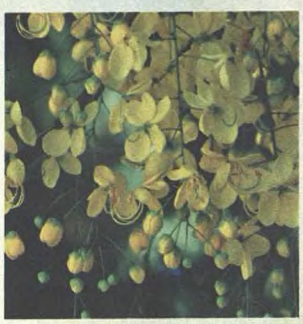
BIORESOURCES AND COMMERCIAL UTILIZATION: TRENDS, MARKET, SUPPLYCHAIN, AND SUSTAINABILITY



KERALA STATE BIODIVERSITY BOARD
REBUILD KERALA INITIATIVE

KERALA STATE BIODIVERSITY BOARD
Kailasam, T.C.24/3219,No. 43,
Belhaven Gardens, Kowdiar P.O.,
Thiruvananthapuram - 695 003

BIORESOURCES AND COMMERCIAL UTILIZATION: TRENDS, MARKET, SUPPLYCHAIN, AND SUSTAINABILITY

KERALA STATE BIODIVERSITY BOARD
Kailasam, T.C.24/3219,
No. 43, Belhaven Gardens,
Kowdiar P.O.,Thiruvananthapuram - 695 003

BIORESOURCES AND COMMERCIAL UTILIZATION: TRENDS, MARKET, SUPPLYCHAIN, AND SUSTAINABILITY

Published By
Member Secretary
Kerala State Biodiversity Board

February 2022

ISBN: 978-93-5620-348-8

BIORESOURCES AND COMMERCIAL UTILIZATION: TRENDS, MARKET, SUPPLYCHAIN, AND SUSTAINABILITY

Editors

Dr. C. George Thomas
Dr. Preetha Nilayangode

KERALA STATE BIODIVERSITY BOARD
Kailasam, T.C.24/3219,
No. 43, Belhaven Gardens,
Kowdiar P.O.,Thiruvananthapuram - 695 003

BIORESOURCES AND COMMERCIAL UTILIZATION: TRENDS, MARKET, SUPPLYCHAIN, AND SUSTAINABILITY

CONTENTS

		Page No.
Message		I
Acknowledgements		III
Introduction		IV
I. AGRICULTURAL BIORESOURCES		
1.1	**Diversity of cultivated crops in Kerala** George Thomas C.	3
1.2	**Germplasm conservation of superior lines of traditional mango variety 'Karpooram' (*Mangifera indica L.*)** Bindu B.	26
1.3	**Farmer friendly banana bunch covering device for quality banana production** Chithra G. and Binu John Sam	31
1.4	**Value added products from pineapple, its commerce and trade in Kerala** Maya T.	36
1.5	**Challenges of post GI mechanism in Kerala: a case study on Vazhakulam pineapple** Akhil Salim	43
1.6	**Polyhouse vegetable cultivation in Kerala and its economic feasibility** Pradeepkumar T. and Dicto Jose	51
1.7	**Ecofriendly insecticides against pests of vegetables – collection, formulation and market value** Berin Pathrose	57
1.8	**Automatic family drip System (FDS) for increased vegetable production in urban sector** Chithra G. and Binu John Sam	67
1.9	**Health benefits and therapeutic importance of south Indian green leafy vegetables** Devika I., Binu John Sam and Jibi Joseph	74
1.10	**Vegetable and fruit market and trade in Kerala** Sivaram Krishnan	79
1.11	**Coconut economy of Kerala: A critical analysis** Geethu P. George and Anil Kuruvila	85

1.12 **Aromatic oil yielding crops of Kerala: cultivation, marketing, and trade.** 95
Gracy Mathew

1.13 **Scenario, prospects, and importance of spice cultivation: a global and domestic overview** 100
Marimuthu R. and Preethy K. Paul

1.14 **Diversity, stocking and management of trees outside forests in Kerala** 109
Kunhamu T.K., Anoop E.V. and Niyas P.

1.15 **Nurseries in Thrissur and its economic output** 120
Prema A. and Rajasree M.

