



**TRADABLE/
COMMERCIALY
POTENTIAL
BIORESOURCES OF
KERALA AND
ECONOMIC VALUATION**

EXECUTIVE SUMMARY





TRADABLE/ COMMERCIALY POTENTIAL BIORESOURCES OF KERALA AND ECONOMIC VALUATION

E X E C U T I V E S U M M A R Y

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TRADABLE/COMMERCIALY POTENTIAL BIORESOURCES OF KERALA AND ECONOMIC VALUATION

EXECUTIVE SUMMARY

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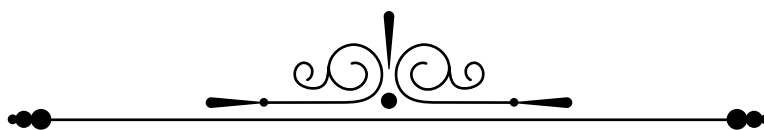


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1	Project Title	:	Database of Tradable/ Commercially potential bioresources and its Economic potential
2	Project duration:	:	Two years
3	Total Budget	:	Rs. 1.00 crore
4	Project No. and Date of Sanction	:	GO (Rt) No 507/2019/P&EA dated 02.12.2019
5	Name and Designation of Principal Investigator (PI):	:	Dr George C. Thomas Chairman, KSBB
6	Name and Designation of Co-Investigators (Co-PIs)	:	Dr Santhosh Kumar, Member secretary, KSBB, Dr. N. Preetha, Senior Research Officer, KSBB
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10	Study Area	:	Kerala





CHAPTER-1

INTRODUCTION-CONTEXT, IMPORTANCE AND BACKGROUND

1.1 PROJECT CONTEXT AND IMPORTANCE

Biodiversity is the natural capital base for a sustainable economy. A rich biodiversity can provide multiple bio-resources, which are extensively extracted by human beings all over the world and used for divergent purposes. Bio-resources-based industries are using genetic/biological resources (plants, animals, microorganisms and genetic materials) from the forests, agricultural land, wetlands and marine ecosystems, as inputs or raw-materials and manufacturing different consumer products.

“ Bio-resources are the base for several industries (such as pharmaceuticals, agro-processing, textiles, fisheries, cosmetics, bio-technology etc.) contributing to the global economy and human welfare. Further bio-resources is the source of employment and livelihood for millions of poor in developing countries like India. In this context, the conservation of biodiversity and the sustainable use and trade of biodiversity-derived products and services can provide countries valuable opportunities for economic development and improvement of livelihoods.

”

For effective implementation of the Access and Benefit Sharing (ABS) provisions of the UN-Convention on Biological Diversity (CBD) each nation or the state requires a comprehensive understanding of their biological resources in their jurisdiction as well as its trade and commercial utilization. As a party in the CBD, India's initiatives in fulfilling its objectives (a) the conservation of biological diversity, (b) the sustainable use of its components and, (c) the fair and equitable sharing of benefits arising from the utilisation of genetic resources were appreciable.

India ratified the Nagoya Protocol on Access and Benefit Sharing (ABS) on 12th October 2014, and implemented the protocol's provisions through well assigned legal and decentralized institutional measures- The Biological Diversity Act 2002 and Rules 2004. The Biological Diversity Act is implemented through a three-tier institutional mechanism: The National Biodiversity Authority (NBA) at the national level; State Biodiversity Boards (SBBs) at the provincial (State Government) level; and the Biodiversity Management Committees (BMCs) to be set up by the elected bodies at the local level. While all the state Governments (28) have set up SBBs, setting up of BMCs is an ongoing process. So far, 2,76,690 BMCs have been constituted by the local bodies in the country (NBA, 2022). For the implementation of various provisions of the BD Act, several notifications have been issued so far. The Guidelines on the Access to Biological Resources and Associated Knowledge and Benefit Sharing Regulations (2014) is a landmark, which prescribe the manner of processing the applications, along with templates and terms for benefit sharing.

Kerala State Biodiversity Board (KSBB) is an autonomous body of the State Government and falls under the provision of the Biological Diversity Act 2002, Rules 2004 and Kerala State Biological Diversity Rules 2008. KSBB is dedicated to conservation and sustainable utilisation of the rich bio resources of the State and fair and equitable sharing of benefits arising out of its commercial utilization. Even though the state registered significant progress in implementing its mandate especially the provisions of the Biological Diversity Act, the ABS agreements signed is limited. In this regard the ongoing project on "Database of tradable or commercially potential bio-resources and their economic valuation in Kerala", through the "Rebuild Kerala Initiative" is significant.

“ Sectors such as: pharmaceutical, biotechnology, seed, crop protection, horticulture, cosmetic and personal care, fragrance and flavor, food and beverage industries etc. access resources and undertake research and develop commercial products from bio/genetic resources. Each of these sectors has different needs and access bio-resources in different ways and each sector has different profit margins. Estimation of the economic value as well as the examination of value addition of bio-resources will help in determining and realizing realistic estimates of benefits derivable from the accessed resources. ”

The conceptual framework on the policy aspect of this project is structured in BioTrade initiative developed by the UNCTAD. The BioTrade emphasis on the collection, production, transformation and commercialization of goods and services derived from biodiversity in environmentally, socially and economically sustainable ways. No doubt that the current attempt on tradable bio-resources documentation and its economic valuation is strongly associated with the BioTrade concept, which contribute to reducing direct pressures on biodiversity and ecosystem services as well as to maintaining and improving human well-being. ABS and BioTrade will mutually benefit one another by promoting sustainable sourcing and use of local biological resources for trade at one end, and fair and equitable sharing of benefits to the communities and conservation of local biological diversity at the other end.

“The report presents a detailed analysis of biodiversity goods production statistics, overall market scenario and revenue of different sectors as agriculture, forest, marine and coastal, animal husbandry etc., export scenario, ABS potential and value chain with value addition at each stage of marketing and manufacturing of selected bio-resources. Further we emphasized on various constraints and opportunities in documentation of Tradable bio-resources and its economic valuation as well as key emerging policy issues. A major predicament in implementing ABS at state level is the lack of traceability of collection source and the project aims to address this gap.”

Documentation of tradable bio-resources in a State is baseline information, which has multiple uses. It helps to understand the demand and supply scenario of each species /resources and promote sustainable consumption. Further, since bio-resources are renewable natural resources considering their increasing demand and trade, effective conservation measures can be designed based on solid knowledge base of BioTrade, even in a legally bound manner. This exercise (documentation) also will be beneficial to multiple stakeholders including: the providers (collectors and cultivators), of bio-resources, different types of traders involved in their business, wholesalers, industries that use bio-resources as raw-materials, and the government departments which are responsible in designing strategies on biodiversity conservation. Further, the documentation of tradable bio-resources is extremely useful for the enforcement agencies (NBA, SBBs, and Biodiversity Management Committees - BMCs) for implementing the Access and Benefit Sharing (ABS) principles prescribed under the BD Act. The

valuation of biodiversity goods (bio-resources) derived from different ecosystems with the help of an appropriate methodology, is a fundamental step towards operationalizing the “Access and Benefit Sharing (ABS)” principle.

This study has been conducted by taking into account the bio-resource value both at the ecosystem stage from which it is extracted and at the commercial stage where value addition and manufacturing is done. Bioresources, such as timber and non-timber forest products, aquatic produce, agriculture produce and livestock produce were considered for valuation. Tourism from natural ecosystems was also considered as a recreational use value. At the value addition stage, bio-resource based MSMEs and large factories (full and partial) were both considered for estimating their value. Additionally, the export and import of bio-resources and bio-resources -based products were also evaluated to understand the extent of importance of these resources in external trade. The report also emphasized the need of a value chain (with value addition) of bioresources and a tentative estimation of the ABS in the State.

1.2 PROJECT BACKGROUND

1.2.1 Project milestones and monitoring mechanism

Although the project was sanctioned during May 2019, the project formally began during November 2020 due to a change in the mode of implementation of the project and the receipt of revised Administrative Sanction. The projects were scheduled to be completed in November 2021 but due to COVID 19 pandemic its operational closing date was extended till June 2022.

Table 1.1 Project milestones

S No	Milestones	Date/ Theme
1	Project Title	Development of Data Base Of Tradable/Commercially Potential Bioresources and their Economic Valuation in Kerala
2	Sanction Order No:	GO (Rt) No 507/2019/P&EA dated 02.12.2019
	Total Sanctioned Amount:	Rs 1.00 crore
	I Instalment: Order No:	G.O(Rt)No.212/2020/ P&EA Dated 15.05.2020
	II Instalment: Order No:	G.O(Rt)No.224/2021/P&EA Dated 15.05.2021
	III Instalment: Order No:	G.O(Rt)No.394/2021/P&EA Dated 07.09.2021
3	Focal Area	Tradable Bio resources quantification and economic valuation
4	Date of hiring of Subject experts and program coordinators	01.11.2020
Major workshops and consultations		
5	Inception Workshop	17.11.2020
6	Training programs to project staff	16.11.2020 04.01.2021 15.02.2021
7	Training to NCC students and volunteers	28.12. 2020 18.01.2021.
8	Regional consultations with industries at Trivandrum, Thrissur and Kozhikode	16.03.2021 02.02.2021 18.02.2021 20.02.2021 20.04.2021 21.04.2021
9	State level workshop on Bioresources and commercial utilization: Trends, Market, Supply chain and sustainability	27.09.2021 - 30.09.2021
Major review meeting held		
10	Monthly review meeting	1 st week of each month
11	Midterm Review date	5.07.2021
12	Departmental monitoring committee meeting	09.12.2020
13	Expert Monitoring Committee	17.12.2020 23.07.2021 09.08.2021 15.09.2021.



1.2.2 Progress Monitoring

The progress of the projects were regularly monitored by committees at different levels constituted for this purpose:

1. A consultative meeting regarding data sharing was conducted with officials of Departments of Forest and wildlife, Fisheries, Ayush - Indian system of medicine, Industries and commerce, Drug controlling Authority, Agriculture, Animal Husbandry, Dairy development, on 17/11/2020, under the chairmanship of Dr Usha Titis IAS, Principal Secretary, Department of Environment, Govt of Kerala.
2. A Departmental monitoring committee has been established vide GO(Rt.) No. 87/2020/Envtd dated 23.10.2020 with Principal Secretary, Department of Environment, Chairman, KSBB, Dr C Bhaskaran, Chairman State Expert Appraisal Committee, and Dr K Satheesh Kumar, Board Member, KSBB. The committee reviews the achievement of the major milestones and the deliverables.
3. An expert monitoring committee with 10 members has been constituted with Dr RVVarma, Former Chairman, KSBB as Chairman to periodically review the progress of the work of project team
4. A daily reporting format and monthly reporting format for field staff has been prepared. The daily monitoring and monthly monitoring was conducted by the Senior Research Officer of KSBB. The project activities were reviewed monthly by Chairman KSBB and documented in Monthly progress report and in the Project monitoring tool of RKI.
5. A mid progress review of the projects was conducted on 5.07.2021

1.2.3 Objectives and Scope of the project

Since the types of bio-resources are very diverse, the entire gamut of tradable bio-resources has been categorized under Forestry, Agriculture, Horticulture, Livestock, Marine and Inland. For this project, no exclusion was made in terms of normally traded bio-resources as defined in the Biological Diversity Act, 2002 and all bio-resources were included within the scope of the study. The study area extends to all the districts of Kerala and an ecosystem based approach has been followed.

1. To estimate current utilization of biological resources (plants, animals, in marine, freshwater and terrestrial ecosystems) by industries (both domestic market and export) in Kerala and their threat status
2. To examine the current central and state regulations and policies relevant to commercial utilization of bioresources along with the details on the implementing agencies and their role.
3. To identify various local, regional, state level, national and international agencies involved undertaking biosurvey, bio research and commercial utilization of bioresources.
4. To propose species of commercial importance and of conservation value for notification under section 38 of Biodiversity Act in order to regulate collection
5. To delineate market linkage between primary harvesters, middlemen and value addition by industries for Species of Interest.
6. To propose necessary changes in the practices and regulatory mechanism in order to promote long-term sustainability of priority species
7. To develop mechanism to implement the Biological Diversity Act, 2002 and Access and Benefit Sharing Provisions in the sector.

1.2.4 Methodology

Inception workshop was conducted during November 2019 and the Inception Report detailed the findings from initial discussions and the milestones, deliverables and time schedule. The report also described the approach and methodology for data collection (primary/secondary), sources of data, mode of consultation, staffing requirements, and questionnaire and work plan in detail. The methodology followed included primary data collection through questionnaire surveys as well as secondary data analysis from various institutional and academic sources and generally followed the methodology detailed in Inception report. Due to COVID19 lockdown delays in the primary data collection has occurred. The methodology employed included both desk review (research) and empirical investigation. The study team met state level and district level officers of the various line departments/ research organizations etc. associated with promotion and management of bio-resources like Kerala Forest Department, Department of Agriculture Development and Farmers Welfare, Ayush, Industry & Commerce, Ayurvedic drug controller, State Medicinal Plants Board, NABARD , KVIB , Various boards like Rubber, Tea, Coffee, Cocoa, Areca nut, Cashew, Spices, Research organizations like KFRI, JNTBGRI, Malabar Botanic Garden, Department of Botany, University of Calicut, ICAR-Central Plantation Crops Research Institute, ICAR-Central Tuber Crops Research Institute (ICAR-CTCRI) Kerala Agricultural University, Kudumbashree, State Poverty Eradication Mission, ICAR-National Bureau of Plant Genetic Resource, Thrissur, College of Forestry, Vegetable and Fruit Promotion Council Keralam (VFPC) etc. Some of the secondary source of information was also obtained from: Agricultural and Processed Food Products Export Development Authority (APEDA), Department of Economics and Statistics, Kerala, Directorate General of Commercial Intelligence and Statistics, MSME, KINFRA, Cochin Chamber of Commerce.

Secondary source of data pertaining to aquatic resources was obtained from ICAR - CMFRI, Kochi, ICAR - CIFT, Kochi, ICAR -NBFGR, ZSI, Regional centre Calicut, NIPHAT, Kochi, Department of Aquatic Biology and Fisheries, Trivandrum, Department of FRM & HT, KUFOS Department of Marine Sciences, Biotechnology, CUSAT, Kochi, Department of Fisheries, Government of Kerala, Matsyafed, Government of Kerala , SAF, Department of Fisheries, Government of Kerala Department of Industrial fisheries, CUSAT , Marine Products Export Development Authority (MPEDA) etc.

1.2.5 Organization of the report

Through this project, we came up with a comprehensive list of tradable bio-resources (flora and aquatic fauna) of Kerala from its different biodiversity rich and fragile ecosystems such as: forests, agriculture, coastal and marine, and freshwater. Further we also attempted to explore the volume of extraction (quantity) of resources, market value (at its collection stage), trade potential and nature of trade, commercial utilization, products manufactured, export, import etc. As part of the project for each sector, state wise and district wise details were collected for five years (2015-2020) and analysis carried out. In order to take into account the impact of COVID 19 and natural disasters of 2018, the cumulative average were considered. The project report is organized into 4 volumes and a volume of Annexures and covers data of tradable floral and aquatic faunal resources in the following sectors:

1. Forestry: Estimates of the quantity of extraction and value of the forest bioresources namely Timber and NWFPs. Depot wise data of timber collection was also collected and analysed.
2. Cultivated crops :The economic information of crop includes: Area of cultivation, Production, Productivity, Farm Price, Value of product and Cost of cultivation of major crops. Value added products from cultivated crops were listed. The annual volume and value of different categories of hardwood and softwood obtained from outside the forests (private land) were also considered.
3. Livestock: Livestock information includes production of milk, meat, unit price and total value from the sector etc.
4. Fishing and aquaculture: Data pertaining to commercial fishing in ocean, coastal and offshore waters and inland waters and tradable bioresources in aquatic sector and value added products were covered in a separate volume.
5. Traders of bioresources with focus on trade of medicinal plants through raw drug dealers and plant nurseries
6. Bioresources based industries with special focus on Ayush sector and projected medicinal plant requirement of drug manufacturers
7. Ecotourism and its economic potential
8. Export and Import data of bioresources and major countries of export and balance of trade in the following categories - food products, marine products, textiles and fabrics, rubber and rubber products, wood and wood products, essential oils, medicinal and other pharmaceutical products, ayush and herbal products, floriculture products, tobacco manufactured , leather and leather products
9. Ecosystem wise different categories of Tradable and ABS Potential bioresources list in Kerala was also drafted
10. Case studies of successful initiatives in bioresources based tribal livelihood, sustainable initiatives in agricultural crops, floriculture, plant extracts and forestry.
11. Estimation of ABS potential of Kerala and bioresource based employment generation
12. Species of conservation concern and policy recommendations

The summary report highlights the key findings of each sector, the calculated ABS potential and ecosystem wise different categories of Tradable and ABS Potential bioresources in Kerala.

CHAPTER-2

TRADABLE/COMMERCIALY POTENTIAL BIORESOURCES OF KERALA


INTRODUCTION

India, a megadiverse country with only 2.4% of the world's land area, harbours 7-8% of all recorded species, including over 45,000 species of plants and 91,000 species of animals. Of the 36 global biodiversity hotspots, 4 are in India, represented by the Himalayas, the Western Ghats, the North-east, and the Nicobar Islands.

The Western Ghats, is recognized as one of the world's eight 'hottest hotspots' of biological diversity. Out of the thirty-nine sites in the Western Ghats inscribed on the UNESCO World Heritage List, 19 are located in Kerala. About 95 % of the flowering plants and about 90% of the vertebrate fauna in the Western Ghats are found in Kerala. Western Ghats harbour more than 7388 species of flowering plants, of which 5584 species are indigenous (India's Fifth National Report to Convention on Biological Diversity ,2014). Out of this 2242 species are Indian endemic and 1261 are Western Ghat endemics. There are 5 national parks, 17 wildlife sanctuaries and one community reserve with a total area of 3213.24 sq km which cover 27.89 % of the total forest area and 8.26 % of the geographical area of state of 38,86,287 ha (www.forest.kerala.gov.in). The western part of the State on the Arabian Sea coast is a low-lying area with estuaries and backwaters rich in aquatic flora and fauna. The State is also having the highest population density implying tremendous pressure on its bioresources which provides all the basic needs for sustenance. Kerala's geographical area has been classified according to thirteen different uses of land which is presented in Table 2.1.

Table 2.1 Land use pattern

S. No	Category	Area	Percentage to total Geographical Area
1	Forest	1081509	27.83
2	Land put to Non Agricultural Use	455897	11.73
3	Barren and Uncultivable Land	10619	0.27
4	Permanent Pastures and other Grazing Land	0	0
5	Land Under Miscellaneous Tree Crops	2143	0.06
6	Cultivable Waste	99810	2.57
7	Fallow Other Than Current Fallow	46931	1.21
8	Current Fallow	57387	1.48
9	Marshy Land	11	0
10	Still Water	100160	2.58
11	Water Logged Area	3077	0.08
12	Social Forestry	2679	0.07
13	Net Area Sown	2026064	52.13
	Total	3886287	100



Kerala's economic growth is driven by sectors such as food processing, aquatic products, spices, rubber, ayurveda, handlooms, apparels and garments, coir and traditional products such as wood carvings, designer jewellery, tourism, IT, electronics, among others. Kerala is one of the leading producers of natural rubber, coir, coconut, cashew, coffee and spices in the country. In the agriculture and allied sector, livestock is one the fastest growing sectors in the state. Manufacturing segment in Kerala largely consists of traditional industries such as coir, handloom and cashew processing. Services is the fastest growing sector in Kerala, with IT and tourism being the key drivers of the state's services sector. The services sector in the state shall remain the cornerstone of the state economy. It is very clear that majority of the above mentioned sectors are biological resources related.

The GSDP growth of Kerala has remained stable from 2015-16 onwards, with the state being able to maintain an average annual growth rate of 7.4 percent between 2015-16 and 2018-19. There has been a change in the state economy with diminishing share of the agriculture and allied sectors in the GSVA over the recent years, and the increase in the share of services in the GSVA of the state. Kerala is a high-income Indian State and, the annual income per capita in Kerala was ₹1,49,563 in 2019-20 against a national average (for 2019- 20) of ₹96,152. The average income per person in Kerala was approximately 1.5 times the Indian average in 2019-20. Crops, livestock, fishing, and forestry contributed 8.03 per cent to Kerala's Gross State Value Added (GSVA) in 2019-20 (constant prices). The share of agriculture and allied sector in GSVA is negligible but Kerala ranks third in India with respect to GVA in agriculture per worker at ₹2.20 lakh. as per SDG India Index 2019.

According to the Department for Promotion of Industry and Internal Trade (DPIIT), cumulative FDI inflow in Kerala was valued at US\$ 269.61 million between October 2019 and March 2021. Exports from the state stood at US\$ 3.94 billion in FY21. Tea export from the state stood at US\$ 75.65 million during 2020-21 (until January 2021). In FY21, the total marine products exports from Kerala accounted for US\$ 511.52 million, which was 15% of the total exports.

2.1 FOREST BIORESOURCES AND TOF

The forest area under the administrative charge of Kerala Forest Department is 11521.993 km² as on 2020 and forms 29.65% of the total geographical area of the State as against the national average of 23.24%. The total plantation area is 1563.16 km² which accounts 13.57% of the total forest area. Considering species wise distribution of plantation, Teak covers an extent of 77237.981 ha which is 49.61% of total plantation areas. Forest produce have traditionally been divided as major and minor, the first category consists of timber, small wood and fuel wood while the second includes bamboos, oil seeds, grasses, fruits, leaves, resins, barks, exudates, honey, spices, medicinal plants, aromatic plants, animal products etc.

Many species in Kerala's forests are of good economic use. There are 117 species used for soft wood purposes, 146 species for extraction of tannin, 29 species for latex, 111 species for gum, 65 species for resin, 284 species for oil and 1170 species are used medicinally. In Kerala, 28 species of bamboo are found. Bamboos from Kerala forests are being supplied mainly for the pulp and rayon units under concessional rates. The revenue from forestry sector by way of sale of timber and other forest produce was ₹236.8 crores in 2020-21. Major portion of the forest revenue is the contribution of timber. In 2020-21, ₹216.8 crore was collected towards revenue from the sale of timber alone which accounted for 91.6 per cent of the total forest revenue.

2.1.1 Timber bioresources

The quantification of timber resources extracted from a wide variety of species allows for an overall assessment of the trend of the quantity and value of these important bio-resources, which are extracted and utilized from different source areas. Such a comprehensive enumeration will also aid in understanding the scope of ABS provisions that can be provided by buyers to the traditional knowledge holders, especially for high value-added species such as Sandalwood.

Species such as *Tectona grandis* (teak), *Dalbergia latifolia* (rosewood), *Swietenia macrophylla* (mahogany), *Artocarpus heterophyllus* (Jack), *Artocarpus hirsutus* (wild jack), *Xylia xylocarpa*, *Lagerstroemia spp.*, *Albizia spp.*, *Terminalia tomentosa*, *Pterocarpus marsupium*, *Grewia tilaefolia* etc. are important traditional structural timber trees for industrial and furniture use. The humid conditions of Kerala facilitate the growth of fast growing trees such as *Ailanthus triphysa*, *Gmelina arborea*, *Mahogany*, *eucalypts*, *acacias*, *casuarinas* etc. These are mainly utilised in matchwood, packing case, pulpwood and plywood industries.

Table 2.2 Commercially important tree species in Kerala

Sector	Species being used	Sources
Construction timbers	<i>Artocarpus heterophyllus</i> (jack), <i>A. hirsutus</i> (wild jack), <i>Tectona grandis</i> (teak), <i>Sweitenia macrophylla</i> (mahogany), <i>Eucalyptus</i> spp, <i>Acacia auriculiformis</i> , <i>Acacia mangium</i>	Home gardens and forests
	Purpleheart or violet wood (<i>Peltogyne</i> spp.), mora (<i>Mora excelsa</i>), beech wood (<i>Fagus sylvatica</i>), taukkyan wood (<i>Terminalia alata</i>), Kwila or merbau (<i>Instia bijuga</i>), green heart (<i>Ocotea rodiei</i>)	Import from abroad
Furniture	Teak, rosewood, mahogany, <i>Xylia xylocarpa</i> , <i>Lagerstroemia lanceolata</i> , <i>Albizia lebbbeck</i> , <i>Albizia odoratissima</i> , <i>Terminalia tomentosa</i> , <i>Terminalia paniculata</i> , <i>Gmelina arborea</i> , <i>Pterocarpus marsupium</i> , <i>Bridelia retusa</i> . purpleheart, rubberwood, acacia sp.	Forests, home gardens, estates , imports from other States and abroad.
Packing case	<i>Eucalyptus</i> spp. <i>Grevillea robusta</i> (silver oak), <i>Albizia</i> spp, <i>Alstonia scholaris</i> , <i>Olea dioica</i> (edana), cashew wood, cocoa wood, <i>A. heterophyllus</i> , <i>A. hirsutus</i> , <i>Erythrina indica</i> , <i>Bombax ceiba</i> , <i>Michaelia chempaka</i>	Estates, home gardens , import from other States.
Matchwood	<i>Ailanthus triphysa</i> (matty), <i>Macaranga peltata</i> (vatta), <i>Alstonia scholaris</i> (pala), <i>Bombax ceiba</i> (elavu) and <i>Albizia</i> spp.	Home gardens, forests
Plywood	Rubberwood, <i>Macaranga peltata</i> (vatta), <i>eucalypts</i> , silveroak, <i>Terminalia chebula</i> (kadukka), <i>Vateria indica</i> (white dammar), <i>kalpine</i> , <i>Sweitenia macrophylla</i> (mahogany), <i>plavu</i> , <i>anjily</i> , imported sp.	Estates, home gardens , imports from other States and abroad.

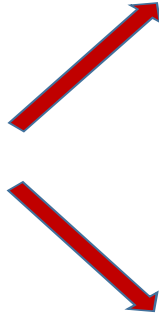
The methodology used to collate data on timber resources utilised in the state incorporated both backward and forward linkages through primary and secondary data collection from both the auctioneers (KFD and KFDC) as well as bidders, who form the intermediate link in the timber value supply chain. Thus, a holistic database creation and trend analysis was made possible through this method.

The data on timber extracted and auctioned by the KFD (Kerala Forest Department) from forest areas was directly obtained from questionnaire interview of depot officers as well as timber depot records. The data on timber resources extracted from plantations was obtained directly from the KFDC (Kerala Forest Development Corporation) records. Data on timber resources extracted and utilised from Trees Outside Forests (TOF) or private lands obtained from the "Report on Saw Mills of Kerala, 2014-15". was also incorporated here. It may be noted that this is one area where there is a large data gap.

In 2020-21, ₹216.8 crore was collected towards revenue from the sale of timber alone which accounted for 91.6 per cent of the total forest revenue. The Marayoor sandalwood has a high demand and auction of the same generated Rs 4.9 crores during 2020-21

TIMBERS OF KERALA

Sources of Timbers



1. Timbers from forest areas

2. Timbers from non forest areas

1. Agroforestry
2. Roads, Railways etc.
3. Private lands

Data Collection

1. Forest timber depots, DO Interview, Bidders details
2. Govt. plantations (Eg: KFDC)
3. Retail sales depots ("outlets")

1. Plantation Corporation
2. Public works department & Social forestry
3. Pri Land (Institution in Thrissure)

Methods of Data Analysis

1. Classification (according to Type, Value).
2. Depts-wise data
3. Preparation of State data.
4. Presentation of analyzed data in a line/bar/pie diagraph.
5. Timber Depots Officers Interview
6. Bidders Data Analysis

Emphasis of Analysis

Scientific

Timber species at glance
Passport Scripts of Major Timber

- Name (Common, trade & Scientific, with author)
- Image
- Habit
- Distribution
- Wood properties
- Processing
- Uses
- Value, Quantity

Economic

- High Value timber + High Volume timber
- Economic Benefits of timber from Forest
- Net benefit of Timber from private land

Table 2.3 Production of major forest produce (2019-2021)

Sl.No	Item	Unit	2019-20	2020-21
1.	Timber	Cum.	30274.605	20664.477
2.	Fire wood	MT	4258.355	3350.75
3.	Honey	Kg.	25661.100	26115.700
4.	Reeds	MT	653.960	918.940
5.	Bamboo	MT	1986.570	60.668
6.	Eucalyptus	MT.	23.264	7.773
7.	Sandal wood	Kg.	69692.000	77872.696
8.	Accaciaauriculoformis	MT	98.413	82.585
9.	AccaciaManjium	MT	2.604	13.18

Source: Forest Department, GoK

Table 2.4 Revenue from forest produce (Rs in lakh, 2018-2021)

S No	Item	2018-19	2019-20	2020-21
1.	Timber	24438.24	22651.6	21682.01
2.	Firewood and Charcoal	138.27	84.75	165.63
3.	Receipts from sale of forest produce coming under the Kerala private forest (Vesting and Assignment) Act.	31.27	10.80	0.00
4.	Receipts from forest development tax	1397.74	1183.18	1128.99
5.	Receipts under Kerala Forest Produce	32.52	22.91	8.00
6.	Other Items	191.01	64.58	70.97
	Total	26229.05	24017.92	23055.60

A. Auction of Timber through Government Depots of Kerala Forest Department

The secondary data pertaining to quantity and value of different timber species of forests of Kerala for the last 5-6 years (2015 - 2020) was collected from the records of 27 timber depots of Kerala Forest and Wildlife Department. The 27 timber depots in Kerala come under six timber sales divisions. The trend of the quantity of timber species sold through e-auction and the revenue generated for this period were collected and analysed.

Teak is the major timber species in all depots of Kerala. The miscellaneous timber represents economically important timbers other than teak. It includes irul, maruthu, vaka, venga, anjily, rosewood, mahogany, kambakam, thembavu, venteak, jack, myla, unnam/chadachi, thanni, karimthakara, poovam, kanjiram etc. The major tree species auctioned by the KFD was Teak, which formed the highest percentage in both quantity and value among all the timber species auctioned from the 27 depots scattered across 6 timber sales divisions in 2015-20.

Among the various depots, Nedunkayam (Palakkad), Walayar (Palakkad) and Achencoil (Thiruvananthapuram) depots auctioned the highest quantities of timber and obtained a comparatively high revenue, while the lowest quantities and values were supplied through Tuet (Punalur), Varappuzha (Perumpavoor) and Parappa (Kozhikode).

The forest depot officers' interview also gave an insight into the intricacies of the auction process, including methods and modes of auctioning, periodicity of auctions, division of timber classes and their pricing as well as payment modes. It was observed that e-auction process imparted more transparency and credibility to the auction process, while also simplifying it. For class I teak (1m³) bid value ranges from Rs. 1,20,000 to Rs. 1,90,000. For class II Teak (1m³) bid value ranges from Rs. 1,00,000 to Rs. 1,50,000. For class III teak (1m³) bid value ranges Rs. 65,000 to Rs. 90,000.

The lack of awareness by depot officials on the details of Biological Diversity Act and ABS norms was also recorded, showing that the ABS potential of timber bioresources has not been tapped. However, the forest department did levy 5% of total material value sold as Forest Development Tax (FDT). The highest number of auctions during the 5 year period of 2015-20 was conducted in Nedunkayam depot (304) of Palakkad division, while lowest number of auctions were held in Varappuzha depot (26) of Perumpavoor division.

The bidders interview provided valuable information on the major marketing channels, through which a broad idea of forward linkages of the timber sector can be obtained. Due to the reduction in productivity of timber from the forests of Kerala, the native bidders expressed that they prefer to buy timber from other states, or even import them from other countries. Information on taxes and rates related to loading and transportation were also obtained from this interview. The bidding timber merchants mostly resell the timber to furniture industries in Kerala, transport them to other states (Tamil Nadu, Karnataka, Andhra Pradesh and Rajasthan), or even export them to industries outside India (Nepal and UAE).

