrient concentration and on the production of mango*” found that the traits of nitrogen in the leaves were high and the concentration of calcium were low and there was an increase in production in all the growing seasons.

MOFPI (Ministry of Food Processing Industries) in its annual report (2000-01), reported that the country’s share in the world trade of processed fruits and vegetables is still less than 1 percent. As such, abundant investment opportunities are there in the expanding domestic market and export arena. An increasing acceptance of new products together with innovative market development efforts is seen.

Pinheiro, *et. al.*, (2005), in their research work titled ‘*Evaluation of microbiological quality of fruits minimally processed commercialized in super markets*’ described minimal processing as handling, preparing, packing and distribution of agricultural products. These together with value added processes such as selection, cleaning, peeling and cutting will increase the value attached to them. The researchers concluded that the need to have a good quality control system, following the good manufacturing practices, implementation of a preventive HACCP system are all essential in order to assure the consumer a healthy and a safe product.

G.K. Kaul (1997), in his report on status of fruits and vegetables in India stated that the annual growth, both in area and production of horticultural crops has gained considerable momentum following

planned diversification in Indian agriculture, encouraged by the Government from the Eighth Five Year Plan onwards. Further he highlighted that several fruit crops have proved to be most remunerative for replacing subsistence farming in the rain fed, dry land, hilly, arid and coastal agro systems.

Surinder Sud (1998), in his article on India's revolutionary progress in food production opined that the interest shown by the domestic corporate sector and transnational corporations in setting up food processing units indicate that India would soon emerge as an important player in the international processed foods market. The Government already has approved about 343 proposals for 100 percent Export Oriented Food Processing Units and joint ventures since the beginning of the economic reforms, i.e., in the early 1990s. These would involve an investment to the tune of ₹ 43040 Million including foreign direct Investment worth ₹ 7880 Million.

Pina, *et. al.*, (2003), studied the mango processing and conservation by combined methods. The physical, chemical, microbiological and sensorial stability of mango pieces was achieved through bleaching using saturated vapor for two minutes, adjusting water activity (A_w) to 0.97, pH to 3.6, addition of 600 ppm of acetic acid, 1000 ppm of Sodium Benzoate and 600-900 ppm of sulphur dioxide. The mango products processed under these conditions showed higher physical, chemical, microbiological and sensory stability than the other methods.

MOFPI report (2001), It's report on summary on fruits and vegetable processing documented in the report of Ministry of Food Processing Industries (MOFPI) highlights the following facts;

1. India is the second largest producer of vegetables and third largest producer of fruits.
2. Thirty percent of the fruits and vegetables get wasted due to lack of proper processing and packaging facilities.
3. Only 2 to 3 percent of the total produce is being processed in India.
4. Total cultivation area under fruit and vegetables is around 12.0 million hectares and accounts for 7 percent of the total cultivation area.
5. Main fruits produced in India are Mango, Banana, Citrus, Guava and Apple. These fruits account for 75 to 80 percent of total fruit production.

Castro Neto, *et. al.*, (2003), in their research work titled '*Effect of water deficit on the transpiration and stomatal resistance of mango tree*' found that flowering induction of mango growth has not given satisfactory results mainly due to inadequate irrigation management. Transpiration and stomatal resistance of mango trees can reflect the water status of the plant. Monitoring the transpiration and stomatal resistance of mango trees during water deficit and irrigation period suggests that the flower induction by water deficit is not efficient due to incorrect irrigation management.

K.P. Prabhakaran Nair (2006), expressed that Indian agriculture is being undermined because of the unreformed policies in the agriculture sector that continue to encourage monoculture such as wheat and rice in Punjab and sugarcane in Maharashtra, where the cultivation has led to exploitation of ground water causing long term environmental degradation. The extensive input subsidies which are not conducive to efficient agro practices may cause greater harm in the future. Indian agricultural extension network is comparatively inefficient when compared with the other countries like China and Brazil.

