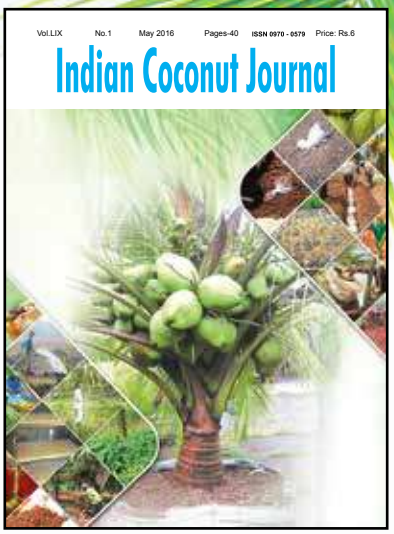


INSIDE

T K Jose IAS relinquished charge of Chairman Coconut Development Board

Shri. T K Jose IAS relinquished charge of Chairman Coconut Development Board on 18th May 2016 after completing five year tenure from 18th May 2011. As a visionary, he gave ideas and shape to many innovative endeavours in coconut sector like creation of green collar jobs of FoCTs and Neera Technicians, aggregation of the unorganized coconut farmers through FPOs, production of Neera and introduction of innovative value added coconut products. Coconut sector in the country has witnessed significant growth in many areas during his tenure as a result of his multi pronged developmental approach.

In order to tackle the grave issue of the dearth of skilled manpower for coconut harvesting and plant protection operations, Shri. Jose initiated a training programme 'Friends of Coconut Tree' (FoCT) which resulted in creating green collar jobs for around 53,000 FoCTs.

Shri.Jose facilitated the formation of the three tier Farmer Producer Organization (FPO) in coconut sector to take up collective farming, product aggregation, primary processing, value addition, by product utilisation and marketing. The FPOs have become a convenient platform for the empowerment of farmers. 10,000 Coconut Producer Societies at primary level, 700 Coconut Producer Federations in the middle level and 61Coconut Producer Companies at the apex level are formed in the country under the patronage of Shri. T K Jose. Large scale entry of FPOs in coconut processing sector could prevent exploitation of farmers by middlemen to a greater extent. Presently around ten lakh farmers are brought in under the ambit of the FPOs. The efforts of FPOs are expected to ensure fair, steady and reasonable price to coconut farmers for their produce.

Developing innovative products from coconut was one of his crazy areas. Shri. T.K. Jose was instrumental in bringing 'Neera' out of the shackles of the 112 year old Abkari Act to unleash its commercial potential, in Kerala. Through his sustained efforts, neera policy is in the offing in Karnataka, Tamilnadu and Andhra Pradesh. Around 3000 Neera Technicians were also given training in extraction of Neera. Neera has become a popular beverage and many value added downstream products have been developed from this natural product under his guidance. Flavoured coconut juice, coconut ice cream and diabetic friendly biscuits are other innovative products developed and widely accepted by public.

Registration of exporters of coconut products got momentum and export of coconut products almost tripled during his tenure. Export of coconut products which was worth Rs. 450 crores in 2010-11 got increased to Rs. 1450 crores in 2015-16. Registered exporters of coconut products reached 2088, which were hardly 600 in 2010-11. Under the Technology Mission on Coconut, 241 projects have been sanctioned with project outlay of Rs.405.95 crore and subsidy of Rs. 56.55 crore.

Three DSP farms of the Board were newly set up during his tenure at Palghar in Maharashtra, Dhali in Tamil Nadu and in Hichachera in Tripura. He gave major thrust in making available quality coconut planting materials to the needy farmers. The production of coconut seedling was enhanced from one lakh to 12 lakh per year. He also made a beginning in the convergence of schemes with various departments in implementation of Board's schemes through NRLM, DDU-GKY, SFAC, NREGS, ASCI etc.

Shri. Jose is a Kerala cadre IAS officer with varied administrative experience across several government departments. CDB wishes him all the very best in his future endeavours.

Dr. Anand Kumar Singh takes over as Chairman, Coconut Development Board

Dr Anand Kumar Singh, Managing Director, National Horticulture Board took over additional charge of Chairman, Coconut Development Board. Dr. Singh hailing from Ghosan village from Jaunpur district of Uttar Pradesh took his graduation in Agriculture from Banaras Hindu University and Post graduation and PhD in Horticulture from Indian Agricultural Research Institute (IARI), New Delhi. He did his post doctorate from Saga University, Japan and University of California. Dr. Singh started his professional career as a scientist at Tata Energy Research Institute and later on joined Indian Counsil of Agricultural Research Institute (ICAR). He was working as the head of the Fruit and Technology division of IARI.

Indian coconut sector sustains premier status

- Domestic price starts ruling below international price
- Scenario presents golden opportunity for export
- All time record of export value, touching Rs. 1450 crores
- Total coconut export reached at Rs. 3280 crores

Introduction

In Indian agriculture sector, coconut crop assumes high socio-economic relevance, as it supports 12 million people in the country. The crop contributes around Rs. 1,00,000 million to the country's GDP and earns export revenue of around Rs. 30,000 million. By breaking the conventional boundaries of an oil seed crop, coconut is of late gaining importance as a contributing factor to the health, nutrition and wellness of human beings. This is due to its multiple medicinal and nutraceutical properties of coconut being revealed day by day. This new development in health sector brought in unprecedented increase in demand of coconut products in domestic and international markets. India is now striving to make use of this opportunity for the growth of Indian coconut sector. It is estimated that there are 5 million coconut holdings and 12 million farmers in the country covering 17 states and 3 Union Territories. Among these, coconut contributes significantly to the GDPs of the states of Kerala, Tamil Nadu, Karnataka, Andhra Pradesh, Goa and UTs of Lakshadweep, A&N Islands and Pondicherry. India is number one in production and productivity among the major coconut growing countries.

Indian Coconut Scenario

Area, Production and Productivity

As per the All India estimates for the year 2014-15, the area and production of coconut in the country is 1.98 million hectares and 20439.61 million nuts respectively. The corresponding figures for the year 2013-14 were 2.14 million hectares and 21665.19 million nuts, recording decrease in area by 7.69 percent and production by 5.66 percent. The four southern states of Kerala, Karnataka, Tamil Nadu and Andhra Pradesh accounted for 87.86 percent of the coconut area and 90.11 percent of the coconut production in the country.

The productivity of coconut at national level for 2014-15 is 10345 nuts per hectare which showed an increase by 223 nuts over the previous year. The highest yield is reported from Lakshadweep Islands at 27591 nuts per hectare followed by Chhattisgarh at 16287 nuts per hectare and Telengana 14994 nuts per ha. Tamil Nadu is having highest yield among the major coconut growing states with 14873 nuts followed by Andhra Pradesh with 13808 nuts.

As per 2013 world statistics India is the largest coconut producing country in world contributing 31.46% of the world production. World Production has decreased from 72758.63 million nuts in 2012 to 72094.59 million nuts in 2013. India, Indonesia and Philippines are the leading coconut growing countries having 75.92 % of the total coconut area and contribute 75.59 % of the coconut production in the world. Among the major coconut growing countries Brazil holds the highest productivity of 11923 nuts per ha. followed by India with 10615 nuts per ha.

Price Scenario

The price of coconut and coconut products was on a declining trend during the last one year. The price which was steadily recording an upward trend from the middle of 2013-14 exhibited a very encouraging trend through out 2014-15; but it was on reverse move in 2015-16. Average domestic price and international price of coconut oil per Metric Tonne was US $ 2410 and 1225 in 2014-15. This has come down to US $ 1710 and US $ 1113 respectively in 2015-16.

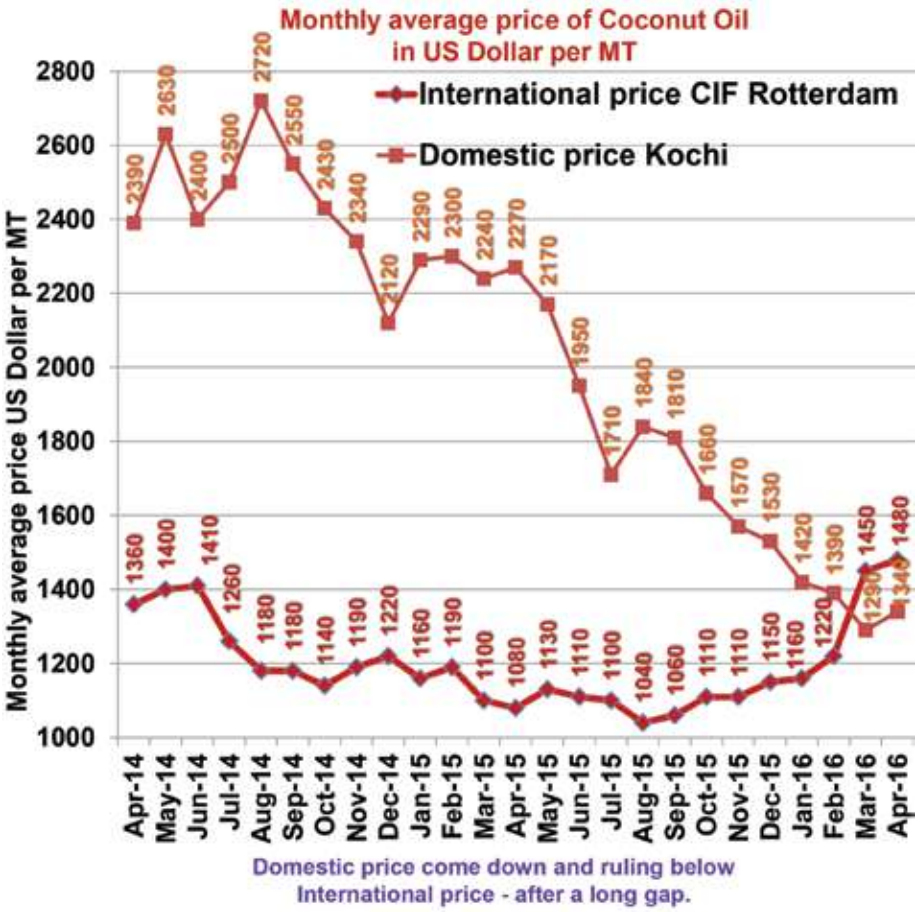
The domestic price of coconut products in India was always ruling higher compared to international price.During many a times domestic price was 100 % higher than international price. But after a long spell, the gap between international and domestic price started narrowing down and in March 2016, the international price became higher than that of domestic price

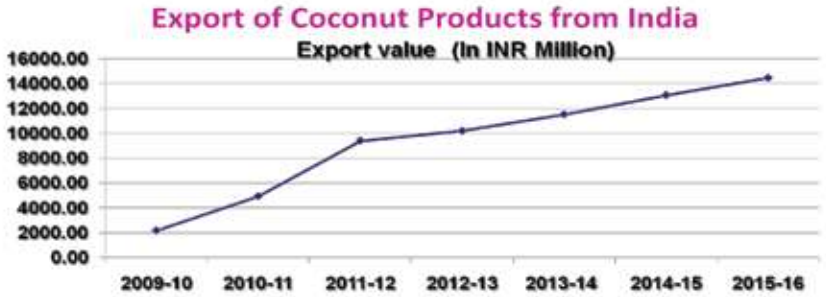
which presents immense opportunity for India for exporting coconut products.

Export of Coconut Products

During the year 2015-16 export of coconut products (excluding coir items) was valued at Rs. 14500 Million against Rs. 13120 Million of the previous year, recording an increase of 10.50 % in terms of value. Activated Carbon was the single largest item of export both in terms of quantity and value of export, at 61212.58 tonnes and Rs. 6320 Million respectively. Significant increase was recorded in the export of desiccated coconut, activated carbon and coconut oil. Activated carbon accounted for 43.58 percent of total export value. Over the last 5 years, value of export of coconut products showed an increasing trend from Rs. 8386 Million in 2011-12, to Rs. 14500 Million in 2015-16.

The export earnings are picking up with the surge in growth of industries like virgin coconut oil, activated carbon, shell charcoal etc. Indian products are moving to US, UK, Germany, Japan, France, Middle East, and African Countries. Advancement in technology development and the technical and financial support extended by India through the Coconut Development Board under the Technology Mission programme for starting coconut based industries have been instrumental





Year	Export value (In INR Million)	Export value (In USD Million)
2009-10	2197.58	46.61
2010-11	4959.22	109.08
2011-12	9432.95	196.39
2012-13	10225.33	187.92
2013-14	11561.19	190.24
2014-15	13113.70	214.03
2015-16	14502.44	221.07

for this success. Added to these, the Board has been designated as Export Promotion Council (EPC) for various products other than coir based products from 2009-10 which also has contributed to a perceptible improvement in export which is depicted below:

In the capacity of EPC, Board has so far given registration to 2088 exporters. This has enabled the Board to monitor the export scenario closely which is an indication of country's growth in the sector.

Strength, Weakness, Opportunity and Threat (SWOT) of Indian Coconut Sector

India being the largest producer of coconut in the world having sufficient raw material surplus, good reputation in global markets, access to good technologies (Virgin Coconut Oil, Packed Tender Nut Water, minimally processed Tender Coconuts, Activated Carbon) and presence of dominant ethnic population in the Gulf, UK and US are the strengths of India. Low level of processing and value addition, weak financial status of the small and tiny exporters, low level of market penetration and competing South East Asian countries, highly disorganized and fragmented supply side and geographical distance from terminal markets are India's weakness.

While the growing demand for coconut products, emerging new findings in health and nutritional sector for coconut products and the current situation of international price ruling above domestic price – opening up new export opportunities for India and having an exclusive mission like TMOC are the opportunities available. there are some threats like vagaries of weather, price fluctuation of copra and coconut oil, increasing cost of production and dwindling labour resource, competition from South East Asian Countries in the world market and uncontrolled nature of pests and diseases.

Programmes and Policies to Promote Development of Coconut Sector

In India, development programmes in coconut are mainly dealt by Coconut Development Board under the Ministry of Agriculture and Farmers Welfare. The programmes undertaken during the last year for the benefit of farming community are listed below along with the overall growth of coconut sector.

Production and distribution of planting material

a) CDB has established Demonstration cum Seed Production (DSP) Farms in different parts of the country for creating infrastructure facilities for production of quality planting materials besides demonstrating and educating the scientific coconut cultivation and processing to various stake holders in those regions. Regional Coconut Nurseries extend support to various participating States for strengthening the seedling production programme, distribution of hybrids/dwarf seedlings in Govt. sector. Establishment of Nucleus Coconut Seed Garden and coconut Nurseries in private sector are taken up under this programme. Last year nearly 20 lakh seedlings were produced and distributed under this scheme. 10 DSP farms have so far been established in different parts of the country.

Expansion of Area under Coconut

This programme is to extend adequate technical and financial support to the farmers to take up coconut cultivation on scientific lines in potential areas to attain significant achievement in the future production potential. Financial assistance is limited to 25% of the cost of Rs.26, 000/-, Rs.27, 000/-and Rs.30, 000/- per ha. for Tall, Hybrid and Dwarf respectively in normal areas and @ Rs.55,000/- and Rs.60, 000/- respectively for hilly and scheduled areas. More than 3000 ha. was covered under new planting of coconut during the last year.

