CHAPTER III

REVIEW OF LITERATURE

3.1 Production and Production Technology of Coconut
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REVIEW OF LITERATURE

The review of the earlier studies and the experience of the researchers help one in evaluating the strength and weakness of the concepts used earlier. An attempt is made here to review several such studies and specify appropriate concepts as applicable to the present study.

3.1 PRODUCTION AND PRODUCTION TECHNOLOGY OF COCONUT

S. Rajkumar and R. Thamil Selvan in their study entitled “Importance of Coconut Cultivation” pointed out the significance of coconut as a source of edible oil and as an agro-based raw material for many industries such as manufacture of shell powder, and handicrafts. Fermented coconut toddy is an intoxicant used widely in the west coast of India. Vinegar and jaggery are important by-products of coconut toddy. The tree trunk is used as a building material and for making furniture. Fifty percent of the total coconut production is converted into copra. Coconut crop is raised in India under varying soil and climatic conditions in 17 states and 3 Union Territories. As the coconut tree is versatile in its adaptability to wide range of soil conditions, coconut cultivation has
begun to spread from the west coast of India to interior regions of Tamil Nadu especially to Erode District and Thanjavur District.¹

In an in-depth study of coconut development in India, Sugata Ghose traces the different stages of coconut development. Expansion of European soap and edible oil companies offered great opportunity to India to export copra in the latter half of the 19th century. Steady increase in export trade enhanced the pace of coconut development. On the eve of the First World War, India was one of the leading exporters of copra, the annual quantum of export being 30 tonnes of copra and 10,000 tonnes of coconut oil. But the post war period witnessed fall in prices. The Second World War worsened the situation. Hence the Government of India set up the Central Coconut Committee in 1945. It did yeomen service for the growth of coconut sector. In 1966 this committee was replaced by the Directorate of Coconut Development. But its powers and objectives were restrictive in processing and marketing aspects and so Parliamentary Act was passed in 1979 which provided for the formation of the Coconut Development Board, which was formed in January 1981. Since the formation of the Board, systematic crop research resulted in the introduction of hybrid coconut varieties. Further optimum manorial and cultural requirements of coconut were determined. Coconut processing technology received greater attention. Major technologies developed were (1) Imparting roasted flavour to coconut oil (2) Production of non-carbonated beverage
from mature coconut water (3) Preservation and packing of tender coconut water (4) pollution free quicker wetting of fresh husk in cement tanks for extraction of white fibres (5) Production of vinegar and nata-de-coco from mature coconut water (6) Production of tannin, lignins, and other compounds from husks (7) coir net and geo-textiles for prevention of soil erosion and land-slides (8) light weight bricks and fuel briquets from coir pith (9) Extraction of lignosulphanates from coir pith (10) Coconut shell or cellular blocks are used in concrete masonry unit (11) Composting of coir pith to organic manure by edible mushroom (12) Production of coconut cream and coconut milk powder. (13) Production of activated carbon from coconut shell by fluidized bed technique. (14) Development of mechanical coconut dehuskers and coconut palm climbing device.

Traditionally, in India coconut was processed to coir, copra and coconut oil. In recent decades manufacturing of edible ball copra and desiccated coconut has gained some importance. Though a few units have been set up for manufacturing shell powder, shell charcoal, activated carbon and different shell and wood handicrafts, processing of wet kernel into different edible products of commercial importance has not yet become popular. The researcher concludes the study with an optimistic note that in all the aspects of the coconut crop development, product marketing in domestic and export sector and processing technology, there is
much scope for further development. Future strategy of the Central and State Governments should be focused to technology development, market expansion and productivity improvement.  

S.S. Nagarajan has found from a study of coconut productivity in the Rangasamudram Village of the Coimbatore District of Tamil nadu, that 75 West-Coast Tall variety palms per acre receiving regularly both organic and inorganic manures at the rate of 30 kgs of farm yard manure, 1 Kg of urea, 2 Kgs each of super phosphate and muriate of potash, 1 kg of micro-nutrient mixture and 2kgs of powdered neem cake per palm per year has resulted in a yield of 100 nuts per tree per year. The nuts are sold locally at an average price of Rs. 4/- per nut. The annual cultivation cost per acre is Rs. 12,000/- Gross revenue is around Rs. 30,000/- and the net income is Rs. 18,000/-. But after application of silt over the entire extent of the garden prior to the onset of the monsoon every year, productivity per tree increased to 120 nuts/yr., raising the total revenue per acre to Rs. 36,000/- at an additional cost of Rs. 3,000/-. Net income per acre rose from Rs. 18,000/- to Rs. 21,000/-. Nagarajan concludes that regular application of silt containing organic matter stimulates soil life, helps multiplication of earth-worms and improvement of physical properties of soil. Ultimately use of synthetic fertilizers can be minimized or even dispensed with as this system depends on the primary production capacity of the soil and positive biotic
interactions. It is also suggested that raising intercrops like banana and turmeric will fetch more income for the coconut farmer.³

Sugata Ghose gives a brief sketch of the different stages in the progress of coconut production in India since independence and points out the encouraging trend after the formation of the Coconut Development Board in 1981. The efforts of the Board resulted in increase in production and productivity and by 1996 total production was 13.9 billion nuts with the index reaching the all time high of 425.6 points. Productivity increased to 7779 nuts per hectare. Even though a slight decrease occurred during 1996 to 98 total production was maintained at the level of 13 billion nuts and India became the highest producer of coconut in the world.⁴

Jose Mathew advocates the advantages of Drip Fertigation as a successful technology for integrating irrigation and fertilization. According to him irrigation and fertilization are the two most critical management factors that influence growth, yield and quality of agricultural crops. The use efficiency of these inputs is very low in India i.e 30 to 40 percent. This leads to low crop productivity, degradation of soil health, and increased environmental pollution apart from the wastage of substantial quantity of these costly and scarce inputs. Adoption of Drip Fertigation technology has opened up new possibilities to optimize and integrate the use of water and fertilizer enabling to harness high crop yield and ensuring a healthy soil and environment.⁵
R. Veeraputhiran suggests the following strategies to implement drip irrigation which will improve irrigation efficiency to 80 to 90 percent: (1) Allocation of government subsidy for drip irrigation, (2) simplified procedure for the disbursement of subsidy, and (3) reduction of gestation period to avail subsidy.

