



Promoting bio-diversity and byproduct utilization in coconut for inclusive and sustainable growth

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PART -II

Coconut based Farming System with biodiversity for inclusive growth:

Introduction

The coconut palm is a perennial horticulture crop, the economic life span of which lasts more than 50-60 years after planting. The capital investment for the commercial cultivation of coconut palm involves heavy pre-bearing investments in the form of non recurring and recurring expenditure during the gestation period and recurring maintenance expenditure till the economic life span of the tree.

The critical issues of many of the coconut producing states are; the scarcity of land, crop productivity and rate of returns per unit area at a reasonable marginal cost. The increasing cost of production and adverse climatic conditions, both having implication for productivity and competitiveness are the other limiting factors. The productivity of a coconut farm is the function of cost, quantity and quality of inputs utilized which in turn is the function of resources available to the farmer. The viability of coconut cultivation in the country can be enhanced by diversification of cropping system, promoting secondary agriculture and full utilization of by-products of coconut. The coconut wood and fronds offer immense scope for commercial exploitation particularly for the manufacture of particle board as an alternative for wood in the emerging depletion of global forest cover. Similarly the coconut shell is the renewable by-product for the commercial manufacture of charcoal

and activated carbon, the full utilization of which can improve the scale return of the individual holdings as well as meet the country's export demand. The economic efficiency of coconut cultivation and industry can be further enhanced by strengthening linkages between on-farm training and extension, balanced soil and plant nutrition, pest management techniques and increasing small farmers' access to advanced technology, quality inputs, harvesting and post-harvest handling, bank credit, marketing and crop insurance. Clustering coconut farmers who are resource scarce, scattered and having fragmented holdings for promoting coconut based farming system with more bio-diversity is the new and unique initiative taken by the Coconut Development Board to induce competition in cultivation and primary processing. The new initiatives introduced by the Board have reinforced the confidence and conviction of farmers for more investment in coconut based cultivation and to go in for group actions particularly on the procurement of inputs, synchronizing harvesting activities and adopting farm level processing.

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Banana, a profitable intercropping under coconut based farming system, a garden in Alleppy, Kerala

The dynamics of coconut cultivation

The coconut palm is a perennial horticulture crop, the economic life span of which lasts more than 50-60 years after planting. The capital investment for the commercial cultivation of coconut palm involves heavy pre-bearing investments in the form of non recurring and recurring expenditure during the gestation period and recurring maintenance expenditure till the economic life span of the tree. The coconut palm is therefore characterized by having high rate of investment during the gestation period and the realization of out put or the pay off in subsequent years. Because of its unique nature of continuing growth and yielding phases, any adversities at any stages of growth of the palm may affect the yield. Generally, in an yielding coconut palm, the primordial formations of inflorescence, spike lets and buttons take place 12-33 months before the appearance of the inflorescence. Any hindrance to the growth of trees at any stage of productive phases

adversely affect the emerging inflorescences which may result into considerable reduction in the output. For example, a drought in an yielding coconut garden marginally reduces the yield in the first year due to buckling and immature nut falls. However, the cumulative effect of such shock in the growth of the tree will be manifested only after 2-3 years⁽ⁱ⁾. Therefore the crop production practices warrant the

need for uninterrupted input application at recommended dose to ensure continuous flow of returns. While the integrated adoption of nutrition management, pest & disease management and water management improves the health of the palm and thereby improve the productivity of coconut substantially, proper and rational utilization of interspaces available in the coconut holdings with other high value horticulture crops can enhance the rate of return per unit area at a reasonably low marginal cost. This in turn will ensure inclusive growth and sustainable development in cultivation.

