

PLANTATION CROPS OF KERALA
DEVELOPMENTS FOR THE NEXT MILLENNIUM



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भारत
ICAR

CENTRAL PLANTATION CROPS RESEARCH INSTITUTE

(Indian Council of Agricultural Research)

KASARAGOD - 671 124.



CPCRI

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DEVELOPMENTS FOR THE NEXT MILLENNIUM

**A Compendium of Papers Presented at
the Symposium held in Connection with
Eleventh Kerala Science Congress**

Editors

**K.U.K. Nampoothiri
V. A. Parthasarathy
A. R. S. Menon
H. H. Khan**



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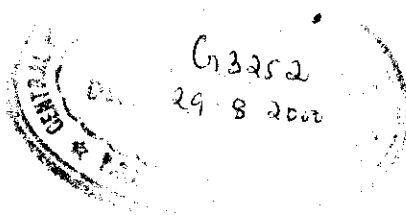
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PREFACE

Plantation crops are vital to the economy of our nation and more so for the state of Kerala, Plantation crops occupying an area of 3.2 million ha. (1. 82 per cent of the total crop land area), generate an income of around Rs. 15,000 millions, which is about 7 per cent of the total export earnings from Agri-Horti crops.

This is the Eleventh Kerala Science Congress organized by the State Committee on Science, Technology and Environment. The Committee has appropriately chosen the theme 'Plantation crops of Kerala, Developments for the next millennium' for the symposium. This is a compilation of the full text of six papers to be presented in the symposium by eminent persons in the field. The first paper on coconut scenario in the country by Dr. H.P. Singh and Sri V.T. Markose, discusses the problems and prospects of the crop. A concise report on the R & D activities of spices is presented by Dr. C. K. George. Sri P.P. Balasubramanian put forward ways and means to sustain cashew and cocoa in next millennium, while strategies on coffee are described by Dr. R. Naidu and his colleagues.

The Editors wish to acknowledge the contributors for accepting our invitation for the presentation of the papers. The financial assistance from STEC, Thiruvananthapuram is also acknowledged.

- Editors

COCONUT IN THE NEXT MILLENNIUM PROBLEMS AND PROSPECTS

H. P. SINGH* AND V. T. MARKOSE**

Coconut Development Board, Kochi - 682 011

* Horticultural Commissioner and Chairman

** Chief Coconut Development Officer

INTRODUCTION

India has witnessed the rapidly changing scenario in horticulture in this decade and is at the doorstep of the third millennium. Production and productivity of horticultural crops have increased manifold and the country has emerged as one of the largest producer of fruits, second largest producer of vegetables and established credibility in export of spices, cashew and many horticultural produces. Horticultural sector contributes significantly to the export earnings in agriculture and immense scope exists to further the export of horticulture produce. With the changing dietary trend there will be enhanced need for horticultural produce which has to be exploited with available land and water resources in an environment friendly manner. Thus, with ample opportunities there are many challenges which has to be faced in the next millennium calling for well thought out strategies and action plans.

Among the horticultural crops grown in the country coconut enjoys a unique position as a versatile crop with its varied uses as a source of food, drink, shelter and as raw material for industrial exploitation. The crop assumes considerable significance in the national economy in view of the rural employment and income generation. In recent years India has attained the top position in production of coconut, overtaking Indonesia and Philippines, Major share of the coconut production in the country is contributed by millions of small and marginal farmers who form the backbone of coconut culture in the

Table 1: All india final estimate of coconut - 1996-97

State / Union Territories	Area (Thousand Ha.)		Production (Million Nuts)		Productivity (Nuts / ha)	
	1995-96 Revised	1996-'97	1995-'96 Revised	1996-'97	1995-96 Revised	1996-97
Andhra Pradesh	90.0	90.0	1231.4	685.9	13682	7621
Assam	18.2	19.6	140.3	118.4	7709	6041
Goa	24.7	24.7	119.0	119.0	4818	4818
Karnataka	278.8	290.0	1450.9	1493.0	5204	5148
Kerala	98.0	1010.0	5908.0	5759.0	6029	5702
Maharashtra	8.2	15.1	169.1	264.5	20622	17517
Orissa	47.3	53.0	246.8	271.5	5218	5123
Tamil Nadu	322.5	328.0	3257.6	3811.6	10101	11621
Tripura	8.8	8.8	5.9	5.9	670	670
West Bengal	23.1	23.7	279.4	313.1	12095	13211
A & N Islands	24.4	24.7	85.4	86.6	3500	3506
Lakshadweep	2.8	2.8	27.0	27.5	9643	9821
Pondicheery (Provisional)	2.1	2.1	31.5	31.5	15000	15000
All India	1830.9	1892.5	12952.3	12987.5	7074	6863

country. It is a fact that wherever coconut is grown the economy of the region is closely inter linked with the prospects of the crop. With an area of 1.89 million ha and production of 12988 million nuts (Table 1), coconut contributes Rs.7000/- crores annually to the GDP. The raw material for coir industry is derived from coconut husk and the country earns valuable foreign exchange to the tune of Rs.240 crores by way of export of coir and coir products. Copra, the dried kernal of coconut is the richest source of edible oil and the contribution of the crop to the total edible oil pool in India is around six percent. The importance of coconut as a food item may be gauged from the fact that sixty percent of the production of coconut is consumed for edible purposes in the households as raw nut, By-products obtained from

coconut such as husk, shell, timber and leaves are utilized for making value added products.

About 10 million people in our country are engaged in coconut cultivation, processing, industry and trade related activities. With the development of value added products such as coconut cream, coconut honey, coconut skimmed milk, tender coconut water in pouches, activated carbon and nata-de-coco etc, coconut offers ample investment opportunities.

The strength of coconut palm lies more with its utility aspect vis-a-vis the environment. It is difficult to think of a more environmental friendly tree or plant other than coconut. The crop has the ability to adapt to a wide range of soil types and environmental conditions. The coconut system can accommodate variety of crops in the inter spaces without adversity to the crops or the environment.

GLOBAL SCENARIO

World production of coconut is 54 billion nuts from an area of 11.6 million hectares. (Table 2 & Fig 1). More than 75 per cent of the world production is contributed by the four major global players viz, India, Indonesia, Phillipines and Sri Lanka. The growth rate recorded in area under coconut during the last decade was very very low (1.1%) while that registered in production was comparatively better (2.5%). Among the major producing countries Thailand and India have recorded excellent growth rate in production(7%) followed by Indonesia(3.6%)

The export performance of coconut and coconut products at global level shows that 88 per cent of the total value of exports is contributed by kernel products. Among these, coconut oil alone commands 64 per cent of the value of exports. The share of other kernel products is around 12 per cent for DC and 15 per cent for copra, copra meal and other kernel products. Thus coconut oil determines the viability of the coconut industry in global trade.

Table 2: Area under productio of coconut in different coconut growing contries of the world (1996)

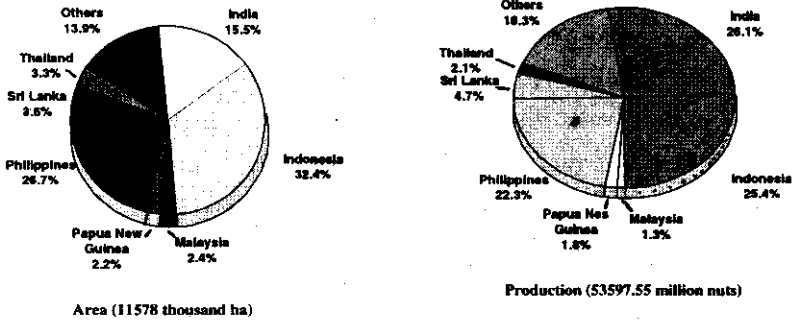
Sl. Country No.	Area (in'000)	Percentage Share	Production in million	Percentage share
1. F.S. Micronesia	17	0.15	40.00	0.07
2. Fiji	65	0.56	196.40	0.37
3. India	1796	15.51	13968.00	26.06
4. Indonesia	3745	32.35	13595.00	25.36
5. Malaysia	280	2.42	722.00	1.35
6. Papua New Guinea	260	2.25	960.00	1.79
7. Philippines	3093	26.71	11935.00	22.27
8. Solomon Island	59	0.51	287.60	0.54
9. Sri Lanka	419	3.62	2546.00	4.75
10. Thailand	377	3.26	1130.00	2.11
11. Vanuatu	96	0.83	346.00	0.65
12. Vietnam	190	1.64	1065.00	1.99
13. Western Samoa	75	0.65	160.00	0.30
14. Palau	14	0.12	70.00	0.13
15. Others	1092	9.43	6576.55	12.27
Total	11578	100	53597.55	100.00

It may be noted that the share of India in the total export earning from kernel products at the global level is a meagre 4 per cent while Philippines, Indonesia and Sri Lanka accounts for major share of exports.

Globally, 50 per cent of the total coconut production is converted to copra and this ratio depends upon local consumption patern. In Philippines about 93 per cent of coconut is converted into copra while in Indonesia and India it is 50 and 32 per cent respectively of the total production. Coconut oil accounts for 5 per cent of total vegetable oils, 40 per cent of which comes from Philippines and 22 per cent from Indonesia while India's share is only

10 per cent. Philippines also accounts for more than 50 per cent of desiccated coconut followed by Sri Lanka with its contribution to the tune of 30 percent of the total desiccated coconut production.

Fig. I : World area and production of coconut (Share of major coconut growing countries, 1996)



In normal years of production, 50 per cent of total copra produced in the world enters the export market, either in the form of copra or coconut oil. However, there has been down-ward trend in trade of copra or oil and priorities have been shifted towards export of processed material. Major producers of coconut oil for export are Philippines (63%) followed by Indonesia, Malaysia and Sri Lanka. In recent years, export of oil cake (copra meal) has shown rising trend. Germany and Netherland are major importers and consumers of oil cake in the world.

The copra prices are about 67 per cent of coconut oil prices which used to be 60 per cent only. Higher prices of copra in relation to oil is attributed to the technological advancement in copra milling which has enhanced recovery of oil. Coconut oil had commanded premium price but it is loosing its competitiveness owing to fierce competition from other vegetable oils. Coconut oil for consumption has major threat from palm oil due to lower prices.

In the fast changing global economic scenerio where liberisation is

pushed up, coconut industry may not be able to survive with protection from the Govt. sectors. Our markets may have to be opened up for products from other countries and coconut industry has to survive by itself by becoming more competitive cost wise and quality wise.

COCONUT DEVELOPMENT IN INDIA

Area, production and productivity

In India coconut is grown under varying soil and climatic conditions in 18 states and 3 Union Territories. It is versatile in its adaptability to wide range of soil conditions. From the coastal regions of India it has now spread to interior areas of traditional belts and even to the extremely non-traditional areas of north and North-Eastern states of the country. The coconut production in the country during 1950-51 was 3282 million nuts from an area of 6.27 lakh ha. It has been possible to increase the area by 301 per cent and production by 396 per cent during the last 5 decades. The increase in area was to the extent of 12.63 lakh ha and production by 9706 million nuts.

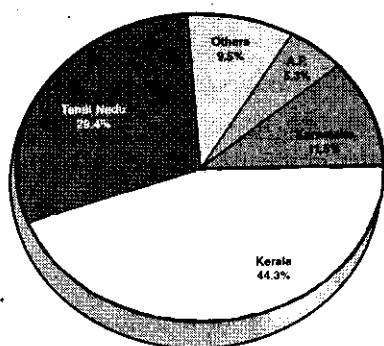
The productivity during the above period increased by 31 per cent ie 6863 nuts per ha from 5234 (Table 3).

About 90 percent of the coconut production is contributed by the states of Kerala, Tamil Nadu, Andhra Pradesh and Karnataka. While the contribution of Kerala to the total production accounts to 44 per cent that of Tamil Nadu is 29 per cent. The contribution of Karnataka and A.P. is 12 per cent and 5 per cent respectively. (Figure.2). These four major coconut producing southern states recorded a total increase in production by 371 per cent during the above period. The contribution of the north and north-eastern states in total production is to the extent of six per cent. Of late the north and north eastern states evince considerable interest and enthusiasm in introducing and expanding the area under coconut. The introduction of the crop in the non-traditional belts of Bihar, Tripura, Assam, Manipur, Nagaland and Mizoram has in fact changed the belief that coconut is suited only to the coastal belts. The maximum increase in area was recorded in the state of Kerala by 6.01 lakh ha.

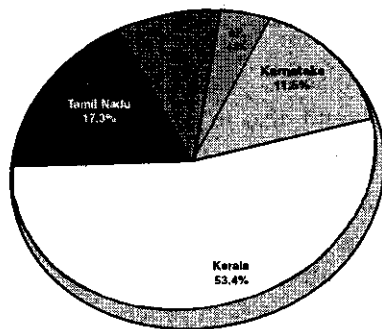
Table 3: Quniquennaial changes in the area, production and productivity of coconut in India since 1950-51

Year	Area (000 ha)	Production (Million nuts)	Productivity (nuts per ha)
1950-51	626.5	3281.7	5238
1955-56	647.6	4224.4	6523
1960-61	717.0	4639.1	6470
1965-66	883.7	5035.4	5698
1970-71	1045.5	6075.0	5811
1975-76	1069.9	5829.4	5449
1980-81	1083.3	5942.0	5485
1985-86	1225.6	6770.3	5524
1990-91	1513.9	9700.2	6407
1995-96	1830.9	12952.3	7074
Growth over the period	1204.4	9670.6	1836.1
Percentage increase	192.2	294.7	35.1
Compound growth rate	2.4	3.0	0.7

Fig. 2: Area and production of coconut in India (Share of major coconut growing states, 1996-97)



Production (12987.5 million nuts)



Area (1892.5 thousand ha)

RESEARCH

The mandate on coconut research is vested with CPCRI under ICAR since 1970. Till then the research stations set up under the erstwhile Madras Presidency as early in the year 1916 was under the administrative control of the Indian Central Coconut Committee. Notable strides have been made in coconut research in the country during the last eight decades. The achievements made in the crop improvement, crop management, crop protection and pre and post harvest technology have contributed substantially towards increase in production, productivity and product development.