Table 2.5 Quantity and value (cumulative annual average: 2015-2020) of Timber auctioned/ supplied through Government Depots in Kerala

S. No	Wood Species	Botanical Name	NTC	Quantity		Value	
				(M ³)	%	(Rs)	%
1	Teak	<i>Tectonagrandis</i>	No	18,384.57	69.58	1,36,84,22,858.98	88.89
2	Irul	<i>Xyliaxylocarpa</i>	No	849.17	3.21	2,10,79,849.22	1.37
3	Maruthu	<i>Terminaliaarjuna</i>	No	2,090.34	7.91	2,23,86,564.50	1.45
4	Vaka	<i>Albizia sp.</i>	No	605.78	2.29	1,48,28,683.97	0.96
5	Venga	<i>Pterocarpusmarsupium</i>	No	230.20	0.87	43,62,168.21	0.28
6	Anjily	<i>Artocarpushirsutus</i>	No	223.72	0.85	72,31,899.02	0.47
7	Rosewood	<i>Dalbergialatifolia</i>	No	348.14	1.32	4,39,34,232.10	2.85
8	Mahagony	<i>Swietaniamacrophylla</i>	No	124.32	0.47	27,86,130.73	0.18
9	Kambakam	<i>Hopeaparviflora</i>	No	61.68	0.23	22,11,825.90	0.14
10	Thembavu	<i>Terminaliaelliptica</i>	No	102.72	0.39	18,85,752.65	0.12
11	Venteak	<i>Lagerstroemia microcarpa</i>	No	471.23	1.78	65,19,291.31	0.42
12	Jack/Plavu	<i>Artocarpusheterophyllus</i>	Yes	38.97	0.15	7,71,471.69	0.05
13	Unnam/Chadachi	<i>Grewiatiliaefolia</i>	No	1,191.00	4.51	1,82,83,513.27	1.19
14	Thanni	<i>Terminaliabellerica</i>	No	169.04	0.64	19,30,217.63	0.13
15	Karimthakara	<i>Albiziaprocera</i>	No	8.30	0.03	18,550.00	0.00
16	Poovam	<i>Schleicheraoleosa</i>	No	99.94	0.38	10,27,638.23	0.07
17	Kanjiram	<i>Anogeissuslatifolia</i>	No	12.15	0.05	33,486.03	0.00
18	Elavu	<i>Bombaxceiba</i>	No	119.95	0.45	7,91,415.17	0.06
19	Kadamaram	<i>Xyliaxylocarpa</i>	No	57.44	0.22	13,01,204.57	0.08
20	Kanikonna	<i>Cassia fistula</i>	Yes	12.13	0.05	9,65,843.00	0.06
21	Karavenga	<i>Pterocarpusmarsupium</i>	No	14.94	0.06	2,54,277.45	0.02
22	Kulamavu	<i>Persea sp.</i>	No	67.65	0.26	6,62,279.00	0.04
23	Manjakkadambu	<i>Haldinacordifolia</i>	No	1.01	0.00	35,208.33	0.00
24	Mazhamaram	<i>Samaneasaman</i>	No	18.06	0.07	1,37,743.78	0.01
25	Mulluvenga	<i>Brideliacrenulata</i>	No	96.30	0.36	12,41,464.06	0.08
26	Pala	<i>Alstoniascholaris</i>	No	7.83	0.03	35,844.78	0.00
27	Pulivaka	<i>Albizia sp.</i>	No	110.67	0.42	32,41,170.84	0.21
28	Uravu	<i>Persea sp.</i>	No	7.95	0.03	59,409.17	0.00
29	Thambakam	<i>Hopeaparviflora</i>	No	0.82	0.00	1,488.00	0.00
30	Miscellaneous Wood			896.07	3.39	1,30,24,057.72	0.84
	Total			26,422.07	100.00	1,53,94,65,539.3	100

Fig 2.1 a Total quantity of Timber auctioned through depots (cumulative annual average 2015-2020)

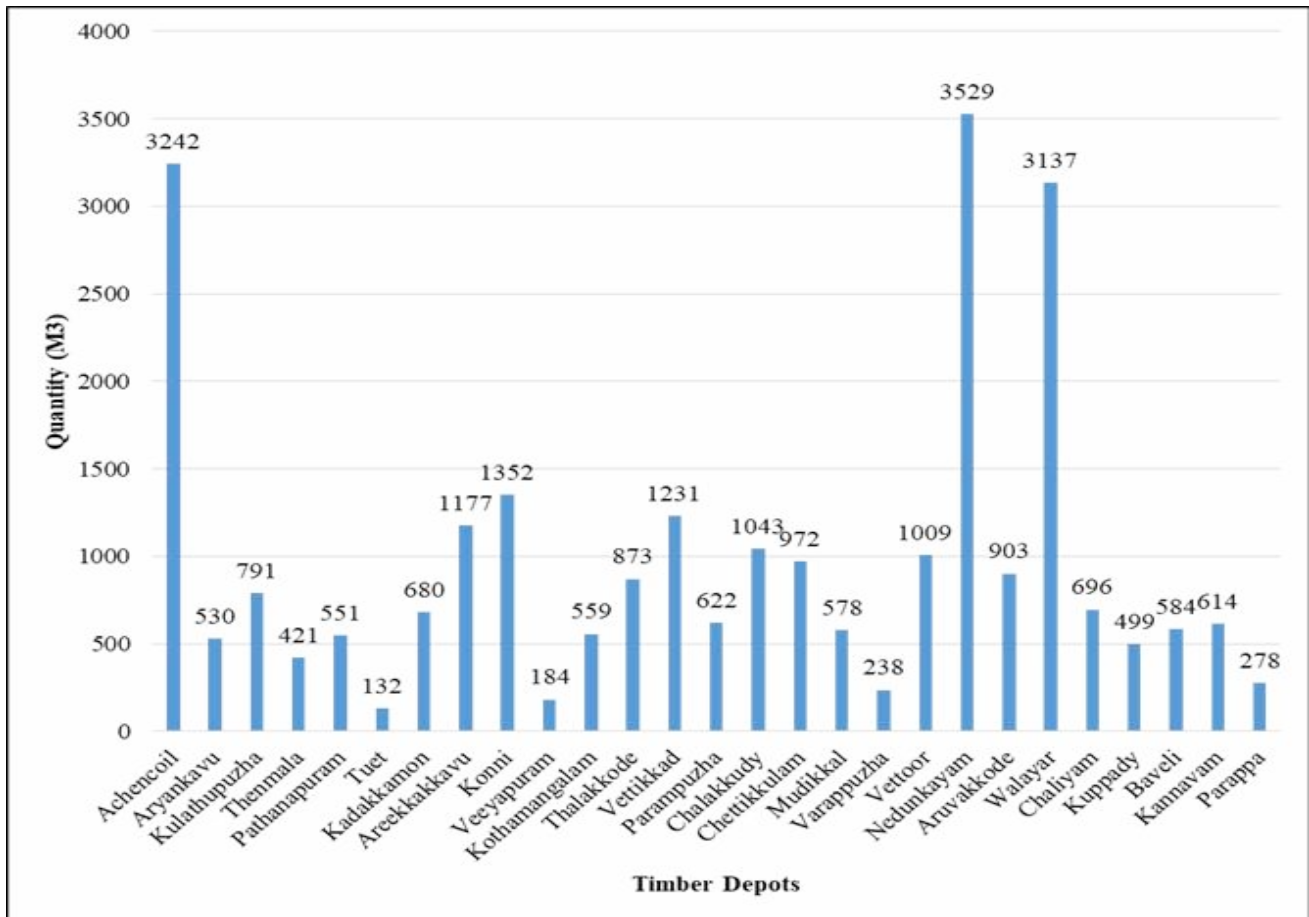
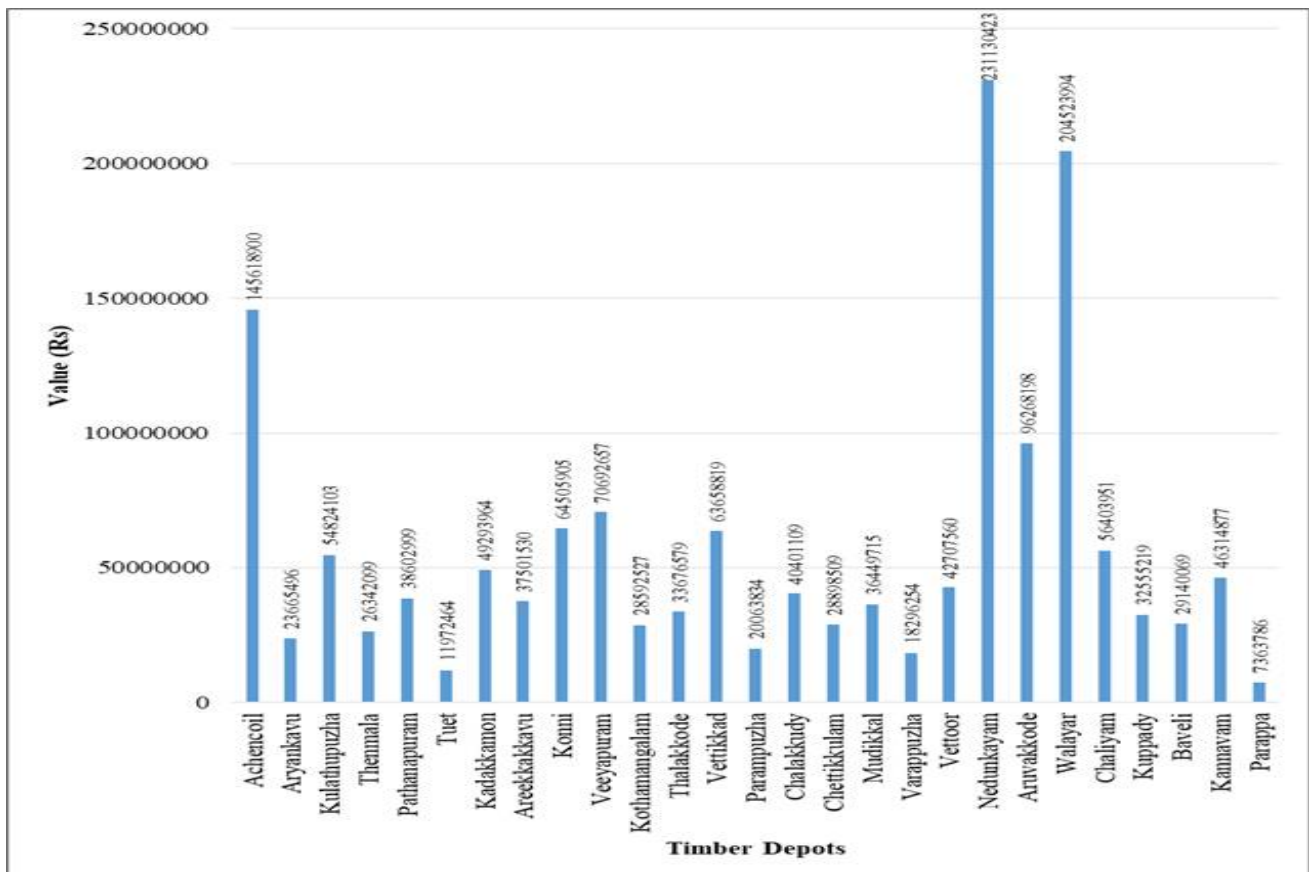


Fig 2.1 b Total value of Timber auctioned through depots (cumulative annual average 2015-2020)



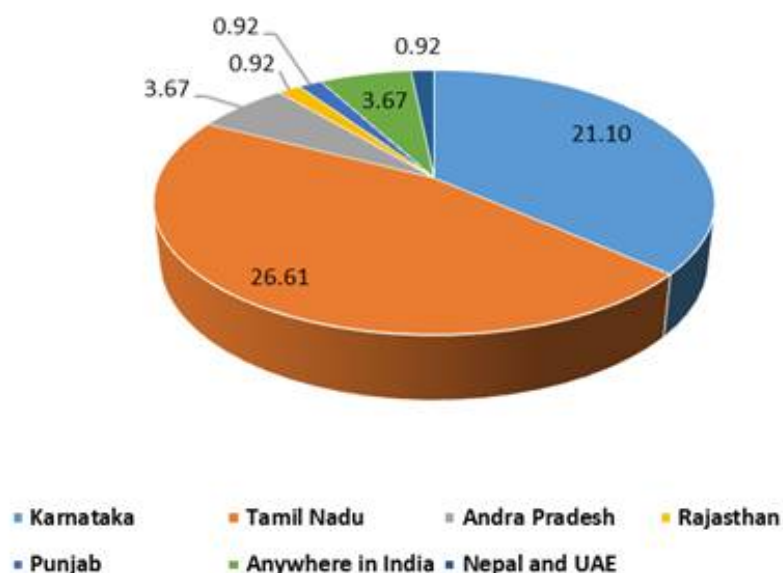


Fig 2.2 Movement of timber (%) outside Kerala

B. Quantity and value of timber auctioned through Kerala Forest Development Corporation (KFDC)

The forestry plantations of KFDC chiefly include Eucalyptus, Acacia, Teak, Albizia and other miscellaneous species. Totally 2600.969 ha of Eucalyptus plantations are maintained in KFDC under Thiruvananthapuram, Punalur, Thrissur, Munnar and Gavi Divisions. Acacia auriculiformis and Acacia mangium are marketed as pulpwood, timber and fire wood. The total area under Acacia species maintained is 1892.007 ha. in Thiruvananthapuram, Punalur, Thrissur Divisions. Acacia mangium and Eucalyptus formed the highest percentage among timber sales by quantity and revenue respectively. Other miscellaneous species included high value species like Sandal and Red sanders, as well as species like Cashew, Kumil and bamboo. At present, 1256.58 ha of teak plantation are managed under KFDC in Thiruvananthapuram, Punalur and Thrissur Divisions. Albizia species are maintained in 62.95 ha under Thiruvananthapuram and Punalur divisions.

Table 2.6 Quantity and value of timber auctioned – KFDC (Cumulative annual average: 2015-20)

	Species Name	Cumulative Annual Average			
		Qty. (M ³)	% Qty.	Rev. (Rs.)	% Rev.
1	<i>Accacia auriculiformis</i>	1079.02	11.14	16300852.16	27.63
2	<i>Accacia manjium</i>	4103.95	42.38	11934726.52	20.23
3	Eucalyptus	3529.27	36.44	18606787.44	31.54
4	Teak* M3	14.27	0.15	545693.46	0.93
5	Albizia * M3	410.46	4.24	1334743.21	2.26

6	Eucalyptus lops & tops * M3	182.29	1.88	110106.49	0.19
7	Sandalwood	365.05	3.77	4233294.77	7.18
8	Red sanders	NA	NA	345082.27	0.58
9	Bamboo	NA	NA	781692.00	1.33
10	Eucalyptus europphylla	NA	NA	159594.00	0.27
11	Acacia Firewood	NA	NA	252067.03	0.43
12	Cashew timber	NA	NA	2257101.00	3.83
13	Kumbil	NA	NA	219130.50	0.37
14	Firewood	NA	NA	477975.67	0.81
15	Teak thinning	NA	NA	445657.00	0.76
16	Teak poles	NA	NA	986233.64	1.67
	Total	9684.30	100.00	58990737.16	100.00

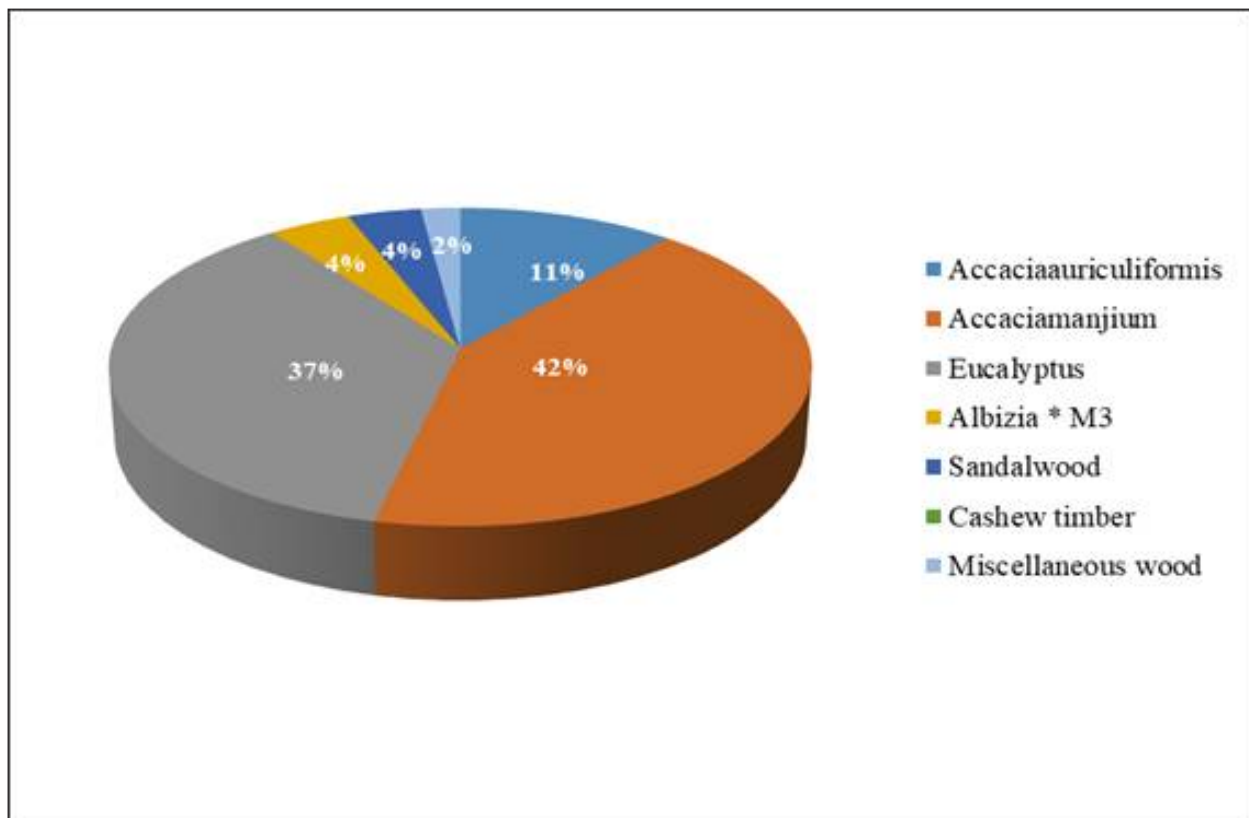


Fig 2.3 Quantity of Timber auctioned - KFDC (in %, cumulative average 2015-2020)

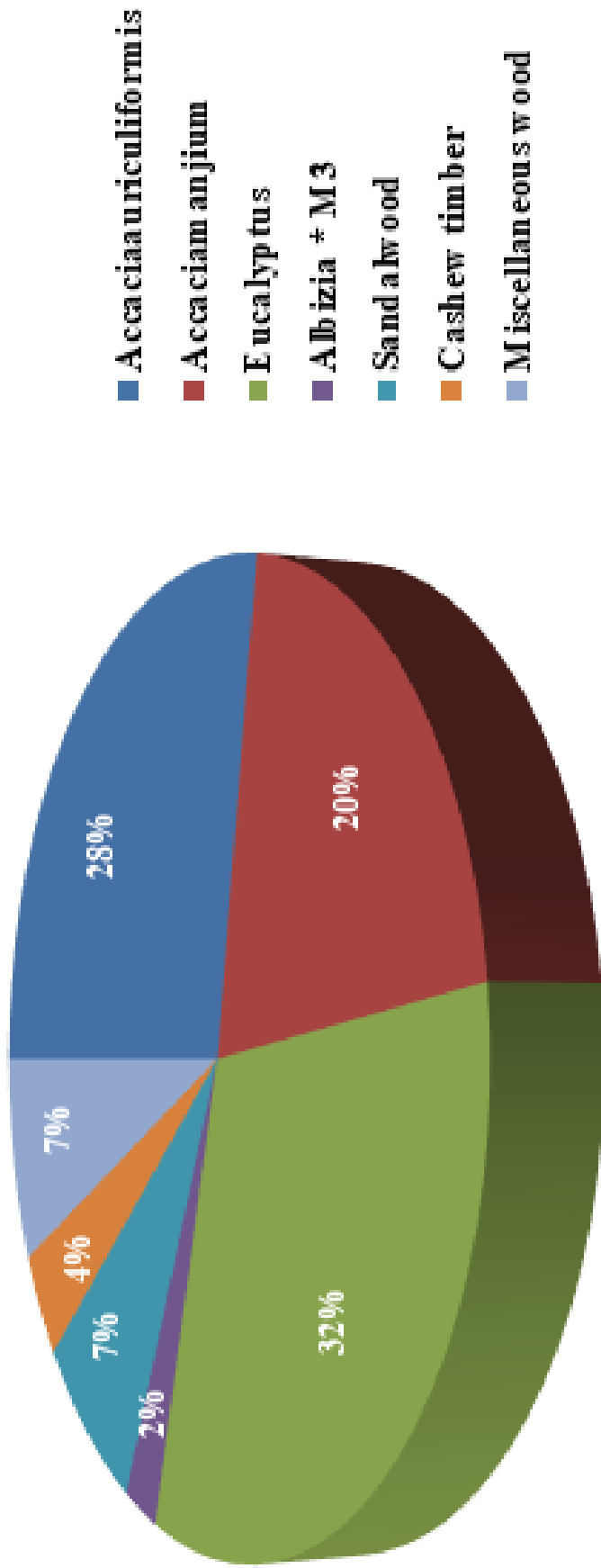


Fig 2.4 Revenue from Timber (in %, cumulative average 2015-2020)

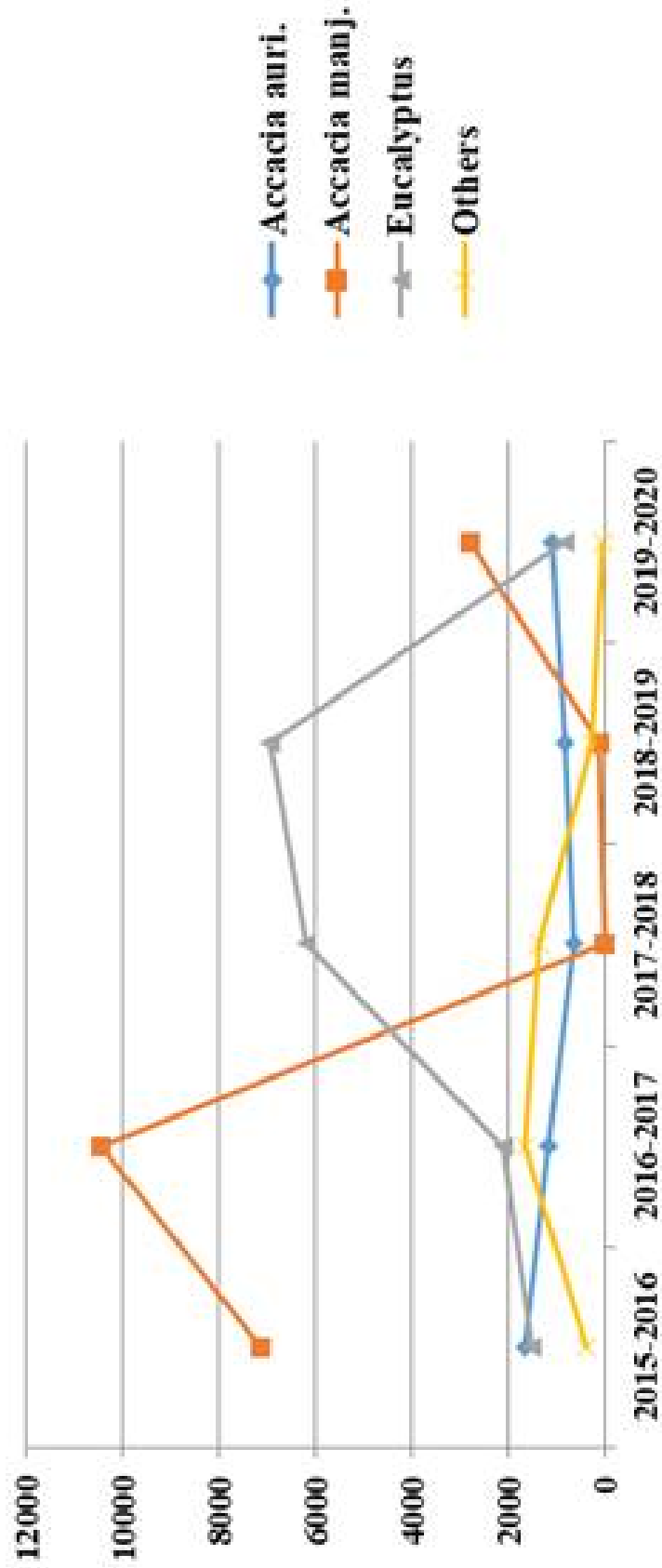


Fig 2.5 Trends in quantity of Timber (cumulative average 2015-2020)

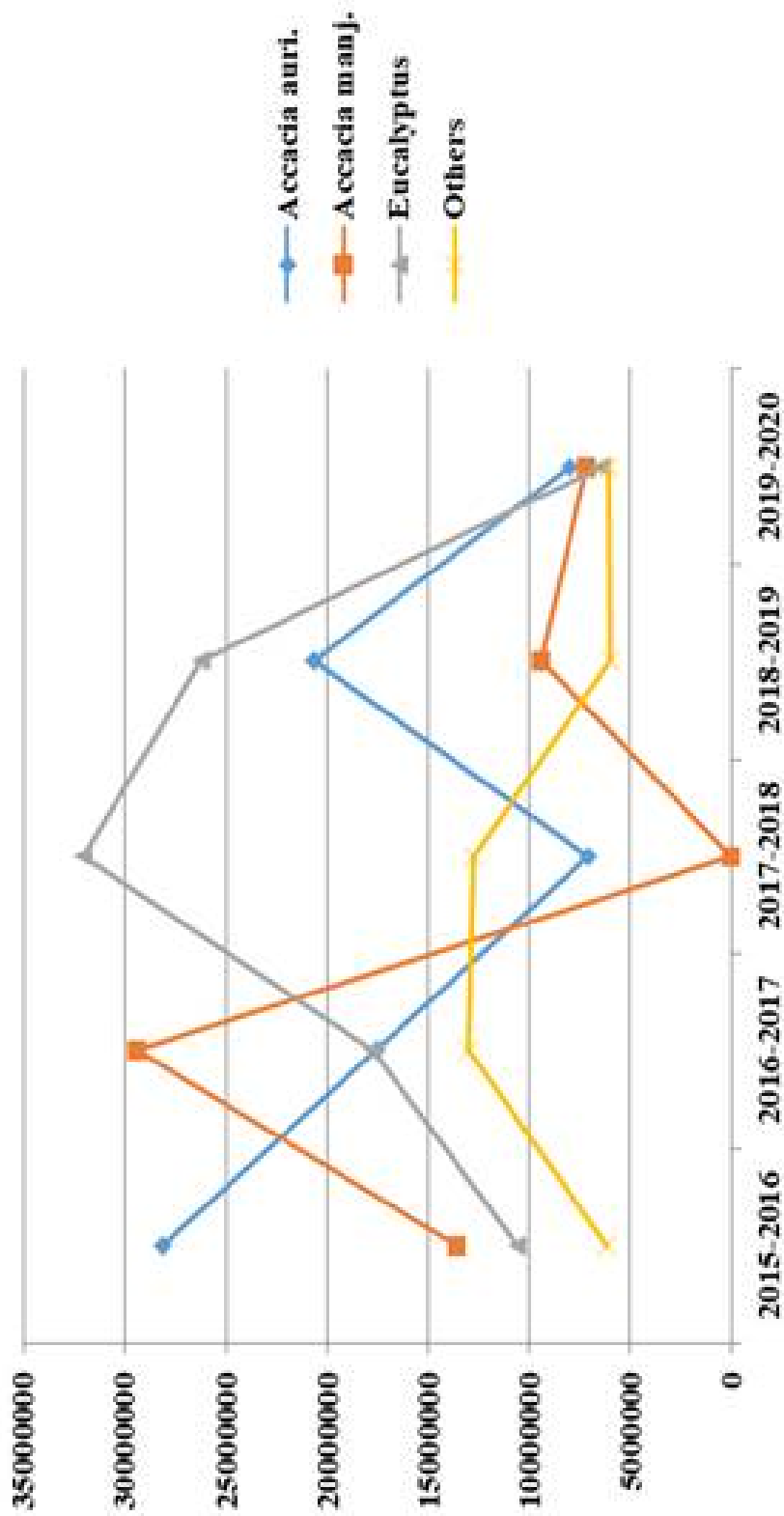


Fig 2.6 Trends in Revenue from Timber (cumulative average 2015-2020)



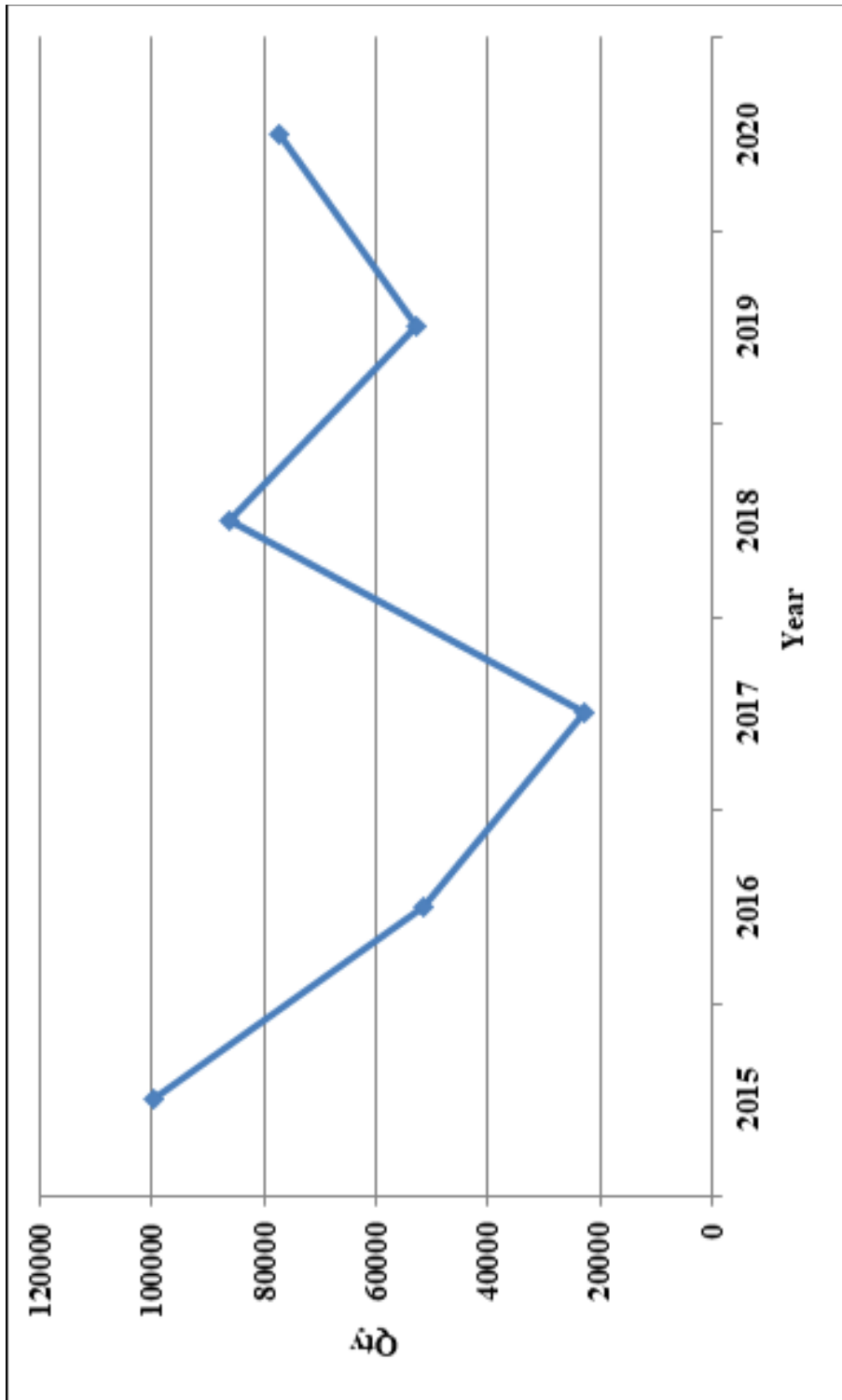


Fig 2.7 Trends in Quantity of Marayoor sandal auctioned (kg)

C. Marayoor Sandalwood

The Marayoor sandalwood reserve in Kerala spread over 1,460.7 hectares is currently one of the very few natural high-quality sandalwood forests in India. With top quality wood and high oil content, the Marayoor sandalwood is of high demand in the cosmetic and perfume industries in the international markets. The Institute of Wood Science and Technology (IWST) has branded the Marayoor sandalwood as the best quality sandalwood available in the country citing its high oil content. The data on sales of Sandalwood bioresources of the Marayoor forest division was separately collected from the Government Sandal Depot Godown in Marayoor which is managed by the KFD. The cumulative average of sales between 2015-2020 were calculated according to different classes of wood. Among the different classes of timber, the Class XII timber formed the highest percentage of cumulative sales by quantity (23.82%), while Class X formed the highest percentage of cumulative sales by revenue (26.81%). Heartwood small pieces, sandal powder and African sandal also formed a minute quantity of total sales from the Marayoor depot.

The information on bidders who had bought the sandalwood from 2015-2020 was collected to understand the nature of end users in the value chain of this precious commodity. It was observed that the Karnataka Soaps and Detergents Limited (KSDL) was the biggest bidder during all 5 years enumerated, except the year 2017 when Karnataka Handloom Development Corporation (KHDC) was the highest bidder. TSR&CO Madras, Al Sana Fragrance Delhi, Una Essential Oils Mehtapur and Oushadhi Thrissur, were some of the other prominent bidders of Marayoor Sandal.

Table 2.7 Marayoor sandal wood (cumulative annual average 2015 – 2020)

Class	Cumulative Annual Average			
	Qty (kg)	%	Amt/ Price	%
I	165.09	0.23	2471556.00	0.50
II	495.52	0.68	7281079.00	1.46
III	419.46	0.57	5914422.67	1.19
IV	160.74	0.22	2160482.83	0.43
V	976.80	1.34	13149124.50	2.64
VI	9734.17	13.34	106736738.83	21.45
VII	6289.00	8.62	74317198.33	14.94
VIII	2768.26	3.79	28836715.60	5.80
IX	2261.98	3.10	22511459.58	4.52
X	13458.37	18.44	133392017.00	26.81
XI	2147.63	2.94	12600089.33	2.53
XII	17389.97	23.82	76851610.00	15.45
XIII	195.00	0.27	585532.50	0.12
XIV	6115.97	8.38	5216630.83	1.05
XV	8710.25	11.93	1498257.50	0.30
Hwsp*	75.80	0.10	344458.00	0.07
S P*	477.00	0.65	2187090.00	0.44
AS*	1150.00	1.58	1449000.00	0.29
Total	72990.99	100.00	497503462.52	100.00

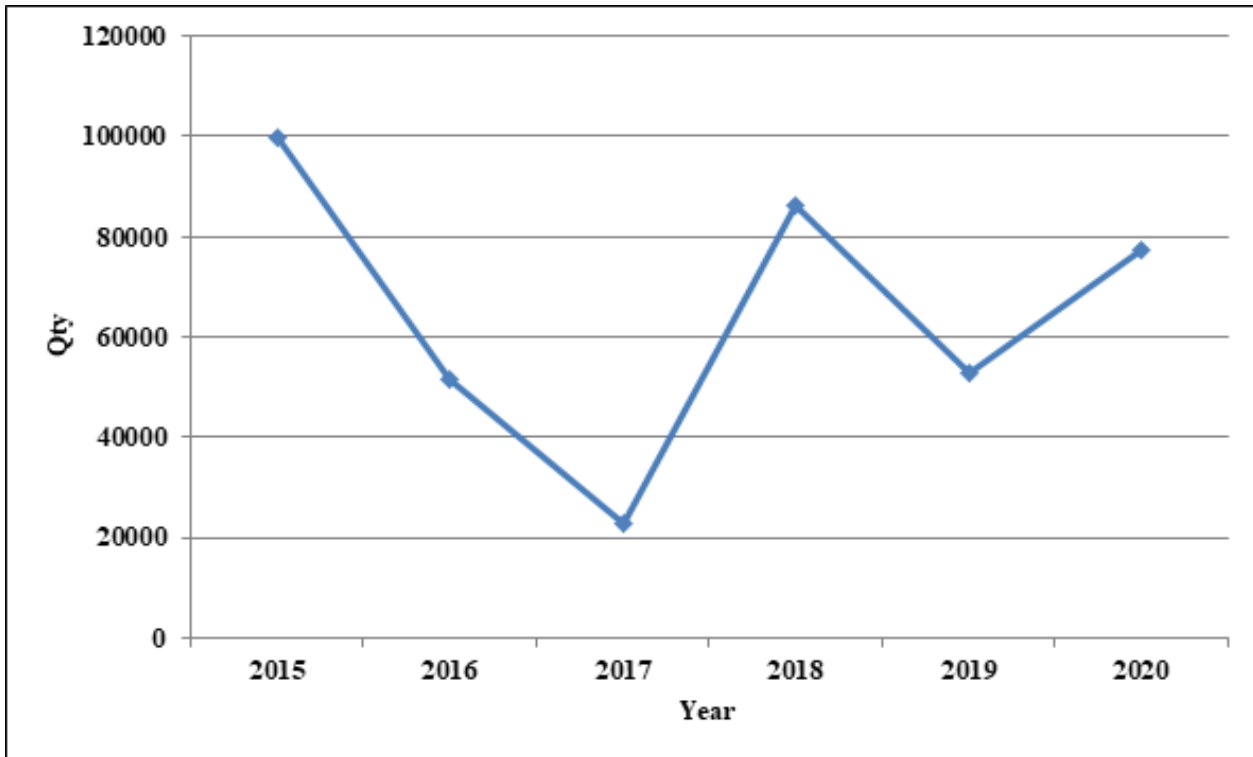


Fig 2.7 Trends in Quantity of Marayoor sandal auctioned (kg)

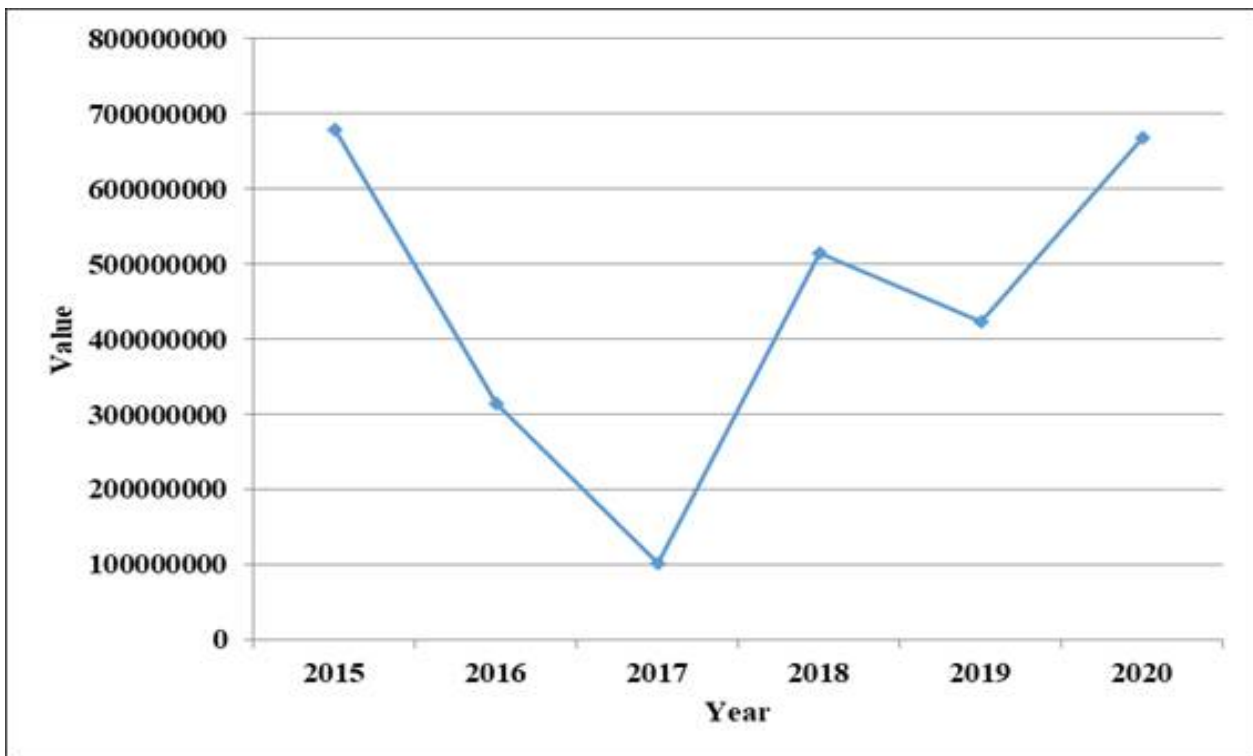


Fig 2.8 Trends in value of Marayoor sandal auctioned (Rs)



Most of the Sandalwood is used to extract essential oils and other extracts used in perfumes, soaps, toiletries, as well as pharmaceutical products. It can also be observed that most of the highly valued sandalwood sourced from Marayoor in Kerala was bid for and bought by industries outside Kerala, showing an abysmal dearth of value-adding industries in Kerala. This signifies a huge potential for setting up of essential oil, perfume and pharmaceutical industries based on sandalwood in Kerala which can provide employment and contribute to the SGDP.