1.16 **Plant nurseries and tradable bioresources - A case study from Cherthala, Alappuzha district** 126
Remya Krishnan, Maya S. Nair, Viswaprabha R., Gowry Jayakumar, Harsha G. Nair, Karunya K., Navya M, Gokul G. and Peter Sha Benny

1.17 **Terrarium – A tiny ecosystem** 137
Smitha S. and Pooja Ghorawat

1.18 **Doubling income of paddy farmers through mechanization in Thiruvananthapuram district** 145
Chithra G. and Binu John Sam

1.19 **Review on physiochemical properties and therapeutic values of honey** 150
Jibi Joseph, Devika I. and Binu John Sam

1.20 **Morphological characterization of honey bees and phytochemical analysis of its bee bread** 157
Suchithra K.R., Ganga G. and Sreekumari C.

1.21 **Management of wild boars using castor oil based repellant** 162
Bindhu R. Mathews and Binu John Sam

1.22 **Economic valuation of regulating services of soil ecosystem in Idukki.** 170
Sreepriya P. R. and Balasubramniam, R.

1.23 **Isolation of pigment producing novel bacterial strain: A source of colourant for industrial applications.** 175
Ashalakshmi C. N., Aiswarya K. and Athira Nandakumar

II. MEDICINAL PLANTS

2.1 **Trends in trade and development goals and policies for Ayurveda** 187
James T.C.

2.2 **Demand and supply of raw materials and base materials used in Ayurvedic industry in Kerala- A review** 192
Divya S. Balachandran

2.3 **Raw materials used in Ayurvedic industry in Kerala -An over view** 197
Gopalakrishnan Valiyaveettil

2.4 **Adulteration in Ayurveda and role of pharmacognosy in quality assurance of herbal medicine** 205
Harinarayanan C.M.

2.5 **Detection and quantitation of acteoside, a phenyl propanoid glycoside with diverse therapeutic activities in some traditional and Ayurvedic medicinal plants of Kerala** 216
Ancy Joseph, Anu Aravind A. P., Shabana Mol A. M. and Gracy Mathew

III. AQUATIC RESOURCES

3.1 **Coral Resources of Kerala** 227
Jasmine S. and Divya Viswambharan

3.2 **Lobsters of Kerala** 233
Rekha Devi Chakraborty

3.3 **Crab Resources of Kerala – commercial utilization, trends, supply chain and sustainability** 240
Jose Josileen

3.4 **Copepods resources of Kerala** 253
Santhosh B. and Ambarish P. Gop

3.5 **Freshwater Crab Resources of Kerala** 263
Sameer Kumar Pati

3.6 **Marine microbial resources of Kerala: Current status and future prospects** 269
Abdulaziz Anas and Sajeevan T.P

3.7 **Phycoprenurship through marine microalgae and seaweed resources of Kerala coast** 274
Kaladharan P.

3.8 **Marine nutraceuticals** 286
Kajal Chakraborty

3.9 **Neutraceuticals from Marine Sponges** 311
Sunil kumar P.

3.10 **Prospective tradable indigenous ornamental fish diversity of Kerala: an overview.** 317
Basheer V. S., Charan Ravi and Rahul G. Kumar

3.11 **Development of small-scale entrepreneurship on saline water aquaculture in selected areas of Kerala** 323
Gopakumar G.

3.12 **Alien and invasive aquatic species in Kerala: Status and trends** 326
Biju Kumar, A., Smrithy Raj and Ravinesh R.

IV. BIOLOGICAL WASTE MANAGEMENT

4.1 **Bio-diesel production from animal fats and bio-gas technology from farm waste** 343
John Abraham

4.2 **Management of fish waste using black soldier fly Hermetia illucens L. (Diptera: Stratiomyidae)** 348
Krishna Kalidas, Manu C.R., and Karl Goodsell

4.3 **Microbial inoculum for household waste management** 352
Jyothi Rachel Varghese and Binu John Sam

4.4 **Effective utilization of bio waste coir pith in planting material production** 356
ManjuThomas and Binu John Sam

3.2 LOBSTERS OF KERALA

Rekha Devi Chakraborty
Crustacean Fisheries Division,
Central Marine Fisheries Research Institute, Kochi-682 018

Introduction

Lobsters are among the most prized and forms luxury seafood with high nutritive value and of significant commercial interest in many countries having great demand both in national and international markets contributing to the foreign exchange. Because of their high value and esteemed culinary worth, much attention has been paid to lobsters in biological, fisheries, and systematic literature. In Kerala, it forms a small scale fishery and the resource is harvested from shallow waters in general and forms a bycatch of the trawl fishery. Fishermen inhabiting along the coastal belts catch lobsters by region specific methods *viz*., commercial crafts and gears including traps, non motorized categorty.

