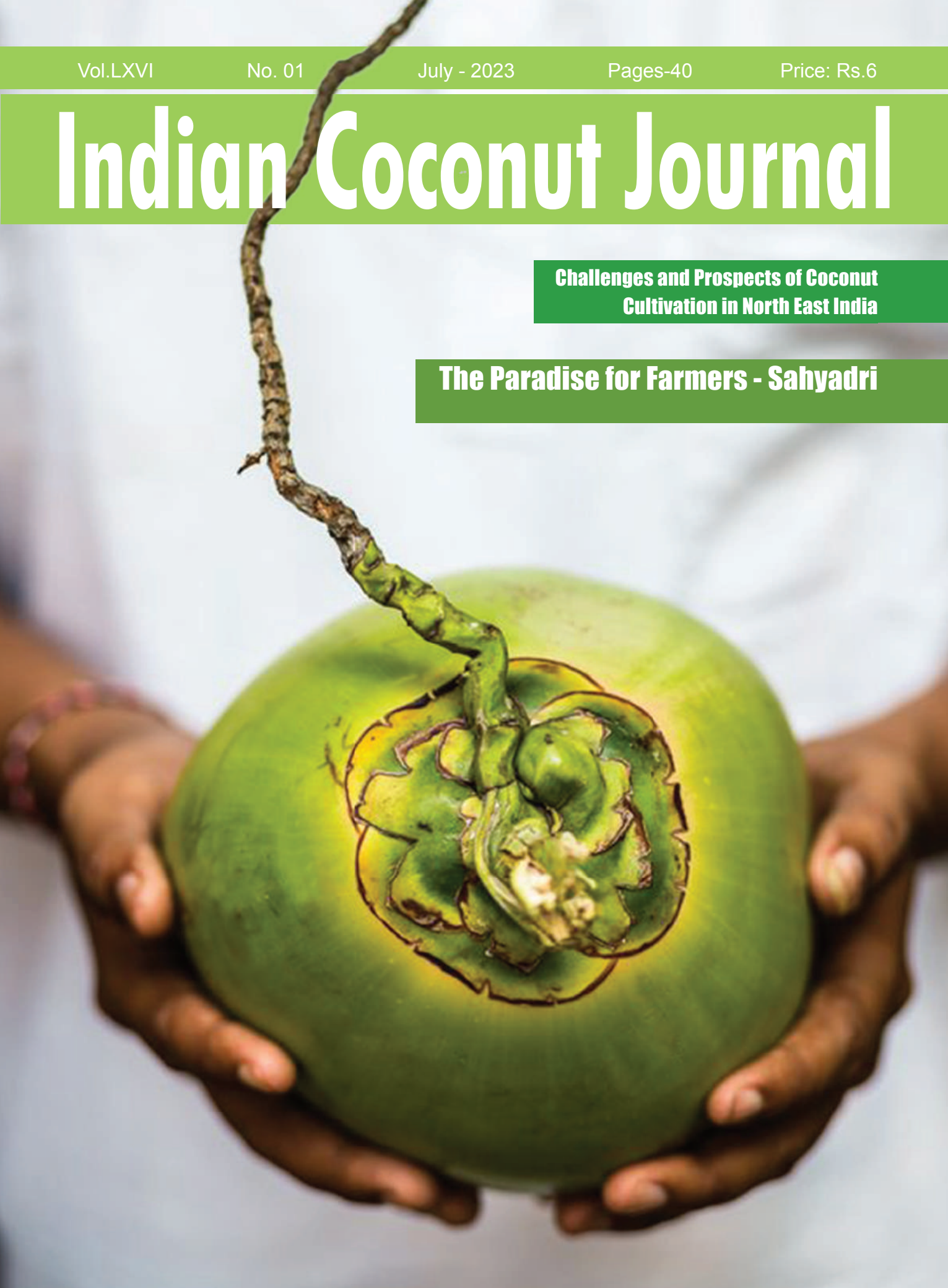
Vol.LXVI No. 01 July - 2023 Pages-40 Price: Rs.6

Indian Coconut Journal

Challenges and Prospects of Coconut Cultivation in North East India

The Paradise for Farmers - Sahyadri



INDIAN
COCONUT
JOURNAL
Vol. LXVI No.01
July - 2023
Kochi - 11

Publisher
COCONUT DEVELOPMENT BOARD
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Department of Agriculture, Government of India
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SUBSCRIPTION

Annual	Rs. 60.00
Single Copy	Rs. 6.00
Institutes / Libraries	
Annual	Rs. 200.00
Single Copy	Rs. 20.00

Articles, research papers and letters on different aspects of coconut cultivation and industry are invited for publication in this Journal. All accepted material will be paid for. The Board does not accept responsibility for views expressed by contributors in this Journal. All remittances and correspondence should be addressed to the Chairman, Coconut Development Board, Kochi - 682 011.

Coconut Development Board

The Coconut Development Board is a statutory body established by the Government of India for the integrated development of coconut cultivation and industry in the country. The Board which came into existence on 12th January, 1981, functions under the administrative control of the Ministry of Agriculture and Farmers Welfare, Government of India, with its headquarters at Kochi in Kerala State and Regional Offices at Bangalore, Chennai, Guwahati and Patna. There are five State Centres situated in the states of Orissa, West Bengal, Maharashtra and Andhra Pradesh and in the Union Territory of Andaman & Nicobar Islands. DSP Farms are located at Neriyamangalam (Kerala), Vegiwada (Andhra Pradesh), Kondagaon (Chhattisgarh), Madehpura (Bihar), Abhayapuri (Assam), Pitapalli (Orissa), Mandya (Karnataka), Palghar (Maharashtra), Dhali (Tamil Nadu), South Hichachara (Tripura) and Fulia (West Bengal) besides a Market Development cum Information Centre at Delhi. The Board has set up a Technology Development Centre at Vazhakulam near Aluva in Kerala.

Functions

❒ Adopting measures for the development of coconut industry. ❒ Recommending measures for improving marketing of coconut and its products. ❒ Imparting technical advice to those engaged in coconut cultivation and industry. ❒ Providing financial and other assistance for expansion of area under coconut. ❒ Encouraging adoption of modern technologies for processing of coconut and its products. ❒ Adopting measures to get incentive prices for coconut and its products. ❒ Recommending measures for regulating imports and exports of coconut and its products. ❒ Fixing grades, specifications and standards for coconut and its products. ❒ Financing suitable schemes to increase the production of coconut and to improve the quality and yield of coconut.

❒ Assisting, encouraging, promoting and financing agricultural, technological, industrial or economic research on coconut and its products. ❒ Financing suitable schemes where coconut is grown on large scale so as to increase the production of coconut and to improve its quality and yield and for this purpose evolving schemes for award of prizes or grant of incentives to growers of coconut and the manufacturers of its products and for providing marketing facilities for coconut and its products. ❒ Collecting statistics on production, processing and marketing of coconut and its products and publishing them. ❒ Undertaking publicity activities and publishing books and periodicals on coconut and its products.

The development programmes implemented by the Board under the project Integrated Development of Coconut Industry in India are- production and distribution of planting material, expansion of area under coconut, integrated farming for productivity improvement, technology demonstration, market promotion and Information and Information Technology. Under the Technology Mission on Coconut, the programmes implemented by the Board are development, demonstration and adoption of technologies for management of insect pest and disease affected coconut gardens, development and adoption of technologies for processing and product diversification and market research and promotion.

Dr. Prabhat Kumar assumes charge of CEO Coconut Development Board

Dr. Prabhat Kumar took additional charge of CEO, Coconut Development Board. Presently he is serving as the Horticulture Commissioner, Mission for Integrated Development of Horticulture, Ministry of Agriculture and Farmers Welfare, Government of India.

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Dear Readers,

The coconut sector in the country is passing through a very dismal situation with coconut prices plummeting to a very low during the past year. The global market has turned into a single marketplace and , the situation is similar internationally too. A series of factors have contributed to the price crash starting from the supply chain and logistic disruptions during the pandemic and post pandemic stages which resulted in increased stock of coconut, copra and coconut oil in all major producing countries including India, the economic slow-down in advanced countries resulting in lesser demand for coconut oil by the oleo-chemical industries, the favourable agro-climatic conditions leading to better production of coconut in major producing areas, reduced processing by industry, especially the desiccated coconut sector and numerous other related factors. Procurement at Minimum Support Price under the Price Support Scheme is being operational in the major coconut producing states of Tamilnadu and Karnataka, with activities having been initiated in Kerala. This has been able to bring about a slight relief in the sector. The forthcoming festive seasons in many parts of India are expected to bring in increased demand for coconut products and it is expected that prices would stabilize to the benefit of the small holder farmers.

Price crash across the agricultural commodities brings in greater attention to the need for more processing and efficient integration of technology in the supply chain. Increased production is a result of the combination of many factors from favourable agro-climatic situations, management of coconut gardens in an efficient manner by the farmers, efficient utilization of the natural resources etc which have worked together contributing to the enhanced production. The benefits of higher production has to be followed by realization of remunerative prices by the farmers, efficient utilization of the product by the processors and finally consumption of the same by consumers. If not, all resources including resources, finance and labour which went into the production will go in vain.

Diversified products of coconut are definitely the favored choices of the future; coconut water and coconut milk are future products where global consumer interest is on the high; it is very much imperative for us to follow path and diversify our coconut products. Enhancing quality of the product, diversifying to various processed products and taking them to the consumer in a convenient form which adds to health and nutrition is the way forward for the agriculture sector. Let us work together towards achieving this vision. Tomorrow, India may feed the world.

Editor

Challenges and Prospects of Coconut Cultivation in North East India

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Coconut, the 'Kalpavriksh' or 'tree of heaven', plays a significant role in the agrarian economy of many states in India. It is also very closely interwoven into the socio-economic and cultural life of a substantial number of farm families. India ranks first in terms of production and productivity of coconut in the world and third in area under cultivation. As per the 2020-21 statistics coconut was cultivated in India in an area of 21.98 lakh ha with the annual production of 20736 million nuts and productivity of 9430 nuts per ha. It is cultivated in 17 states and three union territories. The four southern states viz., Kerala, Karnataka, Tamil Nadu and Andhra Pradesh together contributes more than 90 % of the area and production of coconut in the country. However, since the last many years coconut cultivation has been spreading to non-traditional areas as well, including different states in the North East region of the country. Assam, Tripura and Nagaland are the major North Eastern states having coconut cultivation, together covering about 26,480 ha (as per 2020-21 statistics) and a total annual production of 175.88 million nuts. The average productivity of coconut in these three states is only 6642 nuts per ha which is much less than the national average of 9430 nuts per ha. Other North Eastern states *viz.*, Arunachal Pradesh, Nagaland, Manipur, Meghalaya and Mizoram are also having small extent of coconut cultivation.

State/region	Area ('000 ha)		Production (million nuts)		Productivity (nuts/ha)	
	2000-01	2020-01	2000-01	2020-01	2000-01	2020-01
Assam	21	20.8	136	148.51	6476	7140
Tripura	3.1	4.61	7	18.44	2258	3996
Nagaland	0.9	1.07	5.1	8.93	5667	8373
Total	25	26.48	148.1	175.88	5924	6642
All India	1823.9	2198.98	12678.4	20736.12	6951	9430

Table 1. Trend in coconut cultivation in the North East India
(Source: Horticulture Division, Dept. of Agriculture & Cooperation, Ministry of Agriculture & Farmers Welfare, Government of India)

The coconut sector in the northeast region has been witnessing substantial growth over the past two decades (Table 1). During the period from 2000-2021 to 2020-2021, area under coconut in Assam, the major producer of coconut in the North East region, got reduced by 0.95% while production of coconut increased by 9.2% and productivity increased by 10.25%. In Tripura, area under coconut cultivation increased by 48.71%, production increased by 163.43% and productivity increased by 76.97% during the same period. In Nagaland the increase in area, production and productivity of coconut during the period from 2000-2001 to 2020-2001 was 18.89%, 75.10% and 47.75% respectively. However, as per the 2020-21 statistics, the above three north eastern states together contributed only 1.2% of the total area and 0.85% of the total production of coconut in the country.

Assam: Among the North Eastern states Assam has the largest area under coconut cultivation. It is cultivated in 20,800 ha with a production of 148.51 million nuts and productivity of 7,140 nuts per ha. Coconut plays an important role in the socio-cultural life of the people of Assam. It is mostly raised in small and marginal holdings as homestead crop. Though coconut is grown in most of the districts of Assam, its cultivation is mainly confined to Central and Lower Brahmaputra Valley Zone of Assam. Nagaon district has the maximum area under coconut (2,490 ha) followed by Barpeta (1,636 ha) and Nalbari (1,390). Coconut is grown in most of the districts of Assam covering the Upper (Charaideo, Dhemaji, Dibrugarh, Golaghat, Jorhat, Lakhimpur, Majuli, Sivasagar and Tinsukia), Central (Dima Hasao, Hojai, East Karbi Anglong, West Karbi Anglong, Morigaon and Nagaon), Lower (Baksa, Barpeta, Bongaigaon, Chirang, Dhubri, Goalpara, Nalbari, Kamrup (M), Kamrup (R), Kokrajhar and South Salmara-Mankachar), Hills and Barak Valley (Cachar, Hailakandi and Karimganj) and North Assam (Biswanath, Darrang, Sonitpur and Udalguri).

