Chapter 2

REVIEW OF LITERATURE
2. REVIEW OF LITERATURE

A review of past research helps in identifying the conceptual and methodological issues relevant to the study. This will enable the researcher to collect accurate data and information and subject them to sound reasoning and meaningful interpretation. This chapter provides a brief review of literature in the areas related to the present study.

2.1 Cashew Industry

2.1.1 Cashew production in India

Abdul Salam et al. (1999) opined that during the initial phase of introduction of cashew in India, large scale plantations of seedling origin were taken up in degraded and marginal lands as a means for conserving soil. However, HYV require proper care, particularly during the establishment stage through in situ moisture conservation and supplemental irrigation. Cashew responds well to irrigation, particularly at the time of fruit setting up to the full development stage of the nuts.

The Government of India is providing assistance for adopting micro-irrigation in cashew at 50 per cent of the cost to small, marginal, SC, ST and women farmers and 35 per cent of the cost to farmers of other category. So far, an area of 2,700 ha has been brought under micro-irrigation in cashew, particularly in Karnataka, Maharashtra and Tamil Nadu. The total cost of micro-irrigation system works out to Rs 16,000/ha. If fertigation unit is also added, total cost would be about Rs 25,000/ha. The scheme could be availed for increasing the productivity and quality of cashew. Assistance for micro-irrigation is presently being extended under the Centrally Sponsored Scheme on Macro Management in Agriculture.

Giridhar Prabhu (2002) opined that organized cashew manufacturing in the world originated and developed in India for the first time. It was India which gave the world cashew kernels in marketable form. It is to the credit of the industry that it has so far
evolved its capacity on its own. The industry has inertia in respect of developing any technology of its own unless it is absolutely necessary. International custom wanted Indian industry to look at a change in packaging from conventional tins to plastics. Ultimately, the industry had to settle for a South African machine and an Italian system. There is a need for greater institutional look at the industry form academic and support angle. The constraint is that industry sponsorship will not be forthcoming. Reluctance of scientists and academicians is understandable as it will not further their interests. Though it is an industry which is contributing about Rs 24.50 billion in exports, the Government has not been persuaded to provide a mandate for technology support to the industry. At the moment, an Indian initiative for technological improvement looks bleak. Individual industrialists will continue to make process innovations voluntarily to the best of their ability in an entrepreneurial economy.

Ghosh, S. N. (2002) studied the performance of pineapple as an inter crop in a young cashew plantation at Nellikkuzhy (Ernakulam District). In an area of four acres of hill slopes, 300 softwood grafts of high yielding varieties of cashew were planted during October 1998. The suckers of the Kew varieties of pineapple (12 month crop which can be ratooned for three to four years) used as inter crop. 9,000 suckers per acre were planted in trenches. On an average, ten tons of pineapple per acre was harvested during the first year, another 15 tons during the second year and another 18 tons during the third year. On an average, pineapple was sold at Rs 6 per kg during the first two years and Rs 4 per kg during the third year. The gross income realised from the first three years amounted to Rs 222,000 per acre (Rs 0.888 million from 4 acres). As such, the net income from pineapple from the 4 acres during the first three years amounted to Rs 0.52 million. Due to inter cropping, cashew also received regular attention, better care and management. As a result, a 3-year-old tree showed growth equivalent to that of a 5-year-old tree. During the second year itself, 300 kg of raw nuts per acre was obtained from cashew.

Yadukumar et al. (2002) worked out the unit cost of establishment and maintenance of cashew plantations for different plant densities. It was observed that unit cost of
establishment and maintenance for the first 10 years was high in high-density planting system (87 per cent to 120 per cent more than normal plant density). It was also observed that net income expected from high-density planting is 130 per cent to 150 per cent more than normal plant density (7.5 m * 7.5 m, 175 plants/ha).

2.1.2 Cashew developments in other countries

Falzetti et al. (1985) explained FAO activities which are initiated by the requests received from Governments of developing countries interested in promoting cashew nut development scheme or in improving yield recovery from existing processing plants. The last ten years have seen many countries being interested in developing a cashew program from the already existing few hectares and small plots around villages. FAO was ready to help, since there are many reasons that speak in favour of this crop, such as:

- Marginal lands which are unsuitable for other crops can be utilized for cashew
- It can be grown in small plots by farmers, and with simple but regular plant protection measures, its yield increases well above 10 kg per tree
- It provides cash to the farmer, thus improving rural income
- Processing of cashew in the country provides employment and foreign exchange

Requests received from and assistance provided by FAO since 1979 covers particularly in West Africa, Senegal, Ivory Coast, Togo, Cameroun, Nigeria and in East Africa, Uganda, Tanzania, and Zambia. In Asia, Bangladesh and Sri Lanka and in Latin America, El Salvador and Colombia have asked for FAO assistance. Feasibility studies have been prepared for all countries of West Africa interested in cashew in the last 10 years, with sometimes a follow-up as in Benin, Nigeria and the Ivory Coast where processing plants have been installed.

Jaffee (1994) studied the liberalization process within Tanzania's cashew nut industry, placing emphasis on the nature of the private sector response to market reforms. Section one examines important technical and economic characteristics of cashew nuts, their production and processing, noting possible implications for the organization of cashew nut processing and marketing. Section two reviews the world market situation for cashew nuts and the changing position of Tanzania and other sub-Saharan African countries.
Section three traces the rise and decline of Tanzania's cashew nut industry from the 1980's until 1990. The factors contributing to the decline are Tanzania's villagisation program, the decline in real producer prices and inefficiencies in cooperative and marketing board for collection and downstream activities are described with the industry on the brink of collapse. Section four then examines the process of market liberalization, which has taken place since 1991, emphasising the nature and effectiveness of the private sector response. A relatively large number of private traders have recently entered into cashew buying and selling. Successful entry into export marketing has proven viable only for a small number of companies which are medium to large in scale, diversified across commodities, involved in trading and agro-industry, not indigenous and with strong financial and trading links abroad.