Fishery

The annual marine lobster landings of India ranged from 1617 t in the year 2007 to 1389 t in 2020 with an estimated annual average of about 2000 tonnes. The major gears that contributed were multiday trawlnets (MDTN-50 %) followed by outboard gill nets (OBGN-17 %), single day trawlnets (MTN-11 %), mechanized gill nets (MGN-9.8 %). However, the annual marine lobster landings of Kerala ranged from 149 t in the year 2007 to 15 t in 2020 with an estimated annual average being 103 t along the Kerala coast at a depth range of 60-80 m, whereas the traditional crafts confined to the 10 km range from the shore at a depth of 40-50 m. Due to the rocky bottom, trawl fishing is not undertaken, but a variety of traditional gears are operated to exploit the fishery. Gears majorly contributed by MDTN (70%), NM (15.7%), MTN (8%), OBGN (4.2%). District wise analysis of lobster landings revealed Kollam (51.5%) to be major contributor followed by Ernakulam (13.7%), Malappuram (6.3%), Kozhikode (0.9%).

In general, the lobsters are grouped into three categories such as spiny or rock lobsters, sand lobsters and deep sea lobsters. Among them, sand lobsters and deep sea lobsters forms a bycatch of single day and multiday trawls. However, spiny lobsters are highly priced found in shallow waters with species such as *Panulirus homarus, P. polyphagus, P. ornatus,* and *P. versicolor*, forming major portion of the fishery (62%) followed by sand lobsters (37%) and deep sea lobsters (1%). However, the major inshore species constituted to the total lobster catch of Kerala were *Thenus unimaculatus* (40.5%), *Panulirus homarus* (22.1%), *P.versicolor* (0.1%) followed by a deepsea lobster *Puerulus sewelli* (32%). The fishery for *Thenus* is throughout the year except for monsoon ban while for *Panulirus* the fishery extends from October to April with peak landing during November-January. Coincidence of fishing and peak breeding season results in capture of majority of females in egg bearing stage. Nearly, 60% of the females caught during this period were found to be berried.

Taxonomy

The suborder Macrura Reptantia consists of three infraorders: Astacidea (Marine lobsters and freshwater crayfishes), Palinuridea (Spiny lobsters and slipper lobsters) and Thalassinidea

Chakraborty,R.D. 2022. Lobsters of Kerala. In: Thomas, C.G. and Preetha, N. (eds), Bioresources and Commercial Utilization: Trends, Market, Supplychain, and Sustainability. Proceedings of a conference from 27 -30 Sept. 2021. Kerala State Biodiversity Board, Thiruvananathapuram, pp 233-239.

(mud lobsters). The infraorder Astacidea contains three superfamilies of which only one (the Nephropoidea) is considered here. The remaining two superfamilies (Astacoidea and parastacoidea) contain the freshwater crayfishes. The superfamily Nephropoidea (40 species) consists almost entirely of commercial or potentially commercial species.

The infraorder Palinuridea also contains three superfamilies (Eryonoidea, Glypheoidea and Palinuroidea) all of them marine. The Eryonoidea are deepwater species of insignificant commercial interest. The Glypheoidea includes an almost exclusively fossil group. About 120 species are included in the superfamily Palinuroidea.

The third infraorder, the Thalassinidea, contains a single superfamily, the Thalassinoidea which contains around 100 species. Only few representatives of this superfamily are known to be used as food and bait.

Genus *Thenus* Leach, 1816

Diagnosis: Orbits on the anterolateral angle of the carapace. Body strongly depressed. Lateral margin of the carapace with only the cervical incision. No teeth on the lateral margin of the carapace, apart from the antero-lateral and postcervical. Fifth leg of female without a chela.

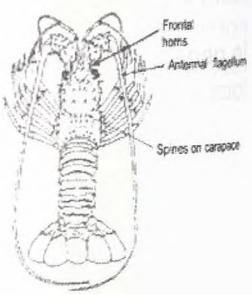
***Thenus unimaculatus* Burton & Davie, 2007**

Diagnosis: Purple to black pigmentation blotch on inner surface of merus of second and sometimes third leg, usually large but variable in extent and may be reduced to a narrow streak; purple pigmentation occasionally surrounding eye socket on carapace; outer phase of propodus of 2nd pereopod having upper-most longitudinal groove bearing obvious setae over atleast proximal half. Merus of third maxilliped with a small spine proximally on inner ventral margin; inner margin of ischium prominently dentate along the entire length.