Being a monocotyledonous plant having adventitious root system, the studies conducted at CPCRI (ICAR) Kasargod, Kerala indicates that only 25 % of the land area is utilized by the palm in the recommended spacing of 7.5 x 7.5m, the remaining 75% space could effectively be tapped for raising remunerative inter crops. The Venetian structure of the coconut crown and orientation of the



Integrated nutrition management improves the quality of nut and copra output - increase of weight from 120gm to 150gm per nut: an immediate impact of cluster programme



leaves facilitate the successful growing of intercrops. As much as 56% of the sunlight is transmitted through the canopy during peak hours, the diffused sunlight facilitates the growth of a number of species crops in the interspaces⁽ⁱⁱ⁾. Coconut based cropping system is therefore important and most suitable for sustaining higher level of investment and income generation with reduced level of marginal cost. The cultural requirement of these crops under mixed cropping system with coconut warrant regular and balanced application of both organic and inorganic fertilizers to the requirement of the crop mix and the proper adoption of plant protection measures apart from keeping the moisture level in the plantation at field capacity. Excess or deficits of any of these critical inputs will affect the health of the plants in the crop complex which ultimately results in the yield reductions among the main and complementary crops in the coconut based agro-eco system. Therefore, the greatest challenge in the adoption of a viable coconut based farming system is the selection of crop mix and the available water resources for which a pre-evaluation of existing cropping system, local demand for the commodities and the prevailing soil and agro-climatic situation play a pivotal role.

The biggest obstacle to the competitiveness of India's coconut sector is the low rate of returns from the holdings and the reduced input-output realization especially in the traditional coconut growing states due to the depletion of soil nutrients on account of continuous growing of coconut and other factor-factor product relationships⁽ⁱⁱⁱ⁾. The continuous growing of a single crop

without adopting crop production and protection tools and enrichment of the soil through organic recycling and crop rotation is considered the root cause for the poor performance of most of the coconut gardens in the country. Hence advocating coconut based farming practices through balanced application of organic and inorganic fertilizers along with the recycling of biomass for improving the soil physical properties can ensure sustainable development and growth of the industry. Even though coconut based farming systems are not being adopted on a scientific manner, many homestead gardens in traditional coconut growing states practice intercropping and mixed cropping in the available land area and family labour. In Tamil Nadu, Karnataka and Andhra Pradesh, coconut is cultivated on a plantation scale with assured irrigation where other commercial crops; like banana, maize, ginger, turmeric etc and perennials like; guava, sapota, cocoa etc are raised as intercrops and earns substantial income. The progressive coconut growers in these states practice growing of betel vine, pepper and other creepers by using coconut as the standard. The success of the cultivation of these crops depend on the timely application of inputs including irrigation. Planting of high value perennial horticulture crops like cocoa, black pepper, nutmeg (*Myristica fragrans*), clove (*Eugenia caryophyllus*), cardamom (*Elettaria cardamomum*), cinnamon (*Cinnamomum zeylanicum*), vanilla (*Vanilla fragrans*) etc are the best crop combinations which can become lucrative enterprises. The coconut based cropping system involving such crops can enhance the level of gross income considerably

besides generating employment opportunities which can sustain the local requirements. The studies conducted at CPCRI Kasaragodu revealed that while the coconut under mono-cropping provide employment opportunities of only 150 man days per ha per year, the coconut based cropping system generate additional employment between 130-606 man days/ha/year^(iv).

Exogenous and Endogenous Variables affecting the farm out-put

The fragmented and scattered nature of coconut cultivation is a major constraint for the successful growing of coconut. Most of the coconut holdings in the country are piled up with a combination of juvenile, old and unproductive and yielding palms. Kerala, the premier state in area under and production of coconut in the country, accounts for 70 per cent of coconut holdings in the country. The holding size of 5 ha and above comprises only 0.23 per cent and hence the scale of economy in operation and the scale return are the limiting factors of production. A field survey conducted by the Board in connection with the implementation of "Laying out of demonstration plots on cluster basis" in 2007-08 in the districts of Kasaragodu, Kannur, Malapuram, Kozhikodu, Palakkad, Thrissur and Trivandrum in Kerala revealed that the average size of coconut holding in Kerala is 0.4 ha and only 78 per cent of the plant population is yielding and the balance being juvenile, old and unproductive palms. The survey also revealed that majority of the gardens were not maintained scientifically and kept under below average management.