Productivity Improvement programmes

The objective of the programme is to improve production and productivity of the coconut holdings through an integrated approach thereby increasing the net income from unit holdings with the following component programmes under Laying out of Demonstration Plots and establishing Organic Manure Units by providing incentives @ Rs. 35000/- per ha. and Rs.60, 000/- per unit respectively. Productivity improvement programme was implemented in clusters in more than 25000 ha. during last year.

Technology Demonstration/Quality testing lab

The Technology Development Centre set up in Kerala is engaged in the development and demonstration of technologies for product diversification and by-product utilization of coconut. The centre is devoted to product development, microbial analysis of coconut based products, apart from skill development programmes

to interested entrepreneurs and self help groups for acquiring technologies on post harvest coconut processing and process demonstration. The Institute is having the recognition of NABL. Many value added and novel products were developed by the Institute during last year and the institute has now been designated as CDB Institute of Technology (CIT).

Marketing, market intelligent services, Statistics and Export Promotion Council

Market information and intelligence service, modernization of coconut processing by the introduction of improved copra dryer/other processing machineries/ equipment, surveys and evaluation studies including concurrent estimation of coconut production and productivity and export promotion activities are undertaken by Board.

Information and Information Technology

The Board is disseminating information on various aspects of coconut cultivation and industry through various media and publication besides organizing training programmes to impart skills and knowledge to farmers, unemployed youths and rural women in various fields related to coconut apart from participation in exhibitions and fairs under this programme.

Technology Mission on Coconut

The Technology Mission gives emphasis on the development of technologies for the management of insect pest and disease affected gardens and product diversification besides demonstration and promotion of these technologies for adoption. Under the Mission, research projects and clinical studies are sponsored through reputed institutions in technology development and also to establish the medicinal and nutraceutical properties of coconut products especially coconut oil. Last year technical and financial support was given to establish 61 processing units with processing capacity of 330 million nuts per year. Subsidy of Rs.145.4 million was extended to entrepreneurs and manufacturers of desiccated coconut(DC), virgin coconut oil(VCO), coconut oil(CNO), packaging of tender coconut water(TNW), flavoured juice etc. So far 402 processing units have been established with the assistance of Board.

Replanting and Rejuvenation of Coconut Gardens.

In pursuance to PNG declaration in 2006, India initiated Replanting and Rejuvenation of traditional coconut gardens in the country. To begin with the programme was introduced in Kerala, the state with longest history of coconut cultivation where 1/3rd of palm population was old, senile and disease advanced. Apart from the longest recorded history of coconut cultivation, the state is under the grip of a lethal disease called root wilt. Cutting and removing the disease advanced trees and giving management care to the existing palm population is the only strategy to manage the gardens. Therefore the R&R programme was implemented in the state from 2009 and is continuing. The main objective of the scheme is to enhance the productivity and production of coconut by removal of disease advanced, old and senile palms, replanting with quality seedlings and rejuvenating the remaining palms by giving compensation to farmers for cutting and removal and replanting and rejuvenation. So far more than 3.3 million palms have been cut and removed under the scheme and nearly 5 lakh ha was rejuvenated. Total subsidy spent under this scheme is Rs. 2340/ million.

Coconut Palm Insurance Scheme (CPIS)

The Coconut Palm Insurance Scheme intends to provide insurance coverage to coconut crop. Under the scheme all healthy bearing palms in the age group from 4 years to 60 years are eligible to get insurance coverage against natural perils leading to death or becoming unproductive. 50% of the premium is borne by the Board and balance is shared between the State Govt. and farmers @ 25% each.

Kera Suraksha Insurance Scheme for Coconut Tree Climbers (CTC)

The 'Kera Suraksha' Insurance Scheme provides insurance coverage to the coconut tree climbers (CTC) @ Rs.2 lakh against 24 hours accident related risk including death. The annual premium of the policy is borne by the Board (75%) and the rest 25% by the beneficiary. The scheme is implemented in all coconut growing states.

Establishment of in house Research & Development Centre

The Board initiated in house field research activities for conducting applied research activities in the DSP Farms of the Board. The researchable areas identified are standardization of quality parameters of seedlings, screening of mother palms, demonstration and standardization of traditional wisdom of farmers for pest and disease management, strengthening biological control of pest disease, studying the effect of climate change on yield of coconut etc.

Centre of Excellence in coconut (CEC)

Establishment of a Centre of Excellence in coconut (CEC) under the auspices of Board is progressing at Dhali, Udumalpet, Tamil Nadu. The Centre will have facility to provide leadership, best practices, research and training in coconut. The focus of CEC will be on sharing knowledge, skill and experience in coconut sector, development of advanced technology for coconut, development of international knowledge centre for coconut and development of skill for excellence in coconut sector. India considers the transformation of Centre of Excellence into a full fledged knowledge hub for coconut as one of the priority areas of future.

Establishment of new Coconut Orchards

The objective of the scheme is to improve the production and productivity of coconut by establishing coconut orchards with high yielding varieties released by research institutes for different agro climatic conditions. The scheme is implemented through Farmer Producer Organization (FPO) in coconut growing states including scheduled and hilly areas @ 25% of cost of cultivation for two years limited to Rs.40,000/- per ha for hilly and disturbed areas and Rs 30,000/- per ha in normal areas.

New policies and initiatives

Three tier Farmer Producer Organization (FPO) in coconut sector.

Coconut Development Board (CDB) has facilitated the formation of three tier Farmer Producer Organization (FPO) with Coconut Producers Societies (CPS) at primary level and integrate them to form Coconut Producers Federation (CPF) at intermediate level and Coconut Producer Company (CPC) at apex level. A Coconut Producer Society (CPS) consists of around 50 farmers and 5000 coconut palms and 20 such societies form federations and 10 Federations form a company. Thus a company which is formed by 10,000 farmers will be producing around 8 crore coconut from their jurisdiction. The main role of the Company is to establish processing unit for production of value added products from coconut procured from the member farmers. There are at present 9729 CPS, 699 CPF and 61 CPCs functioning in the country. FPOs have been ventured into various activities like coconut seedling production, processing and value addition and marketing of all value added coconut products. Eighteen companies are now in production of neera, eight are in neera processing and seven companies are in coconut oil production with high quality standards.

Skill Development Training Programmes (Friends of Coconut tree (FoCT)

Acute shortage of palm climbers to harvest and adopt plant protection measures is one of the problems faced by coconut growers. With a view to tackle this problem, the Board is conducting skill development programme from 2011-12 onwards, to train unemployed youths in developing special skills and confidence in coconut climbing and plant protection activities for the benefit of coconut farming community. The skill fetches the youth handsome income for their decent living and help to make available sufficient manpower to society in coconut climbing.

Promotion of Neera production and marketing

Coconut Development Board has developed technology for neera harvesting and processing: Neera, the vascular sap from coconut inflorescence is one of the most profitable value added products from coconut. Considering its nutritive value, health benefits and profitability its production has been permitted by the major coconut growing states. Coconut Development Board has taken the initiative for developing a pool of Neera technicians. This is achieved in two phases, the first phase concentrating on moulding traditional toddy tappers into "Neera Master Technicians" through a training conducted at CDB Institute of Technology (CIT) for a duration of two weeks. These master technicians in turn will train interested and eligible candidates at the respective Coconut Producer Company and Federation levels.

Product Development

India was lagging behind in technology development for product diversification till the last two decades. Introduction of Technology Mission has given momentum to this area and now India possesses many technologies in value addition. Acceleration of the activities of CDB Institute of Technology, further quickened the product development. For the first time technology for processing and packing of neera and various down stream products like neera sugar, jaggery, honey etc have been developed. Food products like sweet/spicy chips, sweet chunks, chocolate, cookies, burfi, lemonade, flavoured juice, ice cream and milk spread are the other new additions of CIT to the product basket.

Product basket from coconut - Value added coconut products – Existing and new

Water based, kernel based Inflorescence sap (Neera) based and Shell based coconut products are: Packed Tender Coconut Water, Coconut Vinegar, Nata de coco etc. Coconut Oil, Virgin Coconut Oil, Desiccated Coconut, Ball Copra, Coconut Cream, Coconut Milk Powder, etc. Neera beverage and Neera based value added products etc. Shell Powder, Shell Charcoal, Activated Carbon, etc.

Latest additions in product basket are

Neera as a health drink, Neera honey & neera sugar, Flavoured coconut milk –coconut milk shake, Coconut ice cream, Healthy and diabetic friendly biscuits, Sweet

chunk and milk spread

Marketing Strategy

Having achieved considerable progress in value addition and product development, India has to embark upon new marketing strategies for directing coconut products to all domestic and international markets. The current trend in domestic and international markets for various products is encouraging. While considering the domestic market it could be seen that urban India comes ahead of USA in the order of populous nations. The population of urban India is about 360 million which is above the total population of USA. Population of USA is only 315 million. Our domestic market is bigger that that of USA if 75 % urban population is taken into account. More than 78% of India's urban population is located in the 63 major cities. India is aiming at introducing, making available and marketing maximum value added coconut products in these cities. In the international markets, countries like China, India, USA, Indonesia and Brazil are top five most populous countries. In the era of globalization, products of all countries are available in all potential markets. Coconut products of India have to reach the markets of other countries. But quality adherence assumes significance. India is giving thrust to manufacture best quality products with attractive packaging through innovative marketing strategies. Niche markets for pharmaceutical, nutraceutical, and cosmecuetical products with coconut as major ingredient are emerging, by giving further boost to Indian opportunities. India will take the advantage of such new developments.

Future thrust

Indian coconut sector has to improve in many areas inspite of unprecedented progress achieved in selected sectors. There are many issues to be addressed and solutions arrived at. Inadequate availability of quality planting material in tune with the increasing demand, low pace of value addition, low level of productivity than the potential, low pace of expansion of crop and low level of Replanting and Rejuvenation of old plantations and non availability of disease tolerant and short stature high yielding varieties are issues still need solution. Against the annual requirement of 10 million seedlings, the present supply is only 3.5 million seedlings. Considerable area suitable for coconut is available in traditional and non-traditional areas in the country which need to be utilized for expanding the crop. Through convergence of various programmes and bridging the gap in existing schemes, India will try to make coconut a more remunerative crop by enlarging the scale and size of operations and reducing production costs giving more thrust on irrigation, drought management, and soil and moisture conservation. Restructuring of planting population by giving more stress on hybrids and dwarf and more diversion of production to value addition, improvement in quality standards matching with international standards, adoption of new marketing strategy for tapping domestic and international markets and widening the skill development in all essential areas of production and processing will be other areas of priority. More focus on popularizing the health, nutrition and wellness benefit of coconut in the national and international scenario and continuing the aggregation of farmers into FPOs as a platform for empowerment will also be areas of importance to push the Indian coconut sector to the forefront. Bringing the Centre of Excellence initiated in Tamil Nadu as a full fledged Centre as a knowledge hub for coconut is another priority.

Conclusion

Indian coconut sector, with all its pluses and minuses is striving hard to grow further for the benefit of millions of farming community. The country is eyeing on sustaining the premier status enjoyed at global level in production and productivity and also pinning its hopes on gaining the prime position in export front too. India look forward to collaboration and involvement of APCC, its member countries and other international organizations and donor agencies in collaborative research on coconut tissue culture for mass multiplication, clinical studies on medicinal and nutritional aspects of coconut products especially coconut oil, exchange of technologies, joint ventures in coconut sector, etc. ■

Country paper presented by Dr.P. Shakil Ahammed IAS, Joint Secretary, Ministry of Agriculture & Farmers Welfare, Government of India during 52nd APCC Session at Jakarta, Indonesia during 23 - 26 May 2016.

Quality planting material - a crucial input in coconut farming

● **R. Jnanadevan,** Deputy Director, CDB, Kochi-11

The most important criteria for getting sustainable and profitable yield from any crop depend on the quality of the planting material. The production and management of planting material in the nursery decides the performance of coconut in the field and ultimately the quality of the produce. The expectations of each farmer while selecting seedlings for planting will be that it should be early bearing, high yielding, give high copra content and oil, it should be of short stature etc. If poor quality planting materials are used for planting, the performance of the palm will not satisfy the expectation of the farmer causing considerable loss of time and money to the farmer. In the absence of commercially viable vegetative propagation techniques, only seed propagation is possible in coconut. The desirable qualities are controlled by the genes present in 32 chromosomes in each cell of coconut palm which is transferred from generation to generation through seeds. The quality of coconut seedlings, (i.e. the ratio of the performance of seedling in the field and the expectation of farmers) is highly correlated with adult palm characters. Further, as coconut is cross pollinated, the palms do not breed true making the selection of seed nut and seedling more difficult and important. The desirable qualities are transferred to generations through the genes present in these chromosomes. Therefore, for production of seedlings with good qualities, the selection of seed garden, good mother palms and seed nuts assume great importance.

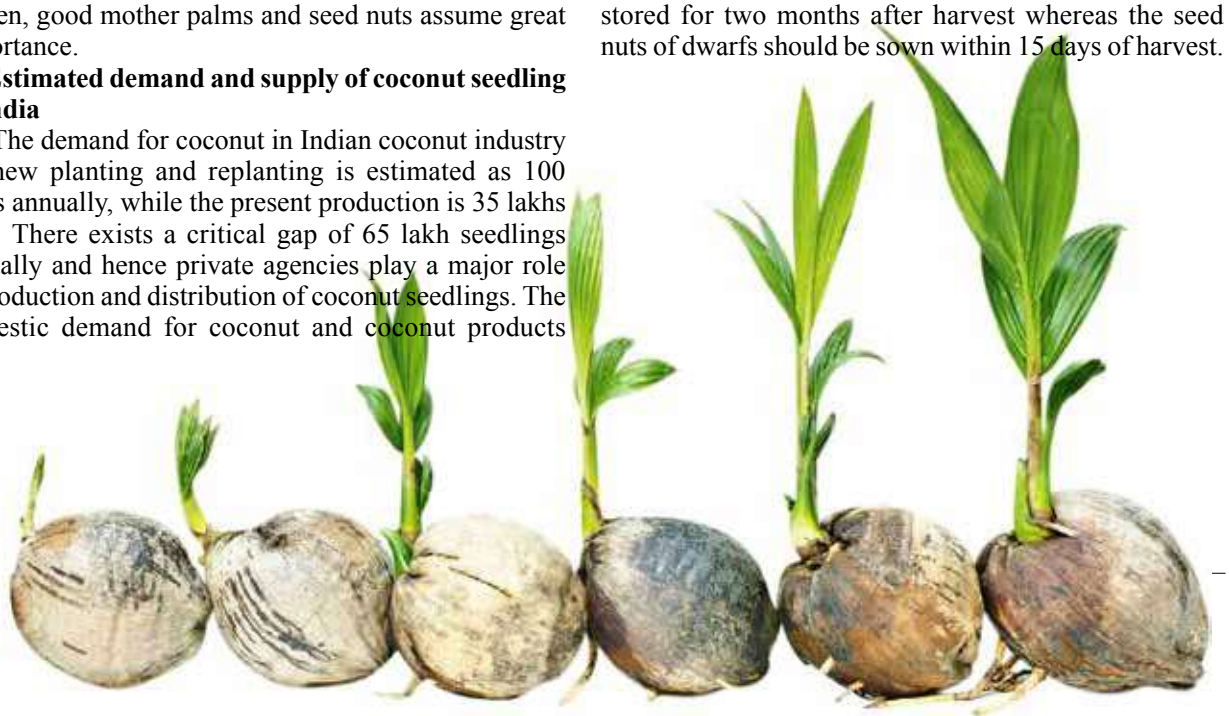
Estimated demand and supply of coconut seedling in India

The demand for coconut in Indian coconut industry for new planting and replanting is estimated as 100 lakhs annually, while the present production is 35 lakhs only. There exists a critical gap of 65 lakh seedlings annually and hence private agencies play a major role in production and distribution of coconut seedlings. The domestic demand for coconut and coconut products is also increasing. Besides, the export of coconut and its products shows tremendous increase. To meet the increasing future demand production and productivity should be increased. This is only possible though increasing the productivity of existing gardens through regular replanting and by adopting better management practices.