The agro-ecological situation of these districts is congenial for coconut cultivation. Coconut can perform well under the soil types such as red sandy loam, alluvial red loam and laterite soils and sub-tropical weather condition receiving an annual rainfall of 1,840 mm to 3,200 mm prevailing in these areas. The low productivity of coconut in Assam, which is less than the national average, is mainly attributed to the lack of adoption of scientific cultivation practices including improved varieties, multiple cropping and integrated farming systems, integrated nutrient management and integrated pest and disease management. If nurtured properly, coconut can be a good source of income for the farmers, even in the small holdings under homestead system.

Tripura: Tripura ranks second among the North Eastern states after Assam in the area under cultivation of coconut. Coconut is cultivated in 4,610 ha with a production of 18.44 million nuts and productivity of 3,996 nuts per ha.The agro-ecological situation prevailing in Gomati, West Tripura and South Tripura districts is congenial for coconut cultivation. Coconut can perform well under the soil types such as reddish yellow brown sandy soils, red loam and sandy loam soils, older alluvial soils and sub-tropical weather condition receiving an annual rainfall of 1,979.6 to 2,745.9 mm prevailing in these areas. The land utilization pattern in the state indicate the huge potential for area expansion of plantation crops including coconut. In Tripura, coconut is cultivated in small and marginal holdings without much care and hence the productivity realized is very low. If farmers are empowered to take up scientific crop management practices coconut productivity in the state can be enhanced substantially.

Nagaland: In Nagaland, coconut is cultivated in a small extent only. It is cultivated in 1,070 ha with a production of 8.93 million nuts and productivity of 8,373 nuts per ha.The soil is acidic, very rich in organic carbon but poor in available phosphate and potash content. PH of soil ranges from 4.8 to 6.8. Dimapur, Peren, Wokha, and Chumoukedima are the districts in Nagaland having good potential for coconut cultivation.

Arunachal Pradesh: Out of the 26 districts in Arunachal Pradesh, eight districts have coconut cultivation in a very limited scale; total area under

coconut being 220 ha. Highest production of coconut is in Changlang district (45.53 million nuts) and highest area under coconut cultivation is in Namsai district (96 ha).

Manipur : Potential area for coconut cultivation in Manipur includes Pherzawl, Jiribam and Tamenglong districts.

Meghalaya: Meghalaya is known for the highest amount of rainfall it receives. The annual average rainfall received is 11,000 mm, highest in the world. The potential areas for coconut cultivation in Meghalaya include West Garo Hills, East Garo Hills, South Garo Hills, South- West Garo Hills, North Garo Hills and Ri-Bhoi districts.

Mizoram: The potential area for coconut cultivation in Mizoram includes Mamit, Kolasiband Lawgtlai districts.

Challenges and prospects of coconut cultivation in the North Eastern Region

There is ample scope for enhancing the area under coconut cultivation in the North Eastern states having congenial agro-ecological situations pertaining to climate and soil. Besides, the productivity and income from the existing coconut holdings can also be considerably increased through better integration of technologies, especially improved varieties, integrated nutrient management, cropping/farming systems and integrated pest and disease management.

The technical feasibility and economic viability of many of the recommended technologies for higher productivity and income from coconut farming have been demonstrated through the research conducted and front line extension programmes organized by ICAR Research Centre, Kahikuchi and also by the Horticultural Research Station, Assam Agricultural University, Kahikuchi. However, field level utililization of the technologies recommended for coconut cultivation is not at a satisfactory level due to various factors.

Major challenges and prospects of coconut cultivation in the North Eastern states are briefly discussed below.

Quality planting material

Though North Eastern states have great potential for expanding area under coconut cultivation, lack of quality planting material is a major constraint for implementing appropriate interventions on area expansion of coconut. Besides, cutting and removal of unproductive senile palms and replanting also requires seedlings of improved varieties. Public sector agencies including the State Agriculture/ Horticulture Departments, ICAR institutions, SAUs, CDB etc do not have the necessary infrastructure facilities for producing sufficient quantity of coconut seedlings of improved varieties to meet the demand for seedlings. Nurseries in the private sector often do not follow scientific nursery management practices and supply inferior quality seedlings. Farmers who produce coconut seedlings also do not possess adequate knowledge about mother palm selection, seednut collection and nursery management practices. The nurseries and farms under various public sector agencies need to take up interventions for raising mother palm orchards of improved coconut varieties to produce more number of quality coconut seedlings. Similarly, efforts are required to identify ideal mother palms of coconut in farmers' gardens and utilize them for seedling production. Decentralized community coconut nurseries can also be promoted with active involvement of Farmer Producer Organizations (FPOs) to enhance the availability of coconut seedlings.

Adoption of scientific cultivation practices

Low productivity of coconut in the existing coconut gardens in the North Eastern states can be mainly attributed to the low level of adoption of recommended cultivation practices. The coconut varieties found suitable for cultivation in North East India include Kalpa Jyothi (dwarf variety), Kamrupa, Kalpa Mithra, Kerachandra and Kera Keralam (tall varieties) and Kalpa samrudhi, Chandra sankara and Kera sankara (hybrid varieties). Besides, scientific recommendations suitable for coconut cultivation in North East India pertaining to agro-techniques for nursery management, planting and after care, management of juvenile palms, integrated nutrient management, water management and irrigation have also been evolved. Non-adoption or low level of adoption of these technologies results in low productivity of coconut in the region. Hence, appropriate interventions are to be formulated and implemented to empower the farmers of the region for the better integration of available technologies for the management of their coconut gardens to realise higher productivity and income.

Fragmented holdings

Coconut cultivation in the North Eastern states is mostly confined to fragmented small and marginal holdings. These holdings suffer due to the resource limitations, both bio-physical as well as socio-economic resources. Hence, individual farmers are unable to adopt latest technologies for enhancing productivity and income from their coconut holdings. Group approaches are to be facilitated among the small and marginal coconut growers to overcome the resource limitations in the fragmented holdings and to better utilize technologies to achieve higher productivity and income. Three–tier FPO set up consisting of Coconut Producer Societies (CPSs), Coconut Producer Federations (CPFs) and Coconut Producer Companies (CPCs) is being facilitated in coconut sector by the Coconut Development board (CDB). These are formed with the main objective of socio-economic development of farmers through productivity improvement, cost reduction, efficient aggregation, processing for value addition, better by-product utilization and efficient marketing of the produce. So far 29 CPSs have been registered in Assam under the CDB. These FPOs are to be empowered to take up group initiatives to strengthen the coconut sector. There is a need to facilitate formation of more number of FPOs in coconut sector by development and extension agencies in other north eastern states also.

Extension support for scientific coconut cultivation

Low level of awareness and knowledge of farmers is one of the reasons for the low level of adoption of recommended scientific practices of coconut cultivation resulting in poor productivity of coconut in the region. Participatory extension interventions ensuring the active involvement of farmers by the concerned agencies including Coconut Development Board and State Agriculture/Horticulture Departments for the capacity development of farmers to enhance their knowledge about scientific coconut cultivation thus assume much significance. Since coconut is not a major crop in the region, only few schemes are implemented by the State Agriculture/ Horticulture Departments to provide extension support and to provide incentives to coconut growers and other stakeholders. Considering the vast scope for expanding area under coconut in the region and the fact that there are many farmers already taken up coconut farming providing extension support to the growers is highly relevant to motivate the farming community.

Promoting coconut based cropping/farming systems

In the north eastern states, coconut is mostly cultivated as a monocrop in the small and marginal holdings. Compared to coconut monocropping, adoption of multiple cropping and integrated farming system in coconut gardens fetches higher income and employment opportunities. Different models of coconut based cropping/farming systems suitable for the north east region have been developed by CPCRI and SAUs. However, adoption of such cropping/ farming systems is very low due to various reasons.

A variety of intercrops like tubers and *rhizomatous* spices (tapioca, elephant foot yam, sweet potato, greater yam, lesser yam, chinese potato, colocasia, Ginger (*Var. Nadia*) and turmeric), pulses and oilseeds (cowpea, green gram, black gram, ground nut), vegetable crops (pumpkin, ash gourd, chillies, potato, french bean, snake gourd, amaranthus, brinjal, bottle gourd, ridge gourd, Coccinia sp., Dolichos bean, Cauliflower, curry leaf and tomato), fruit crops (Banana (*Var. Chenichampa*, Robusta, grand nine) pineapple, assam lemon and papaya), flowering crops (*Heliconia sp., Anthurium sp.*, *Jasminum sp.*, gerbera, tuberose, gladiolus and marigold) and fodder grass and legumes can be raised in coconut gardens up to 5 to 7 years.

During the second growth phase of palms, i.e., 5-20 years of age, growing of other crops in the interspace may be difficult due to poor sunlight availability. However, crops like colocasia, some varieties of banana like Robusta, Grand Naine etc., fodder grass, shade loving medicinal plants etc. which can tolerate shade can be cultivated in this phase.

After the palms attain a height of 5 to 6 m (above 20 years) *i.e.*, in older plantations, the crops mentioned in the initial stage and perennials like cocoa, vanilla, black pepper, cinnamon, clove and nutmeg, sapota and medicinal and aromatic crops Patchouli, Indian long pepper (*Piper longum*) can be grown as mixed crops along with the intercrops.

From the experimental plot on high density multispecies cropping system (HDMSCS) maintained at HRS Kahikuchi, which involves coconut and other crops like black pepper, ginger, assam lemon, banana and pineapple, it is observed that an average annual net income of 3 to 4.5 lakh rupees can be obtained per ha. Besides, 25 tonnes of organic wastes are also made available per ha which can be recycled and applied to the crops as vermicompost. In HDMSCS if organic recycling is effectively carried out, we can reduce the chemical fertilizer input for coconut to two third of the recommended dose.

Hence, farmers are to be made aware about the advantages of adopting coconut based cropping/ farming systems and suitable interventions to promote the same are to be implemented.

Community action for integrated pest and disease management

Coconut growers of the region face difficulties due to the crop loss caused by incidence of pests like

rhinoceros beetle, red palm weevil, eriophyid mite and white fly, disease like stem bleeding etc. Though technologies for the integrated management of these pests and diseases are made available, their field level adoption is very low. Community approaches on a contiguous area basis is to be encouraged among the coconut growers to effectively adopt IPM/IDM practices to avoid crop loss.

Removal of senile and unproductive coconut palms and replanting

Large number of coconut palms in the existing coconut gardens are old, senile and with very low productivity which adversely affect coconut production in the region. Hence, it is suggested to remove such old and senile palms and replant with quality seedlings of improved varieties suitable for the region to enhance coconut productivity.

Promoting value addition

Value addition through product diversification is a viable strategy suggested to enhance income from coconut farming. Large number of value added products can be produced and marketed using coconut kernel, tender coconut, coconut water, shell, leaves and timber. However, due to various factors the level of value addition in coconut is abysmally low in the north eastern states. Hence, appropriate interventions are to be formulated and implemented to promote coconut based enterprises on production and marketing of value added coconut products. FPOs in coconut sector can also be encouraged to take up such enterprises.

Improvement in the general infrastructure for the development of farm sector and specific interventions in coconut sector as discussed above surely will usher in a bright future for coconut in the North East India.

The Paradise for Farmers - Sahyadri

Deepthi Nair S
Director, Marketing, Coconut Development Board

The invite to visit Sahyadri Farms came all of a sudden and I was excited to be among the chosen in the first batch of officials. The training was called Immersion Training - the terminology was new and I was told later that the training would get us immersed in the activities of the farm taking back learnings with us to the betterment of agriculture.

And the training turned out to be that and much much more. The two days were filled with awe, as if we were in another world; different emotions came gushing - pride, respect, happiness, surprise, admiration, hope, triumph and many more. And I felt I should write it down, share with our readers and document the experience because this was an unusual triumph where farmers created history.

Sahyadri farms - Seeding goodness

As we entered the campus of Sahyadri farms, we were welcomed to another world. A green campus in an area of 110 acres, full of trees, hedges, beautiful architecture and more than everything; the campus was very neat with not even a leaf on the ground, nothing out of place. We felt like we were in a multinational company in some advanced country.