Crop Improvement

In crop development, collection, conservation and cataloging of coconut germplasm was accorded top priority. The Central Plantation Crops Research Institute under the ICAR has the World's largest germplasm collection comprising of 132 accessions of coconut of which 46 are indigenous and 86 exotic. Germplasm is also being maintained at various Research Centres. Exploitation of hybrid vigour has resulted in the evolution of 11 hybrids (Table-4). Coconut seed gardens were also established in South India to increase hybrid seed production which could cater the demand for hybrid seedlings. Systematic multi locational evaluation of indigenous cultivars resulted in the release of four cultivars viz Laccadive Ordinary, Philippines Ordinary, Chawghat Orange Dwarf and Pratap.

Crop Management

In crop management, agronomic trials conducted helped to determine optimum manurial and cultural requirements of coconut palm. Multilocational, trials on spacing and planting density and different cropping systems led to pave way for design of coconut based high density multi cropping systems. These systems enable to exploit the potential of interspaces and full solar energy and also to fetch higher income from unit holdings. A technology was also developed and demonstrated for the production of vermi compost from plantation waste.

Crop Protection

The past century witnessed the aggravation of root wilt disease which appeared in the latter half of the 19th century. Though the phytoplasmal etiology has been stated to be proved beyond doubt with the multipronged

Table 1: Performance of released hybrids

Hybrids	Nut Yield paml/ year	Copra yield		Crop Yield ha(t)	Oil con- ten	State for which recom- mended
		Mean /nut (g)	Mean palm/ (kg)			
Chandra Sankara (COD x WCT)	116	215	25	4.4	68	Kerala Karnataka Tamil Nadu
Kera Sankara (WCT x COD)	108	187	21	3.5	68	Kerala Karnataka
Chandra Laksh (LO x COD)	109	195	21	3.7	69	Kerala Karnataka
Laksha Ganga (LO x GB)	108	195	21	3.7	70	Kerala
Ananda Ganga (AO x GB)	95	216	21	3.6	68	Kerala
Kera Ganga (WCT x GB)	100	201	21	3.5	69	Kerala
Kera Sree (WCT x MYD)	112	216	24	4.2	66	Kerala
Kera Sowbagya (WCT x SS Apricot)	130	195	25	4.3	65	Kerala
VHC-1 (ECT x DG)	98	135	13	2.3	70	Tamil Nadu
VHC-2(ECTx MYD)	107	152	16	2.9	69	Tamil Nadu
Godhvari Ganga	140	150	21	3.7	68	Andhra Pradesh
WCT (Control)	80	176	14	2.5	68	

research carried out for a longer period the cure for the disease continues to be an enigma for researchers. The fact that no cure for this malady could so far been evolved tempted to think of evolving disease free or tolerant/resistant cultivars. Programme for evolving disease tolerant varieties has yielded results and further trails are on in this direction.

Effective control measures have been developed for all other known diseases and pests. The Integrated Disease/Pests Management measures have also integrated in future research. A number of and post harvest devices has been developed under technology development. Electrical and solar dryers, coconut dehusker etc are such devices developed under this sector.

The strategies and programmes suggested for the next millennium in coconut research include rationalization of research, Genetic Resource Management, Biotechnology and Genetic Engineering, Post Harvest Technology development. Export Promotional Research and Human Resource Development.

The CPCRI with its main station at Kasaragod and Regional Station at Kayamkulam, Kerala established ten research centres of All India Co-ordinated Research Programmes (AICRP) in various agroclimatic conditions in the country to cater to the need of the country, a seed garden at Kidu, Karnataka and a World Germplasm Centre at Sipighat, A & N Islands. Research on all disciplines of coconut are carried out at these stations to evolve technologies suited for different locations.

In addition State Agricultural Universities of Kerala, T.N, A.P, Orissa, Assam, Maharastra, departmental farms under the state governments and to a certain extent private farms are also actively involved in the pursuit of coconut research.

PROCESSING

Traditional Processing

The traditional processing sector of coconut is confined to copra making, oil milling and coir industry.

Copra making units are scattered all over Kerala, Karnataka, Tamil

Nadu, Andhra Pradesh, Lakshadweep and Andaman and Nicobar Islands of which Kerala State accounts for more than 85 per cent of the units. While milling copra production is prevalent in Kerala, Tamil Nadu, and Andaman and Nicobar Islands and Lakshadweep, Karnataka, and Andhra Pradesh are the major producers of edible copra. There are about 12000 units in the cottage and small scale sector, processing coconuts into copra. Most of the units resort to sun drying followed by kiln drying, while some of the large units recently have built in modern driers operated with electric energy and coconut shells as fuel. Modified small copra driers suitable for cultivators and small processors are also available.

The production of copra during 1996 was around 8.7 lakh tones of which 85 per cent is milling copra and 15 per cent edible copra. Production of coconut oil is around 4.5 lakh tones.

Coconut oil extraction is the traditional industry in the processing sector. The price of coconut continues to be dependent on the price of the coconut oil. Copra milling units are located in Kerala, Tamil Nadu, Andhra Pradesh, Karnataka, Maharashtra, West Bengal and Goa. The production of coconut oil is mainly through the rotaries, expellers and country chekkus, the expeller being the efficient one. There are about 1400 oil mills producing about 4.5 lakh tones of oil annually of which 40 per cent is used for edible purposes, about 46 per cent for toiletry purposes and the remaining for industrial applications like soap making and paints etc. The small scale units mainly sell oil in loose form. The large scale industries market their produce in attractive packing which have ready acceptance among the urban consumers. Oil cake, the by product obtained during the crushing of copra forms a major ingredient for cattle and poultry feeds. A sizable quantity is diverted to solvent extraction units for oil extraction. Oil milling and allied industries provide regular employment to more than 10000 persons. Oil marketed in small and attractive packings is microfiltered and is of superior quality. Demand for small packs is on the increase and hence there is stiff competition among different brands available in the market. The air tight sealing of the packings ensures elimination of contaminants and adulterants to the minimum possible extent. At present there are about 50 brands available in the market.

Desiccated coconut, the disintegrated and dehydrated coconut meat is a product with growing consumer demand. Its manufacture is confined to Karnataka, Tamil Nadu, Andhra Pradesh, Kerala and Orissa with more than 75 per cent of the units located in Karnataka. There are nearly 60 units in the country scattered all over these states. Annual production of desiccated coconut in India is estimated around 20,000 tones. Barring one or two, all the others are in the small scale sector with a capacity of 0.5 or 1 tonne per day. The consumption of D.C. is comparatively higher in the northern states despite its production centred around southern states. The confectionery industry is the main consumer of desiccated coconut in the organised sector.

In comparison to most modern plants in Philippines and Indonesia Indian D.C units still work on out dated technology. When Indonesia and Sri Lanka keep better quality standards to satisfy international market specifications, indigenous product catering to domestic market does not attain that quality standards. This industry needs revitalisation using modern processing technology to maintain quality standards.

Coir is an important agrobased cottage industry of greater significance. It is a highly labour intensive industry converging a wide range of activities such as collection of husks, retting, fibre extraction, spinning and weaving of coir and products. The demand for coir is on the increase than it has been for the last two-three decades. New uses have changed not only markets but also the production economics of coir. The most important of which is the market for coir dust and pith which are of great demand in Horticultural sector.

Biodegradability is the trait that places the coir on top of the world with a promise for the future. It is all the more important that the industry depends on a material that would not damage the environment otherwise, facilitating conservation.

Coir industry in India support around half a million people belonging to weaker sections of the rural population. About 80 per cent of the workers of coir industry is women folk. Coir industry in India produces a variety of products which have wider market in and outside the country. There has been apparent preference at the global level towards the ecofriendly natural

fibres. Coir mats, matting rugs, ropes, coir foam, and geo-textiles are some of the products manufactured in the country.

India is the premier coir producing country in the world earning a foreign exchange to the tune of 240 crores as mentioned elsewhere. Out of 6531 coir units in India, 5124 units are located in Kerala while 217 units are in Karnataka, 262 in Tamil Nadu, 265 in Andhra Pradesh, 100 in Orissa, 75 in West Bengal, 5 in Maharashtra, 6 in Pondicherry and 3 in Goa.

The two major **coir manufacturing methods** are mechanical defibrating process producing the brown fibre and the microbiological retting process producing white fibre. The white fibre production is concentrated in Kerala while the brown fibre production is concentrated in States like Tamil Nadu, Karnataka and Andhra Pradesh. With the increased mechanisation, significant developments have taken place in the coir processing sectors in the state. Consequently brown fibre production has also increased in Kerala and there is a tendency to shift from white fibre production to brown fibre production. A new retting process using coirret, a bacteria developed by the Coir Board is becoming popular in Kerala. This fibre is called green husk fibre which is used for mixing with white fibre to make different coir products.

Other byproducts

The residue left after the extraction of oil from copra is called coconut cake or **poonac**. It is used as a cattle feed in most of the countries. The residual oil in the cake can be extracted by solvent extraction process. The de-oiled cake containing less than one per cent oil is used to make compound cattle feed and the oil is used for industrial purposes. In Kerala there are four solvent extraction units and one of these is utilising even the imported coconut cake.

The commercial utilisation of **coconut shell** is for the manufacture of products like shell powder, shell charcoal and activated carbon. Activated carbon is a value added product, which is in great demand throughout the world. Shell based activated carbon is in demand as adsorbent of gases and in purification of air and drinking water. It is used in gas masks for protection against toxic gases. Shell based activated carbon is used to purify

air in the submarines and the manned satellites. It is also used in nuclear plants to purify radio active waste gas; to manufacture carbon batteries and in effluent treatment plants in various industries. It is also used in the recovery of solvents and other vapours, separation of hydrocarbon mixtures and recovery of gold in the mining industry. In India there are five firms manufacturing shell based activated carbon. A shell based activated carbon plant is being set up near Kochi with German technology which is the first of its kind in Kerala. With the commissioning of this plant, shell charcoal the raw material of activated carbon will have greater demand. Japan is the largest consumer of shell charcoal (CSC) and activated charcoal.

Coconut shell powder is used in bakelite, plastic, laminated board and mosquito mat/coil industries. In India at present more than ten firms are manufacturing coconut shell powder. Of late coconut shell has captured the attention of the western world. The non biodegradable synthetic packings and containers for food items are substituted with biodegradable and natural products. In this context, the coconut shell which is the only natural container with varying sizes, toughness and durability is likely to gain unopposed popularity. Many units in Kerala and Tamil Nadu are exporting coconut shell ice-cream cups to many European countries. The shell which was hitherto unexploited is bound to find new uses as containers and receptacles for various food items, if well planned market promotional activities are taken up to promote and advertise the specific features and characteristics of this byproduct. Coconut shell is also used for the manufacture of a variety of handicrafts and utility articles. In India there are about 100 units manufacturing coconut shell based handicrafts on a cottage scale.

Evolving Technologies to make use of the coir pith a byproduct of husk processing is equally important. The product can be successfully made use in horticultural Sector as a valuable organic manure and moisture retainer especially for indoor gardening lawns and for pot cultures. Coir pith compost present excellent opportunities in the coming years.

Non-traditional processing and new products

The emphasis given by the Coconut Development Board on evolving

technologies for the development of new value added products has yielded and the product diversification and byproduct utilisation has gained momentum in the recent past. Various research programmes sponsored by the Board through the existing research institutions in the country led to the development of new technologies for the manufacture of coconut water based vinegur. Units have been operation in various parts of the country with the technologies so developed.

The technology for **coconut cream** was the first perfected technology by the Board through the Reginol Research Laboratory, Thiruvananthapuram and transferred to an entrepreneur. The Fresh Coconut Products Ltd in Trissur Dist. Kerala has taken over the technology and commenced commercial production. The plant which is the first integrated unit int the manufacture of value added products with the indigenous technology, has a processing capacity of 10,000 nuts per day with a range of products such as coconut vinegur Sip up and so on. The R&D department of the company is at present working on the processing and packing of flavoured coconut milk and an arry of other value added products like coconut wine, coconut chocolates, coconut protein solution etc.

The technology for the spary drying of **coconut milk** was perfected in collaboration with the CFTRI, Mysore. This is the most potential method for preservation of flavour and texture of coconut milk and has got good keeping quality. This has also been transferred to one unit in Tamil Nadu for commercialisation. The setting up of a unit for a processisng capacity of 20000 nuts /day with a capacity of one tonne of powder would involve an investment around Rs 3.5 crores.

The tender coconut water preservation and packing technology has been developed in collaboration with DFRL, Mysore. The packing medium is pouches and cans with a shelf life of more than three months under ambient conditions and six months under refrigerated conditions. This technology has been taken over by three entrepreneurs in Karnataka and one in Tamil Nadu.

The Board under laboratory condition has developed technology for the production of **Nata de-coco**, a gelatinous product prepared from mature coconut water/skim milk by the action of cellulose forming bacteria,

Acetobactor aceti subspecies *xylinium*. It has been found that 100 litres of water would yield about 30 kg of raw nata. The countries like Philippines, Indonesia and Malaysia have gone in a big way for the production of this food item. India could also fetch good market for making sweet products and as an ingredient for desserts and fruit cocktails.

Another value added product developed by the Board through sponsored research is **coconut water vinegar**. The CFRTRI, Mysore developed the technology through a quick generation process. This technology has been transferred to seven entrepreneurs spread in Kerala and Tamil Nadu for commercialisation.