Researcher argued that China's success in the agriculture processing sector is mainly due to their 'bottom up' approach where in around 1.5 million farmer agro technology extension agents, who work shoulder to shoulder with the farmers in the field adopting innovative practices all the time. Whereas we adopt 'top down' approach, where in agricultural scientists, doing research, frame strategies and policies for future in consultation with politicians and bureaucrats. But least importance has been given to extension activities through which technological innovations and advance practices will reach to ultimate farmers.

According to the researcher Indian agriculture sector will bloom only when the mentality of India's agricultural fraternity will give top priority to providing necessary help and support to our farmers in the field.

Renata Tiekko Nassu, *et. al.*, studied the degree of acceptance of fresh and processed fruits namely melon, mango and cashew apple using combined methods by the consumers. The researchers found that fresh cashew apples received lesser acceptance than the processed cashew apples while fresh mangoes were more acceptable than processed mangoes and degree of acceptance of fresh and processed melons were more or less the same.

Paulo Faveret Filho, *et. al.*, (1998), analyzed the production of fruits within Brazil from various perspectives emphasizing the obstacles to establishing a large scale export strategy. The study revealed that the world market for fresh fruits is growing very rapidly, but is heavily

influenced by the government policies of the main importing countries and the level of competition. International competitiveness appears to be increasingly dependent on efficient systems of commercialization which are the result of both public and private sector initiatives, albeit in various combinations. Brazil has not yet succeeded in assembling such a system, a fact that is largely to blame for its poor export performance. Further, authors reported that Brazilian fruit sector lacks the coordinating effects of market and public policies that would permit the establishment of a productive chain together with the required infrastructure and mechanisms of commercialization, which will cater to the needs of both domestic and international markets. These are necessary for it to realize its potential.

Manish Jain (2002), in his article explained that India accounts for 10 percent of the total world production of fruits and ranks second after China. It leads the world in the production of mango, banana, sapota and acid lime and has recorded highest productivity in grapes. Area under fruit has increased from 2.87 million hectares during 1991-92 to 3.729 million hectares during 1998-99 recording an increase of 29.93 percent. Similarly production increased from 28.63 mmt (million metric tons) to 44.02 mmt recording an increase of 53.83 percent. During the same period, productivity of fruits increased by 18.4 percent. Further he listed five largest fruit producing states of the country viz., Maharashtra (17.08 percent), Karnataka (12.37%), Andhra Pradesh (10.42%), Bihar (8.82%) and Uttar Pradesh (8.20%).

Researcher also noted the trend that out of the horticultural crops produced in the country, approximately 60 percent is consumed by the local population or marketed in the nearby market yards and only about 40 percent of the produce is channeled through the regulated markets for the consumption of urban population in the cities. Export markets account for less than 5 percent of the total production except in some commodities like cashew, spices, onion, etc. He noted further that the bare minimum infrastructural facilities are lacking even in the regulated markets. The horticulture produce suffer significant post-harvest losses due to lack of adequate post-harvest and marketing infrastructure viz., Processing units, packaging and grading facilities, cold storage facility, refrigerated transport vehicles/containers, storage and phytosanitary facilities, etc.

Researcher strongly recommends for an integrated development of horticulture industry in order to meet not only the requirements/demand of the domestic market but also to exploit the export potential to maximum extent. Emphasis on quality production needs to be strength-

hened together with sound post-harvest management of the highly perishable horticultural commodities.

Assis, *et. al.*, (2004), in their experimental study on '*Nutritional balance and physiological disorders in mango Tommy Atkins*' concluded that high concentrations of Ca (calcium) and Mg (Magnesium), as well as low ratios of N/Ca (N: Nitrogen) and K/Ca (K: Potassium), both in the flesh and in the skin, were efficient to prevent physiological disorders in mango fruits; the nutrient concentration in the skin may show better, the condition of physiological disorders than the nutrient concentration in fruit flesh; and the TSS (Total Soluble Solids) values and TSS/TTA (TTA: Total Titrable Acids) ratio in fruits with symptoms were much higher than in fruits without symptoms, due to over ripening of flesh tissues.

