Coconut Enterprises in Lakshadweep

Status, Outlook and Strategic Framework

C. Thamban
P.P. Shameena Beegum
P.N. Ananth
A.C. Mathew
S. Jayasekhar
K.P. Chandran
K.B. Hebbar

भा.कृ.अनु.प. - केंद्रीय रोपण फसल अनुसंधान संस्थान
कासरगोड़, केरल, भारत - 671 124
ICAR - Central Plantation Crops Research Institute
Kasaragod – 671 124, Kerala

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Director, ICAR-Central Plantation Crops Research Institute
Kasaragod - 671 124, Kerala, India
Phone : 04994 - 232893, 232894, 232895 & 232996
Fax : 04994-232322
Email : cpcri@icar.gov.in, director.cpcri@icar.gov.in, directorcpcri@gmail.com
Website : http://www.cpcri.gov.in

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FOREWORD

Coconut farming is intrinsically woven into the socio-cultural fabric of Lakshadweep islands. Copra and coir making were the major economic activities and livelihood options for the island people in the olden days. Though coconut production and copra making continue to be important avenues for income generation, the islanders experience various constraints which adversely affect productivity of coconut. There is a perceptible declining trend in productivity of coconut, though official statistics on coconut production in Lakshadweep islands indicate consistently high yield.

Copra and coconut oil have long been the traditional coconut-based enterprises in Lakshadweep. In recent years, a few new enterprises, supported by minimal mechanization, have emerged across the islands, including the production of virgin coconut oil, coconut halwa, medicated hair oil, coconut vinegar etc. Nature and functioning of the existing coconut based enterprises in Lakshadweep islands also are undergoing changes owing to various socio-economic factors.

There is scope for enhancing coconut productivity on a sustainable basis and also for improving the functioning of coconut based enterprises in the islands through better

integration of technologies for higher income. Any intervention for enhancing income from agriculture sector in the islands has to necessarily focus on coconut based enterprises.

During 2022, as part of the technology transfer initiative of the institute, a team of scientists along with personnel of KVK Lakshadweep conducted interface programmes on coconut cultivation and value addition in different islands involving farmers, entrepreneurs and palm climbers and discussed about the techno-socio-economic interventions for improving coconut sector in the islands. In this background, a research project is being currently implemented by ICAR-CPCRI and KVK Lakshadweep with the financial support from Coconut Development Board to analyse the status of coconut based enterprises in Lakshadweep islands and to evolve strategies for their sustainable development.

Thematic areas covered in this publication are mostly based on the data generated on the coconut based enterprises functioning in the islands under the research project and field level interactions with the stakeholders.

Present status of coconut based enterprises managed by women self help groups on neera, virgin coconut oil, coconut halwa etc in the islands, enterprises on copra and oil expelling units and coconut enterprises under public sector agencies have been comprehensively covered in this publication along with suggestions for enhancing efficiency of the enterprises. Besides, technological interventions to

address the challenges due to the declining productivity of coconut in the islands also have been adequately covered.

I congratulate the authors for compiling the useful information and hope that this publication would be useful to planners and policy makers for formulating and implementing meaningful interventions for strengthening coconut industry in Lakshadweep islands.

Kasaragod
1st January 2025

Dr. K. Balachandra Hebbar
(Director)

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Introduction

Agriculture in Lakshadweep islands is based almost entirely on coconut cultivation. Coconut farming is intrinsically woven into the socio-cultural fabric of these islands. It is believed that the earlier migrants from the erstwhile Malabar region introduced coconut in the islands (Mannadiar, 1977; Rao and Anitha, 1996). There are also reports which suggest that certain coconut cultivars in Lakshadweep might have been originated through natural floating, while others were brought by human settlers from west coast of India (Samsudeen et al. 2006).

As per the official statistics for the year 2017-18, the total area of coconut cultivation in Lakshadweep is 2674.87 ha with an annual production of 876.09 lakh nuts and a productivity of 32,753 nuts per ha. Even though the official statistics indicate consistently high level of coconut productivity in the islands, farmers in general perceive a decline in the productivity of coconut palms since the last few years.

In earlier days, farmers in the islands nurtured coconut palms in their farm land with lot of involvement and attention right from raising seedlings and planting. Initially, manuring of coconut palms was not common but later on progressive ryots started using fertilizers, green leaves and fish manure for their coconut trees (Mannadiar, 1977). However, nowadays farmers in general are not giving much

care to coconut palms mostly due to the socio-economic changes and coconut farming is not their main source of livelihood. The younger generation mostly keeps away from farming and seeks employment in other sectors.

Besides fisheries, copra making and coir twisting were the major economic activities and livelihood options for the island people in the olden days. The islanders used to travel annually to the mainland by sailing boat (locally called *odam),* sold copra to the merchants and bought back their essential requirements for the whole year (Ramunny, 1999).

Farmers make copra by sun drying of coconut though many copra dryers of various capacities and different sources of energy are available at present in the market. Copra making in the islands suffers due to problems such as lack of transport facilities and high transportation charges to send copra to the mainland. Even now the traditional method of copra making and marketing continues to be a major economic activity of the farm sector in the islands, though there is a perceptible decline in the number of farmers who take up the activity. Instead of making copra many farmers have started directly selling fresh mature nuts.

Similarly, coir making has been practiced in the Lakshadweep islands for generations which fostered trade relationships with nearby coastal regions, making coir an integral part of the economy of the islands. During 1970s coir demonstration - cum - training centres were established to train the local women in production of thinner coir yarn which has good market value, not only in the islands but

also on the mainland. Currently the coir production centres experience various difficulties such as lack of availability of sufficient quantity of coir fibre, delays in getting spare parts of machineries etc.

The commercial coconut based enterprises of Lakshadweep islands in the private sector are mainly confined to production and marketing of coconut oil. At present Lakshadweep's coconut oil industry comprises 16 oil expelling units spread across islands. These enterprises face many challenges to sustain their functioning. Lack of transport facilities and high transportation charges to send raw materials and products from island to islands and to mainland is the major problem experienced by these enterprises.

Neera (coconut inflorescence sap) tapping and utilization of the sap for consumption as a health drink and preparation of jaggery (locally called *katti*) and vinegar (locally called *surkka*) is a traditional practice in all the Lakshadweep islands. Opportunities do exist for scaling up neera-based enterprises in Lakshadweep islands, especially in the present day context of very promising growth of the tourism sector. Lack of climbers for tapping coconut palms is a major constraint in neera sector of the islands.

Virgin coconut oil (VCO) prepared through the traditional processing method in Lakshadweep islands is locally known as *Benda ney*. Though VCO is attracting attention worldwide as a value-added coconut product having several medicinal and nutraceutical properties there are not many commercial VCO production units in the

islands employing modern methods and machinery. It is mostly a traditional activity managed by women.

The women folk engaged in VCO making are not really aware or concerned about the economics of the enterprise they manage. Instead, they consider it as an activity to remain socially connected with neighboring women.

Lakshadweep halwa (locally known as *aluva or Dweep unda*) is a traditional food product of Lakshadweep islands prepared by women groups using coconut jaggery and coconut gratings which is in very high demand.

The traditional methods of VCO making and halwa preparation by women involve lot of drudgery. Scope for mechanization of these processes has not been utilized by the women folk in the islands.

Coconut oil, VCO and Desiccated Coconut Powder (DCP) were produced and marketed by Lakshadweep Development Corporation Limited, a public sector undertaking, through coconut processing units located in selected islands. However, due to various constraints these units have been discontinued. There is scope for reviving and improving the functioning of these coconut processing units.

The coir fibre factories, production demonstration centres and fibre curling units established in Lakshadweep islands under the Department of Industries are also facing various problems for functioning effectively.

There is scope for initiating interventions to facilitate establishing enterprises to produce and market other value

added coconut products such as coconut ice cream, coconut chips, etc. The opportunity to market value-added coconut products from the islands as 'Lakshadweep organic' brand has also not been properly utilised.

The consumption pattern of coconuts in the Lakshadweep islands indicates the unutilized potential for value addition through product diversification for higher income. Inadequacy of entrepreneurship among the islanders for exploring the potential for income generation through coconut-based value addition enterprises is quite evident.

It is imperative that systematic studies are conducted to generate information about the status of coconut-based enterprises including traditional and household units functioning in different islands, techno-economic efficiency of these enterprises and constraints experienced by them so that appropriate strategies and interventions can be formulated to enhance the efficiency of coconut based enterprises and thereby enhance income from the agriculture sector.

The perceived declining trend in the productivity of coconut also needs to be analyzed to formulate suitable action plan for sustainable coconut production in Lakshadweep islands.

A preliminary step in this direction has been taken through a research project being currently implemented by ICAR-CPCRI and KVK Lakshadweep with the financial support from Coconut Development Board. Under this

project it was aimed to analyze the status of coconut based enterprises in Lakshadweep islands and to evolve strategies for their sustainable development.

The study covered all the 10 coconut producing islands in Lakshadweep. Individual entrepreneurs and SHGs involved in traditional and modern coconut based enterprises in all islands were covered as respondents of the study besides the extension personnel working in different islands under departments and agencies under UT Administration of Lakshadweep implementing interventions for promoting coconut based enterprises.

This publication is mostly based on the data generated under this research project on the coconut based enterprises functioning in the islands and field level interactions with the stakeholders.

Coconut Enterprises in Lakshadweep: Stakeholders and Product Diversity

The congenial agro-ecology of the islands has contributed for the luxuriant growth of coconut palms in Lakshadweep which supported the livelihoods of people by meeting their diverse needs.

Besides fishing, copra making and coir twisting were the major economic activities and livelihood options for the island people in the olden days. These two products were marketed in the mainland to buy rice and other essential items for their sustenance. Coconut oil for their consumption was prepared using the traditional *chakku*, the indigenous method for oil expelling.

Women folk in the islands were making virgin coconut oil through hot processing adopting the traditional method. Food items including the much sought after *halwa* and many other snacks were prepared using coconut as a main ingredient.

Traditional method of neera tapping by climbers for its use as fresh neera and preparation of neera based products like vinegar and jaggery is another type of coconut based enterprise spread across the islands.

Even after centuries, copra making through traditional sun drying method remains the main coconut based economic activity in the islands. Of late, focus is gradually

being shifted to the approach wherein farmers directly sell fresh mature coconuts to the traders instead of copra. Few entrepreneurs in the islands are involved in the marketing of tender nuts also which is a recent trend.

Though technological options are available for value addition of coconut to realize higher income from coconut farming, the islanders have not yet adequately utilized the opportunities and the coconut sector in Lakshadweep islands continues to be revolving around traditional products and conventional methods of production mostly catering to the local population.

The important coconut based enterprise in Lakshadweep in the private sector utilizing modern technologies is coconut oil expelling which have been established in some of the islands catering mostly to the local needs of coconut oil besides being exported to the mainland. Two small scale virgin coconut oil units employing direct micro expelling (DME) technology also function in the private sector.

Tender coconut marketing is another enterprise managed by private entrepreneurs. Currently there are about 17 entrepreneurs engaged in tendernut marketing spread across six islands. In the public sector, the Lakshadweep Development Corporation Limited (LDCL) has been managing few enterprises in the islands on coconut oil, desiccated coconut powder and virgin coconut oil but due to various reasons these units are not functioning since the year 2021-22.

Department of Industries under the UT administration is managing seven coir fiber factories, six coir production-

cum-demonstration centers and three fiber curling units in different islands. Department of Rural Development promotes women SHGs (Dweepsree) for the production and marketing of food products which have coconut as the main ingredient. There are also a few household enterprises on minor coconut based products mostly managed by women in some of the islands.

Department of Agriculture under the Union Territory of Lakshadweep Administration and Coconut Development Board under the Ministry of Agriculture, Government of India implement few development schemes to support the coconut growers and entrepreneurs of the islands.

Providing financial assistance to promote women SHGs for establishing VCO production units which follow traditional hot processing method, subsidies to farmers to set up copra dryers, initiatives to support jaggery makers in the islands to obtain Geographical Indicators (GI) certification for Lakshadweep jaggery and distribution of good quality coconut seedlings to farmers are the important components of the coconut development programmes being implemented by the Department of Agriculture in Lakshadweep islands.

Department of Agriculture also implements the central sector schemes such as PM Formalisation of Micro Food Processing Enterprises (PMFME), Paramparagat Krishi Vikas Yojana (PKVY) and PM KISAN scheme to benefit farmers.

Dweepsree, a pioneering initiative, was established in the year 2007 by the Department of Women and Child

Development under UT Administration across all 10 islands of Lakshadweep to foster women's entrepreneurship, equipping them with comprehensive training for holistic socio-economic development. This structured programme operates through a tiered framework, comprising an Island Level Federation (ILF) as the apex body, supported by Area Level Federations (ALFs) and Neighbourhood Groups (NHGs) at the grassroots level. This initiative has revolutionized women empowerment in Lakshadweep, transforming the lives of thousands through self-sustaining entrepreneurship and collective action.

The Department of Rural Development provides support and incentives to the women SHGs under the Dweepsree initiative for managing coconut based enterprises on production and marketing of coconut products.

Currently, there are about 46 women SHGs involved in VCO making, 15 women SHGs involved in halwa making and 31 women SHGs making both VCO and halwa across the islands.

Coconut Development Board provide incentives for i) replanting and rejuvenation of coconut gardens ii) laying out of demonstration plots on technologies for integrated farming in coconut holdings iii) organizing extension activities on coconut and iv) implementing 'Kerasuraksha' insurance scheme to benefit coconut palm climbers through the Department of Agriculture in the selected islands.

Earlier, the Department of Cooperation played a key role in the copra procurement and marketing in the islands through a network of 10 primary cooperative supply &

marketing societies. However, due to various reasons copra procurement and marketing activities through the cooperative societies has been discontinued since 2022.

Since its inception, ICAR-Krishi Vigyan Kendra, Lakshadweep has been implementing various capacity development programmes to benefit coconut farmers, Farmer Producer Organisations, entrepreneurs, extension personnel, palm climbers and members of women SHGs in the islands. Recently, KVK also jointly implemented the initiative of the National Cooperative Development Corporation (NCDC) to promote a Farmer Producer Organisation viz., Kavaratti Island Coconut Producers' Co-operative Society.

Research support is essential for strengthening the coconut sector in the islands since it is important to evolve appropriate technologies of production and processing to benefit the farmers and entrepreneurs. ICAR-Central Plantation Crops Research Institute (ICAR-CPCRI) Kasaragod has been providing research and extension support for the benefit of coconut farmers and entrepreneurs of Lakshadweep islands earlier through its regional station functioning in Minicoy island up to the year 2016.

The regional station of CPCRI at Minicoy was handed over to ICAR-Central Island Agricultural Research Institute (ICAR-CIARI) in 2016. Since then, the research and extension interventions of CPCRI for the development of coconut sector of Lakshadweep islands have been implemented in collaboration with various agencies including KVK, CDB and Department of Agriculture.

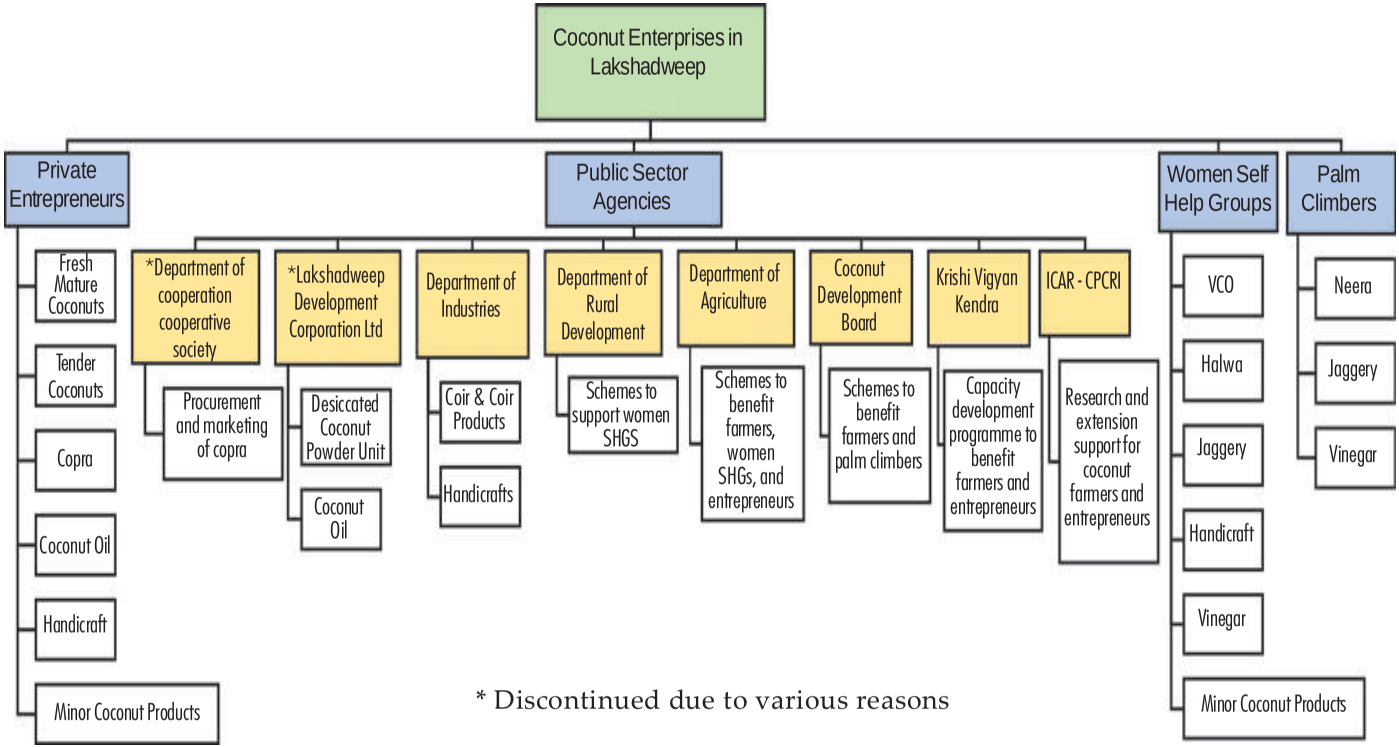

Fig. 1. Coconut based enterprises in Lakshadweep

The coconut based enterprises in Lakshadweep indicating stakeholder categories and product diversity are depicted in Fig.1.

Though different agencies implement various interventions for the development of coconut based enterprises in the islands, lack of coordination among these agencies is a constraint to achieve the desired results. Hence, efforts are required to effectively coordinate the activities of various institutions, groups and individuals to enhance the efficiency of interventions for strengthening the coconut sector in Lakshadweep.

Production and Marketing of Copra

Copra making has been a household activity in Lakshadweep islands since time immemorial and in the past copra was the most important agricultural produce of the islands. The islanders used to travel annually to the mainland by sailing boat (locally called *odam*) to sell copra to the merchants and bring back their essential requirements for the whole year (Ramunny, 1999). Even now the traditional method of copra making and marketing continues to be the major economic activity of the farm sector in the islands, though there is a perceptible decline in the number of farmers who take up the activity.

Copra is made both by farmers and coconut oil industries in the islands. Farmers sell it either to merchants who in turn sell it on mainland or to the coconut oil industries in their respective island or farmers make copra for their own consumption and for selling. They make copra by sun drying of coconut whereas coconut oil industries use both sun drying and copra dryers. Though many copra dryers of various capacities and different sources of energy are available at present in the market, sun drying remains the most economical way of making copra for a farmer in Lakshadweep islands.

Harvesting and storage of nuts

The practice of copra making starts with harvesting of coconut. There used to be a dedicated climber for harvesting

of coconut from all the palms in the land holding of a household. The climber is always well aware of the number of palms in the owner's property, which even the family members may not be aware because some of the palms will be adjacent to the homestead while some palms may be in a distant isolated landholding.

In earlier days, nuts were harvested at intervals of 45 days. However, due to shortage of climbers and high wage rates, harvesting is now carried out once every 60 days or more. Only two harvests are done during the entire rainy season.

Usually palm climbing is done manually which is a very tedious, challenging and physically strenuous job. For facilitating manual climbing of the palm climbers use '*thala*', a simple traditional device made of coir. The *thala* is adjusted in both hands and feet in order to get the required grip for the feet and hands of the climber while climbing up or down. The climber keeps a sharp knife tucked to the hip, secured near his dhoti he wears. Older bunches with fully matured nuts are cut and the whole bunch is slowly allowed to fall to the ground. A skilled climber can climb 20-30 palms in a day and with maximum working hours 3-4 hours.

In the past, after harvesting all the palms, climbers would receive either a portion of the coconuts or a monetary payment in return. However, at present, climbers charge a wage of Rs. 40 per palm for climbing. Of late climbers, who mostly use mechanical climbing device, from mainland are brought to render their service for harvesting coconuts in all the islands.

Coconut Development Board has organized training programmes for youths from the islands on palm climbing using mechanical device under the 'Friends of Coconut Trees (FoCT)' programme. However, it has been observed that only very few of the trained youths remain in the climbing profession.

Coconuts are separated from the bunches by the house owner or family member of the household and nuts are taken to a shed specially made, either with a roof thatched with plated coconut leaves (locally called *kidu*) or with a GI sheet roofing or with a tiled roof for storage for further processing. Harvested coconuts from the land situated away from the household are transported in a power tiller for storing inside the shed. The nuts harvested during the monsoon season, ie. from May to September, are stored in the shed and taken out for copra making during the summer months.

Dehusking

Manual dehusking is followed in Lakshadweep using an iron rod (locally known *paara*). Usually, one rupee is charged for dehusking one coconut. A skilled labour can dehusk 1000-2000 coconuts in 3-4 hours. They start the dehusking work after finishing the morning prayer (locally

called *Fajr*) or after finishing the evening prayer (locally called *Asr*). The dehusked nuts are packed into 50 or 100 kg bags and transported to drying yards for copra production.

Drying

Farmers use either their courtyard or the nearby beach as drying yard. Some farmers also use the terraces of their residence to dry coconut. By December- January, farmers and entrepreneurs prepare temporary drying yards (locally called *koppare beli*) in the open space near the sea shore.

Dried coconut petioles are initially fixed on the four corners of the square shaped yard, followed by covering the sides with plated dried coconut leaves (*kidu*). To reinforce the boundaries, additional petioles are sometimes placed between the sides. Further, nylon nets are used to cover the top and sides to prevent the entry of flies, birds, insects etc.

Dehusked nuts are transported to the drying yard for further processing. The dehusked nuts are cut open using a sharp knife by keeping them on a wooden cutting block, traditionally made using the wood of locally available trees like Thespesia (*sheerani)*, teak wood brought from the mainland etc. Nut water is generally wasted. However, some farmers used to keep flat vessels below the cutting block for collecting the water, which is used as a fresh drink.

The elder person of the house usually does the nut cutting work and the kids and other family members spread the cut opened nuts on the *kidu* (plated coconut leaves). Some farmers engage labourers also for spreading the nuts for drying. The process starts from early morning around 7 am and ends by 10 to 11 am before it gets very hot under the sun.

Based on the capacity of the drying yards, nuts are cut open. On an average, 500-1000 nuts are cut in a day. After 2-3 days (or after two active sunny days, or locally expressed *rand beel*), when the kernel gets loosened from the shell, the shell is removed using a wooden tool. Nowadays, scooping tools made of plastic are commonly used in the islands. The second stage of drying takes around 4-5 days.

Every evening, the nuts kept for drying are covered with tarpaulin sheets to prevent moisture from seeping in during the night and early morning hours. In olden days, plated coconut leaves were specially made to match the size of the drying yard and used to cover the copra during the night time. These coverings were removed by 7 a.m. the next morning. The elders admit that if nuts are not properly taken

care of during the night hours, there is a chance for fungal infection in the nut, resulting in a decline in the quality of the copra.

Farmers assess the proper drying of nuts by test-breaking the dried copra and listening to the sound while breaking it by hand. The good quality whole copra is graded and put in gunny bags, sewn using a needle and plastic rope. It is then weighed and transported to the mainland, to either Mangalore or Calicut port, through the motor sailing vessels (MSV) locally called *manchu*. The leftover copra pieces and chips are pressed to extract oil, which is then used for household purposes.

During the long-term storage in the shed, many nuts get germinated due to the high moisture during the rainy season, which affects the copra quality. Also, the low night temperatures and early morning mist during December and January adversely affect the quality of the cut-open nuts if not properly managed. The rich tradition of copra making in the islands is on the decline. The rich tradition of copra making in the islands is on the decline. Many farmers now prefer selling coconuts as fresh mature nuts instead of following the traditional copra-making process, which they find labor-intensive. Among the current generation, those

who still engage in copra production often do not follow proper processing practices. They leave the cut-opened nuts directly on the white sand, allowing dust to settle and compromising the quality of the copra.

Storage

Copra is usually sold either to the local trader or coconut oil expelling units in their respective islands or to wholesalers in the mainland. Farmers used to store the dried copra in gunny bags till transportation facilities to the mainland were ready or until it was sold to the cooperative society or local trader on the island. Copra is stored without touching the floor, at an elevated place.

Coconut dryers

Copra dryers are used mainly by coconut oil mills and a few entrepreneurs making copra and selling the same in the mainland. Majority of coconut oil mills in the Lakshadweep islands possess one or two copra dryers. All these copra dryers are indirect-type dryers, forced circulation-type dryers, where only hot air comes in contact with the copra, thereby making it good-quality copra. Forced circulation of hot air makes uniform drying possible in this dryer. Coconut shell, a byproduct of the unit, is generally used as fuel. Few of the units use firewood also as fuel. These indirect copra dryers make it possible to produce good-quality, uniformly dried copra. The common capacity of such a typical dryer is 2000-3000 coconuts per batch. It takes two days to dry one batch of copra, right from breaking the coconut to drying.

Quality analysis

As per International Coconut Community (ICC) standards, copra (the dried kernel of coconut) is prepared by sun drying, direct drying (smoking), kiln drying, or other drying methods and is classified into 3 grades, viz., grade A (superior-edible copra), grade B (good quality-export), and grade C (fair quality).

In India, AGMARK standards govern the domestic marketing of copra, differentiating between cup copra for edible use and cup copra for oil milling.

The standards specify three grades (Grade I, II, and III), based on physical and biochemical quality parameters. As per the standard, the copra shall be well dried, reasonably firm and in sound merchantable condition. It may be fumigated by sulphur or other fumigants permissible under P.F.A. Rules, 1955 and shall be free from rancid taste and objectionable odour. The testa shall be whitish to dark brown in colour, and the meat shall be pearly white to ash white in colour.

As part of a recent study on coconut enterprises in the Lakshadweep islands, copra samples were collected from selected islands and analysed at CPCRI, Kasaragod.

The results indicated that with regard to the physical quality of the copra, the samples were clean, pearly white, with less than 0.5% foreign matter (sand, dust, straw, and shell) and were free from any mouldy/black and wrinkled kernels. Moisture content was within the prescribed standard, ie. 6% for all three grades.

Earlier studies had reported that Laccadive micro tall, a coconut cultivar from Lakshadweep, had an oil percentage as high as 75% (Krishnakumar et al., 2014). However, the analysis of copra samples collected from different islands showed oil content of upto 69%. This may be due to the fact that a very limited number of nuts of the Laccadive micro tall cultivar are used for copra making since only a very limited number of palms of the cultivar is available in the islands, which is quite meagre to give a high oil output from the copra used for oil milling.