Veeraputhiran recommends fertigation for applying fertilizers under drip irrigation and herbigation as a new method of weed management. He concludes that drip irrigation system is highly suitable for adoption in growing trees and fruit trees, wide-spaced and commercial crops and that there is great prospect for rapid expansion of area under drip irrigation in the 21st century.

Outlining the water saving irrigation methods followed to supplement the age old surface irrigation method such as Sprinkler/Overhead Irrigation Method and Micro or Drip Irrigation, R.K. Sivanappan concludes that in view of the scarcity of water, it is essential to manage water efficiently for all crops and he recommends the use of drip irrigation for all crops in all soils, particularly for wide spaced high value commercial crops like coconut, grapes, vegetables and fruit crops.

V. Rajagopal et al., of the Central Plantation Crops Research Institute, Kasargod, Kerala dealt at length with the distinctive features of coconut, its strength and weaknesses as a perennial crop. According to him in coconut largest number of germ plasm is available for effective utilization to increase productivity and for
breeding disease resistant varieties. Moreover, there is greater scope for the adoption of new technologies and community level approach for augmenting farm income. Coconut development is a potential source for women empowerment through self-help groups. According to these researchers the availability of time-tested and proven technologies for adoption at the farmers level provides scope for inter/multi/mixed crops in coconut farms. Coconut products and by products of high economic value are potentials for export and earnings in international markets. But decline in farm income imposed by factors such as fluctuating market price, pests and diseases, adverse climatic conditions, non-competitiveness at the global level and decline in general price level of coconut products at the international level are some of the threats faced by coconut industry. To overcome these threats, these researchers suggest certain macro and micro level strategies. At the macro level discouraging area expansion under coconut, increasing the productivity effect on production in the major coconut growing zones and checking the flow of imports by imposing rational import tariff rates will help to maintain a well stabilised price structure for coconut and its products. At the micro level emphasis should be on the theme ‘competitiveness through higher productivity in production, processing and marketing sectors’. Replanting of senile and unproductive plants through high yielding varieties and hybrids, adoption of integrate nutrient management strategies,
water management techniques and integrated pests and disease management strategies are some of the major technologies for realizing sustainable increase in productivity.

These researchers are of the view that coconut based cropping/farming systems assume great significance at present because coconut farmers are facing higher degree of production and price risks. Since coconut is a crop with wider spacing and ideal rooting pattern and canopy of coverage, coconut farming offers much scope for integrating a variety of crop combinations in the inter spaces. The study is concluded with the suggestion that in order to achieve economies of scale in coconut production it is advisable to venture into coconut farming on cooperative basis involving farm women. The research and development agencies should continue to strive for attaining excellence in their respective mandates for achieving sustainable development and improved standard of living of small and marginal coconut farmers in the country.8

Reviewing the progress of coconut production in India over the past five decades, P. Rethinam points out that, India is the third largest coconut producing country in terms of area and production. Coconut area in the country increased from 0.62 million hectares in 1950-51 to 1.82 million hectares in 2002 and production increased from 3281.7 million nuts to 12,821.7 million nuts and productivity from 5238 to 6776nuts/ha/yr. While the area and production
increased considerably, the increase in productivity was only marginal. The traditional cultivation practices, old and senile nature of nearly 45 percent of the palms and the problems of root wilt disease as well as the Ercophyrid Mite are the major causes for the decline in productivity. Rethinam suggests the following strategies to enhance coconut productivity: (1) Scientific planting (2) Selection of proper variety suited for various situations (3) Adoption of the average management practice (4) Timely application of manures, fertilizers and water (5) Production of quality seedlings by farmers (6) Quality control of seedlings by government agencies before distribution for planting. 

According to Sugata Ghose the most common indicator used to understand the crop situation of a country are area and production. But the per capita availability is also an important criterion. The Production Population Ratio (PPR) of coconut in India steadily increased from 9.92 coconuts per head (CPH) in 1951 to 10.56cph in 1961 and to 11.08 cph in 1971 but dropped beyond the 1951 level by 1981 to 8.37 cph due to various constraints. The situation improved during the eighties and the PPR increased to an all time high of 11.49 cph by 1991. Among the 13 coconut producing states, the PPR of Lakshadweep was at the maximum of 512.60 cph followed by Andaman and Nicobar Islands with 289.57 cph and Kerala with 156.06 cph. Maharashtra had the lowest PPR of 1.38 cph.
A. Christopher Lourduraj et al., point out the decline in coconut production in Kerala and the increasing trend in area and production in Tamil Nadu. According to them the increasing trend in Tamil Nadu is due to changing trends in agriculture, non-availability of labour, escalation of wages, conversion of area under annual crops into coconut plantations, higher profits from coconut etc. Based on the survey conducted in the Pollachi Tract in 1991, these researchers attribute decline in productivity to lack of interest on the part of the small and medium farm holders in irrigating or fertilizing the plantations and negligence in taking timely plant protection measures. These researchers suggest regular fertilization and plant protection are a must to increase productivity. According to them the possibility of utilizing coconut by-product and land use efficiency by planned intercropping have contributed to the increase in coconut area.\(^{11}\)