Additionally, according to the Biodiversity Act and Rules, in cases of biological resources having high economic value such as sandalwood, red sanders, etc. and their derivatives, the benefit sharing may include an upfront payment of not less than 5.0%, on the proceeds of the auction or sale amount, as decided by the NBA or SBB, as the case may be, and the successful bidder or the purchaser shall pay the amount to the designated fund, before accessing the biological resource. There is hence a huge potential for collecting ABS revenue from industries which buy sandalwood for commercial utilisation.

2.1.2 Trees Outside Forest (TOF)

According to the latest Indian State of Forest Report (ISFR), 2021 by Forest Survey of India (FSI), the extent of Trees Outside Forest (TOF) is around 11,574 sq.km (Forest cover outside green wash), out of the total forest cover of 21,253 sq.km in Kerala. TOF forms an important component of forestry sector in India, which are grown mostly in private lands like plantations and homegardens. The importance of TOF was reinforced by the analysis of data from the "Report on Saw Mills of Kerala (2014-15)" which was the only credible source for getting information on timber resources extracted from TOF.

The annual quantity of timber sourced from TOF was a mammoth total of 22,56,219.00 m³. The timber was classified to hardwood and softwood species. Among hardwoods, the species contributing highest percentage of timber in quantity and value was Jack (*Artocarpus heterophylus*). Other major hardwood species included Anjili (*Artocarpus hirsutus*), Teak (*Tectona grandis*) and Mahogany (*Swietenia macrophylla*). The highest percentage of softwood timber was contributed by Maavu (*Mangifera indica*), and other major species included Rubber (*Hevea brasiliensis*), Kunnivaaka (*Albizia odoratissima*) and Vatta (*Macaranga peltata*).

- Wood from about 34 species of local wood (Hard wood) is processed by saw mills for direct and indirect sale. Jack (23%), Thengu (21%), Anjili (Aini) (19%), Teak (12%) and Mahogani (11%) are the major species of local species – Hardwood used for timber. About 86 percent were of these five species. The most preferred species are Jack and Thengu.
- Softwood of about 19 species from local wood were consumed by Sawmills for different purposes. The major Local species used (Soft wood) as timber were Mavu (45.4%), Rubber (19.5%), Vatta (8.4%), Mulmurukku (4.9%) and Kasumaavu (4.2%). Out of the total Local timber species (Soft wood) processed in sawmills about 82.5 percent were of these five species. The most preferred species are Mavu and Rubber

In brief, the annual average value of timber (from forest ecosystem and outside forest areas) as a bio-resource is Rs. 2,190.94 Crore.

Table 2.8 Total quantity and value of Timber Outside Forest

Type of Wood / Timber	Quantity (M3)	Value
Hardwood	15,20,433.00	17,31,57,37,886.00
Softwood	7,35,786.00	2,49,76,59,178.00
Total	22,56,219.00	19,81,33,97,064.00

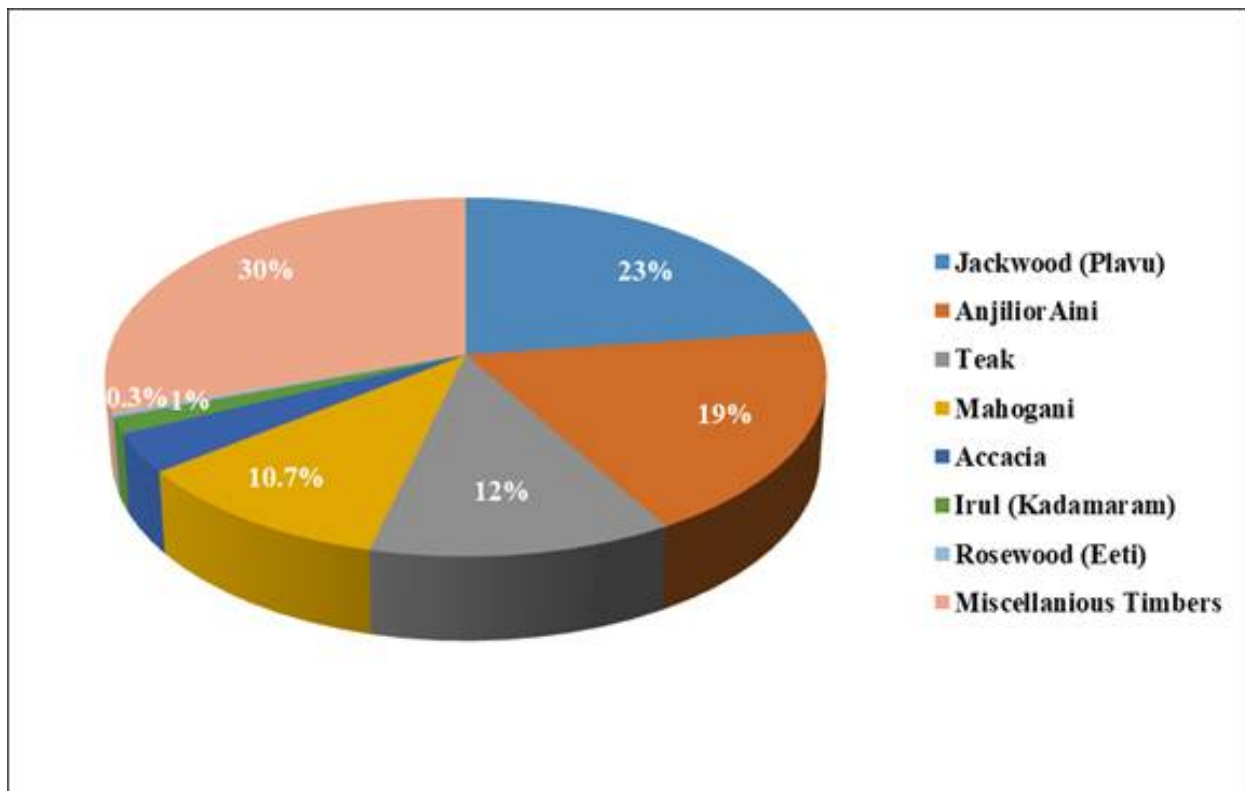


Fig 2.9 Quantity of Local Hardwood TOF 2014-15 (%)

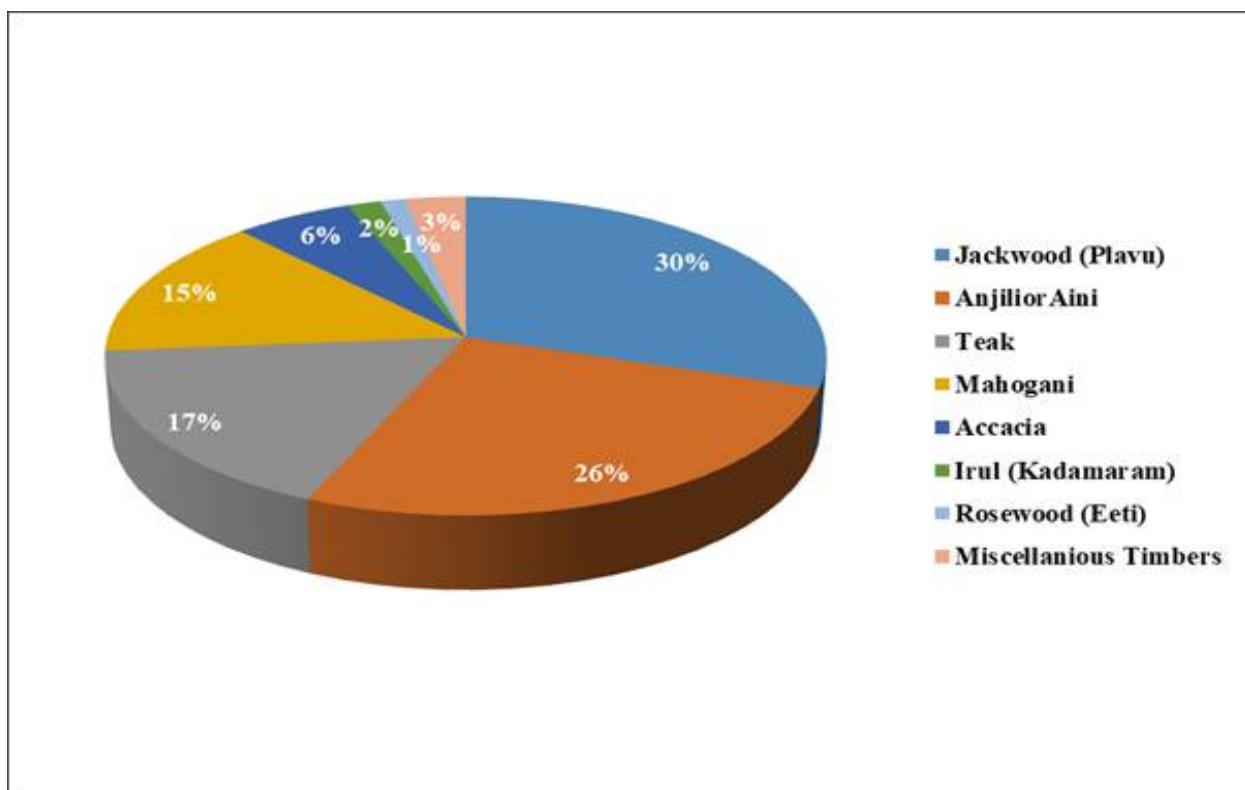


Fig 2.10 Value of Local hardwood TOF 2014-15 (%)

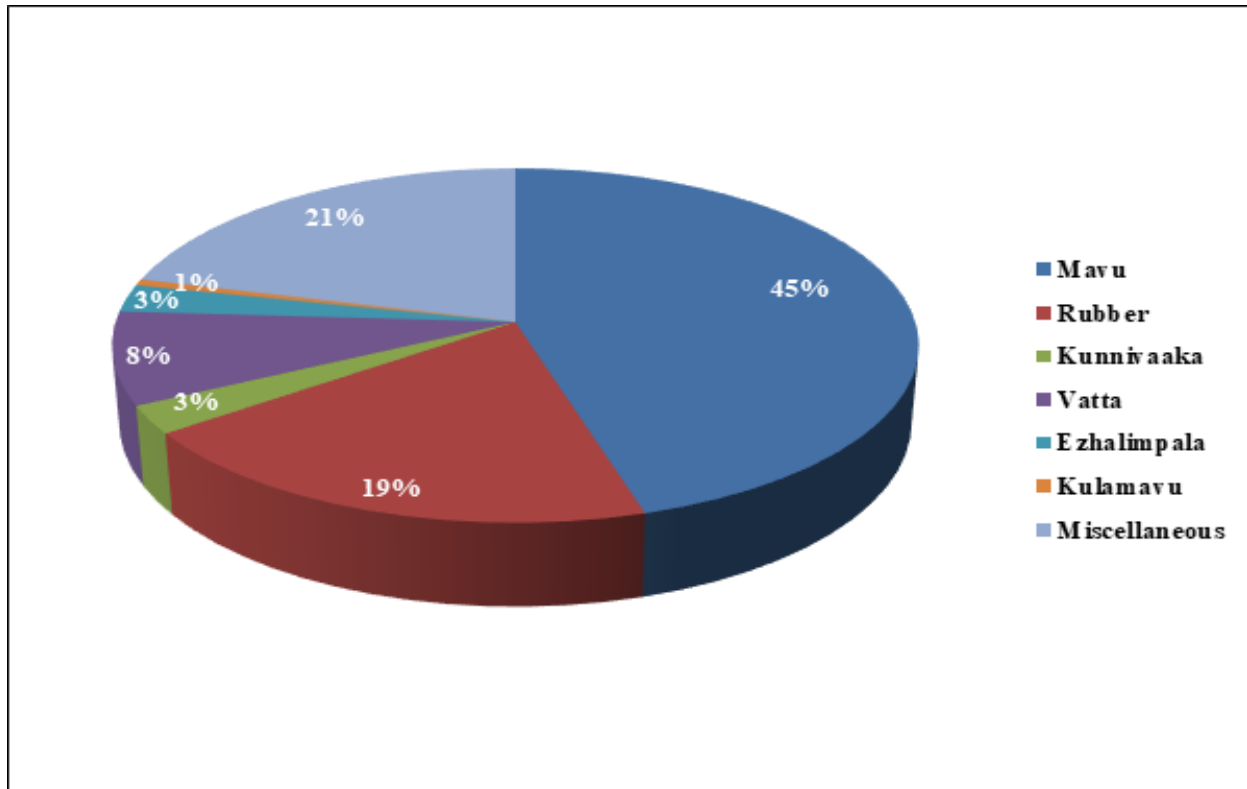


Fig 2.11 Quantity of Local softwood TOF 2014-15 (%)

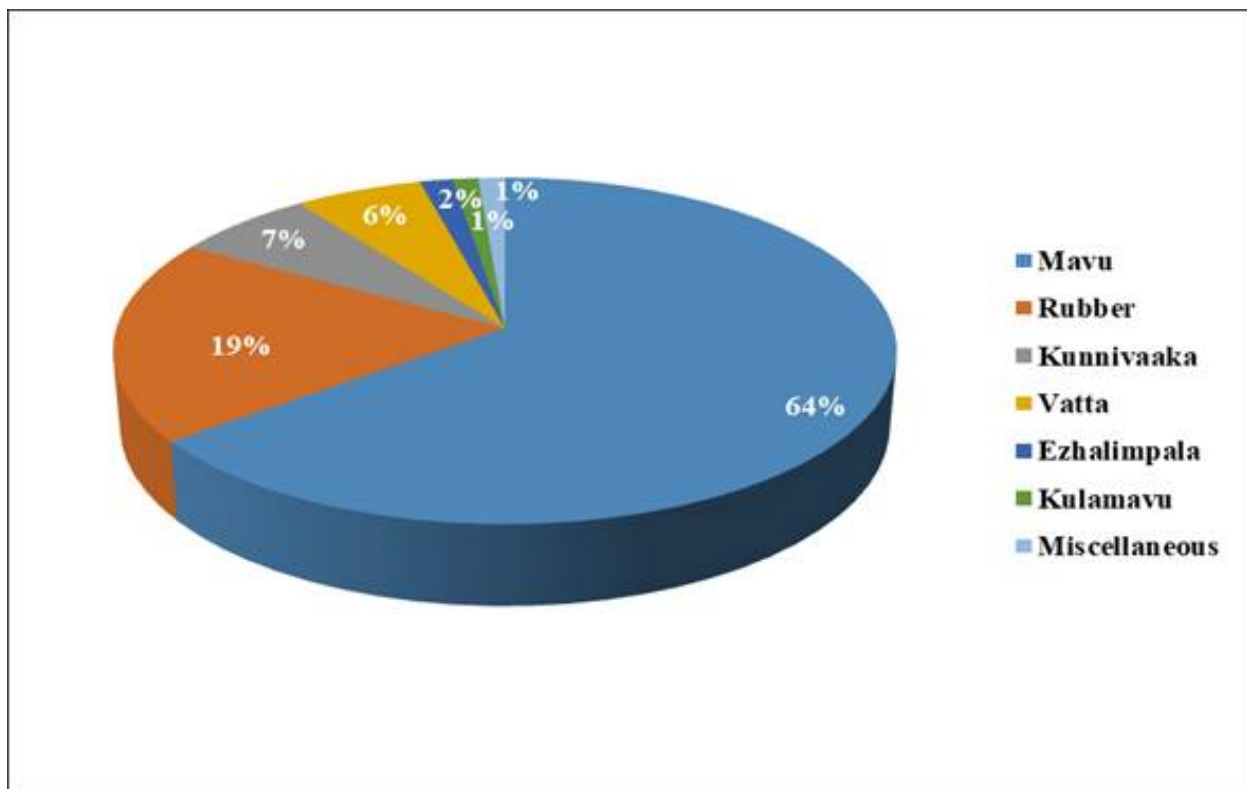


Fig 2.12 Value of Local softwood TOF 2014-15 (%)

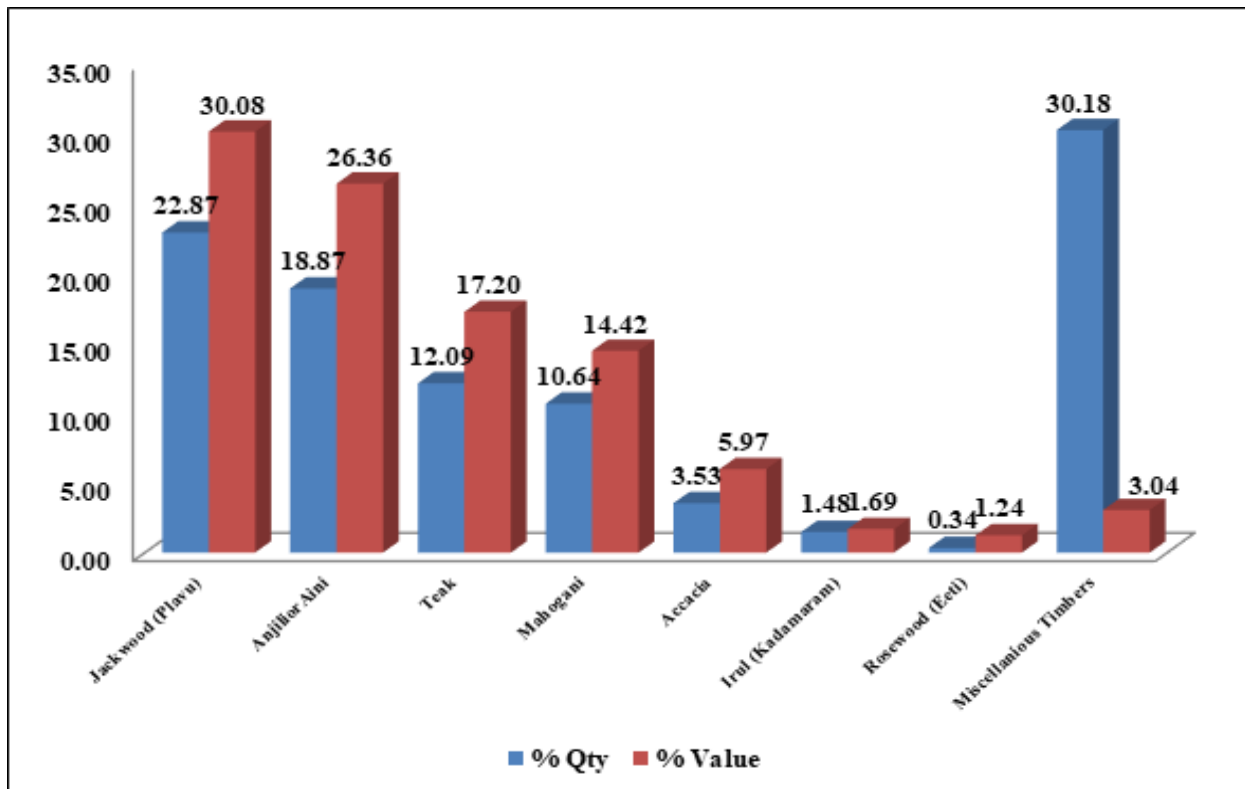


Fig 2.13 Major species of Local Hardwood TOF (Quantity and value %)

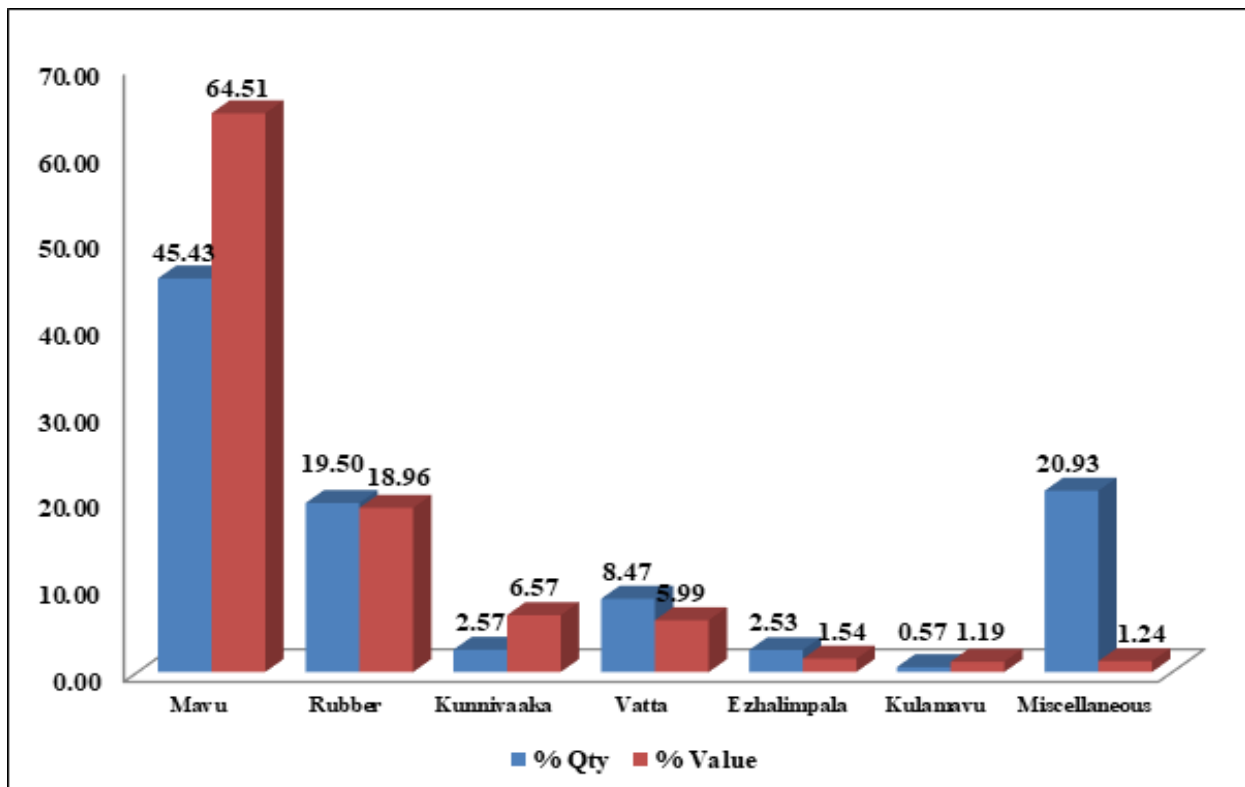


Fig 2.14 Major species of Local softwood (Quantity and value %)

Economic value of timber resources of Kerala

The annual average value of timber (from forest ecosystem and outside forest areas) as a bio-resource is Rs. 2,190.94 Crore. A consolidated picture of the timber in Kerala is provided in the following table.

Table 2.9 Timber from Kerala (Forest and Outside Forest): A consolidated picture

Timber	Mode of Estimation	Quantity (M3/Kg)	Value (Rs. Crore)
FOREST			
27 Timber Depots	Cumulative Annual Average (2015-2020)	26422.07 (M3)	153.95
KFDC	Cumulative Annual Average: 2015-16 to 2019-20	9684.30(M3)	5.90
Marayoor Sandalwood	Cumulative Annual Average (2015-2020)	72,991 (Kg)	49.75
Forest (Total)			209.60
Outside Forest (Total)	Total (2014-15)	22,56,219.00 (M3)	1,981.34
Grand Total			2,190.94



2.1.3. Non Wood Forest Product (NWFP) Bioresources

Plant products of forest origin, other than timber and firewood, include mainly medicine and narcotic, gum and resin, tan and dye, oil and fat, spice and condiment, food and fodder, fibre and floss and bamboos and canes, apart from certain specific products or uses of plants used for making platters and cups, plants used in religious contexts, and so on. Several plants belonging to NWFP group are also extracted or used on a large scale like bamboos, canes, medicinal plants, gums, tans, spices, etc. because of their excessive demand for industrial use.

The Marketing Channels of NWFP's in Kerala

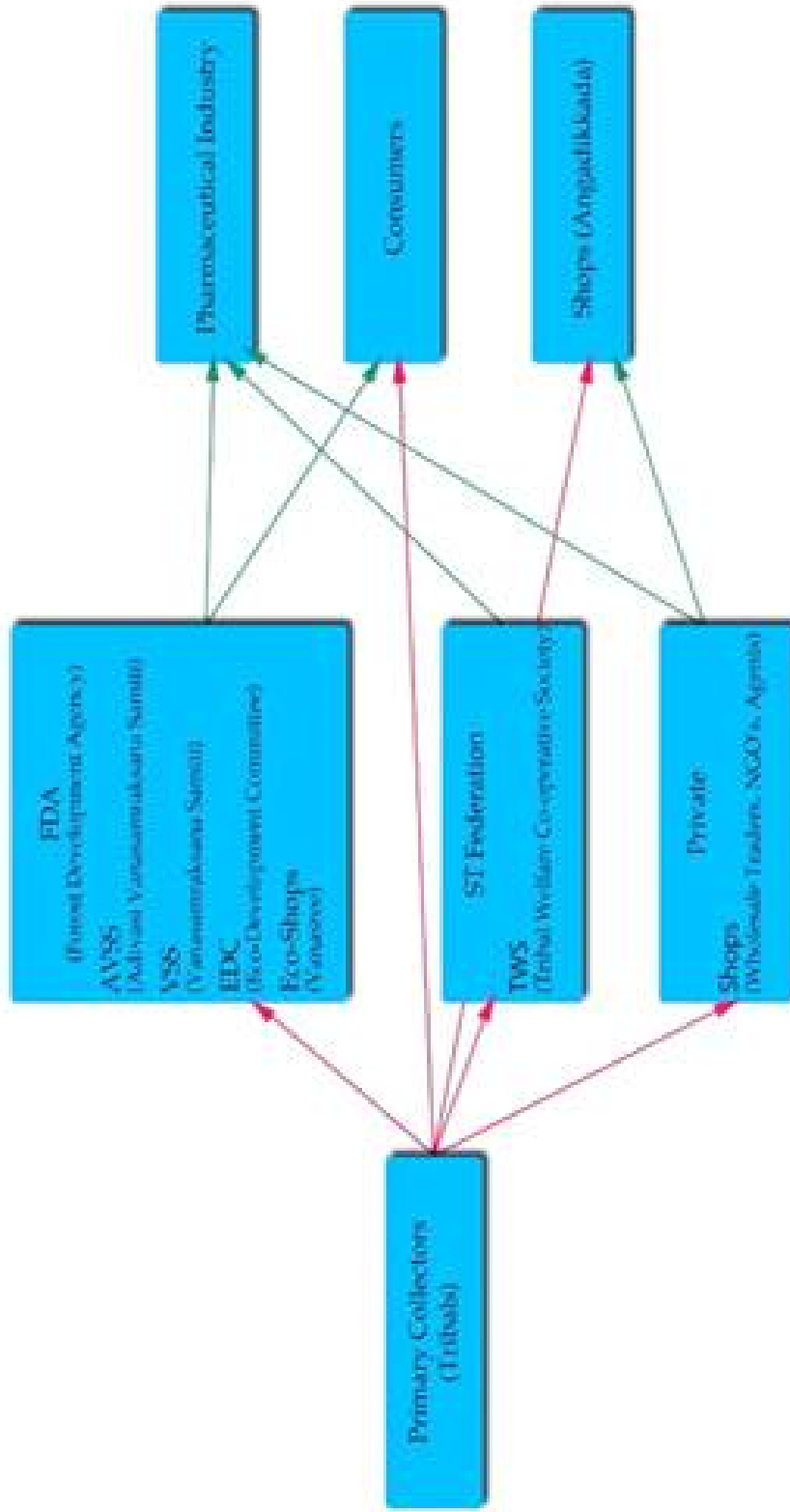


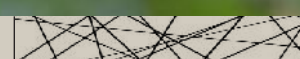
Fig 2.15 Marketing channels of NWFPs in Kerala

Kerala State Federation of SC/ST Development Cooperatives Ltd. – the apex organization of Tribal Cooperative Societies - holds rights of procurement and trade of 145 NTFPs. A total of 30 Tribal Cooperative Societies under Trivandrum, Thirssur and Kalpetta branch are actively involved in purchasing NTFPs from the primary collectors and they are functioning under SC/ST Federation. The value-added products are sold through various channels including bulk supply to different industries and sales outlets of the Federation. The Federation runs an ayurvedic medicine manufacturing unit in Thrissur under the brand name of Ayurdhara and some of the NTFPs are supplied to this unit.

The diversity of flowering plants in Kerala is recorded to be 5094 species, which is about 28% of Indian flowering plants. Around 849 species of plants are having medicinal value and used commercially in Kerala. There are about 462 NTFPs with medicinal value traded as medicinal plants in Kerala. The Kerala Forests and Wildlife Department has notified 145 species as NTFPs, About 28 species that are traded at quantities more than 100 MT per annum at national market are found in Kerala. The Kerala Biodiversity Board has notified 26 plants under the section 38 of Biological Diversity Act as species on the verge of extinction.

Table 2.10 State level – Total NTFP collected in Kerala; 2015-2019

Year	Quantity (Kg)	Value (Rs)
2015	944661.10	38767344.13
2016	510853.30	43745683.20
2017	1022146.00	43585796.50
2018	1265807	60725189
2019	389401.90	24825945.80



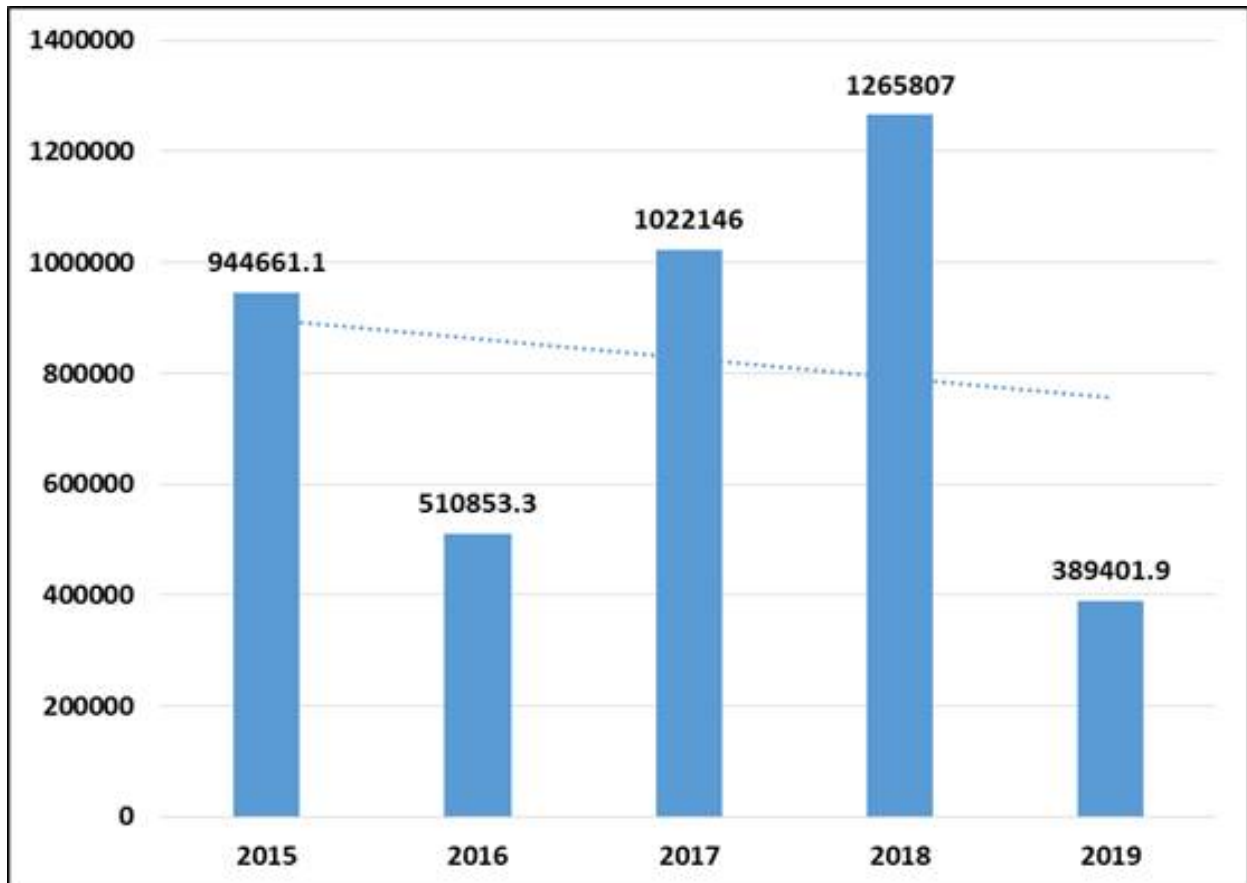


Fig 2.16 Quantity (kg) of NWFP collected (2015-2019)

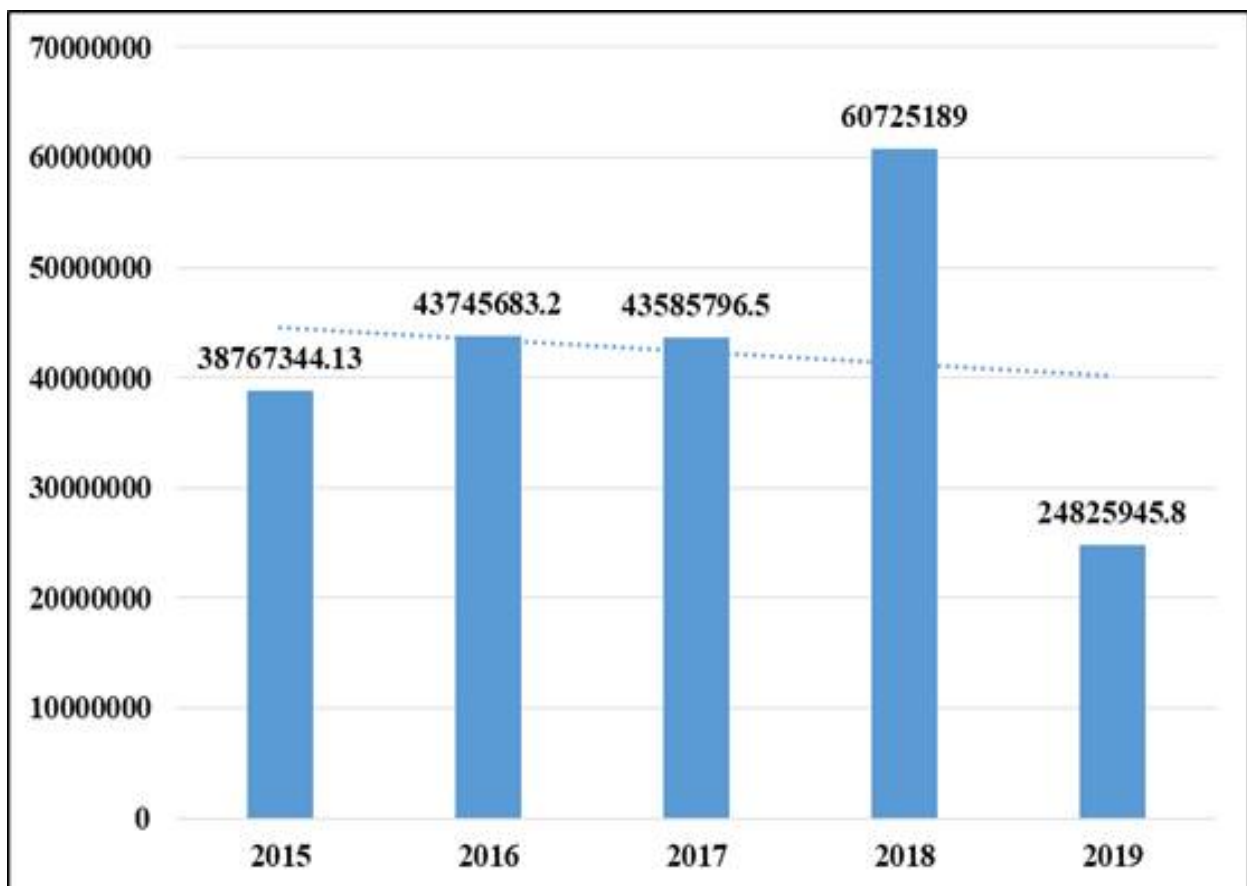


Fig 2.17 Value (Rs) of NWFP collected (2015-2019)



The total quantity of NWFP collected in Kerala increased from 2016 to 2018, then decreased in 2019. The total value of NWFP collected in Kerala have increased from 2015 to 2018, then decreased in 2019.

