REVIEW OF LITERATURE
CHAPTER 2
REVIEW OF LITERATURE

A review of past literature may help in conceptualizing related variables and in
developing a theoretical base for the study. An attempt has been made to search for a
maximum number of related studies, but few aspects of the study remained unexplored in
the past. The review of relevant literature is furnished under the following heads.

1. Transfer of technology
2. Knowledge on recommended practices
3. Adoption of recommended technologies
4. Productivity of coconut
5. Characteristics related to knowledge, adoption and productivity
6. Relationship of characteristics to knowledge, adoption and productivity

2.1. Transfer of Technology

2.1.1. Concept and Process of Transfer of Technology

Technology generation will be meaningful only when it is transferred and
diffused to the ultimate users. Transfer of technology should not be separated from
technology generation, rather it should be viewed as the last step in the process.
Diffusion is a major challenging task of the development agencies acting in co-
ordination with the people, local self-government organizations, financial institutions,
marketing agencies and research institutions. Hence, it is often more complex than
technology development.

Implicit in the process of transfer of technology is the notion of changing
people’s understanding, perceptions, attitudes, skills and perhaps values (Mezirow,
1978). Technology transfer is not just a technical matter (Freire, 1984).
Roy (1994) stated that the development of appropriate technology couldn’t achieve desired results unless appropriate measures are taken for the transfer of technology to the people who deserve it most. While analyzing the neglected issues in the technological changes and rural development in developing countries, he has pointed out two aspects of technology transfer relevant to our condition. First, people who want to adopt the technology should have easy access to it and secondly, measures should be taken to ensure that those who have acquired the technology could adopt it. The benefits of the technological change cannot be maximized in the absence of measures to facilitate the access to and adoption of the technology. Fie has also emphasized that appropriate methods of technology adoption should include measures, which not only reap the benefits of increased agricultural production but also minimize the adverse impact of new technology on the rural society and environment.

Technology transfer can be made effective and faster only when the technology is evolved to solve specifically the problems and constraints causing low productivity in different regions and different sections of the society. For effective transfer of technology, creation of suitable institutional structures entrusted with responsibilities as well as powers, financial resources and trained manpower is a must. What is required now is not new science or new technology but application of new science for the solution of urgent problems especially for the weaker sections, speedy and extensive extension and delivery system of the resultant techniques to the needy (Abba Lakshmy and Shahab, 1998).

Nanavatty (2000) emphasized the need to alter the policy for development of technology and technology transfer in India. The emphasis, besides adopting appropriate technology and increasing production, should be related consciously to the requirements of removing poverty among the masses in the country.
2.1.2. Transfer of Technology in Plantation Crops

Being a perennial crop, technology generation and its transfer are difficult in case of coconut when compared to annual crops. Few constraints specific to plantation crops and influencing transfer of technology have been reported by Muliar and Anil Raj (1981). The constraints related to the four levels such as the research system, extension system, farming system and support system were discussed.

Regarding research system, though technologies regarding hybrid varieties, farming system management and plant protection against pests and diseases were being widely adopted, not much breakthrough had been achieved in production, protection and processing aspects of plantation crops due to long pre-bearing age and higher time lag between treatment and response in every experiment.

Extension constraints were also linked with long duration of the crop. Since most of the state departments of agriculture adopt the same procedure for conducting result demonstrations in both annual and perennial crops, most of the demonstrations in plantation crops are stopped abruptly even before the impact of the technology adopted is visually observable.

Regarding the constraints related to farming system, low contribution of plantation crops to the total income of small and marginal farmers, less time and interest towards better management of plantation crops, huge capital requirement and low immediacy of returns hampered wide adoption of technologies in spite of its high profitability.

The major constraint related to the support system is the non-availability of good quality seedlings. Some traders with low quality seedlings, adulterated fertilizers and 'wonder cure' pesticides are cheating the farming community, utilizing the long duration nature of the crop.
Information sharing and transfer of technology were encountered as the key for the development of coconut industry globally and also domestically, by Singh (2000a). He has emphasized a greater need for the congruence among productivity, sustainability, profitability and equity for sustainable development in agriculture, which requires a system-based approach in technology transfer. Fanning system approach using participatory methods with full involvement and interaction of researchers, extension agents and farmers was therefore, found more suited to the present goal.

2.2. Knowledge on Recommended Practices

English and English (1958) defined knowledge as the body of understood information possessed by an individual or by a culture. According to the Webster’s New International Dictionary of English language, knowledge is defined as “familiarity gained by actual experience; practical skill; technical acquaintance”. It has also been defined by Webster as “acquaintance with fact; the state of being aware of something or possessing information; hence scope of information”. The Oxford English Dictionary defines knowledge as “acquaintance with a branch of learning, a language or the life; theoretic or practical understanding of an art, science, industry, etc.”. The Random Mouse Dictionary of English Language defines knowledge as “acquaintance with facts, truths or principles as from study or investigations”.

Several experts have emphasized the importance of knowledge component in transfer of technology and economic development. According to Gandhiji, “Right knowledge can be said to be the root of right action. Let us always beware of false knowledge.”
Knowledge of technology is a vital factor in the process of technology transfer (Roy. 1094)*. Hence, it is our prime responsibility to feed our farmers with vital and required information. New knowledge of technology requires not only functional literacy but also a willingness to change habits of work and living. Hence, technology change in rural areas of developing countries like India can be ensured only when it is related to value orientation (Nanavatty, 2000)*.

Several research workers have reported the level of knowledge on recommended coconut cultivation practices, as possessed by the coconut growers from various parts of the country.

Mutluidas (1982) observed that majority of the coconut growers from Tenkasi district of Tamil Nadu were found to come under medium level of awareness category (53.34 per cent) in respect of the recommended practices. Majority of them were found to be aware of periodicity of harvest (93.33 per cent), raising intercrops in the garden (X7.50 per cent) and the varieties recommended (73.33 per cent) whereas awareness about control measures of diseases was low (30 per cent).

Dhas (1985) found that majority of the respondents (60.84 per cent) from Kanyakumari had medium level of knowledge about coconut cultivation.

Jnanadevan (1993) reported that the level of knowledge was higher in case of beneficiary farmers of coconut development programmes compared to non-beneficiaries.

Nagabhushanam and Guruprasad (1994) observed that majority of the coconut growers (48.33 per cent) had medium level of knowledge on selection of seedlings followed by low (28.33 per cent) and high (23.34 per cent) level of knowledge in Dakshina Kannada district of Karnataka.
Yogananda et al. (1994) reported that 53.34 per cent of small coconut growers of Karnataka had lower level of knowledge on recommended package of practices of coconut cultivation as compared to big coconut growers who had either higher level (53.34 per cent) and medium level (41.66 per cent) knowledge. More than 50 per cent of the small and big coconut growers had knowledge about selection of mother palms and seed nuts except copra content as an essential element to quality as better seed nut. Also, majority got knowledge on selection of seedlings, except for collar girth and correct planting methods. Even if the farmers had knowledge on amount of organic manure to be used, majority lacked knowledge on method of application of farm yard manure and chemical fertilizer to apply. Majority were found lacking knowledge on control of pests and diseases except termite.

Lakshmi and Manoharan (1994) reported that there was no variation among different categories of respondents in knowledge level when crop production technologies were concerned. However, more of low knowledge on alternate land use was found among marginal farmers. Small and marginal farmers had low level of knowledge in soil conservation works and improved implements compared to large and medium farmers.

A research study was conducted by Babu (1995) on the appropriateness of farming systems and cropping patterns and their level of knowledge and adoption in the Central Zone of Kerala. The study revealed that 61.67 per cent of the respondents had medium level of knowledge about scientific practices adopted in homesteads and 16.66 per cent of them had high level of knowledge.

Kalavathi and Anithakumari (1998), in a research study conducted in Alappuzha district of Kerala concluded that despite having a high literacy rate, the level of correct knowledge of the coconut growers on improved production technologies was not
satisfactory. Knowledge was found to be high for practices which farmers traditionally followed and not involving additional cost for Held adoption. Medium level of knowledge was observed in case of fertilizer application, mulching, application of lime/salt, control of pests like rhinoceros beetle and control of diseases like stem bleeding and bud rot. Coconut farmers possessed only low level of knowledge in managing other pests and diseases and also in bio-control of pests and post-harvest technologies.

Venkattakumar *et al* (1998) reported that majority of the commercial coconut growers (76.35 per cent) in Coimbatore had medium to high level of knowledge about the recommended practices in coconut cultivation. In case of the coconut growers of Madurai district also, the level of knowledge was found to be medium to high, as reported by Saravanan (2000)*.

Ciogia (1999) reported low to moderate levels of knowledge among majority of the coconut growers of Andaman and Nicobar Islands. Significant difference was observed in the knowledge levels of marginal, small, medium and big growers. The study further revealed that most of the coconut growers had high level of knowledge regarding age of mother palm, shape of nut to be selected, method of storing nuts, time required for seed germination, advantages of deep ploughing, recommended inter crops, pit size and mechanical management of rhinoceros beetle. Moderate level of knowledge was noticed for practices like ideal weight of nut, location of nursery bed, recommended irrigation schedule, planting season, spacing and fertilizer application. Most of the respondents had low level of knowledge regarding number of fronds and bunches in mother palm, copra content/nut and pest and disease management.

Satyanarayana and Punna Rao (2000) observed that about 60 per cent of the oil palm growers possessed medium knowledge, while 28 per cent and 12 per cent had high and low knowledge about the recommended technology respectively.
Manoharan and Poonguzali (2000) found that nearly three-fifth (61.67 per cent) of the respondents possessed medium level, followed by about one-fifth (20.83 per cent) at high and about another one-fifth (17.50 per cent) at low level of knowledge on IPM. More than 90 per cent of farmers had more knowledge on cultural methods of plant protection. About one-third of respondents had awareness about concept of IPM. Medium level knowledge was found on the practices relating to eco-awareness, various chemical methods and biological methods of using parasitoid, predators and plant products.

In general, the coconut growers from various parts of our country were found to possess a medium level of knowledge on various aspects of coconut cultivation. The studies revealed significant differences in the levels of knowledge between marginal, small, medium and big farmers. Also, the beneficiaries of coconut development programmes were found to have higher level of knowledge when compared to non-beneficiaries. The literature further revealed low levels of knowledge on correct control measures of pests and diseases and correct method and quantity of fertilizer to be applied, when compared to traditional practices.