Gouri Sundaram (2000), in a study on processed tropical fruits indicated that India is the second largest producer of fruits and vegetables in the world with an annual production of 94 mmt (million metric tons). It has the distinction of producing almost all tropical and exotic fruits and vegetables because of varied climatic conditions. Due to the short life span of these crops, as much as 30-35 percent of the fruits and vegetables perish at various stages viz., harvesting, storage, grading, transport, packaging and distribution. Only 2 percent of these crops are processed in to value added products. Hence there is strong need for maximum commercial utilization of fruits and vegetables and to adopt innovative production and marketing practices to the requirements of the world market and also to cater to domestic demand which over the past few years has been increasing because of various socio economic factors.

Dias, *et. al.*, (2003), in their research work titled '*Incidence and severity of mango flower malformation in six different cultivars (varieties)*' aimed at evaluating the incidence and the severity of mango flower malformation in the six cultivars namely; Rosa, Haden, Bourbon, Palmer, Tommy Atkins and Van Dyke in the semi arid zone of Brazil found that the highest percentage of incidence and severity of flower malformation was gotten by Haden variety where as Rosa and Bourbon cultivars presented minimum occurrence of the disease.

MOFPI Report, (1998), in their documentation on fruit processing submitted to Ministry of Food Processing Industry, highlighted that fruit and vegetable processing industry in India is highly decentralized. A large number of units are in home scale sector, cottage scale sector and small scale sector having installed capacity of 50 tons to 250 tons a year, where as a smaller number of large scale Indian and multinational companies have larger installed capacities in the range of 05 to 30 tons per hour. Due to effective liberalization policies and withdrawal of

excise duty on fruit and vegetable products there has been significant rise in the growth rate of production of this industry.

Offenbach, *et. al.*, (2003), in their research article titled '*The effect of modified atmosphere and refrigeration on post-harvest of mango*' with the aim of evaluating the post-harvest behavior of mango in refrigeration and the potential of the modified atmosphere technology, tending to permit a best post-harvest conservation of mangoes, found that all the parameters such as fruit weight loss, peel and color, firmness, decay incidence, pH, total soluble solids, titratable acidity and their ratios were all within the normal range and reacted positively if PEBD with ethylene absorber sachet is used to modify the atmosphere of the fruit than the other methods such as using PVC sachets, permeable selective film with ethylene absorber sachet (Conservax), etc.

McKinsey and CII study report, (2001), in their article reported that, according to a joint study conducted by McKinsey and Confederation of Indian Industry (CII), a staggering 50 percent of production of fruits and vegetables in India are lost due to wastage and value destruction. In monetary terms, the loss was estimated at over ₹ 23,000 crores a year.

Katar Singh *et. al.*, (2002), in their study on role of Banks in promoting India's export of fruits and vegetables, explained that banks have played an important role in extending finance for agricultural exports since nationalization, i.e., 1969. In 1969 commercial banks provided only 14.6 percent of their total credit to the priority sector and the same had gone up to 43 percent in 2001. Similarly the percentage of credit disbursed to agriculture sector has gone up from 5.4 percent to 18 percent over the same period. They further opined that, to achieve substantial increase in exports of fruits and vegetables we require continuous flow of better eco friendly technologies, easy availability of institutional finance for production and post production operations and higher level of investment in creating basic infrastructure such as roads, markets, power, airports, etc.

Jatosti and Spina (1992), reported that citrus fruit production world wide rose 12.4 percent between 1976 and 1981. Oranges made up 71 percent of total harvest, lemon and lime 9 percent. The greatest expansion of production occurred in Brazil, while US production has stagnated. There was a marked trend towards processing which accounted for one third of production.

Bastine Latha and Palanisami (1994), worked out the growth rates in area, production and productivity of major crops of Kerala. The

exponential function, $Y=AB^t$ was fitted to the data of 25 years (1965-66 to 1989-90) to compute the compound growth rates.

Deepak Shah and Narayan Murthy (1998), studied marketing pattern of horticultural crops in Maharashtra. The grape orchardists marketed their produce either through forwarding agents in whole sale markets or through commission agents or directly to the Wholesaler. The per box (4Kg) total marketing cost was estimated to be the highest when the produce was sold through forwarding agents in the whole sale markets compared to the produce sold through other marketing channels.