R. Halli is optimistic about the scope for India to improve and increase her coconut production. Coconut research concept initiated in the Nileswar Coconut Farm in Kerala as far back as 1916 became a centre of global attraction during 1934-1936. In this farm the first hybrid coconut seedlings were produced under the guidance of J.S. Patel of the Department of Agriculture of the Madras State. But the coveted discovery only remained as an achievement of the researchers for some time. The credit of effecting a break through by giving shape to the largest Hybrid
Coconut Seed Garden on the picturesque plains of Kodimanagalam near Nagamalai, 17 miles away from the temple city of Madurai, goes to the large hearted scientists of the Central Plantation Crop Research Institute and the Coconut Development Board of India. In this farm seed nuts are collected every month from about 4000 tall and 7500 parent palms once the nuts attain 12 months maturity. Seed nuts, thus collected give over 90 percent true seedlings. The D and T hybrid seedlings produced by crossing Malayan Dwarf X Tiptur Tall, Malayan Dwarf X Andarman Ordinary, Malayan Dwarf X West Coast Tall, and Malayan Dwarf X East Coast Tall have excellent performance. They start flowering from the third year. The genetic potentiality of hybrids and their high yielding capacity have revolutionized coconut production. The commercial production of coconut seedlings will certainly lead India to greater heights in the global coconut production front and even open opportunities to export labelled hybrid seedlings to the other coconut producing countries.¹²

R.P.Iyer, E.V.V Bhaskara Rao and M.P.Govinda Kutty are of the opinion that the rural economy of the state is very much dependent upon coconut production, processing and marketing. Even though it is very difficult to ensure information on productivity of a crop like coconut, there is evidently a decline in yield. However, they are optimistic that the present efforts to preserve the high yield potential in subsequent generations of non-propotent elite palms
through tissue culture will be rewarding if only growers extend their cooperation for carrying out scientific investigation for taking coconut to new levels of productivity.\textsuperscript{13}

E.A. Parameswar Gupta holds the view that coconut occupies a unique place in the socio-economic life of the people of the Indian sub-continent. According to him India would emerge as the second largest producer of coconut in the world before the close of the twentieth century.\textsuperscript{14}

Dealing at length with the varied uses of coconut palm products V.T. Markose, Chief Coconut Development Officer of the Coconut Development Board, Kochi says that coconut contributes more than Rs. 7000 crores annually to the GDP. The importance of coconut as a food item may be gauged from the fact that 60 percent of its production is consumed in households as raw nut. Its by-products are utilized for making value added products. Although coconut has assumed considerable significance in our national economy, proper technology needs to be developed for utilizing coconut and other palm products like husk, timber, shell and leaves. Being an environmentally friendly tree, which can adapt to a wide range of soil types it offers employment opportunities to about 10 million people. With the development of value added products like coconut cream, coconut honey, coconut skimmed milk, tender coconut water, etc, coconut offers ample investment opportunities also. The researcher says that the mineral water boom in the
country is an indication of the scope for increasing the use of tender coconut water as a natural soft drink. Since the coconut products are in great demand in the domestic and international market, there arises the urgent need to develop the technology of quality improvement and exploit the vast potential to earn valuable foreign exchange through exports. He is optimistic that with the advancement in technology, product diversification and byproduct utilization, the coconut industry in India has a luminant future. Markose suggests that with the change in the planting system and a reduction of planting density, different food crops and spices can be successfully introduced under a coconut based farming system so as to augment the production of food and spices crops along with coconut.15

E.A.Parameswara Gupta conducted an in-depth study on the trend in area, production and productivity of coconut in India with special reference to Karnataka. He says that the majority of coconut holdings in our country are very small and 98 percent of them are less than 2 hectares. Small and marginal farmers form a sizeable portion of the coconut farming community. The area under coconut showed an impressive rise during 1955 to 1971, but the growth rate declined in the seventies and eighties. The area under coconut declined from 2689.49 thousand acres to 2672.69 thousand acres in 1980-81. The production of coconut declined from 6123.7 million nuts in 1971-72 to 5677.4 million nuts in 1980-81. This was due to
wilt attack (root disease) in Kerala. Though there was general decline in the all-India production per hectare from 5626 nuts per hectare in 1970-71 to 5249 nuts in 1980-81, the productivity in Karnataka showed a steady increase from 4838 nuts to 5178 nuts per hectare. But the average palm yield in Karnataka is 54 nuts and the yield per hectare is lower because of lower palm density. The researcher concludes his study with his findings that the farmers are not yet convinced about the advantages of hybrid varieties. They are also not aware of the improved methods of coconut cultivation. Gupta suggests the following steps to promote coconut culture (1) Establishment of state-owned nurseries in taluks with population above 20,000. (2) The Horticulture Department should undertake vigorous campaign to educate the coconut farmers in improved methods of coconut cultivation. (3) Coconut farmers should adopt recommended ‘package of practices’. (4) Overcrowding of palms in the existing gardens should be discouraged.  