S. No	Wood Species	Botanical Name	NTC	Quantity		Value	
				(M ³)	%	(Rs)	%
1	Teak	<i>Tectonagrandis</i>	No	18,384.57	69.58	1,36,84,22,858.98	88.89
2	Irul	<i>Xylixycarpa</i>	No	849.17	3.21	2,10,79,849.22	1.37
3	Maruthu	<i>Terminaliaarjuna</i>	No	2,090.34	7.91	2,23,86,564.50	1.45
4	Vaka	<i>Albizia sp.</i>	No	605.78	2.29	1,48,28,683.97	0.96
5	Venga	<i>Pterocarpusmarsupium</i>	No	230.20	0.87	43,62,168.21	0.28
6	Anjily	<i>Artocarpushirsutus</i>	No	223.72	0.85	72,31,899.02	0.47
7	Rosewood	<i>Dalbergialatifolia</i>	No	348.14	1.32	4,39,34,232.10	2.85
8	Mahagony	<i>Swietaniamacrophylla</i>	No	124.32	0.47	27,86,130.73	0.18
9	Kambakam	<i>Hopeaparviflora</i>	No	61.68	0.23	22,11,825.90	0.14
10	Thembavu	<i>Terminaliaelliptica</i>	No	102.72	0.39	18,85,752.65	0.12
11	Venteak	<i>Lagerstroemia microcarpa</i>	No	471.23	1.78	65,19,291.31	0.42
12	Jack/Plavu	<i>Artocarpusheterophyllus</i>	Yes	38.97	0.15	7,71,471.69	0.05
13	Unnam/Chadachi	<i>Grewiatiliaefolia</i>	No	1,191.00	4.51	1,82,83,513.27	1.19
14	Thanni	<i>Terminaliabellerica</i>	No	169.04	0.64	19,30,217.63	0.13
15	Karimthakara	<i>Albiziaprocera</i>	No	8.30	0.03	18,550.00	0.00
16	Poovam	<i>Schleicheraoleosa</i>	No	99.94	0.38	10,27,638.23	0.07
17	Kanjiram	<i>Anogeissuslatifolia</i>	No	12.15	0.05	33,486.03	0.00
18	Elavu	<i>Bombaxceiba</i>	No	119.95	0.45	7,91,415.17	0.06
19	Kadamaram	<i>Xylixycarpa</i>	No	57.44	0.22	13,01,204.57	0.08
20	Kanikonna	<i>Cassia fistula</i>	Yes	12.13	0.05	9,65,843.00	0.06
21	Karavenga	<i>Pterocarpusmarsupium</i>	No	14.94	0.06	2,54,277.45	0.02
22	Kulamavu	<i>Persea sp.</i>	No	67.65	0.26	6,62,279.00	0.04
23	Manjakkadam	<i>Haldinacordifolia</i>	No	1.01	0.00	35,208.33	0.00
24	Mazhamaram	<i>Samaneasaman</i>	No	18.06	0.07	1,37,743.78	0.01
25	Mulluvenga	<i>Brideliacrenulata</i>	No	96.30	0.36	12,41,464.06	0.08
26	Pala	<i>Alstoniascholaris</i>	No	7.83	0.03	35,844.78	0.00
27	Pulivaka	<i>Albizia sp.</i>	No	110.67	0.42	32,41,170.84	0.21
28	Uravu	<i>Persea sp.</i>	No	7.95	0.03	59,409.17	0.00
29	Thambakam	<i>Hopeaparviflora</i>	No	0.82	0.00	1,488.00	0.00
30	Miscellaneous Wood			896.07	3.39	1,30,24,057.72	0.84
	Total			26,422.07	100.00	1,53,94,65,539.3	100



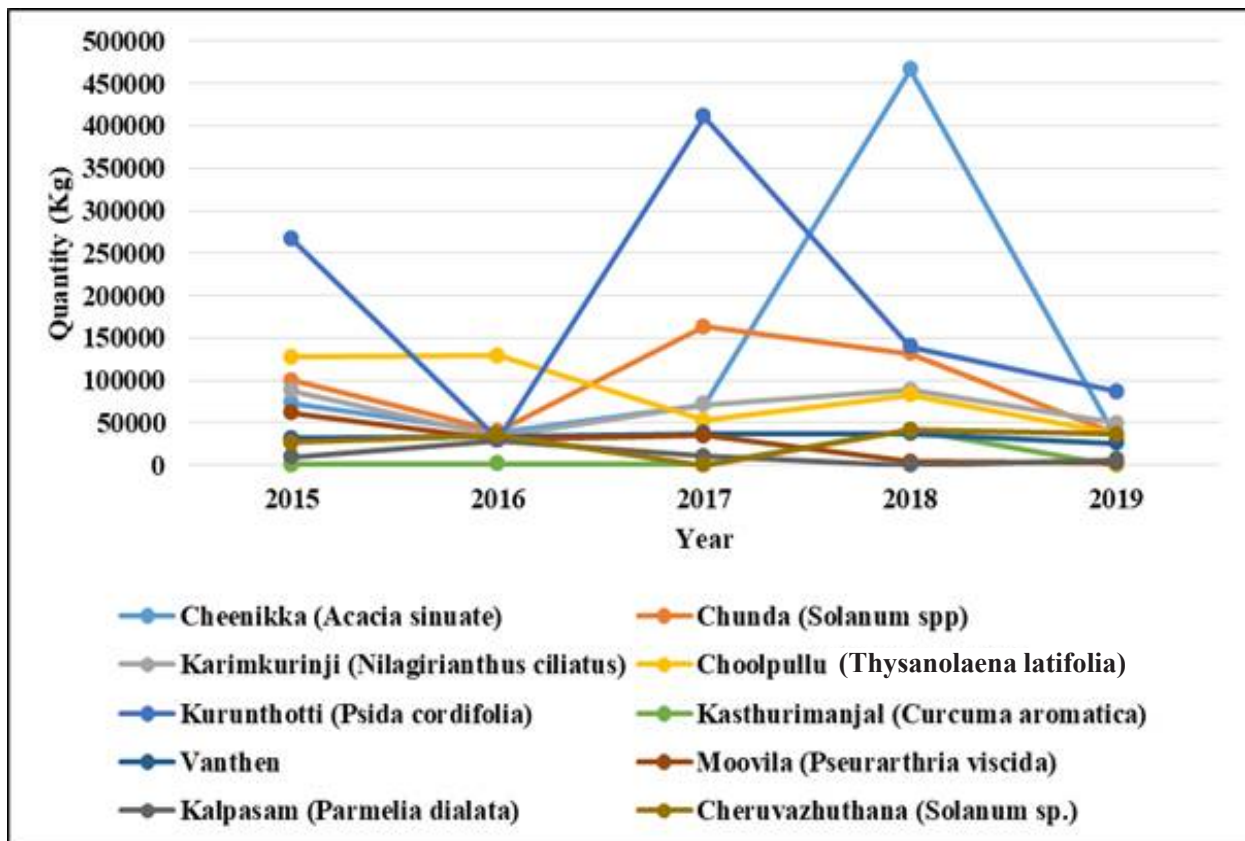


Fig 2.18 Collection trend of 10 major high volume NWFPs in Kerala

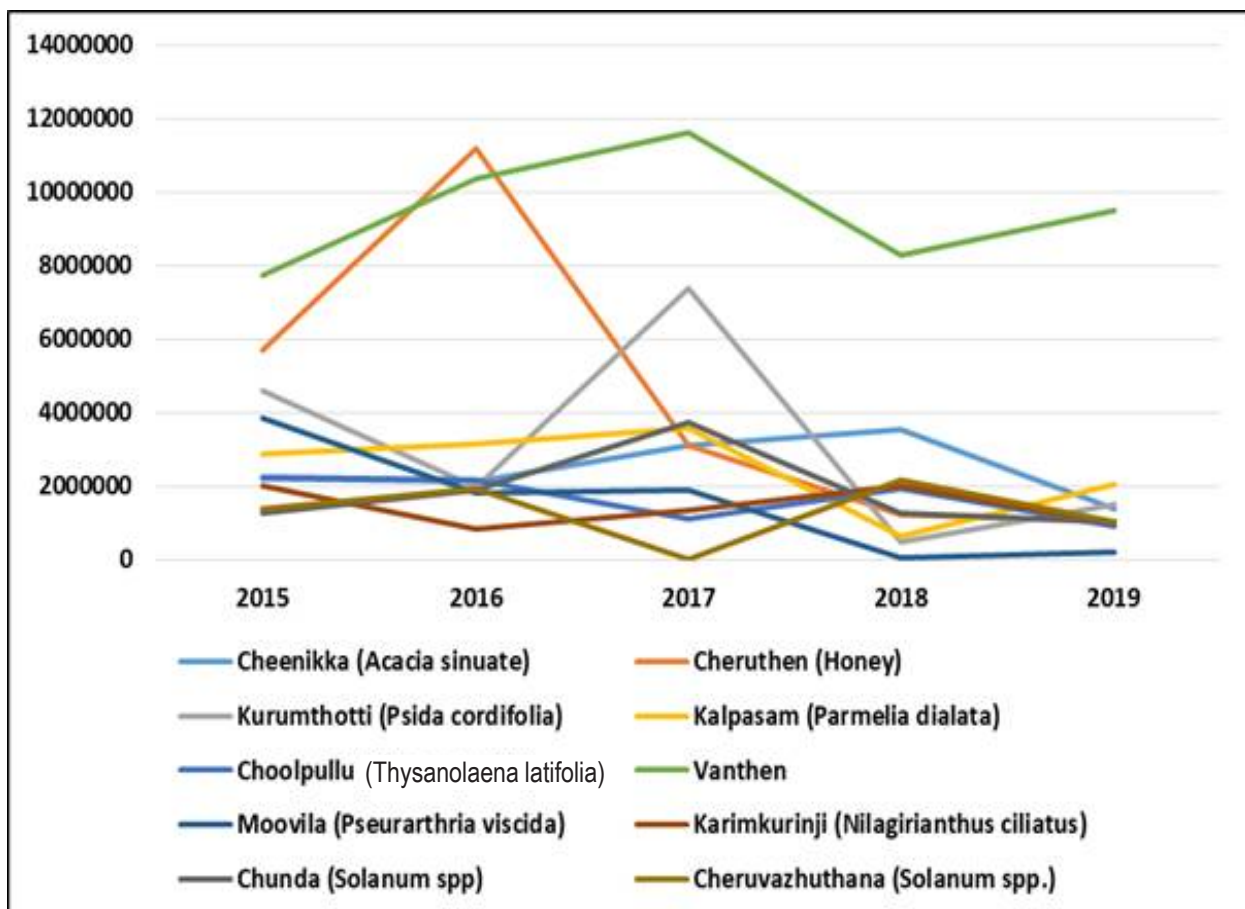


Fig 2.19 Collection trend of 10 major high value NWFPs in Kerala

The ten NWFPs traded in huge quantities during the period 2015 to 2019 are cheenikka, choolpullu, kasthurimanjal, kurumthotti, vanthen, chunda, karimkurinji, kalpasam, moovila and cheruvazhuthana. Kurumthotti (*Sida cordifolia*) is the most heavily collected species. In 2016 and 2018 significant reduction in kurumthotti collection was recorded. The 10 major high value species listed are cheenikka, cheruthen, kurumthotti, vanthen, kalpasam, moovila, karimkurinji, chunda, choolpullu and cheruvazhuthana. Vanthen is the top high total value species in all years except 2016 and its value increased significantly in 2019 when compared to other years.

- Considering unit value cheruthen is having the highest value with Rs 1736 /kg during 2019-20 which is a considerable increase from Rs 125/kg during 2009-10.
- It may be noted that the price of other high valued species such as Adapathian (Rs 350/kg during 2009) had remained almost stagnant (Rs 450/kg during 2019).
- The collection of NWFP shows a decline from 12,73,244 kg with a total value of Rs 47819942/- during 2014- 15 to 389401 kg with a total value of Rs 24825945/-.

Although the value of NWFP in comparison to Timber, is much lower, NWFP plays an important role in tribal economy and also provides employment to tribal people. SC/ ST Federation has fixed a threshold limit for harvesting of NWFPs. For 2020-21 a total quantity of 502117 kg has been fixed with 145676 kg to Adimali society, Adimali, Neriya Mangalam, Anakulam, Mankulam and 19886 kg to Tirunelli society Begur range which together constitutes 32.9 % of the total amount of NWFP.

Providing support for converting the NWFP collected into semi processed value added products will generate additional income and employment to the local tribal communities. Honey being one of the high value species support for stingless bee cultivation in forest fringe areas can be promoted. Other innovative livelihood generating programs need to be implemented utilizing the fund generated through ABS

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One of the successful models of ABS is the initiative of the BMC of Raipassa, Tripura in signing an agreement with the commercial users of Broom grass. According to the agreement, 5 percent of the total proceeds from the sale is transferred to the Joint Forest Management Committee, responsible for collecting the resource. The villagers collect about 50 tonnes of broom grass per season, and sell it at Rs. 22/Kg. The BMC and the Local Biodiversity Fund share 2 percent of the proceeds, while 1 percent is transferred to the state biodiversity fund. In Kerala, during 2019-20, about 36680 Kg of broom grass was collected. In addition cheenikka, moovila, kurumthotti and karimkurinji are collected in large quantities. The NWFP collection for the year 2019-20 shows that Thrissur branch Adalodakam Karimkurinji, Chunda, Broom grass and in Kapetta branch Kurumthotti, Chunda, Vanthen and Cheenikka are collected in huge quantities. Considering the value, apart from these high volume species others as Kurumthotti, Kattupadavalam and Peenari in Thrissur branch and Kalpasam in Kalpetta branch generates huge revenue. Promotion of developing value added products such as Brooms and other innovative models of ABS in association with Federation and commercial users of such resources will ensure sharing of benefits with the local community. As the providers of bioresources are identified it can be ensured that the benefits are ploughed back to the custodians of biodiversity as envisaged in BD Act.



Table 2.12 NWFP collections - 2019-2020 (The Kerala state federation of SC/ST development cooperatives Ltd)

Sl.No	Name of Items	Trivandrum Branch		Trissur Branch		Kalpetta Branch		Total	
		Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
4	Adalodakam Dry	338		8450		338		8450	
5	Adalodakam Pacha	45687		348247		45687		348247	
7	Urinccchikai/Soappinaki	0		0		60	1080	60	1080
8	Orila Dry	2481		125570		2481		125570	
12	Kasthurimanjal	8	580	533		14.5		1113	
14	Cheruthen	203.2	316650	14	11900	371.66	693620	588.8	1022170
15	Kalpasam			6723	2059589	6723	2059589	6723	2059589
18	Kattukurumulaku Valli 1st	831.5	24945	3426	137040	1810.1	63010	6067.6	2344995
21	Kattuthippali veru	62		2520		62		2520	
26	Kakkumkai/Parantakkai	80	2800	1301	41037	2262.6	56665	3643.6	100502
27	Karimkurinji	49271		967950		49271		967950	
33	Kunthirikkom 1st	1527	320400			1736.05	608840.8	3263.1	929240.8
34	Kunthirikkom 2nd	8	1000	92	12580	12	1440	112	15020
35	Kunthirikkom 3rd	210		17900		8	720	218	18620
36	Kurumthotti	7014	280630	5410	329175	500	20000	1294	629805
37	Kurumthotti Pacha					87027	1479459	87027	1479459
40	Kudampuli	65	18750	106	23530			1710	42280
44	Kolinchi/Malainchi	95		4400		95		4400	
45	Pattincha/Incha	2333	129795	77	6160			2410	135955
47	Pathiripoovu 1st	44.5	17075			174.5	60475	219	77550
48	Pathiripoovu 2nd					42.6	8460	42.6	8460
49	Kattupadavalam	7686.7		1606618		7686.7		1606618	

2.1.5. Vanasree Ecoshops of Kerala

Vanasree with 37 outlets is an initiative of the Kerala Forest Department for value addition and sale of different forest products. Vanasree markets its NWFP items through Ecoshops, which are located at locations of tourist attraction. The profits from these outlets are being ploughed back to the MFP collectors through the Vana Samrakshana Samithies. Forest Department and the forest dependent communities, ensure that the marketed “Vanasree” products are sustainably harvested, hygienically processed and packaged in eco-friendly materials. In this endeavour, they target better livelihood for three lakh people who constitute the forest dependant population.

Table 2.13 Vanasree products marketed through Eco shops of Kerala

Personal care	Household	Health	Groceries	Others
Agasthya hair oil	Amukkuram podi	Abhayarishtam	Achar	Alappey boat
Aromatic turmeric	Black dammer	Bee wax	Bamboo rice	Aranyam magazine
Haritha hair oil	Cheenikai	Burncare oinment	Cardamom	Cloth bag stawberry
Dandapala oil	Karuvapatta	Big honey	Cashew plain	Coconut chattukam
Kairali soap	Lemon grass oil	Chavanaprasam	Cashew roasted	House boat
Kalloorvanchi	Marottikkuru	Cherurthane	Clove	Mask
Kasthoorimanjal	Mosqito repellent	Eucaliptus	Coffee powder	Elephant penholder
Kerala sandal family	Pathimugam	Foot crack balm	Ginger pickle	T shirt
Kerala sandal trio	Pathiripoovu	Joint pain balm	Green tea	
Pure sandal powder		Lip balm	Kadumanga pickle	
Raamacham		Murivenna oil	Kudampuli	
Rakthachandana		Naikurunapodi	Mango pickle	

2.2 AGRICULTURAL BIORESOURCES

2.2.1 Cultivated crops

Kerala is famous for homestead farming system, which integrates the home with useful fruit trees and shrubs, vegetables, tuber crops, spice crops, fodder crops, livestock, and poultry in a small (usually about 0.10 ha or more) area of land. A total of 452 crops belonging to 82 families are being grown in Kerala. Among these, 256 crops have edible uses (cereals and millets, pseudocereals, pulses, oil seeds, tuber crops, sugars and starches, fruits and nuts, and vegetable crops). A total of 118 fruits and nuts have been recorded including 22 subtropical fruits. Others in the list are cereals and millets–11, pseudocereals–4, pulses–10, oil seeds–8, tuber crops–24, sugars and starches–8, vegetables–73, spices and condiments– 21, beverages–5, stimulants– 3, cut flowers–20, cut foliage plants–14, green manure crops–10, cover crops–4, fodder crops–42, fibre crops–6, rubber crops–1, essential oil yielding plants–7, medicinal plants–45, and crops of miscellaneous uses–18 (Thomas, 2022). Although 452 crops have been listed, area under cultivation is available for 69 crops only (GOK, 2021). However, area of minor crops are available as groups of ‘other oil seeds’, ‘other tuber crops’, ‘other spices and condiments’, ‘other fruits’, ‘other vegetables’, ‘fodder crops’, ‘green manure crops’, ‘medicinal plants’, and ‘other crops and trees’ indicating that such crops are grown in small scale, as a part of homesteads or along with other crops such as coconut in multiple cropping systems. In Kerala, there are only four crops - coconut, rubber, rice, and banana (including plantain), which have an area above one lakh hectares. Crops occupying more than 10,000ha are 17 only. The maximum area is under coconut (1) followed by rubber (2) and rice (3). Other crops in the order of rank based on area occupied are banana and plantain (4), arecanut (5), jack fruit (6), coffee (7), black pepper (8), mango (9), cassava (10), cashew nut (11), cardamom (12), tea (13), nutmeg (14), papaya (15), drumstick (16), and cocoa (17). Plantation crop include tea, coffee,

rubber, cocoa, coconut, areca nut, oil palm, palmyrah and cashew. These are high value commercial crops of economic importance and play a vital role in improving economy, especially in view of their export potential, employment generation and poverty alleviation particularly in rural sector. Kerala has a substantial share in the four plantation crops of rubber, tea, coffee and cardamom. These four crops together occupied 7.11 lakh ha, accounting for 27.7 per cent of the total cropped area in the State.

Kerala has witnessed major changes in its land use pattern with the shift from cultivation of food crops to non- food crops and increase in area in land put to non-agricultural use. Agriculture plays an important role to achieve the Sustainable Development Goals (SDG) of no poverty, zero hunger, and good health and well-being. Crops, livestock, fishing, and forestry contributed 8.03 per cent to Kerala's Gross State Value Added (GSVA) in 2019-20 (constant prices).

Table 2.14 Agriculture (Area under cultivation and production) details in Kerala

Districts	Food Crops		Non-Food Crops		Total Crop	
	Area Under Cultivation (Ha)	Production (Tn)	Area Under Cultivation (Ha)	Production (Tn)	Area Under Cultivation (Ha)	Production (Tn)
Thiruvananthapuram	48818.65	597314.20	111235.93	31585.58	160054.59	628899.78
Kollam	50439.99	540948.80	89820.98	38959.36	140260.96	579908.16
Pathanamthitta	28385.43	60927.18	76236.20	54971.68	104621.63	115898.86
Alappuzha	64550.85	217725.50	47192.19	5974.80	111743.04	223700.30
Kottayam	57122.07	402798.84	153791.53	111148.60	210913.60	513947.44
Idukki	129720.58	387918.00	136155.67	103402.30	265876.25	491320.30
Ernakulam	52615.22	368343.00	109478.20	60961.07	162093.42	429304.07
Thrissur	64659.58	172841.70	103360.67	189434.70	168020.25	362276.40
Palakkad	146223.79	457480.80	125971.12	41874.04	272194.91	499354.84
Malappuram	73668.07	379097.60	162929.42	43795.61	236597.48	422893.21
Kozhikode	62857.66	89502.92	144227.41	26001.27	193894.67	115504.19
Wayanad	62857.66	169701.30	104212.50	72903.42	167070.16	242604.72
Kannur	69949.56	141555.80	149951.62	49604.16	219901.18	191159.96
Kasaragod	46338.81	93286.80	111519.80	33377.24	157858.61	126664.04
Total	958207.9	4079442.44	1626083.2	863993.83	2571100.7	4943436.2



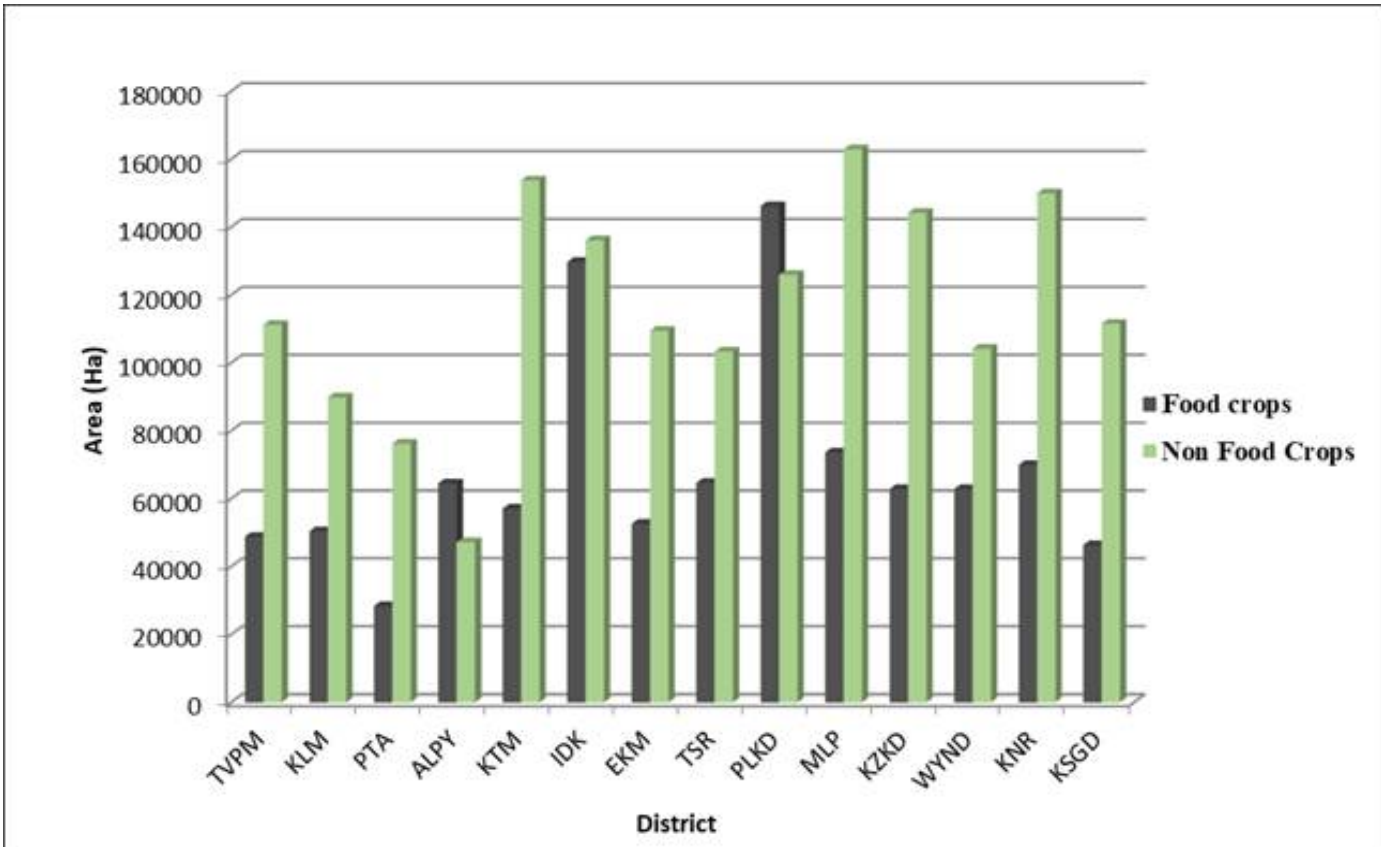


Fig 2.20 Area under cultivation (ha) in Kerala

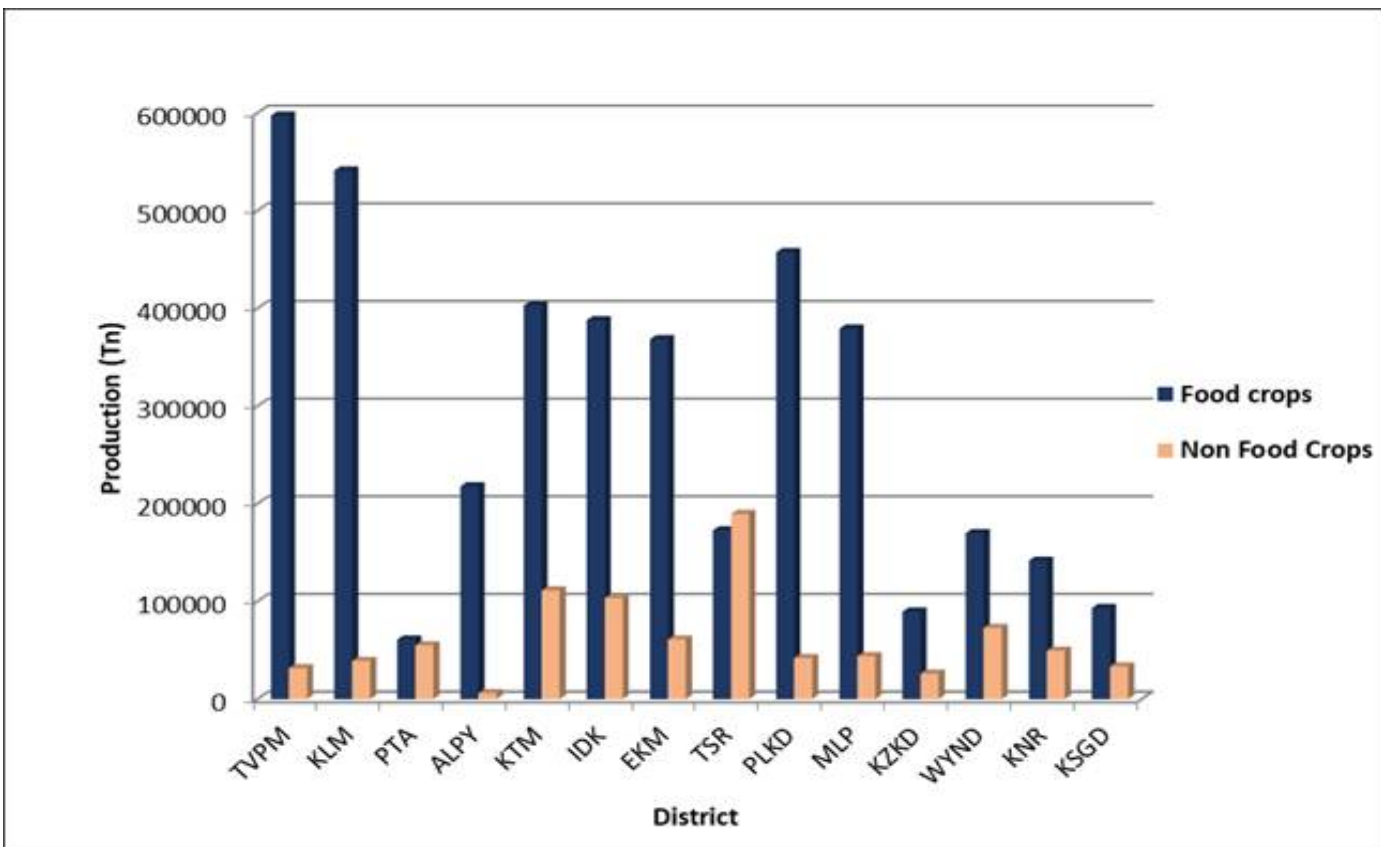


Fig 2.21 District wise production (tn) of agricultural crops

Table 2.15 Area under cultivation and production of principal crops (2019-2021)

Sl.No.	Crops	Area (ha)		Production (T)		Productivity (kg/ha)	
		2019-20	2020-21	2019-20	2020-21	2019-20	2020-21
1	Rice	191051	201865	587078	626888	3073	3105
2	Pulses including Tur	2260.46	2005.95	2103	1922.94	965.9	958.6
3	Pepper	83765	82124.36	34545	33590.933	412	409
4	Ginger	2819	2700.40	11917	12095.265	4227	4479
5	Turmeric	2277	2216.84	6653	7420.478	2922	3347
6	*Cardamom	39697	39143	10076	20570	254	526
7	Areca nut	96921	96570.49	92755	103158.596	957	1068
8	Banana	60678	57694.67	548425	544188.717	9038	9432
9	Other Plantains	56199	53568.83	406902	412864.399	7240	7707
10	Cashew nut	39898	37923.31	19444	20908.992	487	
11	Tapioca	62070	64245.99	2592633	3027749.8273	41770	47127
12	**Coconut	760776	768809.04	4814	4788	6328	6228
13	***Coffee	85880	85880	65459	68545	762	798
14	\$Tea	35871.16	35871.16	59260	66850	1652	1864
15	# Rubber	551030	550650	533500	519500	1559	1534
	Millets						
16	Ragi	213	230.26	261	329.55	1225	1431
17	Small millets	57	51	43	37.70	778	739
18	Sweet potato	194	309.04	2782	4356.53	14340	14097
19	Other tubers	15462	14640.4				

With a net sown area of more than 50% of total geographical area, Kerala has a rich agrarian diversity. Although in recent times, agricultural productivity has declined continuously due to the shift of manpower towards other sectors, agriculture still holds an important place for the livelihood of farmers, especially small and marginal as well as for the food security of the state and nation. Agriculture in Kerala is today dominated by plantation crops like cashew, rubber, coffee, coconut, areca-nut as well as spices like cardamom, turmeric, pepper etc. with the only major field crop being paddy. The conservation of agro-biodiversity in Kerala has been of primary concern especially due to the diversity of landraces of crops like paddy and banana which have earned Geographical Indicator (GI) tags. Although, many of the cultivated crops may not be eligible under ABS due to being listed under Normally Traded Commodities (NTC), the evaluation of selected agricultural tradable bio-resources can widen our scope for their proper sustainable utilization

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The study of selected agricultural commodities was undertaken through analysis of various secondary sources such as Directorate of Economics and Statistics (2021) to give an overall value of these resources at market price. The final estimated annual value of agricultural commodities in the state (2018-19) was found to be around Rs. 23,614 crore. The economic analysis for various major crops was also done through calculation of value using market wholesale prices of each commodity to yield the overall value of bio-resources that can be attributed to the agro-ecosystem. The final value of Rs. 23,614 crore (2017-18) was calculated based on the economic valuation of 26 crops, of which Tapioca showed the highest value of around Rs. 4,040 crore followed by Arecanut (Rs. 3,287 crore) and Mango (Rs. 1,824 crore). The lowest value was obtained from coconut (Rs. 80,968). The gross value of agricultural bio-resources was deducted with the available data on cost of cultivation (Rs.8265 crore) to yield an estimated net income of Rs. 15349 crore. This data can be useful for sustaining and improving the net per capita income of the farmers as well as frame policies for supplementing their income from other sources as well.

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2.2.2 Livestock

Livestock is one of the major allied agriculture activities in India and its significance is more in recent years as people’s lifestyle and food habits are changing considerably. In recent period milk and milk products, meats, and eggs are the major food items and people prefer this more than the traditional agriculture produce like rice and wheat.

As per 20th Livestock Census (2019), the livestock population in the State was 29 lakhs. The poultry population was 29.7 lakh which accounts for 3.5 per cent of the total poultry population in the country. Kerala ranks 9th among the States in poultry population of the country.