About 47 per cent of the gardens were irrigated mainly on account of raising intercrops like; banana, betel vine, nutmeg etc. The physical features of the gardens and the level of yielding are given in the following tables. The average plant density of the gardens were 181 palms per ha and the productivity was 7193 nuts per ha. The highest productivity of 9424 was recorded in Palakkad district followed by 8419 in Thrissur. The survey also revealed that trees were affected by various pests and diseases like; coconut Eriophyide Mite, Red Palm Weevil, Bud Rot etc. The study indicates that coconut gardens in the state are not being maintained scientifically and the farming practices adopted for the management of the coconut and coconut based farming systems vary from garden to garden and hence the productivity and the total output also fluctuate considerably. In the face of prevailing uncertain and increasing complexities and anemic growth of the coconut economy of the county,

the CDB's stance in empowering the scattered and isolated coconut farmers by clustering them for demonstrating the integrated farming and agri-business practices has been most appropriate in preserving the growth momentum while not losing the focus on enhancing return from unit holdings at a low marginal cost.

The price and non price related exogenous factors also affect adversely the farm output. The acute shortage of farm labour, the increasing rate of wages disproportionate to the farm gate price and lack of working capital are the other constraints faced by the coconut farmers in the country. The glimpses of coconut holdings in many traditional states revealed that majority of the coconut gardens are either kept fallow without undertaking any cultural operations and intercropping or piled up with static stock of other tree species casting heavy shade to coconut

palms. Unlike other commercial plantation crops like rubber, tea, coffee etc. coconut gardens are characterized by the adoption of varying nature of cropping system management resulting in considerable fluctuation in the production. The unique feature of cultivation of rubber, tea, coffee etc. are, they are planted on commercial scale and maintained uniformly irrespective of the nature of distribution and size of holdings. The uniformity in management leads to stable and continuous yield. The coconut cultivated in traditional areas are more vulnerable to this exceptional nature of management. The recurring nature of price fluctuations further aggravate the situation. Every crest in the price movement always offers better management of the gardens whereas a trough results in the negligence of the garden. Similarly, variations in the weather conditions on account of climate change also affect the timely management of the garden as well as entail additional investment for mitigating weather related calamities like resurgence of pests and diseases, augmenting the irrigation systems etc. This in turn enhances the cost of production considerably. Occurrence of an unprecedented drought under a rain-fed maintenance results in the total negligence of garden. Recurrence of such aberration and adverse consequences are causing considerable damage and yield loss and concern among the farmers in all coconut growing areas. Therefore majority of the coconut gardens in the traditional coconut growing states are being maintained under traditional subsistence farming. Comparing to traditional places, the cultivation of coconut in non

Table 1. Nature of distribution of coconut holdings in Kerala

Districts	No of holdings	Area in ha	Average size of holdings	Irrigated (%)	Juvenile (%)	Bearing Palms (%)	Old unproductive Palms
Kasaragodu	545	202	0.37	36	12.22	87.03	0.75
Kannur	483	423.66	0.88	43	20.75	74.29	4.96
Kozhikodu	2929	888.93	0.3	31.51	17.47	73.97	8.56
Malappuram	2072	615.75	0.3	28.72	14.05	83.73	2.22
Palakkad	1593	987.54	0.62	76.9	16.74	80.13	3.13
Thrissur	16631	2409.39	0.15	66.19	1.5	92.66	5.84
Trivandrum	880	165.86	0.19	48.75	15.75	55.75	28.5
Kerala	25133	5693.13	0.40	47.3	14.07	78.22	7.71

Table 2. Pattern of yield & Productivity of coconut in Kerala

Districts	Plant density/ha	Yielding palms/ha	Yield nuts/palm	Yield nuts/ha
Kasaragodu	157	138	52	7242
Kannur	189	142	36	5529
Kozhikodu	175	130	57	7302
Malappuram	147	122	47	5599
Palakkad	160	137	68	9424
Thrissur	198	164	52	8419
Trivandrum	241	163	34	6835
Kerala	181	142	49	7193



traditional places satisfy the scientific requirements and hence its productivity in places of recent introduction particularly after 1980s is significantly high. Such gardens are laid out scientifically and maintained under proper care and management with regular application of fertilizers and other plant protection chemicals. The salubrious role played by the Coconut Development Board was instrumental in bringing about a positive change in the coconut cultivation. The area under coconut in the country has reached to the level of 1.894 million ha in 2008-09 recording a compound growth rate of 2 per cent per annum over a period of 30 years. Similarly the domestic production of coconut has also increased substantially. The production from the level of 5942 million nuts in 1980-81 reached 15729.7 million nuts in 2008-09, recording a compound growth of 3.41 per cent per annum. The productivity of coconut has considerably increased from the level of 5485 nuts per ha in 1980-81 to 8303 nuts per ha recording an increase of 51.38 per cent. The per capita availability of coconut in the country has also increased from the level of 9 nuts to 13 nuts which is far below that of Philippines and Indonesia. Hence India has to go a long way to fill the gap between per capita requirement and availability and also to achieve higher level of per capita availability of coconut at least at par with that of Kerala and Tamil Nadu. Hence the imperative need is to enhance the production through improving the productivity of coconut from the existing holdings.