K. Ganesamoorthy, C. Narayanan, D. Packiaraj, S. Rajarethinam and H. H. Khan of the Coconut Research Station, Veppankulam, Thanjavur conducted an in-depth study on genetic improvement of coconut in Tamilnadu. According to them, collection, conservation and evaluation of germplasm of coconut is one of the prerequisites for the crop improvement programme. Systematic survey and collection of indigenous germplasm started by the Coconut Research Station, Kasargod as early as 1918 and
followed up by the Aliyarnagar Research Station at Coimbatore resulted in the enrichment of coconut gene pool. The release of the first hybrid coconut VHC1 developed at Veppumkulam by the Tamilnadu Agricultural University in 1982 was an important landmark in the history of coconut breeding in Tamilnadu. A cross between East Coast Tall x Dwarf Green was found to be the most promising with a mean nut yield of 115 nuts/palm/year and 21648 nuts/ha. Encouraged by the superior performance of hybrids and their reciprocal combinations, different inter and intra varietal crosses involving promising exotic and indigenous varieties were made in all possible combinations viz: Tall x Tall, Tall x Dwarf, Dwarf x Tall and Dwarf x Dwarf at Veppomkulam. Moreover these researchers pin point the efforts made for breeding varieties, resistant to pests and diseases also. They conclude their study with a note that in a crop like coconut which has a long pre-bearing period and takes a long time to attain yield stability, genetic improvement by breeding is slow and time consuming. However significant progress has been made. Successful exploitation of hybrid vigour by the scientists of the Tamilnadu Agricultural University has resulted in the development and release of three high yielding hybrids viz: VHC1, VHC2 and VHC3 with high nut and copra yield. Screening of coconut germ plasm for important pest and diseases viz: leaf blight, basal stem rot and eriophid mite has resulted in the identification of resistant tolerant types and are
being used in the breeding programmes to evolve tolerant varieties.  

R. K. Sivanappan points out the wastage of scarce water in surface irrigation of coconut fields. In surface irrigation the entire field is flooded to a depth of 5 to 7 cm once in 5 to 10 days depending upon the type of soil. The quantity of water applied works out to more than 200 litres/day or about 1000-1400 litres in 5-7 days. The conveyance loss is about 20-25%. In contrast to this method is the Drip/Micro Sprinkler Method which has increased water use efficiency and water saving is up to 40 to 60% and labour saving up to 90%. Further Drip Method increases the yield by 30%. This method successfully meets the problem of irrigating sandy tracts. Many progressive farmers of Tamilnadu and Karnataka have adopted this advanced method of irrigation. Sivanappan feels that the time is not far away when the entire coconut farm in the country will be irrigated by Drip System for its sustainability and to increase yield.  

R. Venkitaswamy and H.Hameed Khan have dealt with Drought Management in coconut in Tamil Nadu and point out that drought management is the foremost requirement in the western districts of Tamilnadu viz: Coimbatore, Erode and Dindugal. They suggest economic utilization of available irrigation water and adoption of the soil moisture conservation practices for containing drought. Methods recommended are: crop irrigation equal to 100%
or 66% of pan evaporation or basin irrigation with 1W/CPE ratio of 1.0 at 4 cm depth and adoption of soil moisture conservation method like surface mulching with raw coir pith, coconut leaves or husks and husk burial.\textsuperscript{19}

M. J. Prabhu says that coconut yield is comparatively low especially in coastal area. Referring to the experiment conducted by the Central Plantation Crops Research Institute, Kasargod, Kerala, Prabhu points out that the reason for the poor nut yield is the poor sandy soils, poor retentive capacity for water and nutrients.

One of the methods to increase nut production is growing different grass varieties in coconut garden using husk and coir pith. Coir pith and husk have high water holding capacity of 5-6 times their weight. Their use increases the water holding capacity by about 40 percent. Husk and coir pith are placed in trenches of about 30x30cm to a height of 5 cm and filled with sand. Hybrid grass varieties such as bajira, napier and Co 3 are planted 50x50 cm apart. Application of farm yard manure and vermicompost at the rate of 5 tonnes per hectare for the coconut trees and fertilizer application of about 50 kg urea, 40 kg phosphorus and 40kg potash at the time of planting grass are recommended. Sprinkler irrigation once in 3-4 days result in harvesting grass after 80 days, subsequent cuttings at 45-50 days interval, thus growing about 100 tonnes of green fodder from one location which is sufficient to maintain a dairy unit of about 6-8 mulch cattle fetching a net
income of Rs. 75000/- to 1,00,000 every year. Husk and pith technology also has the advantage of acting as a natural barrier against entry of sea water in times of natural calamities such as 'tsunami', because the intercropped coconut trees along the coastal belt are able to withstand the saline concentration and water-logging compared with other trees in the coastal regions.  

Srikumar Poduval gives out a list of technologies available with the Coconut Development Board for assisting the entrepreneurs in the preparation of project reports for promoting coconut based industries. The Board’s special attention is to develop small scale cottage industries in the coconut processing sector by providing technical and financial assistance in the form of subsidies and soft loans under the buy-back arrangements. Sreekumar emphasizes that the medium and large industries should come forward to encourage small scale units and assist them in areas like technology transfer, finance and expertise. Further the Research and Development in the coconut processing sector should concentrate its attention on the development of appropriate technology in coconut processing to the advantage of farmers, small scale processors and for regional development. Moreover research collaboration between coconut researchers both within India and other coconut producing countries should be maintained and the possibility of establishing a network within the country and amongst other coconut producing countries should be
explored so as to exchange information on various technologies for mutual benefit.21