Table 2.16 Livestock Population in Kerala (2019)

S. No	Specie	Population (In Thousands)	% of total Population
1	Cattle	1341.99	46.1400
2	Buffaloes	101.50	3.4866
3	Sheep	1.48	0.0500
4	Goats	1359.16	46.7300
5	Pigs	103.86	3.5700
6	Horses & Ponies	0.56	0.0200
7	Donkeys	0.07	0.0024
8	Camels	0.03	0.0010
	Total Population	2908.65	100.0000
9	Poultry	29771.91	

Source: Report on 20th Quinquennial Livestock Census-2019, Animal Husbandry Department

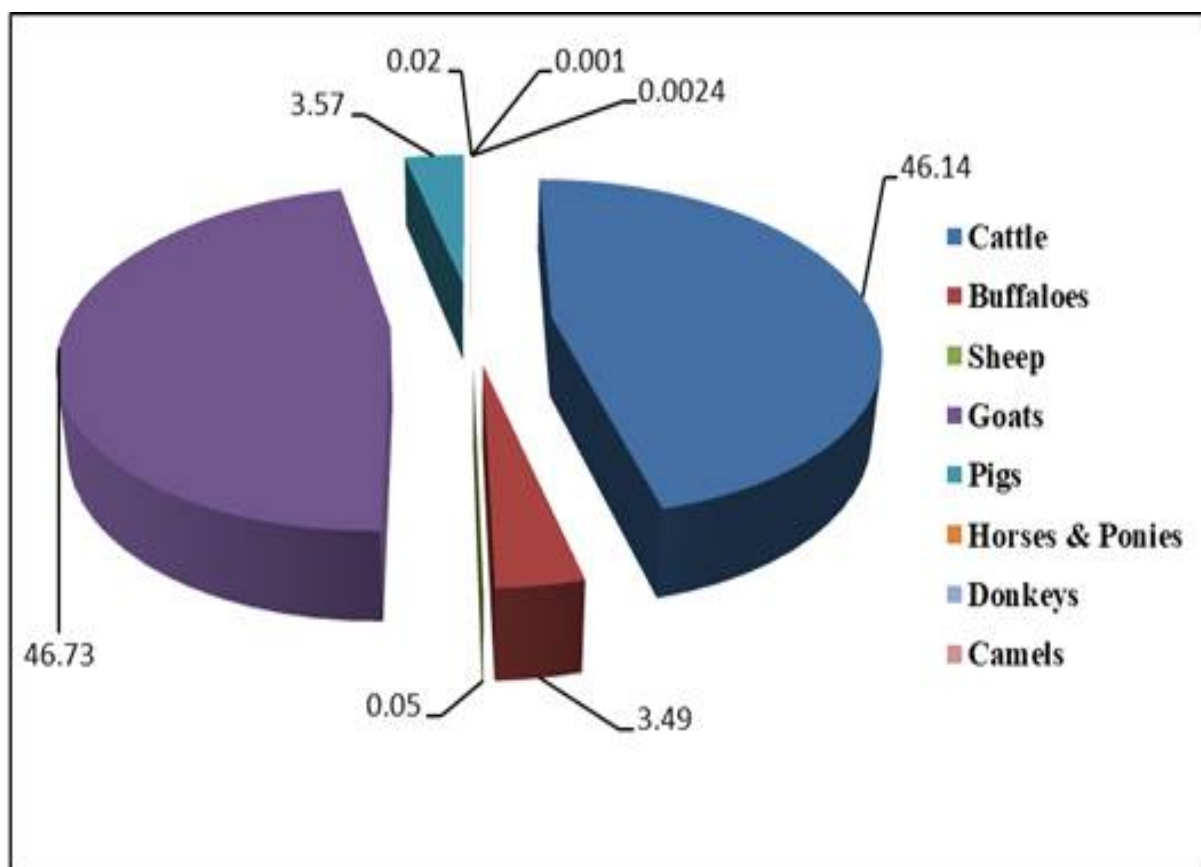


Fig 2.22 Livestock population in Kerala (%)

It is very clear from the above table and figure, the cattle and goats are major livestock in Kerala. Although buffaloes and pigs are presented in reasonable number, others are insignificant.

Milk production

Kerala is one of the states which gives the highest price for milk to the farmers in the country. In 2019-20, a total of 6,789 lakh litres of milk was procured by the dairy co-operative societies in the State, of which 4,516 lakh litres were sent to the dairies and 2,246 lakh litres were marketed locally by the societies. The average milk poured per day by Anand Pattern Co-operative Societies (APCOS) in 2019-20 was 1415 MT against the previous year average of 1528 MT. The procurement/day/society in 2019-20 decreased to 440 litres from 501 litres in 2018-19. The procurement and sale of milk by Kerala Co-operative Milk Marketing Federation (KCMMF) was 3940.76 lakh litres and 4466.27 lakh litres respectively in 2019-20. Except in Ernakulam, Palakkad and Wayanad, sales of milk exceeded procurement. The shortfall between milk procurement and sales was met by arranging milk mostly from State Milk Federations of Karnataka, Tamil Nadu and purchase of skimmed milk powder.



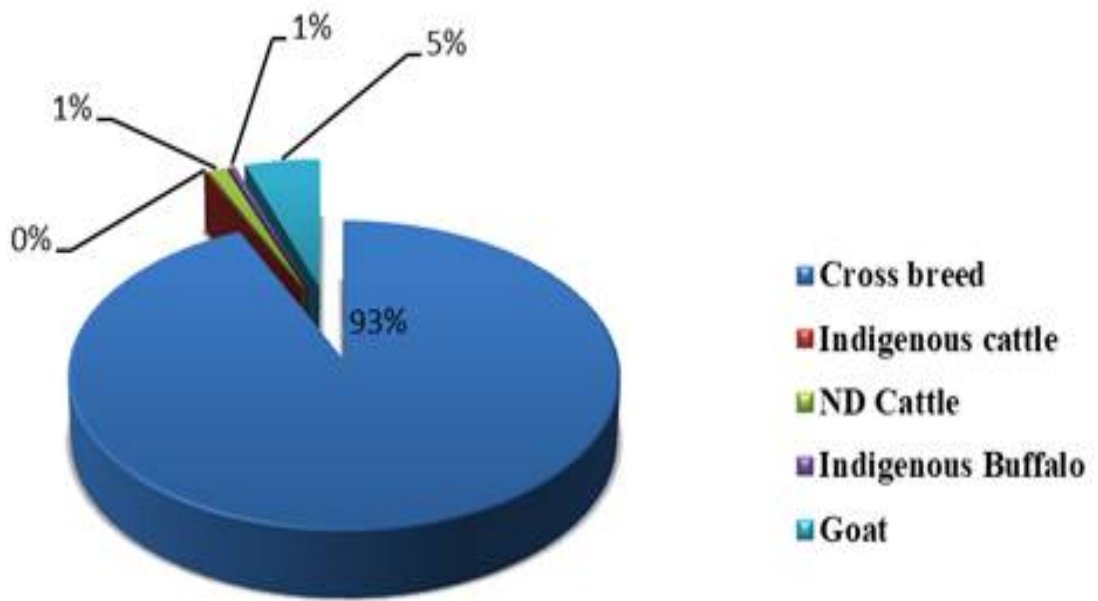


Fig 2.23 Milk production in Kerala (2019-20)

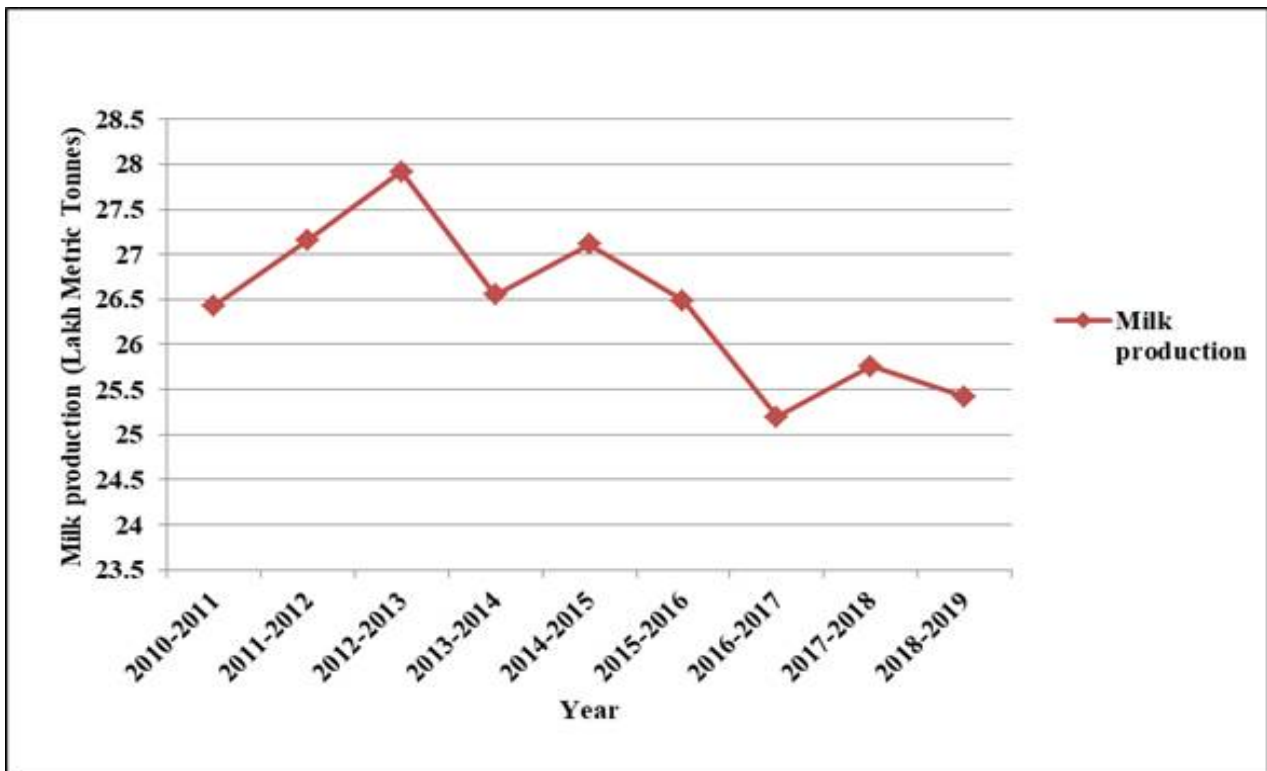


Fig 2.23 Milk production in Kerala (2019-20)

Egg production

Kerala ranks 10th among the states of India in egg production. The total egg production in the State was at 224 crore eggs in the year 2012-13, which has declined to 218 crore in 2019-20. The per capita egg availability is 62 eggs per annum and the per capita consumption was 128 eggs per annum in 2019-20. About 73.9 per cent of the total eggs produced in the State are from improved fowl and around 21.1 per cent are from desi fowl. The contribution of desi duck and improved duck to the total egg production of the State is 2.7 per cent and 2.2 per cent respectively. 99.7 per cent of eggs produced in the State come from backyard poultry. Commercial poultry contributes a very small share (0.27 per cent), warranting emphasis on backyard poultry in future.

The animal husbandry sector in Kerala has to attain a greater degree of self-sufficiency in egg and meat. It is essential to reduce the dependency on outside states for eggs and to produce an additional 75 lakh eggs per day in the State.

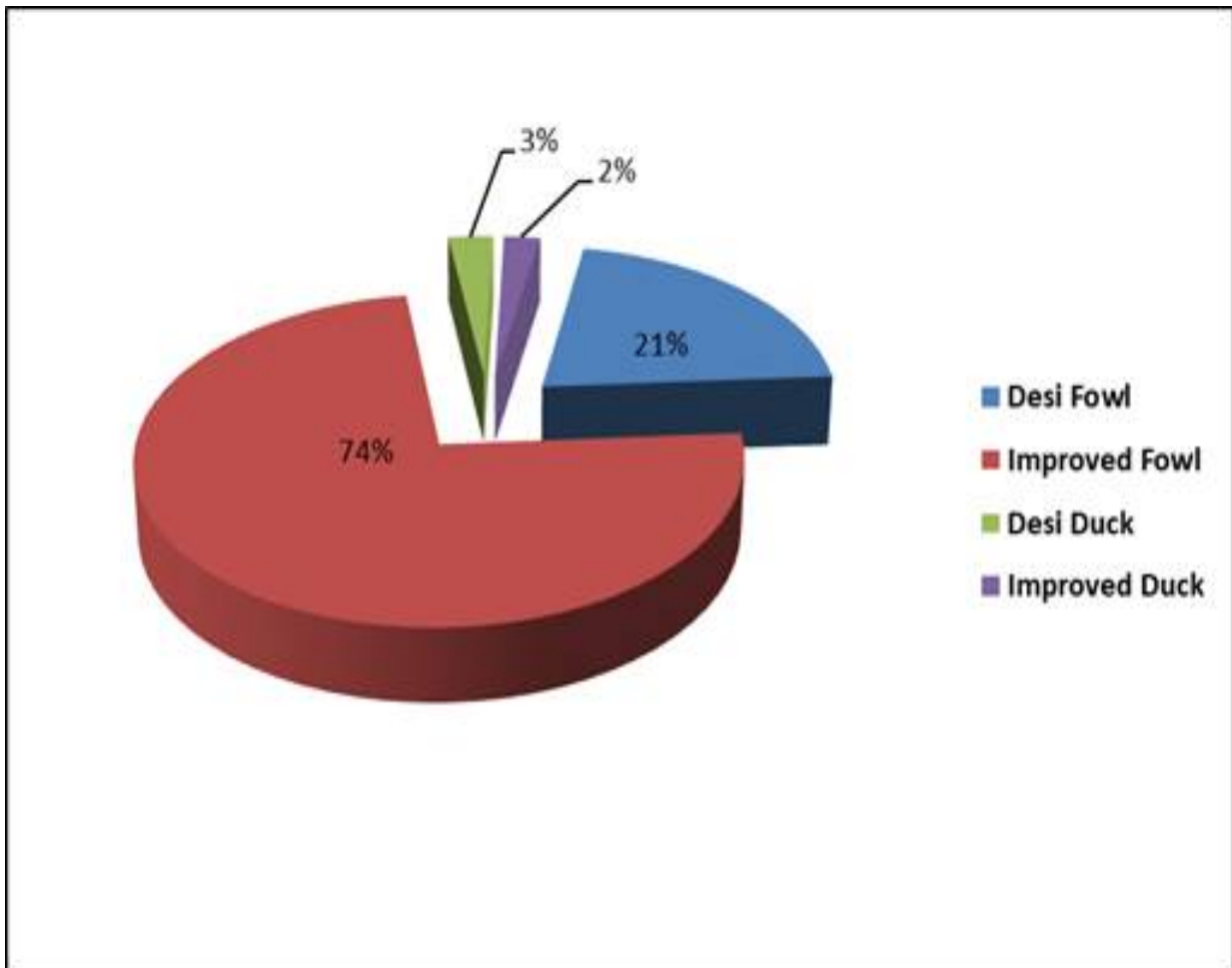


Fig 2.25 Poultry production in Kerala (2020)

Meat Production

The largest producer of meat in the country is Uttar Pradesh producing 15 per cent of the total meat followed by Maharashtra (12.6 per cent), West Bengal (10.2 per cent), Andhra Pradesh (9.6 per cent), Telangana (9.3 per cent), and Kerala (5.6 per cent), which together contribute 57 per cent of total meat production in the country. Species-wise meat contribution shows that nearly 50 per cent of meat production in the country is contributed by poultry. Maharashtra, Tamil Nadu, and West Bengal are the largest producers of poultry meat in the country. Buffaloes and goats contribute 19 per cent and 14 per cent respectively to the total meat production in India. In Kerala, meat production shows a stagnant level of 4.69 lakh MT in the previous two years and declined to 4.57 lakh MT in 2018-19 and 4.55 lakh MT in 2019-20 showing a negative growth. Kerala is the 8th largest meat producing State in the country contributing 5.6 per cent of meat produced in India. The total requirement of meat in Kerala was 4.92 lakh MT; the supply was only 4.55 lakh MT and 0.28 lakh MT of processed meat was imported, resulting in a deficiency of 0.09 lakh MT meat.

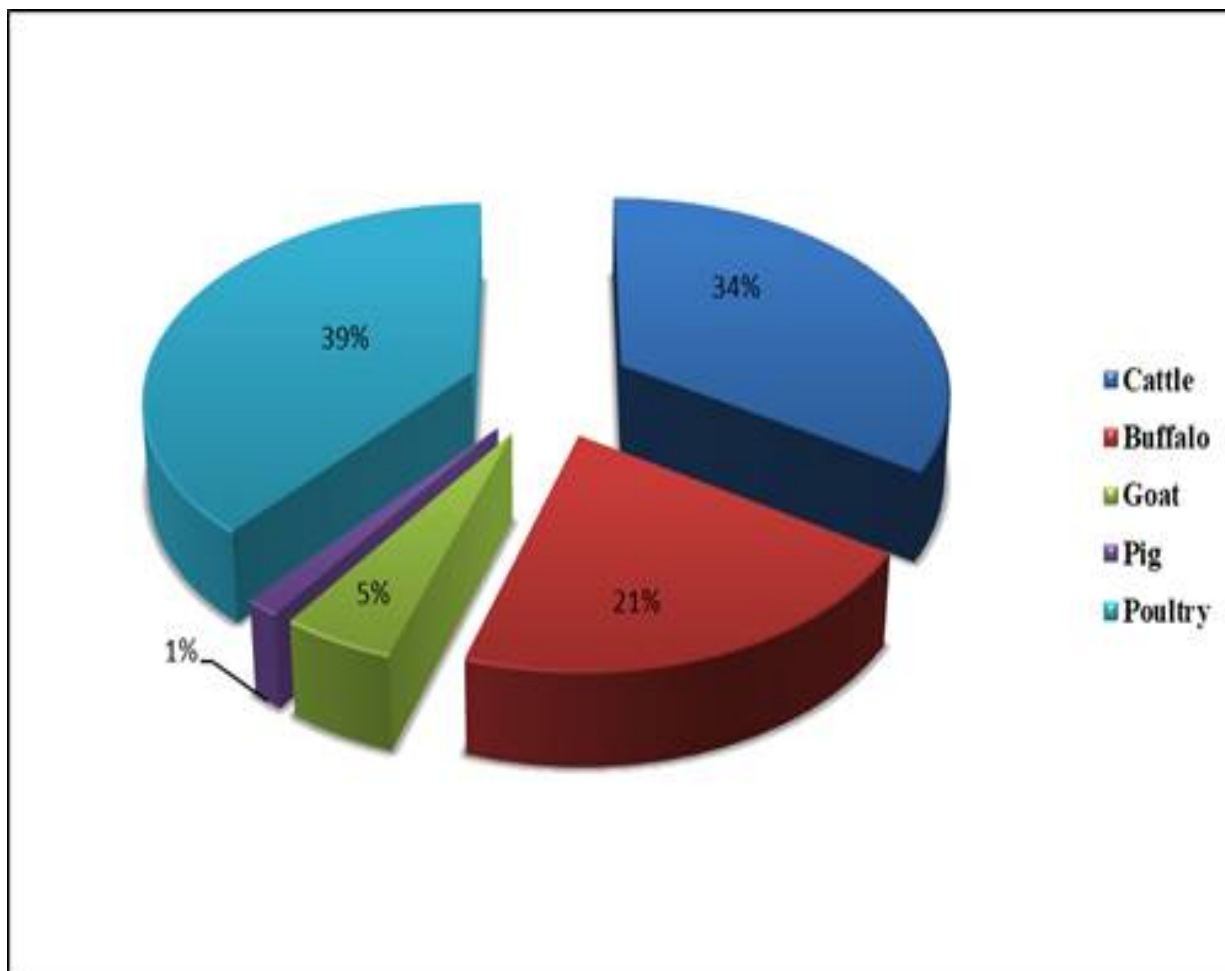


Fig 2.26 Meat production in Kerala (2017-18)



The study of the livestock sector showed that the total economic value of the livestock sector in Kerala amounted up to 28,916.5 Rs.crore, where the value of milk was 12,479 Rs.crore, that of egg was 1,309.5 Rs.crore and that of meat was 15,128 Rs.crore. This data was collated from various sources like the Livestock census 2019 (Animal Husbandry Dept.), the Economic Review of Kerala 2020 and Kerala Co-operative Milk Marketing Federation (KCMMF).

Due to the consistent decrease in milk production in Kerala across the years, this has necessitated the procurement of milk from other nearby states. Hence, the livestock sector requires attention to arrest the decline in milk productivity. However, dairy farmers are the most benefited in Kerala due to the high amount of value they receive for each unit quantity of milk compared to other states.

The poultry sector also showed decline in productivity across the years, leading to dependence for eggs on other states. The per-capita availability was found to be quite less compared to per-capita requirement of eggs.

The conservation and application of technology in breeding can be used to improve the livestock productivity. Protection and improvement of indigenous breeds forms a part of National Biodiversity Targets, which needs to be focused upon for improving the status of dairy, poultry and meat since most of the farmers engage in this sector as much needed source of supplementary income.

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2.3 AQUATIC BIORESOURCES

River systems, their floodplains and wetlands, are among the most biologically diverse and productive ecosystems on the planet. Wetlands are also one of the most degraded ecosystems. The UN FAO estimates that fish consumption (including freshwater) provides more than 3.3 billion people with at least 20% of their animal protein intake, and that the fisheries and aquaculture sectors provide direct employment for 59.5 million people globally. Over 1800 species of fish, crustaceans, molluscs, echinoderms, coelenterates and aquatic plants are harvested by global capture fisheries of which 10 species/species groups account for 28% of production. The total number of reported aquatic fauna of India consists of about 29,900 species excluding micro-organisms (Marine fauna 20,444 and freshwater 9456 species).



A database of >3900 aquatic species has been generated and a consolidated checklist of 185 tradable bio-resources and products prepared are presented in the report. The report was prepared after extensive consultation with the fisherman community and covered 138 marine landing centers and 4000 fishermen. Inputs has also been obtained from Kerala Fisheries Department, Matsyafed, Marine Products Export Development Authority (MPEDA), ICAR-CMFRI, ICAR-CMLRE, ICAR- NBFGR, ICAR- CIFT etc.

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2.3.1 MARINE BIORESOURCES

Kerala has a coastline of 590 km, approximately 10 per cent of India's total coastline, with a continental shelf area of about 41 km². The aquatic open water areas include 44 rivers, 9 lakes (1620 ha), 51 backwaters (65,213 ha), 35 reservoirs outside wild life sanctuaries and 12 within. The state has 222 marine fishing villages, 113 inland fishing villages, 204 fish landing centre, 15 fishing harbours and 39 modern hygienic fish markets.

The fisherfolk population in Kerala is estimated to be around 10.50 lakh including 2.4 lakh inland fish workers. The fisherwomen play an important role in the terms of their involvement in fish related activities such as fish vending, fish drying, prawn peeling, sorting, grading, packing and net making. About 46.35 per cent of women are involved in marine fishing activities and 49 per cent of them are involved in inland fishing. Fish vending is a traditional occupation that has been a means of livelihood for thousands of fisherfolk, especially for women. It is estimated that there are 25395 fish vendors in Kerala as of 2018-19. As per recent estimates Kerala has 21,781 fishing crafts of which total mechanized are 4,722, motorized 11,175 and non- motorized 5,884.

The total fish production in Kerala was 6.14 lakh tonnes in 2020-21, 3.9 lakh tonnes from marine fisheries and 2.24 lakh tonnes inland fisheries. A total of 15.02 crore seed production was achieved through department hatcheries in 2020-21. The high value species among the fish catches are few and prominent among them are seer fish, prawns, ribbon fish and mackerel. The total fish consumption in the State is approximately 9.12 lakh tonnes per annum and about 3 to 4 lakh tonnes is imported from other states or countries. Kerala with its wide network of backwaters, and fresh water has great potential for reducing this gap between demand and supply by promoting aquaculture. Fisheries and Aquaculture contributes 8.71 per cent of the Gross State Value Added (GSVA) at constant prices 2020- 21 (Quick estimates) from the agriculture and allied sectors.

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The important components of biodiversity along the Kerala coast are coastal fisheries, mud bank ecosystems, productive rocky bottoms, mussel beds, and traditional coastal mariculture area.

Marine life constitutes almost 80% of the world biota with thousands of bioactive compounds and secondary metabolites derived from marine invertebrates such as tunicates, sponges, molluscs, bryozoans, sea slugs and many other marine organisms. A database of >3900 aquatic species has been compiled as part of the project and a summary of the same is given in the table below



Table 2.17 Aquatic species of Kerala

Bio-resources	Aquatic flora	Mangrove Ecosystem	Marine Ecosystem	Inland Ecosystem Estuarine	Subterranean	Alien species
Sea weeds/ sea grass/ algae/ phytoplankton	46		92	161		4
Inland floral resource	16					
Riparian vegetation	372					
Typical mangrove plants		20				
Associated plants		37				
Protista		63		39		
Zooplankton		53				2 (ascidian)
Sponges			34	13		
Corals			74			
Cnidaria		6	29			1
Gastrotricha				23		
Bryozoa				45		2
Rotifera				56		
Nematoda		53				
Annelida		36	64	107		
Crustacea		48	377	88	3	1
Insecta		76		113		
Mollusca		22	169	27		2
Echinodermata		33	60			
Ichthyofauna		118	718	151	11	
Fresh water fish				121		28
Frogs & Toads		14		71		
Herpetofauna/ reptiles		47	10	11		
Avi fauna		161	31	103		
Mammals		23	26	3		
Total	434	810	1,684	1,132	14	40

Table 2.18 Marine fishes belonging to IUCN category reported from Kerala

No	IUCN	Category	Number of fish species
1	CR –	Critically Endangered	20
2	EN-	Endangered	53
3	VU-	Vulnerable	47
4	NT-	Near Threatened	37
5	DD-	Data Deficient	59
6	NE-	Not Evaluated	198
7	LC	Least concern	561
		Total	975

Some resources are commercially traded in large quantities and more than 185 bio-resources (crustaceans – 39 species; mollusks – 16; fishes – 100; sponges – 12; ascidians -1; sea weeds – 18) with proven commercial value is given in Table 3.1. Some such as sponges are coming under protected species group, but they are also included because of its bio-active contents. The report has examined the economics of fisheries with fish as a tradable bio-resources. In this respect, the analysis emphasised on the species wise quantity of fish catch from different districts in Kerala, its market/trade value, unit value, export and foreign exchange earning etc. based on the data (last five years from 2015-16 to 2019-20) collected from the Fisheries Department.

Table 2.19 Tradable bio-resources of aquatic ecosystem of Kerala

Sl.No	Scientific name	Common name	Trade information
	Crustaceans		
1	<i>Penaeus indicus</i> H. Milne Edwards, 1837	Indian prawn	Used as food, processing, wealth from waste, Production of chitin, domestic & export markets
2	<i>Penaeus monodon</i> Fabricius, 1798	Tiger prawn	Used as food, processing, wealth from waste, Production of chitin, domestic & export markets
3	<i>Penaeus semisulcatus</i> (de Haan, 1844)	Green Tiger Prawn	Used as food, processing, wealth from waste, Production of chitin, domestic & export markets
4	<i>Penaeus japonicus</i> (Bate, 1888)	Kuruma prawn	Used as food, processing, wealth from waste, Production of chitin, domestic & export markets
5	<i>Melicertus canaliculatus</i> (Olivier, 1811)	Local Witch prawn	Used as food, processing, wealth from waste, Production of chitin, domestic & export markets
6	<i>Metapenaeus dobsoni</i> (Miers, 1878)	Kadal shrimp	Used as food, processing, wealth from waste, Production of chitin, domestic & export markets
7	<i>Metapenaeus affinis</i> (Milne-Edwards, 1837)	Jinga Prawn	Used as food, processing, wealth from waste, Production of chitin, domestic & export markets
8	<i>Metapenaeus monoceros</i> (Fabricius, 1798)	Brown/Speckled Shrimp	Used as food, processing, wealth from waste, Production of chitin, domestic & export markets
9	<i>Parapenaeopsis stylifera</i> (Milne-Edwards, 1837)	Kiddi Prawn	Used as food, processing, wealth from waste, Production of chitin, domestic & export markets
10	<i>Litopenaeus vannamei</i> (Boone, 1931)	White leg prawn, Vannamei prawn	Used as food, chitin, aquaculture, domestic and export market, alien species

11	<i>Heterocarpus woodmasoni</i> Alcock, 1901	Indian Nylon Shrimp	Used as food, processing, wealth from waste, Production of chitin, domestic & export markets
12	<i>Heterocarpus gibbosus</i> (Spence Bate, 1888)	Tomato shrimp	Used as food, processing, wealth from waste, Production of chitin, domestic & export markets
13	<i>Parapandalus spinipes</i> (Bate, 1888)		Used as food, processing, wealth from waste, Production of chitin, domestic & export markets
14	<i>Plesionika ensis</i> (Milne-Edwards, 1881)	Gladiator striped shrimp	Used as food, processing, wealth from waste, Production of chitin, domestic & export markets
15	<i>Aristeus alcocki</i> Ramadan, 1938	Arabian red shrimp	Used as food, processing, wealth from waste, Production of chitin, domestic & export markets
16	<i>Exhippolysmata ensirostris</i> (Kemp, 1914)	Hunter shrimp	Used as food, processing, wealth from waste, Production of chitin, domestic & export markets
17	<i>Solenocera hextii</i> (Wood-Mason & Alcock, 1891)	Deep-sea mud shrimp	Used as food, processing, wealth from waste, Production of chitin, domestic & export markets
18	<i>Solenocera crassicornis</i> (Milne-Edwards, 1837)	Coastal mud shrimp	Used as food, processing, wealth from waste, Production of chitin, domestic & export markets
19	<i>Solenocera choprai</i> Nataraj, 1945	Ridgeback shrimp	Used as food, processing, wealth from waste, Production of chitin, domestic & export markets
20	<i>Acetes indicus</i> Milne-Edwards, 1830	Jawla paste shrimp	Used as food, processing, wealth from waste, Production of chitin, domestic & export markets
21	<i>Acetes erythraeus</i> Nobili, 1905	Tsivakihini paste shrimp	Used as food, processing, wealth from waste, Production of chitin, domestic & export markets
22	<i>Acetes johni</i> Nataraj, 1947	Paste shrimp	Used as food, processing, wealth from waste, Production of chitin, domestic & export markets

23	<i>Macrobrachium idella</i> (Hilgendorf, 1898)	Slender river prawn	Used as food, processing, wealth from waste, Production of chitin, domestic & export markets
24	<i>Macrobrachium rosenbergii</i> (de Man, 1879)	Giant freshwater prawn	Used as food, processing, wealth from waste, Production of chitin, domestic & export markets
26	<i>Portunus pelagicus</i> (Linnaeus, 1758)	Flower crab	Used as food, processing, wealth from waste, Production of chitin, domestic & export markets
27	<i>Portunus sanguinolentus</i> (Herbst, 1783)	Three spot swimming crab	Used as food, processing, wealth from waste, Production of chitin, domestic & export markets
28	<i>Scylla serrata</i> (Forskål, 1775)	Mud crab	Used as food, processing, wealth from waste, Production of chitin, domestic & export markets
29	<i>Scylla tranquebarica</i> (Fabricius, 1798)	Mangrove crab	Used as food, processing, wealth from waste, Production of chitin, domestic & export markets
30	<i>Scylla olivacea</i> (Herbst, 1796)	Orange mud crab	Used as food, processing, wealth from waste, Production of chitin, domestic & export markets
31	<i>Charybdis feriata</i> (Linnaeus, 1758)	Crucifix crab	Used as food, processing, wealth from waste, Production of chitin, domestic & export markets
31	<i>Charybdis smithii</i> (Fabricius, 1798)	Indian ocean swimming crab	Used as food, processing, wealth from waste, Production of chitin, domestic & export markets
32	<i>Charybdis lucifera</i> (Fabricius, 1798)	Yellowish brown crab	Used a food, processing, wealth from waste, Production of chitin, domestic & export markets
33	<i>Charybdis natator</i> (Herbst, 1789)	Ridged swimming crab	Used for food, processing, wealth from waste, Production of chitin, domestic & export markets
34	<i>Thenus unimaculatus</i> Burton & Davie, 2007		Used as food, processing, wealth from waste, Production of chitin, domestic & export markets

35	<i>Panulirus homarus</i> (Linnaeus, 1758)	Scalloped Spiny Lobster	Used a food, processing, wealth from waste, Production of chitin, domestic & export markets
36	<i>Panulirus ornatus</i> (Fabricius, 1798)	Ornate Rock Lobster	Used a food, processing, wealth from waste, Production of chitin, domestic & export markets
37	<i>Panulirus polyphagus</i> (Herbst, 1793)	Spiny Lobster	Used a food, processing, wealth from waste, Production of chitin, domestic & export markets
38	<i>Panulirus versicolor</i> (Latreille, 1804)	Painted Rock Lobster	Used a food, processing, wealth from waste, Production of chitin, domestic & export markets
39	<i>Puerulus sewelli</i> Ramadan, 1938	Arabian whip lobster	Used as food, processing, wealth from waste, Production of chitin, domestic & export markets
40	<i>Nephropsis stewarti</i> Wood-Mason, 1872	Indian Ocean lobsterette	Used as food, processing, wealth from waste, Production of chitin, domestic & export markets
	Molluscs		
41	<i>Lamellidens marginalis</i> (Lamarck, 1819)	Freshwater mussel	Pearl production, domestic and export markets
42	<i>Saccostrea cucullata</i> (Born, 1778)	Hooded oyster	Used as food, processing, wealth from waste, lime production, domestic & export markets
43	<i>Crassostrea madrasensis</i> (Preston, 1916)	Indian Backwater oyster	Used as food, processing, wealth from waste, Production of lime, domestic & export markets
44	<i>Meretrix casta</i> (Gmelin, 1791)	Backwater hard clam	Used as food, processing, wealth from waste, Production of lime, domestic & export markets
45	<i>Meretrix meretrix</i> (Linnaeus, 1758)	Asiatic hard clam	Used as food, processing, wealth from waste, Production of lime, domestic & export markets
46	<i>Perna perna</i> (Linnaeus, 1758)	Brown mussel	Used as food, processing, wealth from waste, Production of lime, domestic & export markets

47	<i>Perna viridis</i> (Linnaeus, 1758)	Asian Green Mussel	Used as food, processing, wealth from waste, Production of lime, domestic & export markets
48	<i>Pinctada margaritifera</i> (Linnaeus 1758)	Black-lip pearl oyster	Ornamental purpose, domestic & export markets
49	<i>Paphia malabarica</i> (Dillwyn, 1817)	Short neck clam	Used as food, processing, wealth from waste, Production of lime, domestic & export markets
50	<i>Villorita cyprinoides</i> (Gray, 1825)	black clam	Used as food, processing, wealth from waste, Production of lime, domestic & export markets
51	<i>Sepia aculeata</i> (Van Hasselt, 1835)	Needle Cuttle fish	Used as food, processing, wealth from waste, Production of chitin, domestic & export markets
52	<i>Sepia pharaonis</i> (Ehrenberg, 1831)	Pharaoh cuttlefish	Used as food, processing, wealth from waste, Production of lime, domestic & export markets
53	<i>Sepilla inermis</i> (Van Hasselt, 1835)	Spineless cuttlefish	Used as food, processing, wealth from waste, Production of lime, domestic & export markets
54	<i>Uroteuthis duvauceii</i> (d'orbigny, 1835)	Indian Squid	Used as food, processing, wealth from waste, Production of lime, domestic & export markets
55	<i>Octopus vulgaris</i> (Cuvier, 1797)	Common octopus	Used as food, processing, wealth from waste, Production of lime, domestic & export markets
56	<i>Cistopus incidus</i> (Raap, 1835)	Pouched Octopus	Used as food, processing, wealth from waste, Production of lime, domestic & export markets
	Fishes		
58	<i>Chiloscyllium indicum</i> (Gmelin, 1789)	Slender Bamboo Shark	Used as food
59	<i>Alopias pelagicus</i> (Nakamura, 1935)	Pelagic Thresher Shark (Whiptail Shark)	Used as food