Deepak Shah (2000), studied the marketing pattern of grapes in Maharashtra. Since majority of the orchardists sold their produce in the domestic market, the estimation of marketing cost was attempted for domestic market only. The following channels were visualized in marketing of grapes in the domestic market.

Channel I : Producer \longrightarrow Forwarding Agents \longrightarrow Wholesaler

Channel II : Producer \longrightarrow Commission Agents \longrightarrow Wholesaler

Channel III : Producer \longrightarrow Wholesaler

Channel IV : Producer \longrightarrow Pre harvest Contractor \longrightarrow Wholesaler

Munir *et. al.*, (1989), studied issues pertaining to post-harvest technology in Uttar Pradesh, India. He suggested that most harvesting; threshing; storage; transport; and marketing processes are still carried out using traditional implements, though modern technologies are used in state farms.

Marchal (1990), opined that after harvest, the organization of processing, marketing and sales activities in the developing countries is not proper and has lead to excessive losses. The position could be improved by setting up processing centers closer to farms and storage yards closer to markets and harvesting at the most appropriate stage and improved handling. He observed that processing was limited and the products were often not suited to the needs of traditional consumption.

Shepherd (1993), studied a market oriented approach to post-harvest management in developing countries. Many past interventions in the post-harvest sector of developing countries have failed because, whilst being technically correct they have been planned without reference to the market needs and the ability or willingness of the market to pay for the supposed improvement. This study emphasizes the need to place post-harvest activities, particularly the loss prevention activities, within a market context. So providing pointers for planners and technologists active in the post-harvest sector is a must.

Chaudhary *et. al.*, (1987), reported that the total number of fruit and vegetable processing units in India were around 1,300 with an installed capacity of 3 lakh MT (Metric Tons). Capacity utilization was increased from 25-30 percent in 1970 to 40 percent in 1982. Factors like high cost of packaging material, high incidence of import duty and lack of research efforts for modernization of packaging and other techniques were found to be affecting the industry's production and exports.

Madan and Ullasa (1991), conducted a survey in orchards, markets and processing units in Karnataka to determine the extent and causes of post-harvest losses in mango. The post-harvest loss to the extent of four percent was estimated at the processing unit end. The major cause for the loss was the occurrence of post-harvest diseases including; 'stem-end-rot', 'Anthracnose', 'Aspergillus' and 'Chizopus rots'. The authors suggested that these losses could be reduced by following the recommended production technology.

Channappa Gowda (1995), reported that in Karnataka, horticultural crops are grown in an area of 12.34 lakh Ha which accounted for 11.5 percent of the total cropped area. As per an estimate, 25 to 40 percent of India's fruits and vegetables production, valued about ₹ 3,000 crores goes waste due to lack of post-harvest infrastructure and handling facilities.

Karwasra *et. al.*, (1997), reported that post-harvest losses in fruits and vegetables in India is worth about ₹ 4,000 crores annually. In general physical terms, post-harvest losses in these commodities vary from 9 to 40 percent. Any reduction in these losses through proper post-harvest management will generate additional quantity to meet internal and external requirements even at existing level of production.

Chengappa *et. al.*, (1981), computed the growth rates of area, production and productivity of coffee in India. Linear model of the type $Y(t) = a + bt$ and exponential model of the type $Y(t) = abt$ were used to work out the growth rates. The exponential function indicated a good fit. The annual growth rate of production was 5.68 percent for Arabica and 7.40 percent for Robusta, while combined growth rate was 6.10 percent.

Mandal and Das gupta (1981), estimated the post-harvest losses for eight fruit crops and six vegetable crops both in terms of quantity and monetary value in whole sale and retail markets of Kolkata, West Bengal during 1977 and 1978. The fruits considered for the study together lost 35460 tons worth ₹ 827.00 lakhs and the six vegetables together lost 73240 tons worth ₹ 61.2 lakhs. The study revealed that the losses varied depending on locality, time period, mode of transportation followed etc.