2.3. Adoption of Recommended Technologies

Adoption is a process starting from the awareness of a technology to a decision to make continued use of it (Rogers, 1983). According to him, the individual passes through various steps viz., Knowledge, Persuasion, Decision, Implementation and Confirmation during the process. Adoption of new technology can have substantial economic and social benefits (Harrison, 1994)*. To derive greater benefits from technology, Roy (1994) insists the developing countries to take action on the following neglected issues: (a) inter-relationship between technology, environment and rural population; (b) need for an appropriate technology; (c) need for a supporting technology; (d) relevant aspects of
technological transfer and (e) an appropriate policy framework. The level of adoption may vary from one region to another based on the prevailing conditions.

An attempt has been made to study the level of adoption of the recommended cultivation practices by the coconut growers under varying conditions. Bastin et al. (1991) reported that 24 per cent of the coconut farmers from North Kerala adopted correct spacing for planting. Among others who have not adopted the practice, 40.4 per cent planted coconut irregularly with adequate spacing and 33.7 per cent of them planted irregularly with inadequate spacing. Regarding adoption of fertilizer, partial adoption was followed by 29.59 per cent and non-adoption by 70.4 per cent of the coconut growers. Irrigation as per recommendation was adopted by only 16.31 per cent of the farmers. Plant protection against pests and diseases was followed by only 3.6 per cent of the farmers. None of the farmers adopted the practice of husk burial to coconut in northern part of Kerala.

Jnanadevan (1993) reported that the extent of adoption of recommended practices was higher in new planting area compared to other areas. Practice-wise adoption by farmers revealed that use of hybrid varieties of seedlings for new planting was the least adopted practice.

Santha et al. (1993) identified a technological gap in the adoption of recommendations on the maintenance of coconut palms. The main constraints that stood in the way of adoption of most of the technologies were educational and economic in nature.

Jnanadevan and Prakash (1994) stated that extent of adoption of recommended practices was higher in the case of beneficiaries compared to non-beneficiaries under selected development programmes of Coconut Development Board.
Nagabushanam and Guruprasad (1994) found that slightly more than half of the respondents (51.67 per cent) belonged to low adopters group, whereas 35 per cent belonged to medium adopters group and only 13.33 per cent belonged to high adopters group.

Ponnusamy et al (1994), in a study on adoption of integrated farming system technologies found that more than three fourth of the target group farmers who received village level training adopted majority of the crop production technologies in Pollachi subdivision of Coimbatore district. Further, it was observed that Bordeaux mixture preparation was being adopted by 73.75 per cent of the farmers, root feeding of coconut by 77.5 per cent, coir pith composting by 80 per cent and enriched farm yard manure preparation by 67.5 per cent of the farmers.

Babu (1995) reported that a good majority of homestead farmers were under the medium category' (69.44 per cent) with respect to the extent of adoption of scientific practices adopted in homesteads.

Geethakutty (1996) reported that 93 per cent of the unirrigated holdings had very low or low adoption index whereas 23 per cent of the irrigated holdings had average to high adoption index. Though the adoption levels of majority of the irrigated farms were comparatively better than those in the unirrigated farms, the utilization of improved farming technology as such was not encouraging.

Singha (1996) found that more than half (53.33 per cent) of the respondents had low level of adoption of the recommended coconut cultivation practices in a progressive area of Assam, while the remaining 25 per cent and 21.67 per cent respondents were found in the high and medium categories respectively. The coconut growers in general were found to adopt traditional methods of cultivation and other management practices due to poor economic conditions of farmers as well as poor knowledge on these complex
practices. He has also reported that among the recommended practices undertaken, 65 per cent of the respondents had full adoption of HYV, 58 per cent had full adoption of water management, followed by plant protection measures in diseases (28 per cent), manures and fertilizers application (27 per cent) and plant protection measures in insect pests (18 per cent). Many of them had partial or no adoption of the recommendations in complex practices of coconut cultivation like fertilizers application and plant protection measures.

Mercy Kutty (1997) reported that majority of the adopters of bio-fertilizers were using it in banana cultivation (96.87 per cent), followed by coconut (87.50 per cent), vegetables (78.12 per cent) and rice (62.50 per cent).

Venkattakumar (1997) reported that majority of the respondents adopted the practices as recommended, viz., recommended variety, appropriate method of planting and spacing, whereas majority of them adopted the practices viz., water management practices, fertilizer application, chemicals application after modification and not adopted the practices viz., application of micro-nutrients and control measures for button shedding.

Kalavathi and Anithakumari (1998) observed a low or faulty adoption of improved technologies by most of the coconut growers. High adoption was mostly observed in case of traditional technologies not involving additional cost for Held implementation. Adoption was found to be in line with level of knowledge as reported elsewhere in the report except for mother palm selection, hybrid varieties, recommended spacing, irrigation and use of farm yard manure.

Padmaiah et al (1998) reported that a little less than one fourth of the respondents from watershed area belonged to high adoption category in the adoption of recommended improved production practices, as against 18 per cent of the respondents from non-
watershed areas in Mahabubnagar district of Andhra Pradesh. Many of the respondents from both the areas belonged to medium adoption category.

Venkattakiimar et al (1998) observed that majority of the respondents (67.12 per cent) had low to medium level of adoption of recommended coconut cultivation practices. Lack of adequate technical skill, costliness and non-availability of the necessary inputs resulted in low to medium level of adoption.

Practice-wise knowledge and adoption of the coconut growers of Kannur district of Kerala was reported by Venugopalan and Thampan (1998). They found the application of organic manure, preparation of pits for planting, depth of planting and time of planting as the areas in which there was high level of knowledge and adoption. Cultivation of hybrids, drip and sprinkler systems of irrigation, fertilizer application to seedlings, control of red palm weevil, coreid bug, white grub, stem bleeding, nematodes, biological control of pests, use of copra dryer, palm climber and moisture meter were the items of low adoption. Inter/mixed cropping, control of rhinoceros beetle, control of rodents, control of bud rot and fertilizer application for adult palms were reported to be having medium level of adoption.

Gogia (1999) reported low to moderate levels of adoption by majority of the coconut growers from Andaman and Nicobar Islands. Significant difference in adoption was observed among marginal, small, medium and big growers. She recorded practice wise adoption in tune with the level of knowledge possessed by the coconut growers on the respective practices.

Saravanan (2000) found that majority of the coconut growers (63.33 per cent) from Madurai district of Tamil Nadu had medium level of acceptance level, followed by low (22.50 per cent) and high (14.17 per cent) levels. Majority of them had high level of knowledge and acceptance for the cultural practices like spacing, pit size, planting
method, inter cultural operation, depth of planting, coconut mixture application, farm yard manure application, intercropping and management measures recommended for rhinoceros beetle, red palm weevil and termite. Most of the respondents had low knowledge and acceptance levels for the management of black-headed caterpillar, bud rot and button shedding. Spread and acceptance was very low for by-products utilization.

Studies from various parts of the country revealed low to medium level of adoption of coconut technologies, in general. Significant difference in adoption was reported between different size classes of farmers, between irrigated and unirrigated holdings and between trained and untrained farmers. Overall view reveals a low level of adoption of complex practices like pest and disease management and fertilizer application as per recommendation, when compared to traditional practices.

2.4. Productivity

Sagar and Ray (1984) conceptualized productivity of crops as a manifestation of farmers' behaviour in obtaining crop yield by utilising the resources at his disposal.

According to Rajagopalan (1986), agricultural productivity may be referred to as the outcome of factors like soil productivity, climatic conditions, level of technology, utilisation of resources etc.

The productivity of coconut varies from region to region based on several characteristics influencing crop growth. The productivity of coconut is expressed either as nuts per ha. or nuts per palm. The available data on the productivity status of coconut in Kerala and Tamil Nadu were reviewed.

Narayana *et al* (1991) remarked that in case of coconut whatever estimates of yield that existed were at variance with estimates thrown up by other agencies for different points of time.
Directorate of Economics and Statistics (1996) in a sample survey conducted in Tamil Nadu estimated the average yield of coconut per palm per year in Coimbatore district as 32 nuts, Kanyakumari as 47 nuts and the state average as 58 nuts.

Geethakutty et al (1996) recorded the average productivity of coconut in the selected unirrigated holdings of Thrissur district as 40 nuts/palm/year whereas it was 64 nuts/palm/year for irrigated holdings.

Kerala State Planning Board (1997a) reported that the productivity performance of coconut in Kerala during the period 1980-81 to 1995-96 had been quite impressive, which increased from 4618 nuts per ha. in 1980 to 6014 nuts per ha in 1995-96.

The results of the evaluation studies on the comparative performance of hybrids at CPCRJ indicated that in terms of nut production and copra yield, Lhey were superior to the local compared to the 80 nuts per palm of WCT and the yield varied from 95 to 140 nuts per palm (Parthasarathy et al, 1998).

Thampan (1999a) in a survey conducted by PTCDF reported that among the farmers surveyed, 86 per cent had adequate knowledge in the management of high yielding varieties and they were getting comparatively better yield varying from 12,000 to 26,000 nuts per ha. in Kerala. But in gardens where the farmer lacks the knowledge in the management of high yielding varieties, the yield level had plummeted to 7,214 nuts per ha. In productivity, hybrids outmatched tall ones with an annual average of 78 nuts per palm against 75 for WCT, 60 for other tall types and only 56 for dwarf.

The results of a farmer participatory survey conducted by him showed that the productivity of coconut varied from place to place depending on planting density, intensity of disease incidence and quality of management. The variation observed was from 4,800 nuts to 11,000 nuts per ha per year. The productivity per palm was as low as
35 nuts in the areas where root (wilt) and leaf rot diseases are prevalent and 60-80 nuts in disease free areas.

Kerala State Planning Board (2000) reported that the productivity recorded during 1999-2000 was 5,747 nuts per ha., which is marginally lower than the yield of 5,817 attained in the previous year.

Report of the Scientific Workers’ Conference (2001), in the econometric analysis of coconut industry conducted in the North Eastern Zone, Western Zone, Cauvery Zone, South Central Zone and Southern Zone of Tamil Nadu found that the area and production was growing at the fastest rate in the Western Zone, whereas yield was increasing at a higher rate in the Southern Zone.

The productivity estimates reported by various agencies at different points of time showed wide variations, as revealed by the review.

2.5. Characteristics Related to Knowledge, Adoption and Productivity

2.5.1, Educational Status

Wharton (1965) has evaluated the fundamental problem of agricultural growth as an educational problem. Universally, education is observed to be a fundamental factor for economic and social changes (Myrdal, 1968).