Sadannakumar (2000) opined among tree crops, cashew is truly a “Global Nut.”. It is produced heavily in five nations viz. India, Brazil, Vietnam, Tanzania and Guinea Bissau and moderately to lightly in 25 other Countries. It is consumed in over 125 Countries, but imported prominently into 65 Countries. The major consumers are USA, The Netherlands, Japan, UK, Germany and Canada. All OECD Countries are heavy consumers of cashew nuts. India is the world’s largest converter of raw cashews into cashew kernels. It imports from over 25 Countries and exports to over 60 Countries. By world standards, cashew trade is considered as small. The total value of raw cashew trade amounts to US$ 250 million. The global cashew kernel trade from producing countries as exports is slightly over US$ 1 billion. Global retail sales can be estimated around US$ 2.2 billion.

Carlos Costa (2001) of Technoserve explained the cashew industry at Ghana. Technoserve has been instrumental in setting up a fledging cashew processing industry at Ghana. In 1996, the company organised a processing workshop for farmer groups. In 1997, a business plan was drawn up for a processing plant with a capacity of 30 tons of raw nuts/year and the equipment was installed the same year. The association that owned the small factory paid 20 per cent of the cost up front, and Technoserve loaned the rest of the costs for that year. Loans for subsequent years were organised through the normal
banking system, guaranteed by Technoserve. In the first year of operation, two tons of raw nuts were processed. Members of the association bought shares in the company. Processing was by hand using both the Indian and Brazilian hand shellers, although the Brazilian’s were preferred over the Indians. All of the machines were made in Ghana. This processing system has been replicated twice more, so now there are three processing factories in all, based at Msawkaw, Kabile and Sampa.

The target for the three units in 2001 was to process 12 tons of kernels (approx. 48 tons of raw nuts). These kernels go to the “Golden Harvest” company for final roasting, salting and packaging for the local market. The kernels are packaged in 100g bags or 250g jars. The Golden Harvest Company is owned by the three processing associations (45 per cent) and Ms. Esi, who owns Mase Foods. Technoserve was instrumental in setting up this arrangement.

Ghana is a new and a small producer of cashew (5,000 tons per year and increasing), but they are already thinking about the benefits of the value addition from processing. This was an important move to initiate a processing industry very early in the cashew development phase.

Singh et al. (2001) opined that out of the total world production of 1.83 million tons of raw cashew nuts, only 0.43 million tons takes part in kernel exports, while 1.4 million tons are either traded as raw nuts or processed and consumed within the producing countries themselves. At global trade, only 24 per cent of the total raw nut produced takes part in cashew kernel conversion for export, while 78 per cent takes part as unprocessed raw nuts transaction for export or for processing and consumption within cashew producing countries. In case of unprocessed raw nuts’ transaction, some countries of Asiatic region and majority of African zone are mostly involved. India does not take part in raw nuts export as such. Most of the nuts from other countries are exported to India. Such exports takes place from Mozambique, Tanzania, Kenya, Benin, Guinea Bissau, Ivory Coast, Ghana, Senegal, Madagascar, Nigeria and Togo of African zone. Similarly, Indonesia and Singapore (not a producing country) from Asiatic zone also takes part in
raw nuts export mainly to India. The Asiatic and African zone together produce 68 per cent of the global production of which 28 per cent takes part in kernel trade, 19 per cent takes part in raw nut trade and remaining 53 per cent goes for local consumption.

**Topper et al. (2001)** conducted West Africa Regional Cashew Survey (covering the countries Guinea, Guinea Bissau, Cote d’Ivoire, Ghana and Nigeria). The major findings of the survey are that the majority of raw nuts harvested in all the five African cashew-producing countries are shipped to India for processing and then re-exported to USA, Europe, Japan, etc. Although this route is perfectly acceptable as farmers can still derive a good income from growing cashew, any potential value addition from processing is lost to the country. Major benefits are to be gained while processing the nut and the apple that can be undertaken locally, rather than exporting the raw commodity. However, care must be taken to ensure that the farmers do not end up subsidising inefficient and unprofitable processing industries. This can happen if high taxes are imposed on the export of raw nuts in order to allow local processing industries to compete with India.

On the positive side is the initiative in Ghana and the CAJUCIS factory at Korhogo, Cote d’Ivoire. In the intermediate position is the SODIRO cashew factory at Odienne, Côte d’Ivoire had a good operating system, but was plagued with marketing problems. On the negative side were the destroyed Premier Cashew Industry Estate factory (Oghe, Enugu State) and the Cashew Processing Industries Factory (Ibadan, Oya State) due to changes needed in the processing stage and obsolete machinery, followed by marketing and financing difficulties. Both these examples are from Nigeria. There is also an abandoned factory in Guinea Bissau.