According to AGMARK standards, deoiled coconut cake should be in the form of flakes or powder and must be free of harmful substances. It should not exhibit rancidity, contain adulterants, have insect infestation, have visible fungal growth, or have any musty odor. The product should also be clean, without dirt, foreign materials, or metallic particles (IS: 3591-1985).

Physical examination of the deoiled cake samples collected from various islands revealed that all were in powdered form, free from rancid smell, visible fungal growth and musty odour.

The moisture and crude protein content were within the specified limits, less than 10% and 18-22% respectively, making these deoiled cakes suitable for use as cattle feed.

Marketing of copra in Lakshadweep islands

Currently the important marketing channels of copra in Lakshadweep Islands are as follows.

- Farmers sell copra directly to the trader in the mainland
- Farmers sell copra to the local traders and local traders in turn sell it to the trader in the mainland
- Farmers sell copra directly to the oil expelling units in the island
- Farmers sell copra directly to the oil expelling units in the mainland
- Farmers sell copra to the local traders and local traders in turn sell the copra to the oil expelling units
- Farmers sell the nuts to the oil expelling units and the oil units prepare copra and sell the surplus quantity of copra (after meeting the requirement for oil expelling) to traders in the mainland

Previously, co-operative societies in the islands were playing a major role in the copra marketing sector. These societies used to regularly procure copra from farmers and market in the mainland. However, since the last two years the societies have discontinued the procurement of copra from farmers due to various reasons. At present coconut oil expelling units and local traders are the important stakeholders in the copra marketing sector of islands.

The island-wise details of copra marketing in Lakshadweep handled by traders are furnished in table 1.

Table 1. Marketing of copra in Lakshadweep islands handled by local traders

S.No.	Island	Number of traders	Average quantity of copra sold to mainland per year (t)	Average quantity of copra sold to oil expelling units per year (t)
1.	Agatti	3	85	10
2.	Amini	13	314	7
3.	Androtт	8	155	31
4.	Chetlat	6	38	-
5.	Kadmat	6	178	17
6.	Kalpeni	7	44	16
7.	Kavaratti	5	52	25
8.	Kiltan	5	16	18
9.	Minicoy	1	-	2
10.	Bitra	3	3	-
	Total	**54**	**885**	**126**

There are about 54 local traders who are engaged in copra marketing business across the 10 islands. Local traders in the islands purchase copra from farmers and sell it to the wholesalers in the mainland or to the coconut oil expelling units in the islands. The total quantity of copra thus traded by 54 local traders in a year is about 1011 tonnes; 885 tonnes sold to the mainland and 126 tonnes sold to the oil expelling units as shown above. Among the islands, the quantity of copra sold to the mainland is highest in Amini followed by Kadmat. Similarly, the quantity of copra sold to oil expelling units is highest in Androth where the four oil expelling units are functioning followed by Kavaratti and Kiltan.

Apart from the volume of copra trade handled by the traders in the islands as discussed above, a substantial quantity of copra is directly marketed by the farmers to different players including oil expelling units in the islands, wholesale copra dealers in the mainland and coconut oil industries in the main land.

Copra price in Lakshadweep islands mainly depends on the rate prevailing in Kozhikode and Mangalore markets in the mainland. The price offered by the oil expelling unit to the farmers is generally Rs. 200-300 lesser than the market price for per quintal of copra. If a farmer is selling copra directly to the trader in the mainland, on an average Rs. 500 per quintal is reduced from the payment he receives for the copra on account of the transportation charges and incidental expenses.

A farmer selling copra to the local trader of the island usually gets the payment after the trader sells the copra in

the mainland and on an average, Rs. 200-300 will be reduced per quintal of copra on account of the transportation charges and incidental expenses. However, some traders make the payment immediately after the purchase.

Of late, the pattern of copra marketing in which the local trader who operates in partnership with a copra trader in the mainland procures copra from the farmers and offer on the spot payment at the prevailing market rate also is very prominent.

Experiences of three farmers in copra making and marketing are furnished below.

❖ Mr. Latheef Haji is an experienced farmer from Kadmat Island who produces copra. All his coconuts are converted to copra by sun drying. Copra making is done only during summer months from December to May for six months. Coconuts harvested during rainy season is stored in a shed and used to make copra during next summer. Many coconuts get germinated by that time resulting in less copra weight. His drying yard is his own courtyard. It takes 8 to 10 days to get properly dried copra. Dried copra is stored in gunny bags and stored without touching the

floor, at an elevated place. Copra is sold either to the coconut oil industry in dweep or to traders in the mainland. Earlier he used to sell coconut shells in mainland. However, there are no buyers for the shells at present, according to him. Monthly production of copra is 120 kg and present copra price is Rs. 95/- per kg. He processes 200 to 250 coconuts per batch for drying. According to him, inadequate transportation facilities and uncertainty in copra procurement are the major problems in copra production and marketing.

❖ Mr. Kunhikoya, Puthiya Illam, 69 years old, is a popular copra trader of Kadmat island. He is in the copra business for the last 15 years. He regularly procures copra and occasionally coconuts also from farmers. He regularly keeps in touch with the coconut growers of the island from whom he purchases copra and coconuts. He has maintained a register with the list of more than 200 farmers who sell their copra to him.

Besides the cost of nuts paid to the farmer, transportation charges for the vehicle to the jetty and from there to the mainland port through *manchu* are the other basic items

of expenditure incurred in the copra trade. In one batch containing 746 bag of copra (weighing 22,528 kg) procured from 95 farmers he incurred an expenditure of Rs.2100 (Rs.300 per trip) transportation charge of hired vehicle to the jetty and a loading charge of Rs. 14,920/- (Rs.20 per bag).

He usually makes immediate payment for copra purchased from the farmers without any delay. The expenditure incurred for transporting copra through *manchu* is met by his trade partners in the mainland who in turn sell copra thus received from the islands to the coconut oil industries in the mainland, located in Karnataka and Tamil Nadu. Mr. Kunhikoya is of the opinion that copra business in general is profitable in the present day context but at times loss also can occur due to price fluctuation of copra.

❖ Mr. Musthafa, a 62 year old is a copra trader from Amini Island. He started helping his father when he was just 16 years old, marking the beginning of his entrepreneurial career in copra trading. He continues his family legacy in this business after his father's demise. He has only primary level of education. Three to four years ago, he leased 250 coconut palms, taking on the responsibilities of copra processing and climbing himself.

Occasionally, he hires a climber for Rs. 50 per palm and compensates the palm owner with one bunch of coconuts. In recent years, however, coconut availability has declined, prompting him to primarily process copra from his own palms. He continues the traditional method of sun drying

copra in his three yards located on the sea shore. He sells approximately 9,600 kg of copra annually to local traders, helping mitigate transportation challenges. Two years ago, he sold copra directly to the mainland through *Manchu*.

Musthafa explained that individual trading posed significant challenges that were difficult to manage, prompting him to shift his marketing strategy to working with commission agents. The primary issue was the decline in both the quality and quantity of coconuts after the Ockhi cyclone, with yields dropping by half.

Additionally, inadequate transportation facilities and high transportation costs further complicated the marketing

process. Even when the copra was ready, proper transportation options were often unavailable. By partnering with commission agents, Musthafa found the process more manageable. The agents provide an advance of Rs. 8,000 per quintal when the copra is ready, eliminating the transportation risks. Prior to adopting this strategy, Musthafa faced substantial losses due to delays in transportation, which led to a deterioration in copra quality.

Constraints and opportunities in copra making and marketing

- Coconut farmers and entrepreneurs perceive that the production and marketing of copra in the islands is on the decline since the last many years. A major factor contributing to the decline is lack of interest among the farmers in copra making and the emerging pattern of selling fresh mature nuts instead of copra since the utilization and demand for fresh coconut is increasing. They also perceive a general decline in coconut productivity in the islands which directly influence the quantity of copra produced and marketed.
- Limited availability and high cost of transportation when available, is the major problem experienced by the farmers, copra traders and coconut oil expelling units. This restricted their market to the respective island itself instead of selling their product in mainland or in other island markets at a more competitive price.
- Sun drying is the most common method adopted for copra making in the islands. Copra making by this method is feasible only during summer months ie for

six months from December to May. Coconuts harvested during rainy season are stored usually in sheds or sometimes just heaped in the farm itself and used for making copra during next summer. Many coconuts get germinated by that time resulting in less copra weight. The germinated coconuts also are used to extract oil. Oil mills pay the farmers low price for this second quality copra.

- Quality of copra is adversely affected due to improper storage of copra from the time it is prepared up to the time when facility is available for its transportation to mainland through MSVs. This delay in transportation of copra happens many times in a year. Similarly non uniform drying of copra by farmers who do not give adequate care to follow proper method for sun drying of copra also results in poor quality copra. In these circumstances many farmers are finding it difficult to meet the stipulated quality standards of copra and thus realizing lower price for the copra they sell. Usually oil expelling units dry the copra procured from farmers which do not conform to the minimum prescribed quality standards, especially moisture content, in their dryer once again before oil extraction.

Interventions

- Timely availability of transportation facility at a competitive cost needs to be assured to entrepreneurs to transport copra between islands and between island and main land. Hence, a system needs to be put in place to

give priority for the coconut farmers and entrepreneurs from the islands for transporting copra between islands and to the mainland especially by utilizing the return trips of barges or MSVs.

- Capacity development programmes can be organized by Krishi Vigyan Kendra for creating awareness and imparting required skill to farmers and entrepreneurs on methods for production of copra having prescribed quality standards.
- Establishing a centralized facility in private or public sector or under FPO which can be provided on hire basis to farmers for dehusking and drying coconut would be a major intervention to produce quality copra at a competitive price in the islands. The machineries required are a mechanical dehusker, electrically operated, of required capacity according to the coconut availability in the respective island and an indirect type copra dryer which would make copra making feasible throughout the year and would help in producing quality copra by assuring uniform drying. Loss of coconuts by germination during rainy season also could be reduced.

Coconut Oil Enterprises

The commercial coconut based enterprises of Lakshadweep islands in the private sector are mainly confined to production and marketing of coconut oil. currently Lakshadweep's coconut oil industry comprises 16 oil expelling units spread across eight islands, as presented in table 2.

Additionally, a few shops across the islands operate small expellers alongside flour pulverizers. People bring sundried copra to these units to extract oil for household use. Currently, there are around nine such facilities operating across the island. Some of the units bottle the oil made from the procured copra in their brands. One such example is "Island Life Organic Coconut Oil" sold by Mr. Sabith of Kadmat island, who process nearly one quintal copra (approximately 65-70 litres) per month and sells around 780-840 litres annually. Similar style of processing is carried out in the, "AL. Ref Ref" flour mill of Kilthan Island.

M/s. Bismi Enterprises, owned by Mr. Mohammed Jaludheen B.T, M/s. Rashidha Furniture Mill, owned by Mrs. Pathumma C.P. and M/s. Roshni Flour and Oil Mill, owned by Mrs. Haleema N are the sole sources of coconut oil for the residents of Chetlat. These oil mills do not possess a copra dryer. Their packaging also is simple, manual. They generally do not have a brand. Mostly the owner himself operates the mill.

Table 2. Coconut oil enterprises in Lakshadweep islands

Island	Name of units	Average annual production (Litres)
Agatti	1.Bismillah Al Ameen coconut processing unit	18000
Amini	2.Meeran oil mill	9200
	3. Island oils and foods (Cocodweep)	16000
Andrott	4. Al-ameen oil and flour mill	9600
	5. Dweep Fibres and Traders (Island Tasty coconut oil)	24000
	6. Lakshadweep Coconut Industries (Cocolaksh)	56000
	7. Thirteen Coconut Oil Mill	32000
Kadmat	8. Al-Raseena coconut oil & flour mill	18000
	9. Darul arham production unit	8000
Kalpeni	10. Beebi enterprises (Cobio), Virgin Coconut Oil production unit	24000
	11. AKS coconut oil mill	18000
Kavaratti	12. Al ameen coconut oil mill	31200
	13. Coconut Processing Unit (Cocolak)	68000
Kiltan	14. Pearl oil mill	29000
	15. Lakshadweep organic coconut oil processing unit (Orgolak)	24000
Minicoy	16. Bismillah oil mill	4800
	Total	**389800**

Besides coconut oil, two of the 16 units of coconut oil expelling units are producing virgin coconut oil also, and one enterprise produces hair oil, vinegar and jaggery on a


orgolak
COCONUT OIL


Al-Ameen
COCONUT OIL


Cocolak
Coconut Oil

very small scale basis.The categorization of processing units, including those for coconut oil, under the Micro, Small, and Medium Enterprises (MSME) sector is based on investment and turnover (https://msme.gov.in/know-about-msme). For instance, a Micro Enterprise is defined as having an investment in plant and machinery or equipment of up to Rupees one crore and an annual turnover of up to Rupees five crore. Thus, as per MSME classification all the coconut oil enterprises functioning in Lakshadweep islands are micro enterprises.

Large scale units are not feasible and are not present in any of the islands. These micro enterprises procure copra from farmers and extract oil and sell it to nearby shops and individuals. They also extract oil for farmers by charging them. They invariably have copra dryers and make copra themselves using the dryer and also by sun drying, when possible. Copra procured from farmers also would be dried again by the oil units before expelling oil. This is because many times copra brought by farmers is either not properly dried or non uniformly dried. These units in general provide labour for 8-10 people.

Capital investment made for establishing these enterprise units ranged from eight lakh rupees to 50 lakh rupees

depending on the production capacity, infrastructure, machinery/equipment used and the level of automation. The major sources of capital for starting these enterprise units include own funds, loan from banks, credit/incentives from agencies such as Khadi Board, MSME etc. Out of 16 units, five units availed credit from banks; four units ventured into the business using personal savings; one unit availed credit from Khadi board and one unit availed credit from MSME.

Table 3. Capital investment of different enterprises

Capital investment made	No. of enterprises	Percentage
Below 10 lakhs	2	17
10-15 lakhs	4	33
Above 15 lakhs	6	50

Scale of operation and marketing

The scale of production of coconut oil enterprises ranged from 800 litres/month to 5000 litres/month. The scale of production in these units is mostly decided by the input resources available, market demand and production capacity.

Table 4. Scales of coconut oil production from different units

Scale of production per month	No. of enterprises	Percentage
Below 1000 litres	1	6
1000-3000 litres	12	75
Above 3000 litres	3	19


Cocolaksh
Organic
Coconut Oil
From Lakshadweep


COCO DWEEP
COCONUT OIL


Pearl
Coconut Oil


Coconut Oil
From Lakshadweep
Nis
Coco
drops

Together, these units produce 3.9 lakh litres per year on average. Androtт island dominates the coconut oil production scenario in Lakshadweep with four oil mills and 1.2 lakh litres of production, followed by Kavaratti with two mills and nearly one lakh litres of coconut oil production per annum. Agatti, Amini, Kadmat, Kalpeni, and Kiltan also contribute significantly. Chetlat and Bitra have no operational oil mills.

The major oil producing units are Coconut Processing Unit (68000 L) in Kavaratti (sold under the brand name Cocolakh), Lakhadweep Coconut Industries (Cocolaksh with 56000 L) and Island Tasty (24000 L) in Androtт. Average monthly coconut oil production among the units varies significantly, ranging from 5600 liters per month production of the Coconut Processing Unit in Kavaratti to a mere 400 liters per month production at Bismillah Oil Mill in Minicoy.

The coconut oil production units in the islands exhibit a distinct seasonal pattern for the oil production. The production is high during the period from June to August because there is more quantity of copra available for processing due to the stored copra from the preceding copra season. Though there is high demand for coconut oil during October-January the units are unable to meet the high demand due to limited raw material availability and increased coconut prices during the period.

During February-April months, oil production declines as households prioritize homemade copra for personal use. During this season some of the units make efforts to market the coconut oil to other islands after meeting the requirement of the island utilizing favorable inter-island transportation facility. Few coconut oil units procure and store sundried copra during the monsoon season, further dry the same and transport copra to Kozhikode market during February-April season. One of the units ships low-grade copra to Kozhikode market during this period.

Oil mills in Androtт focus on oil production by purchasing copra from traders during the main copra production season and process it during the off-season. In Agatti, the coconut oil unit is constrained to limit the oil production to 1500 litres/month due to local market constraints.

Oil mills in Amini, Kadmat and Kalpeni islands are forced to limit the production in the main season due to raw material scarcity. The monthly average production of coconut oil in Minicoy island is extremely low due to limited

coconut production.Hence, coconut oil is imported to Minicoy from main land.

Before making an investment in the coconut oil industry in Lakshadweep, awareness, understanding and analysis about the broader market trends, consumer behavior, export potential, constraints etc. are very important for the entrepreneurs. This kind of analysis and awareness is very important before they make a decision to invest on the enterprise.

Out of 16 enterprises, 10 entrepreneurs had made some efforts on this line.They visited oil mills in other islands and also collected information from different sources including social media to understand the specific challenges such as transportation logistics and also about other location specific issues to be tackled for effectively managing the coconut oil enterprises. The remaining six units have not conducted any such market studies before they ventured into starting the oil expelling units.

Processing operations

The processing operations of all coconut oil enterprise units are mechanized though not fully automated. All the enterprises were having basic equipments/machineries such as copra dryers, cutting machines, oil pressing machines, oil filtering machines, bottling unit and storage tank. The capacity of machineries in these oil processing units varies depending on the scale of production and the type of processing.

Labour requirement of coconut oil processing unit depends on the scale of production and degree of automation. In five units entrepreneurs along with their family members fulfill the labour requirement for coconut oil processing in place of hired labourers. Utilization of own/ family labour offer many advantages such as cost-saving, flexibility and efficient management.

Remaining enterprise units have permanent labourers and contractual workers for the processing work. Two enterprise units hires extra workers during peak season to ensure smooth operation of the unit. Operational/working costs incurred per day for the enterprise units ranges from Rs. 4500/day to Rs. 33200/day.

Equipments/machinery

The medium scale coconut oil units of Lakshadweep islands have all the major machineries required for medium capacity coconut oil production as follows.

a) Copra dryer

The units have usually two copra dryers, each one with a capacity in general of 2000 coconuts per batch. However, since the size of coconut is low, the dryer could accommodate 3000 to 3500 coconuts per batch. The dryers are indirect dryers in which only hot air comes in to contact with copra. Coconut shell is the main fuel used in the dryer. Firewood also is used, if available, by some units.

Coconut shell is burnt in the furnace of the dryer. A thick mild steel plate kept above the furnace gets heated up due to the heat generated in the furnace by burning the fuel.

Air above the hot plate gets heated up and is forced to pass through the copra placed inside the drying chamber above the furnace. Forced circulation of hot air assure uniform drying. Forced circulation of hot air is made possible using an electric blower.

b) Drying process

Coconut is cut open manually and is kept inside the drying chamber after draining the water inside. Coconut is dumped in the drying chamber irregularly and the top one layer is kept concave surface facing down. It takes two days to dry one batch. Firing is done for eight hours in the first day. After first day coconut shell is removed manually using a wooden blunt knife. De-shelled copra is dried for another eight hours the next day. Stage of drying is determined by feeling it, pressing copra with hand. No instrument is used for this purpose. After drying copra is stored in bags till oil expelling.

c) Oil expelling

Copra is cut in to small pieces using a copra cutter run by an electrical motor. Feeding is done manually. Copra after cutting is manually fed to the oil expeller. Majority of the firms have two oil expellers of 6 to 14 bolts. However, only one is usually used to expel oil. Expeller is run twice to expel maximum oil. It takes two hours to complete one run of oil expelling per batch of 3000 coconuts. The residue is reprocessed for a second time to complete the expelling process, which takes about two hours, making the total oil extraction time for 3000 coconuts four hours.

Coconut oil thus expelled is kept in a tank for two days to settle residue before mechanical filtering. Oil after settling is filtered using a screen filter. Few units have two such filters. The filters are having 6 to 14 filter screens.

Filtered oil is stored in SS tanks or HDPE tanks before filling in bottles for selling.

d) Packaging

Packaging is done in pouches or PET bottles of one litre and half litre. Oil is filled in the bottle manually by many units. However, some units have installed semi automatic oil filling machine.

e) Building

The units have fairly good building to accommodate all the machineries with electricity and water connection and are well connected with road. Many have fairly good storage space to store 5000 coconuts and 3000 kg copra at a time.

Technical efficiency of coconut oil expelling units

The coconut oil production units have fairly good infrastructure, building and machineries. However, creating a better hygienic condition is required to explore markets outside island. Though fairly good machineries are available manual labour is involved in all the unit operations. This could be improved by conveying raw material using mechanical conveyors and conduit pipes between unit operations especially after copra cutting without much capital. This in turn creates a better hygienic environment also.

Further, machineries for all unit operations right from copra dryer to filling units are not installed in an order in many units. This would make more human movements to transport the raw material from one unit operation to another.

The units can have a screw conveyor to take copra pieces from copra cutter and feed the same to the oil expeller. From the expeller oil is taken to the settling tank kept at an elevated platform. Oil after settling is taken to the inlet of a positive displacement pump by gravity and is taken to the screen filter at high pressure where the oil gets filtered and comes out. The filtered oil is then pumped to another storage tank, again kept at a higher elevation. Oil is then taken to the packaging unit by gravity through conduit pipes where it gets packed.

Coconut and copra procured from farmers needs to be stored in the storage place where small trucks can approach. Coconut cutting and drying is done manually. Copra after drying could be fed to the copra cutter manually or using a conveyor belt. The copra pieces could be conveyed to the expeller using a screw conveyor. Expelled oil is conveyed to a settling tank through conduit pipes. Oil after settling is conveyed and fed to filter using a positive displacement pump high pressure for effective filtering. The filtered oil is conveyed to the storage tank through conduit pipes and then to the packaging unit again through conduit pipes. In effect coconut oil is conveyed from one machine to another for each unit operations till packaging without any human contact. This would make the coconut oil hygienic.

A team of scientists from ICAR-CPCRI Kasaragod visited selected coconut oil units in Lakshadweep on consultancy basis and also as part of technology transfer initiatives of the institute and conducted the techno-socio-economic analysis of the enterprises. Based on the analysis, suggestions have been made for implementing interventions to enhance the efficiency of coconut oil enterprises.

❖ LDCL Coconut Oil Unit, Amini

Besides the major activity of shipping related enterprises, Lakshadweep Development Corporation (LDCL), a government agency, since its inception in 1987 has been managing enterprises on production and marketing of value added coconut products such as desiccated coconut powder and coconut oil.

The production units under LDCL are located at Amini, Kadmat, Androth, and Kalpeni. The oil expelling unit in Amini started functioning in 2011 with a capacity of 1000 kg of copra (650 litres of coconut oil) per day. Due to various reasons the unit discontinued functioning in October, 2021.

Subsequently LDCL requested ICAR- Central Plantation Crops Research Institute (CPCRI), Kasaragod to depute a team of scientists to visit Amini to render the necessary advice and support to revive the unit to a 'State of the Art Coconut Oil Unit'.

Accordingly, a team of scientists as indicated above from CPCRI Kasaragod, visited the coconut oil unit at Amini on 8th February, 2022. Based on the observations, the following suggestions were made by the team.

Observations and suggestions

The team could observe many types of machinery in the discontinued coconut oil unit in Amini island which can be utilized while the initiative to revive the unit is taken up. A list of machineries that could be utilized and those needs to be replaced with new ones in the coconut oil unit is given below,

Table 5. List of machineries to be utilized/ replaced

S. N	Machinery	New/ Existing	Remarks
1	Copra dryer	New	Existing copra dryer is nearly 10 years old and almost corroded with very low fuel efficiency. An indirect type dryer with two drying chambers and better fuel efficiency could make copra drying technically feasible and economically viable.

2	Copra cutter	New	The existing copra cutter make copra pieces of large size which would reduce the efficiency of oil expelling unit.
3	Coconut oil expeller	New	The present oil expeller is pretty old and its oil extraction efficiency is low
4	Coconut oil filter-24 screen	New	Existing oil filters could not filter out all the solid particles in coconut oil coming out from the expeller.
5	Coconut oil filter-12 screen	Existing. 2011	Two coconut oil filters, 12 screens, available at present could not filter out all solid particles in coconut oil coming out of the expeller. However, these filters would be utilized for primary filtering and as a standby arrangement.
6	Storage tanks	Existing 2011	Three storage tanks, SS, to store coconut oil are available. Six more will be brought from Androth and Kalpeni Islands and will be utilized.
7	Packaging machine	New	No packaging machine is available. This would facilitate hands free packaging to maintain hygiene.
8	Electric motors	Existing 2011	Two 20HP electric motors are available and would be utilized as standby.
9	Oil pump	New	To pump filtered coconut oil to the storage tanks kept on the first floor.

The layout of the machinery, including both existing and new, suggested to be installed in the ground floor and first floor for revival of the coconut oil unit is given in Fig.2 and Fig.3 respectively.

Apart from the machineries, a storage space with GI roofing and concrete flooring to store raw material (coconuts) and space for wet processing and to install copra dryer also needs to be provided outside the building.

Wet processing needs to be made outside the building to keep the hygienic condition in the oil production unit. The dryer also needs to be installed in an open space with roofing for safety to avoid fire hazards. Moreover, premises of the dryer would be very hot and this would make the working condition intolerable for workers if kept inside the building. An inlet needs to be provided near to the copra dryer for easy movement of copra made to copra cutter.

All unit operations involved in coconut oil production *viz.* copra cutting, oil extraction and filtering can be done in the ground floor. The oil thus produced can be pumped to the first floor where it is stored in six SS containers before packaging. Packed coconut oil and copra procured from farmers for future use i.e. to be used during rainy season, can be stored in the first floor.

A simple lifting mechanism to transport copra from ground floor to first floor may also be provided to reduce labour cost. In addition, the open terrace of the building can be utilized for copra making using solar energy. It is also necessary to ensure good quality copra through proper drying methods conforming to the quality standards.