The “law” of large numbers and the multiplier effect in clusters

There are five million coconut holdings distributed in 18 states and 3 Union Territories in the country. The lack of economies of scale in the operation of individual holdings often jeopardizes any profitable investment for enhancing the farm income. For the revival of domestic coconut culture and coconut based farming system, it is inevitable to have adaptation and mitigation strategies to be put in place. Considering the prevailing socio-economic structure and the pattern of distribution of coconut holdings in the country, the challenges of inclusive growth and sustainable development in coconut cultivation is much greater than achieving a nominal growth in production. With the shrinking nature of cultivable land and limited availability of labour and water, the productivity per unit of these scarce resources can be enhanced through effective use of improved technology. The productivity of coconut in many states remain below one ton of copra per ha per year against the potential productivity of 3-6 MT of copra. To

boost farm investment, capital formation and enhance the gross income and productivity of the fragmented holdings across the country, the Coconut Development Board adopted a new strategy of consolidating the fragmented and scattered individual holdings to increase the power of economy and subsequently employing the production function tools on a group approach with the participation of all farmers. The new approach was helpful in determining the optimization of resource use and the level of input use and extent to which production could be increased from the existing natural resource stock including the static plant stocks. The consolidation of holdings coupled with group action to bring in scale of economy proved a thriving agriculture in a coconut based farming system. The collective effort in procuring various critical inputs, timely and scientific applications have helped not only in improving the input use efficiency but also in enhancing the productivity and farm income commensurate with the investment. The magnitude of production coefficients in each



Synchronizing coconut harvest in the cluster enhances the power of economy



garden has indicated positive results and hence become the determinant factor for the optimum level of production for disposal of the marketable surplus. Increase in the household income through integrated farming, employment generation and creation of social capital in the project areas were the tangible results and paved way for returning dynamism in coconut farming.

CDB's Cluster program is not merely a farm management arrangement but a special purpose vehicle for transforming subsistence coconut farming into economically viable coconut based farming system with possible innovations for adoption of secondary agriculture. Its objective is not simply distributing the physical inputs and other resources but to educate the participating farmers the need for the monsoon based scientific management of coconut palms and the efficient use of limited scarce resources for maximization of rate of return per unit area and unit rate of investment. Clusters act as a common platform for delivering a pool of specialized knowledge to all the members of the cluster according to the requirements. The success of the cluster programme implemented by the Board was based on a type of incubation period that has been provided to the beneficiary farmers for the adoption of the new initiatives. The empowerment of farmers by pooling their scarce resources particularly land, available family labour and capital and thereby enhancing their power of economy were the fundamentals of the new initiatives. The timely adoption of integrated nutrient management, integrated pest management,

integrated water management and promoting coconut based farming system which in turn accelerates more investment in coconut holdings in a collective and mutually benefited manner are the uniqueness of the clusters. Bringing about a change in the prevailing social set up of the farming community from individual competition to collaborative actions has paved way for improving the socio economic status of areas as well as for the overall development of the individual farms. Two years of Board's interventions helped in fostering a culture of co-operation, confidence and bargaining power among the member participants. Creation of infrastructure facilities and strengthening of institutions like credit and input providing agencies are the other outcome of the cluster programs. A review of the cluster programmes implemented initially in Kerala has revealed that the farm productivity has improved considerably in the project areas. Increase in the household income through integrated farming and value addition was also observed. Employment generation and creation of social capital in the project areas are added advantages of the programme. After decades of lethargy, the coconut cultivation, production and processing in the country in general and Kerala in particular is on the rebound, fuelled by acceleration in investment in both coconut farming and processing.