The most remarkable use of apples seen during the survey was the production of very good cashew-apple brandy at the MIM Agro and Industrial Projects Estate in Ghana. The unique aspect of this plantation was that they make a very professional cashew-apple brandy. The brandy was an after-thought to the plantation, but to date, they have produced 42,000 liters (60,000 bottles of 0.7 liters) mainly for the local market. They are now trying to access the European market.
Balasubramanian (2002) explained the Government support for cashew industry in other countries. Brazil, the second largest producer of raw cashew nuts in the world is also the second largest supplier of cashew kernels to the world market. The existing and plantations that are coming up in Brazil are all very large, extending over an area of 500 to 1,000 acres making the production and collection of raw cashew easy, organized and cheaper. The Brazilian industry is assured of raw cashew nuts at about half the price at which the Indian industry gets it. They also have the added benefit of close proximity to USA, the largest importer and consumer of cashew kernels in the world. Moreover many USA buyers have invested in cashew plantations in Brazil, and this paves way for the Brazilian cashew kernels to the USA market.

Vietnam at present is the main competitor to India in all its traditional and major markets for cashew kernels. Vietnam had taken up cashew cultivation seriously a few years ago, progressed very rapidly and is now the third largest producer of cashew in the world. During 2000, Vietnam produced 160,000 tons of raw cashew nuts. About 40,000 tons of raw cashew nuts were imported into India from Vietnam during 1992-93. In order to promote domestic processing and export of cashew kernels, Vietnam Government imposed 15 per cent tax on export of raw cashew nuts in 1995. The exports of raw cashew nuts decreased considerably, and from 1998, Vietnam is not exporting cashew in raw form. Vietnam now has a processing capacity of 220,000 tons of raw cashew nuts and to make up any shortfall in the domestic production, they are importing raw cashew nuts from Tanzania, Mozambique, etc. Compared to 20,000 tons of cashew kernels exported in 1999, the export from Vietnam during 2001 is estimated at 40,000 tons. Now, Vietnam is selling its produce to about 15 Countries including Australia, USA, Japan, China, Malaysia, Singapore, Middle East and East European countries. Vietnam meets 80 per cent of Australia's requirements overtaking India, which used to be the leading cashew exporter to Australia. With the Government support, the Vietnam exporters are exploring markets in East Europe, South East Asia and Middle East and East European countries. Of late, both Brazil and Vietnam are competing with India in East and West African countries for purchase of raw cashew nuts.
Mozambican Government and Tanzanian Government have increased the tax on export of raw cashew nuts during 2001 in order to promote domestic processing and exports and to protect domestic processors.

Carlos Costa (2002) explained the cashew industry at Senegal. The cashew sector, even though with various problems, is a very sensitive sector to the Senegal economy. Studies show that it necessitates a readjustment with regards to organization, exploitation and financing in order to envisage a long-lasting development.

Even though the cultivation is localized in some regions, the potentials are still huge. However, it should be mentioned that there is a great discrepancy between the aims (of the importers) and the means used by the farmers. As for yield, the serious degradation of the plantations and the collection of premature nuts should have to be remedied. Marketing is affected by liberalization and globalization, which brings in new tools for harmonization. These tools refer to the quality of the products and the adherence to international regulations regarding trade.

These constraints are characteristic of a sector that lacks organization and coordination. The cashew sector is facing the consequences of an absence of strategy and increased international competition. Liberalisation is a way to definitely involve the agents and the Government authorities in a synergy of revival with the help of lessons acquired from the ten years of experience. In spite of these difficulties, people still believe in the true potential of a sector in crisis for more than ten years. Mobilising the agents around a development strategy of the sector supported by Government authorities and the international organisations will permit the sector to get back its past glory with the creation of employment, increase in revenue in the rural milieu, acquisition of new technologies, and control of the demands on standard and protection of the environment

Solomon Ramahifarison (2002) explained the history of cashew industry at Ivory Costa. The SODIRO cashew (and rice milling) factory at Odienne (Ivory Costa) started processing in May 1998. All the machinery was bought from India, and one Indian
technician spent a year at SODIRO training people. The finished kernels were vacuum packed in nitrogen for export, and smaller packs of ready-to-eat cashew were also produced for the local market (demand apparently was not high). The factory was well organized and maintained, and the environment for workers was very good. The finished kernels looked of a high quality and tasted good.

In early 2000, SODIRO bought 1,400 tons of raw cashew nuts and by January 2001, they had only processed 700 tons, in spite of the fact that the new buying season was about to start. The factory had a capacity of 2,500 to 3,000 tons per year. In 2001 the factory was running at less than one-third of the capacity and most of the machines were idle. The reason for this was that they had not managed to sell a substantial proportion of their processed kernels since 1998 (approx. 4,000 cartons of 22.68 kg each remain unsold in Abidjan). The factory employs 800 people, of which 700 are women. Supply of labour is not a problem. This potentially very serious marketing problem urgently needs to be examined in more detail.

The CAJOU CIS cashew-processing factory at Korhogo was using both mechanical and hand processing equipment to produce kernels. The mechanical equipment was purchased from Oltremare in Italy and installed in 1979. The factory has a capacity of approximately 2000 tons of raw nuts per year. Some of the kernels were organic; apparently some fields have been certified as organic and the produce from these fields was kept separate from the rest.

In addition to the mechanised factory, they started with manual processing using Indian machines in 2000. In 2001 they were processing 1.5 tons per day with this method and hoped to increase to 2 tons per day. Two shifts operated. Kernel out-turn was estimated between 21 and 22 per cent.