M.K.Nair and M.K.Rajesh give a clear exposition of coconut area, production and productivity in the country and attribute the following factors for increasing production and productivity: (1) High yielding varieties and hybrids, (2) Manures and fertilizers, (3) Irrigation, (4) inter cultivation (5) pest and disease management. They also point out the major production constraints viz : (1) the wide gap between demand and supply of quality seedlings (2) smallness of holdings where the farmer raises other crops for meeting his requirements viz: nuts, fruits, vegetables, tubers and even fuel and the consequent neglect of coconut (3) over crowding of palms (4) Insufficient and improper application of manure (5) Irrigation constraints. These researches suggest the following strategies for improving production and productivity: (1)establishing seeds garden to produce seedlings of already proven high-yielding varieties/hybrids (2) Identifying varieties suitable for different agro climatic conditions (3) Evolving hybrids and varieties tolerant to important diseases (4) Developing location specific fertilizer and irrigation taking into consideration soil characteristics, rainfall distribution, temperature, relative humidity, nutrient status, ground water level etc.(5) Effort should be continued to design the already developed pest management technologies to reduce crop loss.22
P.S. Surendira Kumar, et al., have conducted experimental study on intercropping in coconut and point out its advantages. Though the contribution of Tamilnadu to the total area under coconut in the country steadily increased, productivity of coconut plantation on monocrop in the state is not so remunerative. Since the coconut trees are spaced at 7.5x7.5 meters and the active root zone of a palm is confined to a radius of 2 meters i.e. 25% of the land surface laterally, the remaining 75% of the land area can be used efficiently by raising intercrop such as food crops like banana, cereals, legumes and fruits, cash crops like black pepper, cocoa, cinnamon, cloves, coffee and nutmeg, cut flowers like anthurium and orchids as well as pasture crops, spices and condiments. The spices preferred are banana, pepper, coffee, ginger, turmeric, vegetables and pineapple, as these can be grown successfully under shade and they provide a good income to the farmers. According to these researchers, among the different cropping systems tried, coconut+ yam is superior, the annual yield per hectare under the system being 16625 nuts and 11033kgs of yam. Maximum net profit is Rs. 29687 due to less input application for yam. This was followed by coconut + banana. Mixed farming in coconut gardens creates congenial conditions for the rapid multiplication of micro organisms in the soil. Continuous additions of plant residues by the component crops and the organic recycling facilitated by intercropping exert a facilitated development influence on the
microbial population in the rhizosphere and it might influence the nutrition uptake of different crops. Surendirakumar, et al, conclude with an emphasis that coconut +yam increases the return by 35 percent and hence it is a viable agro technique to improve the farm productivity.\(^2\)

According to C. Natarajan, et al, all the hybrids developed in the Coconut Research Station at Veppankulam in Tamilnadu is superior in yield performance. This variety has been developed through cross pollination between well adopted local ecotypes East Coast Tall (ECT) as ovule parent and Malaysian Orange Dwarf (MOD) as pollen parent. The performance of ECTxMOD in comparison with VHC2 on hectare basis shows that the former recorded 22570 nuts/hectare as against 20950 nuts in VHC2. The analysis of nut components indicated that the copra content of VHC3 is 162g/nut as against 146g in VHC2. The new hybrid also gave a high oil yield of 2.55 tones/hectare.\(^2\)

K.M.Pandalai describes the wide adaptability of the coconut palm which can tolerate a very wide range of soil and climatic conditions. Though the palm is described as essentially a native of the tropics, thriving well within 23\(^{\circ}\) north and south latitudes and upto an altitude of about 3000 feet above sea level, it is a sea-side palm flourishing in a sea washed well drained coast with constant moving water in the soil in an atmosphere of saline moisture. The palm has been found to grow in a variety of soil types-white or
gravelly sand, alluvial soils, literate soils, peaty or kary soils, estuarine deposits, lime-stone derived soils, volcanic pumice soils, marine, granite and coral soils. The best soil, however, appears to be a rich alluvium/or loam having proper soil moisture and drainage as found in the backwater areas of Travancore, Cochin, Malabar and the deltaic tracks of the Godavary. Coconut palms come up well in sandy soils especially of the littoral type, provided there is an assured supply of good underground water within easy reach of the roots and proper manuring.  

Mohan Rajesh attributes poor yield of coconut and the consequent frustration of the coconut farmers to lack of proper agricultural management practices. He suggests the following steps to increase the income from coconut plantation:

(a) Removal of unwanted trees which interfere with the main crop of coconut.

(b) Keep only the healthy and vigorous potential palms.

(c) Collect and burn all decaying matters to get rid of black beetles and red weevils which are the most harmful coconut pests.

(d) Conserve soil and build it up with bunds and required drains with silt pits along the leader drains so as to avoid soil erosion.
(e) Conserve moisture by avoiding outflow of rain water from the coconut farm as far as possible without water logging. This will increase nut formation and reduce premature nut fall.

(f) In order to conserve moisture and thereby avoid stresses to the palms during dry periods, coconut husk can be buried in the field itself.

(g) Grow green manure trees like Gliricidia along the borders, sides of internal roads and if possible between coconut rows. Further, creepers such as puraria and vitiver grass can be grown on bunds. Prune these before hardening and put at palm base. This practice helps to loosen the soil to absorb more water during rains and increase the bio-mass content, microbes and earth worm population and thereby enhances soil fertility and reduces costly artificial fertilizers.

(h) Since coconut does not perish in short periods and can be kept for about two months, producers have some staying power and so they can afford to wait for higher prices.