Wet processing technology is a new process of oil extraction from fresh mature coconut resulting in the production **virgin coconut oil** rich in vitamin E and possessing long shelf life. Apart from virgin oil, a number of other value added products like coconut milk, low fat coconut powder, skim milk etc could be developed through this wet processing. The Regent Agro Products Ltd. a Hyderabad based firm, has adopted this technology and the products are being marketed.

The waste heat recovery technology for coconut shell carbonisation which is today available indigenously, reduces the outflow of smoke and produces clean well carbonised charcoal using coconut shell. The flue gases during carbonisation is passed through a heat exchanger producing process heat which could be effectively utilised for drying operation in copra making and desiccated coconut production. The application of the WHU technology would generate coconut shell charcoal which could be utilised for the manufacture of activated carbon.

MARKETING

For a perennial crop like coconut, stable price and adequate marketing facilities are essential for the development of the industry. However, during the past two decades coconut economy has been under the most distressing situation, owing to the violent price fluctuation of coconut oil both seasonal and cyclical. Coconut prices exhibited peaks and troughs during this period. Such variations in prices make supply management, demand satisfaction and optimum uses of resources difficult. Moreover, the producer

should be assured of a reasonable price to increase production and avoid future shortage. The need of a stable price policy is all the more important in respect of coconut crop.

Because of the predominance of small holding and highly decentralised nature of production, the product has very little control over the marketing of coconut. The traders, on collection of coconut process into copra and sell to oil mills scattered all over the state. These mills in turn, sell oil to large wholesalers as well as to retailers for local distribution. In Kerala, the major market for copra and oil, nearly 52 per cent of the total milling copra is locally crushed and the remaining 48 per cent is exported as copra to upcountry markets in Bombay, Calcutta etc. But these upcountry market buyers are having large market power and will influence the market in contrary of the small rotary units of Kerala. Kerala alone accounts for 80 per cent of the total crushing units. But their crushing capacity is only 52 per cent. While in Maharashtra 34 per cent of the crushing capacity is installed where only 8 per cent of the units are located. Oil prices in Mumbai are always higher than Kerala markets and such price differentials and absence of market integration are clear evidence of an imperfect market structure.

Under the marketing the infrastructure available are the bodies like NAFED, MARKETFED, KEREFED, STC, HVOC and a number of private agencies. NAFED is the central nodal agency for procurement of milling and ball copra under price support scheme of the Government of India. The price support scheme is basically to ensure farmers a minimum support price which is worked out by the Commission for Agricultural Costs and Prices (CACP) set up by the Government of India. Marketfed is an apex body of primary marketing societies in Kerala. It is engaged in marketing of coconut also among other agricultural producers and inputs. It provides better marketing facilities and fair prices to farmers. KERAFED an apex Federation in the Co-operative sector to implement a Coconut Development project with EEC assistance through Primary Agril. Credit Societies. The societies procure copra from farmers and deliver to KERAFED for processing. The KERAFED is now aiming at production of value added products on commercial basis and marketed within and outside the country.

COCONUT DEVELOPMENT BOARD AND ITS CONTRIBUTION

The developmental efforts on coconut crop were initiated in 1940's with the establishment of the Indian Central Coconut Committee. The Committee later on was abolished and the Directorate of Coconut Development was formed and subsequently merged with the Coconut Development Board. The CDB came into existence with effect from 12 th January 1981.

The developmental programmes of coconut received more attention after the formation of the Board. The major functions of the Board *inter alia* include adopting measures for the development of coconut industry, recommending measure for improving marketing of cocunut and its products, regulating import and export of coconut and its products, adopting measures for assisting coconut growers to get incenstive prices for coconut and its products, providing financial and technical assistance for cultivation, processing and marketing of coconut, fixing grade specification and standared of coconut and its products etc. With the formation of the Board the development programmes for coconut were given new dimentions, by identifying thrust areas where efforts were to be concentrated. The decade prior to the formation of the Coconut Development Board witnessed a declining trend in production and productivity, with the area under the crop remaining almost stagnant. Fast sprad of the root-wilt discase in the major coconut growing state of Kerala further aggrevated the cococnut situation. The first and the foremost objective identified by the Board was therfore to create a sizeable production potential for stepping up productivity, development of technology for product diversfication and by product utilization and stremlining the marketing system of coconut and its products.

Expansion of area under suitable regions of the states was given top priority as a major developmental programme of the Board. Apart from traditional belts, the crop was introduced succesfully in the non-traditional belts of the north and north eastern regions in the country, like Bastar in Madhya Pradesh, Purnea and Saharsa in Bihar, and in the states of Tripura. Arunachal Pradesh and Nagaland. With the implementation of the subsidy programme for the past 16 years, an additional are of more than 82500 ha has been brought under coconut. This programmes received encouraging responses from the farming community especially from the production front as well.

The present highest production of 13000 million nuts was attained from a base level production of 5807 million nuts recorded at the time of formation of the Coconut Development Board.

The productivity improvement programmes implemented by the Board could make favourable impact in stepping-up the productivity. As on today India stands in the forefront in coconut productivity in the world with a record of 6863 nuts per ha. This was as low as 4980 nuts during 1983.

Dearth of quality planting material was the major lacuna and productivity improvement programmes. This lacuna was solved to a great extent by the production and distribution of good quality seedlings through the establishment of Demonstration cum Seed Production Farms and coconut nurseries in different regions in the country. The Board also assisted the non-traditional states in the procurement of quality seednuts for their nursery programmes.

When the Coconut Development Board came into existence, post harvest processing was in infancy and was confined to traditional copra processing and oil milling in the country. Development of technologies for product diversification and by-product utilization within the country itself was therefore identified as the major thrust area and the Board has been successful in this venture to a great extent. Coconut Development Board could develop technologies with the help of institutions like the CFTRI, DFRL, RRL and through its own laboratory for products like coconut cream, coconut milk powder, vinegar from mature coconut water, preserved and packed tender coconut water and **nata-de-coco**. To promote marketing of coconut and its products sales outlets were opened in different traditional and non-traditional areas in order to create awareness of coconut products among the people.

The publicity and extension activities of the Board disseminate information on various aspects of coconut cultivation and industry throughout the country. The regular publications of the Board viz. The Indian Coconut Journal and the Indian Naliker Journal are the oldest publications in the agriculture sector in our country. Two quarterlies in Kannada and Hindi viz. Bharathiya Thengu Patrika and Bharathiya Nariyal Patrika are

also published by the Board. The journals feature research, technical and popular articles on various aspects of coconut industry in India and abroad. The total circulation of the journals ranges between 12,000 and 15,000 copies.

The Board brought out several adhoc publications such as books, books, booklets and brochures depicting various aspects of coconuts cultivation and industry which could open up new avenues in coconut for farmers and entrepreneurs. In addition, product promotion, participation in exhibitions, the production and screening of documentary films, training programmes, organizing/sponsoring seminars and organizing competitions were regular features of the Publicity and Extension activity. The major achievements made under the extension activities were the creation of awareness among the people on the nutritive value of coconut oil and the tender coconut water.

The information network of the Coconut Development Board was expanded with the initiation of computerized coconuts information centre at the head quarters of the Board with the main objective of exchanging up-to-date information on all aspects of coconut industry among the major coconut growing countries in the world under the Integrated Coconut Information Service programme initiated by the Asian Pacific Coconut Community.

Besides, value addition of various coconut products and product diversification were emphasized as the key pillars to sustain the coconut economy in the country. As a result, a number of coconut based industries were established during the last 10 years in various parts of the country. Technology was transferred by the board to many units for the production of coconut cream, natural vinegar from coconut water and processing and packing of tender coconut as a soft drink.

A part from the Coconut Development Board the State Govt. Department and Financial institutions are also contributing to the pursuit of the development process.

CONSUMPTION PATTERN AND DEMAND PROJECTION

Coconuts are utilised both as tender nut and mature nut. Tender nut is

consumed as thirst quenching natural drink. In West Bengal more than 80 per cent of the total coconut production is consumed as tender nuts while in Karnataka, Andhra Pradesh and Tamil Nadu it accounts for 25-40 per cent of total production. In Kerala since copra making, oil extraction and coir making are wide spread, the consumption of tender coconuts was not popular till recently. But with the promotion campaign organised by the Board the consumption of tender coconuts has increased significantly in the State. However, its consumption has to be increased further to atleast 15 per cent level on all India basis so that the peak arrivals of coconuts during the summer season could be avoided. The 'mineral water boom' in the country is a clear indication of the scope of tender coconuts as a natural soft drink in the cities and towns. There is scope for increasing use of tender coconuts through systematic campaign of the quality and its availability.

Mature coconuts are used for making milling and edible copra and for the manufacture of desiccated coconut and other kernel based food products. Mature nut is also used for seednut purposes. Coconut is used for religious/cultural functions throughout the country from Kashmir to Kanyakumari. While coconut is a food crop at the national level it is more an oil seed in Kerala. In West Bengal it is a beverage crop since more than 80 per cent of coconut is consumed as tender nuts. In the commercial sector coconuts are mainly used for making edible copra and coconut oil. In almost all states coconuts is used in the raw form or in the dry form in the households for food preparation.

In India as much as 48 per cent of the coconut production is used for edible and religious purposes, 10 per cent as tender coconut, roughly 30 per cent as milling copra for oil extraction, 8 per cent for the manufacture of edible copra and the balance is processed into products like desiccated coconut and coconut cream. In traditional coconut growing state of Kerala roughly 40 per cent of total production of coconut is used as raw nuts while little less than 60 per cent of coconut is used for making copra.

In India it is estimated that about 40 per cent of the total production of coconut oil is consumed for edible purpose, 46 per cent for toiletry use and about 14 per cent for industrial uses. The demand for coconut oil for edible uses is mainly confined to Kerala and to lesser extent in Tamil Nadu. At the

all India level the toiletry sector is the major consumer of coconut oil, since coconut oil is used throughout the country as a hair oil and for body massage either as such as or in medicated form. In the production of toilet soaps, liquid soaps, shaving cream and natural shampoo coconut oil finds use as an important raw material. Use of coconut oil for industrial purposes has decreased tremendously especially in soap industry in the last 2-3 decades, due to substitution of other cheaper vegetable oil. The soap industry had consumed 23 per cent of the total production of coconut oil during the 50's while the present consumption is only 5 per cent (Table 5)

Table 5: Consumption pattern of coconut

	Kerala (%)	Other States(%)	All India (%)
Raw nuts	41.02	78.5	61.6
Mature nuts			
(Including Seednuts)	38.2	57.3	48.7
Tender Nuts	2.9	16.8	10.5
(Desiccated Coconut)	Neg	4.4	2.4
Copra	58.5	21.5	38.4
Milling Copra	53	12.8	30.9
Edible Copra	5.8	8.8	7.5
Oil			
Edible	54.8	-	39.4
Toiletry	16.4	-	46.5
Industrial	5.6	-	14.1
Moved to other states	22.9	-	-

In general coconut and coconut products enjoy countrywide demand. The population in the country according to a statistical projection, will cross the level of 135 crores by 2020. If the percapita consumption of coconut increases not only the future production will be consumed fully but also there will be a gap in demand and supply.

With the recent trend in demand for coconut and the consumption

pattern in various sectors, the demand for coconut by 2002 was projected at 24000 million at 10 per cent growth rate. However a more realistic growth rate has been taken in the present context to work out the projected demand after a period of 1 1/2 decades. By restricting growth rate to a lower level of 8 the demand will touch 52 billion nuts by 2015 from the base level of 13 billion nuts which is the production recorded during 1996-97.

The projection of coconut area by 2002 is 2.67 million ha with the growth rate 6% . This will touch the level of 5.4 million ha, if the tempo of the present growth rate continues.

GOVERNMENT POLICY AND ITS IMPACT

The EXIM policy of Govt. of India keeps edible oils (RBD palmolein, Ground nut oil, Cotton seed oil, Sunflower oil, Safflower oil, Rape seed oil, refined Soya bean oil,) under OGL. The oil industry is pressing the Govt. for allowing import of oil seeds. Coconut oil is a channelised item of import thorough STC/HVOC. But till 1997 there was no import of coconut oil or copra. During 1998 negligible quantity of copra import was permitted by the Govt. (800 MTs) However coconut oil, *per se* has not been imported in to the country. The oil price will continue to remain depressed unless the edible demand of the oil are improved the near future. The agencies involved in the developmental process should embark on an aggressive marketing strategy in order to increase the edible use of oil. The restrictions on import may be removed in view of the agreement executed between the member countries of the World Trade Organisation.

POTENTIAL COCONUT PRODUCTS FOR THE FUTURE

As highlighted in the foregoing paras coconut is a crop which offers immense scope for the development of an array of value added products. Though technology has been developed for some of the products, there are still several value added products which can be commercially exploited. Proper technology has to be developed for utilization of coconut wood and other palm parts. The products like coconut chips, shell charcoal, activated carbon, coir pith compost, coconut honey etc. are other products which can fetch great demand in the domestic and international markets. The country needs to develop the technology for quality improvement and exploit the vast

potential to earn valuable foreign exchange through the exports of these products.

The coconut timber is structurally different from that of the traditional timbers. The potential of coconut wood can be exploited as a standard building material for the ever increasing demand for wood/wooden structurals. The present diminishing supply of timber and raw materials from natural forests presents ample scope for maximum utilisation of coconut timber. It is an urgent need to develop suitable technology on wood processing and improve the quality. The Research Institution like IPIRS, Bangalore has initiated some studies on wood processing to convert coconut wood into various end products like pieces of furniture, joinery and building components. Coconut timber will be an extremely valuable wood material in the next millennium. Developing modern technologies in the wood processing therefore assumes greater significance.