60	<i>Alopias vulpinus</i> (Bonnaterre, 1788)	Common Thresher (Thresher)	Used as food
61	<i>Carcharhinus dussumieri</i> (Müller & Henle, 1839)	Whitecheek Shark	Used as food
62	<i>Carcharhinus limbatus</i> (Müller & Henle, 1839)	Blacktip Shark	Used as food
63	<i>Rhizoprionodon acutus</i> (Rüppell, 1837)	Milk Shark	Used as food
64	<i>Scoliodon laticaudus</i> (Müller & Henle, 1838)	Spadenose Shark	Used as food
65	<i>Sphyrna zygaena</i> (Linnaeus, 1758)	Smooth hammer head	Used as food
66	<i>Pristis microdon</i> (Latham, 1794)	Largetooth Sawfish	Used as food
67	<i>Himantura bleekeri</i> (Blyth, 1860)	Bleeker's Whip Ray	Used as food
68	<i>Himantura uarnak</i> (Gmelin, 1789)	Honeycomb Stingray	Used as food
69	<i>Hippocampus kuda</i> (Leach, 1814)	Spotted Seahorse (Yellow Seahorse)	Used as ornamental purposes
70	<i>Hippocampus trimaculatus</i> (Hamilton, 1822)	Longnose Seahorse (Three-spot Seahorse)	Used as ornamental purposes
71	<i>Rachycentron canadum</i> (Linnaeus, 1758)	Cobia (King Fish)	Used as food, aquaculture, processing plants, domestic and export market
72	<i>Parastromateus niger</i> (Lacepède, 1801)	Black Pomfret	Used as food, processing plants, domestic and export market
73	<i>Scomberoides commersonianus</i> (Forsskål, 1775)	Talang Queenfish	Used as food, processing plants, domestic and export market
74	<i>Scomberoides lysan</i> (Cuvier, 1832)	Double-Spotted Queenfish	Used as food, processing plants, domestic and export market



75	<i>Coryphaena hippurus</i> (Bloch & Schneider, 1801)	Common Dolphinfish	Used as food, processing plants, domestic and export market
76	<i>Lutjanus malabaricus</i> (Bloch, 1790)	Malabar Blood Snapper	Used as food, processing plants, domestic and export market
77	<i>Nemipterus japonicus</i> (Bleeker, 1853)	Japanese Threadfin Bream	Used as food, processing plants, domestic and export market
78	<i>Johnius dussumieri</i> (Mohan, 1976)	Sin Croaker	Used as food, processing plants, domestic and export market
79	<i>Mugil cephalus</i> (Bleeker, 1853)	Flathead Mullet	Used as food, processing plants, domestic and export market
80	<i>Siganus javus</i> (Valenciennes, 1835)	Streaked Spinefoot	Used as food, processing plants, domestic and export market
81	<i>Lepturacanthus savala</i> (Klunzinger, 1884)	Savalai Hairtail	Used as food, processing plants, domestic and export market
82	<i>Trichiurus lepturus</i> (Cuvier, 1832)	Large head Hairtail	Used as food, processing plants, domestic and export market
83	<i>Auxis rochei</i> (Lacepède, 1800)	Bullet Tuna	Used as food, processing plants, domestic and export market
84	<i>Auxis thazard</i> (Cantor 1849)	Frigate Tuna (Frigate Tuna)	Used as food, processing plants, domestic and export market
85	<i>Euthynnus affinis</i> (Rüppell 1836)	Kawakawa (Mackerel Tuna)	Used as food, processing plants, domestic and export market
86	<i>Katsuwonus pelamis</i> (Cuvier, 1816)	Skipjack Tuna (Skiy Jack)	Used as food, processing plants, domestic and export market
87	<i>Rastrelliger kanagurta</i> (Temminck & Schlegel, 1844)	Indian Mackerel	Used as food, processing plants, domestic and export market
88	<i>Scomberomorus commerson</i> (Bloch & Schneider, 1801)	Narrow-Barred Spanish Mackerel (King Seer)	Used as food, processing plants, domestic and export market
89	<i>Scomberomorus guttatus</i> (Kishinouye, 1915)	Indo-Pacific King Mackerel (Spotted Spanish Mackerel)	Used as food, processing plants, domestic and export market

90	<i>Scomberomorus lineolatus</i> (Bonnaterre, 1788)	Streaked Seer	Used as food, processing plants, domestic and export market
91	<i>Istiompax indica</i>	Black Marlin	Used as food, processing plants, domestic and export market
92	<i>Thunnus albacares</i> Bleeker, 1851	Yellow Fin Tuna	Used as food, processing plants, domestic and export market
93	<i>Thunnus tonggol</i> (Bleeker, 1851)	Longtail Tuna (Longtail Tuna)	Used as food, processing plants, domestic and export market
94	<i>Pampus argenteus</i> (Euphrasen, 1788)	Silver Pomfret	Used as food, processing plants, domestic and export market
95	<i>Pampus chinensis</i> (Günther, 1860)	Chinese Silver Pomfret	Used as food, processing plants, domestic and export market
96	<i>Parastromateus niger</i> (Bloch, 1795)		Used as food, processing plants, domestic and export market
97	<i>Cynoglossus puncticeps</i> (Day, 1877)	Speckled Toungesole	Used as food, processing plants, domestic and export market
98	<i>Epinephelus malabaricus</i> (Bloch & Schneider, 1801)	Malabar Grouper	Used as food, processing plants, domestic and export market
99	<i>Sardinella longiceps</i> (Valenciennes, 1847)	Indian Oil Sardine	Used as food, processing plants, domestic and export market
100	<i>Chanos chanos</i> (Forsskal 1775)	Milk fish	Used as food, processing plants, domestic and export market
101	<i>Lates calcarifer</i> (Bloch 1790)	Barramundi	Used as food, processing plants, domestic and export market
102	<i>Epinephelus diacanthus</i> (Valenciennes 1828)	Spinycheek grouper	Used a food, processing plants, domestic and export market
103	<i>Epinephelus areolatus</i> (Forsskål 1775)	Areolate grouper	Used a food, processing plants, domestic and export market
104	<i>Lutjanus argentimaculatus</i> (Forsskål 1775)	Mangrove red snapper	Used a food, processing plants, domestic and export market
105	<i>Carinotetraodon travancoricus</i> (Hora & Nair, 1941)	Dwarf pufferfish	Ornamental purposes, domestic and export markets



106	<i>Dawkinsia arulius</i> (Jerdon, 1849)	Arulius barb	Ornamental purposes, domestic market
107	<i>Garra hughi</i> (Silas, 1955)	Cardamon garra	Ornamental purposes
108	<i>Hypselobarbus kurali</i> (Menon & Rema Devi, 1995)	Kooral	Ornamental and food purposes, domestic market
110	<i>Sahyadria denisonii</i> (Day 1865)	Denison barb	Ornamental purposes, domestic and export market
111	<i>Sahyadria chalakkudiensis</i> (Menon, Rema Devi & Thobias, 1999)	Chalak barb	Ornamental purposes, domestic market
112	<i>Batasio travancoria</i> (Hora & Law, 1941)	Travancore batasio	Ornamental purposes, domestic market
113	<i>Glyptothorax housei</i> (Herre, 1942)		Ornamental purposes, domestic market
114	<i>Mesonoemacheilus remadevii</i> (Shaji, 2002)	Devi's Loach	Ornamental purposes, domestic and export market
115	<i>Anguilla bengalensis</i> (Gray, 1831)	Indian mottled eel	Ornamental and food purposes, domestic market
116	<i>Barilius bakeri</i> (Day, 1865)		Ornamental purposes, domestic market
117	<i>Barilius gatensis</i> (Valenciennes, 1844)	River-carp baril	Ornamental purposes, domestic market
118	<i>Channa striata</i> (Bloch, 1793)	Striped snakehead	Ornamental and food purposes, aquaculture, processing, wealth from waste, domestic market
119	<i>Danio rerio</i> (Hamilton, 1822)	Zebra fish	Ornamental purposes, domestic market
120	<i>Dawkinsia filamentosus</i> (Valenciennes, 1844)	filament barb	Ornamental purposes, food fish, domestic market
121	<i>Devario malabaricus</i> (Jerdon, 1849)	Malabar danio	Ornamental purposes, domestic market
122	<i>Pseudetroplus maculatus</i> (Bloch, 1795)	Orange chromidae	Ornamental purposes, food fish, domestic market



123	<i>Etroplus suratensis</i> (Bloch 1790)	Green chromidae	Ornamental and food purposes, aquaculture, processing plants, wealth from waste, domestic and export markets
124	<i>Horabagrus nigricollaris</i> (Pethiyagoda & Kottelat, 1994)	Black collared catfish	Ornamental purposes
125	<i>Horabagrus brachysoma</i> (Günther, 1864)	Sun cat fish	Ornamental purposes, food fish, domestic market
126	<i>Laubuca fasciata</i> (Silas, 1958)	Malabar Hatchet Chela	Ornamental purposes, domestic market
127	<i>Macrogathus aral</i> (Bloch & Schneider, 1801)	one-stripe spiny eel	Ornamental, domestic market
128	<i>Mastacembelus armatus</i> (Lacepède, 1800)	zig-zag eel	Ornamental purposes, food fish, domestic market
129	<i>Nandus nandus</i> (Hamilton, 1822)	Gangetic leaf fish	Ornamental purposes, domestic market
130	<i>Nemacheilus guentheri</i> (Day, 1867)	Gunther's Loach	Ornamental purposes, domestic and export market
131	<i>Mesonemacheilus triangularis</i> (Day, 1865)	Stone loach	Ornamental purposes, domestic and export market
132	<i>Osteochilichthys nashi</i> (Day, 1869)	Nash's barb	Ornamental purposes, domestic market
133	<i>Parambassis thomassi</i> (Day, 1870)	Western Ghat glassy perchlet	Ornamental purposes, domestic market
134	<i>Pethia conchoni</i> (Hamilton, 1822)	Rosy barb	Ornamental purposes, domestic market
135	<i>Pethia ticto</i> (Hamilton, 1822)	Ticto barb	Ornamental purposes, domestic market
136	<i>Travancoria elongata</i> (Pethiyagoda & Kottelat, 1994)	Periyar loach	Ornamental purposes, domestic market
137	<i>Channa diplogramma</i> (Day, 1865)	Malabar snakehead	Ornamental and food purposes, aquaculture, domestic and export market

138	<i>Channa marulius</i> (Hamilton, 1822)	Great snakehead	Food purposes, aquaculture, food fish, domestic and export market
139	<i>Channa striata</i> (Bloch, 1793)	Striped snakehead	Food purposes, food fish, aquaculture, domestic and export market
140	<i>Heteropneustes fossilis</i> (Bloch, 1794)	Stinging catfish	Food purposes, food fish, aquaculture, domestic market
141	<i>Wallago attu</i> (Bloch & Schneider, 1801)	Wallago	Food purposes, food fish, domestic market
142	<i>Tor khudree</i> (Sykes, 1839)	Deccan mahseer	Food purposes, food fish, domestic market
143	<i>Tor malabaricus</i> Jerdon, 1849	Malabar mahseer	Food purposes, food fish, domestic market
144	<i>Amphiprion percula</i> (Lacepède, 1802)	Clown anemone fish	Ornamental fish, domestic and export market
145	<i>Amphiprion ocellaris</i> Cuvier, 1830	False clown anemone fish	Ornamental fish, domestic and export market
146	<i>Amphiprion sandaracino</i> Allen, 1972	Yellow sunk clown	Ornamental fish, domestic and export market
147	<i>Amphiprion frenatus</i> Brevoort, 1856	Tomato clown	Ornamental fish, domestic and export market
148	<i>Amphiprion clarkia</i> (J. W. Bennett, 1830)	Clark's Anemone fish	Ornamental fish, domestic and export market
149	<i>Amphiprion nigripes</i> Regan, 1908	Maldives Anemone fish	Ornamental fish, domestic and export market
150	<i>Premnas biaculeatus</i> (Bloch, 1790)	Maroon clown	Ornamental fish, domestic and export market
151	<i>Pseudochromis dielectus</i> Lubbock, 1976	Redhead dottyback	Ornamental fish, domestic and export market
152	<i>Dascyllus trimaculatus</i> (Rüppell, 1829)	Three spot damsel	Ornamental fish, domestic and export market
153	<i>Dascyllus aruanus</i> (Linnaeus, 1758)	Stripped damsel	Ornamental fish, domestic and export market



154	<i>Pomacentrus caeruleus</i> Quoy & Gaimard , 1825	Blue damsel	Ornamental fish, domestic and export market
155	<i>Neopomacentrus nemurus</i> (Bleeker, 1857)	Yellow tail damsel	Ornamental fish, domestic and export market
156	<i>Chrysiptera cyanae</i> Quoy & Gaimard , 1825	Sapphire devil	Ornamental fish, domestic and export market
157	<i>Chrysiptera unimaculata</i> (Cuvier, 1830)	One spot damsel	Ornamental fish, domestic and export market
158	<i>Chromis viridis</i> (Cuvier, 1830)	Green chromis	Ornamental fish, domestic and export market
	SPONGES (shown here to give emphasis on bio-active compounds)		
159	<i>Spongia officinalis</i> Linnaeus, 1759	Bath sponge	Nutraceuticals, industrial, domestic and export market
160	<i>Xestospongia sp.</i>		Nutraceuticals, industrial, domestic and export market
161	<i>Zezya fuliginisa</i>		Nutraceuticals, industrial, domestic and export market
162	<i>Euryspongia</i>		Nutraceuticals, industrial, domestic and export market
163	<i>Dactylospongia elegans</i> (Thiele, 1899)		Nutraceuticals, industrial, domestic and export market
164	<i>Tridemnum sps.</i>		Nutraceuticals, industrial, domestic and export market
165	<i>Tethyacrypta</i>		Nutraceuticals, industrial, domestic and export market
166	<i>Echinodactylum sps.</i>		Nutraceuticals, industrial, domestic and export market
167	<i>Discodermia dissolute</i>		Nutraceuticals, industrial, domestic and export market
168	<i>Lissodendorys sps.</i>		Nutraceuticals, industrial, domestic and export market



169	<i>Verongia aerophoba</i>		Nutraceuticals, industrial, domestic and export market
170	<i>Theonella</i> sp.		Nutraceuticals, industrial, domestic and export market
	ASCIDIAN		
171	<i>Lissodinium bistratum</i>		Nutraceuticals, industrial, domestic and export market
	SEA WEEDS		
172	<i>Gracilaria corticata</i>	Agar	Culture, industrial production, domestic an export market
173	<i>Gracilaria foliifera</i>	Agar	Culture, industrial production, domestic an export market
174	<i>Gelidiopsis variabilis</i>	Agar	Culture, industrial production, domestic an export market
175	<i>Gelidium pusillum</i>	Agar	Culture, industrial production, domestic an export market
176	<i>Sargassum wightii</i>	Algin	Culture, industrial production, domestic an export market
177	<i>Sargassum duplicatum</i>	Algin	Culture, industrial production, domestic an export market
178	<i>Sargassum tenerimum</i>	Algin	Culture, industrial production, domestic an export market
179	<i>Stoechospermum marginatum</i>	Algin	Culture, industrial production, domestic an export market
180	<i>Dictyota dichotoma</i> and <i>Padina</i>	Algin	Culture, industrial production, domestic an export market
181	<i>Padina</i> sp.	Algin	Culture, industrial production, domestic an export market
182	<i>Hypnea musciformis</i>	Carangineen	Culture, industrial production, domestic an export market
183	<i>Hypnea valentiae</i>	Carangineen	Culture, industrial production, domestic an export market



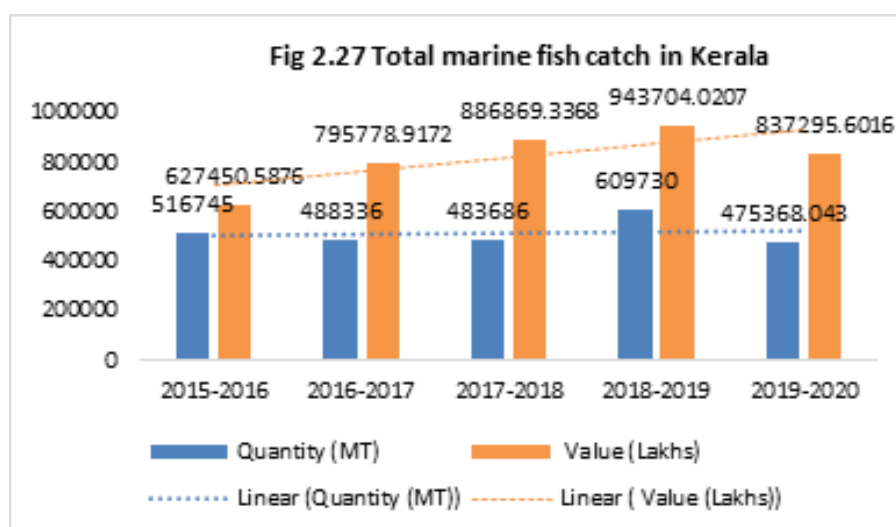
184	<i>Grateloupia filicina</i>	Carangineen	Culture, industrial production, domestic an export market
185	<i>Hypnea musciformis</i>	Carangineen	Culture, industrial production, domestic an export market
186	<i>Hypnea valentiae</i>	Carangineen	Culture, industrial production, domestic an export market
187	<i>Grateloupia filicina</i>	Carangineen	Culture, industrial production, domestic an export market
188	<i>Grateloupia lithophila</i>	Carangineen	Culture, industrial production, domestic an export market
189	<i>Gracilariopsis lemaneiformis</i>	Carangineen	Culture, industrial production, domestic an export market

A. Marine Fisheries Resources Production Data- Kerala

The analysis done in this chapter has emphasised on the species wise quantity of fish catch from different districts in Kerala, its market/trade value, unit value, export and foreign exchange earning etc. based on the data (last five years from 2015-16 to 2019-20) collected from the Fisheries Department.

Table 2.20 Marine Fish Landings in Kerala (Metric tonnes)

Sl. No.	Year	Quantity	Value (Rs. Lakh)
1	2015-16	516745	627450.6
2	2016-17	488336	795778.9
3	2017-18	483686	886869.3
4	2018-19	609730	943704.0
5	2019-20	475368	837295.6
6	2020-21	390597	



- The quantity of marine fish catch has a decreasing trend from 2015-16 to 2017-18 periods. 2018-19 witnessed a big hike in fish catch quantity, but in 2019-20, quantity has decreased.
- The value of marine fish catch in Kerala has showed a steady increasing trend from 2015-16 to 2018-19. But, during 2019-20, the value has decreased from the previous year, in proportion to the reduction in the quantity or fish catch.
- The value and catch was highest during the year 2018-19.

Table 2.21 Marine fish catch in Kerala (cumulative annual average 2015-2019)

S No.	Name of species	Quantity		Value		Unit price (Rs./Kg)
		MT	%	Lakh	%	
1	Elasmobranchs	5430	1.05	9661.76	1.16	182.80
2	Eels	964	0.19	904.34	0.11	101.46
3	Cat Fish	667	0.13	663.82	0.08	103.95
4	Chirocentrius	248	0.05	160.75	0.02	57.39
5(a)	Oil Sardines	59682	11.50	54415.71	6.54	95.48
5(b)	Lesser Sardines	23775	4.58	18877.35	2.27	78.55
5(c)	Hilsa Ilisha	0	0.00	0.00	0.00	0.00
5(d)	Other Hilsa	312	0.06	160.52	0.02	86.49
5(e)	Anchovilla	31333	6.04	27127.80	3.26	84.41
5(f)	Trisocles	6227	1.20	4392.72	0.53	72.50
5(g)	Other Clupeids	3745	0.72	3104.48	0.37	89.61
6(a)	Harpodon Nehereus	0	0.00	0.00	0.00	0.00
6(b)	Saurida & Saurus	9471	1.83	9739.40	1.17	88.13
7	Hemirhamphus & Belone	2212	0.43	322.57	0.04	116.41
8	Flying Fish	1305	0.25	27.66	0.00	361.30
9	Perches	39507	7.62	45843.58	5.51	114.91
10	Red Mullet	607	0.12	777.18	0.09	119.89
11	Polynemids	1080	0.21	407.20	0.05	81.35
12	Sciaenids	9348	1.80	11925.15	1.43	121.94
13	Ribbon Fish	13041	2.51	14127.39	1.70	118.80
14(a)	Caranx	3798	0.73	4207.40	0.51	129.74
14(b)	Chorinemus	613	0.12	623.29	0.07	124.10
14(c)	Thachynotus	912	0.18	9.71	0.00	94.72
14(d)	Other Carangids	32912	6.34	54170.11	6.51	152.79
14(e)	Coryphaena	1162	0.22	3419.33	0.41	326.79
14(f)	Elacate	151	0.03	689.68	0.08	240.72
15(a)	Leiognathus	3090	0.60	3413.97	0.41	113.60
15(b)	Gazza	233	0.04	0.00	0.00	0.00
16	Lactrius	471	0.09	549.59	0.07	146.76
17	Pomfrets	5302	1.02	16557.05	1.99	320.08
18	Mackerel	70033	13.50	80524.60	9.68	114.65

19	Seer Fish	11196	2.16	42867.00	5.15	384.34
20	Tunnis	31955	6.16	65397.84	7.86	200.59
21	Sphyraena	1819	0.35	3182.75	0.38	143.05
22	Mugil	29	0.01	25.88	0.00	106.83
23	Bregmaceros	1428	0.28	0.00	0.00	0.00
24	Soles	9075	1.75	8187.09	0.98	88.03
25(a)	Penaid Prawn	52848	10.19	154753.26	18.61	294.37
25(b)	Non Penaid Prawn	5435	1.05	17827.53	2.14	276.04
25(c)	Lobsters	3052	0.59	24302.60	2.92	832.30
25(d)	Crabs	7533	1.45	8442.72	1.02	118.62
25(e)	Stomatopodes	245	0.05	1398.88	0.17	286.40
26	Cephalopodes	47327	9.12	111404.78	13.40	247.35
27	Miscellaneous	19211	3.70	27072.02	3.26	120.84
TOTAL		518783	100.00	831666.47	100.00	

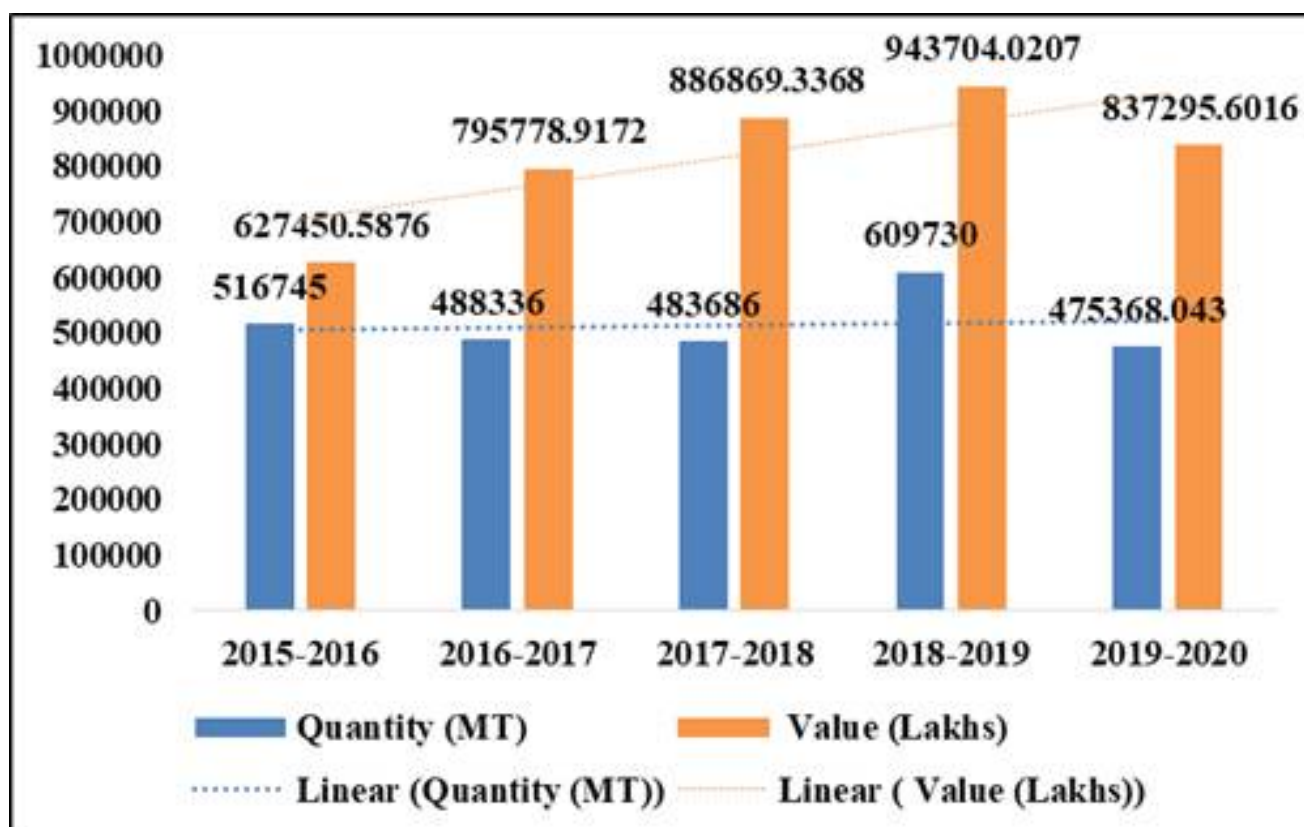


Fig 2.27 Marine fish catch in Kerala (2015-20)

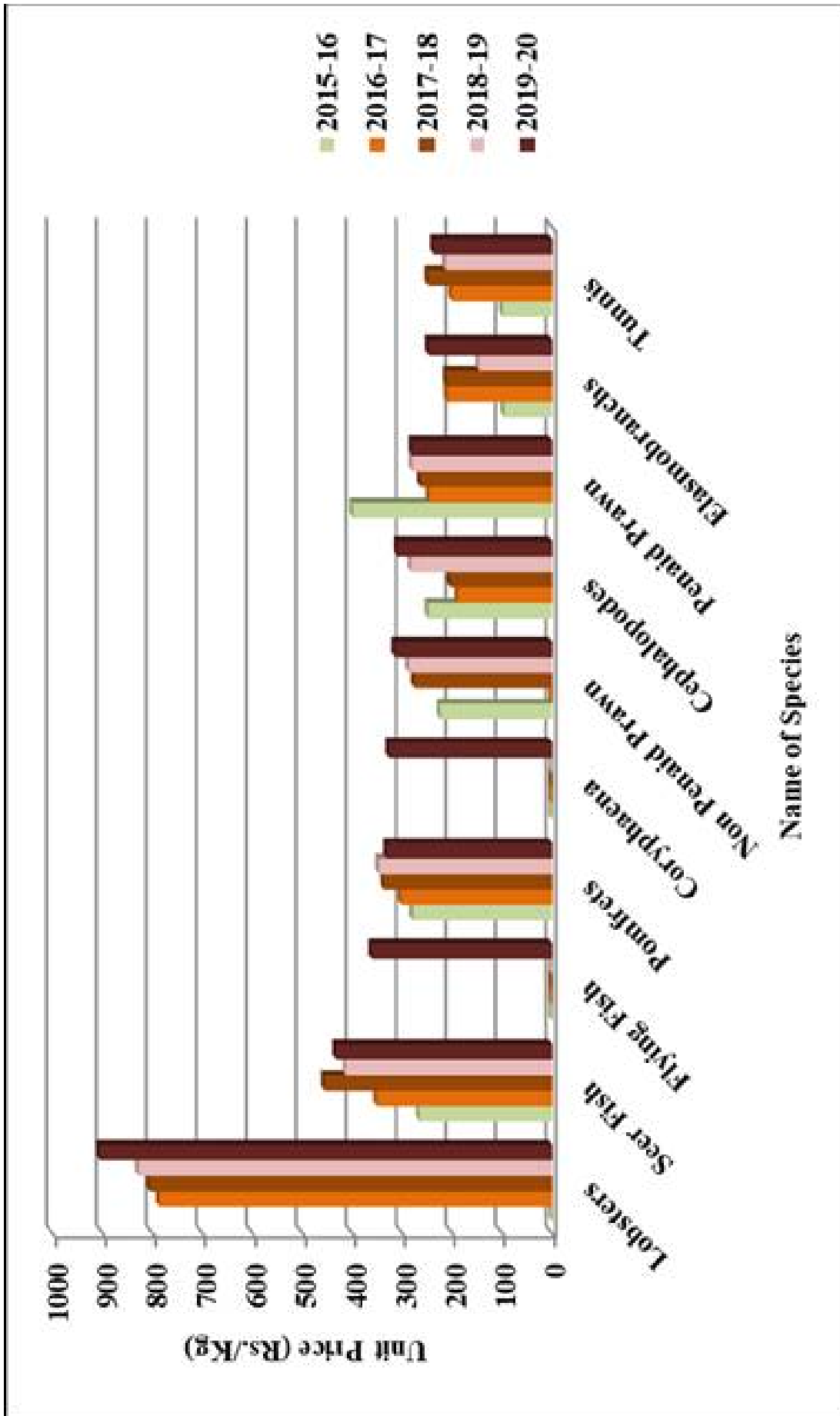


Fig 2.28 Marine catch year wise unit value of selected species

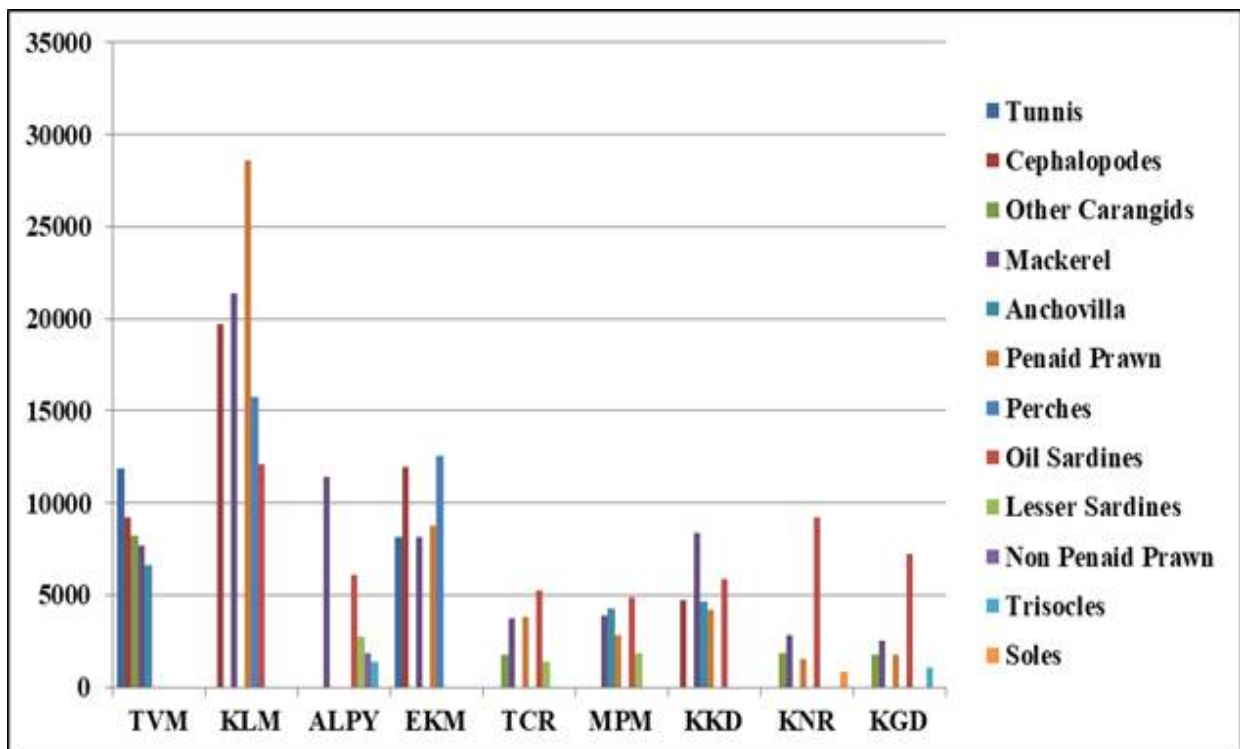


Fig 2.29 District wise cumulative annual average of 10 Major High Quantity Marine Catch in Kerala (Year 2015-16 to 2019-20; Quantity in Metric tonnes)

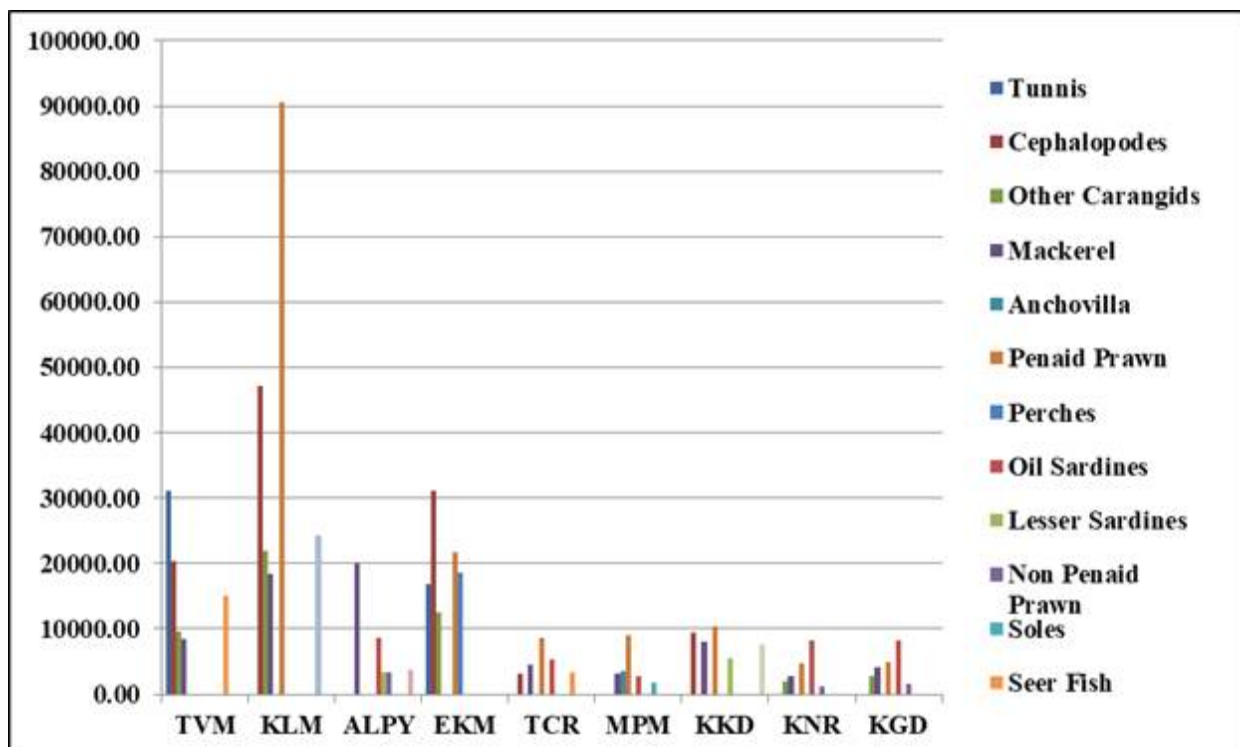


Fig 2.30 District-wise cumulative annual average of 10 major high value (total) marine catch in Kerala (Year 2015-16 to 2019-20; Value in Lakhs)

- The cumulative average of five major high quantity marine catches in Kerala coast was calculated: Mackerel (13.50%), Oil Sardines (11.50%), Penaid Prawn (10.19%), Cephalopodes (9.12%), and Perches (7.62%).
- In terms of total value, the five major high value (cumulative average) marine catches / fishes in Kerala coast were: Penaid Prawn (18.61%), Cephalopodes (13.40%), Mackerel (9.68%), Tunnis (7.86%), and Oil Sardines (6.54%).
- Species such as: Mackerel, Oil Sardines, Penaid Prawn, and Cephalopodes registered in high quantity (catch) as well as high values. Lobsters (Rs. 832.30), Seer fish (Rs. 384.34), Flying fish (Rs. 361.30), Pomfrets (Rs. 320.08), and Non Penaid Prawn (Rs. 294.37) have highest annual cumulative unit value (per Kg.), signifying the high benefits with respect to cost (higher return on investment) that can be gained by farmers by catching these marine high value species. Consequently, the ABS potential of these species especially can also be considerably high.
- The district-wise cumulative annual averages of 10 high quantity, high value and high unit value marine species were also computed to understand the relative contributions of each district in the collection of marine bio-resources. Considering the district-wise data, the leading district in terms of quantity of fish catch was Kollam district followed Thiruvananthapuram, Ernakulam, Alappuzha and Kozhikode. In terms of major high total value marine catches, the same districts showed promising numbers with Kollam district again leading.
- The trend of unit value across 5 years was analysed to achieve an understanding of price trend of some major high value marine species. Most of the species showed a consistent and predictable increasing trend in terms of unit value, with lobster being the highest unit value species in all five years. Elasmobranchs and Tunnis had relatively low unit value, with fluctuating price variations across different years.
- The trend of quantity wise data of different high quantity species was also tabulated to understand the fluctuations in total quantity of catch of these high quantity species. After a year with high quantity catch (2015-16) most of the species showed a decreasing trend in the following 2 years. The quantity then rebounded to a higher amount in most species in the year 2018-19 which was even more than the quantity of catch in 2015-16. This was followed again by a substantial decrease in quantity in 2019-20. Since different factors such as market variations, meteorology, oceanic conditions etc impact the marine fish catch, the reason for these fluctuating numbers cannot be definitively pinpointed. However, these numbers can form a base for further studies on marine species sustainability and the need to allow time for marine resources to repopulate. In terms of high total value trend, this followed the pattern of quantity showing varying fluctuations across different years.