(i) Coconuts can be offered for sale in different markets as curry nuts, copra and for fresh nut export. Hence the farmers should choose the market in accordance with the possibilities for getting higher prices for their produce.26
George V. Thomas, et al., of the Central Plantation Crops Research Institute, Kasargod have dealt with production Technology for sustainable coconut cultivation. Pointing out the fact that the low production of coconut in India i.e around 40 nuts/palm/year is due to lack of adoption of scientific cultivation practices that can enhance productivity, they hold that application of low cost production technologies in the right combination suitable for coconut cultivation can help to enhance productivity. Integrated approach in nutrient management by way of recycling crop biomass, raising green manure legumes and green leaf manure plants and their incorporation and the use of bio fertilizers are some of the efficient low cost production technologies. Biological management of soil fertility in coconut plantation is cost effective, environment friendly, easily adoptable and makes efficient utilization of local resources. Soil and water conservation structures are vital to conserve natural resources for enhanced productivity.27

M. Lathika and C.E. Ajithkumar examined the growth trends in coconut area, production and productivity for five years (2000-2005) in the different coconut producing states of India and came to the conclusion that area effect assumes greater role in output growth in almost all coconut regions of the country, though some states like Kerala and Orissa recently showed signs of a productivity based output growth. States like Andhra Pradesh and Karnataka are already on the path of vast area expansion. But with severe
pressures on land, the states of Kerala, Tamilnadu, Andamans and Nicobar Islands have registered only retarded growth in area. According to these researchers, avenues of replanting or dense - planting of coconut palms should be explored vigorously in some of the traditionally coconut growing states like Goa, Andaman and Nicobar Islands where the current yield level is abysmally low with practically no growth in the second phase i.e. 1996 to 2002. They conclude that area expansion of the crop is still a viable option for certain regions of the country. Yet the problem of growth stability in yield had been trickier to tackle with than the problem of stability in area growth and it warrants urgent attention.28

3.2 MARKETING OF COCONUT

P. Rethinam, Executive Director, Asia and Pacific Coconut Community (APCC), in his study on “Steps for Yield Increase” says that nearly 50 products of coconut are being traded from the producing countries. Of them coconut oil is the largest coconut product. A critical look at the international trade reveals the fact that India has been an importer of all the major coconut products like copra, coconut oil, copra meal, desiccated coconut meta de coco and the like for meeting the domestic requirements. India is the largest single market for coconut. In 2003 India consumed more than her entire production of 12.9 billion nuts and domestic consumption exceeded production by 2.5 percent. The price trend of
copra, and coconut oil in India, Indonesia, the Philippines and Sri Lanka during 2001-2005 reveals that domestic prices are the highest in India and Sri Lanka and the lowest in Indonesia. Hence it is difficult for India to compete with other countries in the international market. This necessitates reduction in unit cost of production. However in view of the fact that every country is looking forward to India for marketing their products, the Indian Coconut farmer can definitely play a competitive role only if he takes up integrated coconut development with proper replanting and under planting, farm level processing linked with market and for a partnership with the private and public sectors.29

According to P. Rethinam India’s share in the export of coir and coir products is sizeable whereas the export of other coconut based products is very negligible. Increasing global population and demand for coconut products, changing consumer preferences, intensifying safety and security concerns and shifting marketing networks have significant impact on the character and shape of the global market for coconut products.

At the same time critical developments like substitutes and increasing volatility of prices are a threat to the future of the coconut industry. Still increasing population world over and decreasing demand for coconut products widens the scope for increasing India’s competitiveness provided productivity is increased and production cost is reduced, besides maintaining
quality standards at international standard. According to Rethinam, of all the coconut based industries like copra making, oil making, cream making, milk powder making, desiccated coconut making, making coconut water concentrate and jam, vinegar, coconut water packing etc only oil and copra making dominate and their marketing only decides the price of the coconut.

The researcher concludes his study by pointing out the need for a more intensified approach in marketing strategy. Besides the efforts of the Coconut Development Board and the Government of India to popularize coconut water as a health drink, it is necessary that India should participate in international exhibitions and exhibit Indian coconut products for which the Gulf countries offer great opportunities.\textsuperscript{30}

K. P. Ganesan points out that after the removal of restriction on the import of 715 items, India faces stiff competition in coconut and coconut oil from the Philippines and Indonesia.\textsuperscript{31}

P.C. Maheswari, et-al, in their study on ‘Marketing Strategies for Coconut’ point out that, inspite of the fact India accounts for 25.57 percent of the world production of coconut, the present system of marketing of coconut and its products is by and large unscientific and unorganized and is almost lacking in vertical integration. Coconut is a notified commodity. Still the absence of an efficient marketing system provides sufficient opportunities for middlemen to exploit the market. In almost all primary markets,
they normally dictate the prices. Further there are several malpractices in the coconut market. Apart from this, during the past two decades there had been abnormal price fluctuation—both seasonal and cyclical. According to these researchers the chief marketing problems are:

1. Farmers are unaware of the current market price of coconut. They are unable to understand the methodology involved in fixing the price based on recovery percentage.

2. Farmers do not have proper storing facilities to keep their produce until higher prices prevail in the market during lean seasons.

3. Import of palm oil and vegetable oil from abroad tells heavily on the prospects of coconut cultivators and oil millers.

4. Credit purchase of coconut by merchants from the garden itself and irregular and delayed payments of the low prices already fixed deprive the producer of his right to get fair prices.

5. Though coconut is a notified product, it is not marketed through regulated markets.

These researchers suggest the following promotional activities: 1) Improving quality for export promotion (2) Reduction of cost of production (3) Product diversification and by product utilization. Diversification should be done at the farm level itself (4)
Formation of Coconut Committees in each Block consisting of representatives from the Agricultural Department, Coconut Board and growers to discuss coconut production and marketing problems (5) To achieve market promotion and consumer awareness, extension programmes should be carried out by conducting trade fares and exhibitions. (6) Cooperative marketing (7) Restriction of import of Copra and edible oils (8) Revival of future trading (9) Integrated multi-cropping (10) Establishment of display and sales outlets for the processed products (11) Establishment of Coconut Technological Development Centres in the main coconut growing areas.32