Learning from Others

As part of capacity building programmes of the Department of Agriculture and Farmers Welfare, Government of India, visits to iconic entities across the country are being organised under Immersion training programmes to have acquaintance about the activities going on in their institutions and update the knowledge of officials. This article is an account of the first visit organized under the programme. The author was part of the team

Sahyadri farms®
Seeding goodness

The environment itself was filled with positivity. The logo of Sahyadri farms welcomed us; it was also symbolic of the successful flight taken by the farmers towards success.

The two day journey started with the screening of a video on Sahyadri farms which unfolded the Sahyadri journey. We were a group of 14, from different organisations and different levels under the Ministry of Agriculture and Farmers Welfare, Government of India, sitting together in a mini theatre, watching the story of this successful farmer venture unfold. It was the triumph of the power of unity achieved by revolutionizing the farming ecosystem.

The Voyage through a decade of hardships

The journey of Sahyadri farms started with the journey of its Chairman, Mr. Vilas Shinde. He was born into a farmer's family in Nashik. He had completed his masters in agriculture and wished to venture into farming as a profession, much to the dismay of his parents who wished him to pursue a job. Farming is the most risky entrepreneurship, and

Vilas Shinde, Founder, Sahyadri

the farmer is the entrepreneur who is the highest risk taker. Mr. Shinde ventured into farming and undertook cultivation of many crops - grapes, corn etc but he realised soon that the vocation was simply not remunerative. There were many intermediaries in the supply chain and the farmer's share of the consumer rupee was very little. Having realised the need for creation of a favourable farming ecosystem and strong supply chain, he took on the challenge. His idea was to collaborate with other farmers and target the export markets where premium prices could be realised.

He started with a group of 10 farmers with 9 acres of land, mostly his family members and peers and ventured into export of grapes, initially through exporters and later direct export of grapes to traders in Europe. They faltered, not able to adhere to the quality parameters insisted by the European market, especially due to high residue of the plant growth stimulant Lihocin; but they were determined, led by the courage of Mr.Shinde who decided to travel to Europe to talk with his buyers and find out the issues with the product exported. It was at a time when he didn't even have money to travel to Mumbai to secure his European visa.

Lessons unraveled by the Europe visit

The Europe visit taught Mr. Shinde the need to maintain quality and transparency in transactions. His travel from Rotterdam to Amsterdam by train was an eye opener since he saw the way farming was done in Europe; the farms were big, the farmers were all rich and technology was integrated in farming in an intelligent way to reap benefits. Mr. Shinde returned as a different person. He got alongside friends, fellow students and farmers who thought alike, worked alongside and trusted him.

They worked on a Standard Operating protocol for grape cultivation in adherence to the quality requirements, undertook cultivation with strict adherence to the critical points and quality standards. The residue limits of all chemicals were strictly monitored, the irrigation was streamlined so as to ensure quality and shelf life of the product and checking of quality was undertaken the day prior to harvesting. The consignment was dispatched as per the order and then it was a wait on tenterhooks, full of anxiety and tension, for the quality testing results by the buyer. And the hard work paid; the quality of the product was above the EU standards. It was a period of jubilation for the farmers, their perseverance and determination paid.

The journey was not very smooth even after this success. Consignments were rejected later also, this time not because of quality issues, but owing to the volatility in the European markets. His debt that had started with Rs. 50,000/- increased to Rs. 75 lakhs during the first consignment and then soared to over Rs. 6.5 crores. He sold his property and paid the farmers when the consignment was rejected, thereby earning the trust of all the farmers in the group. With the money that was left after paying the farmers, he purchased the 110 acres on which the Sahyadri farms now stand. The pitfalls and constraints that they faced made them bolder, stronger and unified.

Sahyadri Farms was built on the acute realisation that post-harvest losses not only imply wastage of food but also represent a colossal waste of human labour, agri-inputs, financial investments and scarce resources like water. The idea was to build infrastructure that enable farmers access the latest technology and processing infrastructure, follow global best practices and offer the highest quality fresh and processed products to discerning consumers globally.

Driven by Determination, Perseverance and Grit

Sahyadri Farmers Producer Company Limited is now a farmer company of the farmers, by the farmers and for the farmers. What began in 2004 as an informal understanding between a group of small landholder farmers has emerged as India's largest fruit and vegetable value chain. It is a 100% farmer owned company formed in 2011 to find solutions to the problems of small and marginal farmers and make farming a profitable venture with sustainable development of agriculture and the rural community.

The Company has a three pronged intervention at farm, processing and marketing levels.

The Company started with grapes and then moved on to relocation of the grape success story

and developed value chains for other horticulture crops like mango, tomato, banana, pomegranate and sweet corn.The crop basket was expanded to include citrus by bringing in new varieties of Lemon, Mandarin and orange.

As the Company grew to around 728 individual shareholders, they started forming Farmer Producer Companies in different villages and these FPCs(48 numbers) are now shareholders in Sahyadri FPC Ltd. The Company further diversified to form three private limited companies - Sahyadri farms Post harvest Care Limited, Sahyadri Supply Chain Company Limited and Sahyadri Agro Retail Company Limited in order to strengthen the activities through better portfolio management.

Sahyadri farms has grown from a company with Rs. 14.8 crore turnover in 2012 to a successful FPC with a turnover of Rs. 1007 crore in 2023. The share capital has grown from Rs. 0.02 crores in 2012 to Rs. 55.67 crores in 2020 and thereafter equity was not collected. They are the largest grape exporter from India exporting over 17000 MT and over 1100 containers in a year.

Sahyadri has a presence across the entire product value chain which ensures reduced wastage, utilisation of low grade fruits and vegetables and revenue diversification. The products range from fresh fruits, frozen aseptic and semi processed

fruits including pulp and processed products from fruits and vegetables. The concept of zero waste is practised in Sahyadri and all waste generated is turned into useful products/ High quality extracts are made from peels and seeds of fruits and vegetables. For instance when the arils of pomegranate go as fresh fruit and fruit juices, punicalagin is extracted from the peel and seed oil from the seeds which extract further value from the by-product.

State of the Art infrastructure

The 110 acre State of the Art Campus at Mohadi, Nashik houses varied infrastructure as detailed below for the service of the member farmers and the varied crops handled.

• Farmers Facility Centre includes an Agri Input facility centre, weather stations and sensor infrastructure, Farmer Consumer mall, R&D farm and nursery infrastructure

• Fresh Fruit and Vegetable section includes packhouses with capacities from 50 MT per day to 300 MT per day, 8 precooling rooms (25 MT each), Vacuum precooling (50MT per day), 8 advanced ripening (25 MT each) and cold storages(4000MT)

• Lab testing facilities - soil, water, petiole and residue testing labs, biopesticide and biofertiliser labs

• Semi-processed food - 8 semi-controlled ripening (40 MT each), IQF process plant (Frozen - 50 MT per day), Aseptic [process plant (250 MT per day), Frozen cold storages (5000 MT) and dry warehouses (10,000 MT)

• Value added FMCG lines - Aseptic juice line, Hot fill Juice Line, ketch up, jam, squash lines

• Ingredients and extracts - pectin extraction plant, punicalagin and ellagic acid, rice mill, raisin processing plant.

Integration of technology

Application of technology in agriculture will revolutionize the sector. Sahyadri farms undertook digitalisation of farms, every QR code on the product ensuring traceability back to the grower farmer. There is data integration from production to consumption on farms, weather, machinery, irrigation, sensors etc.

Digital Impact Square and Sahyadri farms are helping emerging startups in growth and solving societal challenges. The transformation of agriculture through Agritech is undertaken and the initiatives include VESATOGO (mobility as a service), GODAAM(smart warehouse), AGROTRUST(traceability through block chain) SENSARTICS (Climate prediction) etc. Complete digitalisation of the value chain has been achieved.

Research and development

R&D is also undertaken by Sahyadri farms - for agroclimatic acclimatization and multiplication of patented varieties, state of the art germplasm collection of horticulture crops from across the globe and its distribution to the farmers. The farmers are educated on the benefits of better varieties; for instance in grapes - high fertility, rain resistance, negligible plant growth regulators, grower friendly, better taste and extended shelf life.

Certifications

Quality assurance is offered by certification in this globalised world. The Company is certified for ISO 22000:2005, FSSC 22000, BRC, TESCO, Fairtrade,

Global GAP, HACCP, FDA, Halal, Koscher, Rainforest Alliance, SGF

Steady and solid steps towards success

The phase from 2010-2014 laid the foundation for the successful establishment of Sahyadri. The land for the Central Processing Unit building at Mohadi,

Nashik was acquired in 2011 and the foundation laid in 2013.The advanced ripening chambers were installed in 2014 and fresh table grapes exports to Europe commenced.

During the next phase from 2015-17, Sahyadri farms stepped into the big global league. It has maintained its position as India's largest grapes exporter to Europe since 2015. The agri-input activity under SARL in 2015 was launched and the farmer finance was set in motion in the same year. The aseptic and frozen processing was launched in 2015 while tomato paste manufacturing was initiated in 2016. The first domestic retail store was also inaugurated in 2016. Import of patented varieties were initiated - ARRA-19 (Grapa, California), ARRA-15 and Iniagrape One.

The phase from 2018-2020 was concentrated on consolidating the gains and fighting through the pandemic. During this period, FMCG product lines were commissioned and commenced production of Kissan Ketchup (Brand owned by Hindustan Unilever). An indigenously developed automatic weather station was launched to provide live weather data to farmers. Collaboration with Tata Strive Skill Development Centre was initiated to offer skill development programmes; secured exclusive rights for distribution of ARRA grape varieties in India and completed the agri-processing cluster (APC) allocated by MOFPI and won approval for 4 more food processing units in APC.

During the pandemic when disruption of the supply chain was on the rampage affecting the agriculture sector, a mechanism for efficient delivery of food baskets to 300,000 families was established in the lockdown during COVID-19. The Company could also procure over 55,000 metric tonnes of tomatoes despite drought, heavy rains & COVID-19 in the same year. Setting up Sahyadri Farms Post Harvest Care Ltd was also done in this period. The entire processing campus was transferred to Sahyadri Farms Post Harvest Care Ltd.

During 2021 and beyond, Sahyadri farms is aiming at global domination. Setting up Sahyadri Farms Supply Chain Ltd was undertaken and started wholesale & B2B businesses through 50 distribution centres of the Company. A residue testing facility, an advanced lab for soil, water, leaf and petiole testing, biolab, incubation centre for training of FPOs through 'Sahyadri Rural Development Foundation' etc were established.

The Way Ahead

The informal understanding between smallholder farmers transformed into a movement of farmers which has grown today and Sahyadri is servicing over 18,000 registered farmers that cover 31,000 acres and over 25 fruits and vegetables. They have presence in more than 42 countries with over 20000 B2B customers. Sahyadri Farms could establish that a sustainable model of farming could be ensured for the small-landholding farmers by staying together; it could also provide safe and quality food to the customers. The member farmers could be assured of living a life of dignity who is able to provide well for his family. The vision of Sahyadri is to transform the Indian agriculture economy targeting digitalisation, connectivity, skill development, village

redevelopment, sanitization, water distribution, health and education.

The take aways :

Sahyadri farms depicts the power of unity among small farmers. The Company was always sensitive towards the farmers who face varied challenges. They worked on the fact that there is no room for error and no mercy in farming. They rose from adversities rather than falling even lower. The activities were all backed by science. The thrust was always on uniformity, quality and safety and they proved that if small farmers unite, they can compete globally. The major interventions were in seed and planting material, irrigation, fertigation, plant protections, canopy management etc. The success of Sahyadri farms provides us with valuable learnings which would be useful in our forward journey in organising, strengthening and stabilising Farmer Producer Organisations and equipping them to reach the self help stage.

• Slow and steady growth - The initiatives were taken one step at a time, ensuring quality, accountability, ownership and transparency in every step

• Established that farmers are not in need of subsidies, but need an enabling environment and ecosystem to emerge successful

• Targeted the European market quality standards which could be the highest bar in terms of quality standards for fruits and vegetables. The success in adhering to those quality parameters made them equipped to market anywhere across the globe.

• Thrust was in developing a congenial ecosystem; enhancing production and productivity was not the ambition, but establishing processes and practices in cultivation to produce the highest quality fresh produce

• Professional management; each initiative in diversification undertaken with thorough understanding and professional advice

• Trust that the FPC built on its member farmers was enormous. Being together at times of success and failure created a strong bond in the members

• Equity collection was undertaken after the company proved its impact on assuring farmers realise a fair, steady and remunerative price for their produce. And equity was mobilised by profit distribution through shares proportionate to their contribution.

• There is no compulsion on any farmer. When prices are high in the open market, the farmer is free to sell outside.

• Each farm was treated as an industry and each farmer was an entrepreneur with high risk taking.