Considerable work has been carried out on utilization aspects of coconut wood in various countries abroad particularly in the Philippines. Though India is a traditional country in the world with substantial wealth of coconut wood, not much work has been done on coconut wood utilization. Maximum possible utilization of available coconut wood has become very vital in view of the present dwindling supply of timber from natural forests. Economic uses of coconut wood will further act as an incentive too to farmers to replace senile palms with high yielding varieties.

Appropriately sawn, graded, treated and dried coconut wood is potential material for diverse purposes. Its uses in more functional applications like furniture, joinery, flooring boards or parquet and other building components have to be promoted rather than restricting its use to curios and novelty products. This can better be achieved if coconut wood is included in all the relevant Indian standards and the National Building Code. Coconut wood has a number of features that make it unique as a wood material source. There seems little doubt, in view of the increasing demand for wood, coupled with the diminishing natural resource, that coconut wood will become with further research and promotion, an extremely valuable material.

As highlighted coir is a versatile ecofriendly hardfiber used commercially for a wider range of products. As per the estimated production level the availability of husk can be calculated based on the present trend in utilisation. The present husk utilisation is as given below.

Kerala	- 38%
Tamil Nadu	- 23%
Karnataka	- 22%
Andhra Pradesh	- 16%
Orissa	- 15%
Others	- 10%
Mean	- 21%

Coir as geo textiles is a recent end use application of the coir fibre in the world market, having immense potential for export from our country. Coir geo textiles helps to accelerate the establishment of viable vegetation on banks and slopes thereby increasing its erosion resistance. Bio degradability is the decisive reason for preferring coir geo textile over synthetic material for specific uses. Coir fabrics can be used to stabilize the soil temporarily when the constructing roads, or on railway embankments. In land scaping projects or in steep slopes coir geo textiles help to keep soil or humous in place so that grass and other vegetation are allowed adequate time to grow. In water tank constructions geo textiles protect the soil against erosion by overflow. Against wind erosion also geotextiles can be used. The geo textiles made of coir have the advantage of not polluting the environment and on the other hand supplement the soil fertility through bio degradation. In short the geo textile manufacturing sector of the coir industry provides an ideal investment opportunity to the entrepreneurs.

Preservation of tender coconut water in pouches / cans offers enormous scope as a natural beverage without any artificial colour and flavor. Beverage industry in India is one of the areas which have registered fastest growth during the recent past. Of late the consumer is well aware of the

possible health hazards of artificial beverages and soft drinks. Tendernut water is not only a soft drink but is also endowed with therapeutic properties and can be counted upon as a potential export item in the next century.

Fresh and sweet coconut toddy is a similar product that can fetch very good market in the next century. Toddy tapping is a highly remunerative venture to be popularized in the next century. Fresh coconut toddy without fermentation can be promoted as a sweet natural drink. This would be an acceptable drink in the midst of an array of artificial drinks available in the market. Technology could be developed in fabricating and promoting tapping tools to enhance tapping efficiency and preservation of toddy as a soft drink.

Woven coconut thatch for roofing and reusable and easily degraded baskets and bags are among long standing rural capabilities. Water proofing are available technologies by coating with appropriate synthetic resins. It is certain that these technologies, combined with more aesthetic and pleasing designs will provide a massive and sustained contribution towards fulfilling such existing opportunities.

The midrib is also remarkable raw material for many uses in handicraft activities.

The positive qualities of coconut oil should be exploited. The oil which is dominated by saturated fatty acids is likely to regain its glory since poly unsaturated fatty acids rich oils are causing many diseases. The notion that coconut oil causes heart attack has been countered to certain extent with the concerted efforts of the Board and other state govt. agencies. The coconut oil when consumed in a balanced quantity will act as a non-harm diet in all respects. The specific aroma of oil and its resistance to rancidity find extensive uses in food industry especially in infant milk powder, ice-cream, confectionery and bakery products. Of the several resources available for the preparation of Vitamin E, coconut oil is the predominant one.

CONSTRAINTS

coconut industry in India still confronts with varied problems in spite of the bright future it presents. Despite the fact that our country stand in the

forefront in per ha productivity among the major producing countries, its potential for increasing the productivity is yet to be tapped. While the states like Maharashtra, Andhra Pradesh, West Bengal and Tamil Nadu possess higher productivity range of 14000-15000 nuts per ha, the national productivity as well as productivity of certain major states like Kerala and Karnataka remains at a very low level. Further various diseases including root wilt, the tragic menace of the century persist in the country. Coupled with rain fed farming and below average management practices confound the problem.

Violent price fluctuation prevalent in the price behavior of coconut and coconut products is another serious problem confronting the 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 necessitate the functioning of a well defined system to arrest such frequent fluctuations in prices of coconut and its products.

The infrastructure available at present for production of planting material is also inadequate to satisfy the needs of farming community. There is an urgent need for increasing the capacity for production of disease/drought tolerant and resistant varieties among the needy farmers.

The perennial nature of the coconut crop also hinders the researchers from getting a research result within the desired time limits.

India, being a signatory to the World Trade Organisation agreement, called for a liberalised EXIM policy. Import of coconut may be liberalised and it will have a negative impact on coconut industry in the country if it is not made globally competitive, besides in WTO regime sanitary and phytosanitary measures are likely to be the major impediments in export of coconut and coconut products. Therefore, quality control assumes all the more important when we think of export products to the foreign markets. The Coconut Development Board has already explored the possibility of exporting Indian coconut products to foreign countries especially to Gulf countries. It is learnt that if quality products are exported in attractive and hygienic packing the Indian coconut products will present a bright future.

STRATEGIES AND CONCLUSION

With the advancement in technology in product diversification and byproduct utilization, the coconut industry in India presents a luminant future. The interest and initiative shown by the Indian entrepreneurs are encouraging as well. Investment in coconut industry is on the increase though at a slow pace. This needs acceleration with assistance both financial and technological, from the concerned agencies and the government. Inter Institutional linkages, private sector partnership for diversification and value addition export promotional research are areas required to be strengthened in future both in production technology and developmental sectors.

There are several opportunities which provide basic strength for furthering the Indian Coconut Industry. Similarly, there are several problems beset with the industry, to be tackled on priority basis. Product diversification, improving the quality of coconut products, increasing the productivity export promotion are some of the ways to make this industry competitive.

In research attempts should be on to identify lines with resistance to pest and disease coupled with high yield and compactness. Research can also be dovetailed to fabricate devices which enable easy climbing, harvesting, and plant protection and post harvest operations, integrated pest management and disease management, rationalisation of pesticide uses by substituting natural products in the crop protection programme. Micro level processing technologies which can be adopted by the small scale holders need be developed. This will enable to get a fair price by marketing value added products instead of selling raw coconuts.

The outbreak of minor pests in several parts of the country creates panic among the farmers as well as researchers and policy makers. The changes occurring in the cropping pattern, adoption of modern agriculture, inputs and plant protection chemicals may invite the recurrence of such pest outbreak. Hence the control of such minor pests should form a subject of study under IPM practices. Development of efficient bio control strategy against pathogen and insect pests is a major thrust area of research in advanced countries. India will have to follow suit, if export potential is aimed.

Similarly we should widen our market by exploring the demand through awareness both in edible and industrial sectors. Though cheaper substitute enter into market, the potential areas where coconut oil alone can be used should be tapped and uninterrupted supply with reasonable price ensured. Coconut oil should become the raw material for oil based oleoresins and other subsidiary products. The information Technology should be more effectively utilized to promote coconut and coconut products among the vast masses within the country.

Let us pin hopes on this environmentally benign crop and strive hard to exploit its versatility. The versatility of the crop, its ecofriendliness, growing demand all present a bright future for coconut in the next millennium. Its unique growth characteristics and rooting pattern, crown orientation and sunlight penetration, capacity to check soil erosion, offering favourable microclimate, nutrient conservation and recycling, adaptability to problem soils, control of natural weeds, as source of renewable energy, are plus points of the coconut palm. By exploiting the full hidden potential of the crop and furthering of the coconut industry India can play a major role in the emerging global coconut scenario.

RESEARCH AND DEVELOPMENT OF SPICES IN THE NEXT MILLENNIUM IN KERALA

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INTRODUCTION

Future of spices or for that matter, of any plantation crop in India in the next millennium is very difficult to be predicted by any expert. In the next one thousand years many changes are bound to happen in land, environment and climate. Global warming is a phenomenon, which has been accelerated by the unscientific burning of fossil fuel. Many lands, which are fertile and suitable for spice cultivation today, may not grow them due to depletion of fertility, climate change or conversion to non-agricultural purposes by industrialization and/or urbanization. Hence the paper visualizes the issues only of a short period, say next ten years.

At present the world spice import is about 4.5 lakh tonnes valued at US\$ 1500 million per annum. But, global production is quite substantial at about 20 times of the total import running over to 90-100 lakh tonnes. Almost every country is producing one or more spices. Much of the spices production is consumed within the countries themselves. But there are exceptions for spices like cardamom in Guatemala, black and white peppers in Indonesia, where domestic consumption is negligible. As per the terminology of spices and condiments of the International Organization for Standardization, there are 109 spices and condiments of which 63 are produced in India.

Spice imports are largely made by North America followed by European Union. In North America, the United States is the largest importer and in European Union, Germany, Netherlands, France and UK. In Far East, Japan is the leading importer of spices. The present trend of world spice

import shows that the growth is about 3 per cent annum.

Use of spices

Demand of any product is based on the uses for which it can be put. Spices have different uses especially in traditional countries. The most important way spices are used is for culinary purposes. Though no authentic information is available on the extent of consumption for cooking purposes it can be presumed that this sector is the most important and takes about 90 per cent of the global production. Consumption of spices for cooking purposes is generally high in tropical countries. Tropical spices are highly flavoured compared to those produced in temperate countries. Spices of temperate countries are aroma based with less pungency or taste. Another important use of spices is food colouring. Spices such as paprika, certain Indian chilli varieties like Byadagi and Tomato, and turmeric are known for colour pigments. The pigments obtained from these spices are safe to health and can be freely used as food colours. It is estimated that about 3-4% of the world production is utilized for making natural food colours.

Spices are known for medicinal properties. Some of the spices like ginger, black pepper, garlic; ajowan and saffron are having excellent therapeutic values. Medicinal uses of spices are popular largely in the producing countries. Classical example is India and here many spices are essential ingredients in Ayurvedic preparations. As per the rough estimate the use of spices for medicinal purposes may not be more than 2 per cent of the global production.

Spices have cosmetic and beauty care attributes. Being food products they can be consumed or applied externally safely for improving complexion and attraction. Spices such as turmeric, saffron, aniseed, cumin seed and clove find application in many cosmetic and beauty care products. The requirement of spices in the preparation of such products may not exceed 1 per cent of the total production.

Certain spices have perfumery value and oils obtained by distillation from them are used in the preparation of aerosols, eu de colons and body sprays. Oils of spices like rosemary, basil, clove and pepper find application in some of the costly perfumes. But many perfumes and room sprays are manufactured from synthetic compounds. Considering the limited applications of spice oils in perfumes, spices utilized for such purpose may be found to

be less than 1 per cent of the total production.

Some spices are also known for insect repelling or insecticidal properties. Spices like black pepper, chilli and garlic have such properties. As chemical pesticides leave residues in the produce application of spices in or their preparations for controlling insect pests in crops for edible purposes is worth considering. However, such uses of spices are to be developed by research.

Having antiseptic and cosmetic values, spices such as turmeric and basil find their use in religious rites. Use of spices in religious ceremonies is mostly confined to India, particularly South India. The requirement of spices for this purpose is negligible.

Indian production

India is the largest producer of spices. Our production is the highest in the case of black pepper, cardamom (large), chilli, ginger, turmeric, coriander, celery, cumin, fennel and fenugreek. Growth in area, production and productivity of important spices in India during VIII Plan is given in the Table 1:

Total production of spices was 18.81 lakh tonnes in 1991-92. There was notable increase in production in 1996-97 to 26.86 lakh tonnes. But the increase has been achieved mainly from area enhancement than from productivity improvement.

Production of Spices in Kerala

Kerala is the leading spice producing State in India. A number of spices are grown in this state. Important among them are black pepper, cardamom, ginger, turmeric, chilli, clove, nutmeg, cinnamon and tamarind. In the production of pepper, cardamom, ginger, nutmeg and cinnamon, Kerala has the prime position among various states. Though ginger and turmeric are produced in a number of States, the varieties cultivated here are superior as they have better intrinsic quality. For want of good demand from within the country and abroad, cinnamon cultivation is declining. Production of turmeric, chilli and tamarind is very small compared to many other states. Growth in area, production and productivity of spices in Kerala during the VIII Plan period are recorded by Directorate Economics and Statistics, Govt. of Kerala

Table 1: Growth in area and production of important spices in India during VIII Plan (area in Ha, Production in tonnes, Productivity kg/ha)

SPICE	Base Year 1991-92			Last Year 1996-97		
	Area	Prod'n	Productivity	Area	Prod'n	Productivity
Pepper	184200	52010	282	179590	55370	308
Cardamom(S)	81845	5000	61	73593	6625	90
Cardamom(L)	26300	3400	129	26129	5150	197
Chillies	84660	618200	7302	956500	945500	988
Ginger	59830	176950	2958	70910	232510	3278
Turmeric	120300	373200	3102	134000	543000	4052
Garlic	94300	370700	3931	96600	451500	4674
Coriander	349700	158500	453	412100	243100	590
Celery*	2934	3600	1227	2935	3568	1216
Cumin*	163575	64884	397	307046	117122	381
Fennel*	19504	24851	1274	25107	28380	1130
Fenugreek*	26050	25485	992	38485	49968	1298
Clove	**1735	**1477	**851	***2270	***2455	***1081
Nutmeg	****4190	****2840	****678	***4680	***1420	***303
Total	1219123	1881097	1543	2329945	2685668	1152

Source: Cardamom: Spices Board

Clove & Nutmeg: Directorate of Arecanut & Spices Development, Calicut

Others: Dte. of Economics & Statistics, Govt. of India, New Delhi

* State Economics and Statistics Department.