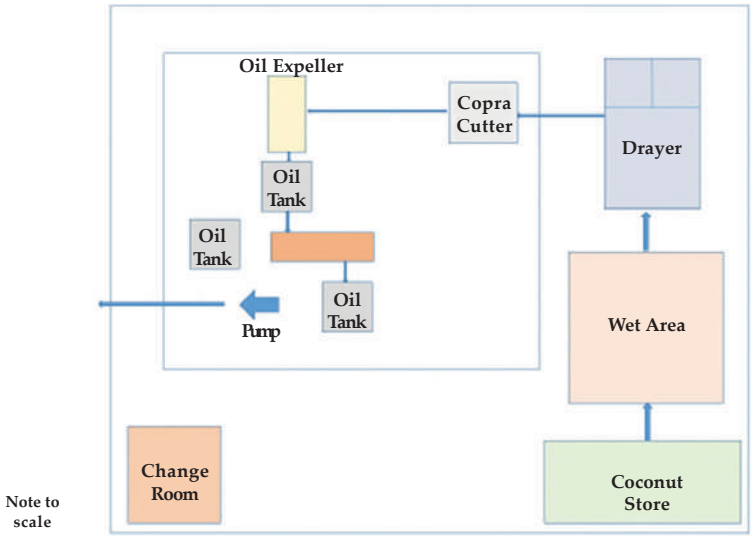

Fig. 2. Layout of machineries to be installed in ground floor

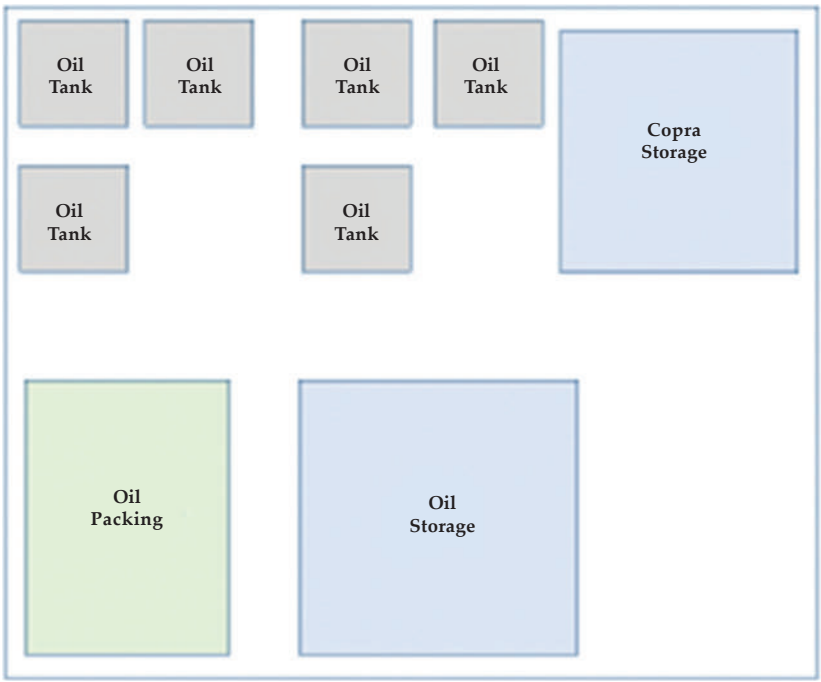

Fig.3. Layout of machineries to be installed in first floor

Table 6. Approximate estimate for reviving coconut oil unit at Amini, Lakshadweep (Capacity-2500 coconuts/ batch)

SN	Machinery	Capacity	Specifications	Approx. cost
I. Procuring and installation of new machineries				
1	Copra dyer	2500 coconuts/ batch	Indirect typeForced circulationFuel-Coconut shell/ fire woodCapacity-2500coconuts/ batch (minimum) Drying chambers-Two.Capacity of each chamber-2500coconuts.Blower-51cm Drying chamber-244cm x 244cmMotor – 3 HP	5,00,000
2	Copra cutter	1000 kg copra	per 4 hours Electric motor capacity-7HP3phase	3,00,000
3	Coconut oil	expeller-9bolt	200 kg copra per hours 9 bolt, 30 HP motor-3phase, chamber size 85cm, with power consumption mechanism and connected materials.	7,00,000
4	Coconut oil filter-24 screen	2300 litres per set of filter cloth	24 plate	2,00,000

5	Oil Pump and accessories	½ HP	½ HP Mono block pump with accessories	5000
6	Packaging machine	20 to 25 pouch	per minutes Mechanical type, capacity 500-1000ml, Production 20 to 25 pouch per minutes with photo sensor, batch coding with all accessories	6,00,000
II.	**Utilizing existing machineries**			
1	Cost involved in the repair and maintenance of existing machineries to be utilized and its installation			4,00,000
			Total (*excluding GST*)*	27,05,000

* The estimate does not include the proposed additional space, with GI roofing and concrete flooring to store raw material, coconuts, and space for wet processing and to install copra dryer and a dress changing room.

The coconut oil unit at Amini can be revived by utilizing the existing facilities including machinery, installing new machineries and restructuring the space available in the building (Table 6). Opportunities to market coconut oil as "Lakshadweep organic" need to be explored so that premium price can be obtained in domestic market and by exporting. Furthermore, efforts should be made for Geographical Indication (GI) tagging for all coconut products from Lakshadweep highlighting its natural farming history. Similar units for the production of high value coconut products such as virgin coconut oil, coconut

chips, coconut sugar etc. can be started in different islands (one island one product) which can act as Agri-Business Incubation Centers to support start-up units and prospective entrepreneurs from the islands.

The same team also visited selected coconut oil units managed by entrepreneurs in private sector also and made recommendations for enhancing the efficiency of functioning of the units. Details with respect to two such units are furnished below.

❖ Coconut Processing Unit, Kavaratti

Coconut Processing Unit in Kavaratti island was started through partnership of five members (Sayed Hamid Cheriyakoya T., Shihab B. K., Abdul Riyas, Musnad P. K. and Jahangeersha T. I) in the year 2015 with the main focus on production and marketing of coconut oil. Later in 2022, these entrepreneurs took initiative with the support of Krishi Vigyan Kendra, Kavaratti to form a Farmer Producer Organization (FPO) 'Kavaratti Island Coconut Farmers Producer Co-operative Society' and enrolled 300 members. National Cooperative Development Corporation (NCDC) provided financial assistance and incentives for the activities of the FPO thus formed.

The entrepreneurs never had any formal training on coconut oil production. The unit produces approximately 5000-7000 litres of coconut oil. Eight people work 8-10 hours daily in the unit. Apart from Kavaratti it also markets its product in Agatti and Minicoy also. The unit received 25% subsidy for establishing the same. Coconut is procured from farmers as per the market rate. This is then dried using the copra dryer of the firm. Apart from coconut copra also is procured directly from farmers. Farmers dry coconut using sunlight. However, many a times improper drying of sun dried copra brought by farmers was a limitation of direct procurement of copra. It needed further drying in the copra dryer by the unit.

Technical details

The unit has all the major machineries required for such a medium capacity coconut oil industry. Coconut procured from farmers are stored in shed and dried in the dryer.

Copra dryer

The unit has two copra dryers, each one with a capacity of 2000 coconuts per batch. However, since the size of coconut is low the dryer could accommodate 3000 to 3500 coconuts per batch. Both dryers are indirect dryers, only hot air comes in to contact with copra. Coconut shell is the main source of energy. Firewood also is used, if available.

Coconut shell is burnt in the furnace of the dryer. A thick mild steel plate placed above the furnace is heated by the heat produced from burning fuel in the furnace. Air above the hot plate gets heated up and is forced to pass through the copra placed inside the drying chamber above the furnace. Forced circulation of hot air assure uniform drying. Forced circulation of hot air is made possible using an electric blower.

Drying process

The coconut is manually cut open, drained of its water, and placed inside the drying chamber. The cut-open nuts are irregularly placed in the drying chamber, with the top layer positioned concave side down. A single batch takes two days to dry, with firing done for eight hours on the first day. On the second day, the coconut shells are manually removed using a wooden or PVC blunt knife, and the de-shelled copra is dried for another eight hours. The drying

stage is assessed manually by feeling and pressing the copra without the use of instruments. No instrument is used for this purpose. After drying copra is stored in bags till oil expelling.

Oil expelling

Copra is cut into small pieces using a copra cutter run by an electrical motor. Copra after cutting is manually fed to the oil expeller. Though the unit has two oil expellers of 6 and 9 bolts, only one with 9 bolts is used to expel oil. Expeller is run twice to expel maximum oil. It takes two hours to complete one run of oil expelling per batch of 3000 coconuts.

The residue is fed again for a second time to complete the expelling process. The residue is reprocessed for a second time to complete the expelling process, which takes about two hours, making the total oil extraction time for 3000 coconuts four hours. Coconut oil thus expelled is kept in a tank for two days to settle residue before mechanical filtering. After settling the oil is filtered using a screen filter, and the unit currently has two such filters.

One filter purchased in 2015, features14 screens but due to dissatisfaction with its performance and capacity the firm has acquired another filter in 2018 with 24 screens which is in the process of installation. After filtration the oil is stored in HDPE tanks before being bottled for sale.

Packaging

The packaging is carried out in PET bottles with capacities of one litre and half a litre, and the filling process

is performed manually. To improve efficiency, the unit has recently procured a semi-automatic oil-filling machine.

Building

The unit has fairly good building to accommodate all the machinerieswith electricity and water connection and is well connected with road. It has fairly good storage space also. It has a storage space to store 5000 coconuts and 3000kg copra at a time.

Economics

Production capacity of coconut oil at present is 5000-7000 litres per month. The procurement price of coconut is Rs. 25 per kg. Copra is directly procured from farmers and the procurement price at present is Rs. 100 per kg. Approximately three and a half coconuts makes one kg in Lakshadweep. Eight workers are required at peak time, days when all unit operations from coconut cutting to bottle filling are done.

Production cost of coconut oil is Rs. 170 per litre including labour charge of Rs.15 per litre. Coconut oil is marketed both in whole sale and retail markets. Whole sale and retail price of coconut oil is Rs. 190 and Rs. 210 respectively per litre. Cake is sold in the local market Rs.20 per kg.

Coconut oil produced by the firm has FSSAI certificate. Though keeping quality claim of the firm for its coconut oil is of six months it could be kept in sealed condition for eight months.

Improvements suggested

The unit has fairly good infrastructure, building and machineries for a medium scale production unit. However, creating a better hygienic condition is required to explore markets outside island.While the machinery is adequate, manual labor is still used in all operations. This could be improved by automating the unit operations especially after copra cutting without much capital. This in turn creates a better hygienic environment also.

Specific interventions suggested

A screw conveyor to take copra pieces from copra cutter and feed the same to the oil expeller. From the expeller oil is taken to the settling tank kept at an elevated platform. Oil after settling is taken to the inlet of a positive displacement by gravity and is taken to the screen filter at high pressure where the oil gets filtered and comes out. The filtered oil is then pumped to another storage tank, again kept at a higher elevation. Oil is then taken to the packaging unit by gravity through conduit pipes where it gets packed.

Typical layout of such a semi automated coconut oil industry is given below (Fig. 4). Coconut and copra procured from farmers are stored in the storage place where small trucks can approach. Coconut cutting and drying is done manually. Copra after drying is fed to the copra cutter manually. The copra pieces are conveyed to the expeller using a screw conveyor. Expelled oil is conveyed to a settling tank through conduit pipes. Oil after settling is conveyed to filter using a positive displacement pump. The filtered oil is conveyed to the storage tank and then to the packaging unit again through

conduit pipes. In effect, coconut oil is conveyed from one machine to another for each unit operations till packaging without any human contact. This would make the oil hygienic.

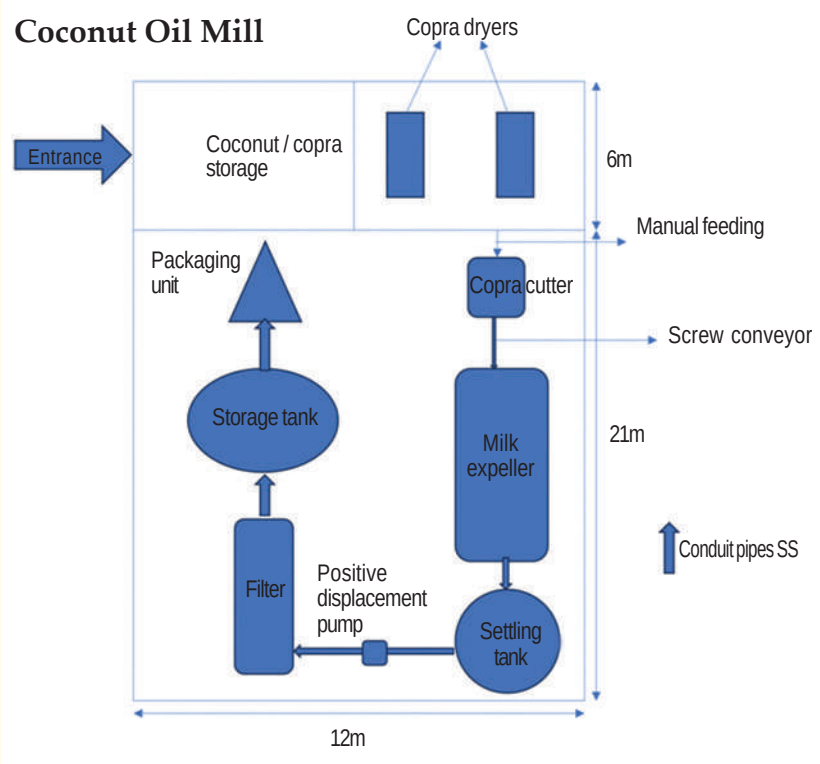

Fig. 4. Schematic representation of a semi automated coconut oil industry

❖ Darul Arham Product

Coconut oil production, masala powder making and sugar powdering are the major activities of M/S Darul Arham Product owned by Mr. Pookunhi in Kadmat island. Copra is procured from farmers directly. He used to purchase coconuts also during summer months and make

copra by sun drying. It takes nine days of sun drying to produce copra from fresh coconut. The copra is then cut in to pieces using copra cutter. Oil is expelled using a four bolt expeller. A 15 hp electric motor is the prime mover. Unlike in other oil industries of the islands power transmission and speed reduction in this industry is done using belts and wheels instead of direct drive. The oil is then kept in a tank

for settling. Oil after settling is pumped in to a 12 screen filter. Filtered oil is pumped in to the screen filter to remove residue. It is then filled in PET bottles for marketing through local shops. People often come to purchase oil directly from the firm. Coconut oil quality is assured by sorting copra at the time of procurement itself. Second quality copra is sorted and procured separately at a lower rate, Rs. 50 per kg and the oil expelled is given to soap industries.

On an average, the firm processes 350 kg copra/day. He has an apprehension about copra produced in dryers. According to him, copra dried in dryer has inferior colour and quality compared to sun dried copra. When sundried copra yields 70% oil only 65% oil is obtained from copra dried in dryer. Procurement price of coconut is Rs. 15 per coconut and that of copra is Rs. 90 per kg. Retail price of coconut oil is Rs. 180 per litre.

Though the firm has a fairly good building, the industry needs some modifications. He has plans to expand his oil industry and is having sufficient space for expansion.

Specific interventions suggested

Based on the observations and discussions with the entrepreneur, the following recommendations were made to enhance the efficiency of the coconut oil expelling unit.

- Installation of a screw conveyor to feed copra pieces from copra cutter to oil expeller and thereafter conveying oil till packaging through conduit pipes to avoid human handling of copra and coconut oil
- Establishing a semi-automatic packaging unit

- Installation of an indirect type copra dryer to enhance the capacity of the oil mill and also to ensure availability of copra through out the year. The farmers, from whom he procures copra, makes copra only during summer months, since everybody adopts sun drying. This limits the copra availability only during summer months. A dryer, if established, copra could be made available throughout the year by procuring coconut and drying the same in the dryer.

Quality control and byproduct utilization

All the 16 enterprise units possess FSSAI license as food safety measure and have their own brand name. The FSSAI license ensures that the products meet the required food safety standards and are safe for consumption. Keeping quality claim of the firms for their coconut oil is generally of six months. However, it could be kept in sealed condition for eight months, according to many units.

Eleven units have done the quality analysis of coconut oil produced in their units through the CDB institute of Technology, under the Coconut Development Board at Aluva. This involves analyzing different physical, chemical, and microbiological properties of the oil to determine if it complies with food safety regulations and meets consumer expectations.

As per AGMARK definition coconut oil is obtained by the process of mechanical expelling or solvent extraction which has been refined by neutralization with alkali, bleached with bleaching earth or activated carbon or both, and deodorized with steam, no other chemical agents being

used. There are sets of physico-chemical parameters and its limits have been set by the AGMARK and FSSAI mainly focusing on the onset of rancidity.

Coconut oil samples from the enterprise units from Lakshadweep islands were collected by the team and tested at the analytical laboratory of CPCRI Kasaragod (Table 7). It was found that the oil expelled and collected from the islands were of ideal quality with respect to the acid value, saponification, and peroxide values.

The moisture content slightly exceeded the AGMARK standard of 0.25%. However, there is no limit prescribed for moisture under FSSAI. Nonetheless, for ensuring better shelf life, it is ideal to reduce the moisture content to less than 0.25%. The iodine value was seen in the borderline range (7–11.55 g iodine/100g). Free fatty acids, although not specified in either standard, are a key factor in assessing rancidity, ranging from 0.38 to 0.77%. The maximum limit of free fatty acids prescribed by the International Coconut Community (ICC) is 2%.

As the biochemical quality parameters are on the borderline of the prescribed limits, it is advisable to follow measures such as proper drying of copra, thorough cleaning of machinery to remove residues from previous extractions, appropriate storage of the expelled oil, efficient filtering, regular cleaning and replacement of filter cloths and the removal of any unfiltered sediments from oil storage tanks for ensuring better keeping quality.

Additionally, the utilization and disposal of byproducts in the coconut oil industry is an important aspect of

sustainable production. Efficient management of byproducts not only helps in reducing waste but also creates opportunities for additional revenue streams, reduces environmental impact and enhances the overall efficiency of the production process. All the 16 enterprise units are using coconut cake, which is rich in protein and fiber, as cattle feed and coconut shells are used as fuel for dryer.

Marketing

All the 16 enterprise units are mostly focusing on domestic markets within the Lakshadweep islands. It is mainly distributed through local retail outlets, such as small shops and cooperatives, where consumers buy small to medium quantities for domestic use.

Only one unit is marketing oil occasionally to mainland. The major product disposal pattern is using own vehicles to the island hubs and using vessel or ship for other islands. No middleman and no agents of the mainland are involved in marketing.

All the 16 enterprise units are following direct marketing techniques.The frequency of distribution depends on how frequently local stores or cooperatives require restocking to meet the demand. All the 16 enterprise units are transporting the products as and when they get intimation about demand for coconut oil for supply.

Marketing coconut oil in Lakshadweep and expanding it to the mainland presents several unique challenges. These challenges range from logistics and infrastructure to competition and consumer awareness. Shipping coconut oil

Table 7. Qualitative comparison of coconut oil from different islands

Island	Moisture (%)		Acid value (mg KOH/g)		Free fatty acids (%)		Saponification value (mg KOH/g)		Peroxide value (meq/ kg oil)		Iodine value(g I2/ 100g)	
	Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean
Kalpeni	0.78-0.87	0.83	1.50-1.62	1.57	0.54-58	0.56	291.39-295.10	293.24	ND	ND	9.33-10.31	9.82
Kavaratti -1	0.39-0.43	0.41	1.96-2.0	1.98	0.76-0.78	0.77	283.27-293.66	288.47	0.56-0.79	0.68	11.30-11.81	11.55
Kavaratti -2	0.42-0.44	0.43	2.15-2.19	2.17	0.69-0.71	0.71	297.54-302.71	300.13	0.58-0.69	0.64	10.93-11.21	11.07
Kiltan	0.28-0.32	0.30	1.06-1.08	1.07	0.37-0.39	0.38	291.60-296.44	294	0.71-0.79	0.75	6.95-7.63	7.29

from Lakshadweep to mainland or even between islands is often delayed and expensive due to limited transportation options. Delays in transit can also affect product quality and shelf life. Lack of availability of raw materials during monsoon season is another major concern raised by all 16 entrepreneurs.

Major share of raw materials are sourced locally by the coconut oil enterprises. The procurement process often involves buying directly from local farmers. All the 16 enterprises units are procuring 90% of coconut from other sources and only 10% procurement are from own coconut farm. No permanent suppliers and no middleman oriented supply are followed by the enterprise units.

The frequency of coconut procurement for a coconut oil enterprise is influenced by a range of factors such as production scale, demand, supply chain logistics, seasonality and storage capacity.

Out of 16 enterprises, 10 units are procuring coconut 2 times/week, 3 units are procuring once in a week and 3 units are procuring on daily basis.

The quantity of procurement ranges from 600 kg/month to 5000 kg/month for copra and 1800 kg/month to 23000 kg/month for fresh coconut. The procurement price of coconut ranges from Rs. 23- 35 /kg and procurement price of copra ranges from Rs. 80-125 /kg.

Economics

Production capacity of coconut oil at present is 5000-7000 litres per month across the 16 units. Procurement price

of coconut is Rs. 25/- per kg. Copra is directly procured from farmers and the procurement price at present is Rs. 100/- per kg. Approximately three and a half coconuts makes one kg copra in Lakshadweep. At peak times, when all unit operations from coconut cutting to bottle filling are in progress, eight to ten workers are required for a unit with an annual production capacity of about 30,000 liters.

The production cost of the coconut oil units ranges from Rs. 160 to 210. The wholesale price of coconut oil ranges from Rs. 170 to 250, while the retail price varies between Rs. 200 and 270. The cake is sold in the local market for Rs. 20 per kg.

Constraints

Coconut oil enterprises in Lakshadweep islands face many challenges to sustain their functioning. Major problems of coconut oil expelling units as perceived by entrepreneurs are the following.

1. Lack of transport facilities and high transportation charges to send raw materials and products from island to other islands and to mainland.

2. Discontinuance of transportation subsidies to entrepreneurs earlier provided by the Department of industries. There was a scheme for grant of subsidy on the transport of raw materials and finished goods to and from certain selected areas with a view to promoting growth of industries implemented during 1971 on meeting the costs by sea and road between Cochin Port and the location of the industrial unit in the Union

Territory, (https://jkdfc.org/schemes_transport_subsidy.htm), which was discontinued during 1990s.

3. Difficulties in procuring bulk quantities of bottles and stickers from the mainland.

4. Lack of availability of raw materials for processing due to the declining productivity of coconut in the islands.

5. Lack of availability of copra during monsoon season.

6. Transportation of the raw materials including packaging materials (bottles, pouches stickers, etc.) is through the passenger ships. Getting shipping bills for such goods is very difficult as major proportion of shipping bills will be booked by the local shop owners of the islands and there is no subsidy for the entrepreneurs transporting their raw materials from mainland to islands.

7. Difficulty in quality testing of coconut oil to furnish before agencies such as FSSAI for certification and high cost of certification procedures.

8. Lack of support for organic certification of the product for exploring export potential.

9. Difficulties in repair of machineries of the expelling unit by the technicians from mainland.

10. Inadequate extension support to conduct capacity development programme for the entrepreneurs and lack of business incubation facilities.

Interventions to enhance efficiency of coconut oil enterprises in Lakshadweep islands

Based on the observations on the functioning of coconut oil enterprises and interaction with entrepreneurs and other stakeholders the following recommendations are made on the interventions to enhance efficiency of coconut oil enterprises in Lakshadweep islands.

- A model processing unit, medium sized, each of coconut oil needs to be established in each island which can act as a training centre/incubation centre and also can be given on hiring basis. Start-up units should be able to begin their production using this facility at a minimum initial investment.
- Service of the technicians and assured availability of spares in the proposed incubation centre shall render their service for the timely repair and maintenance of processing machineries of coconut oil expelling units.
- A common brand with international quality standards needs to be created for the un organised coconut oil production units. This would help to competing in the international market. 'Lakshadweep natural' or 'Lakshadweep organic' certification, if made available, would be an added attraction for better placement of the product in the international market.
- Timely availability of transportation facility at a competitive cost needs to be assured to entrepreneurs to transport the products between islands and between island and main land. Hence, a system needs to be put

in place to give priority for the coconut entrepreneurs from the islands for transporting their products between islands and to the mainland especially by utilizing the return trips of vessels, barges, or MSVs.

- The potential for branding of coconut oil from Lakshadweep as 'Lakshadweep organic/ natural coconut product' is to be utilized along with implementation of interventions for necessary certification procedures.
- A centralized quality testing laboratory facility should be established in Lakshadweep for testing of coconut based products.
- Suitable techno-socio-economic interventions focusing on soil health management are to be formulated and implemented to enhance the coconut productivity in the islands to ensure raw material availability for the coconut oil expelling units.
- A comprehensive plan for skill development of entrepreneurs engaged in production and marketing of coconut products in Lakshadweep islands is to be prepared and implemented for which KVK can take the lead drawing support from research institutions like ICAR-CPCRI.

Marketing of Fresh Mature Coconuts

Of late, a change in the pattern of marketing activities of coconut sector in Lakshadweep islands is very evident. In the olden days the marketable surplus of coconuts were converted to copra and sold mostly to mainland traders. But currently the focus is gradually being shifted to the approach wherein farmers directly sell fresh mature coconuts to the traders instead of copra. This trend is more prevalent in islands like Kalpeni and Androtт because of availability of more facilities for shipping nuts to the mainland, mainly in Kozhikode market.

The shift in focus of trade from copra to coconut is mainly due to various factors including lack of interest among coconut farmers to prepare copra which is labour intensive, declining production of coconut, more number of oil expelling units coming up in islands etc. Factors such as production of coconut, population of the island and quantity of nuts required for domestic consumption, number of coconut oil expelling units and number of traders involved in coconut marketing influence the volume of fresh mature coconuts marketed in the islands.

Marketing channels

The marketing channels of fresh mature coconut in Lakshadweep islands are the following.

- Farmers directly sell nuts to the oil expelling units in the island. About one-fourth of the total quantity of coconut

marketed is purchased by the oil expelling units directly from the farmers.

- Farmers sell nuts to the local traders and traders in turn sell nuts to the oil expelling units in the island.
- Farmers sell nuts to the local trader and the trader in turn sells nuts to wholesalers in mainland.
- Farmers sell nuts to the oil expelling unit and oil expelling units make copra using the nuts thus purchased and if there is surplus nuts, especially during the peak season of coconut production, sells to wholesalers in mainland.

Marketing of fresh mature coconut in Lakshadweep islands

The details of island-wise marketing of fresh mature coconut in Lakshadweep islands through the traders are furnished in table 8. It can be seen that there are about 29 traders spread across nine islands and on an average 20,81,390 kg coconuts are marketed per year.

The prominent islands having coconut marketing are Androth, Kalpeni and Kadmat. Months from October to April have more volume of coconut marketed and monsoon months are not having much activities pertaining to coconut marketing. Besides selling to the wholesalers in the mainland the traders also supply coconut to the expelling units in the islands.

The marketing of fresh coconuts is predominantly facilitated by traders who purchase nuts directly from farmers. The average price received by farmers, who sell

Table 8. Marketing of fresh mature coconut in Lakshadweep islands

Sl. No.	Island	Number of entrepreneurs involved	Average annual marketing (kg)
1.	Agatti	4	296800
2.	Amini	10	328240
3.	Andrott	5	534750
4.	Kadmat	3	336800
5.	Kalpeni	5	435000
6.	Kavaratti	2	149800
	Total	**29**	**2081390**

nuts to an oil expelling unit or a trader is about Rs. 3-4 less than the actual prevailing market price of coconut per kg in Kozhikode market of the mainland; which is the margin of profit for the trader.

Currently by the prevailing market rate of coconut fluctuates between Rs. 33-46 per kg while farmers in the island receive Rs. 29-42 per kg. Oil expelling units offer prompt payment for coconut to the farmers avoiding any payment delays. Traders, on the other hand, follow a weight-based billing system, providing farmers with a bill at the present market price, and amount disbursed only after the nuts are sold to the mainland and the trader receives payment. However, there are few traders who provide advance cash to farmers. As transportation charge, they charges Rs. 110-150 per bag of nuts (weight in a bag is about 53-57 kg).

Constraints

Transportation remains the primary constraint faced by traders in the marketing of fresh coconuts. During the off-season, the lack of availability of reliable transportation services, such as *manchu*, severely hampers the fresh coconut trade with the mainland. As a result, traders have to rely on barge services, which do not have any regular schedule of operations.

Further, the barge services are primarily reserved for government purposes. Hence, traders are forced to transport as much quantity of nuts as possible to the mainland whenever barge services operate which presents several challenges for them.