• Benefit of doing right was visible in the price thereby motivating farmers to follow the path

• Realisation that technology is the real game changer. Integration of science and technology

Conclusion :

When the Immersion training programme started with the film on Sahyadri Farms, the whole group felt that we were part of the journey that Sahyadri took. We were all emotional when they faced challenge after challenge; tense when the quality testing of

First batch of officials of Immersion Training

the consignment in Europe happened even when we knew that they had passed the test; had goosebumps when the results came out and Sahyadri emerged successful in flying colours in the quality testing; in tears seeing the vi suals of the farmers celebrating their success.

In the two days that we spent at Sahyadri, the different initiatives were slowly unfurled; enabling us to slowly devour the success stories, leaving us in a state of bewilderment and surprise on the last day that such an initiative by the farmers is running successfully; a replicable role model for other farmer companies; and finally making us eager to return back to our organisations and share this unbelievable accomplishment of the farmer members of Sahyadri. And this article is my humble way of sharing this success story with all.

Photo Courtesy : www.sahyadrifarms.com

Alley Cropping

a viable option for sustaining coconut gardens

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In the present scenario of climate change and food insecurity, agroforestry is an option for farmers to use their land resources efficiently at reduced environmental costs while producing wide range of crops at different times. Among the different agroforestry systems, alley cropping system is an environment friendly approach for efficient land usage and sustainable food production. Implementing alley cropping in coconut gardens is an ideal option for increasing the productivity of coconut palms, providing diversified products, alternate income source during price fluctuations and calamity, increasing the income and profit with minimum depletion of natural resources in the soil, preserving more organic matter in the soil, reducing soil erosion and keeping more carbon in the soil. Long-term monoculture of coconut can result in land related concerns, such as decreasing land productivity, degraded soil and ineffective resource utilization on a local and global level. Modifying traditional coconut farming with agroforestry concepts is a well suited nature based solution for achieving environmental, social, and economic benefits. Intergovernmental Panel on Climate Change (IPCC) reported that agroforestry will have the highest potential of carbon sequestration by 2040 (600 Mt C year $^{-1}$), while grazing management (375 Mt C year $^{-1}$), forest management (250 Mt C year $^{-1}$), and crop-land management (150 Mt C year^{-1}) are comparatively lower.

Alley cropping - concept

Alley cropping is an ideal agroforestry practice for food and fodder security. The concept of alley cropping was developed during 1970s and 1980s at IITA Ibadan, Nigeria, as an alternative for the conventional bush and fallow system of cultivation. Alley cropping is the cropping system, where arable crops are grown in spaces or alley ways between the rows of widely planted woody shrubs or trees. It is the system of growing perennial trees or shrubs along with agronomic, horticultural, forage crops. Single or multiple rows of trees or shrubs are grown at wide spacing and managed as hedge rows, while suitable crops are grown in the inter spaces or alley ways formed between these hedge rows. In this system, tree species are continuously pruned during the cropping phase and are allowed to grow freely during the fallow phase. Alley cropping concept was developed based on the principle that continuous retention of fast growing, deep rooted, N fixing trees or shrubs can conserve the deterioration of agricultural resource base. Alley cropping is also known as hedge row inter cropping and avenue cropping. In the square system of planting of coconut, spacing of 7.6 m to 9.0 m accommodating 170 to 120 palms per hectare is generally recommended for getting ideal yield. In such planting systems, for the effective utilization of the large available inter spaces and farm resources like soil, sunlight, water and nutrients and for higher productivity, inter cropping with annual or perennial crops in the inter spaces of the coconut garden is commonly practiced. Growth habit, crown characteristics, planting pattern/geometry, and stocking levels of the woody perennial components, besides age of the palms, shade tolerance of the field crops and interplanted trees are major determinants of system productivity. This also calls for proper selection of the components and their manipulation to optimize productivity. By cultivation of fast growing perennial leguminous green leaf manure tree crop and annual food crops together on the same land in the inter spaces of coconut, the farmer can effectively use available land, space, resources and yield multiple products and profit from the land. Alley cropping provides an opportunity for the farmer to grow annual crops generating short term income along with perennial tree crops that can provide long term income. The system also enables crop diversity, improved soil health, better resource use and provides favourable microclimatic condition for improved crop growth and sequesters carbon.

Components of green manure - food crop alley cropping system in coconut gardens

Alley cropping system in coconut garden should have a tree component and an alley component.

Tree Component

In green manure - food crop alley cropping system in coconut garden, the tree component can be different leguminous tree species like *Gliricidia sepium* (Glyricidia), *Leucaena leucocephala* (Subabul), *Cajanus cajan* (Red gram), *Sesbania sesban*, *Sesbania grandiflora* (Agathi) etc. *Glyricidia* is the commonly used green manure tree crop in alley cropping systems. Studies conducted at ICAR-CPCRI have proved that glyricidia can be easily grown in the coconut plantations and can generate adequate amount of nitrogen rich green leaves and application of glyricidia prunings could supply around 90%, 25% and 15% of the N, P2O5 and K2O, requirement of coconut, respectively. Planting of trees like subabul, sesbania etc., will meet the fodder requirement of the farmer in addition to the supply of green leaf manure and N fixation. Dicot tree intercropping in coconut-based production systems in the tropics would be acceptable, if coconut yields were little affected and that the inter-planted trees form a valuable system component. Available evidences indicate that most of the dicot trees evaluated exert either complementary or neutral effect.

Alley component

Alley component can include wide categories of crops such as cereals, millets, vegetables, tuber and fodder crops. Alley crops should be chosen considering the under-storey light availability, their relative shade tolerance and/or competitive/ complementary interactions. Typically, shade tolerant species/varieties with N2 fixing ability are suited for such situations. Pruning is a viable management option to limit competition and encourage temporal complementarity in resource use. Different crops like paddy, sorghum, maize, pearl millet, finger millet, cowpea, green gram, black gram, groundnut, soybean, bengal gram, tapioca, elephant foot yam, greater yam, lesser yam, sweet potato, chinese potato, colocasia, ginger and turmeric, pumpkin, ash gourd, chillies, amaranthus, brinjal, pineapple, flowering crops and fodder grass etc., can be raised as alley crops in coconut gardens between the rows

of green manure trees. The green manure tree is planted in two rows at a wide spacing in the inter spaces of coconut. In the wide alleys of the two rows of green manure tree crop, suitable alley crops can be grown. The green manure tree will be pruned and managed as hedges when the food crops are grown in the alleys ie., during the cropping phase. During the non-cropping phase when there are no crops in the alleys, green manure trees are allowed to grow freely. Before the planting of alley crops in the next season the trees are again pruned and maintained as hedges. The prunings of the tree can be used as green leaf manure/mulching to the coconut palm which can provide nutrients especially nitrogen needed for the coconut palm. Tree fodder based alternate land use options is a boon for achieving forage security and land sustainability. Studies conducted at College of Forestry, KAU, have also reported that intercropping dicot trees do not exert strong negative effects on the yield of coconut palms until they overtop the palms. Improvements in soil organic matter status and water holding capacity and consequential yield increases also have been demonstrated in certain cases, besides low incidence of pest and disease.

Resource-use-efficiency of green manure - food crop alley cropping system in coconut gardens

Alley cropping system is identified as a sustainable crop production system owing to its efficiency in utilization and conservation of the soil, water, light, nutrient and land resources.

Soil

Alley cropping of green manure trees like glyricidia, subabul, sesbania etc., in coconut garden helps in improvement of soil physical, chemical and biological properties. Soil physical properties are improved by the addition of green leaf manures by increasing soil organic matter, increased root activity of hedger ows, better soil aggregation, lowered bulk density, improved soil porosity, increased water holding capacity. Improvement of soil chemical properties include soil fertility and soil productivity improvement and modification in soil reaction (pH).. Soil biological properties are improved by the better decomposition of mulches and increased microbial activity. Alley cropping system established on slopy coconut garden land aids in soil conservation either by its barrier approach, where the deep rooted hedge rows acts as a barrier for checking movement of soil and water along the slope, slows down the fast moving soil particle down the slope and trap the soil particles behind them leading to formation of natural terraces. By the cover approach, the green manure tree canopy and the tree litter prunings applied to the soil so as to intercept the rain fall, thus acts as a ground cover and checks the rain drop impact on soil and prevents runoff.

Water

Improvement in soil structure, aggregate size, stability & water holding capacity will increase water infiltration, retention and reduce runoff which will help in conservation of more water in coconut gardens. Mulching of coconut basins with the hedge row prunings will prevent evaporation loss of water from the soil. This will alleviate the impact of water stress on the coconut palms during the period of drought.

Nutrients

Green manure alley cropping system in coconut offers better nutrient-use- efficiency by the increase in dynamic pool of soil organic matter and plant available nutrients. Green manure trees planted as hedgerows will provide year round supply of nutrient rich leafy mulch or green manure to the alley crop and for the coconut. Application of glyricidia prunings to the coconut palms could meet a major portion of nitrogen requirement of coconut and thus reduce the dose of chemical fertilizer application in coconut. The leguminous trees planted as hedge rows will increase the N input to the soil by way of biological nitrogen fixation which will benefit both the coconut and the alley crop. Hedge row prunings of the green manure trees act as a mulch, reducing erosion of top fertile soil and leaching of nutrients. The deep root system of woody species will take the nutrients from the deeper layers and alley crops which have shallow root system will take the nutrients from the surface layers. Thus there exist complementarity in soil nutrient sharing. Another beneficial effect is that the trees will hold nutrient in their tissue and conserve nutrients in site. The deep root system of trees which are active throughout year, pump up nutrients and these nutrients reaches the surface layers by root decay, through litter fall & decomposition and mineralization of hedge row prunings. Thus due to nutrient cycling there will be continuous transfer of nutrients within the productive system. This will reduce the internal nutrient demand, increase the nutrient-use- efficiency and yield. The leaves of tree

fodders are also nutritious feed source due to their high proteins, vitamins and minerals vital in the nutrition of grazing animals. Although, every part of tree is useful for feeding, leaves are considered most valuable due to their high crude protein.

Light

Adoption of alley cropping in coconut garden helps in effective utilisation of light energy by the coconut, green manure tree & alley species for its growth. Wide spacing, proper orientation and timely pruning of the green manure trees prevent shading of alley crops by green manure trees and thus avoid competition for light during crop period. As the green manure trees are allowed to grow freely without pruning during the non-cropping or fallow phase, light will be a limiting factor in alleys which in turn will reduce the weed germination and its subsequent growth in the alley spaces.

Land

Land is very efficiently utilized by practising alley cropping system in coconut gardens. As more number of crops are taken in a year on the same land with longer cropping period, land use intensity will be increased.

Crop yield

Growing of leguminous green manure trees along with coconut will help in efficient nutrient and water management, moisture conservation, and suppress weed growth in the coconut gardens. In addition, the microclimate in the coconut garden is also improved. All these will have a complementary effect on coconut and there will be an increase in the yield of coconut. Crop diversification will also increase the total production of system. Weed control The leaf mulch from green manure tree provides ground cover in the alley ways and coconut basins during the cropping phase and prevents weed growth. Vigorously growing green manure trees shade the alleys and suppress weed growth during the fallow phase. Thus there will be reduction in weed seed bank in the soil.

Economics

The system is economically stable due to crop diversification. Diversifying the coconut garden through alley cropping reduces the risk of depending on coconut alone. The additional products obtained from the food crops taken in alleys will act as an extra source of income to the farmer. The requirements of external inputs are also less in the system. There will be savings in land clearing, fertilizer and herbicide costs. The onsite & offsite cost due to erosion damage will also be less. Implementing alley cropping system in coconut homesteads requires proper selection of crops, planning and management. Adoption of alley cropping system in coconut garden provides better performance of coconut, enhance soil quality, recycle nutrients, reduce the use of chemical fertilizers, control weeds, reduce erosion, enhance microclimate and diversify crop pattern and contribute to sustainable farming in the coconut plantation. Coconut based agroforestry farming balances the ecosystem functions by increasing species richness, enhancing soil's physical and biological properties, opening new carbon sequestration pathways, purifying air and water resources and mitigating greenhouse gas accumulation in the atmosphere. .

Shri. Renu Kumar B. H. elected Vice Chairman of Coconut Development Board

The 144th meeting of the Board held on 6th june 2023 elected Shri Renu Kumar B. H as Vice Chairman of Coconut Development Board. Shri Renu Kumar is representing the coconut farmers of Karnataka state in the Board.

Coconut Shells
Improvised Honey Chambers

Shwetha. R
Technical Officer, Coconut Development Board, Kochi

Honey bees are social insects that live together in large, well-organized family group engaged in multiple tasks such as complex nest construction, communication, environmental control, defense and division of the labor. These fascinating behaviors make social insects, honey bees in particular, among the most fascinating creatures on earth.