** Figures of 1992-93, *** Figures of 1995-96 **** Figures of 1994-95

- The total production of spices in Kerala was 1,49,230 tonnes from an area of 2,59,750 ha with an average production 575 kg per ha in 1991-92. The area, production and productivity have been decreased in 1996-97 to 2,53,642 ha, 1,46,350 tonnes and 577 kg/ha respectively. While area and production have reduced general productivity remained almost the same.

For some spices, area has come down notably during the five year period. The reduction in area was maximum in pepper and 5,530 ha have been gone out of cultivation of this crop by 1996-97. While the area under tamarind has gone up by 1,950 ha production and productivity have come down drastically to 23,030 tonnes and 1,380 per ha in 1995-96. The reason for this substantial reduction is not known since the statistics of area and production of tree spices are not systematically collected.

The total value of Indian production in 1996-97 commuted on the basis of current prices was Rs. 13,261 crore as against Rs. 1,804 crore for Kerala. As such, Kerala contributes only 13.6% of the value of Indian spice production. In terms of volume, Kerala's share is still less at 5.4%. Since some of the spices produced in Kerala are of high value the State is able to keep a higher share in the monetary value of spice production in India.

In the export front, Kerala contributes substantially especially in black pepper, ginger and turmeric. Among various spices produced in the State, almost entire production of ginger and turmeric and more than 60% of the production of black pepper find export market. Another important spice, cardamom, was once a pioneering export item. Till early part of 1980's more than 70% of cardamom production was reaching the Middle East Market. With the increase in production of cardamom in Guatemala and low price maintained by them for export, Indian cardamom gave away the Middle East Market allowing virtual monopoly for Guatemalan cardamom. It is difficult to regain this lost market unless a world shortage is developed with heavy decline in production in Guatemala. Other spices such as clove, nutmeg, mace, cinnamon and tamarind are for domestic consumption and not exported in any appreciable quantities.

Forecast for the first decade of the next millennium

As indicated earlier it is very difficult to visualize the requirement of spices for the next one thousand years. However, if the present trend in uses such as culinary purposes, medicinal/pharmaceutical preparations, extraction of pigments for food colouring, application in cosmetic and beauty care products, preparation of perfumes etc, continue, there is likely to be reasonable growth in demand in the coming years. As estimated by the Food and Agriculture Organization and International Trade Centre, overall growth in world import of spices is about 3-4% per annum. If Kerala wants to continue to grow as the leader of spices production and export as at present,

the following areas need immediate attention of the R & D agencies:-

Development of disease-resistant varieties

Production of black pepper, ginger and cardamom, the major spices produced in Kerala are threatened with dreaded diseases – black pepper from *Phytophthora* foot rot and little leaf disease; ginger from soft-rot/ rhizome-rot disease and cardamom from Katte, Nilgiri Necrosis and Kokke Kandu virus diseases and Azhukal disease. These diseases damage the production in alarming proportion in some years. There is need to develop disease-resistant varieties of black pepper, ginger and cardamom by intensifying research including areas of biotechnology and production of transgenic plants.

Production of varieties with high intrinsic quality

Spices are valued for essential oils and oleoresins. While essential oil contributes aroma, oleoresin imparts flavour. In spices like turmeric, oleoresin after further purification is used for food colouring. Some of the Kerala spices namely turmeric, ginger and black pepper have preference in the international market on account of the better intrinsic quality compared to those produced in other countries. Spices, which have originated in India or cultivated for a number of centuries in India, have many accessions with better and higher oil and oleoresin contents. It is, therefore, necessary to transfer such qualities to the high yielding varieties by breeding programme so that new varieties have not only high yield but also more intrinsic quality.

Evolving varieties with uniform ripening

In perennial spices like cardamom, pepper, clove, nutmeg, garcinia etc., harvesting period extends to two to six months necessitating more than four visits, if the produce is to be harvested at the right stage only. In crops like pepper and clove what is happening today is harvesting the crop in single operation. In such harvest there is heavy loss in yield and quality being tender or not fully developed. If high yielding varieties are developed which have uniform ripening, the cost of harvesting operation can be reduced and the productivity improved further.

Standardization of micro-propagation of tree spices

• Among tree spices, clove, nutmeg and garcinia are important considering the demand within the country and outside. Appropriate technology to produce tissue culture plantlets of these tree spices are still elud-

ing. By using tissue culture plantlets it may be possible to reduce the long gestation period of clove. Nutmeg and garcinia are dioecious and male plants are produced to the extent of 50% of the seedlings. If micro-propagation system can be developed it would be easy to produce female plants of both nutmeg and garcinia from elite trees.

Retention of genetic purity of seasonal spices of high intrinsic quality

Ginger and turmeric produced in southern parts of Kerala are known as 'Cochin Ginger' and 'Alleppey Finger Turmeric' in the international market. The speciality of 'Cochin Ginger' is low fiber content, higher percentage of oil and plumpy appearance. World's best quality ginger is Jamaican ginger which has qualities like cream white colour, lemony flavour and all good characteristics of the 'Cochin Ginger'. It is essential to develop a variety of this kind in order to make our ginger the most demanded in the international market. In the meantime, what is urgently called for is retaining the purity of the 'Cochin Ginger' which is getting admixed with inferior varieties introduced from outside Kerala. High curcumin content to the extent of more than 5.5% is the speciality of 'Alleppey Finger Turmeric'. There are reports that some isolated plants of 'Alleppey Finger Turmeric' have more than 8% curcumin. Since curcumin is the deciding factor for the commercial value of turmeric efforts have to be made to evolve varieties with 8% or higher levels of curcumin.

Selection of drought tolerant varieties of cardamom

There is no variety of cardamom resistant or tolerant to drought. Drought is a recurring feature in cardamom growing areas. In certain years the loss is so severe that more than 50% of the crop is lost. Due to difficult terrain and non-availability of underground water it is impossible to introduce irrigation in all cardamom plantations. Development of drought resistant or tolerant varieties is important for ensuring high productivity of cardamom plantations. Simplification of methodologies for rapid mass multiplication and application of bio-agents and botanicals for the control of pests and diseases:

As spices are used mainly for culinary purpose there is need to ensure that they are free from pesticide residues. Some of the plant protection chemicals used today leave residues in spices, which are carcinogenic or hazardous to health. Use of bio-agents like *Trichoderma*, *Basillus thuringensis* and various parasites and predators, and botanicals like

neem and garlic are safe and sometimes less costly in application. There is need to work out methodologies for mass multiplication of bio-agents, parasites and predators for effective use of botanicals for protection of spice crops. Research is also to be carried out for identifying more and more bio-agents, parasites, predators and botanicals so that almost all the diseases and pests could be controlled safely by using them.

Modernization of agronomic practices

Farming practices followed for spices in Kerala are highly traditional. There are certain recommendations for varieties, cultural and manurial practices and for controlling pests and diseases. Use of these varieties and practices are helpful for improving the productivity to a great extent. A cultivation system, which improves the fertility of soil with tremendous increase in productivity, is called for. The productivity of spices like pepper in Malaysia and cardamom in Guatemala is reported to be much greater than what has been attained in the State. Being export items, it is essential to attain the average productivity of these crops in Kerala comparable with those of other countries. Substantial increase in productivity can be obtained only by introducing high yielding varieties with high-tech practices in the cultivation of these crops.

Mechanization of spice cultivation and on-farm processing

Many operations in spice cultivation is either highly labour intensive or strenuous. Harvesting of pepper especially when grown on silveroak in coffee plantations needs climbing of trees to 8 to 12 meters. Threshing of pepper is done by hands and legs creating hygienic problems. White pepper preparation needs keeping ripe berries in flowing water for about 9 days. Peeling ginger rhizomes is highly labour intensive. Plucking of clove buds especially from tree tops requires scaffolding. There is need to introduce mechanical devices so that drudgery in spice farming is reduced, quality improved and cost of production brought down considerably.

Production of spices free from residues and contamination

Consumers all over the world especially in the developed countries are conscious on health hazards. Hence very stringent quality specifications are being introduced for food products including spices. The levels prescribed for pesticide residues, aflatoxin and physical contamination are so low that it is safer to produce spices free from the residues and contamination. Pre-harvest and post-harvest operations are, therefore, to be improved so as to ensure that

the produce is totally free from quality complaints.

Strengthening research on new spices

Agroclimatic condition in Kerala is congenial for cultivation of spices like vanilla and cassia and perhaps star anise. They can be grown as inter-crop in coconut and arecanut gardens. While cultivation of vanilla has been attempted in certain locations, cassia is yet to receive attention. Almost entire vanillin essence used in the country is based on synthetic vanillin though consumers will prefer natural product. There is good demand for cassia within Kerala and also in the country. Our present requirement is met by import from neighbouring countries. Hence effort should be made to strengthen research and development of these spices to produce them in sufficient quantity.

Preparation of guidelines for organic spice production

Considering the damage caused to land, water and/or air by industrialization especially due to the production of fertilizers and plant protection chemicals there is a global movement to grow crops following the rules of nature and without the application of synthetic fertilizers, plant protection chemicals and hormones. Though at present, only niche markets are available for organic spices mainly in countries like Germany, Netherlands, UK, USA and Japan considering the ensured quality and freedom from health hazards, their demand is likely to go up much higher in the coming years. Cultivation and processing of spices based on organic agricultural methods are to be developed at least for important spices at the earliest.

TO SUSTAIN CASHEW IN NEXT MILLENNIUM

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Preamble

The 50 years of post independent era of Indian agrarian sector has witnessed a tremendous growth in plantation sector and in Indian commerce involving plantation produces and products. The prominent plantation crops are tea, coffee, rubber and cashew. Cashew though for all practical purposes is viewed as a plantation crop, it is not given administratively a plantation status. All the plantation crops are not original to India but are introduced in the pre-independent colonial regions that existed for centuries. Cashew in the same manner is a crop original to Brazil having got introduced in India nearly 45 decades back. Ever since its introduction, cashew has been playing an important role in the national economy by way of providing sustained anchorage in rural sector, industrial sector and in commercial sector. Cashew cultivation in India is at present confined to the coastal regions of West and East peninsular parts. In the recent past, interior areas like Madhya Pradesh and part of North-Eastern states are also being exploited for its cultivation. According to the official statistics, the area under cashew in India is 7.00 lakh Hectares as at the end of 1997-98. The productive area of cashew in India has been 5.07 lakh hectares in 1995-96, 5.15 lakh hectares in 1996-97 and 5.11 lakh hectares in 1996-97. The production from these plantations for the corresponding period has been of the order of 4.20 lakh MT in 1995-96, 4.30 lakh MT in 1996-97 and 3.60 lakh MT in 1997-98. State wise details are in given Table 1.

Except for the year 1995-96 and 96-97, there was a drastic reduction in production in 1997-98 due to adverse weather parameters detrimentally effecting the production physiology of the plantations. These factors reduced the production by 25% all over the plantations in the country, with regard to the productivity, the variation remained in the range of 5 to 20 per cent in all the three seasons. The average productivity of our plantations has been in the range of 850 to 880 Kg/Ha which is quite low when compared with the production potential of the new varieties recently evolved and getting

Table 1: The area, production and productivities of cashew in different states

State	Area (000 Ha)	Productivity area			Production (000 MT)		
		1997-98	1995-96	1996-97	1997-98	1995-96	1996-97
Kerala	120.00	107.00	117.50	117.70	140.0(150)	134.0(134)	100.0(125)
Karnataka	87.00	68.40	74.85	74.90	37.6 (40)	52.0 (52)	35.0 (45)
Goa	52.00	43.40	46.50	47.10	17.8 (19)	20.0 (20)	25.0 (31)
Maharashtra	103.00	60.60	51.20	40.00	69.0 (73)	80.0 (80)	60.0 (75)
Tamil Nadu	80.00	75.60	76.90	77.40	30.9 (33)	30.0 (30)	30.0 (38)
Andhra Pradesh	124.10	71.70	72.30	72.80	71.7 (75)	60.0 (60)	50.0 (62)
Orissa	108.60	65.70	59.70	59.90	43.0 (45)	40.0 (40)	45.0 (56)
West Bengal	9.00	7.00	7.00	7.00	7.0 (7)	6.0 (6)	6.0 (7)
Others	6.20	7.30	9.00	14.70	8.0 (8)	8.0 (8)	9.0 (11)
Total	700.90	506.70	514.95	511.50	420.0(450)	430.0(430)	360.0 (450)

Figures in parenthesis is the potential production

adopted for future plantation developments.

A concerted effort for the development of cashew started in India from the 4th plan and continued plan after plan thereafter. The area under cashew existed in 1965-66 was 2.40 lakh Ha, which due to the continued expansion programme, increased to 7.00 lakh Ha. by 1997-98 registering more than 200 per cent increased coverage during the past 30 years with an average annual growth rate of 6 per cent per annum. The production of 1.00 lakh MT of 1965-66 increased to a potential production level of 4.5 lakh MT in a span of 30 years which has registered an annual growth rate of 12 per cent per annum . Even though there was 100 per cent increase in productivity, the average annual growth rate has remained below 4 per cent per annum only. The state of affairs even though has been an encouraging phenomena in terms of area coverage attainment of production potential, our plantation continues to exhibit inferior level of productivity due to the non- availability of any proven technologies advocated by research during the course of development of these plantations. The indiscriminant use of seeds and seedlings, inadequate care and attention have been responsible for the bad state of affairs in which

our plantations are entangled in.