The most important factor in the adoption of a new technology, as identified by Roy and Clark (1994), was a farmer’s ability to assimilate and apply new information, which in turn was largely determined by his educational level. According to them, appropriate education refers not only to technical education but to the cultivation of basic human qualities such as tolerance and receptivity to others views and ideas. Considering such an importance, several researchers selected education as a variable in studies related to knowledge, adoption and productivity.
Chandra Bindu (1995) observed that most of the respondents from Kottayam district had primary or secondary level of education.

Geethakutty *et al* (1996) reported that majority of the respondent farmers from Thrissur district had upper primary level of education, in case of both irrigated and unirrigated holdings.

Thangachamy (1993) and Sendilkumar (1994) reported an educational level of high school and above among majority of the farmers from different regions of Tamil Nadu, while Krishnakumar (1996), Sasikala (1997), Venkatesan (1997) and Sunitha (1998) observed majority in functional literate to middle school level category. One third of the respondent coconut growers were reported to be illiterates in Vadipatti Agricultural Division of Madurai district, as reported by Saravanan (2000).

Singha (1996) reported that over two thirds of the respondent coconut farmers (71.66 per cent) in a progressive area of Assam had high level of education.

Gogia (1999) found that majority of the coconut growers from Andaman and Nicobar Islands were educated up to middle level, while Seema (1999) observed that majority of them had primary level education and most of them even did not have formal education.

According to Ramasamy *et al* (1999), the differences in the level of education between adopters and non-adopters as less significant, while Singh (2000b) found that agricultural productivity was strongly determined by the level of technology adoption; and technology adoption was strongly determined by education-education of the individual and of the society.
2.5.2. Occupational Status

Dharmalingam (1990) observed that most of the farmers (87 per cent) were agriculturists and 18 per cent only had some non-agricultural occupation along with agriculture.

Karthikeyan (1994) found that the main occupation for majority of the farmers (88.30 per cent) was agriculture and the remaining only engaged in other occupation.

Swamidasan (1994) observed that most of the farmers (91.42 per cent) had agriculture as their main occupation and the rest (8.58 per cent) had other subsidiary occupation along with agriculture.

Chandra Bindu (1995) found that most of the respondent farmers had farming as their primary occupation.

Geethakutty et al (1996) reported that majority of the respondents under irrigated condition (83 per cent) and unirrigated conditions (70 per cent) had farming as their major occupation.

Based on the literature reviewed, it is concluded that majority of the respondent farmers had farming as their major occupation.

2.5.3. Farming Experience

Dhas (1985) reported that most of the farmers (94.17 per cent) who shifted from paddy to coconut had high level of farming experience.

Rathinasabapathy (1987) reported that majority of the farmers (82.82 per cent) had medium farming experience, while only 14.06 per cent of the respondents had high farming experience and 3.12 per cent had low farming experience.

Desigavinayagam (1994) observed that 70 per cent of the respondents had low farming experience, 22.5 per cent had medium level and 7.5 per cent had high farming experience.
Swamidasan (1994) revealed that 40.00 per cent of the respondents had medium level of experience in tanning which ranged from 24 to 38 years, followed by low level (37.14 per cent) and high level (22.68 per cent). The low level experience ranged only below 24 years as per cumulative frequency value.

Theodore and Mansingh (1994) reported that 54 per cent of the farmers from Thanjavur district had high farming experience, while in Pudukkottai it was only 43 per cent.

ICrishiiakumar (1996) reported that 43 per cent of the respondents had medium level of farming experience, followed by high (43 per cent) and low (15 per cent) levels.

Ravichandran (1996) reported that nearly half (48.5 per cent) of the respondents had medium level of tanning experience with 12 to 18 years. This was followed by low (up to 12 years) and high (above 18 years) farming experience with 30.00 per cent and 21.43 per cent respectively.

Sasikala (1997) revealed that more than three-fourth (75.83 per cent) of the respondents were found to possess more than ten years of farming experience, followed by 24.17 per cent with 5-10 years of experience in farming.

Sunitha (1998) reported that 52.50 per cent of the respondents had high level of farming experience, followed by medium (33.33 per cent) and low (14.17 per cent) level of tanning experience.

Gogia (1999) found that majority of the coconut growers possessed low level of fanning experience in Andaman and Nicobar Islands.

Saravanan (2000) reported that nearly half of the respondents (45.83 per cent) had medium level of fanning experience in coconut cultivation, whereas one third (36.67 per cent) had low level and the remaining 17.50 per cent had high level fanning experience in Vadipatti area of Madurai.
Majority of the coconut growers from various study areas possessed either high or medium level of farming experience, except from Andaman and Nicobar Islands.

2.5.4. Cropping Intensity

Cropping intensity index assesses farmers’ actual land use in area and time relationships for each crop or group of crops compared to the total available land area and time including the land temporarily available for production (Reddy and Reddy, 1997)*. Reports on the cropping intensities and related profitability aspects are reviewed.

Joseph et al (1993) reported that the yield of coconuts in a coconut based cropping system could be increased and the entire system made productive and profitable by meeting the requirements of each of the crops in the systems.

Kaul (1995) inferred that profitability of coconut farming would be determined by the intensity of land use available in the gardens.

Geethakutty el al (1996) reported that the cropping intensity in the unirrigated homesteads of Thrissur District was found to be 126.4 per cent, whereas it was 183.5 per cent in case of irrigated homesteads. In case of unirrigated coconut gardens, 70 per cent had low intensity whereas in irrigated 56.67 per cent of the holdings had average intensity.

Coconut Development Board (1997) in a survey report revealed that 76 per cent of the total area was occupied by coconut in Ernakulam district.

Kerala State Planning Board (1997a) reported that the cropping intensity remained constant over recent years at around 135 per cent. One of the reasons for the cropping intensity remaining stagnant was due to the utilization of the traditional wet lands where more than one crop of paddy along with cash crops like pulses were raised earlier, are getting diverted increasingly for perennial crops where the scope for additional cropping is limited.
John and Nair (1998) observed that coconut accounted for 40.25 per cent of the total plant population in the low lands, but only 5.50 per cent in the high lands and 13.72 per cent in the midlands. When the population of tree crops alone was taken into account, the average number of palms formed 44.44 per cent of the total trees with a variation ranging from 1.829 per cent in the high lands to 51.11 per cent in the low lands.

Kalavathi and Anithakumari (1998) observed that most of the coconut growers adopted intercropping and mixed farming improperly as they did not have a correct knowledge about spacing, proper arrangement of compatible intercrops and the nutrient needs of the system as a whole.

Senthivel et al (1998) reported the present cropping intensity in India as 135 per cent. In irrigated areas the cropping intensity can be increased to 200 to 300 per cent.

Thampan (1998), in PTCDF survey report indicated that 78.87 per cent of the total area was occupied by coconut. Among different size groups, holdings of less than one ha. had 95 per cent of the total area occupied by coconut. High density of over 200 palms per ha. was found common in small holdings. The crowded palm population coupled with poor cultural management causes low productivity of coconut.

Kerala State Planning Board (2000) reported that the average cropping intensity had come down from 130.70 during 1997-98 to 129.12 during 1998-99 in Kerala.

Thampan and Venkatachalam (2000) reported that the extent of benefit depended on the intensity of cropping and the interest evinced by farmers in the management of the holding. The cropping intensity was very high in smaller holdings than in larger ones. The range in contribution to total income across the size classes is 22 per cent to 52 per cent with the highest value recorded for the size group 0.1 ha. and below.
Pal and Khan (2001) stated that a homestead model in Kerala, having 0.2 ha. size with a cropping intensity of 161.84 percent can yield a profit of Rs.37,246 on investing Rs.25,000 with a cost: benefit ratio of 2:5.

2.5.5. Size of Holding

Most often the size of holding plays a major role in technology adoption thereby influencing the productivity. Hence, in many of the adoption studies, this variable had been considered a crucial one. The trend in the distribution of holdings according to size in the major coconut growing areas was reviewed.

Das (1991a) revealed that in Kerala, a typical socio-economic situation calls for an average holding size of only 0.22 ha. with very often, no other land available for other crops as an alternate source of income.

Chandra Bindu (1995) observed the size of land holding as more than two acres for majority of farmers having more than three enterprises mix.

Geethakutty et al (1996) reported the average size of unirrigated holdings in Thrissur district as 0.35 ha., while it was 0.29 ha. for the irrigated holdings.

Tharnpan (1996) stated that coconut is generally treated as a crop of small and marginal farmers. In all the major coconut growing countries small holdings of coconut predominate, though the size class distribution varies from country to country.

In Philippines, over 65 per cent of the total holdings fall under the category of small farms of less than 4 ha. with a holding size of 1.75 ha. In Srilanka, about 75 per cent of the total area under coconut is in the category of small holdings of 8 ha. or less. In Malaysia, over 90 per cent of the coconut area is covered by small holdings. In India, there is no size class grouping as small or large. There are about 5 million coconut holdings with 98 per cent of them occupying only less than 2 ha. In Indonesia,
98 per cent of the coconut area belongs to small farmers and provides livelihood to at least 3 million households.

Coconut Development Board (1997), in a detailed socio-economic survey conducted in one of the panchayats in the Ernakulam district, found that about 75 per cent of the households had an average size of less than 0.08 ha. and only a little above 5 per cent of the holdings had a size of 0.4 ha.

Kerala State Planning Board (1997b) reported that coconut is essentially a small holder's crop in Kerala with the average size of holding as small as 0.25 ha. Out of 2.5 million coconut holdings, about 90 per cent of the holdings covering 60 per cent of the area under the crop are marginal holdings not capable of supporting an average farm family.

Venkattakumar (1997) reported that most of the commercial coconut growers in Coimbatore district possessed small to medium sized farms with low to medium sized areas for coconut alone.

John and Nair (1998) in a study covering 400 households in Southern Kerala found the size of home gardens varied from 0.04 ha. to 3.6 ha. with 95 per cent having a size of less than 0.8 ha., though the average for all the holdings was only 0.33 ha.

Narayana et al (1991) found that 55 per cent of the area under coconut in Kerala is below operational holdings of one ha.

Reddy (1998) stated that in Kerala, the average size of the holding is as small as 0.20 ha. and about 98 per cent of the holdings are below 2 ha. in size.

Thampan (1998) in a survey organized by PTCDF covering 198 holdings representing the northern, central and southern regions of Kerala state, the average holding size was found to be 0.89 ha. Among the holdings, over 90 per cent had an area of less than 2 ha, with an average holding size of 0.73 ha.
Saravanan (2000) observed that more than Three-fourth (65.83 per cent) of the respondents had less area under coconut in Vadipatti area of Tamil Nadu. The size of coconut holdings was observed to be small in all major coconut growing countries of the world, as revealed by the studies.