India is blessed with the art of Apiculture and coconut farming and that both have been adopted by the farmers in the traditional agriculture practices. The coconut shells could be used for brooding the stingless honeybees making the harvesting easy and also to decrease the mortality rate of young bees. The usual ways of harvesting the honey from wild colonies destroys the nest to a larger extent. The bees would spend a long time to mend the damages caused by the harvest. This problem could be minimized by using the coconut shell as the "honey chambers". The coconut shells seem to be an ideal hive, especially in coconut growing areas.

There are two approaches to this method. The first being that a coconut shell can be added to an already established colony and the second method is that the coconut shell traps are made to attract the swarms. The major advantage of adding coconut shells to an already existing nest is that there is no need to relocate the nests and the wild populations of bees are therefore conserved.

The first method was developed in the Philippines and tested with beekeepers for many years. The method starts with the preparation of coconut shell being de-husked and halved. The halved shells are thoroughly cleaned to prevent any kind of infestation. Select a good sized shell with the natural germination holes or "eyes". Small holes can be made around

the rim to accommodate the supporting wires. The shells are now ready to be attached to the beehive. At the entrance of the beehive, the shell will be attached with the help of the wire. If the entrance

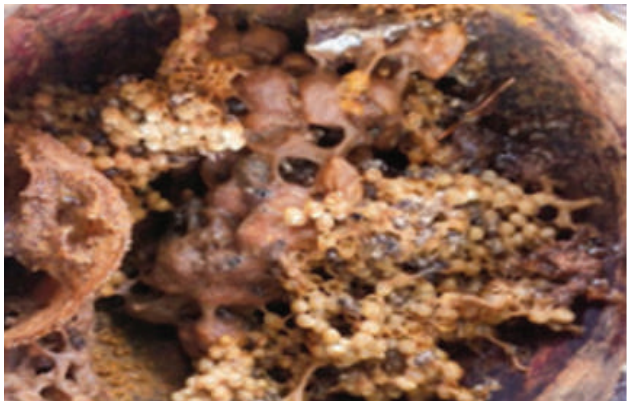
is narrow, enlarge the hole to expose the inside of the shell, which will also help in the movement of the foragers. It may take some time for the bees to occupy the shell if the entrance is narrow. Enlarging the entrance, forces the bees to close the gap inside of the shell making it ready for occupancy. If it is a natural nest on the trees, leaves may be utilized for covering the gaps between the shell and the tree. Now the shell acts as an improvised nest chamber. In this method, the bees keep their brood near the base of the nest hence the upper portion of the nest i.e the attached coconut shells becomes the food chamber. During the season of honey flow and pollen, the coconut shells need to be removed and replaced with the new ones. As time progresses, add one or two shells at a time on the already attached shells. The bees extend their food stores into these new chambers. A colony consisting of up to ten such shells could be termed as a strong colony.

The next stage is the division of colonies. During the swarming season, a strong colony consisting of minimum ten coconut shells is divided. These colonies have queen cells in preparation during the swarming period. The brood chambers containing queen cells along with some adult bees are separated and are placed 1 to 2m away from the original colony. This leads to the formation of new colony/starter colony-from the original colony. One shell each of pollen

and honey should be transferred to the new colony. Now the so called starter colonies are allowed to rear their own queen. Usually two starter colonies are developed from a ten- shelled strong colony. When the nectar and pollen sources are abundant, the new colony shall expand within a span of six months. This method can also be used to harvest honey and pollen from the colonies established in the walls and other structure. At the time of harvest, the top most shell is lifted leaving the brood intact. This technique allows for the harvest of honey and pollen without disturbing the brooding site. The method enables for the conservation of bees as there is no need for relocating the existing colonies formed naturally.

The second method is by making Coconut shell traps. Here again, the empty coconut shells of uniform size are split into half. The holes, if any on the shell, should be plugged using the propolis obtained from the bee hives. Propolis is a substance collected by the bees from the plant parts or wounded trees used for hive construction and protection of the colony from microbial infections. It is a mixture of beeswax and other oils and resins collected by bees used for preserving honey and other perishables. In the lower half of the shell, hole of 5m diameter is to be made using hand drill. This hole is fitted with a flexible rubber tube of 2cm length in such a way that half of

the tube protrudes out from the shell. A thick layer of bee propolis and resin mixture shall be well applied at the outside part of the protruding end of the tube to attract the swarming bees to the trap/nest. Now the two halves of the coconut shell shall be joined together tightly by wires or small rope. These traps can be kept on to a stand using galvanized iron wire and placed in the vicinity of the original colony. The traps shall attract the swarming bees and the bees shall construct new cells, brood cells and pollen and honey storage pots. The traps would be accepted by the bees in a time period of 15-18 days and time taken for constructing new cell would be 12-14 days. The honey pots will appear to be dark brown in colour and pollen pots in pale yellow colour arranged in clusters. On an average, the bees shall construct brood cells in a trap within a time period of eighty days.



The stingless bees use their wing fanning mechanism to thermo regulate the temperature inside the hive. As the hive space increases, it has a negative role in the maintenance of the carbon dioxide balance inside the hive by the worker bees, during the initial days of formation of nest. In this coconut shell trap method, as the nesting space is small, it helps in the successful and easier establishment of stingless bees as less energy is to be spent by the worker bees for thermo regulating smaller space.

The coconut shell trap method stands out as a viable method for the conservation of the natural population of stingless bees. This indicates that the coconut shell could be easily used for trapping stingless bees and to maintain their colony in the urban and rural households. The empty coconut shells find a new value addition as 'stingless bee nest' apart from other uses. These traps could also be placed in relatively unusual sites in varied rural/ urban households to suitably trap the swarming bees. The well-established trap nests of coconut shells can be employed in pollination of crops under protected cultivation.

Apart from the other uses of the coconut shells, the honey trap shells does not require further processing involving labour or machineries. The traps or shell hive could be easily made by an effort of a single farmer individually using household amenities. Trapping of native bees allows for sustainable beekeeping and also reduce start-up costs. The coconut shells thus make an excellent home for the honey bees.

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Feeding behaviour of Apertochrysa astur on exotic rugose spiraling whitefly (RSW) under net-house conditions

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Introduction

Coconut palm, *Cocos nucifera L.*, commonly known as "Tree of Life" or "Kalpavriksha"grown in 2.19 million ha in India, with a production of 20,736.74 million nuts and a productivity of 9,430 nuts/ha (2020-21). An exotic and invasive RSW, *Aleurodicus rugioperculatus Martin*, has entered India and was first reported on coconut palm in August-September 2016 at Pollachi in Tamil Nadu and Palakad in Kerala (Sundararaj and Selvaraj, 2017 and Josephrajet al. 2017). Later in the year 2020, Chalapathi Rao *et al.* reported the initial occurrence of *A. rugioperculatusat* Kadiyapulanka nursery gardens of Andhra Pradesh during late December 2016. The nut dropping of *A. rugioperculatus* infested Godavari Ganga hybrid and East Coast Tall (ECT) variety coconut palms under high Infestation Grade Index (I.G.I) (> 20 spirals per leaflet) was reported to be 35.32 and 28.51 per cent at Dr. YSR HU - Horticultural Research Station (H.R.S), Ambajipeta for the first time by Raghuteja *et al.* 2023. However, natural enemies such asparasitoids and predators play amajor role in combating the population of invasive RSW pest infesting coconut based horticultural ecosystems.

Green lace wing, *Apertochrysa astur,* Banks (Neuroptera: Chrysopidae) is the most promising predator against RSW because of its cosmopolitan distribution, good searching ability and easy rearing in the laboratory (Chalapathi Rao et *al.* 2021). The chrysopids larvae predate on a broad range of pest species such as mealybugs, thrips, aphids, whiteflies, mites and eggs of insect pests while adults are free-living and feed only on pollen, nectar and honeydew secretion. In A.P, natural establishment of *A. astur* was documented against RSW in coconut palms and the technology on its mass-multiplication was standardized at H.R.S, Ambajipeta, Dr. YSR HU, Andhra Pradesh. Henceforth, an effort was made to study the feeding behaviour of *A. astur* against RSW under net house conditions so as to standardize the release rate frequencies of *A. astur.*

Feeding behaviour of *A. astur* instars against RSW eggs on hourly day basis

The feeding behaviour of *A. astur* grubs in the first, second and third instars against RSW eggs was observed on an hourly basis from 6: 00 AM to 19: 00 PM. Predator grubs fed more eggs in the early morning (11 eggs) and late evening (10 eggs), compared to passive, static and very little feeding behaviour (0.2 - 0.3 eggs) during hot midday periods. The grubs were active throughout the morning sunrise hours in quest of food, such as RSW spirals. Consumption began

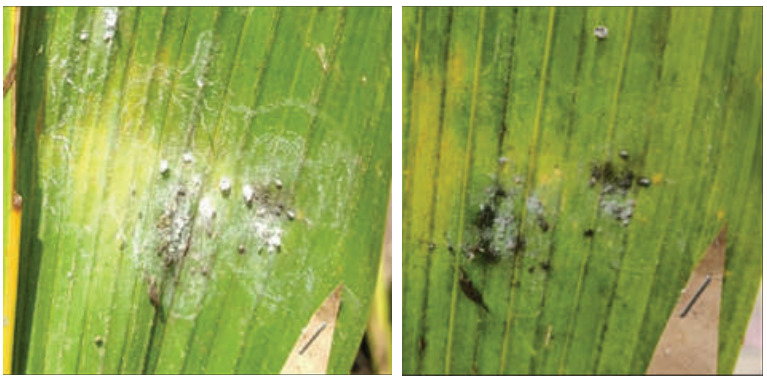

fig 1. RSW spiral on the same leaflet before and after feeding by A. astur grubs.

to decline progressively from 8:00 AM onwards, becoming very low throughout the afternoon hours and then gradually retaining from 16:00 PM onwards. *A. astur* grubs consumed 71 eggs throughout the course of 13 hours, with an average consumption of 5.46 eggs per hour. The number of RSW eggs were reduced from 440 to 369 eggs after the predator consumed 71 eggs during the day and a leftover of 302 eggs was recorded on the next morning, implying that the grubs consumed a total of 67 eggs during the night (19:00 PM to 6:00 AM) time (Table 1 and Figure 1).

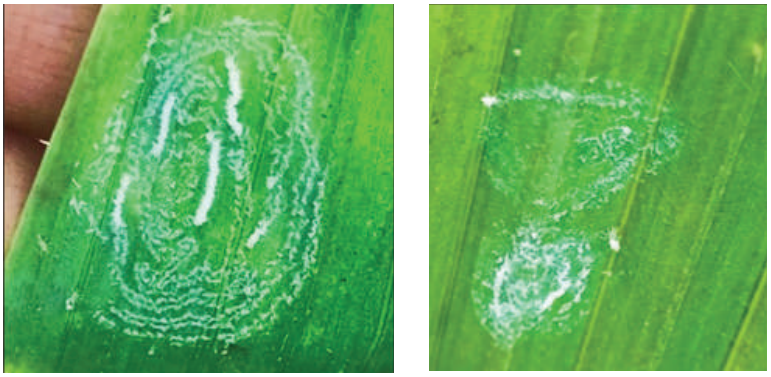

Fig 2. Feeding of RSW eggs by 1st instar A. asturgrubs

Preference of feeding by *A. astur* grubs and migration

The fresh instars of *A. astur* prefer RSW eggs, whereas the 2nd instars prefer nymphs, 3rd instars prefer both eggs and nymphs. The late *A. astur* instars were highly voracious and consumed more RSW eggs due to small prey size coupled with static behaviour. Foraging behaviour of many predators depends on the body size of the predator as well as that of the prey.

The movement of *A.astur grubs* from one seedling to another was also observed on soil after completing consumption of RSW spirals in a plant, whereas in case of adults being winged forms flying behaviour was observed during their movement from one plant to another.