The Indian cashew industry

The cashewnut industry irrespective of the availability of domestic production gathered greater momentum plan after plan and has been maintaining a significant position in the international trade. The processing capacity increased nearly three times during the span of 30 years by increasing the processing set up to nearly 800 units from a meager number of 300 units existed prior to 4th plan. The expansion of industry has been on account of ample availability of rawnuts for import till the 4th plan end. Conspicuous increase in processing setup to the level of 200 per cent was witnessed during the past decade on account of the increased availability of rawnuts from domestic sources. At present there are 800 processing units in the country which can absorb nearly 8.00 lakh MT of rawnuts against which the present availability is hardly 50 per cent.

The Global trend in consumption of cashew kernel is around 2.5 lakh MT of which India's contribution is hardly 70 to 75,000 MT. The present global consumption is nearly 1.5 lakh MT of which 50 per cent share comes from India and the remaining 50 per cent from other rawnut producing countries.

Considering the demand in the global market and the potential for processing availability in the country, India has to take concrete steps for doubling the production for export and internal consumption. The internal consumption at present is almost 50 per cent of the total production. Taking into account the large market available for exploitation within and outside, any amount of cashewnut getting produced will be consumed for which the next millennium has to have concrete steps for increasing the production.

Kerala is the largest producer of cashewnut in the country. Nearly 17 per cent of the national area is in Kerala from where 23 per cent of the national production becomes available. With regard to the productive area of cashew in Kerala it has been remaining more or less stagnant during the past three years. The same is the case with production. Kerala had the advantage of maintaining a premier position till the end of 3rd plan as no other

State in the country was having any substantial production. The State was holding 36 per cent of the area and contributing 70 per cent of the production in the pre-fourth plan period. The predominance gradually declined due to the emergence of other states towards the cultivation front and inadequate expansion measures contemplated by Kerala since 4th plan. While this state has the predominant position in area and production even now, due to the neglect and over aging of the plantation with set in senility phenomena, the production and productivity is coming down. Most of the areas suitable for cashew has already come under the fold of this crop with indisrupt seeds and seedlings and no more expansion is possible with the high yielding clones now available for plantation which can be highly exploited by other states only. The only alternative for Kerala therefore is to replant the existing plantation of overaging status exhibiting declining productivity status due to senility.

Sustainable efforts needed

Cashewnut cultivation has been there prior to 1966 as well. But a coordinated approach was initiated from 1966 by the Directorate of Cashewnut Development. Until the end of 7th plan cashew plantation was possible only with seeds and seedlings, as there was no other means in the form of specific varieties or any other proven technique for multiplication. Because of such massive effort to increase the area under cashew, no scientific plantations of merit could be developed, as, even the selection of such seeds and seedlings were of random nature, which resulted in large hecatrage of unsatisfactory productive ability. Coupled with this, inadequacy of a standardised package of treatments further deteriorated the situation.

Until the end of 7th plan, cashew development has not received adequate support financially, technologically and administratively. Only during the 8th plan as a part of overall development of Horticulture, cashew also received a substantial allocation with which an integrated approach with effective programmes to improve the production build up became possible. Technological advances supported the strategy of cashew development of 8th plan in a sound manner. The research could provide 30 high yielding varieties suited to different agroclimatic tracts, (soft wood grafting) in addition to a comprehensive agri-horticultural packages on canopy manipulation, nutrition, crop protection, water requirement and soil

management. An integrated approach supported by the above advanced technologies was therefore possible. Complete elimination of the use of seeds and seedlings for plantation development and use of clones of the recommended varieties of cashew alone was the salient determined effort towards the development of cashew in 8th plan. Senility, as was posing a serious problem towards augmenting the production, replanting of such areas was introduced on a modest attempt. Establishment of Regional Nurseries to generate clonal planting material was another landmark towards the achievement of the desired objective. Transfer of technology to farming community and executional functionaries, which hitherto remained at a low priority, attained a significant turn in the 8th plan. Development of model clonal gardens as a tool of demonstration of improved cultivation techniques could be adopted as a visual aid towards the transfer of scientific technologies. Publicity on crop promotion was taken up to disseminate the scientific information through literatures developed on regional and vernacular languages.

Technologies available for transfer in cashew

Number of technologies are available for transfer to the field. The scientific contribution are highly proven techniques which still need an aggressive effort for their transfer to the field. A number of varieties are identified which are suitable to different agro-climatic export criteria. Easy and effective method of propagation is available, a comprehensive agri-horticultural management practices are available and these technologies are to be transformed to the field by way of development programmes. The developmental effort is primarily objective oriented and needs regular monitoring in the adoption of the technology by the farming sector for which the extension wing of the developmental agencies have to equip and update their knowledge and systematise their relationship with beneficiaries.

Transfer of technology concept in 9th Plan

The minimum effort adopted in 8th Plan in respect of technologies in promotion of cashew has however revealed that there is every need to bring about a revolutionary change in the attitude and aptitude of the farming sector in accepting the technological advancements so far achieved by the Research. The concept of transfer of technology in the 9th Plan will follow

the pattern accepted and executed in the 8th Plan. Such activity falls into three major aspects :

Technology dissemination through development of model gardens; Technology dissemination through training programme for farmers and field level functionaries; and Technology dissemination through publicity measures.

The development of model gardens will have the primary objective of demonstrating the efficiency of various production technology developed by Research. The different components of production technology are proper nutrition, proper crop protection, water management and plant management. Demonstrations on all the components of production technologies in aggregation or in isolation according to the needs of the location will have to be taken up.

Role of research in transfer of technology

Research support is necessary in the technology dissemination envisaged in the 9th Plan. A greater role and co-operation of National and State Agricultural University researches, particularly in monitoring the demonstrations, imparting training and in bringing out literatures by removing the ambiguity and misnomers in their technologies are needed.

Cashew in Kerala

Kerala is the major supplier of cashewnut in the country. The state contributes around one lakh tonne out of the total production of around 3.5 lakh tonnes. The internal production is not adequate enough to meet the industrial requirement of around 6 lakh tonnes. The annual import of raw cashew is of the order of around 2.5 lakh tonnes. All out efforts for both area expansion and productivity improvement are therefore called for in the case of cashew. Being an export oriented crop, development support of substantial scale is provided by Government of India. However, the resource made available is quite meagre to make any sizeable dent into the problem. The performance of cashew in Kerala during the last decade presents more or less a stagnant picture in respect of both area and production. As per the estimates for 1995-96 the area is around 1.15 lakh ha. with an annual

production of 97000 tonnes. The average productivity recorded was 843 kg/ha. Trends in area, production and productivity of cashew in Kerala are given in Table 2

Table 2: Area, production and productivity of cashew in Kerala

Year	Area (‘000 ha.)	Production (‘000 tonnes) Raw Nuts	Productivity (kg./ha.)
1986-87	133.56	96.77	725
1987-88	121.55	81.48	670
1988-89	119.60	98.88	827
1989-90	123.66	106.26	877
1990-91	115.62	102.77	888
1991-92	112.06	104.60	933
1992-93	109.04	95.62	877
1993-94	106.73	87.51	820
1994-95	103.45	95.55	924
1995-96*	114.82	96.78	843

* Provisional

Kerala is the major state accounting for the largest share in cashew production in the country. However, the internal production is not sufficient to meet the demand of three lakh tonnes to feed the 271 processing factories operating in Kerala. The present production is sufficient to meet only 50 per cent of this requirements. The important constraints in increasing cashew plantation in Kerala are listed below:

Constraints

Land is a major problem in the cultivation of cashew in Kerala. Land ceiling laws prevalent in the state limits its cultivation to the small and marginal holdings, the owners of which are not economically sound. The scientific management practices are not considered to be important. If the land ceiling laws are amended as in the case of other plantation crops, farmers who owned extensive lands will come forward to develop cashew plantations in large scale as in the case of rubber, coffee etc.

In addition, an agewise classification of cashew plantations in the state reveals that plantations of over 30 years covering nearly 56 per cent of area under cashew in the state accounts only for 38 per cent of its production while plantations of 15-30 years of age accounts for 37 per cent of production. It may also be pointed out that plantations of age 15-30 years give maximum productivity, and productivity declined after 30 years of age. Preponderance of cashew plantations of older age group have constraints in the production of cashew in the state. The corrective measure to be taken up in this regard is to replant/rejuvenate all such old and unproductive plantations with high yielding varieties.

Kerala has fully fallen in line with the policy of clonal plantation development and has totally abandoned the use of seeds and seedlings. The capacity of clonal materials generation in Kerala is rather inadequate. During the Eighth Plan, regional nurseries were started, two under Kerala Agricultural University, one under Department of Agriculture, one under Central State Farm, Aralam and three under private sector. The department has five district farms where production of cashew clones is taken up. But there are no adequate well identified mother plants of the recommended varieties in such farms. At present the annual requirement of clones for the state is around three lakh numbers. Such a high demand is being met mostly from the neighbouring state of Karnataka. Only less than 30 per cent of this requirement is met from internal sources of the state. During the Ninth Plan, for larger replanting programme, the state will require nearly 4-5 lakh grafts per annum. The state machinery has, therefore, to take steps to enhance the production of clones.

In Kerala, even though cashew is one of the major horticultural crops earning sizable foreign exchange, the development of this crop is only one of the many activities of the Department of Agriculture. Even though, well built grass root level institutions like Krishi Bhavans are established, the extension workers are not able to disseminate the advanced research technologies developed by the research front. The knowledge on the use of high yielding clones, advocacy of various production technologies like proper nutrition, crop protection, soil and moisture management, canopy management etc, are not percolating to the farming community to the desired extent. At many instances, such knowledge among the extension workers themselves is inadequate. The infrastructure to provide a deep transfer of technology to the farming community, needs strengthening including regular training systems for field workers and farmers and an exclusive cell for monitoring cashew development programme is felt necessary.

TO SUSTAIN COCOA IN NEXT MILLENNIUM

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INTRODUCTION

Cocoa beans, primarily an item of confectionary industries is the produce of cacao plant, mostly grown as a companion crop interspersed within the boundaries of irrigated coconut and/or arecanut gardens. Cocoa like coffee, tea etc. also is a plantation crop but with little plantation status with regard to its cultivation is concerned. The various industries utilising the cocoa beans for processing, projects a demand of 30,000 MT by 2005 AD as against the present level production of nearly 7,000 MT of dry beans. To meet the industrial demand, there has to be an annual growth rate of 20 per cent per annum over the present base level production of 1996-97. The present level of productivity of cocoa is hardly 560 Kg/Ha. If at all the industrial demand is to be achieved, the production will have to be at least doubled if not trebled. The details of area, production and productivity is given in Table 1.

Table 1: Area, production and productivity of cocoa in India (1996-97)

State	Area (Ha.)	Production (MT)	Productivity
Kerala	10,240	5,750	560 Kg/Ha
Karnataka	Traditional	650	
	Non-traditional	120	
Andhra Pradesh	740	420	
Tamil Nadu	140	20	
Total	12,400	6,960	

Indian cocoa scenario

Cocoa a native of South American tropics got introduced into India in the early half of the current century. The commercial cultivation of cocoa however commenced from 1960's only. Kerala was the leading State in promoting cocoa cultivation. Massive area coverage was possible through distribution of cocoa seedlings. Perhaps Cadbury India (Ltd.) was the only industrial unit at that time consuming cocoa beans. There was an attractive price for cocoa pods and beans prevalent till 1980's. This favourable situation coupled with planting material distribution could bring about an enviable coverage under cocoa cultivation recording 29,000 Ha of cocoa by 1980-81. Being a crop subjected to the monopolistic exploitation of the available industrial units; however paved ways for fall in price in 1981-82 and 1982-83; Inadequate marketing network and the fall in price since 1982-83 developed a sense of insecurity among the planting communities, which detrimentally affected its expansion, besides attributing to neglectful approach by the plantation community. Throughout 1980's wet beans price of cocoa remained below Rs.10/- per Kg. Only from the beginning of 1990's the price gradually increased. The Cadbury India Ltd., and CAMPCO rendered limited services towards an effective procurement of Cocoa from producers offering a price varying from Rs.12/- to Rs.17/- per Kg which could help in resetting the cocoa cultivation and industrial consumption back to its track, as we find it now. Average price of cocoa fetched by an Indian farmer is around Rs.15/- per Kg of wet beans at present.

Industrial senario of cocoa

Various cocoa products are confectionery in nature and consumable with palatablenees. Internationally it is an item largely consumed in developed countries. India has gained a foreign exchange of nearly Rs. 9 crores in 1995-96 and Rs. 6 crores in 1996-97 by way of export of cocoa beans and products from India. At present the global production and consumption of cocoa is around 24.00 lakh MT. Compared to this, India's production is far below the World demand.

Potential for cocoa Development in India

Cocoa being a tropical crop, India offers considerable scope for its development. This has been found well adaptive as a companion crop in between irrigated cconut and arecanut gardens because of its need for partial shade. States like Kerala, Karnataka, Goa, some parts of Maharashtra,

Pondicherry, Tamil Nadu, Andhra Pradesh and some parts of Orissa and West Bengal will therefore offer considerable scope for its development as these areas are coastal belts where coconut is grown under irrigated conditions. Of the 15.00 lakh Ha of coconut gardens in India, the coconut areas in Karnataka, Pondicherry, Tamil Nadu and Andhra Pradesh are mostly irrigated in nature. In respect to other states nearly 30-40% are under irrigation. Therefore not less than 3.00 lakh Ha will definitely be suitable for growing cocoa as an intercrop.

Efforts of cocoa development in 8th plan

During the 8th Five Year Plan steps were taken to generate good quality planting materials, to rejuvenate unproductive trees and to support irrigation and marketing network besides measures for transfer of technology through demonstration and farmers training programmes. These measures altogether had an outlay of Rs.3.00 crores only and when compared to the actual demand of the industry, this outlay was quite meagre. Considering the execution of the 8th Plan programmes, production oriented programmes with a project approach and integrated measures were highly lacking. The infrastructural development also was very much limited particularly towards the generation of high yielding clones and hybrid seedlings. Even though research institutes were assisted towards development of clonal seed gardens, there was no proper linkage with area coverage. The assistance proposed were very very meagre which has been found quite unattractive for the beneficiaries to come into the fold of cocoa cultivation.