One major issue is the weight reduction of nuts, as the nut water dry up during the storage or transit. Loss of nuts due to rodent attacks when stored in bags for transport is another problem faced by the traders. Besides, the market value of the nuts is reduced due to damage, particularly during the unloading process in the mainland at Beypore port, Kozhikode due to the improper haldly resulting in breakage of nuts.

Furthermore, the grading of damaged nuts is impossible, especially when nuts are stored in bags, as the barges are often scheduled for transport of goods for government departments within a short notice.

Implications

Coconut farming in the islands faces many challenges due to the socio-economic changes. In the olden times,

production and marketing of copra was a major livelihood option for the island population after fishing.

Farming is no more the major source of livelihood to the people of Lakshadweep. Hence, it is natural that owners of coconut orchards are not keen to prepare copra and sell, especially since copra making is an activity which requires lot of involvement from the growers and is labour intensive. Lack of availability of labour and high wage rate also discourage coconut growers to go for copra making instead prompts them to directly sell fresh mature coconut.

Value addition is the suggested strategy for enhancing income from coconut farming. Hence, directly selling coconut without value addition results in loss of income to the island community. However, lack of easy access to the market in the mainland or export to other countries due to high cost and other constraints in transportation is a major limitation for the enterprises on coconut value added products in the islands. Hence, special attention and incentives are necessary to support entrepreneurs for transporting coconut products to mainland.

Developing unique brand value for Lakshadweep coconut and value added products made from Lakshadweep coconut utilizing the potential for obtaining Geographical Indications (G I) tag with necessary steps for product certification in line with 'Lakshadweep Organic'/ 'Lakshadweep Natural Farming' which would be useful for securing premium price for the products in the mainland and export markets.

Apart from market related and transportation issues lack of availability of sufficient quantity of coconut for preparation of coconut oil is a constraint perceived by entrepreneurs of oil expelling units. Similarly the small scale units on VCO, halwa etc managed by women SHGs also experience the problem of shortage of coconuts.

It is noteworthy that a substantial quantity of nuts is utilized by the island population for the domestic use, especially for culinary preparations. So the volume of marketable surplus of coconut from the islands will not be sufficient to meet the demand for a steady stream of supply of value added coconut products from the mainland or export markets. Hence, the strategy should be to promote the unique coconut products from Lakshadweep islands, even if in smaller quantities, to be effectively sold in 'niche' market segments rather than promoting marketing of mature coconuts as such.

Virgin Coconut Oil

Virgin coconut oil (VCO) prepared through the traditional processing method in Lakshadweep islands is locally known as *Benda ney*. International Coconut community (ICC) defines virgin coconut oil as the oil obtained from fresh and mature coconut kernel (12 months old from pollination) by mechanical or natural means with or without the application of heat, which does not lead to alteration of the nature of the oil. There are mainly four methods of VCO production viz., hot processing, fermentation, centrifugation and direct micro expelling (DME). All methods except DME, use coconut milk as the starting material.

The DME process involves extracting VCO directly from dried grated coconut through hydraulic expelling. In the Lakshadweep islands, the conventional hot processing method has been practiced for generations. However, few entrepreneurs have recently adopted DME technology for VCO production.

The traditional heating method is labour intensive, often taking an entire day to complete. Despite this, the women consider it as a leisure time activity, as they gather to dehusk, grate and process VCO during their free time after finishing their household responsibilities.

Steps involved in conventional VCO processing

VCO processing starts with the collection of mature coconuts either freshly harvested or procured from stored nuts. The nuts are harvested by skilled climbers following traditional method. Of late, people have started using climbing machine for harvesting coconuts.

Further, the dehusking is performed manually using an iron rod (locally known as *paara*). The weight of dehusked

coconuts of Lakshadweep varies from 200g to 560g. The coconuts are thoroughly cleaned using a knife to shave off any adhering husk or fibre portion from the outer shell. The nuts are then split into two equal halves with sharp knife.

The coconut endocarp (shell) carries three longitudinal ridges on its surface, which are as a result of the fusion of the three carpels. It is believed that in order to obtain exactly two halves, the knife should be kept on the ridge having the maximum area among the three ridges of the dehusked coconut.

The next operation is grating which is done using a traditional graters made in the islands known as *shirava*. Although *shirava* are made in all the islands, those made in Minicoy island are favored by the islanders due to their ethnic designs reflecting the unique craftsmanship of the people of Minicoy.

Womens SHGs across the islands use approximately 20-40 coconuts per day for VCO production for which around 4–5 women will be engaged from 11 am (after the completion of household works) to 6 pm (before sunset).

The grating process is followed by the manual extraction of coconut milk, which involves squeezing grated coconut using a muslin cloth. Some groups directly go for squeezing after adding hot water, while others add gratings to boiling water (equal volume as that of gratings so that gratings fully immerse in water) and cook for softening the gratings.








After cooking for 10–15 minutes, the mixture is removed from the heat and left uncovered to cool which will be followed by grinding using a stone grinder or a mixer grinder (in case the quantity is less). If the gratings are stuck between stones a little water will be added during grinding.

The next step is milk extraction which is done by hand and filtered through a sieve. Extracted milk is kept in the open-pan aluminium vessel and heated for concentrating. In the olden days, before starting the process people would chant a prayer for a speedy and effective VCO recovery. The source of fire includes dried coconut spathe, rachilla, shell, etc. Initially the fire is used at maximum intensity. Later as the milk starts to curdle or coagulate, the fuel (1 or 2 spathe) is removed to reduce the heat for the second stage, which is the oil separation phase.

The end of the processing is when the VCO cake (locally known as *uriya*) hardens and breaks into small, round particles. At this stage, the fire is turned off and the vessel is tilted to allow the oil to collect at the bottom separating it from the VCO cake. A large spoon or ladle is then used to collect the oil while the remaining cake is left overnight to release any residual oil. The collected oil is either bottled directly or reheated for 10 minutes if cloudiness is observed for getting clear oil.

DME (Direct Micro Expelling) processed VCO

Recently two entrepreneurs, one in Kalpeni island (Beebi Enterprises selling VCO under the brand name Cobio) and the other in Andrott island (Dweep Fibres and Traders selling under Island tasty VCO) have started VCO production using Direct Micro Expelling (DME) method. In this process, grated coconut is dried to a moisture content of less than 3% followed by extraction using a hydraulic expeller to obtain VCO. While the recovery rate of VCO in this method is higher the resulting oil has a slightly higher moisture

content compared to conventionally hot-processed VCO affecting the shelf life.

The experience of Mr. Iqbal, an entrepreneur from Androtт island, in the production and marketing of VCO employing DME method is furnished below.

The VCO unit managed by Mr. Iqbal of the enterprise 'Dweep Fibres and Traders' has a production capacity ranging from 500 to 1000 liters per month. The process involves using 400 kg of freshly grated coconut which yields approximately 35 kg of high-quality VCO. An electrical dryer is employed to dry maximum 100 kg of coconut gratings ensuring optimal moisture removal for efficient oil extraction.

In between the unit stopped functioning but has recently restarted operations after replacing the shell-fired dryer and manual expeller with an electrical dryer and a hydraulic expeller. These upgraded machines have significantly reduced processing time and labor intensity addressing the challenges that previously affected production. VCO is sold at Rs. 650 per litre wholesale and Rs. 100 per 100 ml for retail.

Constraints

The labor-intensive process of manual expelling makes it less appealing to workers. The machineries are procured from the mainland; incur additional costs for maintenance and repairs. Proper training and experience are essential for workers to operate DME units efficiently, ensuring optimal oil recovery and maintaining quality. A major

challenge is the limited availability of coconuts across the islands often causing the units to remain idle for several days each month.

Besides, entrepreneurs have reported concerns about rancidity in the oil, mostly due to moisture in the DME-produced VCO as confirmed by quality analysis. The method requires thoroughly dried coconut meat to ensure oil quality, but high humidity or improper drying can result in subpar extraction and rancidity. Fluctuations in coconut supply intensify these issues leading to production interruptions and underutilization of DME units.

Quality evaluation of the VCO

The conventional and DME processed VCO samples collected from Lakshadweep islands were evaluated in the laboratory at CPCRI Kasaragod for the physico-chemical quality attributes. The results clearly indicated that the moisture content in conventionally hot-processed VCO was lower than in DME-processed VCO. Consequently, the conventionally processed VCO also exhibited lower values for rancidity indicators, including free fatty acids, peroxide, saponification and iodine values. As per the standard, the moisture should not be more than 0.5%.

Similarly the acid value and peroxide values should not be more than 4 and 15 milli equivalent per kg of oil respectively with a maximum free fatty acid content of 0.2% and iodine value between 4-11. The saponification value and peroxide value should not be less than 250 mg KOH/g oil. However, these values in the VCO samples analysed at CPCRI remained within the acceptable range as per the FSSAI and ICC standards (Table 9).

VCO enterprises managed by women SHGs

The study by CPCRI revealed that 77 women groups across 10 islands produce value added coconut products such as VCO and halwa. Quantity of VCO produced and number of women SHGs involved in VCO making vary between islands. Agatti and Kalpeni emerge as the top producers, with average monthly productions of 225 kg and 240 kg, respectively. These two islands account for approximately 58% of the total production. Kavaratti, Kadmat and Amini follow with moderate production levels

Table 9. Qualitative comparison of virgin coconut oil processed by conventional and DME methods

VCO Processing method	Moisture (%)		Acid value (mg KOH/g)		Free fatty acids (%)		Saponification Value (mg KOH/g)		Peroxide value (meq/kg oil)		Iodine value (g /100g)	
	Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range	mean
Conventional method	0.14-0.25	0.19	0.45-0.47	0.46	0.16-0.17	0.16	293.12-296.17	294.65	ND	ND	6.59-7.73	7.16
DME method	0.28-0.35	0.32	1.19-1.24	1.24	0.43-0.45	0.44	297.41-301.31	299.36	ND	ND	8.29-9.30	8.795

while Chetlat, Androtт, Kiltan, Minicoy and Bitra trail behind with significantly lower outputs. Notably, Bitra has only one women SHG producing a mere 3 kg per month (Table 10).

Table 10. Production of VCO by women SHGs in Lakshadweep islands

Sl. No.	Island	No. of women SHGs	Average monthly production (kg)
1.	Agatti	15	225
2.	Amini	10	46
3.	Androtт	8	41
4.	Chetlat	4	26
5.	Kadmat	9	75
6.	Kalpeni	13	240
7.	Kavaratti	10	97
8.	Kiltan	5	20
9.	Minicoy	2	24
10.	Bitra	1	03
	Total	**77**	**797**

It is observed that due to problems related to raw material availability and fluctuations in demand there is no regular pattern of VCO production by women SHGs; quantity produced vary between months and seasons. Most of the women groups regulate the production based on the demand and do not take any risk of producing more quantity of VCO than the local demand.

Output

In general, the women SHGs of the islands involved in VCO making process about 30 nuts per day. Quantity of raw materials, by products and oil recovery for processing 100 coconuts is calculated as follows:

Table 11. VCO production per day by the SHGs and its comparison with CPCRI method

Particulars	Per day production capacity		
	Using 30 nuts (women SHGs)	Up scaled estimate for 100 nuts (women SHGs)	Estimate for 100 nuts using VCO cooker of CPCRI
Number of coconut	30	100	100
Nut weight (dehusked) (kg)	9.69	32.29	-
Fresh kernel weight (kg)	5.08	16.93	26.5
Milk weight (kg)	8.87	29.58	19 L
Residual weight (kg)	3.10	10.32	9.6
VCO cake weight (kg)	0.66	2.21	3.7
Oil weight (kg)	1.57	5.24	4.56
Oil volume (L)	1.73	5.78	5. 3

In the traditional process of VCO making many pre-treatments are applied for the gratings to get maximum coconut milk yield. The recovery of VCO through the conventional method is higher compared to any of the advanced method of VCO production (ie, 30-34% of the

weight of gratings compared to 20-22% in the modern method). From 100 coconuts, approximately 17 kg of fresh gratings are obtained in the Lakshadweep Islands, while in the Kerala, where the nuts are larger, the grating weight is about 26 kg. The corresponding oil yields would be approximately 5.78 litres in the islands and 5.3 litres in Kerala.

Marketing

The women SHGs usually sell the VCO to households directly; people come to the SHG secretary's house where the product is stored or sell to the nearby shops. Currently the selling price of VCO is Rs 350/- per litre.

There is a good demand from the local community for the VCO prepared by women SHGs following the traditional practice. Tourists visiting the islands also purchase VCO from the women SHGs in small quantities. As such the VCO produced in an island is sold in the same island itself. Often, people place orders and the VCO is sold immediately after it is prepared.

In certain islands, similar to how people provide copra to flour mills, residents would give mature coconuts from their homes to Women SHGs to produce VCO for which they would receive a labor charge in return. As such for VCO, there is no inter island marketing / transportation as the VCO prepared in one island is very well marketed in the island itself.

In earlier times when a woman became pregnant in the household, the elders would prepare VCO in advance with

the help of laborers. After the baby is born, the oil would be donated to the mosque (primarily the Muhiyudden Mosque or Ujra Mosque) to be used for lighting lamps as a vow or promise made perform a specific act of devotion in gratitude to Almighty for fulfilling a prayer or wish.

Table 12. Economics of VCO production in Lakshadweep

Sl.No.	Item	Quantity
1	Average number of nuts processed per day	30 nos
2	Cost of one nut	Rs. 25
3	Number of women involved	4-5 (each woman spending on an average 7-8 hours)
4	Labour charges @ Rs –per day per woman	Maximum Rs. 100
5	Average quantity of VCO obtained	1.5-2 Litre/day
6	Cost of production per litre of VCO	Rs. 450
7	Average sale price per litre of VCO	Rs. 350

Economics

The average economics of VCO production and marketing by women SHGs in Lakshadweep islands is furnished below.

It is evident from the above table that the economic viability of VCO enterprises managed by the women SHGs in Lakshadweep islands is not at all impressive rather it is an enterprise running on loss. They should sell VCO at least Rs. 570/- per litre if at all they want to realize a profit margin of 25%. It is noteworthy that the selling rate of VCO by the commercial VCO manufacturers in the mainland is Rs. 1000-1400 per litre.

The women folk engaged in VCO making are not really aware or concerned about the economics of the enterprise they manage. In fact the members of women SHGs perceive that their get together for VCO making give them an opportunity to remain socially connected with neighboring women. The other important advantage they perceive is that the members can spend time for their household chores as per the routine and comfortably come for the VCO making activity during the remaining hours. They also consider it a social service to make available good quality VCO for use by the local community mainly as new born baby oil and hair oil.

Most of the VCO units run by the SHGs were analysed as part of the survey conducted by the team of scientist from ICAR-CPCRI. Case studies of the two units have been discussed below,

1. Alfana Dweepsree group, Agatti

Alfana Dweepsree group of Agatti was formed in the year 2017 with 12 members Mrs. Ummulkulsu B.P serves as the secretary, providing leadership and manages the day-

to-day operational expenses. All members of this SHG are engaged in many activities including VCO making, snacks preparation, fish pickle making, etc. They follow a rotational system wherein four members take turns

processing. The group has a flexible production capacity with a maximum potential of producing up to 100 litres of VCO per month depending on the volume of orders received. On an average they process between 60 to 100 coconuts per day which they procure locally at a cost of Rs. 30 per kg. The processed VCO is bottled and sold at a retail price of Rs. 300 per litre. They had received financial support from the Department of Agriculture under the scheme on "Support & Promotion of Heat Processed VCO Production Unit".

According to Mrs. Ummulkulsu, there is huge demand for VCO but the group struggles to meet this demand due to the lengthy processing time and the labor-intensive nature of the operations. The group received the best Dweepsree unit award of Department of Rural Development twice in recognition of their achivements.

2. Iqrah Dweepsree, Kadmat

Iqrah Dweepsree group consisting of 13 members is functioning in the southern locality of (ward no.8) Kadmat island. The members of the group make snacks, pickles, bags (sales and repair), halwa and VCO. Three to four

members of the group are actively involved in VCO making. Mrs. Ayshabi, P.M.C lead the group in VCO preparation. Other members involved in VCO making include Mrs. Haseena, Mrs. Hisana, Mrs. Hameedabi, Mrs. Mariyam and Mrs. Sailanibi. Each month the group processes approximately 100 coconuts in four batches, around 25-30 nuts used per batch. They produce approximately 5 litres of VCO per month. Initially, the group sold their VCO at a rate of Rs. 400 per litres, which barely covered their operational costs. However, with the intervention and guidance of CPCRI in May 2024 the selling rate was revised to Rs. 700 per litres enabling the group to enhance profitability of the VCO making activiy.

Advantages of the small scale women enterprises

Initial investment and working capital of these women enterprises are very minimum. They use home appliances their own kitchen utensils like coconut grating machine, open pans, knives, spoons etc. for processing VCO. Building of these enterprises is generally a temporary shed within their neighbourhood. This way the members could manage their household works and VCO making activity without affecting either one.

Limitations

a) Technical limitations

Unit operations such that coconut grating and milk extraction are done manually. Since done manually these unit operations are quite time consuming and involves lot of drudgery. Milk extraction is done with bare hands and

the force that could be applied by the women folks are limited. Coconut milk extraction efficiency also comes down accordingly. Continuous stirring of coconut milk throughout the heating process for about two hours is another cumbersome process. Since the flame comes directly to the open pan containing milk accurate control of temperature would be very difficult. Many a times the milk gets overheated affecting the VCO quality.

b) Economic Limitations

A women SHG in the islands produce an average of 5 litres of VCO per month. With this meagre production, incentives of the members of the SHGs also would be meagre only.

Requirements of the unit

Coconuts are grated by the members in their own houses to save time and brought to the unit for further processing. An electrical coconut grating machine would be of great relief for the members and the grating could be done in the unit itself instead of their houses.

The present heating of coconut milk in the open pan do not have any control over heating. Accordingly the temperature also changes and could go up thereby affecting the oil quality. Continuous stirring is required throughout the heating process which is very tedious. ICAR-CPCRI VCO cooker would be ideal for the hot processing.

VCO production by hot processing as mentioned is the common practice all over Lakshadweep Islands.

Constraints in traditional processing of VCO

In the traditional process of VCO making many pre-treatments are applied for the gratings such as addition of hot water, cooking the grating in boiling water, grinding etc. to get maximum coconut milk yield.

All unit operations of VCO production viz., coconut de-husking, breaking coconut, grating, milk extraction and heating of coconut milk are done manually. Since done manually, all these unit operations are laborious and involve lot of drudgery. The women folk might not be feeling the drudgery since the volume of production is very meagre.

The lengthy open pan heating process is also time consuming (approximately 2 hours to process 10 litre coconut milk) and the women have to bear high temperature from the open pan.

Lack of availability of nuts for VCO making is a major problem perceived by women SHGs. According to them there is a decline in coconut production in the islands. Emergence of coconut oil expelling units also reduces availability of nuts. Further the women groups face problems due to shortage of nuts for processing and high cost of nuts during monsoon season.

With the current level of small quantities of VCO they produce women SHGs of Lakshadweep islands are not in a position to exploit the market potential in the mainland or other countries.

There is no common brand for the VCO made by most of the women SHGs. Unless a common brand is created it

is very difficult for the women self help groups to venture in to the global market. Production also needs to be increased substantially for which modernization of the units is essential.

Strategies for enhancing efficiency

Based on the field level observations and discussions with members of women SHGs and other stakeholders following suggestions are made for enhancing efficiency of enterprises on production and marketing of VCO in Lakshadweep islands.

- Refine the key processing steps in VCO production through mechanization such as grating, milk extraction, and heat processing. Mechanization would also solve the issues of drudgery faced during VCO processing and would enhance efficiency. Technology and machineries for the production VCO through hot processing developed by ICAR-CPCRI is very much suitable for Lakshadweep. One such VCO production unit may be installed in each island. This would enhance the volume of production and assure quality to meet the market demand. Interventions to support small scale women entrepreneurs for purchasing machineries and equipments for reducing drudgery in preparing coconut products may be implemented by ATARI Bengaluru and CPCRI Kasaragod utilizing funds available under Tribal Sub Plan.
- Organise capacity building programmes on VCO production technologies and also on marketing aspects to benefit the members of women SHGs.

- The potential for branding of VCO as 'Lakshadweep organic/ Lakshadweep natural coconut products' is to be utilized along with implementation of interventions for necessary certification procedures.
- Proper packaging and labeling are also important to attract consumers, especially tourists, and to expand market base.
- A standardized pricing system for the marketing of VCO produced by Dweepsree women groups across the islands is to be evolved under the guidance of the Rural Development Department.
- Promote byproduct utilization and value addition. Currently byproducts of VCO preparation viz., coconut water locally known as *thenga thanni*, milk residue known as *fulifeera* and VCO cake known as *uriya* are discarded as waste. It would be beneficial for earning more income from the enterprise if these byproducts are utilized for the production and marketing of value added products. Mature coconut water can be used for making packaged coconut water or carbonated water, vinegar and squash. Coconut milk residue can be used to prepare bakery items like fried snacks, cakes, biscuits, and rusks while VCO cake can serve as a base for confectionery items and fried snacks.

Neera Tapping

Neera (coconut inflorescence sap) tapping and utilization of the sap for consumption as health drink and preparation of jaggery (locally called *katti*) and vinegar (locally called *surkka*) is a traditional practice in all the Lakshadweep islands. The process of neera tapping is locally known as *kattam mooral* and neera is called as *meera* in Lakshadweep. Neera is technically the phloem sap of coconut inflorescence. The traditional practice of *meera* tapping and its value addition to jaggery and vinegar in Lakshadweep islands were documented in early literature (Ellis, 1924).

In the past, the coconut climbers and tappers belonged to a particular social class called as *Melacheri*. Other two social classes prevalent in islands are the *Koyas* who were regarded as the landowning class and custodians of societal knowledge and the *Malmis* who were the chief navigators or sailers. The *Melacheris*, who make up over 70% of the population are the working class traditionally engaged in coconut climbing, harvesting and tapping. Historically the Melacheris were landless labourers (Robinson, 1874; Ellis, 1924). However, of late the number of palm climbers is on the decline in all the islands.

Coconut farmers often indicate lack of climbers as a major problem in coconut farming. Presently tappers are more in the islands like Androtт, Agatti, Kalpeni, Kadmat and Minicoy. Some tappers take up the occupation for only

few seasons while others are engaged in tapping on a permanent basis. Usually the neera tappers have both occupations of tapping neera and coconut climbing. Traditionally it is believed that efficacy of sap flow from the tapped inflorescence depend on factors like the characteristics of selected palm, skill of tapper, tidal wave (low tide and high tide), weather conditions (monsoon, summer and winter) etc. *Meera* production decreases on excessively sunny days and is also affected by rainy weather. It is also beleived that more neera is collected during high tide compared to low tide.

Method of *meera* tapping

The conventional method of *meera* tapping in Lakshadweep involves selection of inflorescence, preparation of inflorescence for tapping, cutting the inflorescence, removal of spathe, keeping collection devices etc. The process of neera tapping is described below.

i. Selection of palm and inflorescence

The important coconut cultivars of Lakshadweep are tall in their growth habit. For *meera* tapping tappers generally

select high-yielding, semi-tall palms with sturdy and robust trunks. They believe that healthy trees with high nut yield give more sap. Though the tall palms yield more neera, due of the difficulties faced with climbing and regular tapping, semi tall palms are chosen for tapping. The swelling at the base of the spathe due to the development of female flowers indicate that the palm has reached the ideal stage for tapping.

ii. Preparation of inflorescence for tapping, cutting and collection of *meera*

Tappers clean the surface of inflorescence with water followed by wiping with a clean cloth. It is essential to clean the crown to expose the spadix for smooth tapping and to create hygienic condition to get fresh *meera*. It is followed by mild beating with the butt and handle of the knife used for cutting the spathe from the base to top for 4 to 5 days for stimulating sap flow and tied with coconut leaflet to prevent the bursting of spadix.

The spadix is gradually bent daily to approximately a 45° angle by securing it with a rope. One end of the rope is tied to the lower petiole while the other end is fastened to the spadix. This is a crucial preparatory step before cutting the spathe to facilitate smooth neera flow and collection. It is followed by cutting about 15 cm from the tip of spathe using a sharp knife.

The cut end and adjacent parts of the spadix is hit and mashed to initiate the sap flow for about three days. After that the entire spathe will be removed. The inflorescence is


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then bound together using coir rope, cotton cloth or plastic to ensure that the rachilla remain closely adhered and intact. Traditionally tappers in the island use coconut shells, PVC or mud pots or plastic bottles for collecting neera. Meera oozing out is collected twice in a day in the collection device kept close to the cut end of the spadix. Tapping is done for about 45-60 days.

The *meera* (light brown in colour) that drips out soon after the spadix is cut is called as *laaya meera* usually collected within three hours of slicing the cut end (tapped by 6.30 am in the morning and and collected by 9 am). The colour of this *laayaa meera* is exactly similar to honey. It is used as a nourishing drink for infants under five years old. Later on due to long exposure time, the *meera* gets slightly fermented and the colour changes.

Quantity of neera collected

On an average the trained tappers tap 10 coconut palms every day which is collected two times in a day. The cut end is sliced for every tapping to stimulate the exudation of neera. Each tapper extracts 0.5-4.5 litres neera per spadix per day. Tappers use either their own coconut palms or lease in palms for neera extraction. The lease amount, which is on an average Rs. 400 per tree per year is paid to palm owners is paid as products like neera, jaggery or vinegar.

Interventions for promotion of neera tapping

Department of Agriculture had implemented a major scheme for promoting neera tapping and jaggery preparation in the islands. As part of the scheme,

Department of Agriculture leased in coconut palms from farmers for neera tapping and paid them a lease amount @ Rs. 1000/palm/year. Experienced and skilled casual labourers were engaged as neera tappers through the village Dweep Panchayat and the department paid them wages. Neera thus collected was sold to the public in the form of neera, vinegar and jaggery. About 80% of vinegar and jaggery requirements of each island were met under this scheme. However, the department closed the scheme during 2021. It would be beneficial if any intervention to incentivize neera tapping is reintroduced so that a steady supply of neera is ensured to meet the growing demand for the product.

Need for improving the traditional tapping

Meera tapped using traditional tapping method is unhygienic and slightly fermented, which is why its colour is oyster white and the end product obtained during concentrating is *katti* and does not granulize to the sugar stage. To improve the quality and make the drink hygienic and non alcoholic it is essential to make refinement in the tapping method.

ICAR-CPCRI has developed a technology for hygienically tapping the unfermented neera using 'Coco Sap Chiller'. The neera thus collected is called as Kalparasa®. During 2021-22, KVK-Lakshadweep with the support of ICAR-CPCRI distributed 40 Coco Sap Chillers (CSC) for quality neera production (Kalparasa). The on-farm testing of the technology was conducted through a tapper, Mr. Jamaludeen, who traditionally produces *meera* using mud






pots, plastic buoys and plastic bottles collecting about 30–40 liters per day. To enhance neera production he was provided with 10 CSCs and trained in producing Kalparasa. Additionally, he prepares katti and vinegar from neera based on consumer demand.

The quality analysis of samples of neera collected through traditional method and CSCs was done in the laboratory at CPCRI Kasaragod. It was found that the properties of *meera* produced using the traditional method differed from the neera produced using the CSCs. The sap collected through traditional method was acidic with pH of 4.0- 4.5 while neera produced using CSC method was alkaline with pH of 7.0-7.5. Fermentation occurs in the traditional method because the sap flows slowly and is highly prone to fermentation which does not arise with the CSC method.