There has been a steady marginalisation of the operational holdings in India and a continuous decline in the average size of holding for all the size groups since the sixties. Even though the inverse farm size-productivity is a stylized fact of Indian agriculture, the marginalisation accompanied by progressive fragmentation of land holdings introduces negative externalities in the permanent improvement of land through irrigation/ drainage, soil conservation, mechanization etc. The modern production technology is scale neutral, but not resource neutral. Hence, there will be disincentives of employing modern production technology in the small and the fragmented holdings (Singh, 2000c).

Micro evidence from an agriculturally developed region, where new agricultural technology had permeated quite thoroughly, showed the existence of inverse farm size-productivity relationship in the production of wheat, paddy and also when all the crops were taken together. The results further showed that the small farms used higher amount of human labour and fertilizer as compared to higher farm size categories (Sharma and Sharma, 2000).

2.5.6. Planting and Cultural Management

Irregular planting and over crowding of plants are most common in coconut gardens of Kerala. As the coconut palm needs plenty of sunlight, the overlapping of leaves resulting from high density planting fails to give satis facio 17 yield. Proper planting methods will be reflected at the bearing stage of coconut.
Muthudas (1982) identified the major problems in the adoption of proper method of planting as the high cost and lack of awareness in adopting the recommended method.

Yogananda et al (1994) reported that majority of the farmers from Dakshin kannada had moderate knowledge about size of the pit and recommended spacing for tall and dwarf variety.

Hippargi et al (1997) found that variable spacing had been adopted in most of the old gardens due to non-availability of specific recommendations. Majority of the new plantations followed recommended spacing with little modifications depending upon the local situations. Adoption of inter-culture was widespread, many of the growers practiced more than 4 times.

Kalavathi and Anithakuinari (1991;S) observed high level of knowledge and adoption on most of the planting and cultural management aspects like pit size, depth of planting and planting time, while a low level of adoption was observed in case of recommended spacing in Alappuzha district.

Venkattaluimar et al (1998) reported that nearly cent percent of respondents adopted recommended appropriate method of planting followed by adopting the recommended spacing (97 percent).

Hampan (1999a) reported that over 90 per cent of the coconut growers adopted various cultural practices in their holdings. The average expenditure incurred on this account was Rs.28 per palm per year.

2.5.7. Irrigation

Irrigation is defined as the artificial application of water to soil to supplement rainfall (or crop production. Irrigation provides favorable environment for higher crop growth and yield (Senthivel et al, 1998)*.
months. The scarcity of water was found as the major reason for not practicing irrigation in coconut gardens.

Thampan (1993) reported that in Kerala not more than 10 per cent of the area under coconut receives irrigation. In holdings where irrigation is given and organic recycling is practiced the productivity is far higher than the general level and is also comparable to that of the best maintained gardens in other states where coconut has a short history of cultivation.

Uthaiah et al (1993), based on a research study conducted at Regional Research Station, Brahntavar, Karnataka concluded that even though significant differences were not noticed among the different mulches and quantity of water applied through different irrigation methods, still application of smaller quantity of water through drip system seems to encourage the growth and development of young coconut palms. The combination of coir pith and earthen pitcher also resulted in better growth.

Bastine and Palanisamy (1995) while evaluating the investments in small holder coconut crop in Kerala had seen that the share of irrigation costs to total cost was 20-25 per cent in small irrigated holdings. The irrigation investments showed wide variation among holdings of different land categories and also different sources of irrigation.

Geethakutty et al (1996) reported irrigation as a decisive input in inducing intensive use of land. The results of the study conducted in Thrissur district of Kerala revealed that 56.71 per cent of the total area was occupied by coconut in unirrigated holdings, whereas it was 48.72 per cent in irrigated holdings. The reduction in the proportionate area for coconut in the irrigated gardens is compensated by the increased area under remunerative crops like areca nut, pepper, nendran and nutmeg. The major
constraints in irrigating coconut gardens were non-availability of water in summer
months, low water table and erratic supply of electricity.

Bhaskaran and Leela (1977) observed that within a period of four years, the
increase in mean yield of nuts in the irrigated plots was 74 per cent over that of controls,
mainly due to a specific increase in production of more female flowers and in the high
setting of buttons.

Kerala State Planning Board (1997b) reported that not more than 10 per cent of
the coconut crop received irrigation in Kerala. Inadequate facility to provide
supplementary irrigation was assumed as the reason for the lack of luster performance of
Kerala in coconut production.

Muralidharan (1988) reported that irrigation alone could increase the yield by 200
per cent within 2-3 years.

2.5.8. Moisture Conservation

Coconut palm require adequate soil moisture during their establishment period of
three to five years for the normal growth and later production of nuts. Soil moisture
conservation is an important factor to overcome the drought effect. Husk burial, green
manuring and mulching the basin can combat the moisture deficit to some extent by
improving soil moisture conservation.

Bhaskaran and Leela (1977) reported that studies conducted at the Coconut
Research Station, Nileswar on burying of coconut husk has recorded 35 per cent increase
in yield.

Liyanage et al (1993) based on the results of a research study revealed that the use
of both husks and coir dust was beneficial to coconut production. This was partly
attributed to their ability to retain moisture in the soil and regeneration of more roots per
unit area.
Santha et al (1993) found that 17.01 per cent of the farmers followed husk burial in coconut gardens. The use of coconut husk as fuel, lack of awareness and high cost of labour and husk had been observed as the major constraints for not adopting husk burial.

Uthaiah et al (1993) reported that mulches are beneficial in most of the perennial crops grown in subtropical situations. Among different mulching materials, spreading of coir pith at 10 cm thickness and one metre radius around the base of coconut palm was found to conserve soil moisture for a very long time, resulting in enhanced growth and development of young coconut palm. The use of locally available materials like coir pith, paddy husk and dry grass as mulch is cost effective in their use.

Vidhana (1998) reported dry mulching as the most efficient moisture conservation practice that could be adopted for coconut lands.

Thampan (1999a) informed from the farmer participatory survey that the major constraint to the adoption of soil and water conservation measures was the shortage of farm labour and high wage rates.

Renaud and Latham (2000) in a study of Northern Thailand experiencing socio-economic changes, argued labour costs as a major constraint for the adoption of conservation practices generally considered for dissemination by many projects.

2.5.9. Soil Fertility Management

Integrated soil fertility management was conceptualized and defined by Magat (1997)* as the combined use of organic/natural and inorganic/mineral fertilizers in coconut fanning aimed at reaching maximum economic yield through a sustainable, economical, environment-friendly and socially acceptable production system. In the recent agriculture situation, the trend is to increase productivity per unit time, which has led to a situation of intensive agriculture with possible nutrient imbalances. Hence it has become necessary to adopt balanced fertilizer application in order to maintain sustainable
productivity. Integrated Nutrient Management (INM) is the best approach under such a situation for proper utilization of resources and produce crops with less expenditure. The concept of INM integrates different nutrient sources viz., organic manures, crop residues, bio-fertilizers, chemical fertilizers etc. and methods of application to maintain soil fertility. (Senthivel et al, 1998)*.

Jnanadevan and Prakash (1992), in a study conducted in Kollam district cited the poor economic status of the coconut growers as the major constraint following intermittency in annual application of fertilizers in the adoption of fertilizer technology.

Megde et al (1993) remarked that with one of the lowest per capita arable land which is further shrinking, nutrient management would continue to play a major role in the future agricultural productivity of our country. Different kinds of organic matters such as farm yard manure, cow dung, compost, green leaves, oil cakes and coconut wastes etc. can be made use of to meet the nutrient requirement of coconut. Under present circumstances it seems conjunctive use of chemical fertilizer, organic manures and crop residues is one of the best methods to derive more benefits.

Santha et al (1993) reported that the adoption of organic manure according to recommendation was only to the extent of 4.98 per cent, while 71.36 per cent of the farmers were not applying any organic manure at all. Fertilizers were not applied by 64.32 per cent of the farmers, whereas the adoption of correct recommendation was practiced by 6.22 per cent of the farmers only. The green manure crops and cover crops were adopted by 6.22 per cent of the farmers only. The major hindrance to soil fertility management was lack of capital. The other constraints were lack of conviction and awareness, high cost of fertilizers and labour and a feeling that fertilizer application is not required.
Yogananda et al. (1994) observed that majority of the coconut growers possessed knowledge on the amount of farm yard manure to be used per ha. of coconut garden. But they lack knowledge on the method of application of FYM and amount of chemical fertilizer to be applied.

Directorate of Economics and Statistics (1996), in a sample survey conducted in Tamil Nadu found that the percentage of unmanured gardens was to the tune of 83.56 in Coimbatore, 94.16 in Kanyakumari and 73.72 for the state as a whole.

Hippargi et al. (1997) observed that only 10 per cent farmers were applying organic matter at 50Kg./palm/year. Majority was found to apply about 5 I/ha. to the entire field. Only 20 per cent of the farmers who did not grow intercrops were found to apply 50 per cent of the recommended rate around the plant.

Kerala State Planning Board (1997b) reported that the percentage of farmers following the recommended level of fertilizer was less than 10, even though 50 per cent of the farmers apply fertilizers. The use of organic matter was also found shrinking thereby adversely affecting the moisture retention and productive capacity of the coconut holdings.

Magat (1997) reported that under unmanaged farm, average annual yields were 35 nuts/tree or 1.02 MT copra/ha., while research stations achieved 107 nuts/tree or 3.6 MT copra/ha. in Philippines. It was concluded that for profitable and sustainable coconut farming, the Integrated Soil Fertility Management (ISFM) using all available organic fertilizer sources (also as soil conditioner and soil moisture enhancer) plus inorganic or chemical fertilizers to complete/balance the coconut nutrition should be practiced. It was also reported that correction of widespread deficiencies in N, Cl, S and K had been achieved even in small-scale farms of Philippines with 142 per cent average increase in
nut yield and 179 per cent increase in copra terms after 3-4 years of application at
moderate rates of fertilizers.

Prabhu et al (1998) reported that among the several reasons for the low
productivity of coconut in Kerala, poor soil fertility and soil characteristics that influence
soil productivity would be playing a major role.

Singh et al (1998) observed that the farmers of North Eastern Region generally
did not apply chemical fertilizers, but these plants got a lot of nutrients indirectly from
urine and dung of cattle sheltered in ox land or homestead.