Quality at Mother palms level

Coconut seedlings quality should start with the mother palm. It should be regular bearers with annual yield of greater than 80 nuts and copra content of not less than 150g/nut under rain fed condition. Palms should have reached full bearing stages and should have consistently high yields for at least four years. Avoid very old palms of above 60 years . Palms which produce barren nuts or those shedding large number of immature nuts should be discarded.

Mature nuts should be harvested when at least one nut in the oldest bunch starts to dry. In Talls, it takes 11-12 months to become a mature seed nut whereas in dwarfs, nuts will mature in 10-11 months after pollination. Seed nuts are preferably selected from the center of the bunch, as development of nuts at top and bottom may not be uniform leading to poor germination or poor quality of seedlings. Harvested seed nuts are stored in shade to prevent drying of nut water, till their husks become completely dry. Seed nuts of the tall variety can be stored for two months after harvest whereas the seed nuts of dwarfs should be sown within 15 days of harvest.



Recommended Coconut varieties released for different region				
Sl No	**Variety**	**Parentage**	**Released agency**	**Recommended area**
	Hybrids			
1	Chandra Sankara	COD x WCT	CPCRI	Kerala, Karnataka, TN
2	Kera Sankara	WCT x COD	CPCRI	Kerala, Karnataka
3	Chandra Laksha	LCT x COD	CPCRI	Kerala, Karnataka
4	Laksha Ganga	LCT x GBGD	KAU	Kerala
5	Kera Ganga	WCT x GBGD	KAU	Kerala
6	Kera Sree	WCT x MYD	KAU	Kerala
7	Kera Sowbhagya	WCT x SSAT	KAU	Kerala
8	Ananda Ganga	ADOT x GBGD	KAU	Kerala
9	Godavari Ganga	ECT x GBGD	APAU	AP
10	VHC-1	ECT x GD	TNAU	TN
11	VHC-2	ECT x MYD	TNAU	TN
12	VHC-3	ECT x OD	TNAU	TN
13	Konkan Bhatye CH-1	GBGD x ECT	RCRS, Bhatye	Konkan
14	Kalpa Sankara	CGD x WCT	CPCRI	Kerala
15	Kalpa Samrudhi	MYD x WCT	CPCRI	Kerala, Assam
16	Kalpa Shresta	MYD X TT	CPCRI	Kerala, Coastal Karnataka, TN
	Tall	Agency released	Qualities	Area recommended
1	Prathap	KKV, Dapoli	High Yield	Konkan region, Kerala
2	Veppankulam-3 (VPM-3)	TNAU	High yield, Drought tolerant	TN
3	Aliyar Nagar -1 (ALR 1)	TNAU	High yield	TN
4	Kamrupa	AAU	High yield	NE region- Assam
5	Kera Sagara	KAU	High yield	Kerala
6	Kera Bastar	AICRP Palms	High yield	Chattisgarh
7	Kera Keralam	AICRP Palms	High yield	TN, Kerala
8	Kalyani Coconut	BCKV	High yield	WB
9	Kalpatharu	AICRP Palms	Drought tolerant, ball copra, high yield	Kerala, Karnataka, TN
10	Chandrakalpa	CPCRI	Drought tolerant, high oil content- 72%	Lakshadweep, Kerala, Tamil Nadu
11	Kerachandra	CPCRI	High yield	All regions
12	Kalpa Pratibha	CPCRI	High nut, oil yield, tender nut, Drought tolerant	Kerala, Tamil Nadu
13	Kalpa Mitra	CPCRI	High nut, oil yield, Drought tolerant	Kerala, WB, AP
14	Kalpa Dhenu	CPCRI	High nut, oil yield, Drought tolerant	Andaman, Kerala, TN
	Dwarf	Agency released	Qualities	Area recommended
1	Chowghat Orange Dwarf	CPCRI	Dwarf, Tender nut	All regions
2	Goutami Ganga	APHU	Dwarf, High yield, tender nut	AP, TN
3	Kalparaksha	CPCRI	High nut, oil yield in RWD prevalent areas	Kerala
4	Kalpa Jyothi	CPCRI	Dwarf, Yellow nuts, Tender nut variety.	Kerala, Karnataka
5	Kalpa Surya	CPCRI	Dwarf, Orange nuts, Tender nut variety.	Kerala, Karnataka & Tamil Nadu
6	Kalpasree	CPCRI	Dwarf, superior oil, high yield in RWD prevalent areas	Kerala

Table 1 Source: CPCRI Kasaragod

Seed nuts of tall varieties begin germination within 60-130 days after sowing and seed nuts of dwarf varieties germinate 30-95 days after sowing in the nursery. Generally, germination is recorded till the fifth month of sowing and a good seed lot will give more than 80% germination. Seed nuts that do not germinate within 6 months after sowing can be removed from the nursery.

Gardens should have palms with a high proportion of heavy bearers but it should not be from very favorable conditions. Garden should be free from the incidence of diseases and not prone to severe attacks of pests

Collect seed nuts from January to April in the West Coast region. Only fully matured nuts i.e. about 12 months old should be harvested. Nuts should not be damaged while harvesting. Discard nuts having irregular shape and size

Quality Standards of Tall Mother Palms
Regular bearing and yielding 100 nuts.
Age - 15 to 50 years
Steady bearing palms irrespective of age
Palms with more than 30 fully opened leaves with short strong petioles and wide leaf base firmly attached to the stem.
Bearing at least 12 bunches of nuts with strong bunch stalks.

Table : 2

Recommended Varieties

The tall varieties are extensively grown throughout India while dwarf is grown mainly for parent material in hybrid seed production and for tender coconuts. The tall varieties generally grown along the west coast is called West Coast Tall and along the east coast is called East Coast Tall. Benaulim is the tall variety grown in Goa and coastal Maharashtra. Laccadive Ordinary, Laccadive

Quality Standards of Dwarf Mother Palms
Regular bearing yielding 100 nuts.
Age - 8 to 30 years
Steady bearing palms irrespective of age
Palms of more than 30 fully opened leaves with short strong petioles and wide leaf base firmly attached to the stem.
Bearing at least 12 bunches of nuts with strong bunch stalks
Palms with all typical characters of dwarf with regard to stem, crown, nut and inflorescence.

Table : 3

Micro, Tiptur Tall, Kappadam, Komadan and Andaman Ordinary are some of the tall varieties. Chowghat Dwarf Orange, Chowghat Dwarf Yellow, Chowghat Dwarf Green, Malayan Yellow Dwarf and Malayan Orange Dwarf are some of the dwarf varieties grown in India. Gangabondam is a semi tall type grown in certain tracts of Andhra Pradesh. Some of the coconut varieties and hybrids released for cultivation in India are given in Table 1.

It is possible to improve the quality of the planting materials through a series of selections at the various levels of seedling production. Through a series of selections made at different stages, it is possible to obtain quality seed nuts and seedlings. For production of quality coconut planting material it is essential to have good seed gardens quality mother palms of the desired varieties. The seed gardens selected for procuring seed nuts should have palms with a high proportion of heavy bearers. Garden should be free from the incidence of diseases and not prone to severe attacks of pests. Mother palm selection is a key factor in planting material production of coconut. The important features of superior mother palms are given in Table 2 and 3

Standards of quality seed for sale:	
Parameter	Standards
Germination	>80%
Purity	>98%
Fruit weight (g)	>400g – Dwarfs / >600g – Talls
Nut water	Present
Pest and disease incidence	Nil
Maturity	10-11 months-dwarf / 11-12 months-Tall

Table : 4

Selection of seedlings from the nursery is an important step for ensuring high yield. Only seedlings with good quality should be selected through a rigorous selection based on characteristics viz: early germination, rapid growth and seedling vigour; six to eight leaves; collar girth of 8-10 cm; early splitting of leaves. The colour of the petiole of the seedling leaf can also be used as a selection criterion for dwarfs and hybrids. The Dwarfs should exhibit the petiole colour of the mother palm while the petiole colour of hybrid seedlings may range from green/brown/intermediate shades of the parents. More vigorous seedlings can be obtained by poly bag nursery. The advantage of polybag seedlings is that there is no transplanting shock and the seedlings are with better vigour and the seedling bear early. Select seedlings, based on the above characteristics. The recovery of good seedlings will be 60 to 65% of total seed nuts sown. There are no serious pest and diseases in coconut nurseries. However, bud rot affected seedlings are to be avoided for planting. The symptoms are yellowing and withering of the spindle leaf followed by drying and death of seedlings. The spindle of the affected seedlings will easily come out with a gentle pull and rotting can be seen in the lower end of the detached seedling. Quality standards for good seedling are shown in table 5.

Standards of quality seedling for sale		
Sl No.	Characters	Standards
1	Age of the seedling	8 to 9 months
2	No of leaves	6 & above
3	Girth at collar region	Dwarfs- >8 cm; Hybrids/ Talls- >10 cm
4	Height	Dwarf- >80 cm; Hybrids / Talls->100 cm
5	Petiole Color	Dwarf should exhibit petiole color of parent; Hybrids green/brown/ interme-diate shades of parents.
6	Disease /pest Incidence	Absent

Table : 5

Selection of right variety and quality of seed material is important as the quality of planting material has got a direct bearing on production and productivity of coconut. It is therefore, necessary to select a consistently yielding elite variety of coconut seeds for plantation. Select high yielding DxT (Dwraf x Tall) and elite tall varieties recommended to each state for commercial cultivation for production of raw nuts, copra and neera. For tender nut purpose select dwarf varieties, Chavghat Dwarf varieties, COD (Orange) CDG (green) and Malayan varieties, MYD (yellow), MDG (green). The Malayan varieties are good for neera production also.

Conclusion

Today we have a number of high yielding coconut varities suitable for specific regions in our country. We also have the production technologies defined for each varieties/regions. Considerable efforts have been made by both research and development departments in establishing seed gardens and planting material sources to cater to the demand of quality planting materials. However there are several limitations for this conventional method of production of planting materials from seed. One seedling can be produced from one nut that too with a gestation period of 20-24 months. Hybrid seedling productions also have limitations. In India 98% of the existing plant population is tall and only limited number of dwarf palms are available. Hence hybrid seedling production is less than 3.5% of total planting material production. Increasing demand for hybrids lead to sale of uncertified planting materials by private nurseries at higher price. Even reputed nurseries levy high price varying from Rs.250-500/- for a single seedling that too after a long waiting period. If quality is assured, farmers show willingness to pay higher price. There is a limit for producing hybrid seedlings from a single mother palm. At present hybridization is carried out in the ten DSP farms of CDB, CPCRI and Farmers gardens. Annual production of hybrids hardly touches 50,000 per annum. Hybrid seedling production is time consuming. As such there is an overall limit for hybrid production. Increasing production in the existing seed gardens and establishment of more dwarf mother gardens is essential to enhance hybrid seedling production. Besides, there should be greater emphasis in popularizing the importance of using quality planting material in coconut production and quality parameters for selection of mother gardens, seed nuts and seedlings. ■

Organic Coconut cultivation

● **Pramod P Kurian,** Assistant Director, CDB, Kochi-11

Organic Coconut

Many people have the perception that chemicals are not used in growing coconuts. Hence they think that all coconuts available in the market are organic or natural coconuts. There is a wrong belief that coconuts are mostly obtained from the wild in tropical countries, which is not true in case of organic coconut farming. Across the world, inorganic chemicals are used for coconut cultivation. Hence not all coconuts are organic coconuts or natural coconuts. Inorganic fertilizers, pesticides, herbicides and fungicides are used in growing coconuts as well. Rhinoceros beetle is one of the most common coconut pest in India. This can be controlled using chemicals such as sevidol (a mixture of sevin and BHC), naphthalene balls, and carbaryl. But in organic coconuts, chemicals such as inorganic fertilizers, pesticides, etc. are not used. An organic coconut farmer uses organic means in growing the palms. A coconut farmer cultivating organic coconut has to ensure that coconuts are cultivated organically in nature.

Production of Organic Coconut

Being a small holder's plantation crop grown in 1.89 million ha area in the tropical belt of the country extending throughout the peninsular India comprising of Kerala, Karnataka, Tamil Nadu, Andhra Pradesh, Goa, parts of Maharashtra and north eastern regions. The major socio-economic features in which this crop is cultivated include predominance of small and marginal holdings, medium to resource poor farm environment and less marketable surplus. The national average productivity of coconut in India is comparatively low. The declining productivity is attributed to the exhaustion of nutrients from soil due to continuous mining of nutrients by the palm without sufficient nutrient inputs. Hence in order to have a sustainable coconut production, practicing of organic farming is very much essential. Application of organic manures such as vermicompost, crop biomass, raising and incorporation of green manure legumes in coconut basins, green leaf manures such as neem, pungam, glyricidia, bio fertilizers, cultural practices like mulching, half moon bunding, catch pit preparation etc., are some of the effective low cost organic practices which are effective in utilization of natural resources for enhancing coconut production in a sustainable manner.

Importance of organic coconut production

Higher demand in global markets for organic coconut products like tender coconut, coconut oil.

Improving country's average nut yield/tree/year.

Minimum water requirement.

Balanced insects and diseases attack that lowers its

management practices.

Higher copra weight than in the conventional farming which provides high returns to farmers.

Sustainable production by increase in soil fertility and nuts yield gradually per year.

Benefits of organic coconut cultivation

Long term corrections: Changes observed in the environment are long term, occurring slowly over time. It aims to produce coconut while establishing an ecological balance to prevent soil fertility or pest problems. Organic production of coconut takes a proactive approach as opposed to treating problems after they emerge.

Soil: Soil building practices such as inter-cropping, symbiotic associations, cover crops, organic fertilizers and minimum tillage are central to organic practices. These encourage soil fauna and flora, improving soil formation and structure creating more stable systems. In turn, nutrient and energy cycling is increased and the retentive abilities of the soil for nutrients and water are enhanced, compensating for the non-use of mineral fertilizers. Such management techniques also play an important role in soil erosion control. The length of time that the soil is exposed to erosive forces is decreased, soil biodiversity is increased and nutrient losses are reduced, helping to maintain and enhance soil productivity.

Air and climate change: Organic cultivation of coconut reduces non-renewable energy use by decreasing agrochemical needs. Organic cultivation of coconut contributes to mitigating the greenhouse effect and global warming through its ability to sequester carbon in the soil. Many management practices used by organic agriculture (e.g. minimum tillage, returning crop residues to the soil, the use of cover crops and rotations, and the greater integration of nitrogen-fixing legumes), increase the return of carbon to the soil, raising productivity and favouring carbon storage. A number of studies revealed that soil organic carbon contents under organic farming are considerably higher. The more organic carbon is retained in the soil, the mitigation potential of agriculture against climate change is higher. However, more research need to be conducted in this field.