Time Period for the predation on RSW spirals

It took a time period of 7-10 days for *A. astur* grubs to completely devour the *A. rugioperculatus* spirals (eggs, nymphs, pupae and adult) in low incidence coconut seedlings, whereas 15-20 and 25-30 days to fully consume medium and high RSW incidence seedlings. The extension of *A.astur* grub period was

Indian Standard Time (IST)	First Instar (1st)	Second Instar (2nd)	Third Instar (3rd)	Total Number of eggs fed (N)
6:00–7:00 AM	4.0	2.0	5.0	11.0
7:00–8:00 AM	3.0	2.5	4.0	9.5
8:00–9:00 AM	2.5	2.0	4.0	8.5
9:00–10:00 AM	2.5	1.5	3.0	7.0
10:00–11:00 AM	2.0	1.0	2.5	5.5
11:00–12:00 PM	1.0	0.5	2.0	3.5
12:00–13:00 PM	0.5	0.0	1.0	1.5
13:00–14:00 PM	0.2	0.0	0.0	0.2
14:00–15:00 PM	0.1	0.0	0.2	0.3
15:00–16:00 PM	0.5	0.0	1.5	2.0
16:00-17:00 PM	1.0	0.5	2.5	4.0
17:00-18:00 PM	2.5	2.0	3.5	8.0
18:00-19:00 PM	3.0	2.5	4.5	10.0
Total number of eggs consumed during day time				**71.0**

Table 1. Number of *A. rugioperculatus* eggs fed by different instars of *A. astur* predator at different time intervals


Fig 3. Devouring of RSW colony by 2nd instar *A. astur* grubs


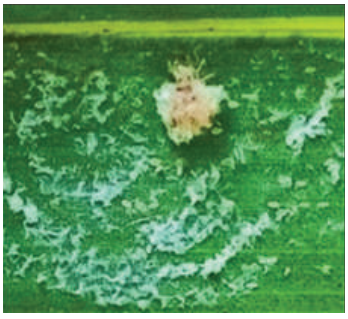

Fig 4. Feeding of bondar's nesting whitefly (BNW) eggs by *A. astur* grubs

observed in high and medium RSW incidence plants whereas; the period was short in low RSW incidence. It might be due to the more availability of food content in the form of number of RSW spirals (eggs, nymphs, pupae and adults) in medium and high incidence plants respectively. Henceforth, the grub period was prolonged in case of medium and high RSW incidence plants.

In addition to RSW, *A. astur* grubs also consumed the eggs of neo-tropical invasive Bondar's Nesting Whitefly (BNW), *Paraleyrodes bondari.* The feeding of *A. astur* was identified against RSW, *A. rugioperculatus* and BNW, *P. bondari* life stages. Unlike *A. rugioperculatus*, nonatural parasitisation by *Encarsia guade loupae Viggiani* (Hymenoptera: Aphelinidae) was reported on *P. bondari* till to date. No specific predators for this species recorded in the literature yet. Henceforth, *A. astur* acts as dual purpose for successful classical biological control of both *A. rugioperculatus* and BNW, *P. bondari* infesting coconut based horticultural ecosystems.

Acknowledgements

The author is thankful to the staff of Dr. YSR HU-Horticultural Research Station (HRS), Ambajipeta.


Fig 5. Migration of *A. astur* grubs through soil

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Coconut treat in coconut shell Kokoscoop & Kokoneer

Amiya Debnath* and **Sharad Aglawe****
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**Senior Field Officer, CDB DSP Farm Phalghar, Maharashtra

Kokoscoop ice cream, served in fascinating and tempting way in the coconut shell along with beautiful toppings over it and the glass of coconut water to sip from the freshly cut coconut itself is a treat to anyone who tastes its. KokoNeer is made from carefully handpicked coconuts which is packed with refreshing energy, vitamins and antioxidants.

Kokoco innovative Beverages Pvt. Ltd, Pune started its journey in the year 2017 with Kokoscoop in a small Kiosk in Magarpatta, Pune. Shri. Anuj and Dyanada Divekar, are the Proprietors of Kokoco innovative Beverages Pvt. Ltd, Pune. They attended a training and took technical guidance from CDB institute of Technology, Aluva, Kerala. Another outlet was started in the year 2020. Even though Kokoco was affected by the outrage of the pandemic, they could overcome it with sheer prudence and determination. At present, Kokoscoop has three outlets in Pune city.

KokoScoop blends the natural goodness of coconut with delicious ice cream, and selection of unique toppings!

KOKOSCOOP

KOKOSCOOP is the combination of premature coconut shell along with coconut malai and ice cream scooped on top. Kokoscoop sources the fresh coconut from Konkan, Maharashtra as well as from South India. These coconuts are firstly de husked and made smooth and soft from the surface so that it makes one feel that you are having the ice cream in the wooden (Shell) cup. These coconuts are broken into two pieces in front of the customer. Then the tender coconut pulp is scrubbed from the coconut and cut into pieces. The ice cream formulations

like milk, fat, gums and emulsifier which are the common ingredients is replaced with ingredients like coconut pulp, cocoa powder, sucrose etc. and is topped with Nata De Coco, adding some beautiful and tasty topping over it. KOKOSCOOP was a a big hit being a new concept of coconut ice cream which is served in coconut shell along with the fresh malai and different toppings over it, this is served with complimentary glass of coconut water which costs Rs.110/-. KOKOSCOOP is very popular in Pune city and around 150 nos are sold every day in the city.

KOKONEER, the Natural soft drink

Worshipped for centuries, coconut water has been proven to control blood sugar and blood

100 % Tender coconut water	
Nutritional information	
Energy (Kcal)	21
Protein (g)	0
Carbohydrates (g)	501
Natural fruit Sugar (g)	5
Added sugar (g)	0
Fat (g)	0
Sodium (mg)	21
Potassium (mg)	200
Calcium (mg)	24
Magnesium (mg)	15

pressure, and helps maintain good heart and kidney health, amongst a league of benefits. KokoNeer is one drink that you can have daily, Which is a health-packed blessing for your body and soul.

Realizing its potential, Shri.Anuj and Dyanada Divekar ventured into the production of Kokoneer, partially dehusked cool tender coconut in 2018, their second product. Since husk constitutes major portion of the volume of tender coconut, major portion of the husk is removed by minimal processing. The tender nuts are machine shaved to an attractive and uniform hexagonal shape, having smallest possible size that can retain the fluid safely inside. After removal of the husk, tender coconut is dipped in anti browning agents like citric acid & potassium metabisulfite. The product is wrapped with food grade polyethylene for aesthetic and hygienic purpose which can be stored up to 15- 20 days in refrigerated condition at 5-7degree Celsius.

The unit is procuring 2000 to 3000 fresh coconut per day which are minimally processed and is sold to the customers @Rs.45/- piece under the brand name kokoneer. The Kokoneer is available across Pune city in Malls, Star hotels and retail outlets.

Shri. Anuj and Dyanada Divekar's third and the foremost important product is 'Cocopith'and 'Cocofibre' which are widely used in nursery, polyhouses and many places for plants and seeds. Cocopith acts as a good plant fertilizer and a good substitute for soil as it is having moisture retaining capacity plus it helps in faster growth of plants. Coco fibre is also used in numerous ways for making products like Mats, Pots, Ropes, articles etc. This waste management which is done from coconut makes the company a Zero waste Company.

For more details KOKOSCOOP, Shop 10 Ridhi enclaves society, Viman Nagar, Pune, Maharashtra 411014. enquiry@kokoscoop.in

From Waste to Wonder

Sunbird Straw Manufacturing Company's Eco-Conscious Straws

Aswathy Satyan
Journalist, CDB

In the recent years, there has been a growing global shift towards eco-friendly alternatives to single-use plastic products. One industry that has faced significant scrutiny is the straw industry, which contributes to plastic waste and pollution. However, amidst this environmental concern, companies like Sunbird Straws have emerged, dedicated to producing sustainable straws made from coconut leaves. This article explores the innovative practices and positive impact of coconut leaf straws in revolutionizing the straw industry.

As the detrimental effects of plastic pollution have become more apparent, businesses and consumers alike have been actively seeking environment friendly alternatives. Traditional plastic straws, taking hundreds of years to decompose, have been a major concern. Being a nature lover Shri. Saji Varghese, Associate Professor, Department of English, Bangalore Christ University,was always behind his dream to manufacture an eco-friendly products to save the nature. He started a venture into the iconic brand Sunbird Straws, offering a sustainable alternative to single-use plastic straws, making straws from coconut leafs.

Shri. Saji Varghese's story begins with a deep concern about the environmental impact of plastic waste, especially plastic straws.Aware of the harmful effects on marine life and ecosystems, he recognized the urgent need for eco-friendly products. The company Sunbird Straws was launched in 2020.But the research on this product started in October 2017. One day when he saw a fallen coconut leaf in the campus, he came up with the idea of making a straw from it. He took few dried leaves and rolled it like a straw and put it on the Idli maker and steamed it. A glow came over the surface of the dry straw. It was then he realized that epicuticular wax was the cause of this shine. When heated, this wax will appear on the surface of the leaf by itself. This wax is anti fungal and water resistant.

Researches had been done on this wax for about five months at CPCRI, Kasaragod.It was found that this wax is healthy. A scientific paper has also been released about it. This epicuticular wax and its

properties have been published in the Asian Journal of Plant Science. But other straws available in the market are using artificial wax for shining. Apart from this Sunbird straws also have SCS Lab certification.

A lot of coconut leaves is becoming agri waste in our country while it is capable of producing natural wax. Then such an initiative started with an idea why not uses it. And it was easy to make straws with coconut leaves because of its vertical alignment. We are making brooms from coconut leaves. But the remaining part is burnt. Such waste parts are used for making straws.

In the beginning, straw was made manually. When the sample straw was shown to his friends, everyone liked it. The afterthought was that they needed a machine to make straw. More straw production can also provide employment opportunities to many people. Especially women are given the opportunity to work as a cottage industry. A team is working hard for the rise of Sunbird Straws. The team consists of Rajkumar, Jobin Jose, Christ University students Chirag and Sandeep and engineer Anoop. They took advantage of the extraordinary potential of coconut leaves and turned them into beautiful and practical straws that serve as a sustainable alternative. In the last two years, the machines required for making straw have been developed by them. Multilayer straws are now manufactured using these machines. Construction works are going on in different states like Kerala, Tamil Nadu and Karnataka.

This straw production unit can be divided into three levels. It works as a hub and spoke model.In the first phase, coconut leaf collection is done locally at Spokes. The leaves then undergo thorough cleaning and treatment, removing impurities and ensuring hygiene. After cleaning the leaves it will be cut into required size using machines. From Kasargod, Kanyakumari Nagercoil part, Palakkad, Karnataka, Kannur, Kozhikode and Thrissur, the women collect the leaves, tear the leaves, separate the leaves and cut them into the same width. This is called Leaf Sourcing and Leaf Processing.These processed leaves are then transferred to the straw production units at Kasaragod, Tuticorin and Bandur. After making two layers of straw, it is heated and then sterilized by ultraviolet rays before it is sold in the market. All straws are packed completely untouched. Bangalore is the hub doing the finishing touches. Five-star hotels in cities like Bangalore and Goa are the main markets of coconut straw. Also, straw is exported to countries like Spain, UK and Dubai.

We all know that plastic straws are available in the market for 15 paise which will have its bitter effect in nature for 700 more years. These natural straws are an alternative. Plastic straws are currently banned; so there is no competition in the market. Instead there is good competition in the market with straws made of paper, bamboo, Pegasus etc. But coconut straw is better than all these. There are many reasons for that. Paper straw, for example, is not actually a natural product. Trees must be cut to build it. Its bleaching process emits more methane. When it is used in drinks, its glue and other substances will mix with these drinks. It is not safe at all. Even if it is bamboo straw, the price in the market will be up to 30 rupees. Also, there is a higher chance of fungus in the cavity; Bagasse and corn starch straws are not in demand in European markets due to their gluten and sugar content. Hay straws can only be produced in a limited quantity. It is not possible to change the diameter as per requirement. Best of all is coconut leaf straw. It is a product from agri-waste.

Saji Varghese, Founder, Sunbird Straws

Straws can range from 4mm to 12mm in diameter and 8 inch (20 cm) to 15 inch (38 cm) in length. It sits in drinks for up to 3 hours. But due to whitefly attack, such diseased leaves cannot be used to make straw. This is a major challenge in this field. And it is difficult to collect the leaves even during the rainy season. No other chemicals are used during manufacturing. The coconut leaf straws are fully biodegradable, decomposing naturally without leaving harmful micro plastics behind.

Currently 30,000 straws are produced per day. Efforts are being made to increase it to 2 lakh straws per day within a year. The price is between Rs. 1.40 to Rs. 2.50 per straw. It is cheaper than other agricultural products. The price will vary according to the difference in its diameter. In India it is mostly sold in Goa. Initially 45 seconds were required to make a straw later on it has changed to one straw per second.

Beyond its ecological benefits, Sunbird Straw Manufacturing has also positively impacted local communities. The company partners with coconut farmers and artisans, providing them with a sustainable livelihood by sourcing the raw materials directly from them. This partnership not only supports local economies but also preserves traditional crafts and knowledge associated with coconut leaf usage.

There is a lot of agri-waste in our country. We pretend we didn't see it and burn it. Generally, young people start technology based startups. But if products are made from such agri-waste, it will lead to global sustainable development. India is a country that can create such globally acclaimed products. To those who want to become entrepreneurs, Mr.Saji Varghese says it is better to bring natural products to the market with this kind of agri-waste. If you go into the agriculture sector, you can make a lot of eco-friendly products. Demand for such products is globally high. It is also very profitable. There is a good demand for such natural products. From countries like Thailand, Sri Lanka and the Philippines the entrepreneurs are showing interest in learning straw manufacturing technology.