Upadhyay et al (1998) indicated that coconut being a perennial crop would
require continuous supply of nutrients from the limited soil volume throughout the year.

Thampan (1999a) reported that while majority of the farmers applied organic
inputs on a regular basis, less than 50 per cent of them resorted to apply inorganic
fertilizers. He also remarked that the farmers realized the importance of manuring though
the quantity applied varied between different size groups.

2.5.10. Genetic Quality of Palms

Selection and use of quality planting materials are of utmost importance in a
perennial crop like coconut. If inferior quality planting materials are used, the garden will
become a continuous source of loss to the grower (Mandal, 1998, Singh et al, 1998 and
Subramanian, 1998)*.

Liyanage (1953) reported that the selection of mother palms had proved to yield
50 per cent efficiency in increasing productivity of coconut in Srilanka.

Non-availability of good quality planting material has been identified as a major
constraint to coconut production by Sivaramakrishnan (1981), Vijayakumar (1983),
Kerala Agricultural University (1984) in its status report mentioned planting of poor genetic material as one of the major constraints in coconut production.

Satyabalan (1998) reported that the varying yield capacity and bearing tendency noticed in the palms might be attributed to the genetic differences between the palms.

Thampan (1999a) reported that the participants of a farmer participatory survey expressed dissatisfaction about the quality of planting material being produced in the departmental nurseries and made available to the farmers. Consequently, 75-80 per cent of the farmers resorted to on-farm production of planting material and for which palms possessing desirable characteristics were identified and used as mother palms.

Nair and Rajesh (2001) reported the annual requirements of planting materials of coconut in India as around 15 million, while the actual production of quality seedlings as 1.2 million hybrids and 4.5 million tails. This wide gap between demand and supply of quality seedlings was assumed as the reason for the supply of poor quality seedlings by private nurseries.

2.5.11. Incidence of Pests and Diseases

Most of the pests and diseases cause considerable damage to coconut palm and thereby substantial reduction in nut yield. Adoption of timely and proper plant protection measures are essential to protect the palms and to reduce the economic loss. With Integrated Pest Management (IPM) and Integrated Disease Management (IDM) practices, the pests and diseases can be controlled and the yield level and the income can be enhanced. In this approach, cultural, mechanical, biological and chemical methods are integrated for the control of pests and diseases in an effective manner.

Nair et al. (1998)* conceptualized Integrated Pest Management programme as a community effort to bring down the population growth of any pests.
Rohini and Nambiar (1998)* defined integrated Disease Management as an approach which attempts to use all known viable methods in a compatible manner for reducing plant diseases/pathogens of: a crop in a field so that their levels below the economic threshold is maintained and the least damage is done to the environment and encosystem. They reported that the annual losses due to pests and diseases in many of the crops were sometimes as high as 20-30 per cent of the total yield. The incidence of pests and diseases depends on many factors viz., weather/climate, agro-ecology, variety of the crops prevalence of parasites/predators/pathogens etc. and thus the damage may vary from year to year.

Anonymous (1985) reported that the annual loss due to root (wilt) disease in Kerala was to the tune of 968 million nuts.

Santha et al (1993) reported that only 19.58 per cent of the farmers adopted plant protection measurers. Lack of awareness about the recommendations and seriousness of the deceases was recorded as the major constraint in adopting plant protection measures,

Yogananda et al (1994) found that majority of the coconut growers had knowledge on control of termite but lack knowledge on control of other pests and disease

Hippargi et al (1997) reported that coconut was subjected to severe pest and diseases menaces such as leaf eating caterpillar, red palm weevil, root grub, stem bleeding, ‘Anabe’, bud rot and leaf spot. It was seen that 75 per cent of the farmers did not adopt plant production measures due to physical constraints and costs.

Murphy and Brisco (1999) reported an yield loss of 10-25 per cent in Tamil Nadu due to Red Palm Weevil.

Singh and Markose (1999) stated that the outbreak of minor pests in several parts of the country created panic among the fanners as well as researchers and policy makers.
They inferred that the changes occurred in the cropping pattern, adoption of modem agriculture, inputs and plant protection chemicals might have invited such pest outbreak.

Thampan (1999a) based on the farmer participatory survey observed that while the pests were more or less common, the incidence of diseases like root (wilt) and leaf rot was prevalent only in the southern and central regions of Kerala. The diseases commonly occurred in all places were bud rot and stem bleeding. Of late, the outbreak of eriophyid mite had been reported in and around Ernakulam. Improved methods of pest and disease suppression were not known to the farmers. Shortage of labour for crown cleaning and application of insecticides and fungicides was stated as the major constraint to adoption of plant protection.

Based on the results of the PTCDF survey, he concluded that not more than 30 per cent of the farmers undertake plant protection in their coconut gardens. Major reasons for the low adoption level are the difficulty in getting the services of traditional palm climbers in time, high cost of labour and the general reluctance of the farmers to use chemicals in their home gardens.

Prathap et al (2000) reported that the gross returns on IPM farms were 24 per cent higher, to which IPM contributed about 56 per cent. The unit cost of production was 19 per cent less on IPM farms.

2.5.12. Media Utility

Helen (1990) reported that majority of dry land farmers did not utilise mass media sources.

Sendilkutnar (1994) pointed out that majority of the farmers (78.33 per cent) were having medium degree of mass media exposure whereas 14.17 per cent of the farmers had low degree of exposure.
Theodore and Mansingh (1994) reported that more than 50 per cent of the farmers had a high level of mass media exposure in Thanjavur district while 43 per cent of the Pudukottai farmers had low level of mass media exposure.

Chandra Bindu (1995) observed medium level of mass media exposure among the respondent farmers of Kottayam district.

Venkattakumar (1997) found a low level of message exposure by the commercial coconut growers of Coimbatore district.

Venkatesan (1997) reported that majority (56.67 per cent) of the respondents had a medium level of exposure to mass media source, followed by 25 per cent with low level and 18.33 per cent with high level exposure.

Gogia (1999) observed that majority of the coconut growers from Andaman and Nicobar Islands had moderate level of media exposure. Medium level of mass media exposure was reported among more than half of the respondent coconut growers (60.00 per cent) of Vadipatti area of Tamil Nadu by Saravanan (2000).

Singh (2000a) stated that media played a significant role in modernization of coconut based farming systems.

2.5.13. Coconut Promotion Strategies of the Government

The Extension support to coconut farmers is provided by both state and central Government agencies. Extension Offices have been set up even up to village level for rendering extension education and services to farmers under state governments. They undertake programmes for distribution of quality planting materials, fertilizer promotion, improving irrigation facilities and promotion of intercropping/mixed cropping along with technological dissemination. Coconut Development Board, the national organizational set up for the integrated development of coconut industry in India implements a number of projects in close collaboration with the state level agencies. Distribution of quality
planting material including hybrids, financial support for new planting and underplanting, productivity enhancement programmes like fertilizer promotion, pest control, irrigation and mixed cropping, extension education in the form of publications, seminars, workshops, exhibition, etc., market promotion and technology development are some of the programmes of the Board. Apart from that, bodies like NAFED, ICERAFED, MARIVETFED, STC & HVOC support the farmers by providing better marketing facilities and fair price to the farmers.

Moni (1977) found that about 95 per cent of the non-beneficiaries were simply aware of the ARDC schemes on coconut. The rate of adoption of coconut technologies increased among the beneficiaries remarkably. The operation-wise analysis of technical assistance revealed that only 57.4 per cent of the beneficiaries were in receipt of the total technical assistance. For operations like making pits, planting seedlings, application of manures and plant protection measures, 50 to 93 per cent of beneficiaries obtained technical assistance.

Samad (1979) found that in areas, where pepper and coconut package of programmes were implemented, knowledge of farmers on improved scientific practices was more compared to other areas.

Muthiah (1981) reported that all the effective farm leaders and a majority of the less effective farm leaders had favourable attitude towards agricultural development programmes and possessed high knowledge about agricultural development programmes.

Jnanadevan (1993) reported that beneficiary farmers' awareness, knowledge and adoption of the recommended practices, though partial in some aspects, were significantly influenced by the coconut development programmes. It was seen that the above factors were higher in the case of beneficiary farmers compared to non-beneficiaries.
Me Guirk et al (1994) reported the importance of incentives, availability of quasi-fixed inputs such as irrigation, fertilizers, roads and transport in the adoption of modem production technology and subsequent rapid growth.

Roy (1994) stated that farmers’ participation, particularly in programme development and feedback, significantly improves the chances of success of an extension training programme.

Kerala State Planning Board (1997a) remarked that for the first time in the history of coconut development in Kerala a comprehensive development programme for coconut was launched integrating the state and centrally sponsored programmes, linking them with institutional finance. The total outlay of the programme was Rs.210 crores. Irrigation support and better management with focus on scientific manuring were the two activities, which received considerable attention during the Eighth Plan.

Markose (1998) stated that the productivity improvement programmes implemented by the Board could make favourable impact in stepping up the productivity at all India level, by reversing the negative trend in productivity. The major achievements made under the extension activities were the creation of awareness among the people on the nutritive value of coconut oil and tender coconut water.

Subramanian (1998) remarked that the implementation of the development programmes of Coconut Development Board has led to the crop improvement, production and productivity improvement and technology development for product diversification in the country.

Santhoshkumar (1999) reported that nearly 76 per cent of the farmers were aware of the Agricultural Development Programmes (ADPs) implemented through People’s Plan (PP) and 24 per cent were not aware. About 63 per cent of the farmers perceived the ADPs implemented through PP as useful to them and 37 per cent as less or not useful to
Them. Fifty seven per cent of the respondents perceived these programmes as relevant to their farming situations.

Awareness about the programmes implemented through People’s Plan was positively and significantly correlated to extension agency contact and extension participation. The most important constraint in the implementation of these programmes was the lack of proper financial assistance for the farmers.

Public intervention is particularly important when new technology requires higher investments for its adoption, which are beyond the capability of the vast majority of small and marginal farmers, and hence become socially desirable (Singh, 2000c).

2.5.14. Extension Orientation

Moni (1977) reported a very low extension agency contact among the beneficiaries and non-beneficiaries of ARDC’ schemes for the coconut growers.

Chandra Bindu (1995) reported a medium level of extension agency contact among most of the respondent farmers from Kottayam district.

Nirmaladevi (1997) reported that about half of the respondents (50.84 per cent.) were having moderate level of extension agency contact, followed by low level (30.83 per cent) contact.