Experience over the years had shown that cocoa comes up very well in the traditional areas in the country (Kerala and Karnataka) as an intercrop of coconut and arecanut especially when cultivated with irrigation. Results of experiments conducted at CPCRI and KAU had also shown that if properly managed with fertilisers and irrigation, the yield of the main crop (coconut and arecanut) also tends to increase. The experience in the farmers fields also had been similar in the early years and it was considered that this crop combination is either compatible or symbiotic. The large return of organic residues by cocoa and the substantial build up of the organic matter content of the soil were the reasons for the benefit to coconut and arecanut. When under neglect, this association can also be parasitic.

Approach for coca development in 9th five year plan

Cocoa, even though comes under the definition of plantation crops, pure plantation of cocoa as such is practically absent in India. Cocoa is generally taken up as an intercrop or more precisely a companion crop in irrigated coconut and arecanut gardens. To some extent it is grown under rainfed conditions in some parts of Kerala. The production of cocoa beans hardly meets 30% of the demand projected by the processing industry in India. As assessed, the demand of cocoa beans is 30,000 MT by 2005 AD. To step up the production to the projections of the industry, at least 23,000 MT are to be produced within a span of 10 years. In other words, if only a 20% annual growth rate is achieved, attaining 30,000 MT by 2005 is possible. In order to achieve this production level 20,000 Ha atleast will have to be brought under cocoa during the 9th Five Year Plan.

To increase production the unthrifty nature of existing cocoa gardens do pose a serious problem. Rejuvenation by top working, a method standardised by the research has been found beneficial. However adoption of such practices is possible only in Kerala and Karnataka. Due to its high location specific nature, adoption of such practices in a large scale is rather difficult. Therefore, emphasis will have to be again on new area development.

The productivity of the existing gardens are not highly encouraging, as such productivity level is only just 30% of the potential exploitable by way of using high yielding clones. The genetic inferiority of the existing plantations is one of the factor for low productivity. Sufficient contribution of the research by way of evolution of good selection and hybrids are available. Clonal multiplication of these varieties have a potential productivity of 3 Kg. of cocoa per tree (Table 2). Basic infrastructure build up by way of regional nurseries is therefore the foremost approach in the 9th Five Year Plan. Technological developments in cocoa by way of proper nutrition, clonal multiplication and pest and disease management are of recent origin and transfer of these technologies among the plantation community is an essential part of propagating economic level of cocoa plantation management. Besides adequate publicity on these aspects as one of the measures of transfer on technology, development of model cocoa clonal gardens also is envisaged in the 9th Five Year Plan. In order to strengthen the present marketing systems in cocoa adequate infrastructure for the formation of

Marketing Societies is also envisaged in the 9th Plan. Integration of Production technologies is the salient approach of 9th five year plan.

Table 2: Varieties recommended for adoption

Variety	Pod Characteristics					Bean Characteristics			
	Wt. (g)	L. (cm)	W. (cm)	Wet Wt. (g)	No.	L. (mm)	W. (mm)	Thickness (mm)	Sin. Dry Wt. (g)
M 16.9	384.7	16.3	7.4	110.8	46.2	19.4	10.8	6.7	0.8
M 13.12	311.3	13.3	7.2	96.5	45.5	21.2	10.5	5.9	0.8
G I 5.9	240.6	11.8	6.7	94.8	42.3	18.6	10.8	5.8	0.8
G II 19.5	402.1	15.5	7.7	126.2	45.4	21.7	11.9	6.8	1.1
G IV 18.5	425.0	14.8	8.3	114.4	45.2	19.4	9.8	5.6	0.8
G VI 55	895.0	19.5	1.0	225.5	48.0	25.3	13.4	7.1	1.1
G VI 56	526.7	17.6	8.7	125.3	46.9	24.3	13.7	8.1	0.9

Wt. : Weight, L. Length, W.: Width, Wet bean Wt.: Wet bean weight/pod, No.: Bean Number, Thickness : Bean thickness, Single Dry Wt.: Single bean over dry weight

Generation on planting materials in 9th five year plan - regional nurseries concept and set up

Cocoa until the end of 7th Plan was raised from pods collected from high yielders. Considerable variation in the yield and growth of cocoa was observed by this means. Using vegetative propagation techniques it is seen that the productivity can be substantially increased. In order to produce budded cocoa plants clonal seed garden for cocoa were established in the 8th Plan under the auspices of CPCRI, KAU, Central State Farms Corporations. Now sufficient contribution of the research by way of evolution of good selection and hybrids are available. Clonal multiplication of these varieties have a production potential of 3 Kg per tree. Basic infrastructure build up by way of Regional Nursery is therefore the utmost necessity in the 9th Plan.

The Research Institutes and their agencies assisted in the 8th Plan for planting material generation will provide the nucleus planting material (clones of high yielding varieties of cocoa) to the identified agencies for establishment of Regional Nurseries in 9th Plan. These agencies will also support the Area Expansion Programme of 9th Plan. The Regional Nurseries established in the first two years will generate F1 Hybrid seedling from the nucleus seed

material obtainable from the research/development agencies identified for such support in the 8th Plan. From 3rd year onwards the Regional Nursery will supply clones of high yielding variety developed from their clonal mother plants stocked under each of such Regional Nursery. A total of 13 number of Regional Nurseries will be established during 9th Five Year Plan.

Cocoa in Kerala

Even though the state had a coverage of around 23,000 Ha in seventies, consequent to the fall in prices and inadequate marketing support the area has come down considerably in the subsequent years. The area now available is only around 12,000 Ha and the production around 5000 tonnes. The average productivity is 0.5 tonnes which is very low. There is potential for raising the productivity to at least one tonne per Ha. The strategy for cocoa development during Ninth Plan should therefore, lay emphasis on improving the productivity through additional irrigation support and scientific management. Still there will be a gap of around 8,000 tonnes for meeting the internal demand. There is scope for expansion of area by another 10,000 Ha. Cocoa is an excellent intercrop with coconut and arecanut under irrigation and intensive management. Cocoa has therefore, to be promoted as intercrop in coconut and arecanut gardens in atleast 100 panchayats which take up the rehabilitation programmes for coconut and arecanut. The central assistance available should be combined with state support so that both help in securing expansion in area of around 10,000 Ha and improvement in productivity from 0.5 to 1 tonne per Hectare. The activities have to be co-ordinated from the state level and nursery support for the rapid multiplication of high yielding cultivars being developed by the Kerala Agricultural University has to be extended.

CAMPCO is providing the marketing support. Expansion of area would demand widening of the marketing network. Growers organisations or selected co-operatives have to be assisted for establishing the additional procurement centres through CAMPCO.

STRATEGIES ON COFFEE RESEARCH TOWARDS NEXT MILLENNIUM

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Coffee is the second largest traded commodity in the international market after petroleum products. This stimulating beverage crop is currently grown in over 80 countries, contributing substantially to their national exchequers. In India, coffee has a place of pride among plantation crops and is mainly cultivated in the hilly tracts of Karnataka, Kerala and Tamil Nadu and to small extent in non-traditional areas such as Andhra Pradesh, Orissa and North-eastern states. The total area under coffee cultivation in India is around 3.05 lakh ha. with an annual average production of around 2.3 lakh MT. During 1997-98, coffee industry contributed nearly Rs.1700 crores of foreign exchange to the national exchequer.

As an agro-based rural enterprise primarily, this industry is a source of direct employment for about 5 lakh people in the area of cultivation apart from providing indirect employment to many in processing and trade sectors. Coffee cultivation is also instrumental in preserving the precious forest ecosystem in traditional areas while in non-traditional areas coffee was introduced to check the Podu / shift cultivation and thus to control denudation of forest and also soil erosion. Thus, the coffee industry is second to none in its contribution to the areas of rural development, environmental preservation, employment generation, etc. in the Indian context.

Coffee research initiatives and present status

Organised coffee research in India was started as one of the UPASI's initial activities and subsequently Mysore Coffee Experiment Station was established during 1925 at Balehonnur, Chikmagalur Dt., Karnataka. In 1946, this Research Station was annexed to the Coffee Board and expanded as Central Coffee Research Institute (CCRI) during 1962.

This is one of the earliest research centres for coffee in the World serving the coffee growers of the country through developing improved planting material, evolving suitable package of practices, tackling the problems of pest and diseases and standardizing the post-harvest operations.

In addition to the main station, a sub-station at Chettalli, Kodagu, Karnataka and four Regional Coffee Research Stations, one each at Chundale (Kerala), Thandigudi (Tamil Nadu), R. V. Nagar (Andhra Pradesh) and Diphu (Assam) were established to pursue location specific research problems.

Significant Research Achievements

The notable accomplishments of the Research Department are;

- Establishment of a massive gene bank of international recognition comprising of over 350 arabica collections, 15 robusta types and 17 different species of coffee.
- Development of high yielding, rust tolerant, widely adaptable varieties (12 arabica and three robusta) which occupy over 95% of the total planted area.
- Standardisation of conventional vegetative propagation techniques like cuttage and grafting and popularization of the same for practical application in the growers fields.
- Standardization of *in vitro* protocols for mass propagation of elite types.
- Evolving improved agro-techniques on soil, plant, shade and weed management aspects.
- Standardization of irrigation schedules for robusta.
- Recommendations on fertilizer schedules and ameliorative measures for nutrient deficiencies.
- Developing drought alleviation methods for drought susceptible robusta.
- Evolving effective methods for integrated management of pests using cultural, chemical and biological means.

- Nematode management in arabica through use of resistant rootstocks.
- Identification of physiological races in leaf rust pathogen *Hemileia vastatrix* for the first time in the World and development of *in vitro* and *in vivo* screening procedures for rust resistance.
- Evolving effective disease control strategies through integrated management.
- Standardization of post-harvest techniques for wet and dry processing of coffee.
- Development of pollution abatement systems to protect natural water bodies and environment from the harmful effects of coffee effluents.

The concerted efforts of Research Department over the past several years resulted in a phenomenal increase in the country's coffee production from around 20,000 MT during 1950's to around 2,30,000 MT by 1995-96. Of course, the systematic efforts of transfer of technology by the Extension wing and also the enterprising nature of coffee growers to adopt the scientific cultivation methods have also contributed immensely towards the above noteworthy achievement.

The Challenges Ahead

Notwithstanding the earlier contributions and achievements, there are many other challenges ahead of the Indian coffee in general and coffee research in particular. The Indian coffee industry has undergone marked changes since 1992-93, in which the protected and monopolistic pooled marketing system has paved way for open market system. The liberalisation of Indian coffee marketing also coincided with boom in International prices and the growers started getting attractive prices for their produce worldwide. Owing to attractive prices, efforts are going on in all the coffee growing countries to enhance their production share. The Coffee Board has projected a target of 3,00,000 MT by the year 2002. As there is not much scope for area expansion, this production increase needs to be met only through enhanced productivity. Increased production would result in surplus stocks in the coming years, leading to buyers market where quality becomes mainstay. Thus, improving the productivity and quality takes upper most priority in the coming years. This should be achieved without harming the

environment and final product, so as find an edge in the International market. In view of above challenges, there is a need to re-orient the present approaches.

Contemplated new strategies

The Research Department is contemplating the following new strategies to meet the above challenges.

1. Reorientation of Research Focus
2. Systematic Management of Research Programmes
3. Strengthening of Research Facilities
4. Human Resources Development

Reorientation of research focus

Under the new research focus, the following thrust areas have been identified.

- Collection, cataloging and conservation of germplasm
- Biotechnological and genetic engineering approaches for crop improvement.
- Standardization of location specific technology
- Input optimization and mechanisation
- Developmental and stress physiology
- Packages for production of speciality coffees
- Eco-friendly approaches towards integrated pest and disease management
- Standards for monitoring pesticide residues towards quality upgradation
- On-farm waste processing and pollution control

Based on the above thrust areas, the following future lines of research are contemplated.

Crop Improvement

- Collection and conservation of germplasm,
- Development of hybrid seed production technology,

- Developing varieties with location specific adaptability and varieties amenable for high density planting and intensive cultivation,
- Characterisation of germplasm through DNA finger printing.
- Bio-tech approaches towards development of haploids, somaclonal variants in arabica, low caffeine coffees through somatic hybridisation, synthetic seeds and cryo-preservation.
- Genetic engineering application for transfer of useful and potential genes for crop improvement and development of disease/pest resistant varieties,
- Studies on stress physiology towards identifying drought tolerant types.

Crop Management

- Standardization of location specific technology,
- Input optimization and mechanisation,
- Integrated nutrient management (INM),
- Developing DRIS concept for nutrient budgeting,
- Bio-fertilizers and vermiculture,
- Water conservation/augmentation,
- Package of practices for high value organic coffee.

Crop Protection

- Crop loss studies and forecasting models for major pests and diseases,
- Use of eco-friendly botanical pesticides/fungicides for integrated pest and disease management,
- Bio-control of pests and diseases using parasitoids, predators and pathogens,
- Rational use of pesticides/fungicides,
- Pheromone and Khairomone studies.

Post Harvest Technology and Quality Improvement

- Standardization of processing machinery,
- By-product utilization,

- Anti-pollution measures,
- Mycotoxins and pesticide residues analysis towards upgradation of quality,
- Establishment of quality standards for speciality coffees,
- Quality education and monitoring.

Systematic Management of Research Programmes

- Constitution of Expert Committees for making the projects technically sound and more profitable
- Identification of time bound reserch programmes
- Introduction of project monitoring system.
- Multidisciplinary and interdisciplinary approach.
- Collaboration with National and International Institutions/Agencies for basic research.