Madan and Subramanyam (1987), conducted a survey in Kolar district of Karnataka to assess the post-harvest loss of Mango fruit at the fields (orchards) as well as at the markets (both whole sale and retail). The commodity movement analysis technique was used to identify the points for where the loss occurred and to identify how the commodity was handled by the different market functionaries. The post-harvest losses of mango were recorded at two stages, i.e., at the assembling markets (14.30 percent) and at the time of storage for ripening at whole sale and retail markets and processing units (11.91%).

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Roy and Pal (1991), assessed the extent of losses in mango at various stages of post-harvest operations. They found that the fruits discarded at the field level were 1.30 percent, culled fruits ranged from 12 to 18 percent and were sold at lower prices. The physiological losses in weight during transportation of the produce were 3.68 percent. At the time of ripening in the boxes total loss was 7.53 percent and the extent of loss was still higher in pile ripening method. To reduce the post-harvest losses in mango, they suggested taking up the spray of fungicides to control storage diseases, which occur primarily due to Anthracnose and stem-end-rot.

Indian Institute for Horticultural Research (IIHR) Report (1992), reported the post-harvest losses in mango, orange and banana among the fruit crops and onion and tomato among the vegetable crops. The estimated post-harvest loss in different varieties of mango varied from a minimum of 17.10 percent (Dashehari) to a maximum of 36.70 percent (Totapuri). The estimated post-harvest loss was 11 to 14 percent in the case of banana. Two percent of loss occurred in field after harvest, 2 percent of loss occurred with the whole sale trader and 8 percent after the ripened fruits reached the retail stage. Out of the total Coorg oranges harvested, 8.5 percent was rejected on the field, 3.5 percent after transportation to the whole sale market and a further 3.5 percent at the retail level. The post-harvest losses in vegetables revealed that the total loss in Bangalore Rose and Bellary red onions was estimated at 13.5 percent and 30 percent respectively. The study also showed that the extent of loss depended on the variety of crop, season and area of production.

Atteri (1994), worked out the physical and economic losses of Dashehari and Chausa varieties of mango in new *sabji mandi* (new vegetable market) of Delhi and found that the quantity of fruits affected ranged from 1.0 percent to 50 percent. It was 15.2 percent at whole sale and 7.74 percent at retail level for Dashehari, where as these figures for Chausa were 21.83 percent and 9.62 percent respectively. The percentage of economic losses for Dashehari at whole sale and retail levels were 7.73 percent and 5.73 percent respectively. The corresponding figures for Chausa variety were 6.02 percent and 6.71 percent. The study suggested to put serious efforts to train farmers for judging the right stage of harvesting so that the losses could be minimized.

Rao and Manohar (1995), studied loss of fruits in packing and transportation and observed the occurrence of damages to the fruits mainly at three stages, viz., harvesting and transportation of the produce to the whole sale markets, repacking and transportation by the Wholesellers and loading and unloading of the fruits at various locations. They also reported that the extent of damage of fruits vary with the packing material used. About 100 to 2000 kgs of fruits were damaged in a truck carrying 7 to 10 tons of fruits where leaves were used as packing material. Where as the extent of loss was only 10 percent when the boxes of 6 mm thickness were used as packing material.

Sharma *et. al.*, (1995), worked out the post-harvest losses during storage, transportation and marketing of major vegetable crops (capsicum, tomato, beans and peas) in Solan district of Himachal Pradesh based on the primary data collected from a sample of 60 farmers. According to the study, the minimum losses were found to be in the case of beans. The extent of losses was found to be highest while transporting the vegetables from fields to the storage yards. The losses during transportation were about 10 percent for peas and beans and more than 21 percent in the case of tomatoes. About 18 percent of the losses were found during grading and packing. The main causes for losses noticed were attack of pests and diseases, breakage of fruits, uneven size and mixture of different varieties. The losses at the market were more than 30 percent for beans and peas while these were less than 15 percent for capsicum.