C. Chandran’s intensive study on “Coconut Marketing in Tamil Nadu” explains the marketing practices such as harvests, grading, packing, marketing channel and the like and throws much light on the marketing costs, margins, price spread, effect of variations in the consumer’s price on the share of the producer seller and the retailer as well as in the efficiency of the market system. Besides analyzing the problem faced by the traders in coconut marketing, the researcher concludes his study saying that marketing efficiency is high due to fewer middlemen and low marketing margin and the producer’s share is inversely related to consumer’s price while the retailer’s share is positively related to consumer’s price.33
M. Linson Mark’s study on Marketing of Coconuts in the Agasteeswaram Taluk of Kanyakumari District reveals that the prices which rule the coconut market do not reflect the changes in demand.\(^{34}\)

N. Namasivayam and V. Richard Paul’s study highlights price spread in the marketing of coconut in the Theni District of Tamil Nadu. As per their analysis the marketing cost incurred by producers per thousand nuts was maximum (Rs. 630.18) in Channel II consisting of Producer Commission Agents-wholesale-sellers-Retailers - consumers, followed by Rs. 610.00 in Channel III i.e. Producer – Wholesaler – Retailers – Consumers. No marketing cost was incurred by producers in channel I consisting of Producers–Pre-harvest Contractors- Commission Agents- wholesalers- Retailers – Consumers, because the marketing cost was met by the Pre-harvest Contractors. Commission Agents incurred no marketing cost because of their non-performance in the field of cutting, loading, counting, grading and transportation. It was also found that under Channel III, the producers realized the maximum share of 58.73 percent in consumer’s price. Their share in Channel II and Channel I was 58.32 percent and 50.20 percent respectively. Commission Agents got very meagre margin with a small effort. Wholesalers got 6.02 percent in Channel III, 4.57 percent in Channels I, and II respectively. The share of the retailers worked out to equal the cost of all channels. The study also revealed that
the marketing efficiency was higher in Channel III followed by Channel II and Channel I. 35

P. Kameswara Rao points out that coconut in Andhra Pradesh is marketed in three major forms viz: dry coconut, copra and coconut oil. The only market for these items in the state is Ambajipeta. Palakol in West Godavari is the centre for water coconut marketing. Nearly 40 percent of the coconut produced is marketed as water coconut and 30 percent as dry coconut. The rest is marketed either as copra or oil or as both based on market demand. But coconut trade is facing certain problems including high degree of price fluctuations. All types of marketing channels viz: farmer, middle men, wholesaler and retailer exist. The existing market committees are not working properly. Most of them lack minimum facilities like sufficient yards and godowns. They collect market cess without providing required facilities. The dry coconut is mostly exported to Rajasthan, Madhya Pradesh and Maharashtra. Even transport has become a major constraint. Upto the 80’s 99 percent of the trade utilized rail wagons for transport. Thereafter the railways stopped allotting wagons. Instead rackes were allotted. It is highly impossible to avail this facility because quantities have to be pooled over a long period to load one racke, which causes spoilage of the commodity. Therefore road transport is resorted to. It is not only costly but also causes hardships to the traders.36
G.L. Kaul has dealt with the global competitiveness of coconut industry. He points out that coconut as a traditional crop, particularly in the third world, has not received the benefit of improved management technologies and market promotion. He has analysed the magnitude of threats facing the coconut industry such as competition from other oil-seed crops, low profitability, fluctuating prices, misconceptions about coconut oil as an edible oil and inconsistent supplies of coconut products. He suggests the following strategies for ensuring a better future for the coconut farmers: (i) Major efforts should be made to improve productivity in all the countries including the coconut producing states of India. (ii) Productivity improvement requires greater research efforts to develop high-yielding varieties/hybrid with large nut size and resistant to major maladies, besides being drought tolerant. (iii) Intensification of land-use in the coconut gardens (iv) Bringing down the cost of production which needs urgent consideration (v) Steps to reduce dependence on coconut oil as an edible oil and intensified efforts towards diversification for developing different products which are more profitable (vi) Product development strategy would have to be supported by strong marketing support for expanding the demand through identification of new markets and undertaking a vigorous promotional campaign to counter the propaganda against consumption of coconut oil and products on health grounds. Kaul concludes that avenues are available to
reduce the impact of the threat to the coconut industry. What is required is a strong political will, supported by major R&D efforts with a more open and strong global coordination to ensure a bright future for the coconut industry. 37

In an exhaustive study of the current status of the coconut industry, P.G. Punchideva says that one of the fears expressed in the sixties regarding the future of the coconut industry, apart from stagnation in production, was the restrictive nature of the market. However, product diversification and value addition brought in its train diversification of international coconut market too. Today more than 100 countries import coconut oil in big or small quantities. America and Europe still dominate the trade. Asian countries are increasingly getting into it and they emerge as a key importer of desiccated coconut. Apart from the traditional products, new products are finding their way to new markets.

Coconut shell charcoal is bought by more than thirty countries in the form of activated carbon, chief among them being U.K., France, Belgium, Holland, Japan, Korea, Taiwan, South Africa and Australia. There cannot be any country in the world where some part or derivative of coconut is not used in the daily life today, in the form of vegetable oil, margarine, beverage, bakery item, sweets, soap, shampoo, cosmetic, pharmaceuticals, carpets, rugs, hand crafts, brushes, mattresses furniture or as peat. Still competing substitutes pose a threat to coconut industry. 38