1. India: Government of India Notifications SO 604 published by the CEPC of India.
Achal cashew (2005) listed the International Organisations involved in cashew. World Bank finances projects for cashew nut development within developing countries. International Standards Organisation sets standards for cashew kernels. Food and Agricultural Organisation is an organisation for monitoring production. Common Fund for Commodities is an organisation for commodities UNECE sets standards for cashew kernels as one of the dried fruits. National Organisations: Japan Nut Association is an active Japanese Association for nut importers and users. It is also an association that looks into consumption of all nuts in Japan. AFI is an association that protects the interests of food importers and has an active Cashewnut Section. CENTA is an European association protecting edible nut interests and is based in London. SINDICAJU is a Brazilian association of cashewnut manufacturers based in Fortaleza.

2.1.3 Cashew processing industry

2.1.3.1 Raw cashewnut processing

Nair et al. (2000) studied the grading of cashew kernel. Common practice uses the American Standard grading system, which is incorporated into the Indian Government export criteria. Cashew kernels are categorised on the basis of colour and condition, with white or ivory kernels preferred over brown ones. The highest prices are typically paid for better quality kernels of the W180 and W210 grades, the largest and heaviest grades. Peeled cashew nuts can be classified into between 11 and 24 grades, roughly divided into three groups: white whole, white pieces and scorched grades.

White whole kernels are graded according to their size on the basis of the number of kernels per pound (equivalent to 454 g). The most common count for Indian and African
kernels is 300-320 per pound (W320) followed by 400-500 (W450), 220-240 (W240) and 200-210 (W210) per pound. Brazil has a large proportion of large kernels; thus, another grade of 160-180 (W180) is available. There are other grades that do not fall into the above classification typically called dessert grades, but which are used for consumption are shipped to countries that have an outlet to the cheaper trade.

Balasubramanian (2001) studied the cashewnut processing units in Kolar district, which follow steam boiling of raw cashewnut and conventional type drier to make kernel amenable for peeling. Kernel peeling is done at home level and finally stored into 15 different grades. The cost benefit ratio of processing in this region has been worked out as 1:1.28. Major interventions are required to develop quality standards for raw cashewnuts, developing skilled manpower at various stages of processing and refined technical parameters to enhance profitability. Considering under-utilization of established facility, i.e., up to 12.5 per cent of total production in this region, inefficient technical and management aspects and the huge investment incurred on raw nuts and machines, existing large-scale processing units are not successful in this region. As small scale processing units generate employment for 3,177 persons for the raw nut produced, profitability of business is up to Rs 88,390 per unit during season and the value addition is Rs 11.04 per kg of raw nuts which is 16 per cent more than existing system, it can be promoted to improve economic status and rural employment.

Giridhar Prabhu (2001) analysed the different types of value addition in cashew kernel industry. Cashew is sold as it is (raw or plain) and in the form of roasted and salted cashews. Two decades ago the honey-coated cashew was generated. After that, similar product development did not take place in the cashew industry. The value addition for cashew kernel can also be done in the existing value chain which comprises decreasing the costs of procurement, improving the firm infrastructure, human resource management, technology development, logistics, finance, marketing, performance, quality, information, characteristics, packaging, flexible manufacture, finding different uses of cashew, marketing broken which could be realized if cashew is used as an input into confectionery, biscuits and cookies, chocolates, ice cream and as a food ingredient.
Balasubramanian et al. (2002) explained the processing cost of cashew. 60 per cent of the total earnings from kernels derived from 1000 tons of raw nuts go towards the value of raw material (raw nuts). The remaining 40 per cent is distributed to various taxes (purchase tax 5 per cent, income tax 3.3 per cent), transportation (0.01 per cent), processing labour 10.5 per cent, fuel for processing 0.1 per cent, packaging material 4.5 per cent, administrative over heads 0.1 per cent, handling of finished products 5 per cent, selling overheads 1.2 per cent and depreciation of movable and immovable assets 0.1 per cent besides a reasonable profit margin of 10 per cent to processor.

Further, he explained the price spread in raw cashew. The actual value obtained by the grower at many instances has been well within the range of 10 per cent variation except in 2002, where difference between ex-factory raw nut price and actual value obtained by grower had been +13 per cent. The farm gate price which remains at 10 per cent less of ex-factory price can be attributed to purchase tax, transportation, pre-pricing handling etc. Thus the value obtained by the grower is not at an alarmingly depreciated rate. The 60 per cent value going towards raw material procurement has to be reduced to provide a still better price to grower, which is possible only through modernizing the processing sector, reducing the infrastructural over heads and to get maximum recovery of kernels. The elimination purchase tax, though is a loss of revenue to the Government exchequer, its elimination will be another measure for the grower to get more prices.

Manuel Fernandez (2003) analysed the evolution of cashew kernel packaging from the days of wooden cases to flexi packaging. A comparative analysis is made of packaging of cashew kernels in tin containers and flexi bags in terms of cost effectiveness and eco-friendliness. The additional investment involved in changing over from tin packaging to flexi packaging works out to an amount ranging from Rs 0.457 million to 1.166 million depending upon the capacity of machine installed. This investment can be recouped within a span of 56 to 96 days based on the type of machine installed. Flexi packaging is cost effective to both processor-exporter and the importer and is eco-friendly.
Ojewola et al. (2004) found that cashewnut meal is a good substitute for soyabean meal at 0, 25, 50, 75 and 100 per cent, and the diets were respectively designated as diets 1, 2, 3, 4 and 5 in a completely randomized design in a 5-week bird feeding trial. Body weight changes, feed intake, feed-to-gain ratio and the economics of production were investigated. The feed-to-gain ratio was significantly (p < 0.05) influenced while other parameters were not. Diet 3 gave the best value (2.24) followed closely by diets 4 (2.25) and 2 (2.28) respectively, while diet 1 had the poorest value (2.53) followed by diet 5 (2.40). The mean daily feed intake improved as the percent cashewnut meal substitution increased from 0 to 100 per cent. Birds fed with diet 4 had the highest value (120.58 g) while birds fed with diet 1 had the least value (115.84 g). The mean total body weight gain (g) was highest (2,214 g) for birds fed with diet 3 while birds fed with diet 1 had the least value (1,878.00 g). The cost/kg diet (N) decreased as the dietary inclusion of the test ingredient increased from 0 to 100 per cent. At the end of the trial, the highest marginal revenue was obtained from birds fed with diet 4 (N 415.32). This was closely followed by birds fed with diets 3, 5, 2 and 1. Cashewnut meal is therefore recommended as a substitute for the expensive conventional plant proteins at 25, 50 and 75 per cent levels.