B. Marine Fisheries Primary Survey: Fishermen

Apart from the extensive secondary data collected from the Fisheries Department, a survey among the fisherman communities especially who involved in fishing from the representative landing sites in Kerala also carried out for boating certain economic information related to fisheries. The survey covered all the 9 coastal districts of Kerala and was conducted during January – February 2021. Based on the number of fishing vessels and estimated number of fishermen, landing centres were selected. In major landing centres, 50 number of fishermen interviews and in minor landing centres, 30 number of fishermen interviews were conducted. Parameters like: Age Group, Educational classification, Fish catch details /day in each landing centre (Catch details like -Fish Scientific Name, Common Name, Malayalam Name, Quantity of fish/day (kg) and Total Price (Rs.)). Total number of fishing vessel, fishing hours and its range, factors influencing price variation, mode of exchange and price determination, involvement of women in the auction sale and value added product development, facilities for storage of the resources, range of expenditure /day, range of money obtained from bio-resource exchange (Rs.) and destination of resources were considered. The highest number of landing centres surveyed was in Thiruvananthapuram district with 22 landing centres, followed by Thrissur (16), Ernakulam (15) and Alappuzha (15). The formula applied for arriving at total landings for the year, total value has been : Total quantity = Quantity per day* Total fishermen / (Sample size* Vessel to fishermen ratio).

Table 2.22 Species wise landings of fishes and shellfishes

Sl. No	Scientific Name	Quantity (Kg)/day	Total Price (Rs.) /day	Price (Rs.)/Kg	Projected quantity (in Ton)/year	Total Price (in lakhs)
1	<i>Acanthocybium salandri</i>	4550	1900000	418	4584.1	19161.6
2	<i>Alepius kleini</i>	135	13500	100	136	136
3	<i>Ambasis</i> SP.	47	2680	57	47.4	27
4	<i>Anodontostoma chacunda</i>	60	8800	147	60.5	88.9
5	<i>Auxis thazard</i>	1423	239150	168	1433.7	2408.6
6	Belonidae	230	29800	130	231.7	301.2
7	<i>Branchiurus</i> sp.	92	22900	249	92.7	230.8
8	Carangids	675	115500	171	680.1	1162.9
9	<i>Carangoides malabaricus</i>	40	12000	300	40.3	120.9
10	<i>Caranx bucculentus</i>	1161	348570	300	1169.7	3509.1
11	<i>Caranx</i> sp.	975	321450	330	982.3	3241.6
12	<i>Carcharhinus limbatus</i>	524	78500	150	527.9	791.9
13	<i>Chirocentrus dorab</i>	1671.5	122950	74	1684	1246.2
14	<i>Coryphaena hippurus</i>	821	272170	332	827.2	2746.2
15	<i>Cynoglossus semifasciatus</i>	9854	1322920	134	9927.9	13303.4
16	<i>Cynoglossus</i> sp.	3574	679170	190	3600.8	6841.5
17	<i>Dasyatis bennettii</i>	915	128630	141	921.9	1299.8
18	<i>Dasyatis bleekeri</i>	4040	564400	140	4070.3	5698.4
19	<i>Decapterus russelli</i>	6018	406670	68	6063.1	4122.9
20	<i>Dussumieria acuta</i>	1291	84890	66	1300.7	858.5
21	<i>Ehirava fluviatilis</i>	5433	510960	94	5473.7	5145.3
22	<i>Elagatis bipinnulata</i>	25	3750	150	25.2	37.8
23	<i>Epinephelus fasciatus</i>	421	70020	166	424.2	704.1
24	<i>Epinephelus malabaricus</i>	670	97250	145	675	978.8
25	<i>Epinephelus</i> sp.	2078	249360	120	2093.6	2512.3
26	<i>Epinephelus tauvina</i>	240	37950	158	241.8	382
27	<i>Escualosa thoracata</i>	11114	1162144	105	11197.4	11757.2
28	<i>Euthynnus affinis</i>	4603	702930	153	4637.5	7095.4
29	<i>Exocoetus volitans</i>	460	81350	177	463.5	820.3
30	<i>Hemirhamphus</i> sp.	56	11200	200	56.4	112.8
31	<i>Hilsa kelee</i>	2197	230400	105	2213.5	2324.2
32	<i>Hyporhamphus dussumieri</i>	79	15800	200	79.6	159.2
33	<i>Istiompax indica</i>	600	86000	143	604.5	864.4
34	<i>Johinus dussumieri</i>	41	4680	114	41.3	47.1
35	<i>Johnius</i> Sp.	306	27000	88	308.3	271.3
36	<i>Katsuwonus pelamis</i>	2237	220300	98	2253.8	2208.7
37	<i>Lactarius lactarius</i>	293	31890	109	295.2	321.8
38	<i>Leiognathus equulus</i>	3698.5	323395	87	3726.2	3241.8
39	<i>Leiognathus</i> sp.	11079	1268240	114	11162.1	12724.8
40	<i>Loligo</i> sp.	2700	945000	350	2720.3	9520.9

41	<i>Lutjanus argentimaculatus</i>	8408	2126865	253	8471.1	21431.8
42	<i>Makaria indica</i>	1508	410340	272	1519.3	4132.5
43	<i>Megalaspis cordyla</i>	380	40200	106	382.9	405.8
44	<i>Metapenaeus affinis</i>	3373	688000	204	3398.3	6932.5
45	<i>Metapenaeus dobsoni</i>	8852	1446335	163	8918.4	14537
46	<i>Metapenaeus monoceros</i>	2608	339100	130	2627.6	3415.8
47	Mud crab	12	4000	333	12.1	40.3
48	<i>Nemipterus japonicus</i>	20149	2383670	118	20300.1	23954.1
49	<i>Nemipterus sp.</i>	639	81550	128	643.8	824.1
50	<i>Nibea soldado</i>	5343	591190	111	5383.1	5975.2
51	<i>Opisthopecterus tardoore</i>	18	1080	60	18.1	10.9
52	<i>Pampus argenteus</i>	10619.5	8163610	769	10699.1	82276.4
53	<i>Pampus chinensis</i>	88	10560	120	88.7	106.4
54	<i>Pampus sp.</i>	10	7000	700	10.1	70.5
55	<i>Panulirus homarus</i>	1096	2411200	2200	1104.2	24292.8
56	<i>Parapenaeopsis stylifera</i>	4691	805435	172	4726.2	8129
57	<i>Parastromateus niger</i>	9396	3685860	392	9466.5	37108.6
58	<i>Penaeus indicus</i>	8186	2508840	306	8247.4	25237
59	<i>Penaeus monodon</i>	5685	1473200	259	5727.6	14834.6
60	<i>Perna viridis</i>	480	57600	120	483.6	580.3
61	<i>Portunus pelagicus</i>	144	20900	145	145.1	210.4
62	<i>Portunus sanguinolentus</i>	2690	476900	177	2710.2	4797
63	<i>Portunus sp.</i>	350	97080	277	352.6	976.8
64	<i>Rachycentron canadum</i>	140	12800	91	141.1	128.4
65	* <i>Rastrelliger kanagurta</i>	143107	14586355	102	144180.3	147063.9
66	<i>Rhinoptera javanica</i>	279	43600	156	281.1	438.5
67	<i>Saedinella fimbriata</i>	15	1000	67	15.1	10.1
68	<i>Sarda orientalis</i>	785	107400	137	790.9	1083.5
69	<i>Sardinella albella</i>	8297	758250	91	8359.2	7606.9
70	<i>Sardinella fimbriata</i>	15342.5	1447195	94	15457.6	14530.1
71	<i>Sardinella gibbosa</i>	48860	7102500	145	49226.5	71378.4
72	<i>Sardinella longiceps</i>	10604	1444515	136	10683.5	14529.6
73	<i>Sardinella melanura</i>	140	15400	110	141.1	155.2
74	<i>Saurida brasiliensis</i>	850	59500	70	856.4	599.5
75	<i>Scomber albacares</i>	2055	287300	140	2070.4	2898.6
76	<i>Scomberomorus commerson</i>	7689	4182850	544	7746.7	42141.9
77	<i>Scomberomorus guttatus</i>	10989	2235210	203	11071.4	22475
78	<i>Scomberomorus lineolatus</i>	5709	3515750	616	5751.8	35431.2
79	<i>Scylla serrata</i>	33	10400	315	33.2	104.7
80	<i>Selar crumenophthalmus</i>	522	54750	105	525.9	552.2
81	<i>Sepia aculeata</i>	151	48260	320	152.1	486.8
82	<i>Sepia pharaonis</i>	4217	1430680	339	4248.6	14402.8
83	Sole Fish	14	3500	250	14.1	35.3
84	<i>Sphyrna barracuda</i>	1300	169850	131	1309.8	1715.8



85	<i>Stolephorus commersonii</i>	15635	1634830	105	15752.3	16539.9
86	<i>Stolephorus indicus</i>	8118	629870	78	8178.9	6379.5
87	<i>Thryssa dussumieri</i>	8602	809975	94	8666.5	8146.5
88	<i>Thryssa purva</i>	200	12000	60	201.5	120.9
89	<i>Thryssa sp.</i>	9401	1150255	122	9471.5	11555.2
90	<i>Tuna albacore</i>	5162	1121200	217	5200.7	11285.6
91	<i>Tuna sp.</i>	13669	2575630	188	13771.5	25890.5
92	<i>Uroteuthis duvauceli</i>	7550	2130490	282	7606.6	21450.7
93	Podimeen	40	2000	50	40.3	20.2
94	Bombla	30	4500	150	30.2	45.3
95	Chaavuri	214	34700	162	215.6	349.3
96	Kalava	295	30000	102	297.2	303.2
97	Klathi	443	34740	78	446.3	348.1
98	Konithi	35	5600	160	35.3	56.4
99	Kuttan	191	12400	65	192.4	125.1
100	Lizard fish	880	86650	98	886.6	868.9
101	Kakka	70	6050	86	70.5	60.7
102	<i>Octopus dollfusi</i>	610	74000	121	614.6	743.6
103	Miscellaneous	6394	587100	92	6442	5926.6
					523688.8	896792

- * The figure indicates high landings of this single species (*Rastrelliger kanagartha*) from Malappuram and Kozhikkode districts (together comes to a lakh kg.)

Fish and shellfish resources landed more than 1000 kg are : *Acanthocybium salandri*, *Auxis thazard*, *Caranx bucculentus*, *Cynoglossus spp.*, *Dasyatis bleekeri*, *Decapterus russelli*, *Dussumieria acuta*, *Ehirava fluviatilis*, *Epinephelus sp.*, *Escualosa thoracata*, *Euthynnus affinis*, *Hilsa kelee*, *Katsuwonus pelamis*, *Leiognathus equualus*, *Leiognathus sp.*, *Loligo spp.*, *Lutjanus argentimaculatus*, *Makaria indica*, *Metapeneaus affinis*, *Metapeneaus dobsoni*, *Metapeneaus monoceros*, *Nemipterus japonicas*, *Nibeas soldado*, *Pampus argenteus*, *Panulirus homarus*, *Parapeneopsis stylifera*, *Parastromateus niger*, *Penaeus indicus*, *Penaeus monodon*, *Portunus sanguinolentus*, *Rastrelliger kanagartha*, *Scomber albacores*, *Scomberomorus spp.*, *Sardinella spp.*, *Sepia pharaonis*, *Sphyrna barracuda*, *Stolephorus spp.*, *Thryssa spp.*, *Tuna spp.*, *Uroteuthis duvauceli*. All these fishes and shellfishes contribute substantially to the economy of the state.

Thus, it can be observed from this study of marine bio-resources that this sector provides an important avenue of bio-resource utilisation contributing substantially to the economy of the state as well as for securing livelihoods of the fishermen community in the state. The sustainability of this sector can be improved through scientific management of marine bio-resources to ensure continuous and consistent yields which can ensure livelihood security for the fishermen and their families. Capacity building of farmers through BMC's can be undertaken to ensure they get maximum benefit of their catch from markets and also ensure forward linkages with fishing industries and exporting firms. Further, the ABS potential from value addition and commercialisation of marine bio-resources also needs to be explored which can act as a supplement for fishing community development.

2.3.2. INLAND AQUATIC BIORESOURCES

The present study details 152 Inland aquatic flora, and 9 zooplanktons. Several major taxonomic groups of protozoa, viz; flagellates, naked and testate amoebae, actinopods and ciliates occur in biological sewage treatment plants. Their role in water purification systems is very significant.

Protozoa also play a vital role in controlling bacterial population and biomass. Thirty nine protozoan bioresources, 13 inland sponge are reported in the study. Nearly 23 species of gastrotrich have been described and as they inhabit in periphyton sedimentation, it is very important for aquaculture and hence have special importance in the consolidated checklists.

The report also describes fishes Estuarine and Freshwater. Estuarine fishes include strictly estuarine, migratory ones from sea and freshwaters. The fishes are highly tolerant to salinity. There is a great demand for this group of fishes and a checklist of 151 species are provided. A consolidated list of fishes from 44 rivers, reservoirs, ponds, and inland swampy areas are presented in the checklist of this report.

Among Inland aquatic resources Crustacean resources form an important group of organisms providing food and nutrition. Copepods, Prawns, shrimps, crabs constitute the major groups and all of them are economically important. 33 species of inland prawns, 19 species of shrimps, 36 species of crabs are listed. Some species like *Scylla serrata*, *Scylla tranquebarica*, *Scylla olivacea* are commercially important. Rotifers (*Brachionus* spp.) are extensively used as first feed in marine larviculture. They are quite small (50 µm–2 mm), slow swimming, and are relatively easy to culture. Hence they are economically important and 56 species are listed. Estuarine fishes include strictly estuarine, migratory ones from sea and freshwaters, highly tolerant to salinity. There is a great demand for this group of fishes and a checklist of 151 species are provided. Inland fishery resources include : fishes such as – *Etroplus suratensis*, Murrels (*Channa striatus*, *Channa diplogramae*, *Channa*), Mulletts (*Mugil cephalus*, *Liza parsia* etc.), Tilapia, *Labeo fimbriatus*, Barbs, *Catla catal*, *Labeo rohita*, *Cirrhinus mrigala*, Common

carp, *Chanos chanos*, *Wallago attu*, *Anguilla bicolor*, prawns (*Macrobrachium rosenbergii*, *M. idella*, *Peneus indicus*, *Penaeus monodon*, *Penaeus vannamei*), crabs (*Scylla serrata*, *Scylla tranquebarica*, *Scylla olivacea*), *Paphia malabarica*, *Villorita cyprinoides*, *Crassostrea madrasensis*, *Saccostrea cuculata*, *Pangasius pangasius* and other resources. Clams bioresources of Kerala constitute black clam (*Villorita cyprinoides*), Yellow clam (*Paphia malabarica*) and white clam (fossil deposit). Black clam is an important bio-resource of Vembanad Lake. 39,243 t was landed during 2019-20. One of the major fishery resource of Ashtamudi backwater system is short neck clam or yellow clam. It is a reputed export item to countries like Japan, Vietnam, Thailand, Malaysia, Indonesia and so on. Large scale dredging for the white clam shells is practiced in Vaikom and Allappuzha. The subsoil deposit of white clams in the lake is estimated at about 4.5 million tons. The shells are taken by dredging at a rate of 41,000 to 69,000t/ yr from 3 m deep and is at present under control of government.

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A. Inland Fish Catch and Value in Kerala (2015-16 to 2019-20)

Inland fishery resources include : fishes such as – *Etroplus suratensis*, Murrels (*Channa striatus*, *Channa diplogramae*, *Channa*), Mulletts (*Mugil cephalus*, *Liza parsia* etc.), Tilapia, *Labeo fimbriatus*, Barbs, *Catla catal*, *Labeo rohita*, *Cirrhinus mrigala*, Common carp, *Chanos chanos*, *Wallago attu*, *Anguilla bicolor*, prawns (*Macrobrachium rosenbergii*, *M. idella*, *Peneus indicus*, *Penaeus monodon*, *Penaeus vannamei*), crabs (*Scylla serrata*, *Scylla tranquebarica*, *Scylla olivacea*), *Paphia malabarica*, *Villorita cyprinoides*, *Crassostrea madrasensis*, *Saccostrea cuculata*, *Pangasius pangasius* and other resources.

Species wise inland fish catch (quantity) as well as its value from 14 districts of Kerala during 2015-16 to 2019-20 was collected from the Fisheries Department, Government of Kerala. A detailed analysis was carried out considering the objectives of the project.

Table 2.23 Total inland fish catch in Kerala (2015-2020)

Year	Quantity (MT)	Value (Lakhs)
2015-2016	210763	288866
2016-2017	188130	395661
2017-2018	189081	403468
2018-2019	192027	401199
2019-2020	205430	431163

The total quantity of inland fish catch in the State has not varied considerably from 2015-16 to 2019-20. However, during these periods, the value generated from inland fishing increased considerably over a period. This might be due to the increasing demand for the inland fishes.

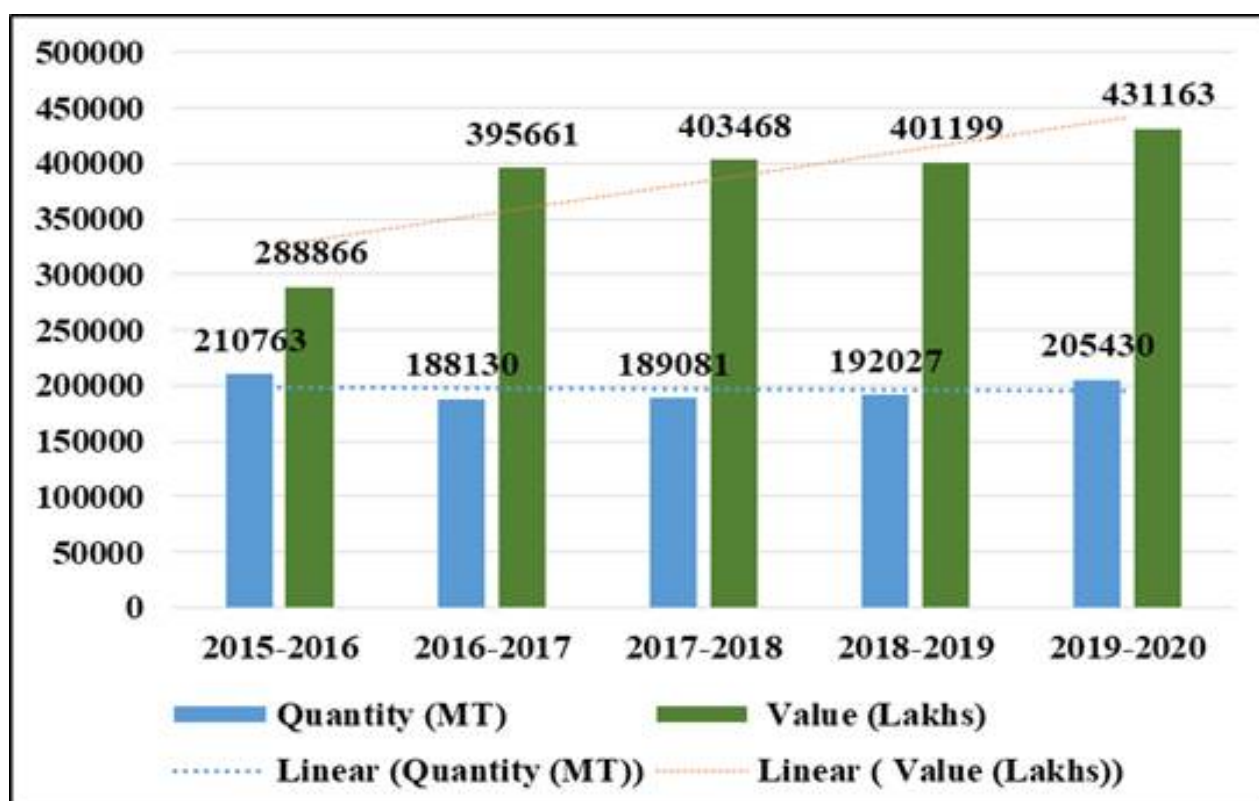


Fig 2.32 Total inland fish catch in Kerala

Table 2.24 Total quantity of major inland species in Kerala (2015-2020)

S. No	Name of the species	Years				
		2015-16	2016-17	2017-18	2018-19	2019-20
1	Prawn	28361.00	27018.00	40802.00	26312.05	26454.38
2	Etroplus	8507.00	8298.00	4879.00	4193.61	4319.27
3	Mulletts	7069.00	6685.00	3188.00	2967.42	3391.63
4	Cat fish	6365.00	5780.00	4657.00	2935.72	4772.51
5	Tilapia	13129.00	12776.00	5199.00	3894.58	4707.23
6	Mrigal	12650.00	13910.00	6302.00	4096.37	1338.31
7	Common carps	12461.00	11712.00	4703.00	3136.77	1228.02
8	Catla	30242.00	30830.00	11282.00	9096.04	6712.75
9	Labeo-Rohitha	29783.00	26504.00	10889.00	5149.07	4897.50
10	Mussel	24060.00	9537.00	2541.00	2096.62	3118.67

Table 2.25 Total value of major inland species (lakh)

Name of species	Year				
	2015-16	2016-17	2017-18	2018-19	2019-20
Prawn	87919	108072	188492	128490	129704
Etroplus	13186	33192	20568	18026	18181
Mulletts	5794	21684	8812	9047	5324
Cat fish	18379	38439	5983	5697	6665
Tilapia	7002	6358	5667	5188	6612
Mrigal	17068	22358	9719	2579	9228
Common carps	13283	13910	7999	4503	1617
Catla	36897	44704	17458	14999	11879
Labeo-Rohitha	35740	37106	15311	6964	7339
Mussel	13955	8393	2711	3670	5169

The inland fisheries sector represents a sunrise sector with huge potential for growth, due to the large networks of freshwater and brackish water systems within the state. Although, its share does not match the fish bio-resources catch obtained from the marine sector, the inland fisheries yield is showing substantial growth in terms of value, which has been conclusively established from the present study. The secondary data was collected from the Fisheries Department of Government of Kerala, and subsequently analysed rigorously to provide a broad picture of the inland fisheries bio-resources in the state. For the purpose of this analysis, the cumulative averages of all the studied years according to districts and species were taken. The total quantity of inland fish catch in the State has not varied considerable from 2015-16 to 2019-20. However, during the period, the value generated from inland fishing increased considerably. This could be due to several influencing factors such as higher demand for inland fish species, increasing overhead costs, increase in quantity of catches of high value species etc. Nevertheless, the increasing trend in value of inland fisheries resources presents a promising picture for growth of this sector.

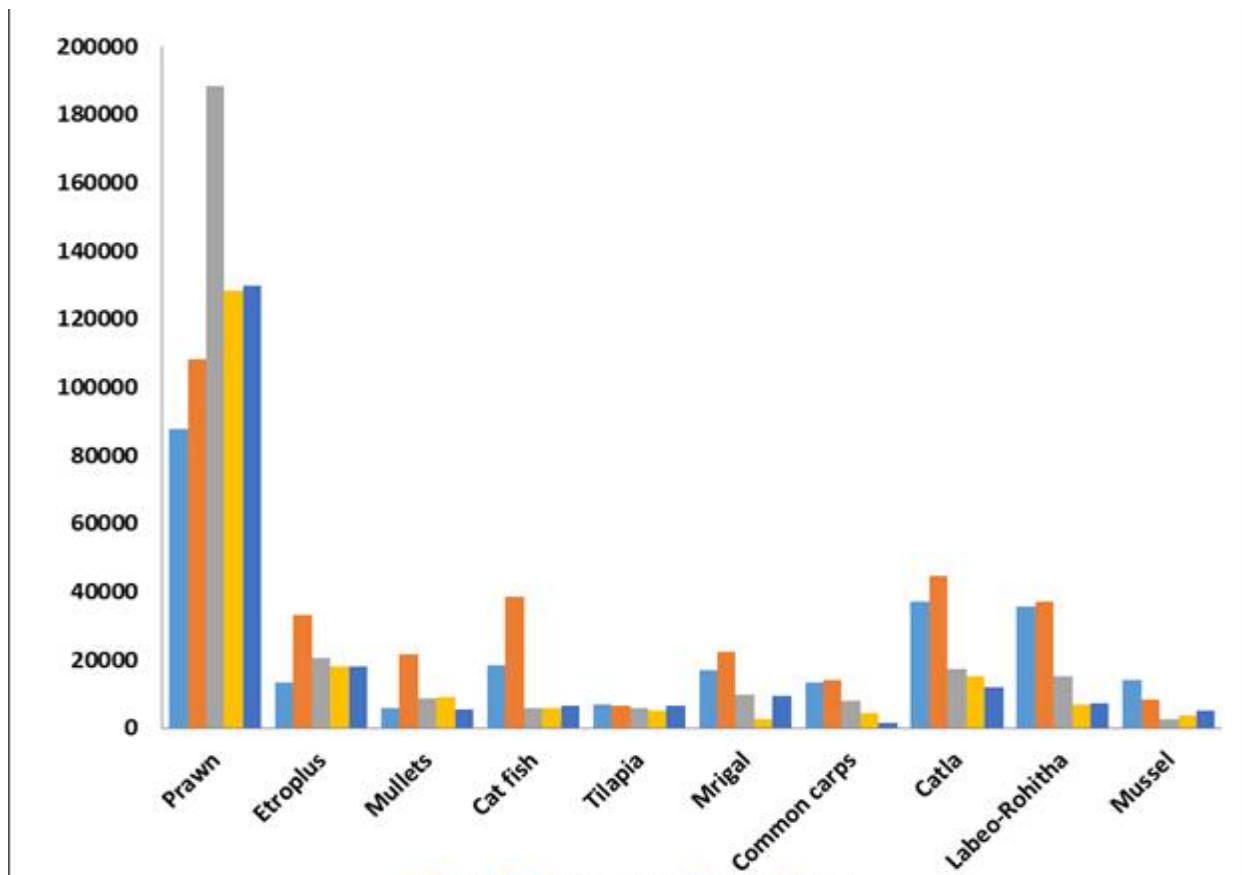


Fig 2.33 High value (total) inland catch – state level (lakh)

In order to get a more detailed idea of the inland fisheries bio-resources, the data was also classified into district-wise quantities and values, where 10 high quantity and high value species and their cumulative averages within each district were analysed. With respect to high quantity species of inland fish, these were Prawn, Etroplus, Mulletts, Cat fish, Tilapia, Mrigal, Common carps, Catla, Labeo-Rohitha and Mussel. Prawn (27.33%) showed the highest catch in quantity among the ten selected high quantity items, followed by Catla (16.18%) and Labeo rohitha (14.17%) respectively. The cumulative annual average of ten major high quantity inland fish catch was found to be highest in Ernakulam (23.50%) followed by Alappuzha (18.02%), Thrissur (16.64%) and Palakkad (10.66%). Among the 14 districts, Ernakulam showed the highest cumulative annual averages (in quantity) of Prawn (50.55), Mulletts (21.93%), Catfish (23.50%) and Tilapia (29.16%). Kasargod was the only coastal district where the cumulative annual average of ten major high quantity marine catch was minimum (3.45%). However, the cumulative annual average of Mussel catch (83.39%) is highest in Kasargod relative to all other districts of Kerala. This matches the cultural and traditional significance of mussels in the food habits of the northernmost district of Kerala.

With respect to high value species of inland fish, these were Prawn, Etroplus, Murrels, Mulletts, Cat fish, Tilapia, Mrigal, Catla, Labeo-Rohitha and Mussel. This shows that high value species are largely the same as high quantity species except common carps which feature in high quantity but not in high value list of species. This signifies the lower unit value of this particular category of species which can be further analysed in the next section on high unit value species. On the contrary, Murrels did not feature in high quantity but did feature in high value list indicating its probable high unit value. The cumulative annual average of ten major high value (total) inland fish catch is highest in Ernakulam

(33.19%) followed by Alappuzha (20.99%) and Thrissur (13.64%) respectively. Among the 14 districts, Ernakulam showed the highest cumulative annual averages (in value (total) of Prawn (51.70%), Mulletts (24.06%), and tilapia (28.69%). Wayanad was the district where the cumulative annual average of ten major high value (total) inland fish catch is minimum (0.62%). Prawns (50.72%) recorded the high value (total) item among the ten selected high value (total) items, followed by Catla (9.94%), Etroplus (8.14%) and Labeorohita (8.09%) respectively.

With respect to high unit value species of inland fish, these were Prawn, Etroplus, Murrels, Mulletts, Jew fish, Tilapia, Barbus, Crabs, Catla and Chanos. The cumulative annual average of ten major high value (unit value) inland fish catch is highest in Thrissur (8.36%) followed by Alappuzha (8.12%), and Ernakulam (8.06%) respectively. The cumulative annual average of ten major high value (unit value) inland fish catch is highest in Thrissur (8.36%) followed by Alappuzha (8.12%), and Ernakulam (8.06%) respectively. Crabs (15.04%) recorded the highest value (unit value) item among the selected high value (unit value) items followed by Prawn (14.79%) and Etroplus (14.22%).

The total quantity and value of high quantity and high value species was also analysed across the 5 years studied to understand overall trend of inland fish catch. The high quantity marine catch was highest in the year 2015 (31.68%) followed by 2016 (28.09%), 2017 (17.33), 2018 (11.72%) and 2019 (11.18%) respectively. Etroplus, Mulletts, Catfish, Tilapia, and Labeorohita catch was highest during 2015. Mrigal, Common carps and Catla catch was highest during 2016. Prawn catch was highest in 2017.

The inland fisheries bio-resources present a unique heritage of Kerala's combined systems of aquaculture within the agro-ecosystem, which has been practiced through integrated farming in the estuaries and backwater regions of Kerala. The Pokkali rice cultivation in central Kerala is an important example of this unique and ecologically sustainable integrated farming system. The Kuttanad rice cultivation below mean sea level has also been recognized as a Globally Important Agricultural Heritage System (GIAHS) by the Food and Agricultural Organisation (FAO). Such traditional practices may be considered while estimating the potential ABS amount from inland fisheries bio-resources. It may be noted that these combined systems of inland aquaculture and agriculture not only sustains the livelihoods of farmers and fishermen, but also conserves the rich biodiversity of these unique estuarine ecosystems. The freshwater rivers flowing from the Western Ghats and into the Arabian Sea also act as a storehouse for the inland fisheries bio-resources, warranting special attention for conservation.

Further, the increasing demand for inland fish species present an opportunity for creating forward linkages of aquaculture farmers with the local, national and international markets. Infrastructure development for storage, preservation and value addition also act as constraints for achieving the true potential of this sector in improving the livelihoods of the cultivators. Capacity building efforts through the agricultural department and BMC's to provide quality seed and feed for improved yield may also be explored.

Thus, the overall scenario of the economic value of inland fisheries bio-resources of Kerala has been comprehensively studied and analysed highlighting important districts and species with substantial contributions. This can provide a roadmap for further studies on ABS potential as well as interventions for improvement of this sector as mentioned above.

2.3.3 FISH PROCESSING AND PRODUCTS :

Shrimp products : stretched shrimp (Nobashi), Barbecue, Sushi (Cooked butterfly shrimp), skewed shrimp, shrimp head-on (centre peeled), shrimp head-on cooked (centre peeled), AFD shrimp, A F D Powder, Blanched / Cooked shrimp, Cooked shrimp, IQF Head on/ Headless shrimp, IQF peeled Tail-on cooked shrimp, Cooked salad shrimp, IQF Tray pack shrimp, shrimp curry, Breaded and battered shrimp, IQF Marinated shrimp, Fried shrimp.

Cephalopod products : Double skinned cuttlefish IQF Sashmi Grade, AQF cooked/ blanched squid

cuttlefish fillets, Sashimi grade, cuttlefish strips blanched, squid strips blanched, cuttlefish pine cut/diamond cut, stuffed squid IQF Tray pack, squid tube tray pack, squid ring blanched IQF, IQF tray pack squid, cuttlefish skewers, Vacuum packed squid & Cuttlefish products in trays, marinated squid, battered breaded cephalopod products, AFD cuttlefish / Squid, CIFTEQ® Osmo-dehydrated squid rings, CIFTEQ® Microwave vacuum dried squid flakes

Lobster products : Half cut cooked lobster, IQF/ Tray packed peeled lobster meat, Blanched/cooked lobster tail

Crab products : Frozen crab meat, Frozen pasteurised crab, Frozen stuffed crab, Frozen crab claws, Frozen mud crab, Frozen cut crab with claws, Frozen cut swimming crab, Frozen cut crab, Frozen dressed crab, Frozen swimming cut crab without claw, IQF whole crab, Frozen pasteurised, crab meat, Frozen whole crab, Frozen crab meat with shell/crab chunks, Frozen soft shell crab, Frozen crab stick, stuffed crab (crab balls/ saicie), crab cakes, Breaded crab cakes, paddle crab in trays.

Products from clams/ mussels : Mussels/ clam meat pickles, raw clam meat, Fried bivalves.