Distribution: Indo-west Pacific region. In India, the species is distributed along the northwest, southwest, southeast and the northeast coasts. Forms commercially fishery in Saurastra region, Kollam (Kerala) and Chennai.

Superfamily Palinuroidea Latreille, 1802

Three families make up this superfamily, namely the Palinuridae (spiny lobsters), Synaxidae (furry lobsters) and Scyllaridae (slipper lobsters). Antennal flagellum long and consisting of numerous small articles, whip-like or spear-like.



Family: Palinuridae Latreille, 1802

Antennal flagellum long and consisting of numerous small articles, whip-like or spear-like. Rostrum absent or visible as a small on anterior margin of carapace. Carapace with a pair of frontal horns above the eyes, and usually with spines on the dorsal surface; hairs on carapace, if present, few and scattered.

There are 11 genera in this family *Justitia, Jasus, Linuparus, Nupalirus, Palibythus, Palinurus, Palinustus, Panulirus, Projasus, Puerulus, Sagmariasus,* (those in bold letters are represented in Kerala).

Panulirus homarus–Scalloped spiny lobster

Diagnosis: Abdominal segments 2-5 with transverse grooves interrupted in the middle; antennular plate bearing four equal well separated large spines, each abdominal segment with a transverse groove, body greenish in colour with numerous white spots, transverse bands absent, antennules banded white and green, legs with white spots and stripes.

Distribution: *P. homarus homarus* subspecies has a broad geographic range extending from East Africa to Japan including Indonesia, Australia, New Caledonia and the Marquesas Archipelago (Holthius, 1991). North-west, southwest, southeast coast of India, A& N Islands and Lakshadweep Islands. Forms fishery along southwest and southeast coast; promising species for aquaculture.

Panulirus ornatus- Ornate spiny lobster

Diagnosis: Antennular plate with one pair of principal spines anteriorly and a second pair half the size of first. Abdominal segment smooth without transverse grooves. Each abdominal segment with dark pale spot on the outer margin. Abdomen greenish or brownish grey. Legs with alternate bands of black and white.

Distribution: Tropical Indo-Pacific; It ranges from Natal in South Africa, along the coast of East Africa and the Red sea to southern Japan, the Solomon island, Papu New Guinea, Australia, New Caledonia and Fiji (Holthius, 1991). Forms fishery along the southeast and southwest coast of India.

Panulirus versicolor- Painted spiny lobster

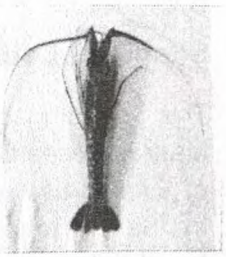
Diagnosis: Antennular plate with 4 strong spines arranged in a quadrangle. Abdominal segments without transverse grooves. Blue black patches and white lines on carapace and abdominal segments. Legs, antennules longitudinally striped. Bases of antennae bright pink.

Distribution: This species known throughout Indian ocean (east coast of Africa and the Red sea) east Japan, Micronesia, Melanesia, Polynesia, and northern Australia (Holthius, 1991). Along the Indian coast the species has been reported from southeast, southwest, A & N Islands and Lakshadweep.

Genus *Puerulus* Ortmann, 1897

Antennular plate distinct, a stridulating organ present. Carapace with a median ridge behind the cervical groove, often with spines or tubercles, but without submedian rows.

Puerulus sewelli Ramadan, 1938



Puerulus sewelli Ramadan, 1938 is commonly known as deep sea spiny lobster or whip lobster. The presence of deep sea lobster off Kerala coast recorded by Alcock,1901. They mainly inhabit in grounds with coarse sand and less frequent on muddy bottom. In general they are carnivorous and feed on fishes, crustaceans and gastropods.