Cluster approach in coconut farming for "Forward and Backward Linkages":

Cluster development has been gathering importance across the globe from the point of industry

perspective. However, cluster approach for coconut farm development is a new initiative. The constraints in coconut cultivation are multi-dimensional. The major bottlenecks in the adoption of scientific management in coconut holdings are; i) lack of combining enterprises ii) size of holdings and nature of distribution iii) persistence of decreasing returns to scale and iv) an existence of a price system as "the invisible hand". As a result, millions of resource scarce small and marginal farmers who undertake coconut farming individually without any coordination are becoming the victims of market exploiters, like; copra processors, coconut traders and the oil manufactures on account of price fluctuations. As a result of price uncertainties majority of the farmers often skip input applications totally or partially due to lack of savings, exorbitant cost of production, cost of procurement of inputs and marketing of out put. The market instabilities and the price uncertainties particularly at the time of major harvests further aggravated the situations. To optimize the cost of production, timely procurement and application of inputs, to ease the access of credit needs and to build up marketable surplus in adequate quantity and its timely disposal, pooling of farmers, their scarce resources and integration of farm activities for the promotion of coconut based farming are essential. To achieve this goal in coconut farming it is necessary to cluster the farmers in economically viable and technically feasible sound groups and establish linkages for vertical and horizontal growth. Coconut clusters are geographic concentration of



coconut holdings of large number of farmers in contiguous manner, irrespective of size of holdings. Every farmer in the cluster are interconnected for various farm activities, specialized suppliers, service providers and associated institutions in the relevant field. It is expected that clusters foster high level of land utilization and productivity. The clusters induce competition, driving the directions and pace of innovations which ultimately end with the formation of new farm activities and agribusiness within the cluster. For achieving these objectives, the Coconut Development Board has been aggressively promoting the cluster formations for the implementation of productivity linked programmes of the Board. The Board is supporting the formation of coconut clusters in compact and contiguous areas not exceeding 50 ha for easy and effective manageability. The clusters are formed in selected Panchayath/ village where innovative farmers are encouraged to form themselves into viable groups and subgroups with conveners and farmer leaders to shoulder responsibilities for



Active involvement of local bodies enhances confidence and conviction in coconut cultivation

undertaking group activities such as baseline survey to take stock of the field inventories, field problems and decide on the technological interventions followed by concrete plan of actions and their timely execution. The group actions was helpful in inducing a sense of responsibility among the participating farmers and a new and unique input management which was hitherto absent, has been added as one of the factors of production in coconut based farming system.

The cropping intensity in the scarce resource of land has increased many fold by integrating allied activities such as dairy farming, poultry farming, apiculture, aquaculture besides promoting coconut based farming system with high value agriculture. The interventions of the Coconut Development Board with technology disseminations and financial support has paid rich dividend. Backward linkages exist due to increased level of production possibilities on account of additional investments. The Backward linkages also exist when increased production by downstream firms provide positive pecuniary externalities to upstream firms. For example the increased and steady use of farm inputs in the cluster area induced more demand for the inputs which in turn increased the production activities of input manufacturing firms leading to an increase in firms' annual turnover. These linkages are backward because new changes are transmitted back to a previous stage of production.



Extension education, an integral part of the cluster programme

The cluster programme envisaged an end to end approach by



A coconut garden in Andamans intercropped with clove & nutmeg

establishing appropriate linkages from production to processing to marketing on a group basis with the technical and financial support from the Coconut Development Board. Thus the presence of an external catalyst removed all production barriers such as timely availability of credit, procurement and supply of inputs including seeds and other planting material requirements. The technical support involves awareness programmes for motivating the participating farmers, both husbands and wives, to adopt scientific management in coconut and coconut based farming systems, to encourage the farmers to go in for collective procurement of inputs, weather based timely cultural operations and the adoption of soil and water conservations followed by regular training and visits to individual farms by the technical resource group. The unique feature of the programme is the implementation of a common crop husbandry programme formulated by the group after