2.1.3.2 Cashew apple processing
Mandal et al. (1985) opined that about 0.2 million tons of cashew apples are produced in India annually, which are presently being just wasted, except in Goa where it is utilized for the preparation of ‘fenny’. Sporadic attempts to promote its economic utilization have proved infruitious in other states. The juice though one of the richest sources of vitamin C is not acceptable as a soft drink due to its high astringency. The juice is a good media for alcoholic fermentation as it contains all the nutrients for growth of yeast. The cashew wine contains about four per cent alcohol, but has astringency. Brandy - distillate of wine - does not have the astringency, but possesses the exotic flavour of cashew apple. The utilization of cashew apples for the manufacture of liquor as a cottage industry in Goa has been described in detail. Further, the possibility of manufacturing industrial alcohol is dealt in brief. Studies conducted at Central Food Technological Research Institute, Mysore have shown that the cashew apple hitherto considered as a waste can be profitably utilised in preparing alcoholic beverage.
Vaidehi (1990 and 1995) pointed out that cashew apple can be used for preparation of various products. About 50 to 60 per cent of raw juice with 9-10 per cent soluble solids can be obtained from cashew apple. The cashew apple contains 87.5 per cent moisture, 11.6 per cent of carbohydrate and 0.2 per cent protein. Cashew apple is one of the richest sources of vitamin C (0.26 per cent) and minerals. Cashew juice with mild powder spray dried at a given percentage of juice from 10-15 per cent results in excellent quality products. This could be utilized in reconstituted milk shakes, ice-creams and flavoured dahis. Frozen desserts and dairy confectionery opens an excellent avenue for cashew apple utilization. The Rheological properties like Farinography and Amylograph of the products at 10, 15, 20 per cent with wheat flour blend shows the powder is best suited to cookies, buns and confectionery products which shows a comprehensive baking industry and dairy industry set up along with cashew apple industry for better utilization of this crop and more efficiency in the industrial set up.

Roopa (2000) suggested that intensive training program and support for small scale processing units with local participation of planters is a must for the better utilization of unconventional fruits. Highly negligent handling of cashew apple should be immediately stopped by making it mandatory to the cashew plantation owners to start a fruit processing centre alongside; this should be enforced stringently by the Cashew Development Board or any other body that can do this effectively. The rotten cashew apples lying all over the field and illicit liquor preparation are creating environmental and health hazards in the country. This should be taken as a serious matter in the cashew plantation area. Women and youth should be given incentive to start product-oriented industrial units for cashew apples per se a teach area of cashew production and research centers and in State Agricultural Universities to encourage participation by the urban dwellers. All the mass communication medias should be intensively and persistently used for some 5 years to imbibe in the minds of people regarding the benefits of cashew apple and product technologies available for use by the concerned. Vocational institutes should teach how to utilize lesser utilized fruits and their products in value-added products. Urban NGOs and environmentalists should purchase fruits and their products for marketability and consumption and popularize as health care products.
Fanimo (2003) investigated the nutritive value of dried cashew apple waste (CAW). A basal (control) diet was formulated to meet requirements of growing rabbits and three other diets were formulated by substituting 10, 20 and 30 per cent of the basal diet with CAW. Thirty-six 6-week-old rabbits were fed with these diets and growth performance was recorded. Faecal apparent digestibility of nutrients was measured in 12 rabbits. Rabbits fed with diets with 20 and 30 per cent CAW gained weight faster than those fed with the control diet. Feed efficiency increased with levels of CAW in the diets with rabbits on 30 per cent CAW being most efficient. Crude protein digestibility decreased with increased level of CAW. There were no significant differences in the blood metabolites except cholesterol level which increased with CAW inclusion in the diets. Inclusion of CAW also increased the relative weights of kidney, liver and carcass cut parts. It is inferred that dried CAW can be included in growing rabbit diets up to 30 per cent of the dry matter.