An On Farm Trial (OFT) was conducted by KVK Lakshadweep with the support of CPCRI Kasaragod to compare the traditional and CSC methods of neera production. Based on selected indicators the following observations were made during the comparative assessment of traditional and CSC methods of neera production. (Table 13)

Table 13. Comparison of traditional *meera* tapping and Kalparasa® tapping technology

Indicators	Traditional Method	Coconut sap Chiller
Palm selection	High yielding semi tall cultivars	High yielding tall cultivars , as soon as attaining stable yield
Selection of inflorescence	Any inflorescence in the crown	-do-
Indication of tapping	External bulging of the inflores-cence seen from the base of the spathe.	-do-

Pre-treatments before tapping	Cleansing the inflorescence with water. Gentle massaging using butt and handle of the knife used for cutting the spathe	Gentle uniform beating and massaging using a mallet
Bending of the unopened inflorescence	Gradual bending(45° angle) is facilitated for the easiness in collection of sap.	Gradual bending (45° angle) is facilitated for the easiness in collection of sap
Spathe removal	Spathe is removed before cutting the inflorescence (around 15 cm from the tip of spathe)	Cutting is done (around 7-10 cm tip) with spathe intact
Tying for support	Tying is done with coconut leaf after removing spathe	Tied around with a strong coir or plastic rope to prevent it from bursting
Duration of tapping	45-60 days sometime upto 3 months till neera stops oozing from the spadix.	40-45 days
Sap collection tools	Coconut shells, PVC cups or buoys, mud pots or plastic bottles	Coco sap chiller kept with ice cubes
Presence of contaminants in the product	Ants, bees, pollen etc. were present	Nil

Quality parameters		
pH	4.0- 6.8	7.0-7.5
TSS	5-9	12-16
Colour of neera	Oyster white	Golden brown
Taste	Sweetish with slight carbonation bite or tangy taste	Sweet
Fermentation	Ferment within 2-3 hours in open condition	In open condition it remains fresh for 12 hours. Under refrigeration it remains fresh upto 45 days

As part of the OFT the perceived attributes viz., relative advantage, compatibility, complexity, trialability and observability of the innovative method of neera collection using CSCs were analysed among selected tappers from Kavaratti, Agatti, Amini and Kadmat islands (Table 14).

Table14. Perceived attributes of the innovation on use of CSCs for neera production

Attributes of Innovation	Reflections of Neera Tappers
Relative Advantage	The innovation for the production of *Kalparasa* is economically profitable. However, considering the comparatively higher cost of production of *Kalparasa*, innovation will be more profitable if popularized and health benefits are made known to the consumers.

Compatability	Highly compatible with the existing values. Lakshadweep islands is under total prohibition for the use of alcohol. *Kalparasa* being a zero alcoholic beverage it will have demand from larger sections of the community.
Complexity	The innovation is simple to understand and it requires minimum level of skill to practice.
Trialability	The innovation can be tried out on a limited basis. The cost of innovation is only Rs. 1200/- which can be purchased by a tapper. However, the source of technology (details of fabricators) has to be made known to the tappers to purchase.
Observability	The physical characteristics of neera extracted using CSC is clearly visible and is different from *meera* collected using the traditional method. Taste and other parameters are also distinctly clear to the tappers and consumers.

(Source: Ananth *et al*., 2022)

The analysis of perception of tappers on the attributes of the innovation on use of CSCs for neera production indicate the potential for popularising the use of CSC method for neera production in Lakshadweep islands.

Meera tapping in Lakshadweep islands

The recent study by CPCRI revealed that there are 52 tappers engaged in *meera* tapping spread across nine islands together producing on average 15955 litres of *meera* as

Table 15. Neera tapping in Lakshadweep islands

S. No.	Island	No. of tappers	Average monthly production (L)	Sold to Islanders for domestic use as neera (L)	Neera sold to Women groups/ entrepreneurs as jaggery (L)	Sold to tourists as neera (L)	Sold as Vinegar (L)
1.	Agatti	8	2285	1131	819	250	85
2.	Amini	7	1760	880	-	-	880
3.	Androtт	14	5780	1525	2680	-	1575
4.	Chetlat	4	1100	1079	21	-	-
5.	Kadmat	7	2040	1615	20	-	405
6.	Kalpeni	5	1440	915	110	120	295
7.	Kavaratti	2	420	134	14	200	72
8.	Kiltan	3	630	420	-	-	210
9.	Minicoy	2	500	350	-	150	-
Total		**52**	**15955**	**8049**	**3664**	**720**	**3522**

furnished in table 15. Number of tappers and production of *meera* is highest in Androtт island followed by Agatti and Kadmat. These three islands collectively contribute 55% of the total *meera* production. In Bitra island there are no tappers and *meera* production.

The monthly average production varies between islands and it ranges from 420 litres in Kavaratti to 5780 litres in Androtт. Consumption by the local community accounts for 55% (8049 litres) of total sales of *meera*.

Highest monthly average *meera* consumption by the local community is in Kadmat island followed by Androtт and Agatti. Women groups and entrepreneurs purchase substantial quantities for jaggery production, especially in Androtт and Agatti islands. Tourism fuels neera sales in Agatti, Kavaratti, and Minicoy, while Androtт and Kadmat lead in vinegar production.

Marketing pattern of neera in Lakshadweep islands

Marketing pattern of neera in Lakshadweep islands indicate that 55% of the total quantity of neera produced is sold as neera for local consumption, 22% sold as vinegar and the remaining 23% sold as jaggery (Fig. 5 & Table 16).

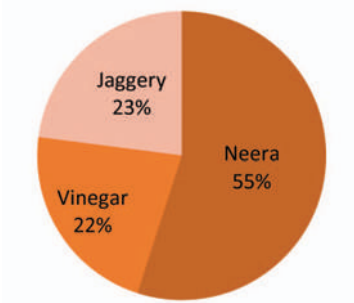


Fig. 5. Marketing patern of neera and its value added products

Table 16. Marketing pattern of neera in Lakshadweep islands

Product sold	Quantity of neera used (Litres/month)	Percentage
Neera	8769	55
Vinegar	3522	22
Jaggery	3664	23
Total	**15955**	**100**

The selling price of neera varies between islands. At present the price of neera is Rs. 200/litre in Kavaratti, Rs. 150/litre in Agatti and Rs. 50/litre in Androtт. Price of neera is decided by the tapper. If only few tappers are there in an island the price of neera in that island tends to be comparatively high.

The demand for neera is growing across the islands, especially due to the surge in tourism activities but tappers are unable to meet the demand in many islands.

Constraints in neera production and marketing

Though opportunities do exist for scaling up neera-based entrepreneurship in Lakshadweep islands the sector experiences many constraints. According to tappers damage to the coconut inflorescence prepared for tapping by the rodents is a major constraint in neera tapping. Decline in neera yield is another important problem perceived by tappers. They attribute climate change and increase in atmospheric temperature as the main cause for the declining yield. They also opined that farmers in the islands do not nurture coconut palms properly which has adversely affected palm health and consequently neera yield.

Seasonal fluctuation in neera yield and difficulty for climbing palms during rainy season also adversely affect tapping. Presence of contaminants in neera and fermentation of neera collected through the traditional method also creates difficulty for the tappers due to the adverse effect on quality of neera.

Lack of support or any incentive from governmental agencies for tapping is another constraint as perceived by tappers. The scheme for promoting neera tapping and jaggery preparation implemented earlier by Department of Agriculture was discontinued in 2021. Lack of skilled palm climbers is a major problem in neera tapping which actually limits the neera production in the islands.

Experiences of neera tappers

As part of the survey and interactions conducted by the team of scientists from ICAR-CPCRI, Kasaragod, across the island, experiences of a few neera tappers were documented as presented below.

❖ **Mr. Ummer Mammil, Agatti**

Mr. Ummer Mammil is a 69 yrs old traditional palm climber from Agatti island who is actively pursuing *meera* tapping. Mr Ummer is living with his son Busser Jamhar who is a tourist guide. His wife and a daughter passed away few years back. Since then he has been trying to overcome the grief due to the personal loss he suffered and finds solace in his work on climbing palms and meera tapping with a passion and in a dedicated manner.

He had formal education only up to the primary school level. He learnt the skill of palm climbing from his father who was into the traditional palm climbing profession. For coconut harvesting he charges Rs. 50 per palm. Currently he is tapping on an average 5-6 palms.

According to Mr. Ummer, the average yield of *meera* tapped is only one litre per palm; which can go up to 2-3 litres per palm during the period from October to December. He sells *meera* thus tapped to the local community or tourists visiting Agatti island @ Rs.200 per litre.

On an average he spends 3 hours in the morning and 3 hours in the evening for tapping *meera*. If there is a balance quantity of meera unsold he uses it for vinegar making, locally called *surkka*. Vinegar also is sold at the same rate ie Rs. 200 per litre. Sometimes semi solid jaggery (*katti*) is also prepared using *meera*. It is prepared by boiling and concentrating *meera*. Two litres of *katti* is obtained from 10 litres of *meera*.

According to Mr. Ummer the yield of *meera* is on the decline which he attributes to climate change and the subsequent increase in atmospheric temperature. Damage to the coconut inflorescence selected for tapping by the rodents is the other major problem in meera tapping, Mr. Ummer opined.

❖ Mr.Mohammed Koya, Amini

Mr. Mohammed Koya is a 42 years old resident of Pallam in Amini island who at the age of 15 years started his palm climbing journey, following the footsteps of his

family's traditional occupation. Despite having only primary education, he possesses a wealth of indigenous practical knowledge gained from his father, Ibrahim, who taught him the art of palm climbing. With vast experience, he scales palms to extract *meera*, contributing to the local economy and preserving the island's traditional practices.

Initially, he was accompanied by his two brothers who shared his passion for climbing palms. However, one of his brothers eventually secured a government job prompting him to relinquish his climbing pursuits. He continued climbing profession charging Rs. 50 per palm for coconut harvesting services. A turning point came in 2019 when he received specialized training from the Department of Agriculture equipping him to venture into neera tapping.

He leased 10 palms for neera tapping at a monthly rate of Rs. 1000 per palm. However, after careful selection and initial tapping he found that two palms yielded insufficient neera, prompting him to focus on the remaining eight palms. This strategic adjustment allows him to optimize his daily tapping practice, averaging eight palms per day. The neera yield ranges from 1 to 1.5 litres per day per palm. According to Mr. Mohammed Koya during the winter months, from November to January, yield of neera increases up to 2 to 3 litres per palm per day.

Tapping is done twice a day and he spends on an average three hours each in the morning and evening for the same. To reach a wider customer base he employs a dual marketing strategy. Locally he sells neera directly to the community while also marketing neera to other islands as per demand.

Neera is priced at Rs. 150 per litre. Remaining neera that hasn't been sold is kept for fermentation for about 41-day to produce vinegar. This value-added product is then sold at Rs. 200 per litre, being his additional income generating avenue.

According to Mr. Mohammed Koya, the neera yield of coconut palms, of late, has witnessed a significant decline primarily attributed to climate change and rising temperatures. Mr. Mohammed Koya perceives that the trend of declining neera yield has profound implications for the sustainability of neera sector in Lakshadweep islands.

❖ Neera based enterprise under Socio Economic Arts & Sports Empowerment Society (SEASES)

Androtт island is well known for producing coconut-based products like vinegar, neera, and jaggery. In 2017, the Socio Economic Arts & Sports Empowerment Society (SEASES), an initiative of a group of youngsters in Androtт island registered as a society started an enterprise to promote and market locally-sourced neera, process the same to vinegar and jaggery. This group comprises of 40 members who are actively engaged in community development through charitable initiatives, sports and cultural events. Prior to establishing this enterprise members were involved in different avenues of contractual work.

Initially the group procured and sold neera as fresh drink and also as vinegar. They collected neera from seven skilled tappers at Rs. 100 per litre and sold part of neera as fresh drink and part of neera was processed and prepared vinegar

and sold. But the payments to tappers for the neera purchased were delayed by about six weeks due to the time required for neera to be processed to vinegar. Because of this issue, despite its promising start, the efforts of the group for neera collection and sales were halted in 2019.

However, two dedicated members, Mohammed saleem K (45) and Mujthaba N (48) took it upon themselves to revive the initiative assuming responsibility for neera collection and

focusing on its transformation into vinegar for sale. These two SEASES club members overcame a critical financial hurdle to sustain their neera-based enterprise by implementing a strategic diversification plan. They processed fresh neera into jaggery ensuring immediate returns and enabling prompt payments to tappers within two to three days of collection.

This adaptive approach stabilized cash flow, fostered a stable and equitable supply chain and strengthened partnerships with local tappers. By securing a sustainable source of high-quality neera the club's enterprise thrived, demonstrating the power of innovative problem-solving and collaborative relationships.

They have a small processing shed for the fermentation of neera to vinegar. Per day collection of neera is about 11-15 litres i.e. approximately 340 litres monthly. Interestingly, the demand for vinegar surpasses that of jaggery, indicating a strong market preference for this product. In contrast, jaggery is primarily sought after during social functions like marriages when it is required to prepare various traditional snacks.

The SEASES club's monthly operations involve purchasing approximately 2375 litres of neera from seven local tappers at a rate of Rs. 100 per litre. This neera is then transformed into value-added products like coconut jaggery and vinegar. On an average the club produces around 125 kg of coconut jaggery; seven litres of neera yielding about one kg jaggery. Jaggery is sold @ Rs. 1000 per kg.

Additionally, 225 litres of fresh neera are sold at Rs. 130 per litre, and 1,275 litres of vinegar sold at Rs. 200 per litre.

The club finds it difficult to meet the demand for jaggery though there is high demand during the season of social functions due to the drudgery in the traditional method of jaggery preparation. Similarly, there are problems in arranging safe storage for processing and fermentation of neera to produce vinegar.

In 2020, ICAR-CPCRI, Kasaragod empowered the group with comprehensive training on neera collection technology utilizing the Coco sap chiller and sugar production methods. This expertise significantly mitigated losses due to auto-fermentation, enhancing overall efficiency. Furthermore, in 2024, CPCRI provided a jaggery-making machine (open pan neera cooker) under the Tribal Sub Plan scheme, catalyzing substantial improvements in production and marketing capabilities. As a result the jaggery production increased, enabling the members to accept bulk orders and ensure timely delivery with enhanced customer satisfaction. Building on this momentum the members plan to expand production and marketing across all islands, prioritizing high-quality products with consistent taste, texture and safe and attractive packaging thereby stabilizing their position in the market.

Strategies for strengthening *meera* sector in Lakshadweep islands

Based on the field level observations and interaction with tappers and other stakeholders following strategies are

suggested for strengthening neera sector in Lakshadweep islands.

- Implement interventions for popularising among the traditional tappers the technology developed by ICAR-CPCRI for hygienically tapping the unfermented neera using 'Coco Sap Chiller'.
- Organise training programmes for palm climbers on neera collection technique using 'Coco Sap Chiller'.
- Implement suitable scheme for promoting neera tapping using 'Coco Sap Chiller' technology and jaggery preparation by Department of Agriculture.
- Implement interventions by the Department of Rural Development to support women SHGs in selected islands, especially islands having more tourism activities, to establish kiosks to market neera collected through 'Coco Sap Chiller' technology. For this, functional linkages are to be facilitated between trained climbers and selected women SHGs.
- Implement interventions for improving coconut productivity and health of palms to enhance neera yield.
- Implement suitable interventions to train more youth in palm climbing using mechanical climbing device and motivate the youths already trained under 'Friends of Coconut Trees' (FoCT) programme of Coconut Development Board to sustain in climbing profession so that the problems due to lack of palm climbers are addressed.

Coconut Jaggery

The traditionally tapped neera (*meera)* is utilized for making jaggery (*katti* or *shakkara*) and natural vinegar (*surkka*). *Katti* plays a significant role in Lakshadweep cuisine, particularly in the preparation of Lakshadweep halwa. It is also enjoyed as a refreshing drink when diluted with water commonly known *katti thanni*. In addition to its use in beverages, *katti* serves as a natural sweetener in numerous traditional dishes. One popular preparation involves adding it to coconut milk often served with *kilanji* made by grinding raw rice and egg, forming a thin delicate layer that pairs perfectly with the coconut milk sweetened with *katti* creating a delicious and traditional meal in Lakshadweep.

Preparation of *katti*

The preparation and use of *katti* has been a longstanding tradition among the islanders of Lakshadweep dating back to ancient times. *Katti* is made by concentrating freshly extracted *meera* in an open pan (locally known *Kaychemb* or *vattalachembu* or *olachembu*) using dried coconut residues such as spathe, rachelle, petiole, pedicel etc as fuel.

During the initial heating, more fuel is used to bring the *meera* to boiling stage thereafter froth begins to form. At this stage a white coral stone (calcium carbonate) with fine pores is put to it. It starts alleviating the acidity. During the initial boiling stage the stone starts making sound by hitting

the bottom of the vessel. But later on when the *meera* starts thickening the sound stops and stone is removed. At that time, heating temperature will be reduced by removing some of the fuel material, continuing the concentrating process until it reaches a semi solid form.

Since, the pH of *meera* extracted from the islands is slightly acidic or partially fermented (pH below 6.8), further crystallization does not happen and *katti* (semi solid form of concentrate or spread) is the end product. The *katti* thus obtained is packaged in glass or plastic bottles and stored for further use. Women groups generally purchase *katti* from the tappers and entrepreneurs who usually prepare it.

Over the years, the shortage of tappers across the islands has significantly affected the supply of *katti*. To address this, people have adopted alternative methods of preparation using mature coconut water.

They replicate the traditional process by adding sugar (approximately half a teaspoon or around 2.5 g per litre of water) or at times commercially available jaggery (around 15 g per liter of water). The mixture is then concentrated to achieve the same consistency as traditional *katti* maintaining its usability in various traditional dishes and beverages despite the shortage of naturally tapped *meera*. According to the tappers involved in making *katti*, approximately 1 kg of *katti* can be produced by boiling and evaporating 7-10 litres of *meera* over duration of about 3 hours.

Quality analysis

The *katti* prepared in different islands were analysed for its qualitative attributes (Table 17). The moisture content of the collected samples varied from 8.46% to 13.22%. Currently, there are no specific standards established for *katti* or jaggery, or syrup. The International Coconut

Table 17. Quality analysis of *katti*

Locality	Moisture (%)		Total sugar (%)		Total minerals (ash) (%)		Protein (%)	
	Range	Mean	Range	Mean	Range	Mean	Range	Mean
Agatti-1	16.19-17.09	16.64	77.18-76.65	76.92	4.98-5.02	5.00	1.65-1.24	1.44
Androtт-1	12.43-12.44	12.44	81.61-81.27	81.44	4.72-5.03	4.88	1.23-1.26	1.24
Agatti- 2	6.99- 9.94	8.46	87.50- 83.56	86.39	4.69-5.35	5.02	0.72-0.75	0.73
Agatti -3	10.49-13.31	11.90	83.89-81.19	81.10	4.59-4.90	4.75	1.02-1.32	1.03
Androtт-2	13.56- 11.90	12.73	82.54-81.05	80.08	4.09-4.61	4.35	1.03-1.04	1.32
Kalpeni	12.70-13.75	13.22	80.23-78.60	79.41	6.1-6.34	6.22	0.97-1.3-	1.14

Community (ICC) has defined standards for coconut sugar. But similar guidelines for coconut jaggery or syrup are lacking.

Katti lies between jaggery and syrup in terms of consistency. According to the ICC, coconut sugar contains 80–96% total sugars and 2.4% ash. On the other hand, a laboratory report by the Coconut Development Board (Aneeta Joy and Praseetha, 2016.) indicates that coconut jaggery contains 9.1% moisture, 87.54% total carbohydrates, 0.72% protein and 1.97% total minerals.

The total sugar content, proteins and minerals in the *katti* samples ranged from 76.92% to 86.39%, 0.73% to 1.44% and 4.33% to 6.225 respectively. The mineral content was relatively high in all samples especially the phosphourous, potassium and calcium probably due to the calcareous and sodium-rich soils of Lakshadweep.

Katti is in high demand in the islands, but its supply is limited due to the shortage of *meera* tappers across the islands. Tappers need to be incentivized through support provided by the Department of Agriculture/industries. Additionally, efforts are needed to introduce neera technologies with improved mechanization, quality and hygeine across all the islands.

In this regard, ICAR-CPCRI technology for Kalparasa collection with Coco sap Chiller and coconut sugar production offers significant potential. This natural sugar could be marketed as 'Lakshadweep Sugar' emphasizing its organic nature and unique attributes.

The traditional method of preparation of *katti* is laborious and involves drudgery. To maintain the taste and reduce acidity in the *meera*, additional steps of adding coral stone are practiced, which can be avoided by adopting cocosap chiller technology. Initial trials for producing coconut sugar were successfully carried out at Kavaratti with the support of KVK, yielding promising results in terms of recovery and quality. Additionally, in Kalpeni and Kavaratti, three tappers extracted jaggery from Kalparasa.

❖ Mr. Jamaluddeen, a native of Agatti island, has been tapping from his childhood. As a skilled professional, he collaborated with KVK to produce coconut sugar for the first time in Kavaratti island during 2021-22. Earlier he was extracting *meera* using traditional methods with mud pots, plastic buoys and plastic bottles collecting 30-40 liters of *meera* daily. Through KVK he was provided with 10 coconut sap chillers and trained in Kalparasa production and coconut sugar making.

During the trial, the collected Kalparasa was heated in a large pan over firewood for 30 minutes, with continuous stirring to prevent charring. After 30-45 minutes, the kalparasa began to crystallize into sugar granules. The mixture was then rapidly cooled and stirring continued to break up any lumps. Finally the content was sieved to ensure a uniform particle size resulting in high-quality sugar.

He also produces *katti* and vinegar based on buyer demand. After successfully making coconut sugar, he was further supported with an open pan *neera* cooker to concentrate the *neera* for coconut sugar production.


CMFRI
KG
NEERA PRODUCTS
കെ. ജി
നീര ഉൽപ്പന്നങ്ങൾ
Entrepreneur: Mr. K. Jama
സംരംഭകൻ: ശ്രീ.കെ. ജമാ
Promoted and facilitated
KVK-Lakshadweep
ICAR-Central Marine Fisheries Resea
Technical guidance
ICAR- Central Plantation Crops Researc

According to Jamal, there is a steady demand for coconut sugar. However, the need for ice and a deep freezer to store the collected Kalparasa remains a challenge. Currently he is working to address these two issues.

Future prospects in *katti* and coconut sugar

The inadequate supply of *katti* (coconut jaggery) remains a persistent issue for preparing coconut halwa on a sustainable basis across all the islands. Hence, efforts are to be made to encourage and promote tappers by providing suitable incentives to ensure a consistent supply of *katti*. Additionally, there is significant potential for the production and marketing of organic coconut sugar and exploring collaboration between ICAR-CPCRI, KVK and the U.T administration could be beneficial.

Coconut Vinegar

The traditional practice of fermenting tapped neera (*meera*) into vinegar is popular across all the islands. Vinegar is commonly known as *surkka*. Approximately 3522 litres of vinegar is produced and marketed annually across the islands of Lakshadweep. Technically vinegar is an acidic liquid containing acetic acid as the main component, made from fermentable carbohydrate source within two steps: alcoholic fermentation and acetification (Beegum et al., 2018).

Any substrate containing at least 10% of fermentable sugar and starch is suitable for vinegar making. Commercial natural vinegar is made from apple. However in Lakshadweep islands, neera is the only substrate used for making vinegar. It is an essential item commonly used for the preparation of fish curries and fish pickles to enhance flavor and to extend shelf life. In addition, small quantity of vinegar is also used while frying fish and chicken.

In earlier days, when processed drinks like squash or RTS (Ready to Serve) drinks were not popular, vinegar based RTS was consumed. One teaspoon of vinegar is added in one glass of water along with sugar and cardamom and used as a ready to drink product.

Method of preparation of *surkka*

Tapped *meera* is transformed into vinegar either by the tapper himself or by entrepreneurs who purchase it from tappers. They produce vinegar and sell it to the local community. Alternatively, individuals buy meera and ferment it into vinegar at home for household purposes.


VINEGAR


KAKACHI
FOODS
LAKSHADWEEP
coconut
VINEGAR
500 ml.

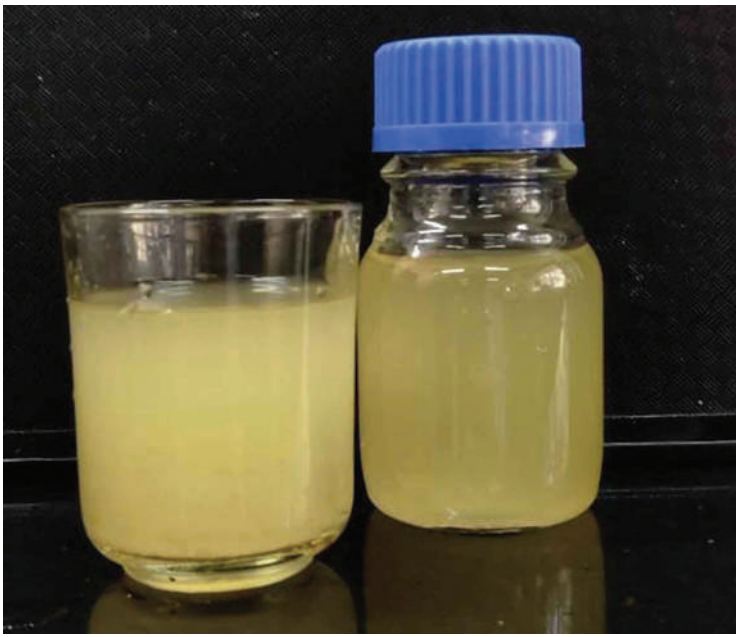
Traditionally for making vinegar, the collected meera is put into an earthen pot (locally called *sheeni* or *shaadi*) filling three-fourth capacity with covering the lid with muslin cloth and tying the ends with a piece of that cloth. Nowadays HDPE (High density polyethylene) drums are also used for making vinegar. The fermentation process lasts for about 40 days. Till then it is kept undisturbed. Technically this process is aerobic fermentation where the alcoholic ferment is the starting material for converting into acetic acid. In the islands vinegar is sold at Rs. 200 per litre.

Surkka is prepared in almost all the islands which is always in high demand. Presently vinegar production is adversely affected due to the shortage of tappers across the islands. Hence, a substantial quantity of synthetic vinegar is marketed through the local grocery shops to meet the growing demand. Of late, some of the coconut oil entrepreneurs have started making natural vinegar from mature coconut water.

The Lakshadweep organic coconut oil processing unit of Kiltan island make coconut water vinegar and sell under their brand name of 'Orgolak' and traded to the 'Kakachi' brand based on the training obtained from Coconut Development Board, Kochi. The process involves addition of refined sugar followed by pasteurization and keeping for alcoholic fermentation by adding yeast for almost a week followed by addition of mother vinegar (a thin gelatinous film formed on top of previously fermented coconut vinegar) and keeping for fermentation for next 20-21 days.