Venkatasan (1997) observed that three-fourth (75.00 per cent) of the respondents had medium level of extension agency contact, followed by 15 per cent with low and 10 per cent with high level extension contact.

Murukanandam (1998) reported that majority (62.50 per cent) of the respondents have medium level of extension agency contact, followed by 20.00 per cent and 17.50 per cent with high and low levels of contact respectively.
extension agency contact has been round to be high among minority of the coconut growers from Andaman and Nicobar Islands (Gogia, 1999).

Seerna (1999) reported a low extension agency contact among majority of the coconut growers from Andaman and Nicobar Islands.

Saravanan (2000) reported that majority of the coconut growers from Vadipatti area of Tamil Nadu were found to have medium (50.00 per cent) to low (30.83 per cent) level of extension agency contact.

Most of the studies revealed a medium to low level of extension agency contact among majority of the coconut growers.

2.5.15. Dependence on Agriculture

Narayana et al (1971) remarked that households with small holdings are for the most part dependent on income from coconut, then their resource position would be weak and their ability to increase production through intensive use of inputs would be limited.

Muthudas (1982) found that nearly 70 per cent of the coconut growers of Tenkasi allotted more than 21 per cent of their total land to coconut, which contributed to more than 49 per cent of their total income.

Thampan (1996) while evaluating the potential of small farms in achieving sustainable productivity, observed that the population pressure on land was causing subdivision of already uneconomic coconut holdings with the result that the traditional farmers were forced to neglect coconut cultivation and seek alternative sources of income and employment. Socio-economic studies conducted in Kerala revealed that in general, coconut has qualified only as a supplementary source of income to the families. As such, there is neither time nor incentive for family members to attend the agronomic requirements of coconut palm.
Remani (1999) emphasised coconut as a life supporter of more than 10 million people in the country by employment and income generation.

Thampan (1999a) observed inadequate attention devoted to farming by those whose major source of income is not coconut.

2.5.16. Personal Supervision of Crop

Sagar and Ray (1984) reported that supervision of crop production contributed significantly and positively to the prediction of productivity of crops of the marginal, small and pooled sample of farmers. Personal supervision by the farmers of important farm operations and surveillance against possible damage to crops was found to be an essential component in influencing the productivity of crops.

2.5.17. Economic Motivation

Economic motivation of the farmers was found to be an influential factor in the acquisition of knowledge and adoption of technologies, based on several studies. According to Moni (1977) economic motivation was found to be associated with becoming a beneficiary and also in adopting technologies.

Swamidasan (1994), Ninnaladevi (1997) and Gogia (1999) reported a low level of economic motivation by most of the farmers, while Swathilekshmi (1995), Venkattakumar (1997) and Sunitha (1998) observed a high level of economic motivation among most of the respondents. Most of the marginal farmers (67.50 per cent) were found to have low economic motivation, while majority of the small farmers had high economic motivation, as reported by Nirmala Devi (1997). Medium to high level of economic motivation was observed among majority of the coconut growers from Vadipatti area of Tamil Nadu by Saravanan (2000).
2.5.18. Labour Utility

Non-availability and high cost of labour have been identified as major constraints in adoption and coconut production by Prasannan (1987), Prakash (1089) and Gogia (1999)*.

Sakeer Husain (1994) reported that 52 per cent of the coconut farmers of Thiruvananthapuram district perceived the availability of coconut climbers as more than sufficient and 48 per cent perceived it as not sufficient to meet their requirements.

Commission for Agricultural Costs and Prices (1997) observed that in most of the states, except Kerala where wage increases are larger, actual wages have been increasing at roughly the same rate as the cost of living index for agricultural labourers. The labour cost alone was found accounting to about 42 per cent of the total cost of cultivation of coconut.

John and Nair (1999) while studying the constraints faced by the homestead farmers of Southern Kerala identified labour scarcity as the major issue despite the increased family labour utilization. They felt that higher labour cost resulted in increased cultivation cost.

Thampan (1999b) remarked that with the scarcity of farm labour for doing timely cultural operation and high wage rates, the cost of production of coconut had gone up over the years.

Renaud and Latham (2000) reported that direct or opportunity labour costs often play an important role in farmers' decision making when it comes to the adoption of new agricultural practices.

2.5.19. Investment in Coconut

Higher investment made in coconut plantations, by way of using more inputs has been pointed out as the major reason for the higher productivity in Tamil Nadu, when
compared to Kerala. Hence few studies revealing the investment pattern in different coconut growing areas and aspects related to this have been collected.

Geeethakutty et al (1996) worked out the average cost of cultivation at the cost Al level which is inclusive of items like hired labour, material cost, depreciation on farm implements and machineries, interest on working capital and land revenues for one hectare of irrigated garden as Rs.42,294 and Rs. 18,000 for the unirrigated garden.

Commission for Agricultural Costs and Prices (1997) quoted the cost of cultivation of coconut as worked out by Coconut Development Board, Kerala Government and Karnataka Government as Rs.3.95, Rs.5.53 and Rs.3.52 per nut respectively.

Kerala State Agricultural Prices Board (1997) estimated the cost of cultivation per nut as lying between Rs.3.76 to Rs.6.61 on a regional basis with an average of Rs.5.19. The average cost of cultivation for the state as a whole was Rs.34,207 per ha. per year, of which the fixed investment was Rs. 18,543 and the average annual maintenance accounted to Rs.15,664. It was also inferred that when the market price of coconut was Rs.2.84 per unit, the cultivator’s return covered only his fixed investment, but would not get any interest for his investment. In order to get a 10 per cent interest, they have suggested a price of Rs. 4.73 and for 20 per cent return, Rs.7.05.

Remold (1999) reported the annual expenditure incurred per hectare of irrigated coconut in Central State Farm, Aralam, Kerala as Rs.52, 573 and the annual income derived as Rs.78, 750.

Thampan (1999a) observed the average cost of production as Rs.2.69 per nut in holdings of size below 0.5 ha. in Kerala. The present cost of cultivation in holdings of size below one hectare had been found to vary from Rs.25, 473 to Rs.27, 455 per ha. per
year. Out of the total cost of cultivation, 35 - 40 per cent is on manures or fertilizers and their application. 18 per cent on plant protection, 14-16 per cent on cultural practices, 7-11 per cent on irrigation and 11-17 per cent on harvesting. The farmer participatory survey conducted by him revealed a maintenance cost of Rs. 150 to 180 per palm per year excluding labour charges. The average cost of cultivation based on this survey was found to be around Rs.33, 000 per ha.

2.5.20. Market Infrastructure

The farmers’ incentive to innovate, adopt technologies, improve existing practices and increase production depends on the prospects for farm profits. Farm profits depend on the cost of inputs and the farm gate prices received by the farmers for their produce. Although public policies relating to agriculture and industry, trade, and exchange rate exercise considerable influence on those costs and prices, adequate marketing facilities also play a very important role (Roy, 1994)*. A marketing system brings the sellers with their produce in contact with those who buy with their money. The information that a marketing system provides in respect of demand from inside and outside the country, as also about the competing products and their prices, enable the producers to make decisions regarding production. The level of prices acts as an incentive to producers to use improved technology and maximize production (Agrawal and Kundan Lai, 1996)*.

A cursory look into the price structures of coconut, copra and coconut oil reveal that the price fluctuations are not only infrequent, but also most violent. The seasonal indices show different patterns for different products. The compound growth rates of wholesale prices for coconut products are found to be around 10 per cent per annum between 1970 and 1989. The indices however suggest that the relative prices in coconut sector are declining even though the absolute prices show significant growths (Das, 1991b).
Santha et al (1994) reported that wide fluctuations in price discouraged the farmers to undertake the improved cultivation practices. Further, Kerala State Planning Board (1995) stated that the tendency for coconut price falling below remunerative levels and persisting for considerably long periods particularly when the prices of other commodities were showing upward trends would put the rural economy of Kerala in dire straights.

Sathees and Mathew (1996) reported that most of the farmers dispose nuts in the raw form with husks immediately after harvest. They concluded that the seasonal peak in coconut production was coupled with a seasonal trough in coconut prices and vice versa, thereby indicating the prevalence of a distorted market in Kerala to the disadvantage of coconut growers.

Haridoss and Chandran (1996) reported that the marketing channels linking producers and consumers consist of intermediaries namely commission agents/wholesale dealers and retailers within Tamil Nadu. In case of inter-state trade, it passes from wholesale dealers/commission agents of the state to the wholesale dealers/commission agents in other states. Both commission agents and wholesalers have facilities for storing nuts till they are despatched to distant markets. It was observed that most villages where coconut cultivation is carried on are not well connected by pucca roads. Therefore, the harvested nuts are to be carried as small head loads from homestead garden to the nearby road points. Lorry transportation is the main mode of transportation for coconut within the state and other states. The share of producer in the net retailers price was found to be 80.93 per cent.

Kerala State Planning Board (1997a) has pointed out the severe competition faced by coconut in the global markets. As the production is spread over millions of tiny holdings mobilising marketable surpluses, primary processing, transport etc. are all
becoming difficult as well as costly. Even though co-operatives are operating fairly active they are yet to gain any effective control on the market forces,

John and Nair (1999) reported that the sale of produce from the home gardens took place mostly through middlemen (42.25 per cent), thus making the marketing system defective. The farmers experienced problems relating to absence or lack of grading, lack of storage and transport facilities. Marketing facilities were found to be poor to fair.

Thampan (1988) pointed out that there should be adequate institutional support to the growers’ organizations both for the creation of basic, infrastructure facilities and for the regular marketing of copra at remunerative support prices.

Seema (1999) reported that almost all the coconut growers from Andaman and Nicobar Islands sold their produce in the farm itself to private traders due to erratic and costly transport facilities. Some of the constraints related to marketing were lack of exclusive market for coconut, lack of government procurement system, lack of cooperation from the traders, lack of export facilities, low price for produce, high commission demanded by commission agents, high cost of transport, lack of facilities in the market, lack of village level co-ordination and lack of storage facilities in the farm.

Singh and Markose (1999) stated that for a perennial crop like coconut, stable price and adequate marketing facilities are essential for the development of coconut industry. Because of the predominance of small holdings and highly decentralized nature of production, the product has very little control over the marketing of coconut. Under marketing, the infrastructures available are the bodies like NAFED, MARKETFED, KERAFED, STC, HVOC and a number of private agencies.