2.1.4 Cashew marketing and trade
Unnikrishnan (1985) presented the details of enactment of Export (Quality Control & Inspection) Act, 1963; establishment of Export Inspection Agencies (EIAs) - taking over the scheme of Quality Control and Pre-shipment Inspection by the Cashew Export Promotion Council (CEPC); grade specifications notified by the Government of India; improvements brought in vita packing machine; inculcation of personal hygiene; improved method of conditioning of kernels; regular anti-infestation and dis-infestation measures; improved packing and adoption of good manufacturing practices. In addition, phenomenal growth of cashew industry during the past decade; increase in quality; increase in foreign exchange earnings; increase in unit value; how quality sustained the markets, especially in the context of emergence of competitors; enhanced confidence of buyers; minimised complaints from abroad; sustained image of India as a supplier of quality product are discussed. The need for continued surveillance to ensure product quality and the role of EIA officers in bringing about discipline in the processing industry and the resultant increase in productivity and quality, the most important factor in creating and retaining markets, are detailed.
Nayar (1995) studied the role of cashews in the Indian economy and India's position as a cashew nut exporter. Future prospects for value-added products are also studied. Cashew was India's second largest foreign exchange earner among agricultural commodities in 1993-94. Current total world production is around 750,000 tons, of which India produces around 350,000 tons. Average yield of cashew in India is 0.6 tons/ha as compared with a potential yield of one ton/ha, if proper planting materials and the latest technologies were employed. World exports of cashew kernels exceeded 100,000 tons in 1994, of which India accounted for 77,000 tons. Over 99 per cent of Indian cashew goes in bulk packaging and as plain cashew kernel. These are imported by big wholesalers in the consuming countries, repacked in retail packs either as such or after roasting and salting and sold to retailers. These retail packs are marketed under well-established brand names of the local packers. It is quite unfortunate to note that even with over seven decades of experience in international trade in cashew kernel, Indian exports of cashew kernels in value-added forms/consumer packs constitutes less than one per cent, and its value is less than Rs 10 million. Consumer packs of different varieties (salted, spiced, etc.) exist, but no serious efforts have been taken by Indian exporters to market these in foreign markets. Various products could also be produced from the cashew apple, cashew shell and cashew shell liquid.

Balasubramanian et al. (1996) studied the trend in pricing and import of raw cashew nuts in India between 1981 and 1995. The dependence of cashew nut export trends on the international market price for kernels and on the foreign exchange rate of the rupee is examined. The pricing trends of raw cashew nuts in different states are evaluated and the effect of a monopoly procurement policy in 1981, 1982 and 1988-93 on the price obtained by farmers is critically discussed.

Balasubramanian (1999) analysed that the export of kernels will reach about 0.15 million tons and the domestic consumption about 75,000 tons by 2006-07 by using the annual growth rate of export and indigenous consumption in India. Thus, the raw nut requirement will be one million tons. Since import of raw nuts from other cashew producing countries will be increasing in the near future, the Indian production has to
meet the challenges by reducing cost of production and improving quality. Cashew producing countries are exporting nearly 0.17 million tons of kernels out of a total production of 0.29 million tons while the remainder is consumed indigenously. The present absorbing capacity globally is almost getting fulfilled. Therefore, he suggested that any effort to increase production will have to commensurate with the commercial feasibility and the competition from other countries. Hence, efforts in increasing production will have to be supplemented with aggressive marketing promotion measures. Efforts will also be needed to promote local consumption.

Raghuram (2000) pointed the problems faced by the cashew industry in Karnataka. Over 160 cashew producers and 20,000 members of the labor force in different cashew production units in Karnataka are facing an uncertain future due to the downtrend in the availability of raw cashew and the heavy burden of taxes on the industry. Nearly 60 per cent of the cashew trees in over 40 per cent of the cashew plantations in the state were over aged and their productivity had come down, at least, by 50 per cent. The APMC has levied one per cent market fee even on imported raw cashew while manufacturers are paying a similar fee for imports, which amounted to paying double fees. The industry also faced double taxation in our country, the Government considers raw cashew and cashew kernel to be two separate commodities because of which sales tax and turnover tax are payable both on the input and the output. The cashew industry is burdened with around 14 per cent taxes at the purchase and sale points.

Krishna Pillai (2002) opined that cashew is a versatile crop with unlimited export potential for cashew kernels and allied products. The policies and programs for development of cashew industry in India are to be on the following lines.

- Abolishing all types of taxes on raw cashew nuts purchased for processing and exports.
- Declaring cashew as a plantation crop and exempting cashew farms from the purview of land ceiling laws.
- Increasing the domestic production of raw cashew nuts to 0.1 million tons by 2010 and 0.16 million ton by 2015.
• Developing the infrastructure for post harvest operations, warehousing, transportation etc.
• Improving the quality at all levels, especially in processing and packaging of cashew kernels and also popularizing the nutritional values of cashew kernels.
• Diversifying the markets for cashew kernels by strengthening the non traditional markets.
• Promoting the exports of value added and branded consumer packed products from cashew kernels.
• Promoting the use of cashew kernels (broken) in confectionery and biscuit industries.
• Encouraging the establishment of ancillary industries to make use of cashew apple, cashew shell, cashew testa etc.

2.2 Analytical Tools Used in Research Work

2.2.1 Economics of cost of cultivation and processing

Seavert et al. (1992) conducted a study to determine the costs and returns of establishing and producing a standard planting of hazelnuts in Oregon’s Willamette Valley. In addition, the costs and returns of establishing and producing a double-density hazelnut orchard were estimated and the economic benefits of the two densities compared. The standard density orchard consisted of trees planted 6.2 m x 6.2 m for 267 trees/ha vs. doubling the density and removing every other tree in year 11. The first year cash cost for the standard density orchard was US$ 2,839/ha. Nut production begins in year 4 with .19 ton/ha and increases to 2.93 ton/ha at full production. A positive cash flow begins in year 5. In year 11, the orchard returns a sufficient amount of gross income to pay all previous years’ cash costs of establishment with US$ 1,869/ha above prior costs. However, when total economic costs are included, the orchard cannot pay back all previous years’ establishment costs by year 12 and thus the US$ 26,125 remaining costs are amortized over an assumed 25-year period and assessed against future crops. A double-density orchard of 533 trees/ha increases the positive cash return in year 5 from US$ 26/ha to US$ 566/ha. The additional cash costs to plant a double-density hazelnut orchard in the first year are US$ 1,717/ha (US$ 4,556 - US$ 2,839). However, the net gain to the grower at the end of year 12 is US$ 1,658/ha (US$ 6,113 - US$ 4,455). The additional
revenues begin to offset the additional costs by year 9, rather than year 11 in a standard planting.