Since coconut trees are abundant and renewable, their leaves serve as an endlessly renewable resource for straw production. Our innovative natural product manufacturing makes us known worldwide. By choosing Sunbird Straw, consumers are not only choosing an eco-friendly alternative, but also becoming active participants in the fight to reduce plastic waste. By using these natural straws, they contribute to the protection of marine life and ecosystems and nurture a green planet for future generations. Mr. Saji Varghese, through his mission, goes beyond providing an alternative product and aims to create a global shift towards more responsible

Retirement

Shri K. S. Sebastian, Deputy Director retired from the services of Coconut Development Board on 30th June 2023 after serving the Board for more than 35 years.

Training for KVK Officials of North-East Region

A Five-days training programme for KVK officials of North-East Region on 'Scientific cultivation of coconut, arecanut and cocoa' was held at ICAR -CPCRI Kasaragod. The training programme was inaugurated by Dr. K. B. Hebbar, Director, ICAR-CPCRI on 14th July, 2023. Dr. Hanumanthe Gowda, Chief Coconut Development Officer, Coconut Development Board, Kochi, was the chief guest of the programme

In his inaugural address Dr. K. B. Hebbar, Director, ICAR-CPCRI, said that "North east is the future hope and suitable region for plantation crops and thrust is to increase productivity in the region. There is a need for better understanding of the crop and availability of technological alternatives towards achieving the goals". He stressed the need for innovation and technology development to tackle changing climate. Value addition is the means to tackle price fluctuations.

Dr. Hanumanthe Gowda, in his address briefed the economic concern for the plantation crops. He

urged CPCRI to release State-wise specific package of management practices of coconut, which will help in betterment of productivity.

Guest of Honor, Sri H. Krishnakumar, MD, CAMPCO in his address spoke on the need for complying to best quality in agricultural products for maintaining a high position in the global market. For this collaborative work is to be carried out involving scientists, industrialists and farmers. He also told to adhere to FSSAI standards to maintain the quality.

Progressive farmers, officials from state agriculture departments, KVK officials of North-East Region and scientists of ICAR-CPCRI participated in the programme.

Farmer – Scientist Interactive Meeting cum Training on Cinnamon Cultivation in Coconut Garden

ICAR – CPCRI in collaboration with Horticulture department of Karnataka conducted one day Farmer – Scientist interactive meeting cum training on 'Cinnamon cultivation in coconut garden' at Horticulture department, Bhatkal in Uttar Kannada district of Karnataka on 29th May 2023. The programme was inaugurated by Dr. Homey Cheriyan, Director, Directorate of Arecanut and Spices Development (DASD), Calicut in the presence Dr. Ravi Bhat, Head, Crop Production, Shri. H. K. Bilgi, Senior Assistant Director of Horticulture (SADH) and Smt. Divya C. V., Assistant Director, DASD. Dr. Subramanian P., Principle Scientist (Agronomy) briefed on Cinnamon Cultivation in coconut garden followed by visit to cinnamon demonstration plot of Shri Umesh Hegde at Kelaginakeri village of Katagarkoppa. More than 35 farmers participated in the meeting. Many farmers expressed interest to cultivate cinnamon as intercrop in coconut gardens to effectively utilize the interspaces

available in coconut gardens. The Director, DASD assured financial support to expand the area of cinnamon cultivation under coconut gardens in the region and ICAR – CPCRI will provide the technical information on scientific cultivation of cinnamon. The programme was concluded with vote of thanks by Dr. Sandhya Bhat, Assistant Horticulture Officer (AHO) and the programme was coordinated by Dr. Surekha, Scientist and Dr. Rajkumar, Senior Scientist, ICAR - CPCRI, Kasaragod

Report prepared by Dr. Surekha, Scientist and Dr. Rajkumar, Senior Scientist, ICAR - Central Plantation Crops Research Institute (CPCRI), Kasaragod - 671124, Kerala

Cultivation practices for coconut-August

New planting

Plant the coconut seedlings after the cessation of the monsoon in low lying areas subject to inundation during monsoon.

Incorporate green manure legumes into coconut basin / interspace

Green manure crops sown in the coconut basin or in the interspace of coconut gardens have to be incorporated into the soil if they have attained 50% flowering. In the coconut basin, green manure, legumes can be incorporated by using a spade. If tractor is used for incorporating the green manure in the interspace of coconut garden, care should be taken to avoid injury to the coconut trunk.

Nursery management

If sufficient moisture is not available due to insufficient rainfall, continue irrigation for the seedlings in the nursery until rains set in to provide sufficient moisture. Weeding has to be done wherever necessary.

Drainage

Wherever water logging is experienced provide drainage channel to drain the excess water. If continuous heavy rain occurs, make raised bunds around the planting pits of newly planted coconut seedlings to avoid entry of water into the pits.

Manuring

In rainfed areas, circular basins of 1.8 m radius and 25 cm depth may be dug during the fag end of August and green leaf or compost or farm yard manure may be spread at the rate of 50 kg per palm basins. The remaining two-third of the recommended dose of fertilizers may be spread over the green leaf or compost and covered. Application of 500 g N, 320 g P_2O_5 and 1200 g K_2O per palm per year is generally recommended for adult plantations. To supply two-third of the above nutrients it is necessary to apply 0.67 kg urea, 1 kg rock phosphate (in acidic soil) or 1.4 kg Super Phosphate (in other soils) and 1.35 kg of Muriate of potash (MOP). Whereever boron deficiency is observed borax can be applied @100 g/palm. It is always advisable to test soil in the coconut garden periodically (once in 3 years) based on the results of which, type and dosage of chemical fertilizers can be decided.

Moisture conservation practices

Most of the coconut growing tracts in the country received less than average monsoon showers during this season. The month of June recorded 40-50% less rainfall compared to the average. Same trend is being observed during July also. The erratic behaviour of south-west monsoon indicates the significance of conserving each drop of water received. Depending upon the topography and soil type, the following soil and moisture conservation practices can be adopted in coconut gardens.

Mulching

In order to conserve soil moisture in the coconut plantations, mulching with various types of organic materials can be practiced. The best time for mulching is before the end of the monsoon and before the top soil dries up. For mulching, cut coconut leaves into two or three pieces. To cover 1.8 m radius of coconut basin, 10 to 15 fallen coconut leaves are required and can be spread in two to three layers.

Mulching with composted coir pith to 10 cm thickness (approximately 50 kg/palm) around coconut basin is also an ideal method to conserve moisture. Coir pith can hold moisture five times its weight. Due to its fibrous and loose nature, incorporation of coir pith considerably improves the physical properties and water holding capacity of soil. The applied material may last for about 1 to 2 years. Coconut husks are also used as surface mulch around the base of the palm. It can hold moisture to the tune 3 to 5 times of its weight. Approximately 250 to 300 husks will be required for mulching one coconut basin. Mulching is usually done up to a radius of 2 m leaving approximately 30 cm near the palm. Two layers of husk may be buried in the coconut basin with the concave side facing upwards. These layers facilitate absorption of moisture. Above this, another layer of coconut husk is placed with the convex side facing upwards to arrest evaporation. Effect of this mulch lasts for about 5-7 years.

Husk burial

Burial of husk in trenches in between the rows of palms is also effective for moisture conservation in coconut gardens. Husk burial is to be done at the beginning of the monsoon, in linear trenches of 1.2 m width and 0.6 m depth between rows of palms with concave side of husks facing upwards and each layer is to be covered with soil.

Catch pit filled with coconut husk

Catch pits can be constructed at slopes to conserve soil and water. Though there are no standard dimensions for catch pits, catch pits of 1.5 m length x 0.5 m width x 0.5 m depth can be constructed. A bund is to be made at the downside using the excavated soil and pineapple suckers may be planted on it. This pit is also to be filled with coconut husk.

Contour trench filled with coconut husk

This measure is to be taken up where the land slope is high. Trenches of 50 cm width x 50 cm depth and convenient length are to be made in between two rows of coconut palms. These trenches are to be filled with coconut husk. Coconut husks need to be filled in layers with the bottom layers facing up and top layer facing down. A bund of 20 cm height and suitable width (>50 cm) is made at the downstream using the excavated soil. Two layers of pineapple plants are to be planted on the bund with a spacing of 20 cm x 20 cm. Pineapple plants would stabilize the bund and provide additional income to the farmer. The runoff water from the upper side would be collected in the trenches. Soil particles would also get deposited in the trench along with the runoff water. Coconut husk retains the moisture and makes it available for plants during summer months.

Half-moon bund around coconut basin reinforced with pineapple

This measure is to be taken up where there is mild slope (15-20%). Here a flat basin with a slight inward slope towards upstream is made by excavating soil from the upstream side and filling the excavated soil at the downstream side. After making the basin, a bund of 30 cm height and >50 cm width is made at the downstream side of the coconut using the excavated soil. Two layers of pineapple plants could be planted with a spacing of 20 cm row to row and 20 cm plant to plant on the bund. The bund prevents runoff and water gets collected within the basin and percolates down. Pineapple would help to protect the bund and stabilize the same in addition to giving fruit yield.

Plant protection

August marks the transition phase between the two monsoon periods. Since the quantum of monsoon showers had dropped significantly, there is more emergences of sucking pests in this phase, especially the coried bug and spiralling whiteflies. Extreme care should now be focussed on the early diagnosis of coreid bug incidence as this pest causes a greater damage on the nut yield potential in different parts of the country more specifically in Southern Kerala. In areas where rugose spiralling whitefly was not reported so far, this pest could emerge as well for which greater emphasis is laid on biological control. Greater emergence of the killer disease, bud rot is more visible in this part of the year for which adequate prophylactic measures need to be undertaken to tackle this problem. Weakening monsoon showers as well as weather dynamics favoured a major shift in the pest and disease kinetics invading coconut, and therefore warrants systematic monitoring and timely prophylactic measures.

Pests

▶ *Rhinoceros beetle (Oryctes rhinoceros)*

Being a ubiquitous pest, the incidence of rhinoceros beetle is quite common during all periods. However its damage is well pronounced during monsoon phase when seedlings are also planted. In seedlings just planted, the spear leaf gets damaged and distorted by beetle damage. Juvenile palms are also prone to pest attack and sometimes appearing as elephant tusk-like symptoms. Damaged juvenile palms are stunted and get delayed in flowering. Of late incidence of nut boring symptoms are also noticed. Moreover, the attack by rhinoceros beetle would invariable incite egg laying by red palm weevil as well as entry of bud rot pathogen during this period.

Management

- Prophylactic treatment of top most three leaf axils

Life stages of the pest

Nut damage

Elephant-tusk like symptom

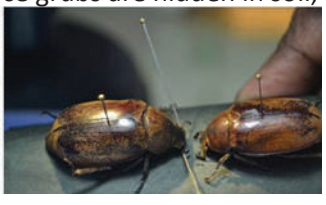
Metarhizium packets

with either botanical cake [Neem cake /marotti cake / pungam cake (250 g)] admixed with equal volume of sand or placement of 12 g naphthalene balls covered with sand.

- Routine palm scrutiny during morning hours along with brushing of teeth and hooking out the beetle from the infested site reduces the floating pest population. This strategy could reduce the pest population significantly.
- Shielding the spear leaf area of juvenile palms with fish net could effectively entangle alighting rhinoceros beetles and placement of perforated sachets containing 3 g chlorantraniliprole /fipronil on top most three leaf axils evade pest incursion.
- Dairy farmers could treat the manure pits with green muscardine fungus, *Metarhiziuman isopliae* @ 5 x 1011 /m3 to induce epizootics on the developing grubs of rhinoceros beetle. Area-wise farmer-participatory approach in technology adoption could reduce the pest incidence very effectively and forms an eco-friendly approach in pest suppression.
- Incorporation of the weed plant, *Clerodendron infortunatumin* to the breeding pits caused hormonal irregularities resulting in morphogenetic transformational aberration in the immature stages of the pest.
- Crop diversity induced by intercropping and ecological engineering principles would disorient pests and provide continuous income and employment as well.

White grub, *Leucopholis coneophora*

This subterranean pest feeds on the roots of coconut and cause yellowing of leaves, premature nut fall, delayed flowering, retardation of growth and reduction in yield. Since grubs are hidden in soil, symptom diagnosis is very crucial in the identification of pest damage. Grubs initially feed on organic materials, roots of grasses and intercrops before feeding on the palm roots. Adults emerge from the soil during the month of June. The pest is very severe in certain sandy belts of Kasaragod, Kerala and parts of Karnataka.