According to them, violent price fluctuation prevalent in price behaviour of coconut and coconut products is a serious problem confronting coconut industry. The
market economy of coconut and its products is controlled by coconut oil industry, which consumes 40 per cent of the production of coconut in India. The fall in price of coconut affects the small and marginal farmers adversely. This situation necessitates the functioning of a well-defined system to arrest such frequent fluctuations in prices of coconut and its products.

Thampan (1999a) documented the farmers' suggestion that regulatory measures are to be introduced to minimise fluctuations in the prices of coconut products. To provide basic support for achieving the desired objective, farmers' co-operatives are to be strengthened through the creation of adequate infrastructure facilities for procuring coconut directly from the farmers by weight of dehusked and dewatered nuts and their processing and marketing at different levels. Along with this, processing of coconut in the non-traditional sector has to be developed in order to delink the prices of coconut from that of the fluctuating coconut oil prices.

Thampan (1999b) stated that processing of coconut products and by-products other than coconut oil and coir has not developed, and as a consequence, the coconut-based economy of the farmers is inextricably linked with the price behaviour of coconut oil, which exhibits unpredictable and violent fluctuations.

George (2001), while analysing the prospects of farming in India, revealed the reducing returns from coconut during recent years. The prices of 100 nuts were found to be Rs.510, Rs.417, Rs.555 and Rs.250 during 1997, 1998, 1999 and 2000 respectively. He concluded that all plantation crops were facing a steep fall in prices, galloping costs, loss of export markets and influx of imports.

Report of the Scientific Workers’ Conference (2001), in their econometric analysis of coconut industry conducted in the North Eastern Zone, Western Zone, Cauvery Zone, South Central Zone and Southern Zone of Tamil Nadu revealed that the
price of coconut, expenditure on fertilizers and human labour had a significant positive influence on the supply of coconut to the market.

2.5.21. Product Diversification

Product diversification is an important area that needs attention in India in view of the fierce competition in international market for coconut oil (Navnpoothiri et al. 1998)*. Further, Singh and Markose (1999)* emphasized value addition of various coconut products and product diversification as the key pillars to sustain the coconut economy in the country.

Balasudhahari and Mukundan (1993) reported the major problems faced by the oil millers of Kozhikode as the shortage of raw materials, power shortage, market fluctuation, unhealthy competition among units and shortage of finance and lack of credit facilities.

Commission for Agricultural Costs and Prices (1997) remarked that though the technologies for several new coconut based products like coconut cream, coconut milk, aseptically packed coconut water, coconut vinegar, nata-de-coco, coconut spread, spray dried coconut milk powder, coconut liquor etc. were available with the Coconut Development Board, their commercialisation had only begun recently. The domestic market potential of these products were reported to be promising also. Hence the commission recommended hastening the process of dissemination and commercialisation of available technologies for product diversification and to commission studies for development of technology for fruitful utilisation of wastes from green coconuts.

Kerala State Planning Board (1997b) identified technology development, product diversification and by-product utilization through integrated processing units as the major areas holding promise for coconut trade in future.
Nandanasabapathy et al (1999) reported that though India produced 13 million nuts per annum, the growth of product development and by-product utilisation was considerably lower in comparison with other countries like Philippines, Indonesia and Thailand.

Since the price of coconut is fixed based on the ruling price of coconut oil in the wholesale market as highlighted, the farmer has only limited control over the produce. Moreover, the price of coconut oil fluctuates according to its demand and supply and very often is influenced by the price and availability of substitute oils especially the imported palm oil. As long as the dependence on a single commodity like the coconut oil continues, the coconut farmers have a little say in controlling the prices of coconut. An analysis of the available data on price trend indicates that the coconut price is liable to violent fluctuation and unpredictable variation. One of the possible steps to ensure better price to farmers will be farm level processing enabling value addition at farm gate level (Singh et al, 1999).

Thampan (1999a) remarked that the coconut based economy can be stabilised only when the dependence on coconut oil as a single product is minimised through the promotion of farm-household and community level processing of the multiple products and by products obtained from the palm. He also reported that at farm household level not more than 5 per cent of the farmers were engaged in copra making for sale. However, in most of the houses, copra is made occasionally for edible and toiletry purposes. Harvesting of tender coconut for sale was not being reported from any of the study areas. Shortage of palm climbers for regular harvest and marketing problems had been stated as the major constraints.
Saran (2001) pointed out that experts advocated improvement in crop productivity to bring down cultivation costs. But according to the author, what was needed was to invest in post harvest infrastructure so that it could use what has grown.

Anithakumari and Kalavathi (2001) indicated cent percent non-adoption and a meager one per cent knowledge among small and marginal coconut farmers about post harvest technologies. The need for developing small-scale household oil extracting units along with other simplified mechanization aids for coconut cultivators had been emphasized.

2.5.22. Appropriateness of Technology

Rogers (1983) remarked that 49 to 87 per cent of the variance in rate of adoption is explained by the five attributes namely relative advantage, compatibility, complexity, trialability and observability. In addition to these perceived attributes of an innovation, such other variables as (1) type of innovation-decision, (2) the nature of communication channels diffusing the innovation at various stages in the innovation-decision process, (3) the nature of the social system and (4) the extent of change agents promotion efforts in diffusing the innovation, affect an innovation's rate of adoption.

It was also reported that most of the change agencies usually promote the adoption of innovations, rather than seeking to teach clients the basic skill of how to evaluate innovations themselves. He also generalised that change agent success is positively, related to increasing clients' ability to evaluate innovations.

Thamilmani (1985) reported that farmers had high perception towards profitability, low initial cost, availability, complexity, efficiency, feasibility, observability and lower perceived risk of blue green algae. The attributes trialability' and immediacy of returns were not favourably perceived by BGA adopters.
Sulaiman (1989) found that the perception about the attribute of an innovation and their appropriateness as judged by the farmers was crucial in deciding their adoption behaviour.

Sundaramari (1989) reported complexity of recommended practices and lack of conviction about the recommended practices due to improper teaching by VEW as some of the problems in performing the expected roles by effective and less effective farm leaders.

Adhiguru and Perumal (1994) concluded that technologies that have relatively intangible impact even with low cost would not motivate the farmers to go for adoption.

According to Roy (1994), an important issue in technological change is the devising of an appropriate technology that includes measures to ensure sustainable agriculture.

Babu (1995) reported that majority of the homestead farmers had medium level of perception about the appropriateness of farming systems and cropping patterns adopted in the homesteads of Kerala. Evaluative perception of homestead farmers was positively and significantly correlated with level of knowledge and extent of adoption. The results of step-up regression analysis revealed that 69.55 per cent of variation in evaluative perception about the appropriateness of farming systems and cropping patterns adopted in the homesteads could be explained by four variables namely information sources used, extension participation, economic motivation and scientific orientation.

Chandra Bindu (1995) reported that technology adoption was found to be fifty per cent or less for the homestead crops since the available package of technologies were found to be inappropriate or not practical.

Singh et al (1998) reported that North Eastern Region was far behind in the adoption of new technologies, as most of the technologies related to coconut production
were suitable for the agro-climatic condition of southern states specially the Kerala condition.

Floyd et al (1999) revealed that except where the availability of inputs is critical for adoption, the suitability of a technology to an area was a more important determinant of adoption.

Nimal (1999) reported that the generation of wide range of technologies is based on certain laboratory and field experiments and the experience gained from very limited field applications. Social as well as economic impact of most technologies has not been fully assessed under a variety of soils and climatic conditions existing in the coconut growing areas of Srilanka.

According to Muthiah and Krishnaveni (2001), a technology will be deemed appropriate only when it is properly set in a particular social milieu with a positive viable and sustaining effect to the user.

2.6. Relationship of Characteristics to Knowledge, Adoption and Productivity

2.6.1. Characteristics Related to Knowledge

A number of variables are found to influence the level of knowledge of the farmers and the researchers have established several such relationships.

Mathaian and Manoharan (1993) established a significant association between knowledge gain and characteristics like farming experience, farm size, socio-economic status, social participation, extension agency contact, mass media exposure, economic motivation, scientific orientation and cosmopolite-localite value orientation.

Sekar and Alagesan (1994) reported that variables such as educational status, farming experience, annual income, farm size, mass media exposure, scientific orientation and economic motivation were found to be positively and significantly associated with their level of awareness.
Yogananda et al. (1994) revealed that the socio-economic characteristics like education, extension participation and information sources of all coconut growers and education, extension participation, information source consultancy pattern and mass media participation of big coconut growers were positively and significantly related with their knowledge level.

Babu (1995) reported that only four variables namely education, extension participation, information sources used and value orientation were positively and significantly correlated with the level of knowledge. Multiple regression analysis revealed that out of 15 variables, only value orientation was found to be positively and significantly associated with level of knowledge of homestead farmers.

Jeyaraj (1997) reported that educational status, farming experience, farm size, social participation, socio-economic status, economic motivation, scientific orientation, information seeking behaviour and innovativeness had positive and significant association with knowledge.

Nirmaladevi (1997) reported that educational status, extension agency contact, mass media exposure, information source utilisation, scientific orientation, economic motivation, risk orientation, innovativeness, annual income and attitude towards guava cultivation had a positive and significant association with knowledge level.

Veeraiah et al. (1997) found that socioeconomic status, cosmopolitaness, scientific orientation and level of aspiration were found to be positively significant in contributing to knowledge, whereas age was found negatively significant.

Murukanandam (1998) revealed that educational status, farm size, social participation, extension agency contact, mass media exposure, economic motivation, socio-economic status, information seeking behaviour and attitude towards rainfed technologies had a positive and significant association with knowledge.
Satyanarayana and Punna Rao (2000) reported that education, land holding, farming experience, annual income, information source consultancy, training received, economic orientation, scientific orientation, management orientation and risk orientation were positively significant to knowledge. It could be seen that unit increase in education, farming experience, annual income, information source consultancy and economic orientation would result in increase by 1.86, 1.61, 0.14, 0.45 and 0.95 units of knowledge respectively keeping all other variables constant.

Ashalatha (2000) concluded that education, economic motivation, innovation-proneness, risk orientation, attitude towards scientific agriculture and information source utilization were positively and significantly related with knowledge level of the farmers.

2.6.2. Characteristics related to Adoption

Many barriers impede technology adoption, in terms of resource constraints, social attitudes, personal traits, infrastructure requirements and an unfavourable legal and institutional environment (Harrison, 1994)*. Research studies have been conducted all over the world to identify such factors limiting the adoption of various technologies. Few studies relevant to the present study are quoted.

Thamilmani (1985) found that the attributes of BGA and intensity of cropping were the two factors that significantly influenced the BGA adoption. Among ten attributes, profitability, low initial cost, feasibility and observability significantly influenced the BGA adoption.