Ecological services: The impact of organic coconut cultivation on natural resources favours interactions within the agro-ecosystem that are vital for both coconut production and nature conservation. Ecological services derived include soil forming and conditioning, soil stabilization, waste recycling, carbon sequestration, nutrients cycling, predation, pollination and habitats. A critical review of the relationship between organic cultivation of coconut and the environment as well as other aspects needs to be researched.

Constraints of Organic Coconut Farming

Marketing facility is not available exclusively for

organic products. Conversion period is longer for obtaining organic certification.Higher risks are involved in obtaining European Standard of Certification for exporting organic products. Supply of sustainable quantity and quality product should be intensified for exporting more organic products.

Conclusion

Organic fertilization is indeed a versatile component in a coconut-based farming system. It does not only influence the soil and coconut, but also the farmer as an important element in the system. However, at present there is still dearth of research-based information on organic fertilization of coconut.

While the government is helping to alleviate the plight of the farmers, technologies remain aloof to them. Organic fertilization, for instance, as a cheaper source of nutrients, has just gained concerns lately. If this is realized by the coconut farmers, the use of coconut fertilizer may reduce the cost of their farm inputs, helping to increase net profits and conserve the dollar reserve of the country.

Coconut productivity remains low because of the dependence of farmers on the natural fertility of the soil. As a perennial crop, coconut takes a long life cycle and calls for abundance of nutrients to sustain growth and yield. Since the demand is continuous, the supply will eventually be depleted. Some researches in coconut-growing countries revealed that organic fertilizers alone or combined with chemical fertilizers (as KCl or NaCl) promote early flowering and increase yield. Organic fertilizers can be obtained by recycling coconut by-products or other sources like animal manures or industrial wastes. However, farmers should be educated on the proper management of these materials as they may pose danger to human, coconut and the environment.

There are many constraints that make organic materials less acceptable, particularly the offensive odour, bulkiness, low nutrient content, labor requirement, and the non-immediate effect on the plant. However, a sustained research and development effort can make organic farming in coconut a success. ■

Value addition to coconut - opportunities and challenges

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Coconut palm is a versatile crop found in most of the countries located in and around the equatorial region. It is less susceptible to abnormal climatic conditions and grows even in severely depleted soil. Coconut palm referred to as Kalpavriksha has been traditionally cultivated in India from ancient time. The three states Kerala, Tamil Nadu and Karnataka account for about 85 per cent of the Coconut in the country.

Coconut tree with its capacious biomass is an alternative source of renewable energy. The midribs of leaves are useful in making brooms, fish traps and baskets. The husk yields fiber which itself is a made into hundreds of products. The pith is a soil conditioner and also acts as a rooting medium. The coconut shell is used as a fuel besides it also acts as a starting material for shell powder, shell charcoal, activated carbon, utility articles and attractive show pieces. Coconut shell powder finds extensive uses in plywood and laminated board industries, as filler in synthetic resin glues, mosquito coils and Agarbathy industries. Activated Carbon is a non graphite form of carbon widely used in the purification of water, bleaching of vegetable oils and also in gas masks.

Coconut is a food as well as an oil seed crop. Tender Coconut is used as a nutritious health drink. The water of mature nut is the starting material for value added products such as vinegar, jelly and wine. The kernel is an important constituent of the diet in many countries. Coconut oil cake, the residue left over after the extraction of oil is a good cattle feed. Coconut oil is used as important food ingredient. Coconut oil is used as hair oil and also as skin care body oil. It is an important source of C12-C18 fatty acids highly desired by the oleo chemical industry. Neera is sweet sap tapped from unopened spadix of the coconut palm is a delicious health drink, rich in carbohydrates. It is also raw material for many value added products like palm syrup, palm jaggery and palm sugar.

In India coconut crop economy is mainly linked with fresh coconut or copra, as over 40% of the total nuts produced are consumed in the form of either fresh or tender nuts and about 50% of the nuts are converted into copra and consumed as coconut meal and coconut oil. Very small proportion is consumed as desiccated coconut and other products. It is evident that despite of the multitude opportunities for product diversification, value of coconut in India is regarded mostly in terms of copra or coconut oil. It is necessary to delink this dependency by means of developing and popularizing more value added products.

Coconut oil – a raw material for lubricant application

Most of the lubricants which are in use today are derived from petroleum. These products being non biodegradable are cause of concern as they are contaminating the flora and fauna. Growing environment

awareness and stringent regulations in the recent past have renewed interest in environment friendly lubricants. Coconut oil has good oxidative resistance in comparison to other vegetable oils due to the presence of high content of saturated fatty acids. In addition, coconut by virtue of its inherent properties has huge potential as a raw material in total loss lubricant applications such as metal working fluids (MWF) and greases.

Green Cutting Fluid (GCF)-Coconut oil based Metal Working Fluid

Metal Working Fluids (MWF) are used in various machining operations to lubricate and cool the tool and work piece. It is also used to flush away the chips generated during the machining process. Traditionally MWFs are prepared using mineral oil derived from the crude petroleum. MWFs also have biocides as functional additives in their formulations and due to this machine operator are facing increased risk of respiratory and skin disorders. Petroleum itself is known for causing irreversible damage to the environment. Further, these products would be unsustainable. In order to overcome these problems several countries have enforced environmental legislations making MWF formulators to abide by these rules.

Several studies have been done in the past and MWF formulations have been developed using the vegetable oils. Those formulations are unsustainable as the conventional additives which are carcinogenic in nature are used. A product is sustainable only if it is derived from renewable sources, biodegradable, non toxic and should be completely replenishble. Thus toxicity and biodegradability testing of base oils, additives and final product is essential to term a product as sustainable. Since coconut oil is a renewable source and completely biodegradable, it would be ideal choice for MWFs and greases.

The present work is significant in terms of sustainability as it gives an overview of how coconut oil based MWF called "Green Cutting Fluid" is developed. The product is unique as the base oil (coconut oil) and the other constituents of the formulations such as emulsifiers and additives are non toxic to aquatic life and benign to environment. The overall process and key findings of this process are discussed in briefly.

Selection of emulsifiers and additives and evaluation of stability

Commercially available food grade emulsifiers (E-1, E-2 and E-3) were selected for this purpose and their final composition was adjusted to get the required Hydrophilic lyphophilic balance (HLB) value of coconut oil. Further the ratio of oil to emulsifier was also adjusted to get small particle size and extended stability.

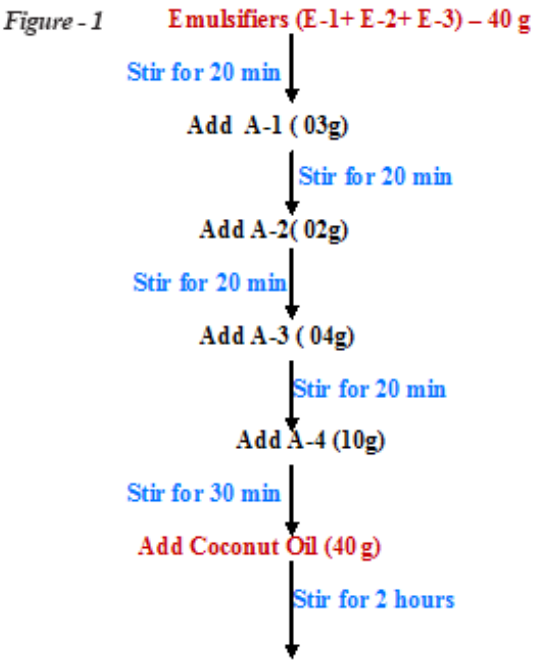
Toxicity testing of emulsifiers and additives

Aquatic toxicity of each ingredient and the final formulation was carried out as per OECD 203 method. Fishes which were pre-acclimatized to the testing condition were used in experiments. Concentration of test substance was increased at the geometric series of 2.2 and seven fishes were exposed to test substances for

Sample Details	Toxicity level (LC_{50}) In mg/L
Coconut oil	>2342.56
E-1	>1064.8
E-2	>1064.8
E-3	>1064.8
A-1	>1064.8
A-2	>1064.8
A-3	>1064.8
A-4	>1064.8
GCF	>1064.8
MWF	<100

Table - 1

Figure - 1



Store the formulation mixture at room temperature. Dilute the formulation mixture in 1:20 ratio with deionized water and use for machining processes.

(Where E-1, E-2 and E-3 are emulsifiers and A-1. A-2, A-3 and A-4 are the additives used for preparing the GCF)

96 hours. Dissolved oxygen and PH were monitored throughout test duration. Mortality of fishes was recorded at an interval of 24 hours for four days. The studies have shown that coconut oil, emulsifiers and additives used in GCF formulation were found to be non toxic even at 1000 ppm. Whereas the conventional MWF formulation found to be highly toxic well below 100 ppm concentration as shown in the Table 1.

Green cutting fluid formulation and Optimization of formulation

The emulsifiers and additives which were found to be nontoxic in the fish toxicity test were used in GCF formulation. The schematic representation of process is shown in Figure 1

Cytotoxicty and fish embryo tests

The *in vitro* cytotoxicity of cutting fluid samples was evaluated by MTT assay. The studies have revealed that GCF does not have any toxic effect even at a concentration of 50 µg/ml even after 24 hrs, where as MWF showed significant reduction in cell viability with in 2hours. These results clearly indicate the toxicity of commercial cutting fluids in human keratinocyte cell lines.

Zebra fish free from externally visible diseases and pharmaceutical treatments aged from 6 to 24 months were used for egg production. The 24 hours post fertilization embryos were used for testing. In two replicates for each test concentration, 10 embryos were transferred per well into a 24-well plates having test concentration of 1 µg/L, 10 µg/L, and 100 µg/L and incubated at 26°C. The embryos were inspected at 24, 48, 72 and 96 hours of exposure equivalent to 48, 72, 96 and 120 hours respectively. The studies have revealed that the LC50 value for GCF after 120 hours was estimated to be 100 µg/L compared to < 1 µg/L. for MWF clearly indicating that MWF is highly toxic to the fish embryos where as GCF is relatively non-toxic.

Machining performance of cutting fluids on mild steel

The performance of cutting fluids was evaluated by means of turning and drilling experiments. Commercial grade AISI 1018 mild steel cylindrical rod of diameter 25mm was used as work piece for turning experiments and Turning experiments were performed in a lathe equipped with a 3-axis dynamometer to measure tangential force, feed force and radial force. Experimental results for turning have shown that GCF has performed better than MWF

It is evident with the above results that coconut oil based metal working fluid is a sustainable product. It was found to be non toxic to aquatic species and benign to environment.

Conclusion

Despite of having opportunities for product diversification, value of coconut in India is regarded mostly in terms of its potential to produce oil due to lack of awareness and low efficacy of transfer of technology. There should be a proper mechanism to procure and convert surplus coconut into value added products, which will strengthen the coconut economy of the country.

Coconut oil derived Oleo chemicals offer great value addition to coconut oil. Coconut oil holds tremendous potential in lubricant sector especially as MWF and grease which not only add value addition but also helps to abide by the edicts of environmental regulations.

A completely sustainable coconut oil based metal working fluid "Green Cutting Fluid" has been developed. The cytotoxicity, fish toxicity and fish embryo tests have shown that GCF is non toxic to aquatic species and benign to environment. The turning and drill dynamometer tests have shown that the performance of GCF was comparable to conventional metal cutting fluids.

Acknowledgement

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CDB Regional Office at Patna

CDB opened a new Regional Office at Patna by converting the State Center office of the Board. Regional Office Patna will look after the activities of Bihar, Jharkhand and Chhattisgarh. Board is already having Regionl Offices at Tamilnadu, Karnataka and Assam.

Pulverization of coconut leaves for efficient vermicomposting

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Vermicomposting is a useful technology for recycling agro-wastes to good quality manure. The decomposition of the wastes by oxidation followed by stabilization is driven by the combined action of earthworms and the microorganisms (Dominguez *et al.,* 2010). The earthworms chew the pre-decomposed wastes to very small pieces which facilitate bacteria, fungi and actinomycetes to further quickly decompose the material into manure. The decomposition helps in unlocking the nutrients present in the agro-wastes into easily available form for the plants.

All types of agro-wastes can be converted to vermicompost right from easily degradable vegetable wastes to highly recalcitrant wastes like coconut leaf, coir-pith and others. Urban wastes such as sewage sludge is also converted to vermicompost. The common epigeic earthworms that are used for vermicomposting of agro-wastes are African night crawler (Eudrilus eugeniae), red worm or tiger worm (Eisenia fetida), red wrigglers (Lumbricus rubellus) and blue worm or India blue worm (Perionyx excavatus) (Kale, 1998).

Addition of vermicompost helps in improving the soil porosity and water holding capacity of soils. It adds valuable organic carbon, plant nutrients and beneficial microorganisms (Gopal *et al.,* 2009) which improves the fertility and health of soil in ecologically safe manner (Thomas et al., 2007). Most of all, it helps in circular economy of the carbon i.e., the vermicomposting technology helps in recycling and sequestering carbon to soil which would have otherwise been burned or linearly removed from land and lost to environment as carbon dioxide leading to the warming up of the planet earth.

Coconut leaf vermicomposting technology

Among the many agro-wastes, plantation crops such as coconut palm generate large quantities of biomass residues. It has been estimated that from one hectare coconut garden roughly 6-8 tonnes leaf residues alone is produced annually (Upadhyay *et al.,* 1998). Owing to its high lignin content, close to 30%, the coconut leaf does not decompose easily when left to environment. It will take not less than 12 to 18 months for it to degrade naturally. ICAR-CPCRI had developed a successful technology for recycling coconut leaves to vermicompost using an indigenous strain of Eudrilus sp. earthworm (Prabhu et al., 1998) which decomposes within 60-75 day period. In this technology, the senescent coconut leaves are cut into two or three pieces using a knife and then stacked inside cement tanks (7.5 x 2 x 1m) and cow dung slurry is spread over the coconut leaves. Two to three layers of the substrate is filled inside the tank which is watered regularly. The top is covered with mulch and plastic net. The moist substrate is allowed to undergo pre-decomposition for 20-30 days and then the CPCRI Eudrilus sp. is added to the pre-decomposed substrate.

For one tonne of coconut leaf waste, about 100-200 kg cow dung slurry and 1000 earthworms are required for the effective decomposition. At the end of 60-75

days period, a maximum of 60-70% of the substrate is converted to vermicompost by this method leaving behind some 30-40 % partially decomposed material like the leaf midrib and the hard petiole portions. At the end of the process, vermicomposted material is separated from undecomposed/ partially decomposed substrate and the earthworms are separated and used for next cycle of vermicompost production. The coconut leaf vermicompost, thus produced, is air-dried and used for application in field. The undecomposed materials are segregated to be added in the next round of production for complete recycling. This method can be easily adopted by small and marginal farmers or group of farmers on a small scale. However, this method is time consuming. It requires labour to chop the leaves and stack it manually inside the tank. Approximately four mandays are required to fill four tanks of dimensions (7.5 x 2 x 1) m / (8.8 x 1 x 0.7) m with each tank capable of holding one tonne of substrate.