Quality analysis of the traditional vinegar made from Lakshadweep was carried out at CPCRI Kasaragod and the results showed that the quality of vinegar is good in terms of the percentage acidity content. On an average 5% acidity in terms of acetic acid was obtained with light yellow colour and a sweet taste. According to the FDA (Food and Drug Administration, USA) standard, vinegar should contain not less than 4% acidity.

At present, production of natural vinegar in the islands is not sufficient to meet the demand from the local population. Since the limiting factor is lack of availability of *meera* on a regular basis efforts are required to enhance the *meera* availability throughout the year for continuous supply of vinegar for which more number of palm climbers are to be attracted to the enterprise on *surkka*.



Lakshadweep Halwa

Lakshadweep halwa (locally known as *aluva or Dweep unda*) is a traditional food product of Lakshadweep islands which is in very high demand. It is made with coconut gratings and *katti*.

The word "halwa" refers to a kind of confectionary that originated in Persia and is extensively distributed throughout South Asia and the Middle East. Most types of halwa are dense confections sweetened with sugar or honey. It is a popular dessert prepared in Indian households that resembles a very thick pudding. It is usually associated with auspicious celebrations. It is made from different sources including refined wheat flour, semolina, green gram, chickpeas, carrots, etc. Halwa is described as yellow-brownish, opaque, soft and smooth in texture in North India (such as *carrot halwa*) whereas it is a translucent, lustrous, jelly-like substance in Southern India (such as *Kozhikodan halwa*).

Generally, refined wheat flour is used as the major ingredient in halwa in addition to refined sugar and fat. India has a wide variety of halwa, unique to particular regions of the country. However, Lakshadweep halwa is entirely different and unique from the popular varieties of halwas of India and south East Asia because of its choice of ingredients.

Preparation and use of halwa has been known to the islanders since time immemorial. The knowledge and skill for halwa preparation has been transfered through generations and many of the women of the present generation in Lakshadweep islands actively follow the traditional methods of halwa preparation.

Ingredients used in halwa preparation

Grated coconuts and *katti* are the two exclusive ingredients used for making halwa. The product is unique since all of the ingredients are derived entirely from coconut. The maturity of the kernel is very critical which influence the quality of the final product. Less fibre content in coconut kernel is desirable for halwa preparation since it enhances the consistency of the product. Hence, 9-10 months old nuts are used for preparing halwa. The nuts are harvested by skilled climbers following traditional method.

Women of the neighborhood prepare the halwa as a community activity. In addition, men are also engaged in halwa making. In every island, women groups are actively involved in preparation and marketing of halwa. Usually the quantity of halwa prepared and frequency of preparation depend on the demand from the local community. However, in islands like Agatti where there is more visitors from the mainland, some of the women groups are involved in preparation and marketing of halwa on a continuous basis.

There is more number of women groups in such islands who pursue halwa related income generating activities. Furthermore, in islands like Agatti the availability of *katti*

is comparatively high due to the larger number of tappers. In the past, Department of Agriculture was implementing a scheme for promoting neera tapping in the islands.

As part of the scheme, neera tappers were engaged by Village Dweep Panchayath and the Department used to pay them the wages. Neera thus collected was sold to the public which was either converted to *katti* or fermented for making coconut vinegar. However, the availability of neera is on the decline as the scheme for promoting neera tapping by the Department was discontinued since 2021.

Katti is made by concentrating freshly extracted neera (*meera*) in an open pan (locally known as *Kaychemb*) using dried coconut residues such as spathe, rachella, petiole, pedicel etc as fuel.

During the initial heating time, more quantity of fuel will be used to bring the *meera* to boiling stage thereafter, once it starts thickening, heat will be reduced by removing some of the fuel material continuing the concentrating process until it reaches a semi solid form.

Since, the pH of *meera* extracted from the islands is slightly acidic or partially fermented (pH below 6.8), further crystallization does not happen and *katti* (semi solid form of concentrate or spread) is the end product. There is a traditional practice of putting coral stone (calcium carbonate) during boiling of *meera* for adjusting the acidity level. The *katti* thus obtained is packaged in glass or plastic bottles and stored for further use.

Method of preparation of halwa

The women group prepares halwa in the backyard of the house of one of the members. The members find the convenient time for halwa preparation setting apart enough time for household routine activities. Usually it is done during evening hours. The first step in the preparation of halwa is grating of the kernel, which is done manually using traditional graters. In a group, 3-4 women sit together for grating the kernels.

The open pan is heated first and then *katti* is poured into it to melt completely. Once it is melted completely, the gratings are added to it. This is the ancient traditional method adopted for making *katti*. Over the years different groups have modified the way *katti* is prepared. Some women groups pour required amount of water in the pan and heat, followed by adding *katti* to the water inorder to dilute the *katti*. Instead of water, coconut water obtained while splitting the nuts is also used for halwa preparation by some of the women groups.






They believe that use of coconut water enhances the taste of halwa. The diluted *katti* (locally known as *katti thanni*) will be further concentrated until it reaches one-string consistency.

The gratings are added once the liquid reaches one string in consistency and are mixed well to get the kernel uniformly coated with the liquid *katti*. Generally the women group make halwa with 1 kg *katti* and 12-20 slightly immature coconuts. This large variation in coconuts used for making halwa is due to the differences in the preparation method employed by different groups across the islands.

In some groups where coconut water is used for melting *katti*, the ratio of coconut gratings, coconut water and *katti* is about 1.5: 1.5: 0.5 respectively. Fresh coconut petiole is shaped and used as ladle for stirring the concentrate. The rationale for using the coconut petiole ladle is the belief that the stirring of the mix would be easier especially at the finishing stage of halwa making, when the mix would come closer to the petiole. The whole process is carried out under low flame. The process is stopped when the grating adheres to the ladle without sticking to the vessel. By the end of the process the greenish petiole turns to brownish in colour.

The halwa thus made will be made into ball shape when it is still hot and packaged with dried banana leaves. The two tips of the packet will be tied with banana leaf fibre. Halwa yield obtained will be about 40% of the total quantity of ingredients used. One packaged halwa will weigh approximately 35-40 g.




Nutritional quality and shelf life

The halwa is an Intermediate Moisture Food (IMF) as the moisture content of the ingredients is reduced to nearly 15-20% by concentration through heating during its preparation. Quality evaluation of halwa conducted at ICAR-CPCRI revealed that the moisture content of halwa prepared by the women groups ranged from 9% to 13%. It has comparatively lower fat content as the gratings were taken from the 8-9 months mature coconuts. The average crude protein, carbohydrates and total minerals were 3.43% 66.36% and 1.55% respectively (Table 18).

Since, the sweetness is completely contributed by *katti*, halwa can be recommended as diebetic friendly product with lower Glycemic Index (GI).

Table 18. Qualitative evaluation of coconut halwa

Sample	Moisture (%)	Fat (%)	Protein (%)	Ash (%)	Carbohy drates (%)
Coconut halwa	21.86± 0.13	6.53± 0.73	3.43± 0.47	1.55± 0.21	66.36± 0.66

Systematic studies on the shelf life of Lakshadweep halwa is scanty. However, its long shelf stability is evident from the experiences of the islanders. The reminiscences of elderly people of the islands reveal that halwa was prepared in large quantity for the Haj Pilgrims during olden days when it was long travel days in Indian-style boom boats (*odam or paykappal)* (which take 45–60 days to Mecca and to return to the islands) and the leftover halwa packaged in dried banana leaves brought back by the pilgrims tasted as fresh as the newly prepared halwa.

Production and marketing of Lakshadweep halwa by women SHGs

Women SHGs organized under the Dweepsree mission are actively engaged in the production and marketing of Lakshadweep halwa in the islands the details of which are furnished in table 19. A recent study by CPCRI Kasaragod indicated that there are 47 women SHGs spread across nine islands currently produce halwa with a monthly average production of 520 kg halwa.

Among the islands Amini tops the halwa production with a monthly average of 141 kg followed by Kadmat and Agatti with 68 kg and 69 kg respectively. Kalpeni and Kavaratti record relatively lower production at 46 kg and 30 kg respectively. Notably, Minicoy has no women group

reported halwa production while Bitra has only one group with a modest monthly production of 4 kg.

Table 19. Production and marketing of Lakshadweep halwa by women SHGs

Island	No. of women groups	Average monthly production (kg)
Agatti	10	69
Amini	9	141
Andrott	4	43
Chetlat	6	61
Kadmat	6	68
Kalpeni	2	46
Kavaratti	3	30
Kiltan	6	58
Bitra	1	04
Total	**47**	**520**

Halwa production in Lakshadweep is not a year-round regular activity, instead the quantity of halwa prepared and frequency of preparation mostly depend on the demand from the local community or from tourists. Due to the scarcity of neera, the important ingredient for halwa making, now a days many of the women groups use sugarcane jaggery and rice powder for making halwa instead of *katti* thus the authenticity of traditional method of halwa preparation and its unique taste are compromised. However, in islands like Agatti where there are more number of neera tappers ensuring a steady supply of sufficient quantity of neera for halwa making the women SHGs are able to stick on to the traditional method of halwa

preparation using *katti* and assure authentic product quality. Coconut jaggery-based halwa has a longer shelf life than the halva made using cane jaggery and rice powder.

As part of a recent study scientists of ICAR-CPCRI documented the process of Lakshadweep halwa preparation by some of the women SHGs and conducted techno-socio-economic analysis of such enterprises.

❖ Halwa preparation and marketing by Iqrah Dweepsree group, Kadmat

The Iqrah Dweepsree group is functioning in the 8th ward of Kadmat island. The group started its activities in the year 2017. Though there are 10 members, five of them only are actively involved in the preparation of VCO, halwa and snacks. The active members of the group includes Mrs. Ayshabi, Mrs. Beebi Khadeeja, Mrs. Haseena, Mrs. Hameedabi and Mrs. Hisana. Based on the order from customers, they make halwa and also for some special occasions like family members or relatives is going for Haj or higher studies etc.

The group utilizes on an average 15-20 nuts per day for the preparation of halwa. Coconut will be harvested specially for the preparation of halwa. Nearby climbers will be informed one day before and as per the requirements, especially with respect to maturity stage nuts will be harvested.

The whole process of halwa preparation depends on the availability of *katti*. If half a kilogram of *katti* is available,

approximately 10 nuts will be used. Grated material will be used to completely fill the diluted *katti.*

From 15 nuts, approximately 1.5 kg of gratings will be obtained. To that, 0.5-0.75 kg *katti* is added along with 1.5 litre coconut water. Almost 3.7 kg prepared halwa will be obtained, counting around 45 numbers of halwa pieces weighing 35 g each. It takes 2-2.5 hours to complete the process. One piece of halwa is sold at Rs. 20.

❖ Muhammadiya Neighborhood Group, Amini

The group started as a Neighborhood Group in 2018 and consists of three members involved in halwa making under the leadership of Mrs. Najeemath Beegum K.B.

Halwa production is primarily carried out based on demand and orders, with a maximum production capacity of 35 kg per month. For each batch they process 20 coconuts which are procured at Rs. 29 per kg, while coconut jaggery is sourced at Rs. 1000 per kg. Mixing the gratings of 20 coconuts with 2 kg of coconut jaggery yields an average of 3.15 kg of halwa.

Grating 20 coconuts takes approximately two hours, and the process of achieving the halwa consistency and forming it into balls takes an additional 5–6 hours. The halwa is sold at Rs. 30 per 35 g.

Economics

The processing of 20 coconuts incurs a total production cost of Rs. 2220. This includes Rs. 200 for coconuts (20 × Rs.10), Rs 1500 for 1.5 kg of jaggery and Rs. 520 for 8 hours

of labor (Rs. 65/hour). The return from this production amounts to Rs. 2250 achieved by selling 75 halwa balls at Rs. 30 each with a total weight of 2.625 kg.

Constraints and opportunities

Presently the halwa preparation is done manually which involves lot of drudgery for the women folk. The process of preparation of halwa involving grating the coconut, preparing *katti* and concentrating the ingredients through continuous stirring is quiet lengthy. It would take 2-2.5 hours to process 3 kg of raw materials.

Besides, the workforce has to bear the high temperature from the pan while preparing halwa. Hence, it would be quiet beneficial if the process is mechanized through the use of an open pan kettle with electrical stirrers (similar to VCO cooker or khoa kettle) to reduce the drudgery. In addition, making halwa balls is done when the halwa is hot which a cumbersome activity is. Use of suitable moulding equipments can ease the job.

Halwa is a unique value added product of coconut with high nutritional value exclusive to Lakshadweep islands with vast potential to become a Lakshadweep GI (Geographical indication) product. Though it has a great potential for marketing, the cost of halwa is higher due to the high cost of the *katti* (presently *katti* costs about Rs. 800-1000 per kg). As a result a wide variety of comparable items with a retail price of Rs. 5 per piece are available in the mainland market that is prepared using jaggery or refined sugar.

In the mainland such items are sold as Lakshadweep halwa or island halwa which actually lack the unique quality of the original product. As a result it is getting difficult to market the original Lakshadweep product which has to be sold at the rate of Rs. 35 to 50 per halwa piece to make it remunerative. Hence, it is imperative that some meaningful interventions are implemented to exploit the market potential of Lakshadweep halwa by the concerned agencies.

It is learnt that Lakshadweep administration has initiated steps for obtaining GI tag for Lakshadweep halwa. It is also necessary to document the unique properties of halwa including method of preparation, nutritional facts and nutraceutical potential. Once GI tagged, the vast potential of Laksadweep halwa for production and domestic as well as international markets can be better exploited which would enhance the income and employment opportunities of the islanders.

The added advantage of branding the halwa prepared by ingredients collected from coconut grown under the natural farming situation in Lakshadweep islands can also be effectively utilized. Needless to say, the coordination of efforts of various research and developmental agencies with active participation of islanders, especially women, is essential to effectively implement interventions to exploit the potential of Lakshadweep halwa.

Tender Coconut Marketing

Traditionally consumption of tender coconuts by the people of Lakshadweep islands was mostly confined to the festival season of Ramzan. Of late, the demand for tender nut is on the increase due to the surge in tourism activities.

A recent study conducted by CPCRI Kasaragod and KVK Lakshadweep indicated that there are about 17 entrepreneurs engaged in tendernut marketing spread across six islands (Table 20). Four islands *viz*., Amini, Chetlat, Kadmat and Bitra do not have any entrepreneurial activity pertaining to marketing of tendernut. All the 17 entrepreneurs together market on an average 20480 tender nuts per month; 17600 tendernuts sold to the local people and 2880 to tourists.

Kalpeni island leads with an average monthly marketing of 4980 tender nuts by three entrepreneurs, closely followed by Androtт and Kavaratti with 4800 tender nuts with three entrepreneurs each. Among the six islands Agatti has the highest number of five entrepreneurs engaged in tendernut marketing. Kiltan and Minicoy have one entrepreneur each marketing about 300 and 2100 tender nuts per month respectively.

The tender nut marketing scenario in the islands is characterized by seasonal fluctuations and the marketing efforts are mostly confined to November to April months during the Ramzan and peak tourism season.

Table 20. Marketing of tender coconut in Lakshadweep islands

Sl. No.	Island	Number of Entrepreneurs involved	Marketing pattern (Average nos. per month)	
			Sold to islanders (Nos.)	Sold to tourists(Nos.)
1.	Agatti	5	2500	1000
2.	Androtti	3	4800	-
3.	Kalpeni	4	4500	480
4.	Kavaratti	3	4000	800
5.	Kiltan	1	300	-
6.	Minicoy	1	1500	600
	Total	**17**	**17600**	**2880**

Broadly three patterns of entrepreneurial activities can be observed in the tender nut marketing in Lakshadweep islands.

i) Entrepreneurs buy tendernut from farmers and contractual climbers. In this pattern the entrepreneur focus on sales of tendernut.

ii) Coconut orchard owner himself is the entrepreneur and skilled climber and he sells tendernut directly to the consumers. Currently the tendernuts are sold @Rs.40-50 per nut.

iii) Entrepreneurs who own the coconut orchards hire the services of climbers usually paying Rs. 80-100/palm and sell the tendernuts during tourist season.

Apart from the above channels selected entrepreneurs usually receive order for bulk supply of tendernuts also

during peak tourist season from the Department of Tourism. Tender nut marketing has the potential to be a more vibrant and sustainable sector, benefiting both island communities and the broader economy. In some islands like Agatti tendernut marketing is becoming more vibrant activity because of the high demand from the tourists.

There are few entrepreneurs as discussed above engaged in tendernut marketing spread across the islands. Mr. Hidayath of Kavaratti island is one among them.

❖ Mr. Hidayath, a 51-year-old entrepreneur from Kavaratti island, recently has started a new business as a

tender coconut trader. Currently, he sells around 1400 tender coconuts per month. He sources tender coconuts by employing climbers and also leasing coconut trees from farmers.

He pays Rs.10 per tendernut to the farmer for the leased palms and Rs. 100 per tree to the climber. The climber takes a premium amount of Rs. 100 for harvesting tendernuts from each palm instead of the usual Rs.40 for the regular harvest of mature coconuts. Because harvesting tender coconuts requires extra care with the bunches tied and lowered slowly to avoid cracks on the nuts.

Each tender coconut is sold for Rs. 40. For instance, if a climber harvests three palms in a day, getting 15 tender coconuts per palm, the expenses incurred by Mr. Hidayath include Rs. 450 to the farmer (10 x 45), Rs. 300 to the climber (100 x 3) and Rs. 150 for transportation, totaling Rs. 900. By selling 45 coconuts at Rs. 40 each, he earns Rs.1800. After deducting the total expenses of Rs.900, he earns a profit of Rs. 900.

He sells tender coconuts in the roadside without any shelter or stall and manually chop the husk with a knife. There is potential to strengthen his business by introducing mechanized tools such as tender coconut punch and cutter and establishing a proper tender coconut parlor instead of selling in the open area.

Another entrepreneur in tender coconut marketing is Mr. Sabjan, (62 years old) from Agatti island who is known by the nick name *Elappa.* His prime customers are the tourists arriving once a week on the Cordelia cruise ship, besides

the local buyers and inter island vessel passengers. His marketing spot is close to the jetty where he has set up a tendernut parlour.

He harvests tender nuts from selected farmers' plot by engaging a climber. He pays climbing charge @ Rs.60 per palm to the climber. The climber also harvests the mature coconuts from the palms for the farmer who need not pay any charge to the climber. Around 10-20 palms are climbed to harvest tender nuts at a time, getting a maximum of 200 nuts.

Tendernuts from palms of orange dwarf cultivar (locally called *chentheng*) are often directly purchased by him from farmers' coconut gardens by paying at Rs. 40 per nut and selling at Rs. 60 per nut. Tendernuts of other varieties are sold at Rs. 40 per nut for the local buyers and at Rs. 50 for the cruise guests. At present all the operations for preparing tendernut for serving to customers are done manually by

Mr. Sabjan. Hence, machineries like tendernut punch & cutter and Snow Ball Tender Nut machine can be introduced in his tendernut parlour to reduce drudgery and to enhance income.

As there is growing demand for tender coconuts, mainly due to the increasing number of visitors to the islands, further value addition of the tender coconut can fetch a better price and entrepreneurs can earn more money. One such product is snowball tender coconut.

Snow ball tender coconut

Introducing a Snow Ball Tender Coconut machine (SBTN) developed by ICAR-CPCRI to serve tendernuts to tourists is a way to attract tourists and get more income for the entrepreneurs. The snowball tender nut is a ready-to-use tender coconut product, prepared without the husk, shell, or testa. It is round in shape, snowy white in appearance and retains the coconut water inside. The white kernel is carefully scooped out while keeping the water intact. It is served in an ice cream cup, customers can drink the coconut water by piercing the kernel with a straw and later consume the kernel using a fork.

Adopting a snowball tender coconut machine can increase the value of each tender nut, fetching Rs. 100-120 per unit compared to Rs. 50 otherwise.

This technology holds significant potential for application in regions like Lakshadweep, particularly Agatti. Key locations in Agatti island such as the eastern and western

jetties frequented by foreign cruise ships and domestic vessels and the airport present promising opportunities for introducing SBTN machine in tendernut parlours.

Constraints

Lack of availability of tendernut during the peak period of demand is the major problem in the tendernut sector of Lakshadweep islands as perceived by the entrepreneurs and palm climbers. The ideal coconut palms suitable for tendernut purpose, especially the palms of dwarf cultivars such as such as Lakshadweep orange dwarf, Lakshadweep yellow dwarf and Lakshadweep green dwarf is very meagre in Lakshadweep islands.

Lack of availability of good quality coconut seedlings especially seedlings of dwarf varieties of coconut is a major problem to popularise coconut cultivation for tendernut purpose. Climbing the tall palms and harvesting tendernut without damaging it is a tedious job for the palm climbers. Coconut growers are of the opinion that, of late, there is a decline in the coconut productivity and tendernut availability also is limited due to the declining production. Besides the above, loss of tendernuts due to rodent attack is another problem resulting in reduced tendernut availability.

Strategies

Based on the field level observations and interactions with entrepreneurs, palm climbers, coconut farmers and other stakeholders few interventions are suggested for implementation for strengthening tender coconut sector of Lakshadweep islands as follows.

- Identification and selection of suitable mother palms of dwarf coconut cultivars, producing seedlings by utilizing them and raising coconut orchards in suitable locations for tendernut purpose in Lakshadweep islands.
- Introducing the tender coconut punch and cutter developed by ICAR-CPCRI. Currently the tendernuts are cut and served manually and only very minimum level of mechanization is employed.
- Establishing tendernut parlours in tourist centres to be managed by women SHGs or FPOs and introducing Snow Ball Tender Coconut machine to serve tendernuts to tourists.
- Enhancing coconut productivity through suitable eco-friendly soil health and plant health management practices and also rodent management through restructuring coconut orchards to ensure optimum palm density.

Desiccated Coconut Powder

Desiccated Coconut Powder (DCP) is one of the export oriented value added products of coconut. It is technically the white kernel of the coconut, comminuted and desiccated to a moisture content of less than 3%. Earlier, DCP was produced and marketed by public sector enterprises under the Lakshadweep Development Corporation Ltd, U.T. of Lakshadweep. There were four DCP units, one each in Kadmat, Amini, Kalpeni and Agatti islands, which are currently non-functional due to various reasons. During production time approximately 35-40% of DCP produced were sold locally at Rs. 250/- per kg with LDCL Kochi serving as the primary marketing outlet. There was good demand for DCP during the tourist season from October to March and buyers were attracted since the DCP was made from organically produced coconuts in the islands.

Desiccated Coconut Powder Unit, Kadmat

The unit was established in the year 1993 and discontinued operations in November, 2021. There were 19 labourers. Though the processing capacity of the unit was 2500 coconuts, only 1500–2000 coconuts were used to produce on an average 150 kg of DCP per day. Besides desiccated coconut powder, the unit also produced and sold coconut testa oil and occasionally, coconut oil.

The officials of LDCL perceived reasons such as problems in marketing, low demand for the product in the islands, higher production costs compared to the mainland, delays in transporting products from Lakshadweep to the mainland etc for the closure of the units. However, the unit could provide employment to many islanders and also benefitted the coconut farmers through regular procurement of coconuts required for processing of DCP.

As part of the study on coconut enterprises in Lakshadweep, team of scientists from CPCRI Kasaragod had visited the DCP unit functioning at Kadmat during 2020, documented the functioning of the unit and made suggestions for enhancing the efficiency of the unit.

During the visit, it was observed that the furnace and blower inside the factory were emitting intense heat, causing discomfort for the workers. In addition, many of the

machineries were out-dated and had low efficiency. Suggestions were made for enhancing the efficiency of the DCP unit as follows.

- The existing machineries are to be replaced with newer versions to increase the efficiency and to reduce drudgery.

Unit operation	Existing practice	Suggestions for increasing efficiency
Dehusking	Manual	Manual (employment generation for localites)
Deshelling	Manual	Use of mechanical deshelling machine
Testa removing	Manual	Use of testa removing machine
Pulverizing	Mechanical but out dated	Replacement with new pulverizer
Drying	Tray drying	Newer model with automatic control panel
Packaging	Manual	Form Fill Seal (FFS) machine

- The DCP produced in Lakshadweep has the advantage of being made from organically grown coconuts which can appeal to health-conscious consumers and niche markets in the mainland and global market. The potential for branding the DCP as 'produced from organically grown coconuts' was not utilized by LDCL. Highlighting its organic origin and uniqueness through

proper labeling and marketing strategies can attract premium price and larger markets.

- The old buildings and infrastructure need to be renovated and advanced equipments and machineries to be introduced to utilize the production capacity of the DCP units in the islands. In addition, a small scale quality control laboratory has to be set up along with the existing plant.
- The tourist season from October to March would give an opportunity for direct sales which can create high demand for organic DCP and other locally made coconut products among visitors.
- More attention needs to be paid for maintaining quality standards for the finished product such as moisture content, fat content, free fatty acids, microbial load etc.
- In the DCP unit, the process chain can be completely mechanized for producing export quality DC powder from Lakshadweep.

Coir and Coir Products

The history of Lakshadweep is intertwined with the coir industry, which was a traditional livelihood for the islanders. Coir twisting, a skilled craft involving the conversion of

coconut husks into durable yarn, has been practiced in the islands for generations. Historically, the people were engaged in a barter system, where twisted coir was exchanged for the essential groceries.

A coir monopoly system existed both pre and post independence. After independence, the Government of India assumed control over the collection, processing and sale of coir to ensure fair pricing for producers. Twisted coir was exchanged for staple rice which was procured from the Food Corporation of India in Nileswar, Kerala. The rice was

temporarily stored at the Central Warehousing Corporation in Mangalore until gets the transportation facility to the cooperative societies in the islands (Ramunny, 1999). This system not only supported the livelihood but also fostered trade relationships with nearby coastal regions making coir an integral part of the economy of Lakshadweep.

Coir demonstration–cum-training centres were established during 1974-75 by the Department of Industries under UT administration to train the local women in production of thinner coir yarn which had good market value, not only in the Islands, but also in the mainland.

There are seven coir fiber factories (in Androtт, Kadmat, Chetlat, Agatti, Kiltan, Kalpeni, and Amini) six coir production-cum-demonstration centres (Androtт, Kadmat, Chetlat, Kavaratti, Agatti and Amini) and three fiber curling units (Androtт, Minicoy and Kavaratti) functioning in different islands.

In addition to the above units, the department has also established one coir spinners industrial cooperative society in Amini during in 1997. As per the data available with the Department of Industries, the above coir units produced a total of 34.4 t of coir fibre, 53 t of coir yarn and 24 t. (LD-1801/1/2024-IND-TECH-IND) from 2018 to 2024.

A coir jewellery unit was also established as an extension to the coir production cum demonstration center in Androtт. Besides, handicraft training centres are also functioning, one in Kavaratti since 1973 and another one in Kalpeni since 1979, under the Department of Industries providing training to interested persons in making seashell-toys, coconut shells-

craft, wood carving etc. Out of these, the centre at Kalpeni was closed in 1988.

In the coir fibre factory in Kadmat island about 1200 coconut husks are processed per day for making coir fibre using the retting method. The yield of fibre obtained is about 70-75 kg. Coir pith, the by product, is unutilised. In this factory 10 women labourers are engaged in coir spinning. The conveyer belt is not in working condition. The existing machineries can be replaced with improved alternatives. Setting up of facility with improved machineries will result in drudgery reduction and enhanced output. Sales of the mat produced are confined only to the factory outlet. Collaboration with other agencies like Coir Board should be utilized for marketing these coir based products. The Coir Production Centre in Androtт island engage 12 workers; 11 women and one male. There are eight spinning machines in the centre, two are damaged and need to be repaired.