**3.3 COST EFFICIENCY**

P.K. Thampan’s study on the cost of raising and maintaining coconut plantation and the profitability of coconut farming reveals the fact that after meeting the initial expenditure on land, fencing, irrigation and buildings, in most places in Kerala the average expenditure over the first 7 years after planting tall variety palms is around Rs. 125,000 per hectare while the same in Tamil Nadu exceeds Rs. 175,000. The components which constitute maintenance cost are expenditure on manures and fertilizers, plant protection, cultural management, irrigation and harvesting. A Farm Household Survey involving 198 households ranging in farm size from 0.5 ha to 5 ha drawn from 10 panchayats representing the northern, middle and southern regions of Kerala, brought out the fact that the average quantity of organic manures used was 32.45 kg per palm per year and over the different size classes, the expenditure incurred on manures and fertilizers showed variation from Rs. 47.43 to Rs. 68.63 per palm per year, the average being Rs. 38.19 per palm per year. The next expenditure component is cultural management involving digging or ploughing, forming solid mounds and subsequent levelling. For this expenditure per palm is the highest at Rs. 44 for the size class below 0.5 ha and Rs. 40 for the size class above 5 ha. The amount spent for plant protection varied from Rs. 13 to Rs. 50 per palm per year, the lowest being in small holdings of less than 0.5 ha in size. In the state only less than
50 percent of the holdings have irrigation facilities. In the study the per palm expenditure varied from Rs. 1.95 to Rs. 14.37 with the annual average for all size classes being Rs. 10.16. Harvesting cost is met in cash and kind. Cash part varies from Rs. 150 to Rs. 360 and kind part from 60 nuts to 4 nuts per 100 trees. At a price of Rs. 4 per nut and for an average 6 harvests per year the total expenditure ranged from Rs. 18 to 24 per palm per year.

The said survey’s revelation is total maintenance cost increased progressively from Rs. 25,473 per ha for the lowest class below 0.5 ha to Rs. 28,190 per ha for the highest size class above 5 ha. An analysis of cost of production and income shows that the average household income from all the holdings worked out to Rs. 46,343.5 per ha. The highest household income is for size class 2-3 ha at Rs. 55,313 followed by class 1-2 ha at Rs. 50,969 and the lowest for the size class above 5 ha.

Thampan concludes his study pointing out that coconut farming in Kerala is generally profitable but the level of profitability showed substantial increase when intercropping with or without livestock, component is practised.\textsuperscript{39}

M.K. Nair, C.V. Sairam and Gopalasundaram of the Central Plantation Crops Research Institute, Kasargod have conducted an indepth study of the possibilities of reducing the cost of production of coconut. According to them cost of production of coconut in India has increased considerably due to the steep rise in the factor costs,
mainly of labour, fertilizers and transportation. The average cost of cultivating the palm in one hectare under rain-fed conditions with good management in Kerala ranges from Rs. 20750 during the first year to about Rs. 10500 between 6-7 years and to about Rs. 12000 between 8-60 years (at 1993-94 prices). But the average yield per palm is only 40. This low productivity and high cost results in low profit margin. Hence the researchers suggest this problem may be overcome through two approaches: (i) by reducing the annual cost of cultivation and (ii) by reducing unit cost of production through higher productivity. Competitiveness in coconut production can be achieved by using non-monetary/low cost inputs, improved management practices and by adopting coconut based farming systems as well as by using modern equipments like dryer for post harvest operations. Low productivity of coconut in India is due to the predominance of local cultivars which are generally late bearers and poor yielders compared to high yielding varieties / hybrids. Therefore it is preferable to invest in high yielding varieties which have a higher benefit cost ratio, pay back period and internal rate of return.40

K. Gopalan and M.S. Venkataraman classified the cost of cultivation of coconut as follows: (i) Cost of bringing up the palms to the stage of bearing (ii) Cost of maintenance under the first category includes cost of land, seedlings, manuring, watering and fencing.
The second category includes all agricultural operations, manuring and harvesting. 41

M.V. George and P.I. Joseph carried out a study on ‘Cost Benefit Analysis of Investment in tree crops and arrived at the cost of production of coconuts by taking into account both capital and current expenses as the opportunity cost of land.42

3.4 PROBLEMS OF COCONUT CULTIVATION

D. Chowdry in his study “Problems and Prospects of Coconut Cultivation in Assam” pinpoints the following problems of coconut cultivation in Assam. First, there is lack of awareness of the farmers on recent developments related to crop improvement, crop protection, production and cropping system; Secondly, there is a lack of quality planting materials to the farmers; Thirdly, lack of proper management practices, as coconut is grown in a very uncared condition without applying fertilizer and irrigation; Fourthly, pest problems and diseases caused by fungi and phytoplasma result in different degrees of crop loss.43

Srinivasan reports that the productivity of the coconut crop is constrained by various stresses. Among them, the root (wilt) disease is the major problem in southern districts of Kerala and Tamil Nadu and also in Goa. Srinivasan also reports that the root (wilt) affected palms are also affected by leaf rot. Incidence of leaf rot increases with increase in the incidence of root disease (wilt).44
Srinivasan and Gunasekaran have assessed the nature of the leaf rot disease. Leaf rot disease is considered as one of the devastating problems. They have assessed the quantitative pattern of fungal association and species composition of the disease. Srinivasan also found that the black rat, rattus tinn, is an important rodent pest of coconut in most of Lakshadweep Islands. It damages 35-50 percent of the standing crops.45

Desai and others point out that coconut palm is attacked by 107 pests. Among them the leaf eating caterpillar is one of the major pests. It infests the coconut palm throughout the year with varying intensities. Under varying conditions sporadic outbreaks lead to severe damage. A peak infestation occurs during the months of February to May, which may even prolong to June in case of delayed monsoons.

Caterpillar lives on the lower surface of leaflets in galleries and feeds on chlorophyll. Dry and green patches which appear on the lower surface of the leaves are the major symptoms of infestation. Palms of all ages are susceptible to infestation by black headed caterpillar.46
Footnotes