Vermicompost production using pulverized coconut leaves

Pulverizing or shredding improves stabilization of organic material by composting and vermicomposting (Tognetti et al., 2007). Pulverizing the coconut leaves including the woody petiole using a 40 HP tractor mounted mechanical pulverizer is an alternate option to hand chopping for scaling up the production. This pulverizer shreds a complete coconut leaf (about 5-7 m long, 3-5 kg weight), even the thick petiole base, in less than 12 seconds. Using this machine, a turnover of 2.5 to 3.0 tonne of the pulverized substrate is possible within an hour. Thus, large quantity of pulverized substrate can be easily and quickly filled inside the tank for vermicomposting.

Comparative trials with chopped and pulverized coconut leaves

Preliminary trial in basins

An experiment was initiated to study the effect of substrate size (chopped and pulverized coconut leaf) on vermicomposting efficiency in plastic basins. Coconut leaves minus the thick woody petiole base, chopped to 15 cm bits in chaff cutter, and pulverized whole coconut leaf (including the thick woody petiole) were separately mixed with cow dung in equal proportions (1:1, w/w basis) and allowed to pre-decompose for 15-20 days and then 20 kg of pre-decomposed chopped and pulverized substrates were filled separately in plastic basins. To each basin, 20 adult coconut leaf eating earthworms, Eudrilus sp., were added. Three replications per treatment were maintained. The basins were regularly watered in order to maintain about 40-50% moisture. At the end of vermicomposting period, the amount of compost produced, number of earthworms multiplied and the nutrient content and microbial load of vermicompost produced were analyzed.

The vermicompost turnover and the earthworm multiplication were higher in the pulverized material compared to chopped coconut leaves, by 7% and 13% respectively. Similarly, higher potash content and pH was observed in the vermicompost produced from pulverized coconut leaves (Fig.1).

Microbial analysis too showed that pulverized vermicompost had higher fungi, actinomycetes and fluorescent pseudomonads count on dry weight basis (Table1). The trial indicated that the earthworms were able to convert the pulverized coconut leaf including woody petiole to vermicompost in similar fashion of the chopped coconut leaves minus the woody petiole.

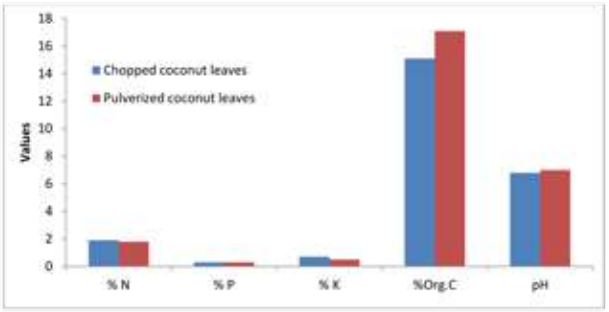

Fig.1. Chemical properties of vermicomposts produced from chopped and pulverized substrates in basin trials

Table 1 : Microbiological status of chopped and pulverized substrate treatments in basin trials

Method	Bacteria	Fungi	Acti-no-my-cetes	N2-fixers	Fluo-rescent pseudo-monads
Manual cutting of leaves	147 x 106	52 x 104	193 x 105	215 x 102	17 x 102
Pulveri-zation of leaves	149 x 106	77 x 104	282 x 105	218 x 102	37 x 102

*All values are mean of nine replications and represent cfu/g of vermicompost

Based on the results obtained in small scale trial, further scaling up of the process was taken up in large cement tanks.

Large scale trials in cement tanks

Cement tanks with dimensions of (8.8 x 1.0 x 0.7 m) having three compartments were used in large scale vermicomposting studies. In one tank, coconut leaves,

chopped into two or three pieces manually using knife, were filled. Cow dung slurry was spread above the stacked leaves. Three such layers were filled inside the tanks. About 400 kg of chopped coconut leaf substrate was accommodated in each compartment. In another tank, pulverized coconut leaves were filled in similar fashion. Per compartment, a maximum of 350 kg of pulverized coconut leaf substrate could be accommodated. Watering was done regularly to keep the substrates moist in both the tanks and allow pre-decomposition of the material. After three weeks of pre-decomposition period, earthworms were added @ one adult coconut leaf degrading worm per kg of substrate. The tanks were covered with net to prevent rodent/insect entry. Watering was done regularly to keep the substrate sufficiently moist so as to allow the earthworms to carry out their composting activity. At the end of the vermicomposting period, the decomposed material was separated from partially decomposed material, earthworm numbers were counted and the vermicompost produced from chopped and pulverized treatments were analyzed for physico-chemical and microbial properties.

Advantages of vermicomposting pulverized coconut leaves

Vermicomposting of coconut leaves by conventional method of chopping and filling the tanks takes approximately 60-75 days. By pulverization too, the vermicompost is produced in same period of time. But the advantage is that even the hard petiole portion which takes more than two to three cycles of composting for decomposition in the conventional chopping method will be completely converted to vermicompost in one cycle by the pulverized method. Table 2 gives the information on input to output details for both the methods. It can be observed that in case of chopping method, the conversion efficiency is slightly above 60% and it is as high as 80-85% in case of pulverizing method. Higher efficiency of vermicomposting by pulverization method can help in recycling higher quantities of residues, on an annual basis, with the same set of available facilities.

Mature vermicompost produced from pulverized (left) and chopping (right) method

Table 2 : Comparative input and output data on different vermicomposting methods

Biomass treatment	Substrate Input (kg)	Vermi-compost harvested (kg)*	Earthworms added (nos.)	Earth-worms har-vested (nos.)*
Manual cutting of leaves	400	230	400	1340
	400	250	400	1620
Pulveri-zation of leaves	350	290	350	1600
	350	300	350	1670

* Values are mean of three replications

The nutrient content and microbial make up of coconut leaf vermicompost produced by both the methods are given in Tables 3 and 4. It can be seen that the vermicompost produced from pulverized coconut

leaves is slightly superior in terms of nutrient contents compared to chopping method. However, the pH is in alkaline range. This makes the pulverized coconut leaf vermicompost more suitable for the acid soils of Kerala and other regions where coconut is commonly grown. In terms of microbial composition too, the vermicompost produced from pulverized coconut leaf was superior in harbouring higher populations of general (bacteria, fungi) and plant-beneficial microbes (nitrogen fixers, phosphate solubilizers and fluorescent pseudomonads).

Table 3 : Physico-chemical characteristics of vermicompost produced by two different methods

Coconut leaves	Total N %	Total P %	Total K %	OC %	pH %	Moisture %
Manual cutting	1.85	0.25	0.16	16	6.3	61
Pulverization	1.73	0.25	0.26	18	7.4	68

*All values are mean of six replications

Table 4: Microbial analysis of vermicompost produced by two different methods

Coconut leaves	Bacteria	Fungi	Actinomycetes	N2-fixers	Phosphate solubilizers	Fluorescent pseudomonads
Manual cutting	94 x 106	75 x 104	27 x 105	64 x 103	49 x 104	25 x 103
Pulverization	100 x 106	101 x 104	28 x 105	86 x 103	56 x 104	38 x 103

*All values are mean of nine replications and represent cfu/g of vermicompost

Overall, pulverization results in reducing the coconut leaves to small sized substrate with higher surface area that leads to quicker conversion to vermicompost having higher nutrient and microbial populations that will be more beneficial as soil amendment.

Disadvantages

Some disadvantages of vermicomposting using pulverized material are also noticed. One of them is compaction of the substrates inside the tank during the process that reduces proper aeration as well as easy movement of the earthworms. However, no adverse effect was observed on their multiplication. This can, however, be easily overcome by adding intermediary layers of chopped coconut leaves that will prevent compaction to good extent.

Conclusion

Pulverization of coconut leaves including its woody petiole base improves the recycling efficiency of vermicomposting unit by 20-25% compared to using chopped coconut leaves minus the woody petiole base. The vermicompost produced by this method has better physico-chemical and microbiological properties which will be suitable for acid soils. The method can be adopted conveniently by farmers' groups or societies to do vermicomposting in a cooperative mode.

In nutshell, 20-25% more coconut leaf residues can be converted to vermicompost on an annual basis by pulverization method, without loss in any of the analyzed properties, which is beneficial for soil health and its fertility.

References

Dominguez, J., Aira, M and Gomez-Brandon, M. 2010. Vermicomposting: Earthworms enhance the work of microbes. In: Microbes at Work. (Insam, H., Frank-Whittle, I and Goberna, M., Eds.).p.93-114. Springer-Verlag Berlin Heidelberg.

Prabhu, S.R., Subramanian, P., Bidappa, C.C., Bopaiah, B.M., 1998. Prospects of improving coconut productivity through vermiculture technologies. Indian Coconut J. 29: 79 – 84

Gopal, M., Gupta, A., Sunil, E & Thomas G. V. 2009. Amplification of plant beneficial microbial communities during the conversion of coconut leaf substrate to vermicompost by Eudrilus sp. Curr. Microbiol. 59: 15-20.

Kale, R.D. 1998. Earthworms: nature's gift for utilization of organic wastes. In: Earthworm Ecology (C.A. Edwards Ed.), Soil and Water Conservation Society, Ankeny, Iowa St. Lucie Press, New York (1998), pp. 355–373.

Thomas, G.V., M. Gopal and A. Gupta. 2007. Vermicomposting for soil fertility improvement and solid waste management in plantation crops. In Earthworms for Solid Waste Management. (Ed. Satyendra M. Singh), International Book, Lucknow, pp. 219-234.

Tognetti, C., Mazzarino, M.J. and Laos, F. 2007. Improving the quality of organic waste compost. Bioresource Technology. 98 (5): 1067-1076

Upadhayay, A.K., Reddy, DVS., Biddappa, C.C. 1998. Organic farming technology for coconut. Indian Coconut Journal. 28(4) : 74-78 ■

Organic certification & emerging trends in coconut

● **Bobby Issac,** Director, Lacon Quality Certification Pvt. Ltd, Thiruvalla, Kerala.

Organic agriculture has been gaining momentum in the recent years. The market for organic products is also on the increase, since more consumers started purchasing organic products. More and more consumers are becoming aware of the safety of food and they prefer to buy food, which is free from pesticide residues and harmful chemicals. The need for certified organic products have increased many folds as it is required to establish the trust between the consumers and the farmers who are separated by a distance. Organic products are grown in most effective environment friendly way and are verified as per the national and international organic standards. Dependence on external inputs for manuring, pest, disease and weed control are minimized or even excluded. Thus the cost of cultivation is minimized and the resultant products are nutritionally rich and have better shelf life.

Organic certification addresses a growing worldwide demand for organic food. It is intended to assure quality and to promote sustainable business. Such certification was not necessary in the early days of the organic movement as the consumers used to source directly at farmers' markets. As organic products gained popularity, more and more consumers started to purchase organic food through traditional channels, such as supermarkets and fine food shop. Hence the consumers start relying on third-party regulatory certification.

LACON, one of the leading German certification bodies, has been involved in organic certification and other quality certification since 1989. The Indian office of LACON was started in Kerala in 2002, accredited by the National Accreditation Board having its secretariat at APEDA. Lacon certifies project across 24 states, including North-Eastern states of India. The brand value of LACON has helped the farmers to access international market in addition to the growing domestic market.

In India, Agricultural & Processed foods Export Development Authority (APEDA), regulates the certification of organic products as per National Standards for Organic Production (NPOP). "The NPOP standards for Agricultural production and accreditation system have been recognized by European Commission and Switzerland for unprocessed products, as equivalent to their standards. Similarly, USDA has recognized Indian conformity assessment procedures of accreditation as equivalent to that of National Organic

Programme (NOP) which is the organic standards of USA. With these recognitions, Indian organic products duly certified by the accredited certification bodies of India are accepted by the importing countries, especially in Europe and USA.

Organic certification is a third party verification check to confirm the compliance level of the farm or the chain of activities involved in farm production, processing and trade with the respective organic standards. In general, any chain of activity, directly involved in organic food production needs to be certified, including agricultural production of individual farms or group of farms, processing, packing, storage, labeling and transport.

Requirements vary from country to country, and generally involve a set of production standards for growing, storage, processing, packaging and transportation that include;

Avoidance of synthetic chemical inputs as per the NPOP standards (e.g. Soil Conditioners, Plant protection products, Fertilizers, food additives etc.), genetically modified organisms, irradiation and the use of sewage sludge.Farmland that has been free from prohibited synthetic chemicals for a number of years (often, 2-3 years) need to be used.Detailed written documentation on agricultural production, processing and sales records (audit trail) and strict physical separation of organic products from non-certified products should be kept. Periodic annual on-site inspections need to be conducted.

Certification is essentially aimed at regulating and facilitating the sale of organic products by creating trust between producers and the consumers. Individual certification bodies have their own trade mark, which can act as branding to consumers. Being a reputed German brand, LACON's logo has high consumer recognition value and gives a marketing advantage to the farmers.

For the farm certification, the soil must meet basic requirements of being free from use of prohibited substances (synthetic chemicals, etc.) for a number of years. A conventional farm must adhere to organic

standards for this period, often two to three years. This is known as conversion period. The perennial crops require three years, whereas the annual crops require two years of conversion period, to get the organic status.

The Organic certification efforts of small holder groups helped the small farmers, especially in India, to participate in the organic certification and this has impacted upon the livelihoods of producers and the environment. Organic certification of small farmers in based on effective functioning of the internal control system (ICS) which is a similar verification system practiced internally by the group members. ICS help individual small farmers to interact and invoke group dynamics. Thus the group can build on their strength and opportunities for collective marketing and gain better price. LACON builds the trust to develop and broaden the external links with major buyers and exporters.

Certification for operations other than farms, like processing and trade follows similar procedures. The focus is on the traceability of the raw materials, quality of ingredients and other inputs used during the processing or handling stages. In addition, short-notice or surprise inspections can be made, and specific analyses (e.g. soil, water, plant tissue) may be performed.

Organic food products manufactured and exported from India are marked with the mandatory "India Organic" certification mark, which is the registered trade mark of Indian organic products. The products are labeled as per the percentage of organic ingredients used in the final product, according to the national and international organic standards. There are specific label requirements for each country and it is stipulated in the respective regulations.

The awareness on health triggered a new revolution on organic food & wellness industry worldwide. Proportionately the demand increased and currently there is shortage of genuine suppliers of such organic certified products. The sale of organic products in the domestic market as well as the export markets have increased and the demand for certified organic products are on the rise. Organic food and cosmetic segments have registered steep growth and will continue to grow for a long term.

Recent recognition of the health benefits of coconut products has increased the demand for the products, especially for virgin coconut oil & coconut palm sugar. The use of coconut based products for the cosmetic industry has also increased tremendously. American medical journals and European research associations have identified the value of coconut products recently and hence there is sudden uptake of the above products during the last one year. As a result, many of the international buyers are trying to locate organic certified sources of coconut garden and processing units to cater to the demand. There are specific reasons for the increase in demand of thsese products.

Coconut Palm sugar: A sugar substitute that seems to be gaining popularity in the national and international market. It is made from sap that is extracted from the coconut tree which is usually sold as "Neera". For cooking purposes, it has a very low melt temperature and an extremely high burn temperature so it can be used in baked products in place of sugar. Its low glycemic index, (a measure of how a food raises blood glucose) is a better choice for people with diabetes than regular sugar.