analyzing the existing agricultural situation of the individual holdings and taking stock of the farm inventories in the clusters by conducting farmer participatory baseline surveys. The production constraints identified in the cluster area; such as prevalence of pests & diseases, status of soil health etc., are common and hence address the issues jointly in an organized manner in each cluster. The farmers' participation with different levels of leadership and management improve the efficacy of technology adoption and farm output. The financial support by the Board in the form of critical inputs triggers input-use efficiency and farm activities leading to employment generation and employment guarantee to local labours. The pooling of agricultural labours and their efficient deployment for undertaking the cultural operations in the cluster according to the predetermined calendar of operations have not only improved the labour use efficiency but nullified the disguised

unemployment. Two years of consecutive and concurrent support ensures cohesiveness and sense of responsibility among the farmers in the cluster. The clusters were further strengthened to form Producers Company to manufacture intermediary goods for upstream industries and thus encouraged an end to end approach in farm productions. Forward linkages exist due to the increased production of farm output which in turn augment the productions of upstream firms.

Practicing Secondary Agriculture in coconut for Farm level Value addition

The fruit of coconut palm is the raw material for many varied products such as copra, coconut chips, coconut vinegar, edible ball copra, desiccated coconut powder, spray dried milk products, coconut cream, coconut based convenient food products, virgin coconut oil etc. In India bulk of these products are manufactured in the upstream industries. The coconut farmers are not being benefited proportionally due to the absence of value addition and value chain process and hence deprived of the price advantages. In order to narrow down the price spread and to realize maximum value for the farm output, it is necessary to promote farm level primary processing such that coconut, at farm gate itself, could be segregated into a number of different products for varied utilization. The success of secondary agriculture in coconut in the country may depend mainly on the consistent availability of coconut at farm level and its scale of economy of operation. In India, more than 90 per cent of five million holdings are less than 2 ha. The average size of coconut holdings in



Kerala, which hold the hegemony of coconut cultivation and production in the country, is about 0.2 ha. The state is also unique in having the maximum number of homestead gardens in the country. The nature of distribution of the holdings in many states and the lack of infrastructure facilities restrained the farmers from adopting any type of primary level processing and hence they depend upon the local copra merchants or the coconut traders for marketing of their products who in turn exploit them by paying lesser price besides with-holding the payment till the next harvest. Hence, to safeguard the interest of coconut farmers, majority of whom are small and marginal, as well as to relieve them from the clutches of market exploitation by coconut merchants, it is inevitable to practice secondary agriculture in coconut holdings. However, the success of such ventures will definitely depend on the active involvement of farmers group and participation of competitive forums, working groups, associations of coconut farmers and multidisciplinary government departments. The establishment of common facilities centers in Kanjikuzhi panchayat in Alleppey district, establishment of copra drier units by farmers' group in Malapuram district for the production of FAQ grade milling copra by the member farmers, establishment of integrated processing units by farmers Co-operative Societies at Kallamkundu and Karalam in Trichur district are the success stories and the emulative experience gained in this field at the behest of Coconut Development Board in Kerala.

Product diversification and by-product utilization gained

momentum in many countries and is the major attribute for the stability and growth of coconut industry in those countries. The introduction of integrated coconut processing by establishing coconut industry cluster in Indonesia has made tremendous changes in the coconut industry of that country. Even though there was initial set backs in the implementation of these programmes for want of continuous supply of adequate quantity of raw material, the major hurdles in the supply was removed on implementation of coconut cluster programme through which linkages were made with production and supply with out affecting the regular supply of nuts to meet the daily need of existing large oil milling and DC manufacturing industries. The establishment of networked coconut industrial cluster involving participation of competitive forums, working groups, associations of Indonesian coconut farmers and multidisciplinary government

departments; such as ministry of agriculture, ministry of industry and ministry of trade with backward and forward linkages is the uniqueness of Coconut Industrial Cluster. Mapping of coconut raw material potency, rejuvenation of coconut plantations, strengthening of extension requirement, capacity building for processing sector, creating business partnership between coconut farmers and processing industry, establishing working groups, preparing industrial investment profile on coconut processing and developing appropriate coconut based industries and suitable marketing strategies are the prime responsibilities of the cluster. When comparing countries like; Philippine, Thailand, Vietnam, India is yet to make any remarkable changes in the farm level processing of coconut.