**Selvarajan (2000)** attempted to examine the cost structure and economic feasibility of small-scale rubber plantations in Assam. The total cost for establishing one hectare of rubber holding was estimated at US$ 1233.40. During the tapping period, maintenance cost required was US$ 390 per hectare per annum. The total cost of production of rubber was US$ 592.40 per hectare per annum. Labour, manure and fertilisers were found to be the dominant items of cost. In spite of the high cost of production, small-scale rubber cultivation in Assam is a highly remunerative enterprise with a net return of US$ 637 per hectare per annum. It was also found to be economically viable and cost effective as indicated by satisfactory values of net present worth (US$ 1101.50), benefit- cost ratio (1.71) and modified internal rate of returns (17.58 per cent).

**Prakash Khakhar (2003)** analysed that the cost of cultivation for tissue-cultured banana as main crop in Raver taluk of Maharashtra at Rs 49,600 per acre. The major cost was for seed material (Rs 16,800) at the rate of Rs.12 per plant followed by installation of drip irrigation constituting Rs 12,500 of the cost. The cost of fertiliser (Rs 12,500), pesticide (Rs 5,000) and manure (Rs 8,500) constituted around 30 percent of the total cost. The yield per acre was about 23.4 tons, and the total returns were Rs 119,340. The cost of cultivation of banana for the ratoon crop was around Rs 25,000 with a net return of Rs 38,000, which was slightly higher than the net return for the main crop. For cultivation of non-tissue cultured banana with drip irrigation the cost was Rs 49,600 and Rs 21,200 for main and ratoon crops respectively. The total return was Rs 86,000 and Rs 51,000 respectively for main and ratoon crops, and the net return was higher in ratoon crop compared to main crop.

**Praveen et al. (2003)** analysed the cost involved in processing of tamarind pod to pulp in southern states of India. The cost was highest in Kerala (Rs 4,852 per '000 kg of pod) mainly due to higher labour charges in the state followed by Tamil Nadu and Karnataka while the cost was the lowest in Andhra Pradesh. The benefit-cost is highest at 1.30 for
Karnataka due to highest returns. There is variation in the recovery of final output (pulp) because of the specific pulp characteristics like thickness of the pulp, less fiber content etc. Processing tamarind into flower incurs an additional expenditure of Rs 30 to 50 per quintal and fetches around 25 to 30 percent higher price compared to ordinary ones.

Shilpa et al. (2004) studied the cost components of potato cultivation in major growing areas in India. In most of the study regions, seed cost accounted the highest followed by labour cost to the total cost of cultivation. In Darjeeling, 49 per cent of the total cost accounts for seeds, while fertiliser and labour accounts for 16 and 14 per cent respectively. In East Khasi, West Khasi and Jaintia hills, labour cost contributes to a maximum of 29, 30, and 34 per cent of the total cost respectively. The cost of cultivation of potato per hectare is highest in Agartala (Rs 47,560) due to the higher seed cost and good management practices followed. Seed cost in Agartala is about Rs 900 per quintal compared to the average seed cost of Rs 500 per quintal in other regions. In hilly regions, the average cost of cultivation is in the range of Rs 26,000 to 28,000 per hectare except in East Khasi hills, where the cost of cultivation is around Rs 32,000 per hectare. Higher cost of cultivation in East Khasi hills is due to higher fertilizer application over other hilly regions.

2.2.2 Growth rate and stability

Chengappa (1981) studied 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 $Y_t = a b^t$ were used to work out the growth rates. The exponential function indicated a good fit and obtained an annual compound growth rate in production of 5.68 per cent for Arabica and 7.4 per cent for Robusta, their combined growth rate being 6.1 per cent.

Achoth et al. (1988) analysed the available data to document the changes that had occurred in pulse production in Karnataka and also to identify the important components of variability during and after the green revolution. The study revealed that production of pulses in Karnataka had registered a significant increase during the decade following the green revolution period. This increase was contributed by the increase in production in
Gulbarga district. The instability for the state as a whole had increased in the decade after the green revolution. Most of this instability was contributed by minor pulse growing districts. The instability induced by changes in the area variances was the single largest component, which increased instability of pulse production in the state.

Pal (1992) estimated the annual compound growth rates in the exports of principal agricultural commodities from India during the period from 1970 to 1989. The growth of export earnings from all agricultural products comprising food and animal products, beverages and tobacco, crude material and animal and vegetable oils was estimated at 6.67 per cent per annum. The growth of export earnings from fish and fishery products was higher at an average annual rate of 12.26 per cent. In contrast, the export earnings from forest products were stagnant during the last two decades. The export earnings from agricultural products increased because of the rise in the unit value and export of non-traditional products.

Jerome et al. (1993) examined the growth and instability in world pepper market for the period from 1975 to 1990. An exponential model of the type $Y_t = a b^{ct}$ was fitted to estimate the growth rate of pepper trade, and the instability index was calculated using the residuals of the exponential trend equation. Among the exporting countries, Sri Lanka recorded the highest annual compound growth rate of 24.59 per cent with a high degree of instability. This was mainly due to its low base in the initial year. Positive and statistically significant growth rate and stable index was recorded in case of India. In contrast, the growth rate in total exports from the other producing countries was statistically non-significant. The growth rates of pepper imports ranged from a negative level of 2.56 per cent for Argentina to a high and positive level of 11.64 per cent for Saudi Arabia. The instability indices varied between 0.07 (Japan) to 0.55 (Egypt).