Diagnosis: Median keel of carapace with 5 post-cervical and 2 or 3 intestinal teeth. Fifth pereopod of male not chelate

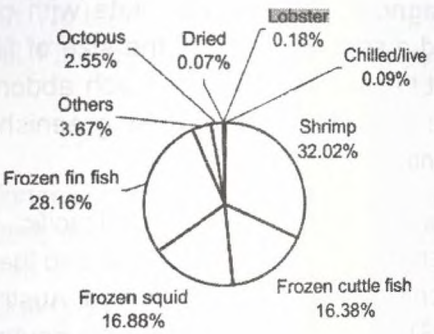
Distribution: Western Indian Ocean; Somalia, Gulf of Eden, off Pakistan, southwest (Quilon Bank, Mangalore) and southeast (off mandapam and Tuticorin, Gulf of Mannar) of India and A&N Islands.

Exports of Lobsters

Export of whole lobsters since late 80's and live lobsters since 1993 and the ever increasing demand for Indian lobsters have resulted in their regular and organised exploitation. Maharashtra and Gujarat are the major lobster fishing states followed by Tamil Nadu.

Live Lobster export from Kerala

Spiny lobsters are exported in live condition. Sea water was collected in rectangular tank and the temperature was reduced to 15°C by using ice without any direct contact and are stored in the holding tanks. During export, the lobsters were dipped in sea water and wrapped with wet clothes (seawater) then individually wrapped with newspapers and are placed in the thermocol boxes with ice bottles for cooling. Whole packed items are exported to Honkong and China from Trivandrum. Lobster from Kerala account to less than 1% to the total seafood export. Kerala primarily caters to the South East Asian and EU markets in terms of the volume exported. EU is the main market for seafood from Kerala accounting for 33% by volume and 36% by value.



Export Chains for Seafoods processed in Kerala

Once the boat comes ashore, the catch is auctioned at the auction site and sold to the highest bidder. The buyers/processors inspect the catch for its freshness and colour. The size and weight are the major determinants of price. Once purchased, the raw material is iced and transferred in plastic crates to the processing plant. The main exit points for lobster export from Kerala are the Kochi and Trivandrum.

Prospects for spiny lobster farming in India

Spiny lobsters fetch very high price in the domestic and export market are categorized into different quality grades based on their weight, as > 200 g, 100-200 g and <100 g being the first, second and third grades, respectively and accordingly prices are fixed. In the domestic markets of Kerala lobsters fetched a minimum of 700 to 4000 / Kg for those weighing >100 g while Rs 100 to 1300/Kg for below 100 g weight.

Scope for Lobster culture

The Central Marine fisheries Research Institute (CMFRI) at the Kovalam Field Laboratory of Madras Research Centre initiated breeding and larval rearing of spiny lobsters in 1976. Larvae of *P homarus* were reared to stage 6 in 60 days and then to stage 7 at Calicut Research Centre. Several other laboratories also attempted larval culture but with little success. An improved larval culture system was set up at Cochin. The upwelling system used by the Japanese were

modified in such a way that a major portion of unfed Artemia and waste could be flushed out by circulating water through the system. This improved the health status of the system to a great extent. Mussel meat was not much acceptable to the early *P homarus* larvae. Phyllosoma larvae is known to feed on the chaetognath *Sagitta* sp. and probably live feed culture of several planktonic organisms will have to be developed to meet the food requirements of the phyllosoma larvae. Enriched and embedded Artemia may be good for late stage larvae. *P. homarus* have been reared to stage 6 in 60 days. Recently, larvae were reared to stage 8 in 42 days on a mixed diet of Artemia and plankton.

Scope for Lobster farming and fattening

All commercially important species of shallow water spiny lobsters in India have been bred in captivity, but their whole larval cycle is yet to be completed. In CMFRI, rearing lobster larvae to more than half way stage was achieved and are on to complete the larval cycle. Success has been achieved recently in Japan in completing the life cycle of a few temperate and sub-tropical species of spiny lobsters, but hatchery produced lobster seed is yet a distant dream. Hence, any lobster culture venture in India particularly Kerala, at present, has to start with collection of lobster juveniles from nature and growing them to the required size. These juveniles can be utilized for lobster culture/fattening. Another strategy that can be adopted by prospective lobster farmers is fattening of big size lobsters for 2 to 3 months to increase their "grade" in the live export trade. The most promising method of lobster farming/fattening appears to be intensive culture in indoor tanks and flow through systems. It can be either a semi-closed system with biological filters or an open system