Virgin Coconut Oil: Although it is a 90% saturated fat, organic coconut oil contains medium-chain fatty acids that can improve human health in many ways. Organic coconut oil is very stable to cook, as it withstands high temperatures without heat damage. Organic coconut oil is now being recognized by the medical community as a powerful tool against immune system related diseases. Several studies have been done on its effectiveness in this area and research is currently underway concerning the incredible nutritional value of pure organic virgin coconut oil. Organic coconut oil is highly nutritious and contains a superior disease fighting fatty acid called lauric acid. It is also rich in fiber, vitamins, and minerals.

There are many other products like organic coconut vinegar and beverages; coconut meat and desiccated coconut, in addition to the non-edible products like fiber, activated carbon etc, which are unique and having ever growing demand in the international market.

The potential of organic certified coconut based products are immense and hence there is great potential for the coconut farmers to earn better profitability from coconut cultivation. The wide range of value added products that comes out of a single tree can be the best investment for the farmers. Since there are positive reports released by the research scholars, the demand may increase tremendously. Thus coconut is one of the promising crops for the Indian farmers.

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Discover the power of coconut milk

● **Jyothi K Nair**, Food Processing Engineer, CDB, Kochi-11

With its creamy texture and slight natural sweetness, coconut milk is often considered a "miracle liquid" since coconut milk nutrition offers great ability to build up the body's immune defenses and prevent diseases.

Coconut milk is a product obtained by extracting the juice out of coconut meat. Coconut milk contains about 17-24% fat, depending upon the amount of water used for it's preparation.

Coconut milk is rich in healthy saturated fat and energy. It contains Vitamin B, C and E and is also a good source minerals like Potassium, Iron, Magnesium, Phosphorous, Calcium, Sodium, Copper, Manganese, Selenium and Zinc.

Coconut milk is a treasure trove of medium chain fatty acids (MCFA). Nature's richest dietary source of medium chain fatty acids are coconut oil (64%) and palm kernel oil (58%). MCFAs in coconut oil consist of 48% lauric acid, 8% caprylic acid, 7% capric acid and 0.5% caproic acids. The most active components among these fatty acids are lauric acid and capric acid. These fatty acids give coconut milk its amazing antimicrobial properties and are generally absent in all other vegetables and animal oils.

Researches show that the presence of medium chain fatty acids in mother's milk is the primary ingredient that protects new born infants from infections for the first few months, while their immune system is in the developing state. The fatty acids that make coconut milk so effective against germs are the same ones nature has put into mother's milk to protect infants. Dr. Jon J Kabara, Consultant, Michigan State University, USA has done pioneered studies on the antimicrobial properties of fatty acids in the 1980s. Two of his most important conclusions are that lauric acid is the most active antimicrobial fatty acid and that monolaurin is the most effective antimicrobial compound that can be derived from coco chemicals. According to him, MCFAs in coconut milk are similar to fats in mother's milk and have similar nutraceutical benefits.

As MCFAs gets immediately broken down and absorbed by the cells, they do not circulate in the bloodstream to the degree that other fats do. Consequently they do not get packed away inside fat cells or clog artery walls. They are used to produce energy, not fat cells and not arterial plaque. This makes coconut milk juice an ideal health drink for people suffering from diabetes, obesity, gall bladder diseases, pancreatitis, crohn's diseases and pancreatic insufficiency.

As an anti-oxidants

What do the conditions like : heart disease, cancer, hypertension, wrinkled skin, aging spots, arthritis, cataracts and failing memory have in common? You might say they are all conditions associated with aging, but age is not the only cause. The one thing that ties all these together, as well as most other degenerative diseases, is free radicals.

Free radicals are renegade molecular entities that cause destruction throughout the body. Free radicals are unstable molecules that have lost an electron, causing

them to become highly active. In an effort to achieve equilibrium, they steal electrons from neighboring molecules. A chain reaction occurs where hundreds and even thousands of molecules are affected. Once a molecule becomes a free radical, its physical and chemical properties change. The normal function of such molecules is permanently disrupted, thus affecting the entire cell of which they are a part. A living cell attacked by free radical degenerates and becomes dysfunctional. It is the accumulation of this damage over many years that result in the degeneration and loss of functioning of the cells that typifies the symptoms of old age. In fact, some researchers believe that free radicals are the primary cause of aging.

Free radicals are a product of oxidation in our body. As a means of self protection, our body produces many antioxidants that can stop free radical chain reactions. Many nutrients in our food such as vitamin C and E also act as antioxidants. The antioxidants and free radicals present in human body depend upon the types of food they eat and also the environment they live in. Coconut milk contains saturated fatty acids which are chemically very stable and resistant to oxidation. They act as powerful anti oxidants by protecting unsaturated fats from oxidation, thus preventing the development of cancer.

Heart Diseases

The oil present in coconut milk tends to increase HDL cholesterol and improve the cholesterol profile. HDL is the good cholesterol that helps protect against heart disease. Total blood cholesterol, which includes both HDL (good) and LDL (bad) cholesterol, is a very inaccurate indicator of heart disease risk. A much more accurate way to judge heart disease risk is to separate the two types of cholesterol. Therefore, the ratio of the bad to good cholesterol (LDL,HDL) is universally recognized as a far more accurate indicator of heart disease risk. Because of coconut oil's tendency to increase HDL, consumption of coconut milk improves the cholesterol ratio and thus decreases risk of heart disease.

Studies in 1970s and 1980s indicated that coconut oil is heart friendly. Compared to other dietary oils, coconut oil consumption was found to reduce the risk of heart disease by improving cholesterol readings, lowering levels of blood and liver cholesterol, lowering body fat deposition, reducing tendency to form blood clots, reducing uncontrolled free radicals in cells and increasing antioxidant reserves in cells. These studies alone shows coconut oil as healthy or at least benign for heart.

But there is another factor that is even more important, that reveals coconut oil as not simply a benign bystander but a very important player in the battle against heart disease. Heart disease is caused by atherosclerosis (hardening of the arteries) which is manifested by the formation of plaque in the arteries. According to recent studies, atherosclerosis initially develops as a result of injury in the inner lining of the arterial wall caused by certain toxins, free radicals, viruses, or bacteria. If the cause of the injury is not removed, it will result in further damage of arterial wall. As long as irritation and inflammation persist scar tissue continues to develop.

Special blood clotting proteins called platelets circulate freely in the blood. Whenever an injury is occurred, these platelets become sticky and act as a bandage to the damaged tissue for facilitating healing. This is how blood clots are formed. The injury inside the artery wall triggers the release of protein growth factors that stimulate growth of the muscle cells within the artery walls. A complex mixture of scar tissue, platelets, calcium, cholesterol and triglycerides are incorporated into the site to heal the injury. This mass of tissue forms arterial plaque. When this process occurs in the coronary artery, which feeds the heart, it is referred to as coronary heart disease

A number of studies have reported associations between heart disease and chronic bacterial and viral infections. Studies made on animals have provided more direct evidence that bacteria might contribute to chronic inflammation and plaque formation.

The bacterias (Helicobacter pylori and Chlamydia pneumonia) and viruses (CMV) that are most commonly associated with atherosclerosis can be destroyed by the MCFAs present in coconut milk. The MCFA in coconut milk are known to kill all three major atherogenic organisms. MCFAs are powerful germ fighters and are

known to kill dozens of disease causing organisms. Not only can coconut milk help protect you from the germs that cause ulcers, lung infections and herpes but also heart disease and stroke.

Diabetes

The two most common types of diabetes are type 1 and type 2. Type 1 occurs when pancreas in our body is unable to produce enough insulin needed for the body. In type 2 diabetes, the pancreas may be able to produce normal amount of insulin, but the cells in our body have become unresponsive to it. This is called insulin resistance. A low- fat diet is generally recommended for diabetes because fats are believed to increase the risk of obesity and heart disease, both of which are associated with diabetes. However, the MCFAs present in coconut milk can be one of the best cures for diabetic patients. Glucose as well as long chain fatty acids require insulin to enter the cells. Medium chain fatty acids present in coconut milk do not need insulin. They can pass through the cell membrane and enter without it. Not only do MCFAs pass through the cell membrane with ease, but they also penetrate the mitochondria (energy producing organs of cell) without assistance. Mitochondria take glucose and fatty acids and transform them into energy required by the cell. Mitochondria has a double membrane, making it impossible for glucose and fatty acids to enter without the aid of special carriers called carnitine tranferase. MCFAs can penetrate the double mitochondrial membrane without the assistance of this enzyme. They are also oxidized faster to carbon di oxide with energy liberation. Therefore, they can provide cells with nourishment whether insulin is present or not. When you drink coconut milk, you give your cells a boost of energy. It helps supply energy to cells because it is easily absorbed without the need of enzymes or insulin.

Liver Diseases

The most common liver problems we hear about are hepatitis and cirrhosis which can be fatal. Various factors can cause hepatitis; among them are alcohol, drugs, viruses and bacteria. Three types of hepatitis, known as hepatits A, B and C are caused by viral infections.

Two most destructive enemies of liver are viruses and free radicals – both of which can be protected against by the regular consumption of coconut milk. Studies show that MCFAs can prevent alcohol-induced liver injury by inhibiting free radical formation. Several other studies have also shown that fatty acids found in coconut milk protect the liver from alcohol-induced free-radical injury and tissue death. Several doctors recommend using fatty acids (from tropical oils) as a dietary treatment for alcoholic liver diseases. Consumption of coconut milk could be beneficial in this regard.

Of all the organs in the body, liver probably receives the greatest benefit from coconut milk. The liver is under constant stress, filtering out waste, neutralizing toxins, dismantling and reconstructing fats and proteins, storing and producing energy, and performing a hundred other functions. Diseases causing germs and free radicals constantly attack the liver, affecting its function. MCFAs from coconut milk help relieve the stress by stopping free radicals and killing harmful germs. Coconut milk also functions as a natural detoxification agent by neutralizing the effects of poisons. Drinking coconut milk gives the liver a break, reducing its work load, protecting it from free radicals and supplying it with energy. The MCFAs in coconut milk is used by liver as a source of fuel to generate power and metabolism. Thus, it improves the functioning of liver.

Conclusion

Coconut has been used both as a food and medicine for centuries in many cultures throughout the world. Traditional forms of medicine use coconut milk and oil for a wide variety of health problems, ranging from the treatment of burns and constipation to influenza. Modern medical research is now confirming the effectiveness of coconut milk for many of these conditions. Research over last decade has demonstrated that the medium chain fatty acids in coconut milk are digested and metabolized differently from those of other fats. This difference gives the coconut milk many health benefits obtained from no other sources. It has been recommended for use in the treatment of malnutrition because it provides a quick and easy source of nutrition. It also improves the absorption of minerals (particularly calcium and magnesium), B-vitamins and fat soluble vitamins as well as amino acids. It stimulates metabolism, increases energy and improve thyroid function, all of which aid in reducing unwanted body fat. For these reasons, it has gained a reputation as being the world's only natural low-calorie fat beverage and researchers have recommended this for preventing obesity. Coconut milk is also healthy for heart. It does not negatively affect blood cholesterol, does not promote stickiness that leads to blood clot formation and does not collect in arteries. Even it possesses anti-inflammatory, antimicrobial and antioxidant properties, all of which protect arteries from artherosclerosis and from heart diseases.

In a nutshell, coconut milk is a miracle food and the uses of it are countless. A daily sip of coconut milk helps you stay healthy and live long ■

References:

1. Bruce Fife, C.N., N.D (2004). The Coconut Oil Miracle. USA: Penguin Group.

2. Bruce Fife, C.N., N.D (2004).Coconut Cures.USA: Piccadilly Books.

3. Dr. Josh Axe, Coconut Milk Baby Formula Recipe, viewed 4 May 2016,< http://draxe.com/recipe/coconut-milk-baby-formula/#>.

Coconut juice: an energy booster

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Coconut milk has been a part of culinary items for centuries. Now it is readily available as a ready to drink beverage. Coconut milk, a liquid extracted from coconut kernel, mixed with water in right proportion, 'Coconut Juice' is increasingly becoming popular.

Coconut Juice, which is rich in Medium-chain triglyceride (MCT) fatty acids, is popular in sports nutrition. MCTs are composed of 3 medium chain fatty acids linked together by a single glycerol molecule. When MCT is consumed, it gets converted into monoglycerides and medium chain fatty acids (MCFAs), both of which posses powerful antimicrobial properties capable of destroying disease causing bacteria, fungi, viruses and parasites.

Athletes can use coconut juice to reduce and control their body weight. It also provides important minerals needed to maintain blood volume, regulate heart health and prevent dehydration or diarrhea. Studies have found that MCT fatty acids present in coconut milk increase energy expenditure and help enhance physical performance. Following exercise, muscles also need plenty of nutrients — including electrolytes like magnesium and potassium that are found in coconut milk — to repair broken down tissue and grow stronger.

Regular consumption of coconut juice increases energy levels of the body. MCTs present in the juice break down into Medium Chain Fatty Acids (MCFAs) and are easily absorbed by the energy-producing organelles of cells in our body, which increases metabolism. With MCFAs naturally present in coconut juice, its regular consumption produces more energy, which help body perform better, thus leading to greater endurance. The fact that MCFAs digest immediately to produce energy and stimulate metabolism has led athletes to use coconut juice as a means to enhance their athletic performance.

Study to test the physical endurance was made on human beings. The study was made on conditioned cyclists, who were provided three kinds of energy drinks; an MCFA solution, a sports drink and a mixture of a sports drink and MCFA solution. The cyclists pedaled at 70% of maximum energy for two hours, then immediately embarked on a 40 kilometer time trial ride, which lasted about another hour. The ones who consumed the mixture of sports drink and MCFA solution delivered the highest performance during the time trial.

The researchers theorized that MCFAs gave the cyclists an additional source of energy, thus sparing stored glycogen. Glycogen is the energy stored in muscle tissue. This energy would have been used during the three hour ride. The higher the amount of glycogen in the muscles, the greater is the endurance of athletes. Many of the powdered sports drinks and energy bars sold at food stores contain MCTs to provide a quick source of energy. The MCFAs most often present in sports drinks and energy bars are in the form of MCT oil, which is a natural ingredient of coconut juice. This ingredient is usually listed as MCT on food, supplement and infant formula labels. Athletes and other active people looking for nutritional, non-drug methods to enhance their physical performance can opt for coconut juice.

Regular consumption of Coconut Juice increases energy levels of the body

Besides increasing energy levels, there are other important benefits of boosting metabolic rate i.e. it strengthens the immune system and protects the body from illness and also promotes quick healing. When metabolism is increased, cells function at higher rate of efficiency. This heals injuries quicker by replacing old and diseased cells with young new cells which are generated at an increased rate. The MCTs present in coconut juice can help lower inflammation, which is associated with painful conditions like arthritis and general joint or muscle aches and pains.

Studies generally, show that a single dose of MCFA mixtures has little measurable effect on energy and endurance levels. However the results were more significant when MCFAs were consumed as a part of daily diet. This also applies to those people who diet and feel low in energy because of food restriction. The MCTs present in the milk can do the same for them. If coconut juice is consumed regularly, it can provide a boost in their energy levels throughout the day. The boost in energy is not like the one who gets a kick from caffeine. It is more subtle than that, but last for a longer period. As mentioned earlier, the metabolism of the body is elevated and remains so for at least 24 hours.