Management

- Repeated summer ploughing to expose the immature stages of predation
- Handpicking of adult beetles during evening of two weeks commencing from the onset of monsoon.
- Application of neem cake in the palms basin @ 5 kg /palm for regeneration of roots.
- Soil application of aqua suspension of entomopathogenic nematode, Steinernemacarpocapsae @ 1.5 billion/ha and need based repeated application

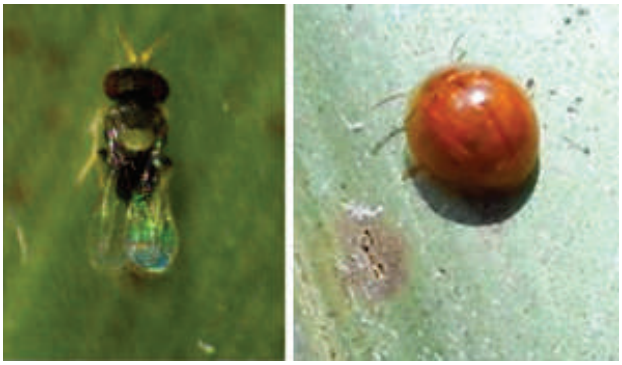
Rugose Spiralling Whitefly *(Aleurodicus rugioperculatus)*

This period could also witness the establishment of the invasive rugose spiralling whitefly (*Aleurodicusrugioperculatus*) in new areas as well as re-emergence in already reported areas. Presence of whitefly colonies on the lower surface of palm leaflets and appearance of black coloured sooty mould deposits on the upper surface of palm leaflets are characteristic visual symptoms of pest attack. In severe cases, advancement in senescence and drying of old leaflets was observed. Leaflets, petioles and nuts were also attacked by the whitefly pest and a wide array of host plants including banana, bird of paradise, Heliconia sp. were also reported.

Management

- In juvenile palms, spraying of water with jet speed could dislodge the whitefly and reduce the feeding as well as breeding potential of the pest.
- Ensure good nutrition and adequate watering to improve the health of juvenile and adult palms

Rugose spiralling whitefly Parasitized pupae



Encarsiaguadeloupae Sooty mould scavenger beetle

- No insecticide should be used as this causes resurgence of the pest and complete destruction of the natural aphelinid parasitoid, *Encarsiaguadeloupae*. A pesticide holiday approach is advocated for the build up of the parasitoid.
- Installation of yellow sticky traps and conservatory biological control using *E. guadeloupae* could reduce the pest incidence by 70% and enhance parasitism by 80%.
- Habitat preservation of the sooty mould scavenger beetle, *Leiochrinusnilgirianus* could eat away all the sooty moulds deposited on palm leaflets and cleanse them reviving the photosynthetic efficiency of palms.
- A close scrutiny should be made for the presence of other whiteflies including the nesting whiteflies on coconut system.

Coreid Bug, *Paradasynus rostratus*

Nymphs and adults puncture the meristematic regions of tender buttons (1-3 months old) injecting toxin around the feeding site causing necrosis. Feeding punctures develop into necrotic lesions and these spindle-shaped depressions could be visible when the perianth of shed button is removed. Female flowers are attacked prior to pollination and such flowers get dried and can be seen attached to inflorescence on the crown resulting in production of barren buttons. Most of the infested buttons and tender nuts shed down. Retained nuts on the bunch develop furrows and crinkles on their husks and are malformed. In many cases gummosis can be seen on such

Management

- Crown cleaning to destroy eggs and immature stages of the pest
- Spraying of azadirachtin 300 ppm (Nimbecidene) @ 0.0004% (13 ml / l) reduced the pest incidence at the highest level. Two rounds of azadirachtin spray on young coconut bunches 1-5 months old during May-June and September-October are quite essential for satisfactory control of the pest in the field
- Among the natural enemies, the weaver ant, Oecophyllasmaragdinais found to be the most efficient predator of coreid bug in the field.

● Two egg parasitoids, namely *Chrysochalcissaoviceps* and *Gryonhomeoceri*, were identified as potential egg parasitoids. Forty per cent parasitism was observed in the egg mass collected from the field due to these parasitoids.

● Spraying cholrantraniliprole 0.3 ml/litre or lambda cyhalothrin @ 1.0 ml/litre on the pollinated bunches was found effective.

Disease

Bud rot or immature nut fall *(Phytophthora palmivora)*

In certain humid locations bud rot occurred regularly killing hundreds of trees. In India, bud rot incidence is recorded as less than one per cent. Pathogen attacks the bud region leading to rotting of bud and death of palms. The first visible symptom is withering of the spindle marked by pale colour. The spear leaf or spindle turns brown and bends down. The affected spear leaf can easily be pulled out as the basal portion of the spindle is completely rotten emitting a foul smell. Temperature range of 20- 24ºC and relative humidity of 98% - 100% were found optimum for the development of the bud rot disease. Contiguous occurrence of such "favourable days" during rainy seasons determines the development of the disease and the intensity of infection. As Phytophthora diseases are known to be extremely fatal, a close scrutiny is mandatory during monsoon period to assess the health of the palm especially the spear leaf zone.

Management

● Regular cleaning of the crown and prophylactic spraying of Bordeaux mixture (1%) to the crown just before the onset of monsoon and one more spray after 35-40 days help in reducing the bud rot incidence. For the newly planted seedlings also prophylactic spraying of Bordeaux mixture (1%) can be given to avoid infection. In localities where heavy wind is experienced and leaves of coconut palms got damaged, spraying of Bordeaux mixture (1%) is essential to prevent infection by Phytophthora.

● Field sanitation and provide proper drainage during rainy season.

● Placement of two Trichoderma (Trichoderma harzianum CPTD28 isolate) enriched coir pith cakes in the inner most leaf axils just before the onset of monsoon and again after every two months as prophylactic measure.

● In disease affected palms, remove the entire rotten portion of the spindle by cutting with a sharp knife and apply 10% Bordeaux paste to the wound and cover with polythene sheet to prevent entry of rain water. The protective covering has to be retained till normal shoot emerges.

As envisaged, timely monitoring and prophylactic measures are very critical to safeguard palm health and provide optimum nut yield. Protection is therefore the key strategy to boost up productivity and double farmer's income. ■

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Market Review – June 2023

Domestic Price

Coconut Oil

During the month of June 2023, the price of coconut oil opened at Rs. 13050 per quintal at Kochi and Alappuzha market and Rs.14000 per quintal at Kozhikode market.

The price of coconut oil closed at Rs. 12600 per quintal at Kochi and Alappuzha market and Rs.13800 per quintal at Kozhikode market with a net loss of Rs. 450 per quintal at Kochi and Alappuzha market and Rs. 200 per quintal at Kozhikode market and it showed a downward trend during the month.

During the month, the price of coconut oil at Kangayam market opened at Rs. 10667 per quintal and closed at Rs. 10133 per quintal with a net loss of Rs. 534 per quintal.

Weekly price of coconut oil at major markets Rs/Quintal)				
	Kochi	Alappuzha	Kozhikode	Kangayam
01.06.2023	13050	13050	14000	10667
03.06.2023	13050	13050	14000	10667
10.06.2023	12900	13000	14100	10467
17.06.2023	12700	12700	13800	10333
24.06.2023	12700	12700	13800	10267
30.06.2023	12600	12600	13800	10133

Milling copra

During the month, the price of milling copra opened at Rs.8200 per quintal at Kochi and Rs.8150 per quintal at Alappuzha and Rs.8000 per quintal at Kozhikode market.

The prices of milling copra closed at Rs. 7850 per quintal at Kochi market, Rs. 7650 per quintal at Alappuzha market and Rs. 7950 per quintal at Kozhikode market with a net loss of Rs.350 per quintal at Kochi, Rs.500 per quintal at Alappuzha and Rs.50 per quintal at Kozhikode market and it showed a downward trend during the month.

*NR-Not reported

During the month, the price of milling copra at Kangayam market opened at Rs.7500 and closed at Rs.7100 with a net loss of Rs.400 per quintal during the month.

Weekly price of Milling Copra at major markets (Rs/Quintal)				
	Kochi	Alappuzha (Rasi Copra)	Kozhikode	Kangayam
01.06.2023	8200	8150	8000	7500
03.06.2023	8200	8150	8000	7530
10.06.2023	8000	7950	8100	7400
17.06.2023	7800	7750	7900	7300
24.06.2023	7900	7750	7950	7275
30.06.2023	7850	7650	7950	7100

Edible copra

During the month the price of Rajpur copra at Kozhikode market opened at Rs. 8350 per quintal expressed a mixed trend during the month and closed at Rs. 8300 per quintal with a net loss of Rs. 50 per quintal.

Weekly price of edible copra at Kozhikode market (Rs/Quintal)	
01.06.2023	8350
03.06.2023	8350
10.06.2023	8450
17.06.2023	8300
24.06.2023	8400
30.06.2023	8300

Ball copra

The price of ball copra at Tiptur market opened at Rs. 8600 per quintal and closed at Rs.7600 per quintal with a net loss of Rs. 1000 per quintal.

Weekly price of Ball copra at major markets in Karnataka (Rs/Quintal) (Sorce: Krishimarata vahini)	
01.06.2023	8600
03.06.2023	8603
10.06.2023	8800
17.06.2023	8000
24.06.2023	8100
30.06.2023	7600

Dry coconut

At Kozhikode market, the price of dry coconut opened at Rs. 9500 per quintal and closed at the same price during the month.

Weekly price of Dry Coconut at Kozhikode market (Rs/Quintal)	
01.06.2023	9500
03.06.2023	9500
10.06.2023	9500
17.06.2023	9500
24.06.2023	9500
30.06.2023	9500

Coconut

At Nedumangad market in Kerala, the price of coconut opened at Rs. 14000 per thousand nuts and closed at the same price during the month.

At Pollachi market in Tamilnadu, the price of coconut opened Rs. 21000 per ton and closed at Rs. 19000 per ton with a net loss of Rs.2000 during the month.

At Bangalore market in Karnataka, the price of coconut opened at Rs. 20000 per thousand nuts and the price was almost steady during the month.

At Mangalore market in Karnataka, the price of coconut opened Rs. 25000 per ton and closed at Rs. 22000 per ton with a net loss of Rs.3000 during the month.

Weekly price of coconut at major markets				
	Nedumangad (Rs./1000 coconuts)#	Pollachi (Rs./MT) ##	Bangalore Grade-1 coconut,(Rs./ 1000 coconuts) ##	Mangalore Black coconut (1 tonne) ##
01.06.2023	14000	21000	20000	25000
03.06.2023	14000	20500	20000	25000
10.06.2023	14000	20500	20000	24000
17.06.2023	14000	19500	20000	24000
24.06.2023	14000	19500	20000	24000
30.06.2023	14000	19000	20000	22000

International price

Coconut

The price of coconut quoted at different domestic markets in Philippines, Indonesia, Srilanka and India are given below.

Weekly price of dehusked coconut with water				
Date	Domestic Price (US$/MT)			
	Philippines	Indonesia	Srilanka	India*
03.06.2023	130	140	249	250
10.06.2023	130	141	232	250
17.06.2023	128	141	215	238
24.06.2023	129	140	204	238
				*Pollachi market

Coconut Oil

International price of coconut oil expressed a downward trend during the month. International price and domestic price of coconut oil at different international/ domestic markets are given below.

Weekly price of coconut oil in major coconut oil producing countries					
	International Price(US$/MT)	Domestic Price(US$/MT)			
	Philippines/ Indonesia (CIF Europe)	Philippines	Indonesia	Sri lanka	India*
03.06.2023	1013	1080	NR	2258	1300
10.06.2023	975	1073	NR	2097	1276
17.06.2023	985	NR	NR	2097	1260
24.06.2023	999	NR	NR	1964	1251
					*Kangayam

Copra

The price of copra quoted at different domestic markets in Philippines, Srilanka, Indonesia, and India are given below.

Weekly International price of copra in major copra producing countries				
Date	Domestic Price (US$/MT)			
	Philippines	Indonesia	Srilanka	India* * Kangayam
03.06.2023	617	595	1197	918
10.06.2023	619	600	1182	902
17.06.2023	621	594	1100	890
24.06.2023	624	590	1039	887
				* Kangayam

#(Source: Epaper,Kerala Kaumudi),
##(Source: Star market bulletin)

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July 2023
Vol. LXVI No.01
Price: Rs.6

Registered No.KL/EKM/721/2021-23
Licence No. KL/CR/EKM/WPP-18/2021-23
Licensed to Post Without Prepayment
RNI No. 3032/1957

INDIAN COCONUT JOURNAL
Date of Publication - 24/7/2023

Printed and Published by Mini Mathew on behalf of Coconut Development Board, Printed at M/s KBPS, Kakkanad, Kochi-30
and Published at Coconut Development Board, Govt. of India,
Ministry of Agriculture and Farmer's Welfare, Kera Bhavan, Kochi-11, Editor: Deepthi Nair S