Strengthening of Research Facilities

- Striving for higher budget allocation under both Plan and Non Plan.
- Strengthening of infrastructure facilities at CCRI and its Regional Stations.
- Approaching national and international funding agencies such as D BT, Environmental Ministry, World Bank, FAO, ODA etc., for sponsored schemes.

Human Resources Development

- Deputation of scientists for advanced training to national and International Laboratories.
- Introduction of career policies for scientific and technical personnel on par with those of other organizations.

NATURAL RUBBER IN THE NEW MILLENNIUM

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INTRODUCTION

The global economy is on the verge of a new millennium. The emerging trends on the eve of the next millennium are saddled with a number of economic, social and political issues and changes which may usher in the emergence of a new world economic order. Though the issues and changes were evident since the early 1990's it became rampant with the signing up of the General Agreement on Tariffs and Trade (GATT) in April, 1994 and the subsequent emergence of the World Trade Organisation (WTO) to implement and monitor the objectives of the treaty. One of the main objectives of the treaty has been to reform a highly distorted world trade characterised by direct and indirect subsidies resulting in a deceptive comparative advantage and inefficient use of world resources. The resultant policy change in the global economic climate cutting across national and ideological frontiers consisted of decontrol, deregulation and liberalisation. These three policy inputs have been the harbingers of the ongoing process of market integration and globalisation of economic activities. The increasing integration of the international economy can be witnessed in the growth of products ranging from fast foods to financial services, which are marketed in a standardised and structured format around the world, and which compete primarily with similar global products. Organisations will have to master new competencies and the managers and workers will require new skills in the context of a global conglomerate. The steady increases in the number of mergers and acquisitions among national and multinational companies since mid 1990's are broad indicators of the basic tenets of the emerging structure of global economic scenario in the next millennium. The mantra and the motto for success for an entrepreneur or a firm in the 21st century is "globalise or

perish". It is in this backdrop that the emerging issues confronting world natural rubber (NR) sector are analysed and the policy perspectives on Indian rubber sector are underlined.

World NR scenario ; Major structural characteristics

Any serious attempt to delineate the potential implications of the emerging trends in the global economy on the world NR sector has to primarily focus on the production sector. Logically the major impact of the structural adjustments consequent to the challenges arising from the new economic order is expected to take place in this sector. The three cardinal features of world NR production sector are a very high degree of geographical and sectoral concentration of production and the export orientation. Table 1 illustrates the major characteristics of the world NR production sector.

Table 1: Major characteristics of the World NR production sector (1997)

Region	NR production (000'tonnes)	Relative share in World NR production (%)	Relative share of smallholdings in NR production (%)	Domestic consumption of NR as a percentage of production
Asia	5955.3	92.8	NA	38.1
Others	464.7	7.2	NA	65.1
World Total	6420.0	100.0	72.6	40.0

Source : International Rubber Study Group (1998), Rubber Statistical Bulletin, Vol-53, No.3, December.

As evident from Table 1, world NR production is geographically concentrated in Asia which accounts for about 92.8 per cent of the total production. In fact, the four largest producers, viz; Thailand, Indonesia, Malaysia and India control more than 79 per cent of the world NR production. The sectoral concentration of production shows that 72.6 per cent of the total

production is from the dominant smallholdings sector although there are significant variations across the major producing countries in the relative share of this sector. The domestic consumption of NR is a crude indicator of the extent of rubber based industrialisation and value addition in the producing countries. The share of domestic consumption of NR (40%) in the producing countries indicate that even after a century, the crop is basically dependent on export average. However, there are substantial deference in the extent of absorption of NR in the major producing countries. Table-2 shows the extent of domestic consumption in the six major NR producing countries.

Table 2: Domestic consumption of NR in the major producing countries (1997)

Country	Domestic consumption of NR (000'tonnes) of production	Domestic consumption of NR as a percentage
Thailand	182.0	9.0
Indonesia	141.0	9.4
India	326.9	33.7
China	571.7	98.5
Vietnam	48.0	23.9
Total	2169.6	37.8

Source : Same as Table-1

Table-2 shows the extent of variation in domestic consumption of NR among the major NR producing countries and it varies from 9 per cent in the largest producing country (Thailand) to more than 202 per cent in the fifth largest producer (China). Even though Table-2 is illustrative of the difference in the extent of rubber based industrialisation in relation to the raw material base in the major NR producing countries, it is obvious that these countries have well defined limits in absorbing the shocks and responding to the challenges in the emerging global economic scenario. This is primarily due to three factors, viz; (1) a high degree of dependence on the export markets and the resultant vulnerability to economic changes in the major NR consuming countries, (2) negligible value addition in the NR producing countries and (3) inherent constraints of the dominant smallholdings sector

in adapting and adjusting to the changes.

An important feature of world NR consumption is that not only the developed industrialised countries are consuming a major share (60%) but also it has been concentrated in the tyre and tyre products manufacturing sector over time. Table-3 show the relative share of the tyre and tyre products sector in total NR consumption among the major non-NR producing countries.

Table 3: Relative share of tyre and tyre products sector in total NR consumption (1997)

Country	Domestic consumption of NR (000'tonnes) of production	Domestic consumption of NR as a percentage
USA	1044.1	76.9
Japan	713.0	86.0
Germany	212.0	81.5
France	192.3	91.9
UK	121.0	82.1
Italy	117.0	75.2
Total	2399.4	81.4

Source : Same as Table 1

Table 3 highlights a very high dependence of NR on the dominant tyre products manufacturing sector in the major non-NR producing countries. Even in the major-NR producing-cum-consuming countries such as China (the 2nd largest consumer) and India (the 4th largest consumer), the tyre sector is the single largest consuming industry. Therefore, to a large extent, the prospects of the tyre and tyre products sector are controlled by a handful of multinational companies. The mergers and acquisitions among the tyre companies since the mid 1980's have only increased the concentration of global tyre production.

Emerging trends

The potential implications of the emerging trends have to be assessed

in the context of the major structural characteristics of the NR production and consumption sectors outlined in the previous section. NR is one among the ten core commodities covered by the Integrated Programme for Commodities (IPC) under the auspices of UNCTAD for assistance. However, its case is a clear example illustrating the vulnerability of the developing countries to price fluctuations in the world market inspite of the market interventions by the International Natural Rubber Organisation (INRO) since the 1980's to stabilise the NR price. Although volatility of prices of the major agro-based products exported from the developing countries has been a common feature during the post-colonial era, the extent of fluctuations and uncertainty assumed serious proportions since the 1980's. The free market price indices of NR declined to the extent of 40 percentage points in 1990 from its 1980 level (George and Sethuraj, 1996). During the 19 year period from 1980-98, the trend growth rate of world NR price has been only 0.17 per cent in nominal terms. However, the most important issue seriously debated on world NR market has been the steep fall in the prices (in dollar terms) since 1996 after achieving a record peak level in 1995 during the 19 year period. The negative annual growth rates recorded in 1996 (-12.5%), 1997(-28.4%) and 1998(28.4%) are confounded by the Asian financial crisis. The recent fall in world petroleum prices may further worsen the situation with commensurate decline in synthetic rubber (SR) prices. Though the net impact of the price fall vary across the major NR producing countries, the gravity of the crisis is evident from the estimated loss of US\$ 115 million in the case of Thailand during the period between 1997-98 (World Bank, 1998). The INRO has in-built constraints to intervene in the market as the benchmark price (denominated by the Singapore dollar and Malaysian ringgit) is above the intervention level due to devaluation. The available forecasts on NR prices are revolving around the perception that recovery from the ongoing crisis is possible only with sustained economic growth in the South-East Asian region and the industrialised countries in Europe, USA and Japan. In this context, there are well defined limits to inter and intra-sectoral adjustments in the world NR economy to offset the negative impact of the crisis. Nevertheless, future NR scenario is likely to be dictated by the comparative competitiveness in cost of production quality and value addition.

Indian NR scenario

The performance of the rubber plantation Industry in India since independence has been impressive. The country has achieved excellent

progress in area, production and productivity of rubber. Currently, India is the fourth largest producer, next to Thailand, Indonesia, and Malaysia, sharing about nine per cent of world's NR output. Table 4 depicts the trends in area, production and yield per ha of NR in India.

Table 4: Trends in area, yield and production of NR

Year	Area (^{'000} ha)	Yield (kg/ha)	Production in production (tonnes)	Annual growth (%)
1950-51	75	284	15,830	
1960-61	244	365	25,697	
1970-71	217	653	92,171	
1980-81	284	788	153,100	
1990-91	475	1076	329,615	
1991-92	489	1130	366,745	11.3
1992-93	499	1191	393,490	7.3
1993-94	508	1285	435,160	10.6
1994-95	516	1362	471,815	8.4
1995-96	524	1422	506,910	7.4
1996-97	533	1503	549,425	8.4
1997-98	545	1549	583,830	6.3
1998-99(E)	557	1550	605,000	3.6

E Estimate

Source: Rubber Board, Statistics and Planning department, Kottayam

The factors contributed to such an impressive achievement are the research and development (R&D) programmes, a well co-ordinated extension network initiated by the Rubber Board, the positive price policy followed by the Government and a high degree of receptiveness of the growers.

During the period 1992-93 to 1996-97 (VIII th Plan) the average annual progress in production was 8.4 per cent. Despite this higher growth

rate, the overall production was short of consumption. But during 1997-98 the country's consumption of NR registered only 1.8% increase as against 8.5% increase anticipated. The lower demand growth was due to the impact of the all pervasive recession in the industrial sector, particularly in the automobile tyre & tube sector, which is the dominant consumer of NR in the country. The poor growth of the industry coupled with a 6.3% growth in NR production led to a surplus for the first time after 1997. The situation resulted in a crisis leading to accumulation of rubber stocks and depressed market conditions characterised by declining rubber prices. Table 5 gives the annual growth in consumption vis-a-vis production

Table 5: Growth in consumption vis-a-vis production of NR

Year	Consumption ('000 tonnes)	Annual growth (%)	Production ('000 tonnes)	Annual growth (%)
VIIIth Plan				
1992-93	414	8.9	393	7.3
1993-94	450	8.7	435	10.6
1994-95	486	8.0	472	7.4
1995-96	525	8.0	507	7.4
1996-97	562	7.0	549	8.4
IX th Plan				
1997-98	572	1.8	564	6.3
1998-99(E)	594	3.8	605	3.6

E -Estimate

Source : Same as Table 4

After scaling to unprecedented heights in 1995 and 1996, the price started declining. The average price of RSS 4 grade sheet rubber which was Rs 51.12/kg in October 1996 came down to Rs 34.95/kg in October 1997. The gloom in the rubber market further aggravated during 1998 and the average market price for RSS 4 grade rubber hovered around Rs. 26.95/kg in

January 1999. Crop shift in response to price decline may not happen in the short run due to the rigidities of rubber being a perennial crop. But the cessation of yield augmenting cultural practices as already reflected in the estimates for 1997-98 and 1998-99.

Projections on NR production and consumption in India

In the backdrop of the emerging trends in the Indian NR sector, projection have been done on the annual planted area tapped area, productivity, production and consumption of NR till 2010 ad (Tables 6 and 7).

Table 6: Projections on area, tapped area and productivity of Rubber in India

Year	Area ('000 ha)	Tapped area ('000 ha)	Productivity (kg/ha)
1999-00	569	395	1588
2000-01	581	403	1615
2001-02	593	411	1640
2002-03	603	410	1881
2003-04	613	427	1679
2004-05	623	433	1697
2005-06	633	436	1715
2010-11	683	470	1790

Source : Same as Table 4

The estimated area under rubber at the end of 1998-99 is 5.57 lakh hectares with 3.87 lakh hectares under tapping. The targets proposed for new planting and replanting during the five year period 1997-2001 are 60,000 and 30,000 hectares respectively. Out of the proposed new planting 58 per cent is in non-traditional region especially in the North-Est.

Table 7: Projections on production and consumption of NR in India

Year	Consumption	Growth	Production	Growth	Deficit
1999-00	624	5	627	3.7	+3
2000-01	664	6	661	3.8	-18
2001-02	710	7	674	3.6	-36
2002-3	760	7	694	3.0	-66
2003-04	813	7	717	3.3	-96
2004-05	866	6	735	2.5	-131
2005-06	921	6	748	1.8	-173
2010-11	1217	6	841	2.4	-376

Source : Same as Table 4

The outlook for future is that of a widening demand-supply gap. The estimated deficit may increase from 1300 tonnes in 2000-01 to 376000 tonnes in 2010-11. These projections do not include present stock, probable imports and exports.

Policy perspectives on the Indian Rubber sector

The hitherto insulated status of the Indian rubber sector has been undergoing significant changes since 1991-92 consequent to the implementation of liberalised economic policies. The major identifiable consequence is a considerable dilution in the extent of protection given to the NR production and the rubber products manufacturing sectors. To a certain extent, this has affected the growth prospects of the industry as a whole as evident from the emerging trends. Therefore, the future priorities and strategies of Indian rubber sector shall be focused on the basis of the issues confronting the NR production, rubber products manufacturing and export sectors.

The focus on the production sector is confined to the NR sector due to its dominant position in total rubber production and consumption in the country. In spite of the achievement of the highest reported productivity of NR in the world, there exists marked differences in productivity among the different rubber growing regions to the extent of more than 40 per cent. The major issues in the traditional rubber growing region of Kerala are: increasing share of part-time farmers, growth of homestead farms and operational

level problems associated with the availability of hired labour. In the emerging scenario, there are serious constraints in pursuing expansion of NR cultivation in marginal areas where the realisable productivity is below the national packages are required to enhance productivity in such regions as competitiveness and quality are the prime guiding factors determining the feasibility of NR production in the context of globalisation.

The attainment of the short-term and long-term targets and realisation of the projections depend to a great extent on the potential issues influencing the relative profitability of NR production in the country.