With all these nutritional and energy benefits obtained from a single source, coconut juice is ready to bring a new prospect in the health beverage industry. It is a healthy dairy substitute and also a vegan food. A product which has been a part of culinary items for centuries is now increasingly being recognized as a natural and nutritious energy drink.

References:1. Bruce Fife, C.N., N.D (2004), The Coconut Oil Miracle, USA: Penguin Group.

Indian Coconut products export growth continues

K.S. Sebastian, Assistant Director, Export Promotion, CDB.

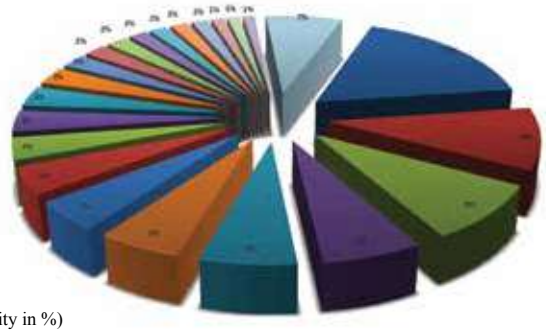
Export of coconut products during the month of April 2016 touched Rs. 133.64 crores. Compared to the export during the corresponding month of the previous year an increase of 8.35% was recorded in coconut product exports. Significant increase was recorded in the export of desiccated coconut, copra and coconut oil. Export of coconut products from India during month of April 2016 is given in table 1.

Table1

Export of coconut products in April 2016				
Items	April 2015		April 2016	
	Qty (in MT)	Value (Rs. In lakhs)	Qty (in MT)	Value (Rs. In lakhs)
Activated Carbon	5352.88	5456.01	5238.11	5367.60
Coconut Fatty Soap		253.72		198.60
Coconut Hair Cream		27.95		30.05
Coconut Oil		132.95		190.07
Coconut Hair Oil	529.90	1116.28	889.93	1399.08
Coconut Water		46.51		99.74
Copra	151.46	151.92	1222.63	850.58
Desiccated Coconut	318.26	477.04	1208.35	1225.73
Dry coconut	1993.13	2266.53	1756.69	1673.66
Fresh coconut	2443.21	909.52	3163.08	979.45
Grated/sliced coconut	140.48	302.45	215.85	370.25
Oval coconut shell	123.20	71.28	213.53	148.15
Shell charcoal	639.60	207.26	404.12	155.65
VCO	143.79	458.00	14.71	41.60
Misc coconut products		457.43		634.16
Total		12334.86		13364.36

Activated Carbon

The export of activated carbon from India during the month of April 2016 was 5238.11 MT. United States was the major importer of Indian Activated Carbon, followed by United Kingdom. Details of export of Activated Carbon from India is given in table 2



(quantity in %)

Table 2

Country wise export of Activated Carbon in April 2016		
Country	Qty(in MT)	Value(Rs in lakhs)
United States	902.63	963.36
United Kingdom	525.46	531.48
South Korea	468.66	474.71
Canada	342.20	342.34
Germany	326.80	365.17
Sri Lanka	286.10	261.56
Philippines	248.48	261.23
Turkey	230.03	188.80
Italy	187.20	152.79
South Africa	182.65	193.55
Netherlands	175.50	168.21
Russia	152.00	159.24
Tanzania	119.00	134.08
China	105.23	148.06
France	101.40	112.09
Papua New Guinea	88.00	86.856
Thailand	85.85	85.26
Japan	84.70	114.45
Belgium	79.60	71.07
Estonia	62.00	72.21
Argentina	60.00	58.08
Iran	57.20	58.16
Other Countries	367.42	364.83
Total	5238.11	5367.60

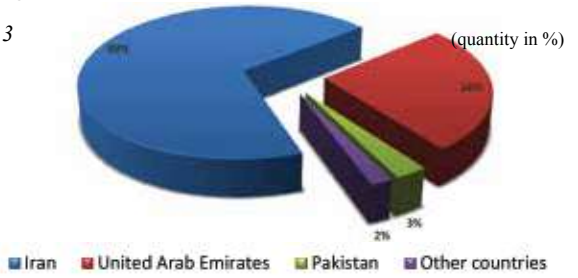
Dry Coconut

During the month of April 2016, 1673.66 MT of dry coconuts were exported from India. Out of this 1221.03 MT was to Iran. Countrywise export of dry coconut from India is given in table 3.

Table 3

Export of dry coconut (April 2016)		
Country	Qty (in MT)	Value (Rs in lakhs)
Iran	1221.03	1172.73
United Arab Emirates	455.54	363.37
Pakistan	48.00	47.47
Other countries	32.13	90.09
Total	1756.69	1673.66

(quantity in %)



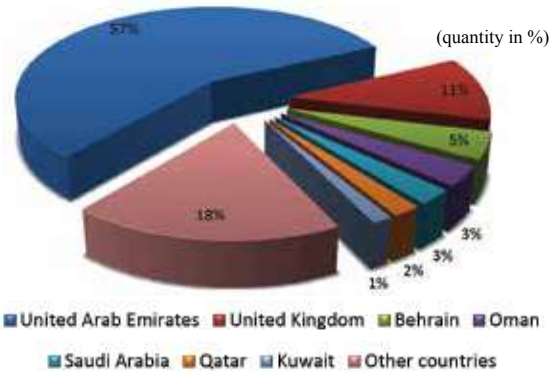
Fresh Coconut

Export of husked coconut from India during the month of April 2016 was 3163.08 MT. Major portion of export was to UAE. Countrywise export of fresh coconut from India is given in table 4.

Table 4

Export of fresh coconut (April 2016)		
United Arab Emirates	1794.11	538.23
United Kingdom	348.36	139.34
Behrain	146.25	46.80
Oman	107.68	43.07
Saudi Arabia	80.15	32.06
Qatar	62.07	24.83
Kuwait	43.73	21.87
Other countries	580.73	133.25
Total	3163.08	979.45

(quantity in %)



Desiccated Coconut

Export of desiccated coconut powder in April 2016 was 1208.357 MT which was 279.67% more than the desiccated coconut export in April 2015. Country wise export of desiccated coconut powder during the month of April 2016 is given in table 5

(quantity in %)

Table 5

Export of DC from India during April 2016		
Country	Qty(in MT)	Value(Rs in lakhs)
United Arab Emirates	436.86	429.86
Saudi Arabia	245.40	257.00
Egypt	204.00	207.62
United States	77.52	74.83
Brazil	50.00	55.31
Poland	50.00	49.39
Yemen	27.00	25.08
France	26.00	29.08
Algeria	25.00	23.42
Qatar	25.00	28.13
Israel	13.00	13.01
Bahrain	12.50	18.12
Nepal	11.08	10.27
Other countries	5.00	4.59
Total	1208.35	1225.73

Coconut Oil

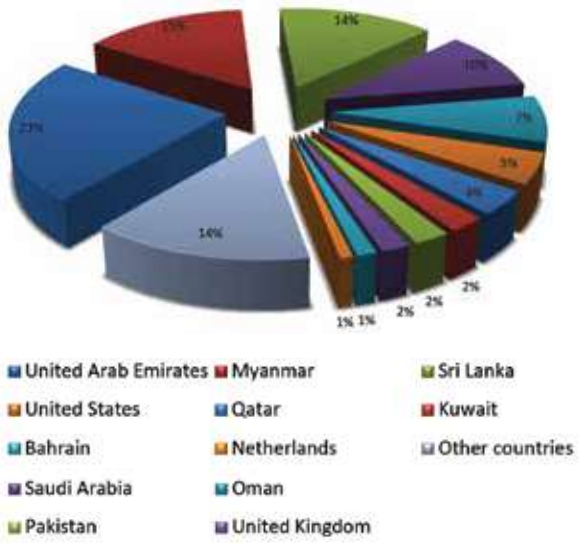
Export of coconut oil from India during the month of April 2016 was 889.93 MT, which is 67.94% higher compared to 529.90 MT recorded during the corresponding month of last year. UAE alone imported 204.67 MT of coconut oil from India.

Coconut oil was also exported to Myanmar, Srilanka, Saudi Arabia, Oman, United States, Qatar, Kuwait, Pakistan etc. Export of coconut oil from India during the month of April 2016 is given in table 6.

Table 6

(quantity in %)

Export of coconut oil (April 2016)		
Country	Qty (in MT)	Value (Rs in lakhs)
United Arab Emirates	204.67	307.00
Myanmar	130.28	203.04
Sri Lanka	124.34	123.12
Saudi Arabia	85.65	131.90
Oman	66.22	75.33
United States	43.58	122.03
Qatar	33.26	53.22
Kuwait	20.91	29.84
Pakistan	20.75	39.90
United Kingdom	16.45	42.77
Bahrain	11.21	24.79
Netherlands	7.38	23.97
Other countries	125.23	222.17
Total	889.93	1399.08



Import

During the month of April 2016, India imported Rs 37.69 crores worth coconut products. Copra expeller cake, coconut fatty acid and coconut shell charcoal were the major items imported in April 2016. Details of import of coconut products into India during the month of April 2016 is given in table 7.

Table 7

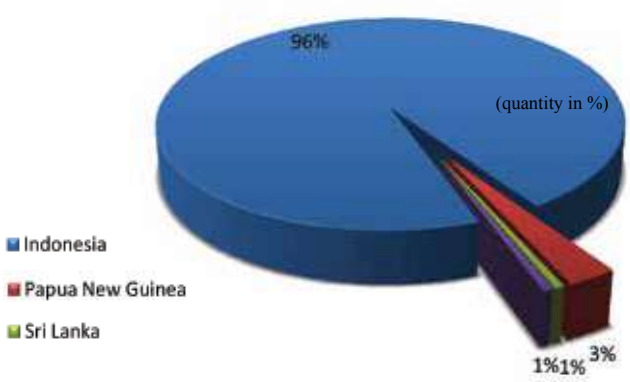
Import of coconut products (April 2016)				
Item	April 2015		April 2016	
	Qty (in MT)	Value (Rs. in lakh)	Qty (in MT)	Value (Rs. In lakhs))
Coconut fatty acid	378.24	328.45	689.70	555.05
coconut oil	551.39	634.10	0.00	0.00
Copra oil cake	8231.06	1271.29	19684.67	2836.81
Coconut shell charcoal	1870.17	608.52	324.62	96.34
Cream-milk-powder		98.75		197.23
Copra	24.42	17.47	0.00	0.00
Misc coconut products		40.62		83.84
Total		2999.21		3769.27

Copra expeller cake

Copra expeller cake is the major coconut product in terms of quantity and value importing to India. During the month of April 2016, the quantity of import of this product was 19684.67 MT of which 18900.00 MT is from Indonesia. Details of import of this product is given in table 8.

Table 8

Import of coconutoil cake (April 2016)		
Country	Qty (in MT)	Value (Rs. In lakhs)
Indonesia	18900.00	2706.49
Papua New Guinea	562.57	93.51
Sri Lanka	109.35	20.87
Other countries	112.75	15.94
Total	19684.67	2836.81

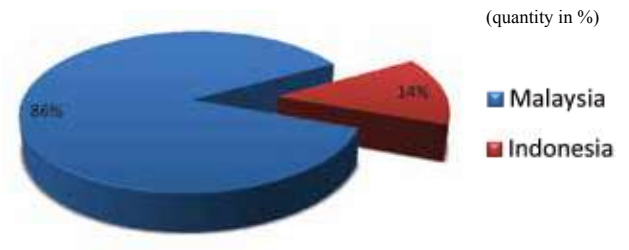


Coconut Fatty Acid

Import of coconut fatty acid into India during the month of April 2016 was 689.70 MT, out of which 595.30 was from Malaysia. Import of coconut fatty acid during the corresponding month of last year was 378.24 MT. Details of import of coconut fatty acid to india is given in table 9.

Table 9

Import of coconut fatty acid (April 2016)		
Country	Qty (in MT)	Value (Rs.in lakhs)
Malaysia	595.30	477.85
Indonesia	94.40	77.21
Other countries	0.00	0.00
Total	689.70	555.05

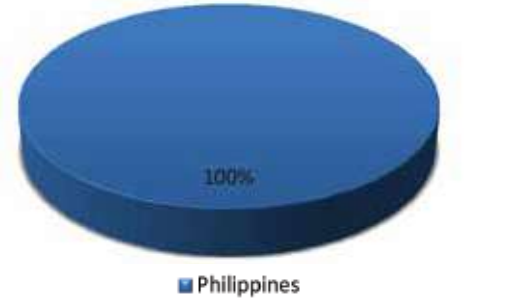


Coconut Shell Charcoal

Import of coconut shell charcoal into India during the month of April 2016 stood at 324.62 MT. The highest import was recorded from Philippines. Details of import of coconut shell charcoal to India is given in Table 10. Import of coconut shell charcoal during the corresponding month of previous year was 1870.17 MT.

Table 10

Import of coconut shell charcoal (April 2016)		
Country	Qty (in MT)	Value (Rs. In lakhs)
Philippines	324.62	96.34
Other countries	0.00	0.00
Total	324.62	96.34



Monthly operations in the coconut gardens- June

Open basins around palms of a radius of 2m from the base of the palm. Apply 25 to 50 kg of cattle manure or compost and 10-20 kg of ash per tree and cover the basins with soil. Remove the weeds in the nursery.

Andhra Pradesh : Continue manure application if not done during June. Plant seedlings in the main field. As a prophylactic measure against the infestation of rhinoceros beetle, fill the youngest three leaf axils with a mixture of 250g powdered marotti/ neem cake with equal volume of sand or place naphthalene balls(12g/palm) and cover them with sand thrice a year. If the attack of the mite is noticed, spray neem oil - garlic – soap emulsion 2 percent (20 ml neem oil +20 g garlic emulsion + 5 g soap in 1litre water) or commercial botanical pesticides containing azadirachtin 0.004 per cent @ 4ml per litre on bunches, especially on the perianth region of buttons and affected nuts or root feed neem formulations containing azadirachtin 5 per cent @ 7.5 ml with equal quantity of water.

Assam : Do not allow rain water to accumulate in the pits of transplanted seedlings. Clean the crowns of the palms. If stem bleeding disease is noticed, (1) remove the affected tissues of the stem and apply 5 percent calixin on the wound. When this is dry apply warm coal tar (2) root feed the affected palm with 5 ml calixin in 100 ml water per palm at quarterly intervals (3) apply 5 kg neem cake per palm per year along with the organic manure during the post monsoon period (4) regulate field regime by providing proper drainage during rains and irrigating the palms during summer. If bud rot disease is noticed, remove and clean the infected tissues and apply Bordeaux paste on the affected portion. The treated portion should be given a protective covering to prevent washing out of the paste during rains. Spray the neighbouring plants with 1 percent bordeaux mixture. Adopt plant protection measures when the weather is clear. Remove the weeds from the nursery.