Mamatha (1995) evaluated the growth rates of production and export of selected spices for the period from 1970 to 92. The considered spices were pepper, chilies, turmeric and ginger. She found positive growth rate in respect of production and export of the selected spices due to the increased domestic production and increased demand for these spices in
the international market. The increased domestic production and exports are attributed to the several measures taken by the Spices Board on improved methods of production, assistance for the export of spices by setting up facilities for upgrading quality and technical advice on scientific post-harvest operation and processing.

2.2.3 Direction and changing pattern of trade

Mellor (1984) made an attempt to introduce the Markov chain model as a mechanistic model of behaviour in an agricultural setting. The concept of time varying transition probabilities was introduced as a feasible alternative to the standard stationary assumptions. The results tend to support the view that the basic model was simple and benefits from the introduction of explanatory variables influencing the transition probabilities. The results indicated that neglect of important variable lead to an undesirable consequence if the model was used for forecasting purpose.

Wilson et al. (1990) studied importer loyalty in the international wheat market by adopting Markov model. Results showed that, in general, the USA had relatively strong import loyalty compared to others such as Canada and the European community.

Veena (1992) analysed the direction of trade of Indian coffee exports using the Markov chain model. It was observed that India could not retain its previous market share to USA, Netherlands, Yugoslavia and other importers. However, the actual quantity exported to all these countries had increased, which was due to increased quantity of Indian coffee exports. India retained its market share to former West Germany, erstwhile USSR and Italy.

Jalajakshi (1994) studied the changing pattern of Indian shrimp exports between two periods using Markov model. Period- I covering from 1970 to 1980 and period- II covering from 1980 to 1990. During period- I India could not retain 11 per cent of its precious market share in the EEC countries due to the gradual acceptance of tropical shrimps in these countries.
Sreenivas Murthy et al. (1999) attempted to measure the dynamics of changes in the exports of onion from India to different countries with the help of a Markov chain model. From one step transitional probabilities, the model has extended to n step for future forecasting. The results have shown that Malaysia, United Arab Emirates (UAE) and Singapore were having high probability of retention and will continue to be the major importers in future also. As revealed by the low values of probability of retention, Saudi Arabia and 'others' were unstable importers of Indian onion. In the next decade, Sri Lanka and Bangladesh were likely to increase their imports from India though it might be at the cost of UAE. The exports of onion from India would increase to 0.506 million tons by 2004-2005.

2.2.4 Market integration

Gemtessa (1991) analysed the integration of Ethiopian coffee prices with world price using the correlation coefficient. The correlation coefficients for the monthly average prices secured at domestic and world market for 12 months lags were calculated. The bivariate correlation coefficient of the two markets worked out to be 0.68. This positive correlation between the two markets prices of coffee revealed that they move together in the same direction. The lagged cross correlations of domestic prices and world prices of coffee for the period from 1979 to 1988 indicated that the world price of coffee had a stronger influence on the domestic prices than that of domestic price influence on world prices of coffee.

Baharumshah et al. (1994) employed the co-integration technique to analyse the long-run relationship between pepper prices in six different markets in Malaysia. The co-integration technique was applied to weekly pepper prices for the period from 1986 to 1991. The empirical findings of the study indicated that regional pepper markets in Malaysia were highly co-integrated, and the prices of pepper tended to move uniformly across spatial markets indicating competitive pricing behaviour.

Mohammad Haji Alias et al. (1998) presented a co-integration approach to ascertain whether there exists long-term relationship between palm oil price and soynbean oil price.
A related objective is to investigate causality patterns between the two price series using the Granger causality test. The study establishes that the time series on palm oil and soybean oil prices are co-integrated even though separately, each time, series is non-stationary. This suggests there exists a long-term time series is non-stationary. This suggests there exists a long run equilibrium relationship between the two variables. Bidirectional causality is established at the five per cent level of significance for the F-test; however, at the one per cent level of significance, a unidirectional causality from soybean oil price to palm oil price is established.

Ghoshray et al. (2000) used co-integration analysis to investigate the short and long run dynamics of the relationship between the export prices of the European Union (EU) wheat and of other major exporters in the world wheat market. The aim of this study is to determine whether long run relationships existed between EU prices and its major competitors. Based on the monthly data from 1980 to 1998, the results show that most of the prices are co-integrated. Furthermore, the export prices of the major competitors were found to be weakly exogenous to the EU prices. The latter result may be an indication that the EU sets its export subsidies in relation to prices of competing wheat exporting countries.

Shahidur Rashid (2004) analysed how Ugandan maize markets performed in the years following agricultural market liberalisation in the early 1990s using weekly price data for two sub-periods. For each time period, the extent of integration, causality among spatial locations and relative importance of spatial locations in price formation are examined. The extent of integration, defined as a set of markets that shares common long-run price information, and the causal relationships among markets have been tested within Johansen's co-integration framework. The relative importance of each market location is examined by estimating the common trend coefficients with a dynamic vector moving average model. Results indicate that while there has been an overall improvement in spatial price responsiveness, the northern districts, which have been in a state of insurgency since 1986, continue to lack integration with major consumption markets in the central region. Causality test results show that, compared with the 1993-1994 time
period representing the early years of liberalisation, interdependence among markets has increased. Estimates of the common Integrating trend suggest that public policies such as price stabilisation can have desired impacts by targeting a small number of locations. These results are consistent with recently conducted household and market surveys in the country.