Challenges and strategies

The coir units under the industries department experience many constraints including lack of availability of sufficient quantity of coir fibre and delay in getting spare parts of machineries. Once the machines are damaged there is huge delay in getting the same repaired. The efficiency of coir fibre and spinning units can be enhanced by improving infrastructure, introducing new machineries and equipments, timely repair of machineries and product diversification etc.

Other Minor Coconut Enterprises

Besides the important coconut enterprises discussed in the previous sections, Lakshadweep islands are known for enterprises on a variety of other minor coconut products also. These small scale or household enterprises are mostly based on products that are made using coir, kernel, water, shell or sap etc.

i. Coir jewellery

Coconut husk is generally used as a fuel in households after drying under sun, besides selling to coir fibre factories situated in islands like Androth, Kadmat, Chetat, Kavaratti, Agatti, Amini and Kilthan.

During 2009, a coir jewellery unit was established as an extension of the coir production cum demonstration centre situated in Androtт. Initially, five women workers were trained on coconut fibre based jewellery and handicrafts making at National Coir Training & Design Centre (NCT&DC) functioning under the Central Coir Research Institute (CCRI) of Coir Board, Kalavoor, Alappuzha district of Kerala. Since then, making of coconut fibre based ornaments and jewellery items were successfully initiated in the island. By 2016, these master trainers started imparting training to selected women from the island.

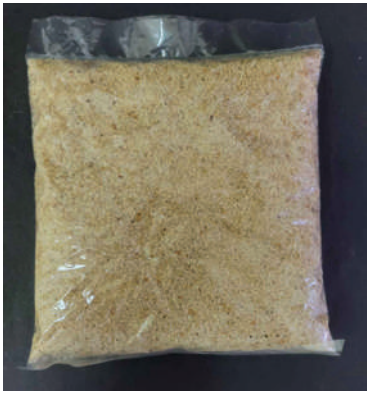
Presently there are about 50 trainees working in the unit. They make a variety of items including earrings, pendants, necklaces, finger rings, long chains and bangles. The initial


M.I.J. Jewells
Pink
Green
Blue
Violet
White
Black
Blue
Red
White
Black
10/-Zirconia
10/-
TEENAGE




step in the chain/ necklace making is the formation of coir fibre duct. It will take around 10 minutes to make one duct. A long chain will be consisting of such type of 200 ducts. Minimum two days are required to finish one product. It needs immense patience and soft skill to make these kinds of products. Recently training was provided to school students on the coir craft making. Of late, many people from other islands also received training from CCRI and started producing and marketing coir jewelleries. They sell the products during exhibitions, tourists visits etc.

ii. Roasted coconut gratings



Roasting the coconut gratings before using in any food product is a traditional practice followed in the islands. The roasted flavor of coconut is much preferred and it enhances taste. However, the commercial market potential is yet to be explored. Some of the Dweepsree women SHGs in Chetlat prepares roasted coconut gratings in small quantities and market locally.

In addition, the Island Level Federation (ILF) of Chetlat prepares products such as hair oil, coconut dry nuts, *lehyam* from coconut inflorescence, *kayakkatti* (health mix for pregnant ladies), oil mix for acidity relief etc. in small quantities and sell to the local consumers.

iii. Roasted coconut paste

In the past, roasted coconut paste was a key ingredient in nearly all traditional curries and gravies. Manually grated coconuts are roasted in a cast iron *tawa* till the gratings turn to golden brown in colour and crispy texture. After cooling down to the ambient temperature it is ground using a traditional stone grinder (locally known as *ammi*). Nowadays, women use electrical stone grinders for grinding the roaster grating. However, there is no commercial venture on roasted coconut paste as yet in the islands. Approximately, 1 kg paste would be obtained from 2 kg gratings.

iv. Coconut based Ready To Eat Snacks

Many raedy to eat fried snacks are made in the islands with coconut as a major ingredient which are mainly prepared and marketed by the women groups. They make snacks with wheat flour or rice flour along with other ingredients including coconuts, namely; *feerappam*,

madkkmand, baara, kaththiyura, masappam etc. These snacks have high demand among the islanders and mainland people and sold as *dweep palahaarangal*. At present, one packet of snacks (100 g) is sold at Rs.10-20. However, the challenge they face is the presence of oily flavor and rancid taste during the storage of these products. Hence, majority of the self help groups use palm oil for frying the snacks.

v. Coconut handicrafts

Coconut shell based handicrafts are very popular in all the islands. Earlier, the Department of Industries organized several capacity building training programmes on coconut

handicrafts. Among the women SHGs across the islands, the group in Agatti showcase their products during the arrival time of Cruise ship (once in every week), and also market in Kavaratti island. However, the products need some refinement as they lack finishing. Efforts should be made for organizing refresher training programmes to benefit the selected skilled craft persons.

vi. Hair oil

Apart from the Ddweepsree groups, private entrepreneurs also are engaged in the production of coconut oil based hair oil. The Lakshadweep organic coconut oil processing unit (with the brand name of Orgolak) produces and markets small quantities of hair oil infused with coconut oil and lavender essential oil for fragrance.

vii. Coconut leaf based products

The plated fresh and matured coconut leaves which are locally known as *kidu*, are traditionally used for various

purposes such as making roof thatches, flooring for drying copra in open yards, covering the natural fences made with coconut petiole etc. Huts with thatched coconut leaf roof are often sought after by the tourists from various parts of the world visiting the islands.

In the olden days children holding toys made from coconut leaves during the evening hours was a regular feature of the beaches. In addition, coconut leaves are plated for making traditional hats for the fisherman and baskets for collecting fishes.

viii. Coconut petiole for making fences

Traditionally, households and plots of land in the islands were demarcated by fences made from coconut petioles, which were durable and lasted for many years. Currently a few youngsters prepare and sell coconut petioles to the islanders to make fences for which they charge one rupee per petiole.

ix. Coconut lemonade

Recently, some coconut oil expelling units have started producing mature coconut water based drink known as lemonade by adding ginger, lemon juice and refined sugar. This drink is diluted before serving. Additionally, a few units produce vinegar from mature coconuts by adding yeast and mother vinegar, addressing the shortage of *neera* vinegar in the islands.

x. Coconut wood based furniture units

A few coconut wood based furniture making units operate in some islands. An industrial cooperative society of furniture makers was functioning in Kavaratti island, which was closed a few years ago (District Census

Handbook of Lakshadweep, 2011). In addition to coconut wood, other types of wood available in the islands such as *Thespesia*, is also utilized for making furnitures.

xi. Coconut nursery

At present there is no coconut nursery enterprise existing in Lakshadweep though there is demand for quality coconut seedlings. Earlier, the farms under the Department of Agriculture were supplying coconut seedlings to the farmers. But after the closure of these farms islanders are finding it difficult to procure quality seedlings for planting. Currently one entrepreneur, Mr. Abdul Hameed, in Chetlat island is engaged in the production and marketing of coconut seedlings.

Mr. Abdul Hameed (52), Edanilam, is a progressive farmer from Chetlat island. He cultivates vegetables in his tiny holding of 7 cents. In 2014, he established a coconut nursery in his small farm and named it as Ria Agri Farm.

Presently it is the only coconut nursery that exists in Lakshadweep. He usually sells six months old coconut seedlings within the Lakshadweep islands and to the mainland. Last year he sold about 100 coconut seedlings of Laccadive Ordinary Tall, Orange Dwarf, and Green Dwarf varieties. He is also marketing vegetable seeds, organic manure and agricultural tools. In the initial years of establishment of the farm he procured 25 seed nuts each of the Orange Dwarfs (*Chendeng*) and Green Dwarfs (*Pathinettampatta*) from K. P. Mohammed Shafi, a farmer in Minicoy and A. P. Akber Ali from Andrott. The Ordinary Tall variety was selected from his own farm.

Technical support from the Department of Agriculture, Chetlat, along with traditional knowledge passed down from his ancestors guided him in identifying the mother palms and raising seedlings. Currently he is selling coconut seedlings @ Rs.300 per seedling. He is keen to conserve the coconut genetic resources in the islands and his vision is to make available quality planting material to the islanders.

He was honored with cash award for his outstanding performance in farming under the Nutri-garden project of the Department of Agriculture in 2023. He also received 'Best individual farmer award' instituted by **Fenix** Arts and Sports Association, Chetlat in 2023. The potential for the enterprise on production and marketing of coconut seedlings in the islands can be effectively utilized by entrepreneurs. Capacity development programmes can be organized by KVK Lakshadweep on scientific practices for planting material production in coconut to benefit the prospective entrepreneurs of the islands.

xii. Broom from coconut leaf midrib

It is a traditional practice by some of the islanders, especially women, to make brooms with coconut leaf mid ribs. One or two persons in each island are popular for broom making activity. Mrs. Haseena, P.C., a 40 years old woman from Kadmat island is one such skilled person engaged in making and selling brooms with coconut leaf midrib since the last 13 years.

The process of making brooms from coconut midribs involves cutting the matured coconut leaves, stripping for separating the midribs from the leaflets, drying them under shade, and cutting them to uniform lengths. The midribs are then bundled together and tightly tied with coir yarn or any other twine.

Some skilled workers used to make handles with plastic or iron for providing better grip for the broom. Broom made from coconut leaf midrib is an eco-friendly household product. Presently Mrs. Haseena makes 15-20 brooms per month.

In addition to local sales in Kadmat, she receives orders from nearby Amini island and has even supplied to customers from mainland. In addition to making brooms, she also repairs bags and footwear and make cloth bags, for which she got trained from the department of Women and Child Development. Among the 30 women who participated in the training programme, Mrs. Haseena only continues to pursue this as a profession. The Island Level Federation of Kalpeni island also sells such kind of brooms.


ILF, Kalpeni
Dept. of Rural Development, UTLA

Other Potential New Coconut Based Enterprises for Lakshadweep Islands

Coconut based enterprises in Lakshadweep islands at present are mostly confined to the coconut oil expelling oil units managed by private entrepreneurs, small processing units on traditional products like VCO, halwa etc managed by women SHGs and small scale enterprises on other minor coconut based products. There is potential for introducing some other enterprises on coconut based products in the islands which are briefly presented below.

i. Coconut chips

Coconut chips are prepared by osmotic dehydration of the kernel. The slightly immature nuts of 9-10 months are ideal for making coconut chips. The process starts with dehusking, deshelling, testa removing, slicing, osmosis (dipping in salt or sugar solution) and drying.

A coconut oil unit from Kiltan island, the Lakshadweep Organic Coconut Oil Processing Unit, has recently started producing and marketing a limited quantity of sweetened coconut chips under the brand name 'Orgolak.' Coconut deshelling, testa removing, slicing and drying are done manually. Recently, a slicer and a dryer were supplied to the unit under the Tribal Sub Plan (TSP) fund of ICAR-CPCRI.

Coconut chips unit would be also ideal for the women self help groups. A machinery investment worth Rs. 5 lakhs is required for processing of coconuts (250 coconuts) for chips production and packaging.

ii. Value added products from virgin coconut oil

Virgin coconut oil can be further diversified into various value added products such as baby oil, massage oil, hair oil, VCO capsules, oil pulling mouthwash, nasal spray etc. This product diversification can offer significant opportunities for generating additional income, especially for women self-help groups, by enabling them to tap into new markets and expand their entrepreneurial ventures.

iii. Frozen coconut delicacy

These are coconut-based alternatives to commercial ice cream. Since Lakshadweep lacks dairy milk plants or outlets, coconut serves as the primary milk substitute in nearly all cooking recipes, including payasam, sweets, curries and other dishes. Therefore, ice cream made from coconut products, such as coconut milk and tender coconut, would be a potential product to start entrepreneurial ventures in the islands.

A small scale ice cream plant of 50 litre capacity requires processing steps such as coconut mixing ingredients, pasteurization, homogenization, ageing, continuous or batch freezing and hardening after extracting coconut milk.

A centralized ice cream production facility could be established on at least one island with financial assistance from the Department of Industries, or Coconut

Development Board or any other supporting agencies. IACR-CPCRI has already transferred the technology for frozen coconut delicacy to the KVK, Lakshadweep.

iii. Coconut milk residue (CMR) and VCO cake based products

Coconut milk residue (CMR) and VCO cake are the two byproducts obtained during virgin coconut oil production. CMR is a rich source of fibre (approximately 25%) while VCO cake is a good source of protein (approximately 20%). These byproducts can be effectively utilized in the preparation of bakery, confectionery, ready-to-eat snacks such as biscuits, cookies, cakes, muffins and extruded products. Their utilization not only enhances income of VCO production units but also serve as an effective means of waste management. Women SHGs can effectively utilize hands on training programmes organised by different agencies like KVK Alappuzha, KVK Kasaragod, ICAR-CPCRI, CDB etc.

iv. Coconut based ready to eat snacks

Many traditional snacks are prepared and marketed in Lakshadweep. However, the current practice involves manual frying and packaging which can be improved through several strategies. Introducing FFS (Form Fill Seal) packaging would streamline the process, which can improve the efficiency and ensure product quality apart from attracting more customers.

Establishing a common facility for packaging would further optimize production and reduce costs. Additionally,

improved branding can help to create a distinctive identity for the products. These snacks items can be branded as 'Lakshadweep food product' and marketed among the local consumers and tourists visiting the islands.

v. Tender coconut marketing

a) Tender coconut punch & cutter machine

The tendernut marketing units in Lakshadweep can make use of the **tender coconut punch** for punching the tender coconut to drink the water instead of chopping with knives thereby enhancing the efficiency of the tender coconut vendors. Besides, using the cutter provided in the machine would help to hygienically cut the tender coconuts to take out the tendernut pulp for consumption.

b) Snow Ball Tender Nut (SBTN)

Another product to be introduced is the snow ball tender nut. It is the deshelled tender nut (eight months old) with snowy white kernel obtained by scooping out the kernel with water intact using a snow ball tender coconut machine (SBTN). Tendernut parlours using SBTN machine would be ideal in tourist spots and jetties across the islands in Lakshadweep.

vi. Dehydrated coconut gratings

Enterprises on grated and dehydrated coconut would be highly suitable for Lakshadweep as none of the DCP units under the LDCL are currently operational. Small-scale processing of dehydrated coconut gratings would be ideal

for the islands, where the grated or pulverized coconut kernel can be dried using a tray dryer.

vii. Mature coconut water based products

Mature coconut water which is generally wasted during cutting of mature nuts for copra or VCO production. A variety of value added products such as *Nata de Coco*, coconut squash, concentrated water, vinegar etc. can be prepared using mature coconut water.

Nata de Coco, a jelly-like fermented product, is prepared by mixing coconut water with sugar and inoculated with a bacterial (*Acetobactor xylinium)* culture. Coconut squash, a sweetened and flavored concentrate is a refreshing drink made from mature coconut water.

A few coconut oil enterprises in the islands are already utilizing coconut water for squash, RTS (Ready to serve) and vinegar. Small scale enterprises on mature coconut water based products can be a source of income and employment opportunities for entrepreneurs and women SHGs in Lakshadweep.

viii. Production and marketing of organic inputs

Agriculture in Lakshadweep islands has been declared as organic and organic inputs in huge quantity is required for managing the coconut palms and subsidiary crops under organic farming practices. Hence, enterprises on production and marketing of organic inputs such as vermicompost using coconut leaves, coir pith compost, *Trichoderma* cake etc hold significant potential for Lakshadweep islands.

The recyclable biomass available in plenty in the coconut gardens of the islands including coconut husk, coir, coconut leaves, etc., which are otherwise discarded as waste can be effectively utilized for the production of organic inputs. Women SHGs can be supported to manage enterprises on production and marketing of organic inputs in the islands.

ix. Coconut leaf straw

Enterprises on coconut leaf based biodegradable straw have been successful in the mainland. Production of coconut leaf straw by the women SHGs in the islands and marketing of the same under the 'Lakshadweep organic' common brand name has potential to be a successful enterprise in Lakshadweep islands.

The potential for establishing small scale enterprises on new and emerging coconut based products can be effectively utilized by the entrepreneurs as well as women SHGs in the islands especially in the present day context of increasing tourism activities.

Besides, the potential for branding of these products as 'Lakshadweep organic/ natural coconut products' can also be utilized along with implementation of interventions for necessary certification procedures. Capacity development programmes to benefit the prospective women SHGs and entrepreneurs are to be organized on the production technologies and marketing strategies for effectively managing the small scale enterprises on new and emerging coconut based products in the islands.

Sustainability of Coconut Enterprises

The coconut based enterprises in Lakshadweep islands face many challenges in sustaining their activities effectively as envisaged. Lack of transport facilities and high transportation charges, lack of availability of raw materials for processing, difficulty in quality testing of the product, difficulties in repair of machineries of the production unit by the technicians from mainland, constraints in marketing of the product, lack of support for organic certification of the product for exploring export potential etc are some of the common problems experienced by the coconut based enterprises. Timely and appropriate interventions are necessary to address these challenges and sustain the functioning of coconut enterprises in the islands. Two years ago i.e. in 2021-22 all the coconut processing units under the Lakshadweep Development Corporation Limited (LDCL) were closed as per the details given in table 21.

Major reasons perceived for the closure of coconut enterprises under LDCL include the following.

- Huge financial loss
- Lack of efforts for modernization of coconut processing units
- Dependence on expertise from mainland for repair of machineries
- Marketing related constraints

Table 21. Discontinuance of coconut enterprises under LDCL

Island	Enterprise	Product	Year of start	Capacity	Year of closure
Kadmat	DCP unit	DCP & Coconut oil	1993	150 kg DCP/ day 320 lit. of Coconut Oil/ day	2021-2022
Agatti	DCP unit	DCP & Coconut oil	2011	Didn't start production	-
Kalpeni	DCP unit	DCP & Coconut oil	2011	650 lit.of coconut oil/ day and 150 kg DCP Per day	2021-2022
Andrott	CMP unit	VCO	2011	10 lit. VCO/ day (Hot process)	2021-2022
Amini	DCP & OE unit	DCP & Coconut oil	2012	650 lit. of coconut oil / day and 150 kg DCP/ day	2021-2022

- Low demand for the product in islands
- Higher cost of production than the mainland
- Lack of facilities for timely transportation of the products from Lakshadweep to mainland
- Lack of efforts for branding as Lakshadweep organic product

Similarly, the desiccated coconut powder and virgin coconut oil production unit in Kavaratti island which was started functioning in the year 2006 under the village dweep panchayat was also closed few years ago.

It has been reported that constraints such as inadequate infrastructure facility, outdated machineries, water scarcity in the production unit, lack of packing and filtration unit, focused on employment generation rather than sustainable production, lack of transportation facilities etc resulted in the discontinuance of the enterprise.

Some of the private entrepreneurs also have discontinued their coconut based enterprises in the islands. Mr. Masood M, Madapalli closed his coconut oil enterprise in Amini island in the year 2018 mainly due to the problems connected with the machineries of the oil expelling unit. Besides, he faced difficulties in procuring quality copra from farmers and also problems related to quality and shelf life of coconut oil.

Another entrepreneur from Kavaratti, Mr. Shahi K, Kunnil closed his coconut oil enterprise in the year 2010 due to constraints related to the machineries of the oil expelling unit and lack of manpower. The coconut oil

expelling unit in Kadmat island owned by Mrs. Kadeejommabi P. K., Puthiyakulap is remaining closed since the year 2022 and the reasons she attribute for the closure of the enterprise include machinery problems and lack of availability of sufficient quantity of copra for processing.

Mr. Gaddafi K, an entrepreneur was engaged in the trade of fresh mature coconut in Kavaratti island. He discontinued his coconut marketing business during 2022 due to problems such as quality deterioration of nuts due to delay in transportation and breakage of nuts during transportation and high transportation charges.

Functioning of enterprises on production and marketing of coconut products such as VCO and halwa managed by women SHGs in the islands also gets adversely affected due to various constraints including lack of availability of sufficient quantity of nuts for processing. Under such circumstances instead of working as a group any one or two members sustain the processing activities utilizing available small quantity of raw materials.

Fajr Dweepsree women SHG in Kalpeni island thus discontinued production and marketing of VCO in the year 2016 working as a group. However, one individual member of the group is currently managing the enterprise because of the lack of availability of sufficient quantity of nuts for preparing VCO by the SHG.

If all the members of the SHG are engaged in the production of VCO with small quantity of coconut available

for processing the output of VCO and the profit margin will be too meagre to be divided meaningfully among the members of the group. Instead, it is more rational to continue the production and marketing by one or two of members of the group.

The discontinuance of coconut based enterprises in Lakshadweep islands as discussed above clearly indicates the necessity for handholding and providing support to the entrepreneurs as and when they are confronted with different challenges.

Entrepreneurship development programmes are to be organized to give proper guidance to the coconut entrepreneurs. A comprehensive plan for skill development of entrepreneurs engaged in production and marketing of coconut products in Lakshadweep islands is to be prepared and implemented.

Lack of sufficient quantity of coconuts for processing is a common problem experienced by the entrepreneurs. Hence, suitable techno-socio-economic interventions are to be formulated and implemented to enhance the coconut productivity in the islands to ensure raw material availability for the coconut processing units.

Similarly, model training-cum-incubation centres on coconut processing are to be established in the islands through which service of technicians and assured availability of spares for the timely repair and maintenance of processing machineries of coconut enterprises can be ensured.

Special efforts are required to revive the functioning of coconut based enterprises under public sector agencies such as LDCL. Interventions aiming at their revival and sustained functioning have to focus on enhancing technical efficiency of the processing units and on evolving viable business models for ensuring profitability.

Coconut Production in Lakshadweep Islands

Coconut palms are in abundance in all the Lakshadweep islands. However, it is not cultivated in a systematic and scientific manner. Various constraints such as fragmented holdings, overcrowding of palms, senile and unproductive palms, lack of adoption of multiple cropping and integrated farming, lack of availability of skilled palm climbers and high wage rate, crop loss due to rodents, incidence of pests like rhinoceros beetle, eriophyid mite, spiralling white fly, deficiency of nutrients; especially micronutrient like boron, low level of product diversification, lack of transport facilities, lack of storage and marketing facilities, lack of interest among youths for coconut farming related activities, inadequate extension support etc adversely affect coconut production in the islands.

In general, farmers perceive that the productivity of coconut palms is on the decline in Lakshadweep islands since the last few years. However, the official statistics indicate consistently high level of coconut productivity in the islands (Directorate of Planning, Statistics & Taxation, Lakshadweep, 2018).

During February 2022, a team of scientists from ICAR-CPCRI, Kasaragod and Krishi Vigyan Kendra Lakshadweep conducted interface programmes in different islands with coconut farmers, entrepreneurs, palm climbers and tappers. During the interaction sessions in these

Table 22. Coconut cultivation in Lakshadweep islands (2017-18)

Island	Area (in ha)	Production (no. of nuts)	Productivity (nuts per ha)
Kavaratti	392.40	13964339	35587
Agatti	338.12	12131746	35 880
Amini	243.50	8675905	35630
Kadmat	306.10	10300265	33650
Kiltan	149.60	5068448	33880
Chetlat	100.10	3379376	33760
Bitra	7.70	51359	6670
Androth	452.75	16593288	36650
Kalpeni	258.50	8931175	34550
Minicoy	426.10	8513478	19980
Total	**2674.87**	**87609378**	**32753**

(Source: Directorate of Planning, Statistics & Taxation, Kavaratti, Lakshadweep)

programmes farmers and other participants opined that there is decline in coconut productivity.

The diagnostic field visits by the team to selected coconut gardens also revealed various field problems which adversely affect coconut productivity. Deficiency of nutrients, especially deficiency of potassium, nitrogen and boron, incidence of stem bleeding disease, infestation by white fly and eriophyid mite were the major field problems observed. Crop loss due to rodents continues to be another important field problem experienced by coconut growers in the islands.

Overcrowding of coconut palms prevalent in the islands is quite congenial for intensified rodent attack and

subsequent crop loss. Taking into cognizance the island agro-ecology and socio-economic situations appropriate interventions are to be implemented to overcome the field problems experienced by coconut growers in Lakshadweep islands.

Care and management of coconut palms

As per the official statistics for the year 2017-18, the total area of coconut cultivation in Lakshadweep is 2674.87 ha with an annual production of 876.09 lakh nuts and a productivity of 32,753 nuts/ ha (Table 22). Though the data on the production and productivity of coconut in the islands indicate higher productivity compared to the national average, the average productivity of coconut palms realized in farmers' field at present is about 70-100 nuts per palm per year only, according to many farmers who were present during the interface programmes.

Mr. Aboo Salam Koya, Darul Salam House in Agatti Island, a 71-year old farmer and Mr. Hamza Haji, Pallam House in Kadmat Island, a 75-year old coconut grower, during discussions gave detailed account of the yield of coconut in their orchards which is in line with the general perception of farmers about the coconut productivity in Lakshadweep islands. All farmers perceived that over the years, the care and management given to coconut

orchards has gradually declined, which in turn has resulted in reduced palm health and yield. During earlier times there were many indigenous technical knowledge (ITKs) and practices related to the care and management of coconut palms from planting to harvesting to ensure high yield. Some of them are furnished in table 23.

Table 23. Traditional practices of coconut cultivation

Mother palm selection and seed nut collection	· High yielding palms over 35 years old
Sowing	· Inclined position with the eye upward
Nursery management and selection of seedlings	· Early germination · Early splitting of leaves · Maximum girth · Transplanting in *'Pathiyakett'* which is a raised nursery · Regular irrigation during the initial two years.
Field planting and aftercare	· 1-2 year old seedlings selected from the *Pathiyakett* nursery are planted. · 2-3 years old seedling are planted in low lying '*thottam*' areas · Regular irrigation provided to palms using water from the open wells. · Application of ash in palm basins · Mulching of palm basins using dried leaves · Community action for '*Elinayatt*' (rat hunting) for rodent management in coconut gardens
Harvesting	· Traditional climbing method using rope · Harvesting in an interval of 45 days · Crown cleaning twice in a year

Selection of mother palms for seednut collection, nursery management and selection of good seedlings were systematically followed by the farmers. During the interface meeting at Kavaratti Mr. Aboobacker Koya of Kavaratti island narrated the genetic diversity of coconut nurtured by farmers in different islands.

The predominant local ecotypes of coconut prevalent in islands in olden days were *chenga* (green nuts), *karinga* (orange nuts), *cherukka* (smaller nuts), *thodom* (bigger nuts), *chentheng* (orange dwarf) and *pathinettampatta* (green dwarf). Nuts of both the *chenga* and *karinga* types are of medium size. *Chenga* types are steady yielders.

The most common coconut varieties in the islands are Laccadive ordinary tall and Laccadive micro tall, which have been used in the coconut breeding programmes by institutes such as ICAR-CPCRI and Kerala Agricultural University. Seed nuts are selected from high-yielding palms of more than 35 years of age. Nuts are sown in an inclined position with the eye facing upwards. When the seedlings attain three leaves stage, seedlings with good girth are taken for nursery planting for almost two years.

Traditional nursery set up was known as "*pathiyekket*", where the sprouted seedlings are sown in a raised bed in which the hard pan is broken to get water, which is in turn used for irrigating the seedlings. Mr. Ahamed Musliar (Pathada House) of Kadmat island mentioned that the young seedlings were provided with stakes of *Thespesia* plant and also fencing was provided to the nursery with

dried and plated coconut leaves to protect them from sun scorching and also from animals.