Sea Ranching of Spiny lobsters / Sand lobsters

The production and release of juvenile marine organisms in order to augment the fishery is termed as sea ranching. Spiny lobsters are ideal species for sea ranching as they have very limited migration and can be grown in their natural habitats and harvested when they reach commercial sizes. Determination of the extent to which hatchery reared lobsters contribute to the natural populations is very essential. Tagging studies and detailed ecological investigations have to be conducted regularly to assess the contribution of the ranched population to the fishery. Private entrepreneurs may be encouraged to take up the sea ranching programme as was done in other countries

Management options

The Ministry of Commerce and industry, Government of India promulgated the Minimum Legal Size (MLS) law in July 2003 prohibiting export of lobsters below MLS.

Species	Live/chilled/frozen	Whole cooked	Tail
P.homarus	200 g	170 g	50 g
P.polyphagus	300 g	250 g	90 g
P.ornatus	500 g	425 g	150 g
Thenus unimaculatus	150 g		45 g

Notification No. 16 (RE 2003)/2002-07 dated 17 July, 2003; Ministry of Commerce and Industry. Government of India

Participatory Management and Conservation of Lobsters: MPEDA and CMFRI

A participatory management project initiated by CMFRI and funded by MPEDA has made little progress in changing the mindset of fishermen and traders and may inculcate the sense of responsible fishing and trade. Village level meetings, distribution of educative posters, stickers and pamphlets, video film shows, "V" notching and releasing of egg bearing lobsters involving the fishermen and distribution of lobster traps to wean the fishermen away from using the destructive fishing methods are some of the activities implemented under the programme. Enforcement of MLS for export was a positive step from the ministry of Commerce and Industry, Government of India. However, implementation of a minimum legal size for fishing, closure of fishery during peak spawning in the rock lobster fishery and ban on trammel nets are regulatory measures recommended for management of this vulnerable fishery. Lobster fishing being a socio-economuc activity involving the local fishermen, any regulatory measure shall consider the socioeconomic view point so that the fishermen are not adversely affected.

Constraints

Kerala's lobster fishery constitutes a low volume resource, and therefore, fishing regulations are not strictly enforced. The quantum of juveniles caught in trawls is low. Artisanal gears such as trammel nets, gill nets and traps are also used for fishing in inshore areas. Gears like trammel nets operated in inshore areas bring in a large quantity of juveniles and subadult lobsters which fetch only low price. The undersized lobsters procured from the fishermen were exported until the Ministry of Commerce and Industry, Government of India, notified the Minimum Legal Size (MLS) limit for export in 2003. Nearly 50 % of the lobsters caught in trammel nets are undersized. The secondary holding centres keep the lobsters under highly stressed condition due to paucity of space and seawater facility, and therefore, the lobsters become weak and highly stressed. They may contract disease even if brought and stocked for ongrowing. If proper care is given, these undersized low value lobsters can be used to acquire better grades which can fetch a higher price.

Recommendations for sustainable exploitation and management of the lobster resource

- Co-management/Participatory approach: Government Organizations, Fishermen, traders- to inculcate the sense of responsible fishing and trade. Lobster fishing being a socio-economic activity involving the local fishermen, any regulatory measure shall consider the socioeconomic view point so that the fishermen are not adversely affected.
- Mesh size regulation
- Closure of fishery during peak spawning in the rock lobster fishery
- Minimum legal size for export
- Releasing of berried lobsters back to the sea
- Sea ranching, Marine protected areas
- Scope for lobster farming and fattening of juvenile lobsters
- Awareness programmes- Participatory approach
- Allot research fundings – Development of Breeding and hatchery technology

Acknowledgements

The authors are grateful to the Director CMFRI, for giving opportunity to present the chapter in the "Conference on Bioresources and Commercial Utilization- Trends, Supply Chain and Sustainability" and HOD, CFD for encouragement. The catch data received from FRAD, CMFRI is gratefully acknowledged.

References

Holthuis, L. B. 1991. FAO species catalogue. Vol. 13. Marine lobsters of the world. An annotated and illustrated catalogue of species of interest to fisheries known to date (No. 125). FAO Fisheries Synopsis, Food and Agriculture Organization, Rome. https://www.fao.org/3/t0411e/t0411e00.htm.