Narayana et al (1991) stated that the poor diffusion could be attributed to lack of a clear direction in research efforts on the one hand and the poor extension work earned out by the department concerned on the other; but the major problem seemed to be constraints faced by the coconut cultivators.
Snehalatha (1991) reported that education and information seeking behaviour were positively and significantly associated with the extent of adoption of TNAU technologies under irrigated system whereas education and annual income were found positively significant for dry land farmers.

Sophia (1991) reported that social participation, mass media exposure, economic motivation, urban contact, awareness- knowledge and how-to do knowledge were significantly related with adoption level of dry land farmers.

Parshad (1993) identified knowledge, educational level and degree of extension contacts as the predictors of adoption level of alkali reclamation technology and crop production.

Nagabhushanam and Guruprasad (1994) reported that characteristics like social participation, land holding, irrigation facilities and knowledge level played a significant role in adopting the recommended practices of coconut.

Sekar and Alagesan (1994) observed that variables like educational status, farming experience, annual income, farm size, mass media exposure, scientific orientation and economic motivation were found to have positive and significant relationship with their extent of adoption of cane technologies whereas age was found to have a negative and significant relationship.

Sundarambal and Annamalai (1994) reported that characteristics namely contact with extension agency, risk preference and credit orientation were found to be positively associated with adoption behaviour of farmers.

Theodore and Mansingh (1994) found that extent of adoption of Pudukkottai farmers was the function of their age, farm experience, income, mass media exposure, risk orientation and knowledge on black gram cultivation practices. In the case of
Thanjavur fanners it was the function of age, education, farm experience, income, risk orientation and scientific orientation.

Babu (1995) reported that education, farm size, annual income, extension participation and economic motivation were positively and significantly correlated with the extent of adoption of scientific practices. Step-wise regression analysis revealed that 58.12 per cent of the variation in adoption was explained by economic motivation, annual income, irrigation index, farm size and personal guidance for better farming.

Chandra Bindu (1995) observed a positive and significant relationship of adoption with education, contact with extension agencies, mass media exposure, cosmopolitan ness, credit behaviour and size of land holding. Regression analysis revealed that education and nature of family had positive and significant influence on adoption.

Singha (1996) reported that variables like education, extension contact and risk preference were positively and significantly related to adoption, while a negative relationship was established between age of the farmers and extent of adoption.

Moni (1977) found that extent of adoption mainly depended on farm size, economic motivation and credit availability to coconut growers.

Sriram (1997) observed that educational status, extension agency contact, message exposure, economic motivation, innovativeness, risk orientation, awareness and attitude had a positive and significant relationship with the adoption of eco-friendly agricultural practices. Age, occupational status and fanning experience were negatively and significantly related to adoption.

Venkattakumar (1997) found that out of the fifteen variables selected, education, annual income, farm size, area under coconut, information seeking behaviour, farm power, social participation, message exposure, economic motivation, risk preference and material possession had shown positive correlation with extent of adoption. But in the.
multiple regression analysis, information seeking behaviour, social participation, risk preference and message exposure had shown positive and significant relationship, whereas scientific orientation was negatively and significantly related to extent of adoption.

Murukanandam (1998) reported that educational status, social participation, extension agency contact, mass media exposure, economic motivation, socio-economic status, information seeking behaviour and attitude towards rainfed technologies had positive and significant association with adoption.

Padmaiah *et al* (1998) concluded that the attributes namely education, farm size, development opportunity, employment generation, credit orientation, perception of usefulness of watershed development programme and risk orientation played a decisive role in the adoption of recommended practices. Out of sixteen variables studied only one variable namely economic motivation was significant in explaining the variation in the adoption levels both in the watershed as well as non-watershed areas.

Venugopalan and Thamban (1998) reported that socio-economic characteristics such as educational status, occupation, size of holding, annual income, social participation and extension orientation were positively and significantly correlated with the level of adoption of recommended technologies by the coconut growers.

Floyd *et al* (1999) established that the level of adoption of the technologies was consistently and significantly affected by the level of extension input. Increased levels of extension input were associated with increased levels of technology awareness, with increased rates of trying once aware and with a lower frequency of information/input related constraints.
Veeraiah et al (1999) reported that variables like socio-economic status, scientific orientation and level of aspiration contributed positively to adoption of recommended critical skills in rainfed groundnut cultivation.

Ashalatha (2000) found that innovation proneness, level of aspiration, information source utilization and knowledge about the improved practices were observed to be positively and significantly influencing the adoption behaviour of the farmers.

Saravanan (2000) found educational status, mass media exposure, information seeking behaviour and scientific orientation as the significantly contributing and crucial variables for deciding the acceptance level of coconut growers.

2.6.3. Characteristics Related to Productivity

Productivity of a crop is decided by umpteen number of factors other than adoption of recommended technologies. Review of the related literature would give an insight for the present study on the factors related to productivity of coconut.

Sagar and Ray (1984) conducted a research study on factors associated with productivity of crops in Nadia district of West Bengal. The findings revealed that eight variables namely supervision of crop production, irrigation index, innovation proneness, knowledge about plant protection, status of land ownership, level of fertilizer use, level of aspiration and farm mechanisation had contributed significantly to the productivity of major field crops.

Few constraints related to coconut production were also reviewed, considering them as the negative determinants of productivity.

The Kerala Agricultural University (1984) in its status report of the NARP identified the following constraints related to coconut production.

In the Central Region (NARP), unscientific crop combinations and mixed cropping systems, planting of poor genetic material, non-manuring, under manuring and
imbalanced manuring and absence of regular economic replanting programmes were the reported constraints.

In the Northern Region (NARP), lack of scientific crop combinations, lack of fertilizer recommendation for cropping systems, lack of irrigation schedules based on climatological parameters, severe button shedding and insect pests like leaf eating caterpillar, rhinoceros beetle and diseases like stem bleeding and bud rot were the major constraints.

In the Problem Region, the major constraints reported were the problem of incidence and spread of coconut root (will) disease and lack of proper manual schedule for the coconut based cropping systems.

Thampan (1988) reported lack of irrigation facilities, inadequate attention and the prevalence of the devastating disease root (wilt) as the major limiting factors responsible for the poor performance of coconut crop in Kerala.

Muliar (1989) attributed the following reasons for the low productivity of coconut in Kerala-traditional methods of cultivation, lack of manuring practices, moisture stress and lack of irrigation facilities, poor water management and soil health problems, senility of the palms, absence of systematic replanting programmes, non-availability of quality planting materials, non-availability of high yielding hybrids and varieties, prevalence of serious disease problems such as root (wilt), problems of certain pests, socio-economic constraints such as poor economic status of the growers, lack of credit and inputs in time, fluctuating markets and infrastructure facilities.

Prakash (1989) analysed the production constraints of coconut, individually significant in predicting the yield. They were low adoption of chemical fertilizers, drought and lack of irrigation in the Southern Region. In the Central Region, lack of irrigation, lack of knowledge about plant protection chemicals, low adoption of chemical
fertilizer and incidence of pests and diseases were found to be individually significant in predicting the yield of coconut. In the High Range Region the constraints namely non-availability of quality seedlings, small form size, incidence of pests and diseases were individually significant in predicting the yield while low adoption of chemical fertilizers, incidence of pests and disease and incidence of root (wilt) disease were the significant production constraints in the Problem Region for predicting the yield.

He also reported the major production constraints of coconut on a regional basis. Lack of irrigation, drought and high wage rate of agricultural labour were the high-ranking production constraints in the Southern Region while low adoption of chemical fertilizers, high cost of fertilizers and lack of irrigation ranked high in the Central Region. In the Northern Region, the high ranking constraints were low adoption of plant protection chemicals, high cost of fertilizers and low labour productivity, whereas high cost of seedlings, high cost of fertilizers and pests and disease incidence ranked high in the High Range Region. Root (wilt) disease, high wage rate of agricultural labour and high cost of plant protection chemicals were the high-ranking production constraints of coconut in the Problem Region.

Aravindakshan (1991) reported lack of irrigation facilities, severe incidence of diseases like root (wilt), high plant density, senility of existing palms and sub optimal management levels as the factors responsible for the poor performance of crop in Kerala.

According to Thampan (1993), lack of irrigation facilities and the low input use, particularly organic inputs, are undoubtedly the limiting factors responsible for the poor performance of coconut crop in Kerala.

Santha et al (1993) suggested that by way of intensifying extension activities the production could be enhanced by effective transfer of technology.
Adhiguru and Perumal (1994) concluded that subsidy coupled with effective supply of inputs had got its own impact in the immediate adoption of technology which would go a long way to narrow down the yield gap between the demonstration farm and farmers holdings resulting in high productivity and production.

Venkattakumar (1997) reported non-availability of good quality seed nuts, lack of knowledge on soil moisture conservation practices, non-availability of low cost inputs, problem soils, unavailability and high cost of labour, lack of research on coconut based intercropping systems, lack of adequate storage and processing facilities and lack of proper marketing channels as the major constraints felt by commercial coconut growers.

Hippargi et al (1997) identified the important production constraints of coconut in Karnataka as imbalanced use of fertilizers and poor pest management,

Nimal (1999) found that the lack of knowledge to identify the potential and needs of the plantations on the basis of soil, climatic and locational conditions appeared to be one of the main constraints to coconut production in Srilanka. The knowledge required to identify the potential of a coconut land is not only confined to new cultivation technologies, but also farming experiences and marketing strategies.

Thampan (1999a) attributed reasons for the low productivity of coconut as shortage of farm labour for attending to timely cultural operations, prevalence of debilitating diseases such as root (wilt) and leaf rot, inadequate attention devoted to farming by those whose major sources of income is not coconut, unattractive price for the produce and fascination of younger generation for off-farm employment.

Saravanan (2000) reported the poor quality of inputs, non-availability of inputs in time, lack of consultancy services, lack of plant protection equipments, lack of skilled labour, inability to identify pests and diseases, lack of knowledge about crop insurance scheme and lack of transport as the major constraints in cultivation of coconut.
Nair and Rajesh (2001) slated that neglect of coconut in the homestead garden lead to low productivity and high cost of production. They also found that the crowded small holdings with poor management resulted in low productivity.

Rajagopal and Kasturi Bai (2001) stated that the growth, development and productivity of any crop depend on various environmental factors viz., soil factors (soil type, soil characteristics and water holding capacity) and atmospheric factors which include humidity, temperature, precipitation and evaporation.