For planting, pits of around 2 feet height, 2 feet width and 2 feet depth were taken and the dried leaves and farmyard manures were added along with the top soil, and then the seedling was planted at the centre as stated by Mr. Aboo Salam Koya.

Basin opening was also practiced once a year. Crown cleaning was an important activity regularly carried out twice a year, mainly in the monsoon season as a prophylactic way to prevent rodents and other pests.

Mulching of coconut basins with dried leaves was also done. Gap filling with new seedlings was ensured by planting four seedlings in place of cutting two palms. Palms were planted closely in places where it is comparatively hotter. Nonetheless, presently, these indigenous technical knowledge has almost vanished from the islands as the younger generation lacks interest in farming.

Coconut climbing is a tedious operation in coconut farming. There is a traditional way of harvesting and undertaking post-harvest operations among the people of Lakshadweep. Palm climbing is done in the traditional manner with rope by skilled workers belonging to certain sections of the population. In addition, the services of skilled workers from the main land are also utilized by the farmers. The present wage rate is attractive; however, a shortage of skilled climbers is faced in all the islands as climbing coconut trees is considered an inferior

job by the upper elite sections of the population.

Drudgery involved in palm climbing is another factor which deter younger generation from taking it up as an occupation. Recently, a few climbers have started using palm climbing machines. However many traditional climbers perceive that climbing with machine takes more time compared to the traditional climbing method.

An experienced climber can climb 15–30 palms in 3-5 hours of climbing in a day, whereas as with the machine climbing takes much time. On an average wage rate for climbing palm is Rupees 50 per palm. Similar to their attitude towards coconut farming, younger generation doesn't show any interest to take up palm climbing.

In earlier days, harvesting was done once in 45 days, which now has been reduced to once in 3-4 months. Other alternate jobs for the climbers are fishing and assisting in construction work. Many climbers have noticed alternate bearings in coconut palms.

There is a phenomenon called *'Kulachaatam'* where the bunches tend to bend in the direction of the wind, as stated by Mr. Aboobacker Koya. It is a common practice to store harvested nuts in heaps under shade for a few days before they are further processed.

Farmers believe that this has many advantages, such as easier husking and shelling and superior quality of copra produced. In some places, harvested nuts are heaped in open areas till dehusking is done, which may affect the seasoning of the stored nut and further lead to deterioration of quality.


Traditionally, husking is done manually by skilled workers with the help of an iron spike driven into the ground. A skilled worker can dehusk around 2000-2500 nuts per day.

Current scenario of coconut farming in Lakshadweep island is that it no longer attracts the younger generation and at the same time, elderly farmers are unable to manage the cultivation of coconut in a systematic way. Because of the low level of management there are many field problems which results in low yield. In some localities farmers experience problems due to shortage of water for irrigation in coconut gardens. Palms in the coconut orchards of islands look unhealthy with symptoms of nutritional deficiency including that of boron, potassium, nitrogen, etc.


Soil test results of the sample collected from the farm under Department Agriculture in Kadmat island indicated that the status of potassium, magnesium and boron were very low, which clearly indicated the need for interventions to improve the soil health so that sustainable coconut production can be ensured.

Many families have taken up cattle rearing and goat rearing as an income generating activity. However, non availability of fodder lead to poor health of animals.


Incidence of pests and diseases such as white fly, eriophyid mite and stem bleeding are observed in some localities.

Farmers perceived that the recently observed widespread infestation of whitefly made life miserable as the interspaces of coconut palms used for parking vehicles, drying clothes, were spoiled with honey dew secretions.


Overcrowding of palms in coconut gardens which enhances rodent infestation and the substantial loss of nuts is another major problem in coconut farming in Lakshadweep islands. Rat hunting, locally known as *'Eli nayattu'* organized as a community action for the control

of rat menace in the coconut gardens is not followed at present in the islands.

Technological options for sustainable coconut cultivation in Lakshadweep

Taking into account the field problems observed in coconut gardens and the policy on organic farming prevalent in Lakshadweep islands various suggestions on technological options for higher productivity and sustainability of coconut cultivation in Lakshadweep islands are suggested below.

Restructuring coconut orchards for optimum palm density

Coconut orchards in the islands do not have any practice of systematic replanting and gap filling and new planting is continuously done when coconut trees are damaged/dead due to senility, diseases or natural calamities. Hence, coconut gardens in the islands are overcrowded with densely planted coconut palms of different age groups which adversely affect productivity.

The average number of coconut palms in Lakshadweep is 408 ha as per the official publication on 'Basic statistics – 2018' published by the Directorate of Planning, Statistics & Taxation, UT of Lakshadweep. Crop loss due to rodent damage is mainly due to the overlapping of leaves in the crown because of the overcrowded coconut palms. Since there is no sufficient inter space available due to overcrowding of palms, systematic inter/mixed cropping in coconut gardens also is very much restricted.

Considering the island ecosystem and socioeconomic condition, optimum coconut density needs to be worked out experimenting with various spacing of palms that can optimally harvest available sunlight. Coconut farmers need to be made aware about the significance of thinning down the palm density to maintain optimum palm density for higher productivity. Model coconut gardens highlighting the benefits of maintenance of optimum palm density should be developed in all islands.

Interventions for cutting and removing old and senile coconut palms and scientific replanting by maintaining optimum plant density should be given emphasis while formulating strategies for enhancing efficiency of coconut sector in the islands and farmers should be provided with adequate incentives for the same.

The replanting of coconut seedlings are to be taken up in a scientific manner rather than the current practice of planting in a very unsystematic way. The following measures are suggested.

- Opening of pits @ 75 cm x 75 x 60 cm
- Husk incorporation in the planting pits
- Regular watering of seedlings upto 2 years

Soil health management

Soil in the islands is calcareous and sandy which is formed by fragmentation of coral lime stones and sedimentary rocks. As per the official policy of UT of Lakshadweep use of chemicals in farming is restricted.

Coconut farming in the islands is natural farming by default with farmers in general not doing any cultivation practices except planting and harvesting. Also farmers do not apply any inputs to coconut palms and problems due to deficiency of nutrients are quite evident on coconut palms and vegetable and fruit crops grown in the islands.

Symptoms of nutritional deficiency including that of boron, potassium and nitrogen are observed in palms in the coconut orchards of islands. Organic recycling of biomass available in coconut gardens, use of fish waste as organic manure, use of sea weed as manure, green manuring, green leaf manures, and use of biofertlizers are some of the technological options for soil health management in the coconut gardens of Lakshadweep islands.

i) Biomass recycling

About 15 to 21 tonnes of biomass as leaves, bunch waste and husk is available in one hectare of coconut garden which can be effectively used for *in-situ* organic recycling to improve soil health.

ii) Green manuring and green leaf manuring

Raising green manure crops such as cow pea, sun hemp, daincha and mimosa in the basin and interspace of coconut palms and incorporating into palm basins can be adopted for improving the soil health. The potential for raising green leaf manure crops such as glyricidia, thespesia, calotropis etc can be utilized to generate substantial quantity of green leaf manure for application to coconut palms.

iii) Organic nutrition using bio-inoculants

Carrier based inoculants containing high population of plant-beneficial microorganisms capable of enhancing the availability of nutrients to plants can be used for coconut palms. These micro organisms helps in fixation of atmospheric nitrogen (eg. *Azospirillum*) and solubilisation of phosphorus (eg. *Phosphobacterium*), produce plant growth promoting substances, enhance root growth and induce systemic resistance in plants to pests and diseases.

iv) Soil and water conservation

The soils of Lakshadweep are generally sandy, derived from the coral. This soil is very poor in organic content and has a pretty low water holding capacity. It is very important to improve the organic content and water holding capacity

of soil to sustain agriculture, mostly coconut farming. It may be noted that the coconut cultivation in the island is 'natural' without any inorganic input.

Organic input also is very meagre, limited to kitchen waste mainly because cattle rearing is very rare. Under this circumstances it is imperative that the available bio wastes needs to be recycled to replenish the macro elements especially potassium, in the soil.

It is often seen that many farmers burn these biowaste to keep their farms clean to help the Lakshadweep administration in a cleaning drive to enhance tourist attraction. Burning the biowaste invariably make majority of the nutrients get lost besides environmental pollution.

Coconut husk, fallen fronds and other palm debris are abundant in the coconut gardens in the islands. Soil and moisture conservation techniques such as systematic mulching of coconut leaves around palm basin as well as husk burial in trenches made in the interspace can be adopted wherever feasible; especially in those coconut orchards where the palms are not overcrowded and there is some interspace available for taking trenches. Available

biowaste, especially coconut leaves and husk can be buried in trenches taken in the coconut interspaces. Though the trench could be of any dimension, considering the limitation in coconut farming in the island especially over crowding and the difficulty in taking trenches in the calcareous soil, it is ideal to make trenches of approximately 50cm width and not more than 50cm depth and of convenient length. The trench is then filled with any biowaste.

When coconut husk is used ideally the bottom layers of the husk is placed keeping the concave side facing up to harness maximum water during rain and top one or two layers facing the concave side down to reduce evaporation loss. The coconut husk has a capacity to absorb six to seven times its weight of water. The effect could last for seven years. The practice could be replicated in the coconut basin also.

In addition to soil and water conservation, this strategy will improve the organic content in the soil. Microbial load and availability of nutrients also get enhanced in the process. Overall, the coconut production would be become more sustainable and in the long run will enhance nut yield.

Promoting coconut based multiple cropping and integrated farming

Interventions to promote coconut based farming systems as part of enhancing agro-biodiversity in Lakshadweep islands are highly relevant and significant. The potential for inter/mixed cropping of vegetables and fruits in coconut gardens if properly utilized can considerably reduce the dependence of the islands on import of such items from the

mainland. However, to popularise the adoption of coconut based farming systems restructuring of the existing coconut gardens to ensure optimum palm density is to be carried out which is not practically an easy task.

Preference of farmers in the islands about the component crops and subsidiary enterprises to be integrated with coconut cultivation needs to be analysed and performance of such combinations are to be assessed in farmers' field.

Demonstration plots on coconut based inter/mixed cropping and integrated farming can be established in all islands. Interventions to promote coconut based farming systems are to be linked with interventions for cutting and removing old and senile coconut palms and scientific replanting by maintaining optimum plant density.

Islanders mostly depend on the mainland for meeting their requirement of vegetables and fruits. Of late, many people have started growing these crops in roof top gardens in the terraces of their houses, mostly in grow bags with the support of Department of Agriculture. Vegetable crops like brinjal, bhindi, tomato, amaranthus, chilli, cabbage, cauliflower etc are grown in grow bags in terraces of houses.

Incidence of pests and diseases, nutrient deficiencies, lack of availability of quality seeds and planting material, lack of changing/refilling grow bags with suitable potting mixture etc are some of the problems experienced in cultivation of vegetables and fruit crops in terrace farming. Few farmers are cultivating vegetable and fruits in low lying areas of islands known as 'thottam'. Banana is mostly cultivated in such areas.

Interventions to i) facilitate formation of FPOs and provide incubation support to take up enterprises on poly house/ hi-tech farms for production and marketing of vegetables in suitable localities in islands where open space is available ii) facilitate formation of women SHGs to take up production and marketing of quality seeds and planting material of vegetables, fruit plants and tuber crops and potting mixture for grow bags can be implemented. Schemes to support farmers for effectively utilising potential for marketing of organic vegetables should also be implemented.

Inclusion of fodder trees in the coconut based integrated farming system

Fodder trees like glyricidia or subabul can be included in the coconut based integrated farming system to enhance the availability of fodder to the animals.



Plant protection

Being an organically declared Union Territory, Lakshadweep Islands are greatly focussed on environmentally responsible plant protection approaches with greateremphasis on agro-ecological crop protection in

coconut with diversified intercrops including fruit trees and vegetables.

Use of neem cake enriched with *Trichoderma harzianum* (10:1) as well as bio-suppressive compost fortified with *T. harzianum* need to be popularised for the bio-management of stem bleeding and basal stem rot diseases of coconut.

Similarly, eco-friendly pest management methods against coconut rhinoceros beetle, coconut eriophyid mite and non-native whitefly infestation are to be promoted as part of plant protection measures.

Crown cleaning and leaf axil filling with powdered neem cake/marotti cake/ pongamia cake @ 250 g/palm + fine sand (250 g) per palm during pre and post monsoon months as a prophylactic measure against coconut rhinoceros beetle can be undertaken. Regular monitoring of juvenile palms and hooking out beetles from the crown are to routinely undertaken to reduce the incidence of coconut rhinoceros beetle.

Use of *Oryctes rhinoceros nudivirus* (OrNV) for biological suppression of coconut rhinoceros beetle and release of nudivirus inoculated beetles (12 / ha) brings down the pest population which forms a validated technology in all Island system. In addition, all breeding sites including cow dung pits, fallen tree trunks etc are to be applied with the green muscardine fungus, *Metarhizium majus* @ 5 x 10 11 /m 3 .

Spraying against coconut eriophyid mites requires an oil garlic-soap mixture at 2% concentration (neem oil 200

ml, soap 50 g, and garlic 200 g mixed in 10 litres of water) to be done one-month after pollination.

Severely infested palms, especially dwarfs with non-native whiteflies, can be given a 0.5% neem oil spray. In addition, encourage build-up of the aphelinid parasitoid (*Encarsia guadeloupae* and *Encarsia dispersa*) and re-introduce parasitized pupae along with predators such as *Apertochrysa sp.*, *Cybocephalus sp.*, coccinellid beetles to emerging zones of whitefly outbreak. Install yellow sticky traps on the palm trunk to trap adult whiteflies.

Tin banding, trapping and placement of bromadiolone cake on palm top could reduce damage by rodents in the Islands. Introduction of barn owl from the mainland is a successful attempt in the suppression of rodents. Krishi Vigyan Kendra Lakshadweep in collaboration with ICAR-CPCRI can implement suitable interventions to conduct front line demonstrations and capacity development programmes to create awareness among coconut growers on these practices.

Research support

Besides the above interventions, it is also necessary to conduct research and on farm trials to evolve appropriate strategies to address the problems experienced in coconut cultivation in Lakshadweep islands taking into cognizance the unique agro-ecological situations prevailing in the islands. Some of the relevant thematic areas for research are as follows.

- Considering the island ecosystem and socio-economic condition, optimum plant density of coconut needs to be worked out experimenting with various spacing of palms that can optimally harvest available sunlight.
- Isolate nitrogen fixers and phosphorus solubilizers from the soil of Lakshadweep islands and develop location specific microbial consortia for nitrogen fixation and solubilisation of phosphorus.
- Develop location specific microbial consortia and plant decomposers for enhancing the decomposition of recyclable biomass in the coconut gardens.
- Sea weed manure utilisation for the management of potassium nutrition of coconut palms.
- Effective utilisation of fish waste as organic manure for coconut palms.
- Screening of fodder varieties suitable for rainfed condition and high pH of soil prevailing in the coconut gardens of islands.
- Comprehensive assessment of soil health status and formulation of recommendations for soil health and crop health management taking into cognizance the local availability of inputs and policies related to the ban on the use of chemicals in agriculture and organic farming in the islands.
- Assessing production and productivity of coconut in Lakshadweep Islands for evolving package of practices

of cultivation, streamlining development interventions and extension advisory services.

Co-ordinated efforts of ICAR institutes like ICAR-CPCRI, ICAR-NBSS&LUP, ICAR-CIFT, ICAR-IIHR are necessary to effectively implement the above research and OFTs apart from the active involvement of ICAR-KVK Lakshadweep and Department of Agriculture, UT of Lakshadweep Administration.

Strategies for Sustainable Development of Coconut Based Enterprises in Lakshadweep Islands

Coconut plays a vital role in the socio-cultural and economic life of the people of Lakshadweep islands. Copra making and coir twisting were the major economic activities and livelihood options for the island people in the olden days. Coconut sector in these islands continues to be revolving around traditional products and conventional methods of production mostly catering to the local population in spite of the availability of technological options for value addition to realize higher income. Interventions for enhancing income from agriculture sector in Lakshadweep islands are to be essentially focusing on income enhancement from coconut farming and value addition through product diversification is an important strategy for enhancing income from coconut farming.

A major limitation for modernizing the coconut sector in Lakshadweep and transforming it to make it competitive at the national and international level is the comparatively low volume of nuts produced from the limited area under coconut cultivation; as per the latest official statistics available pertaining to the year 2017-18 the annual production was only 87.6 million nuts from an area of 2674.87 ha. Further, a substantial quantities of coconuts produced are consumed by the local community as fresh coconut, coconut oil and coconut based traditional products.

Entrepreneurs managing the few oil expelling units in the islands and the women SHGs managing the small scale enterprises on traditional coconut based products such as VCO, halwa etc experience the problem due to lack of nuts for processing. Coconut growers in all the islands perceive a declining trend in coconut yield over the last few years. Official statistics on coconut production in Lakshadweep, however, indicate a consistently higher productivity of coconut.

Taking into cognizance the present status of coconut production and processing, a framework for action, specific strategies and interventions are suggested for the sustainable development of coconut sector in Lakshadweep islands as follows.

- A revisit is required to the current statistics on the production and productivity of coconut in Lakshadweep islands since the official figures do not match with the yield of coconut realized in field situation as perceived by farmers and other stakeholders. It is also imperative to conduct an in-depth analysis of the factors responsible for the declining productivity of coconut.
- Suitable techno-socio-economic interventions focusing on soil health management are to be formulated and implemented to enhance the coconut productivity in the islands. Besides, coconut based cropping/farming systems are to be promoted along with appropriate restructuring of the coconut gardens taking into account the unique island ecosystem. Relevant OFTs can be initiated by KVK Lakshadweep with the support of

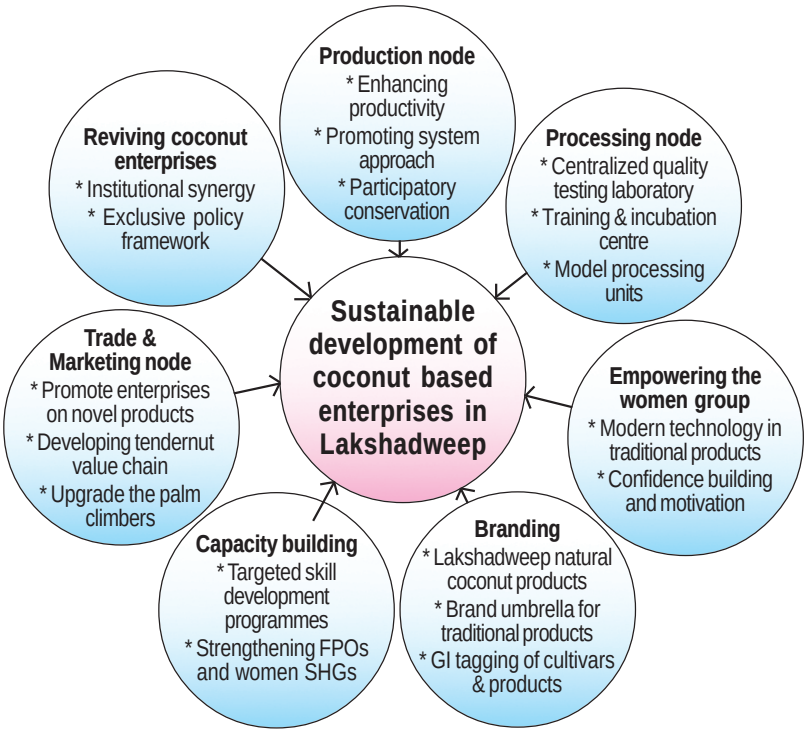


Fig.5. Sustainable development of coconut based enterprises in Lakshadweep-A framework for action

ICAR-CPCRI. KVK can also seek the support of ICAR-IIHR for conducting OFTs on performance of varieties of vegetables and fruits as intercrops in coconut gardens.

- There is a need to implement interventions for farmer participatory conservation and utilization of coconut ecotypes in Lakshadweep islands for which ICAR-CPCRI Kasaragod can take the lead with the support of Department of Agriculture under UT administration and KVK Lakshadweep. Similarly, Department of Agriculture can promote participatory decentralized initiatives for the production and distribution of quality

coconut seedlings utilizing the superior coconut mother palms identified in islands.

- Department of Agriculture has already taken necessary steps for the GI tagging of coconut jaggery of Lakshadweep. GI tagging of other unique products of the islands such as halwa and indigenous coconut ecotypes of Lakshadweep should also be undertaken. Concerned development departments under the UT administration can initiate the necessary action for the same with the support from ICAR-CPCRI Kasaragod and KVK Lakshadweep.
- Introducing the tender coconut punch and cutter developed by ICAR-CPCRI. Currently the tendernuts are cut and served manually and very minimum level of mechanization only is employed.
- Establishing tendernut parlours in tourist centres to be managed by women SHGs or FPOs and introducing Snow Ball Tender Coconut machine developed by ICAR-CPCRI to serve tendernuts to tourists.
- Collaborative efforts are required to integrate modern technologies/gadgets to enhance efficiency and to reduce drudgery for the production of traditional coconut products like VCO, halwa, jaggery etc. Development departments under the UT administration such as Department of Rural development and Department of Agriculture can lead the relevant interventions. ATARI Bengaluru and CPCRI Kasaragod can also support this intervention utilizing funds available under TSP programme.

- Demonstration units on neera extraction using 'Coco sap chiller' and production of coconut sugar shall be initiated under KVK with the technical support from ICAR-CPCRI Kasaragod.
- The inadequate supply of *katti* (coconut jaggery) remains a persistent issue for preparing coconut halwa on a sustainable basis across all the islands. Hence, efforts are to be made to encourage and promote tappers by providing suitable incentives to ensure a regular supply of *katti*.
- Common brands and a standardized pricing system for the marketing of VCO and halwa produced by women SHGs under Dweepsree mission across the islands are to be evolved under the guidance of the Rural Development Department.
- Establishing a central facility in private or public sector or under FPO which can be provided on hire basis to farmers for dehusking and drying coconut would be a major intervention to produce quality copra at a competitive price in the islands.
- A model processing unit, medium sized, each of coconut oil needs to be established in each island which can act as a training centre/incubation centre and also can be given on hiring basis. Service of the technicians and assured availability of spares in the proposed incubation centre shall render their service for the timely repair and maintenance of processing machineries of coconut oil expelling units. Besides, women SHGs can be supported

to establish homescale units for production and marketing of coconut oil using screw press.

- A centralized quality testing laboratory facility should be established in Lakshadweep for testing of coconut based value added products to support the entrepreneurs.
- Special efforts are required to revive the functioning of coconut based enterprises under public sector agencies such as LDCL. Interventions aiming at their revival and sustained functioning have to focus on enhancing technical efficiency of the processing units and on evolving viable business models for ensuring profitability.
- Interventions are to be implemented to enhance the efficiency of coir fibre and spinning units under the Department of Industries by improving infrastructure, introducing new machineries and equipments, timely repair of machineries and product diversification etc.
- A comprehensive plan for skill development of women SHG members and entrepreneurs engaged in production and marketing of coconut products in Lakshadweep islands is to be prepared and implemented for which KVK can take the lead drawing support from research institutions like ICAR-CPCRI. Similarly, suitable capacity development programmes are to be formulated and implemented for the benefit of coconut growers, palm climbers and extension personnel.
- Collectives of coconut growers were facilitated by department of Agriculture in all the islands few years

ago to promote organic farming. However, these FPOs have become almost defunct. Hence, interventions are required to revitalize the functioning of Farmer Producer Organizations in the islands.

- The potential for branding of all the value added products of coconut from Lakshadweep islands as 'Lakshadweep organic/ natural coconut products' is to be utilized along with implementation of interventions for necessary certification procedures. CDB can play a major role to provide support for the certification, branding and marketing/export of value added coconut products.
- Appropriate policies and programmes are to be implemented to address the major constraint ie lack of transportation facility experienced by the entrepreneurs in coconut processing and marketing. A system needs to be put in place to give priority for the coconut entrepreneurs from the islands for transporting their products between islands and to the mainland especially by utilizing the return trips of vessels, barges, or MSVs.
- Interventions are to be implemented to support entrepreneurs in the private sector as well as women SHGs in the islands for establishing small scale enterprises on new and emerging coconut based products. Capacity development programmes to benefit the prospective women SHGs and entrepreneurs are also to be organized on the production technologies and marketing strategies for effectively managing the small scale enterprises on new and emerging coconut based products.

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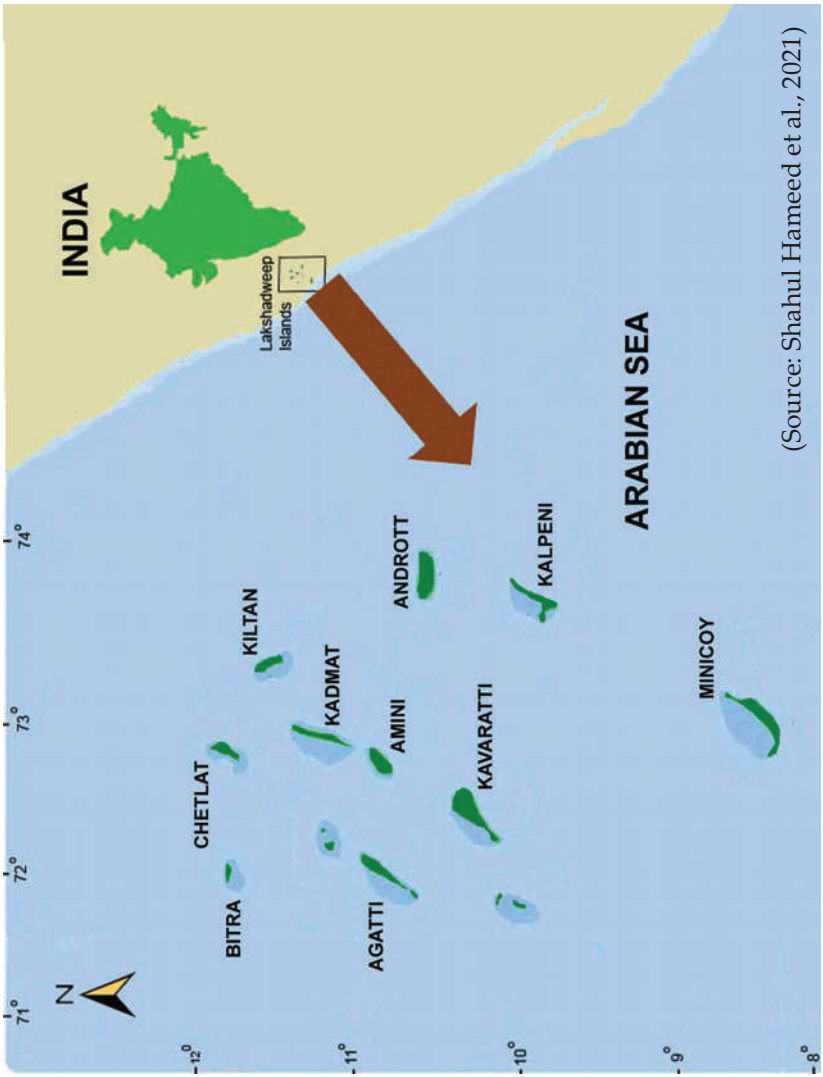
Lakshadweep islands



(Source: Shahul Hameed et al., 2021)