Indian Institute for Subtropical Horticulture (1996), conducted a survey in Farukhabad and Kanpur regions of Uttar Pradesh to estimate the post-harvest losses in Papaya. It was reported that the losses during harvesting occurred mainly due to accidental falling of the fruits. About 10 percent of the fruits got cracked in varying intensities during harvesting. Rottening losses to the extent of 25.1 percent were observed at the ripening stage. The aggregate loss at retailer level was 7.2 percent.

An analysis of pooled losses in entire post-harvest distribution system of Papaya revealed that only 53.03 percent of the produce reached the consumer in good marketable condition. In other words 46.97 percent of the produce was lost at various stages.

Srinivas *et. al.*, (1997), conducted a survey to assess the post-harvest losses of Totapuri (Bangalore) and Alphonso (Badami) mangoes in Karnataka and reported a total post-harvest loss of 17.9 percent (3.5 percent at the orchard or farm; 4.9 percent during transportation; 4.1 percent during storage; and 5.3 percent at the retail level). The major causes for losses observed in the order of their occurrence were physical injuries like breakages, spoilage due to poor handling and storage, immature or over maturing of the fruits, under size or over size, pilferage during transportation and handling and damages caused to fruits by birds and hailstorms.

Gajanan (2002), studied the marketing practices and post-harvest loss assessment in Poovan variety of Banana in Tamil Nadu. Trichy district was selected based on its maximum contribution to the area under banana. The producers of banana were found to use two main channels for marketing their produce, i.e., selling in the local market either through pre-harvest contractor or commission agents (channel I) and selling to the agents or the Wholesalers in the distant markets like Bengaluru, Mumbai and Chennai (channel II). The post-harvest losses in channel I was found to be slightly less at around 19 percent when compared to 21 percent in channel II. The main reason for the higher loss in channel II was transit loss. Further, in order to make the best use of the utilizable waste banana fruits, it was suggested to establish processing units of banana in the main production area as it was found feasible.

Sreenivasa Murty *et. al.*, (2002), conducted post-harvest loss estimation in Bangarpalli variety of mango at different stages of marketing. Krishna district in Andhra Pradesh was selected as it ranked first in terms of area and production in the state. The post-harvest losses in mango at different stages of mango were estimated under two heads, viz., physical Post-harvest Loss (PHL) and economic Post-harvest Loss (PHL). The average physical PHL at the farm level in Bangarpalli variety was 15.6 percent. This was due to the harvest of immature and small fruits. It was observed that physical PHL at market level was virtually zero. On an average about 128 fruits out of 1440 fruits were found to be damaged due to poor handling.

Subramanyam and Mrityunjaya (1978), based on their study on marketing of fruits and vegetables in Bangalore suggested the following;

1. Regulation of marketing of fruits and vegetables through fixing reasonable commission by the middle men and strict supervision.
2. Creation of vegetable marketing organization units with assembling centers located at growing areas.
3. Arrangements to provide the financial assistance and the other essential inputs
4. Creation of commodity marketing boards for each or a group of similar fruits and vegetables to take care of both supply and marketing of the same.
5. Providing cold storage facilities to the farming community and establishment of retail outlets to protect the interests of farming community and consumers.
6. Organizing market surveillance and intelligence activities and dissemination of the above information through all possible means of communication for improving the marketing efficiency of fruits and vegetables.

Nagaraj *et. al.*, (1985), in their study on market appraisal of fruits and vegetables documented the problems and remedies for vegetable producers and intermediaries. The problems documented were lack of storage facilities, delay in getting the sales proceeds from the intermediaries, higher rates of commission, improper weighing, wide fluctuation in prices, higher handling costs at the market, etc. However retailers and commission agents complained about congestion in the market yards. The remedial measures suggested by the participants were;

1. Regulation of markets and equipping with a network of infrastructure facilities ranging from scientific storage to transportation and processing.
2. Regulation of futures trading.
3. Spreading the tentacles of cooperative marketing and reducing their procedural formalities involved to encourage producers.
4. Providing financial assistance to purchase well ventilated vehicles/temperature controlled vehicles and fruit and vegetable storing plastic crates/cartons, which are to be used for transporting and marketing of perishables.