Bihar / Madhya Pradesh/ Chhattisgarh : Provide proper drainage; do not allow rain water to accumulate for a long time in the pits. Transplant selected good quality seedlings in the already prepared and half filled pits. Drench the basins of transplanted seedlings with 0.05percent chlorpyriphos twice at 20 to 25 days interval against the attack of termites. Apply 2 kg bone meal or single superphosphate in the pit before planting. Open the basins around the palm of a radius of 2m upto a depth of 15-20 cm, and apply manures and fertilizers and cover with soil. During this month apply 30-50 kg farmyard manure/ compost per palm in the basin before the application of fertilizers. In irrigated and well maintained gardens apply the fertilizers @ 275g of urea, 500g single super phosphate and 500g muriate of potash. In rain fed gardens apply the first dose (1/3 of the recommended dose) of fertilizers i.e. 250g urea, 350g single superphosphate and 400 g muriate of potash, per adult palm and cover with soil. The gaps caused by the death of seedlings (previous year's planting) should be filled up, preferably with polybag seedlings. Similarly, remove all unhealthy and defective seedlings and replant with healthy seedlings. Check the palms for bud rot. If bud rot is found, remove the affected parts and apply bordeaux paste. Spray the neighbouring palms/ seedlings with 1 per cent bordeaux mixture.

Karnataka : Open circular basins around the palm, of a radius of 2m. Take appropriate control measures if attacks of rhinoceros beetle and red palm weevil are noticed. Keep the garden free of weeds. Give a prophylactic spray with 1 per cent bordeaux mixture

if not given during the last month. Seedlings can be planted during this month. If the attack of the mite is noticed, spray neem oil - garlic – soap emulsion 2 percent (20 ml neem oil + 20g garlic emulsion + 5g soap in 1 litre water) or commercial botanical pesticides containing azadirachtin 0.004 per cent @ 4ml per litre on bunches, especially on the perianth region of buttons and affected nuts or root feed neem formulations containing azadirachtin 5 per cent @ 7.5 ml with equal quantity of water.

Kerala/Lakshadweep : Open basins around the palms, of a radius of 2 m and fill them with green manure cuttings or green leaves @ 25kg per palm or bulky organic manures like cowdung, compost, etc.@ 50kg per adult palm and close the basins partially, if not done in June. Clean the pits in which seedlings have been planted. Search the crowns of trees for rhinoceros beetle, red palm weevil and also for bud rot disease. Take steps to check them. Clean the crown of the palm.

If the attack of the mite is noticed, spray neem oil - garlic - soap emulsion 2 percent (20 ml neem oil + 20g garlic emulsion + 5g soap in 1 litre water) or commercial botanical pesticides containing azadirachtin 0.004 per cent @ 4ml per litre on bunches, especially on the perianth region of buttons and affected nuts or root feed neem formulations containing azadirachtin 5 per cent @ 7.5 ml with equal quantity of water. Remove the weeds from the nursery.

Maharashtra/ Goa/ Gujarat: Bury husk in trenches between palms with concave side up. A prophylactic spray with 1 per cent bordeaux mixture may be given against fungal diseases.

Orissa: As a prophylactic measure against the infestation of rhinoceros beetle, fill the youngest three leaf axils with a mixture of 250g powdered marotti/ neem cake with equal volume of sand or place naphthalene balls(12g/palm) and cover them with sand thrice a year. Hook out the rhinoceros beetles. Manure vegetables and other crops. Give a prophylactic spray with 1 per cent bordeaux mixture against fungal diseases.

Tamil Nadu/ Puducherry : Open basins around the palms. Keep the garden free of weeds. Give the

palms a prophylactic spray with one per cent bordeaux mixture to prevent bud rot and other fungal diseases. Apply the first dose of fertilizers i.e. 300g urea, 500g single superphosphate and 500 g muriate of potash per adult palm if not applied during last month. Search for rhinoceros beetle on the crowns of the palms with the beetle hook and kill the beetles. As a prophylactic measure against the infestation of rhinoceros beetle, fill the youngest three leaf axils with a mixture of 250g powdered marotti/ neem cake with equal volume of sand or place naphthalene balls (12g/ palm) and cover them with sand thrice a year. Planting of seedlings in the main field can be done during this month. Search palms affected by Thanjavur wilt and take appropriate management practices. If the attack of the mite is noticed, spray neem oil - garlic – soap emulsion 2 percent (20 ml neem oil + 20g garlic emulsion + 5g soap in 1 litre water) or commercial botanical pesticides containing azadirachtin 0.004 per cent @ 4ml per litre on bunches, especially on the perianth region of buttons and affected nuts or root feed neem formulations containing azadirachtin 5 per cent @ 7.5 ml with equal quantity of water.

Tripura: Basin around the palm should be cleaned by removing the weeds. Green manure crops sown in May if any, should be ploughed and incorporated during the month. As a prophylactic measure against the infestation of rhinoceros beetle, fill the youngest three leaf axils with a mixture of 250g powdered marotti/ neem cake with equal volume of sand or place naphthalene balls(12g/ palm) and cover them with sand thrice a year. Collected seed nuts may be sown in seed beds without delay by taking advantage of the rain.

West Bengal: Apply green manure at the rate of 25 kg per palm. Keep the garden free of weeds. Start planting of seedlings in the main field. A prophylactic spray of 1 percent bordeaux mixture against fungal diseases may be given. ■

MARKET REVIEW – APRIL 2016

Highlights

- The price of milling copra and coconut oil expressed an erratic trend in the major markets in the country during April, 2016.
- The international price of coconut oil & copra expressed an erratic trend during the month of April 2016.

Coconut Oil

The price of coconut oil which opened at Rs.8300 per quintal at Kochi market, expressed an increasing trend from the beginning of the month and closed at Rs.9100 with a net gain of Rs.800 per quintal. The price of coconut oil at Alappuzha market which opened at Rs.8300 increased to Rs. 8400 on 5th and thereafter expressed a similar trend as that of Kochi market and closed at Rs. 9200 with a net gain of Rs.900 per quintal. The price of coconut oil in Kozhikode market which opened at Rs.8400 increased to Rs. 8500 on 5th expressed a steady upward trend and attained Rs.9000 on 25th and closed at the same price with a gain of Rs.600 per quintal. The monthly average price of Rs.8756 per quintal at Kochi market, Rs.8744 per quintal at Alappuzha market and that of Rs.8664 per quintal at Kozhikode market were more than 4 percent, 9 percent and 1 percent respectively compared to the previous month and 39 percent, 35 percent and 43 percent lower than the those of corresponding month of last year in the respective markets. The monthly average price of Rs.7947 per quintal at Kangayam market in Tamil Nadu was 12 percent more than that of the previous month and 40 percent lower than that of the corresponding month last year.

Milling copra

The price of FAQ copra opened at Rs.5350 per quintal at Kochi market, increased to Rs. 5450 on 4th, to Rs.5850 on 19th closed at Rs.6150 with a net gain of Rs.800 per quintal. The price of Rasi copra at Alappuzha market opened at Rs. 5300 per quintal expressed an upward trend declined slightly and closed at Rs.5900 with a net gain of Rs.600 per quintal. The price of milling copra at Kozhikode market opened at Rs. 5400 per quintal also expressed an upward trend and closed at Rs.5700 with a net gain of Rs.300 per quintal. The monthly average price of milling copra per quintal was Rs.5796 at Kochi market, Rs.5616 at Alappuzha market and Rs.5596 at Kozhikode market, which were more than 7 percent,2 percent and 1 percent respectively compared to the previous month and 42 percent, 41 percent and 44 percent lower than that of the corresponding month last year markets.

The price at Kangayam market opened at Rs.5200 per quintal, expressed a mixed trend and closed at Rs.5400. The monthly average price of milling copra at Kangayam Market in Tamil Nadu was Rs. 5455 per quintal which was 7 percent more than that of the previous month and about 43 percent lower than that of the corresponding month last year. The price at Ambajipeta market opened at Rs.4800 per quintal expressed an upward trend and closed at Rs.5000.The monthly average price of milling copra at Ambajipeta market in Andhra Pradesh was Rs. 4856 per quintal, which was about 2 percent lower than the previous month and about 47 percent lower than that of the corresponding month last year.

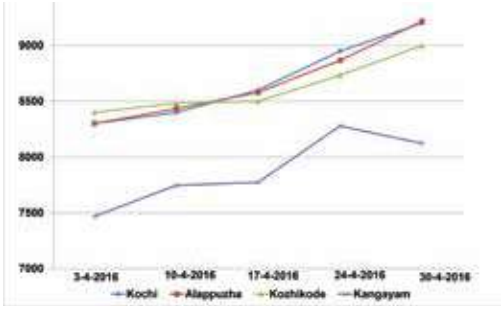
Edible Copra

The price of edible copra at Kozhikode market opened at Rs.8600 per quintal. The price depicted a fluctuating trend throughout the month. On 26th the price decreased to Rs.8450 closed at Rs.8200 with a net loss of Rs.400. The monthly average price of Rajapur Copra at Kozhikode market was Rs.8398 per quintal, which was about 3 percent lower than the previous month and about 42 percent lower than that of the corresponding month last year.

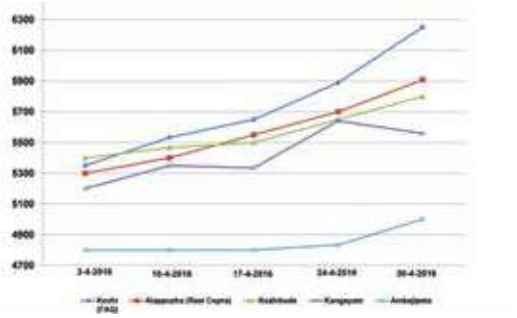
Ball Copra

The price of ball copra at Kozhikode market depicted a fluctuating trend. The market price opened at Rs.7500 and closed at Rs.7100.The monthly average price of ball copra at Kozhikode market was Rs. 7356 per quintal, which was 3 percent lower than that of the previous month and about 43 percent lower than that of the corresponding month last year.

At Tiptur market the price opened at Rs.9500, increased to Rs. 9540 on 2nd closed at Rs.8300.The monthly average price of ball copra at Tiptur APMC market in Karnataka was Rs. 8849 per quintal, which was about 6 percent more than that of the previous month and about 33 percent lower



Price behaviour of coconut oil during April 2016



Price behaviour of copra during April 2016

than that of the corresponding month last year.

Price at Arisikere market opened at Rs.8500 and gradually increased and reached at Rs.9000 on 21st. On 29th it decreased to Rs. 8300 and closed at the same price. The monthly average price of ball copra at Arsikere APMC market in Karnataka was Rs.8652 per quintal, which was about 2 percentage more than that of the previous month and about 26 percent lower than that of the corresponding month last year.

The price of ball copra at Bangalore market opened at Rs.13000 and ruled at same price till 29th and closed at Rs.12800. The monthly average price of ball copra at Bangalore market was Rs.12992 which was almost same as that of the previous month and about 16 percent lower than that of the corresponding month last year.

Dry Coconut

The price of dry coconut at Kozhikode market opened at Rs.7550. On 30th price increased slightly and closed at Rs. 6250.The monthly average price of Rs. 6907 per thousand nuts of dry coconut at Kozhikode market was 4 percent more than that of the previous month and about 41 percent lower than that of the corresponding month last year.

Coconut

The price of coconut opened at Nedumangad market at Rs.9000 and was same till 4th. On 5th the price declined to Rs. 8000 and ruled at same price till 30th. The monthly average price of partially dehusked coconut at Nedumangad market was Rs. 8133 per thousand nuts, which was 6 percent lower than that of the previous month and about 49 percent lower than that of the corresponding month last year.

Price at Arisekere market depicted a highly fluctuating trend during the month under report. The price opened at Rs. 10000 per quintal. On 29th it fell down again to Rs. 8200 and closed at the same price. The monthly average price of partially dehusked coconut at Arisekere APMC market in Karnataka was Rs.8914 per thousand nuts, which was 4 percent lower than that of the previous month and about 35 percent lower than that of the corresponding month last year.

At Bangalore the market price opened at Rs. 12000, increased to Rs. 13000 and closed at same price. The monthly average price of partially dehusked coconut at Bangalore APMC market in Karnataka was Rs.12800 per thousand nuts, which was 9 percent more than that of the previous month and about 19 percent lower than that of the corresponding month last year. The monthly average of Grade-1 quality partially dehusked coconut at Mangalore APMC market was Rs.15000 per thousand nuts, which was same as that of the previous month and about 17 percent lower than that of the corresponding month last year.

Tender Coconut

The monthly average price of Tender coconut at Maddur APMC market in Karnataka was Rs. 10280 per thousand nuts, which was 3 percent higher than that of the previous month and about 2 percent lower than that of the corresponding month last year.

International

The International monthly average price of coconut oil at Philippines (C.I.F. Rotterdam) market was US$ 1590 per MT. This was about 10 percent higher than that of previous month and about 53 percent higher than that of corresponding month in the last year. The monthly average price of US$ 1045 per MT of copra was 17% higher than that of the previous month and 46% higher than that of the corresponding month last year.

The domestic price of coconut oil during the month of April 2016 in Philippines was US$ 1557 per MT and in Indonesia the price was US$ 1549 per MT. The international price of Palm oil was US$ 723 per MT, Palm kernel oil (RBD) US$ 1307 MT and Soybean oil US$ 796 per MT during the month of April 2016.The price of desiccated coconut at Philippines market opened at US$ 2243 per MT and closed at US$ 2320 per MT. The price of desiccated coconut at Indonesia market was US$ 2142 per MT and closed at US$ 2100 per MT. At Sri Lanka market price was US$ 2039 which closed at US$ 2069 per MT. ■

Prices of coconut oil , copra and coconut at various marketing centres during April 2016

Date	Coconut Oil (₹/Qtl)				Milling Copra (₹/Qtl)					Edible Copra (₹/Qtl)	Ball Copra (₹/Qtl)				Dry Coconut	Coco-nut	Partially dehusked Coconut (₹/1000 nuts)		
	Kochi	Alappu-zha	Kozhi-kode	Kan-gayam	"Kochi (FAQ)"	Alappu-zha (Rasi Copra)	Kozhi-kode	Kan-gayam	Amba-jipeta	Kozhi-kode	Kozhi-kode	Tiptur	Ban-glore	Ar-sikere	Kozhi-kode	Nedu-man-gad	Ar-sikere	Banglore	Mangalore (Grade-1)
4/3/2016	8300	8300	8400	7467	5350	5300	5400	5200	4800	8700	7600	9520	13000	8500	7550	9000	10000	12000	15000
4/10/2016	8400	8433	8483	7746	5533	5400	5467	5350	4800	8333	7317	8913	13000	8521	7283	8167	8950	13000	15000
4/17/2016	8600	8580	8500	7773	5650	5550	5500	5335	4800	8280	7240	8820	13000	8595	7150	8000	7849	13000	15000
4/24/2016	8950	8867	8733	8278	5890	5700	5650	5642	4833	8467	7450	8833	13000	8833	6933	8000	8724	13000	15000
4/30/2016	9200	9217	9000	8122	6250	5908	5800	5558	5000	8392	7317	8600	12967	8700	6087	8000	9237	12500	15000
Average	8756	8744	8664	7947	5796	5616	5596	5455	4856	8398	7356	8849	12992	8652	6907	8120	8914	12800	15000

Source: Kochi: Cochin Oil Merchants Association and Chamber of Commerce, Kochi - 2, Kozhikode: The Mathrubhumi daily
Alapuzha: The Malayala Manorama daily, Arsikere : APMC, Arsikere. Price quoted for office pass copra at Kozhikode and Rasi copra at Alappuzha markets.