Notes and References

1. Annon (2005) The Cocommunity APCC, Jakarta (see p-1).



Coconut as monocrop under coastal ecosystem (A view from Port Blair)



2. Cutter, V.M.Jr., Wilson, K.S. & Freemon B, (1955). "Nuclear behavior & cell formation in the developing endosperm of *cocos nucifera*", *AMJ.Bot.*42:109-115.
3. Dale C.Dahl and Jerome.W Hamnord (1977) "Market and Price Analysis – The Agricultural Industries" ML Gran Hill Book Company, New Delhi (New York) p.122.
4. Hanumantha Rao, C H (2006) "Faster and more inclusive growth" *The Economic Times* August 31, 2006.
5. Kartha, A.R. & Narayana, R. (1956) "Development of Oil in the ripening Coconut" *Indian Agri. Science*, 26:319-327.
6. Nampoothiri, KUK et al (2000) "Coconut Cultivation Technology" Coconut Development Board, Kochi.
7. Ohler J.G. (1984 "Coconut Tree of Life" FAO, Rome p343.
8. Pillai et.al, (1973) Studies on Photoperiodic responsive reaction in Coconut; *Journal of Plant Crops* 1(Sept.) 89-92.
9. Ramesh Chand (2008) "The Global Food Crisis: Causes, Severity and Outlook" *EPW* June 28, 2008.
10. Singh, H.P. and Mathew, M.T.(2002) "Sustainable Production and utilization of Coconut" Coconut Development Board, Kochi.
11. Thomas Mathew, M. (1990) Turmeric, A profitable intercrop in coconut garden" *Indian Naliker Journal* Vol. XIX, No.9, July 1990.
12. Thomas Mathew(1990) Water Management: A pre-requisite for coconut gardens in Tamilnadu *Indian Coconut Journal*, March 1990, Vol. XX, No.11.
13. Thomas Mathew, M (1992) "Economics of Marketing of coconut" M. Phil. Dissertation submitted to JNU Delhi.
14. Thomas Mathew, M (1998) A Success Story in Farm Development" *Indian Coconut Journal* Vol.XXVIII No.11 March 1998.
15. Thomas Mathew, M (1998) "Banana Cultivation in Coconut Garden for enhancing income" *Indian Naliker Journal* May 1998 Vol.27 No.7.
16. Thomas Mathew, M (2004) Coconut Industry in India : An Overview – *Indian Coconut Journal* Vol.XXXV No.7 November, 2004.
17. Thomas Mathew, M (2006) "Coconut Development-Bringing about a change" *The Hindu Survey of Indian Agriculture* 2006 pp93-100.
18. Thomas Mathew, M (2007) Coconut oil: The king of vegetable oils Article contributed to the Book- *Changing Global Vegetable Oils Scenario: issues and Challenges before India* Published by Indian Society of Oilseeds Research, Hyderabad. pp379-390.
19. Thomas Mathew, M (2009) "Staying Organized- the key to the success of coconut industries in North Sulawesi Province" *Indian Coconut Journal* Vol.LII(1) pp2-10.
20. Vinod Mathew (2005) "Caught in a cleft over clusters" *Business Line* September 14, 2005 p 11.
21. William M. Powers (2004) "Forward and Backward Linkages and the Location of International Production" *University of Michigan* pp 1-26.
22. Yujiro Hayami & A Damodaran (2004) "Towards an Alternative Agrarian Reform- Tea Plantation in South India" *Economic and Political Weekly* September 4, 2004.
 - i. For more readings refer, "J. S. Patel (1938) - *The Coconut - A Monograph*, pp 90-133.
 - ii. Refer, Rethinam P & Sivaraman K (2009) - " Poly Culture in Coconut for Humid Tropics and Coastal Plains". *Planning Commission, Govt. of India*, pp 80-89.
 - iii. The increasing behaviour of fragmentation of coconut holdings in the country have made them unviable to adopt scientific management. The Principle of Factor - Product relationship in coconut explains that the successive coconut growing with the constant application of input factors initially result in increased production at the first instant but finally decrease the output constantly after certain point. As long as the increase of total physical output is more than proportional to the input utilization, the production process can be continued profitably. However, as soon as the increments to total product become negative, cultivation of coconut may not be remunerative unless remedial measures are adopted.
 - iv. Ref., H P Singh, V T Markose and Remany Gopalakrishnan (1999)- *Thirty years of Coconut Industry in India*, Coconut Development Board, pp 22-23.