Battered and breaded products : (Portioning/ forming, predusting, battering, breading, pre-frying, freezing) – fish finger or fish portion, fish fillets, fish cutlets, fish balls, Fish steaks, minced based products, ready to serve fish products in retortable pouch, extruded products, intermediate moisture products

(IMF), seaweed products/ seaweed incorporated products, fish caviar substitutes

Other fish products : fish pickled products, pickled products from others bio-resources, fish curry, fish soup powder, fish flakes and wafers, fish paste, fish noodles, tray pack fish, pre-cooked lions, Fried fish, CIFTEQ® Chitosan coated dried Bombay duck: Improved drying method for production of dried Bombay duck, CIFTEQ® Shellac coated dried Bombay duck: Improved drying method for production of dried Bombay duck, CIFTEQ® INSTAFISH - Instant Fish Gravy Mix, CIFTEQ® Restructured product from Bombay duck isolate: functional value-added fish products from Bombay duck fish mince, CIFTEQ® Fish Pasta from Bombay duck, CIFTEQ® Nile Tilapia Gravad : Value added fish with extended shelf life, CIFTEQ® dehydrated fish fingers

Fish drying: sun drying, electric drying, CIFTEQ® Drish® Dry fish products

Other fishery products : Seafood and vegetable mix, mixed seafood skewers, seafood mix in tray pack, surini analogue products, patties, nuggets, seafood sausage, frozen seafood curry and rice, frozen seafood curry with porotta, seafood in brine/ oil/ sauce, CIFTEQ® NUTRIBAR - Ready to eat convenient snack of good nutritional and sensory characteristics due to their high protein, carbohydrate, lipids and mineral content, CIFTEQ® NUTRIMAYO - Mayonnaise, fortified with tuna protein hydrolysate, CIFTEQ® Fish oil microencapsulates fortified pasta, CIFTEQ® Fish oil fortified sausage: enriched with with n-3 PUFAs, CIFTEQ® MARINE COLLAGEN PEPTIDE BISCUITS – Collagen peptide supplementation increases the bone mineral density and supports healthy joints, CIFTEQ® Gel Chito Film - Gelatin-chitosan film for enhancing the shelf life of chilled stored fish, CIFTEQ® Chito Bianano Film – Chito oligosaccharide based gelatin chitosan bio-nano composite film, CIFTEQ® Ginger PLA film – Biodegradable active films from poly lactic acid (PLA) added with ginger essential oil for fish packaging application, CIFTEQ® Freeze dried broth cubes from rohu frame waste: effective utilization of fish fillet frame waste for developing nutritive rich dishes.

Products from microbes : Nitrifying bioreactor, Microbial consortium for waste management, Microbial consortium for industrial odor control, Microbial consortium for bioremediation, Probiotics, Lactobacillus probiotics, (for detergents) - Fungal enzymes, Microbial protease, Microbial enzymes, L-asparaginase as human medicine, Bacterial pectinase in food processing, Microbial Beta Glucosidase (BGC) as biofuel, Bacterial melanin for human cosmetics, Polycyclic tetramate macrolactam PTM as human medicine, Terreusinone for anti-inflammatory and UV protectant, Microbial polymers (PHB)

Products from seaweeds : CIFTEQ® NUTRIDRINK – Seaweed based nutritional drink rich in micronutrients and fucoida, CIFTEQ® NUTRIDRINK – Seaweed incorporated cookies, CIFTEQ® SEAJERKY – Energy and protein rich food from seaweed, CIFTEQ® Seaweed dietary fibre: Nutritional supplements,

CIFTEQ® SEANOODLES: Seaweed and fish enriched noodles, CIFTEQ® Edible seaweed-based sachet : Biodegradable sachet from seaweed, CIFTEQ® Seaweed dietary fibre fortified fish sausage, CIFTEQ® SEAYOGURT - Seaweed based preparation, CIFTEQ® Seaweed biofilm – Seaweed based biodegradable film for fish packaging application,

Value added products : Functional sea foods (or nutraceuticals) enriched with natural ingredients have proved good for human health and hence there has been serious research in recent years on the subject. High value secondary bioactive metabolites from the marine organisms are attracting attention because of the growing demand for new compounds of 'marine natural' origin, having potential applications in pharmaceutical fields, and concerns about the toxic effects by synthetic drugs and their derivatives. Marine bio-resources proved to contain vast resource for new medicines to combat major diseases such as cancer, AIDS, malaria, and neuromuscular diseases. Newer natural compounds of marine origin have delivered promising bioactive compounds with previously undescribed structures/skeletons, and these could be used as promising nutraceuticals and therapeutic agents against various ailments.

ICAR -CMFRI has developed a number of nutraceuticals and includes

1. Cadalmin™ Green Mussel extract (Cadalmin™ GMe) to combat joint pain and rheumatoid arthritis
2. Cadalmin™ Green Algal extract (Cadalmin™ GAe) to combat rheumatic arthritic pains
3. Cadalmin™ Antidiabetic extract (Cadalmin™ ADe) for use against Type II diabetes
4. Cadalmin™ Antihypercholesterolemic extract (Cadalmin™ ACe) for dyslipidemia
5. Cadalmin™ Antihypothyroidism extract (Cadalmin™ ATe) to combat hypothyroid disorders
6. Cadalmin™ Antihypertensive extract (Cadalmin™ AHe) for use against hypertension
7. Cadalmin™ Antiosteoporotic extract (Cadalmin™ AOe) to treat osteoporosis
8. Cadalmin™ Immunoboost extract (Cadalmin™ IBe) to boost innate immunity

2.3.4 WEALTH FROM WASTE

Largely, seafood processing operations generate both liquid and solid wastes; solid waste being the bulk ranging from 30% to 65% of the weight of the landed fish. Head, viscera, skin, fin, swim bladder, bone, frame meat, dark meat, scale, gills, shells (crustacean, mollusca), cephalopod pen, ink sac etc. are the major components of solid waste. A significant, proportion of world fisheries production is processed into fishmeal and fish oil thereby contributing indirectly to human consumption when they are used as feed in aquaculture and livestock raising. The USA, Japan, India, Canada, China, South Korea, Russia Norway and Other Asian countries generally use the reject of crustacean fishing waste for production of Chitin and Chitosan. The main industrial source used for the extraction of the biopolymer is the waste of the fishing industry, mainly the shell of prawns, crabs and lobsters. The maximum waste was generated from processing of shrimps followed by fin fishes and cephalopods. On the context of environmental pollution, waste generation from fish processing is of great concern today. This waste can be used for the preparation of high value added products including proteinaceous foods. These are also a valuable source of raw materials that can be produced from discards. Additionally, inappropriate disposal is a major cause of environmental pollution. These wastes can originate from landing centre, markets, processing plants and discards. From prawns 60% and from fish 25-30% wastes are being generated. If these wastes are not utilized properly environmental contamination will result and may cause consequent health problems for humans and other biota. Therefore, programmes and planning to wealth generation from waste is unavoidable.

The products from fisheries waste include : From prawns, squilla, crabs, lobsters : products - chitin and chitosan production, carotenoid pigments. The presence and recovery of pigments like astaxanthin and its esters, b-carotene, lutein, astacene, canthaxanthin and zeaxanthin from crustacean waste. From

fish - Animal feed supplement : Fish meal, Fish solubles, Fish silage and foliar spray, Fish manure/ guano/ compost. Fish meal is the most vital products obtained from fish waste, by-catch, and other abundant species. Fish meal is usually used as an ingredient in food for fish and crustaceans. Fish silage is from viscera of fish (stomachs, pyloric caeca, intestines, liver, pancreas, etc.) and other organs like spleen and gonads. Products from meat of fish waste/ underutilized fish : Fish protein concentrate (FPC), Fish protein hydrolysate (FPH), pet food. FPH is a liquefied product but different from silage. Fish oil products : Fish body oil (eicosapentaenoic acid EPA; docosahexaenoic acid DHA), Fish liver oil, squalene. Fish oils are often extracted from the entire fish, skin or liver (in the case of some species). Products from fish skin and scales : Leather, collagen peptides, gelatine, fish glue, pearl essence, ornamental products, shagreen. Products from fish fin : shark fin rays- New biologically active compounds have been isolated from fishery discards. One example is the discovery of the antifungal and antibacterial properties of the epidermis, epidermal mucus of different fish species, liver, intestine, stomach, and gills of some fish species and the blood and shell of some crustaceans. Fish mucous is known to have significant biological functions, acting as an immunological barrier. A variety of biologically active compounds, proteinases, peptides, or polypeptides with high molecular weight are responsible for these functions. Products from fish bone : Calcium phosphate, Hydroxyapatite (HAp), fish bone meal, shark cartilage & Chondroitin sulphate, ornamental products and pigments. Fish calcium can be used for the pharmaceutical purpose. Products from air bladder : Fish maws and Isinglass, gelatin. Products from fish viscera : Insulin, surgical suture, enzymes (various). Proteases or the proteolytic enzymes that are found within the gut might be helpful in fish protein hydrolysate production. Proteolytic enzymes like alkaline, α -chymotrypsin, neutralise, papain, pepsin, trypsin, pancreatin, flavourzyme, bromelain, pronase E, protamex, orientase, thermolysin, validase, protease A amano, protease N amano and cryotin F that derived from plant, animal, and microbial sources are successfully tested for the assembly of antioxidative peptides from fish protein sources. Today, there's an increasing demand for fish proteolytic enzymes thanks to their wide selection of applications. Proteases play an important role in industries due to their multifarious applications in leather and detergent industry, food and pharmaceutical industries and also in bioremediation processes. Antifreeze proteins from waste : Antifreeze proteins (AFPs), which are found in diverse species of marine fishes, are characterized by their ability to stop ice formation by cooling below the melting point. From mollusca : products - calcium carbonate, cuttle bone, cephalopod ink

2.3.5 AQUACULTURE POTENTIAL

In Kerala a large number of native species are being cultivated for food, namely, *Penaeus indicus*, *Penaeus monodon*, *Penaeus semisulcatus*, *Macrobrachium rosenbergii*, *Scylla serrata*, *Scylla tranquebarica*, *Etroplus suratensis*, *Mugil cephalus*, *Liza spp.*, *Chanos chanos*, *Lates calcarifer*, *Lutjanus argentimaculatus*, *Rachycentron canadum*, *Trachinotus blochii*, *Heteropneustes fossilis*, *Anabas testudineus*, *Channa striata*, *Channa marulius*, *Channa spp.*, *Clarias dussumieri*, *Perna viridis*, *Perna indica*, *Crassostrea madrasensis*, *Saccostrea cucullata* and so on. Major cultivating species in the state are those transplanted species, such as, *Catla catla*, *Labeo rohita*, *Cirrhinus mrigala*, *Clarias batrachus*, *Anabas cobojius*, *Pinctada fucata*, *Ompok pabda*. There are several species brought over to India and also Kerala for aquaculture purpose. These are *Penaeus vannamei* (= *Litopenaeus vannamei*), *Hypophthalmichthys molitrix*, *Ctenopharyngodon idellus*, *Cyprinus carpio*, *Oreochromis mossambicus*, *Oreochromis niloticus*, *Pangasius hypophthalmus*, *Pangasius pangasius*, *Pangasius sutchi*, *Piaractus brachypomus*. Policy makers should pay attention to : utilize the areas of waters resources which are unutilized at present for aquaculture for which sustainable incentives must be announced; purposeful elimination of unwanted exotic fishes (species like *Clarias gariepinus*) from aquaculture in the state; stressfully protect native species for aquaculture (like pearl spot, giant freshwater prawn, naaran chemmeen, kaara chemmeen, red snapper, mud crabs and so on); actions for bringing a number of hill stream fishes for domestication and bringing them under cultivation at least in hilly areas and cage culture in reservoirs; establishing proper storage facilities throughout the state; proper supply chain development for marketing and economic development.

Ornamental fisheries

Ornamental fisheries is a multi-billion industry spread across more than 125 countries. Major marine ornamental mollusk are *Babylonia spirata* and *Babylonia zeylanica*. These are dominant in the marine catches of Kollam District.

Live feed

Under controlled conditions (hatcheries, aquaria) smaller sized feeds are developed from the larval or adult stages of minute organisms like micro-organisms, phytoplankton (microalgae), zooplankton such as, rotifers, copepods, cladocerans, artemia, tubifex, chironomid larvae. They are generally termed as live feeds. Live feed organisms contain all the nutrients such as essential proteins, lipids, carbohydrates, vitamins, minerals, aminoacids, fatty acids, minerals etc. hence are commonly called as 'Living capsules of Nutrition' Micro algae cultured as live feed are : *Chetoceros*, *Skeletonema*, *Scendesmus*, *Isochrysis*, *Monochrysis*, *Tetraselmis*, *Dunaliella*, *Nannochloris*, *Chlorella* and so on. Microalgae are ideally small to be fed to larval forms of many species of fishes and mollusks. *Moina* used to be the most common live feed organism for feeding young fish larvae. *Artemia* are yet another important live feed in almost all prawn hatcheries. Fish hatcheries also make use of this live feed for successful rearing of larvae. Copepods are cultured for feeding the larvae of hatcheries.

2.3.6 POTENTIAL MARKET OPPORTUNITIES IN THE AQUATIC BIO-RESOURCES SECTOR

The opportunities for starting up of new enterprises in fisheries sector are immense and will create a large number of employment opportunities Entrepreneur Models in Fisheries and Aquaculture under the Pradhan Mantri Matsya Sampada Yojana (PMMSY) of Government of India will provide support in startup endeavours. For effective functioning incubation centres are to be established to provide hand holding such as training, converting entrepreneurial ideas into business models and doling out seed money to the new as well as existing business entrepreneurs keen to make big in the segment. Existing storage and processing facilities (chilled storage, dry storage and other storage) of marine products stood at 76,874 MT in 2018-19, which is significantly low as the fish production in the state stood at 8.01 lakh tonnes in 2018-19, of which an estimated 1.87 lakh tonnes was intended for the exports market necessitating state-of-the-art cold storage facilities. Seafood processing units in the state have a capacity to process nearly 4,352 tonnes of seafood, which is also much lower and the average annual capacity utilization is around 25-30 percent. The state should leverage these processing units for realizing greater value from exports of marine products. The areas proposed are listed below

1. Fish storage facilities, marketing (internet booking and door to door delivery system)
2. Fish seed production units (hatcheries)
3. Facilities for advanced rearing of fish seed units
4. Integrated, composite, mono-species aquaculture programmes
5. Aquaculture and disease management analyzing systems
6. Live feed culture centres
7. Brood stock centres for candidate species for aquaculture
8. Ornamental fish seed production units
9. Aquarium trade and accessories
10. Consultancies for aquaculture and ornamental fish seed management
11. Net production units
12. Fish processing units
13. Processed fish food marketing units
14. Fish Pre-Processing line ● Retort Pouch Processing unit ● Fish Canning line ● Fish Sausage production line ● Fish extruded product line ● Fish Curing and Drying line ● Fish battering and breading line ● Fish product packing system line
15. Health food from bio-resources from sea and inland waters (non-contaminated)
16. Fish Feed mill/Feed plant
17. Fish Value Add Enterprise units
18. Manure plants
19. Chitin & Chitosan Production line
20. Fish oil production units
21. Fish meal production units
22. Wealth from waste units
23. Nutraceutical units
24. Bioactive compound production at industry

- level
25. Tourism related activities
 26. Brood stock centres for cobia, pompano and seabass , grouper, Pearl spot, red snapper
 27. Hatcheries for production of seed of cobia, pompano, grouper , Pearl spot and seabass
 28. Nursery rearing centres for production of ready to stock fingerlings of cobia, pompano, Pearl spot and sea bass
 29. Development of cage/pond farms for cobia, pompano, grouper, pearl spot and sea bass
 30. Production of grow out feeds for cobia, pompano, grouper, pearl spot and seabass
 31. Fabrication of site specific and cost effective cages and mooring systems
 32. Establishment of hatcheries for green mussel, edible oyster and pearl oyster
 33. Farming systems for green mussel, edible oyster and pearl oyster
 34. Hatcheries for marine ornamental species
 35. Conditioning centres for green certified wild collected ornamental species trade
 36. Production of seaweeds through farming
 37. Commercial level production of designer pearls
 38. Development of commercial level Integrated Multi-trophic Aquaculture (IMTA) systems
 39. Grow out Production through Recirculation Aquaculture Systems
 40. Freshwater pearl production units
 41. Curio trade centres with seashells
 42. Training centres for HR development



CHAPTER-3

BIO-RESOURCES BASED MANUFACTURING SECTORS

3.1 MICRO, SMALL, AND MEDIUM ENTERPRISES (MSMEs)

The Micro, Small and Medium Enterprises (MSME) sector is fast emerging into a major income generating and employment providing sector in Kerala with relatively lower investment. Kerala is one of the main centres of MSMEs in the country. As per the MSME survey & Quick Results of 4th Census 5.62 % of all India share of MSME enterprise is in Kerala.

MSME sector can lead the State economy by increasing exports through quality production techniques and products. Government provides various schemes in MSME sector, targeting various social groups like SC, ST, Women, Youth, and Physically Handicapped etc. Within the MSME Sector there is a significant increase of Micro Enterprises, both in terms of working enterprises and employment. There are over 6000 various MSME products ranging from traditional to high-tech items which are manufactured in this sector.

The industries coming under this sector are handicrafts, Handloom, Khadi, Food processing industries, Garment making and Textile industries, industries related to coir/wood/bamboo/Plastic/rubber/leather/clay products etc.

Table 3.1 Bioresource based enterprises profile of Kerala

Sl.No.	Categories	Number of Enterprises
1	Ayurveda and Herbal cosmetics	586
2	Food Processing	15927
3	Cashew products other than nuts	207
4	Marine products and Sea foods	174
5	Textiles and Handlooms	9964
6	Coir products	1159
7	Wood, Bamboo and Cane based industries	9629
8	Herbal Wellness Centres	3245
9	Paper based products and printing	3317
10	Rubber based products (Tyres, Footwares etc.)	2023
11	Wax products	254
12	Others	1056
	TOTAL	47541

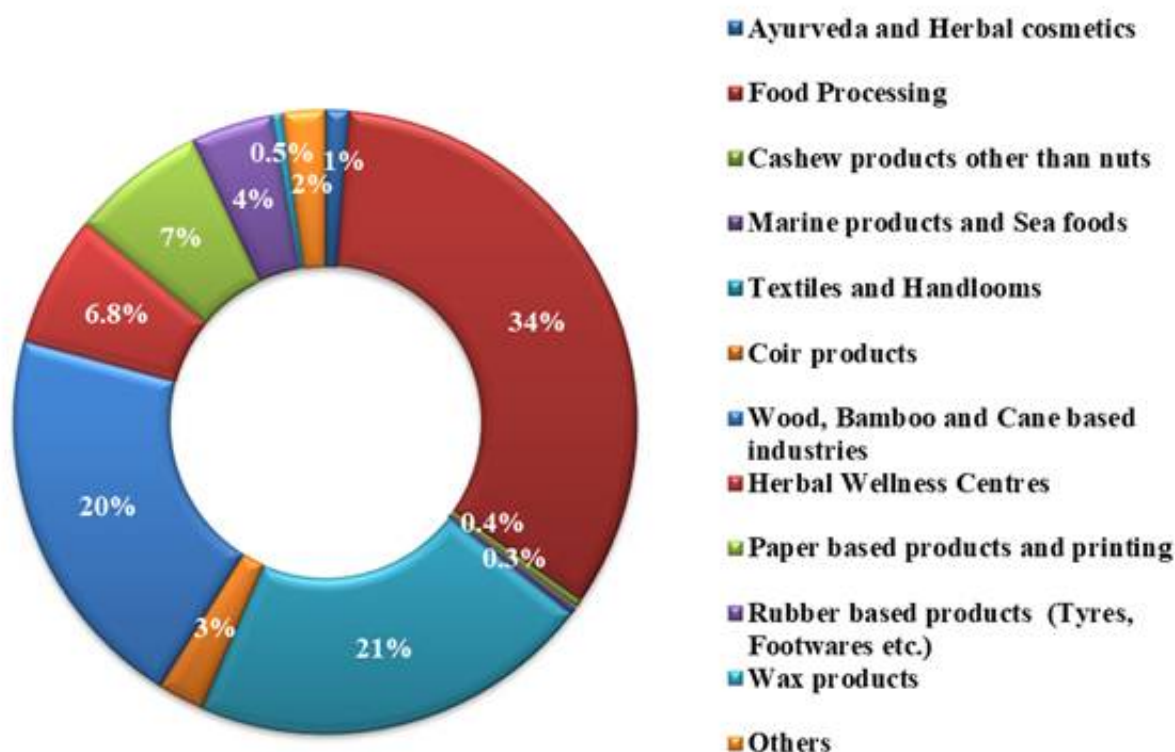


Fig 3.1 Percentage of bioresources based enterprises, Kerala

- Maximum bio-resource-based enterprises belong to the food processing category (15927).
- Textiles-Handlooms and wood based industries are the 2nd and 3rd largest enterprises in Kerala.
- The least number of MSME enterprises are in the 'Marine and Sea Foods category' (174).

Table 3.2 . Proportion of MSME in different categories

Sl. No.	Category	Micro	Small	Medium	Total
1	Ayurveda and Herbal cosmetics	533	47	6	586
2	Food Processing	15068	804	55	15927
3	Cashew products other than nuts	202	5	0	207
4	Marine products and Sea foods	98	66	10	174
5	Textiles and Handlooms	9785	166	13	9964
6	Coir products	1096	53	10	1159
7	Wood, Bamboo and Cane based industries	8921	698	10	9629
8	Herbal Wellness Centres	3218	26	1	3245
9	Paper based products and printing	3010	296	11	3317
10	Rubber based products (Tyres, Foot wares etc.)	1713	303	7	2023
11	Wax products	254	5	0	259
12	Others	1008	40	3	1051
	TOTAL	44906 (94.45%)	2509 (5.27%)	126 (0.26%)	47541 (100%)

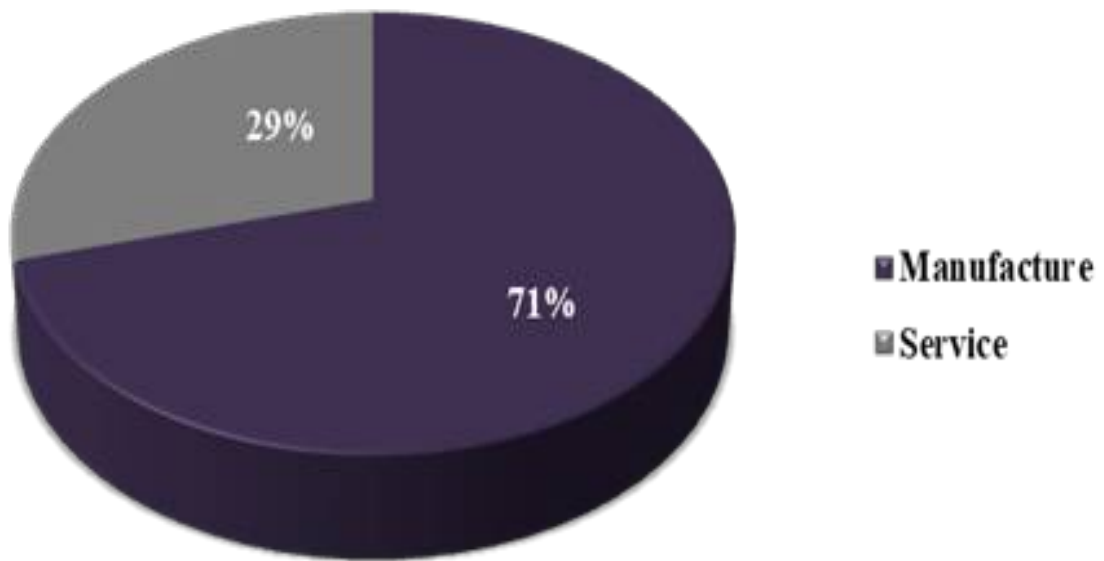


Fig 3.2 Proportion of manufacture and service based industries

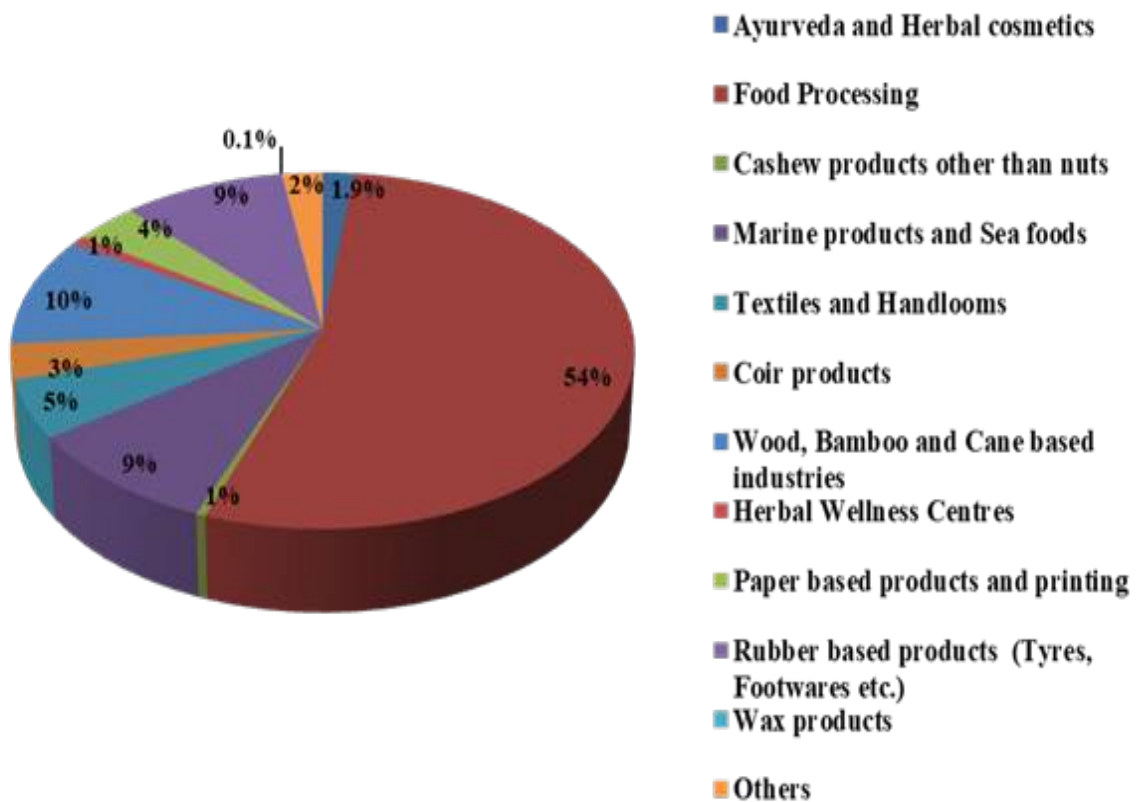


Fig 3.2 Proportion of manufacture and service based industries

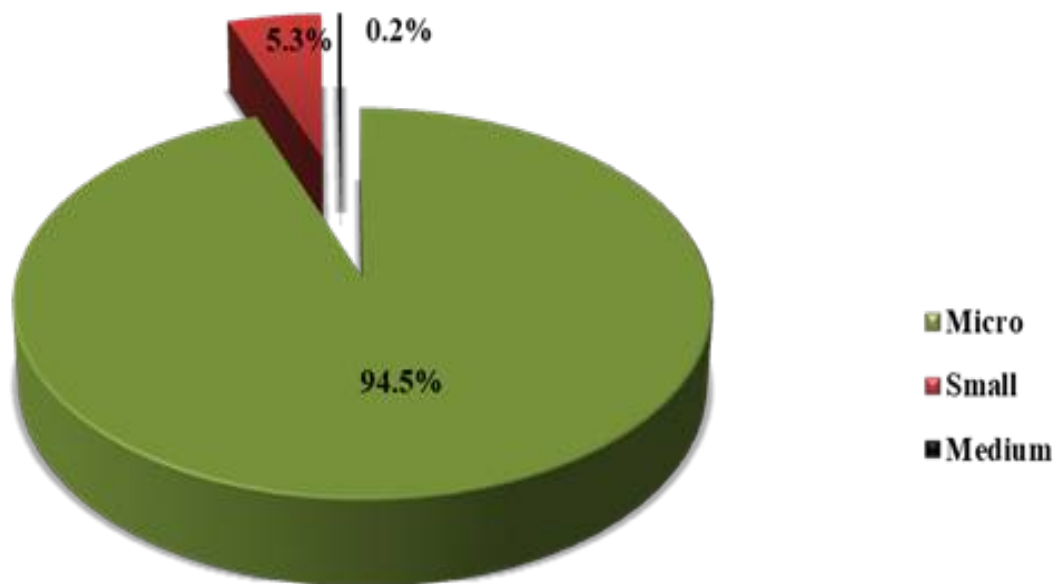


Fig 3.4 Proportion of micro small and medium enterprises

- Manufacturing/ Servicing details are not available for Palakkad (1082) and Kasargod (483) districts. By considering remaining 12 districts majority of enterprises are in manufacturing sector (71 %).
- In food processing, textiles, and wood-based enterprises there is a higher proportion of manufacturing activity.
- In the Herbal wellness centres, the maximum enterprises are service-based ones.
- The highest total annual turnover among various categories of bio-resource-based enterprises is in the Food processing category which accounts for 54% of total annual turnover of Kerala.
- The percentage share of 'Marine products and seafood categories' and 'Rubber based products' to the total annual turnover is much higher despite the lower number of enterprises in these categories.
- The lowest percentage share to total annual turnover is for the 'Wax products,' 'Cashew other than nuts' and 'Herbal wellness centres,' and this could be attributed to a lower number of enterprises in this category.



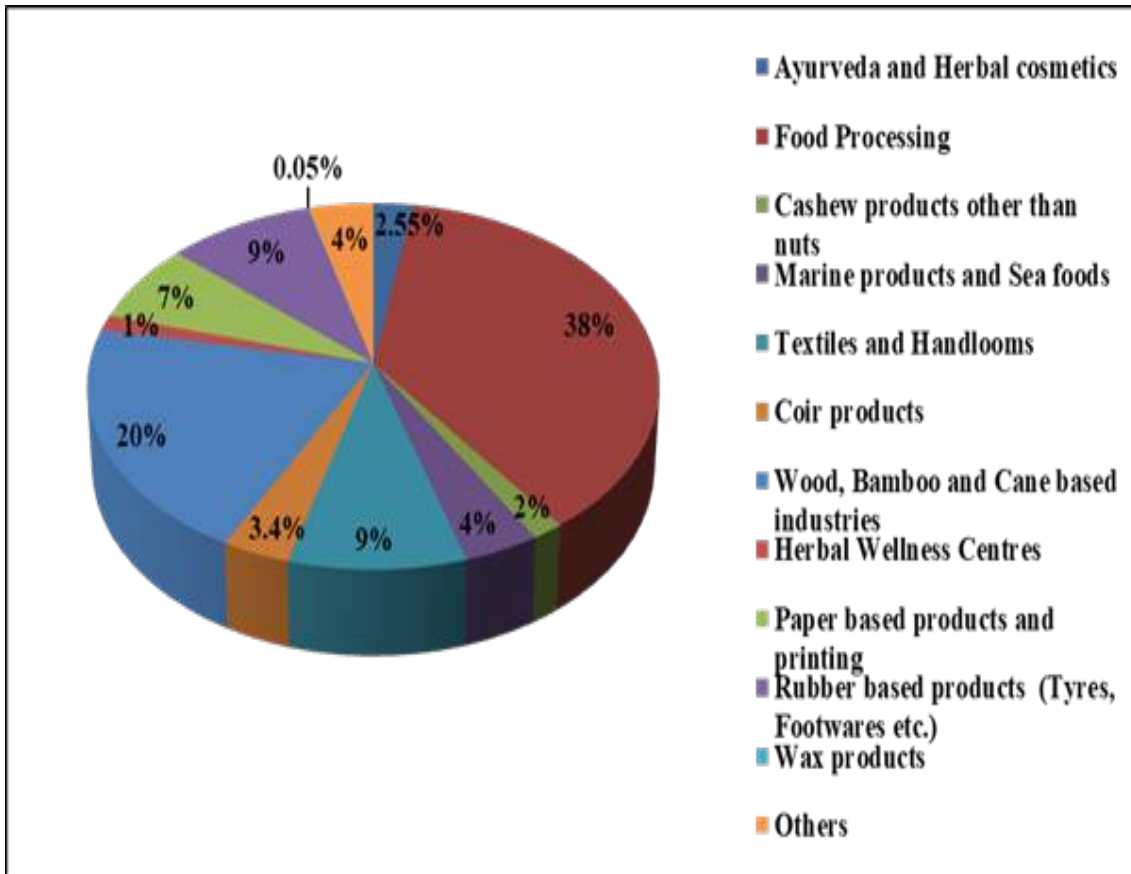


Fig 3.5 Proportion of enterprises based on investment

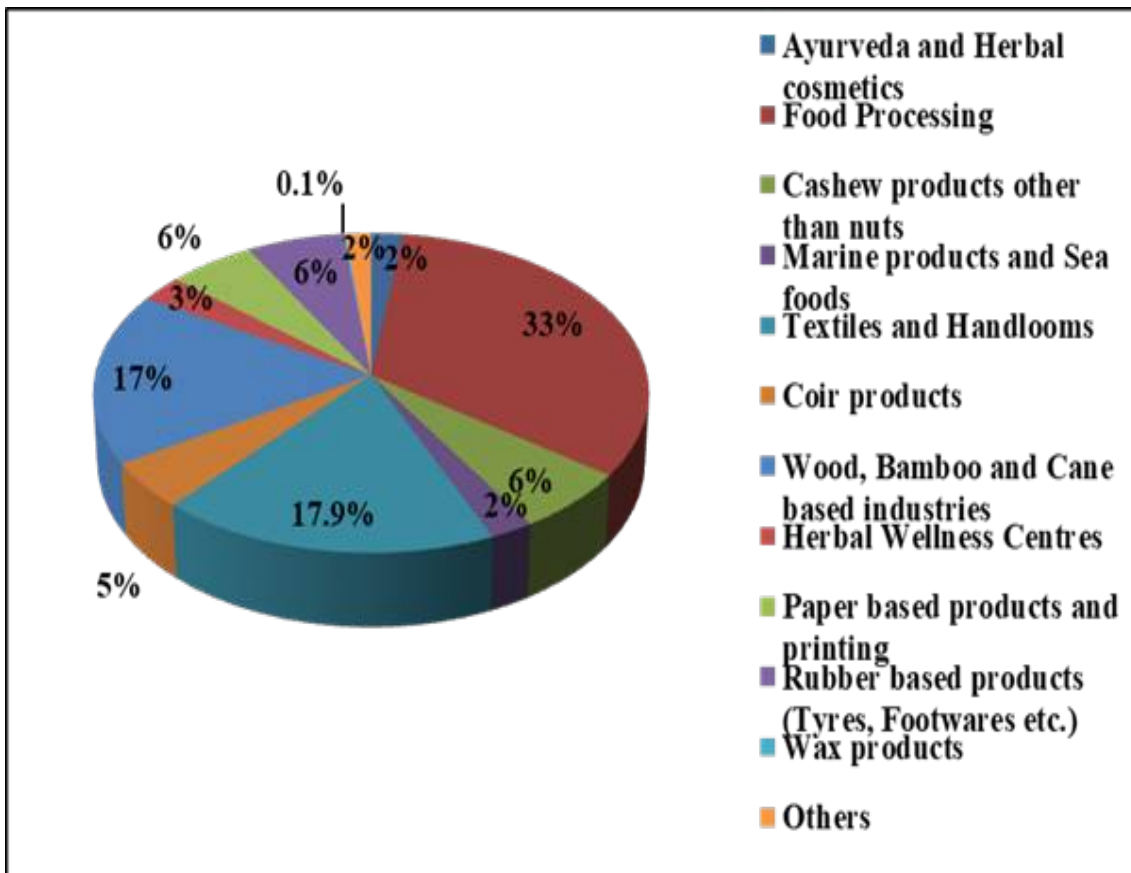


Fig 3.6 Proportion of MSMEs based on number of employees

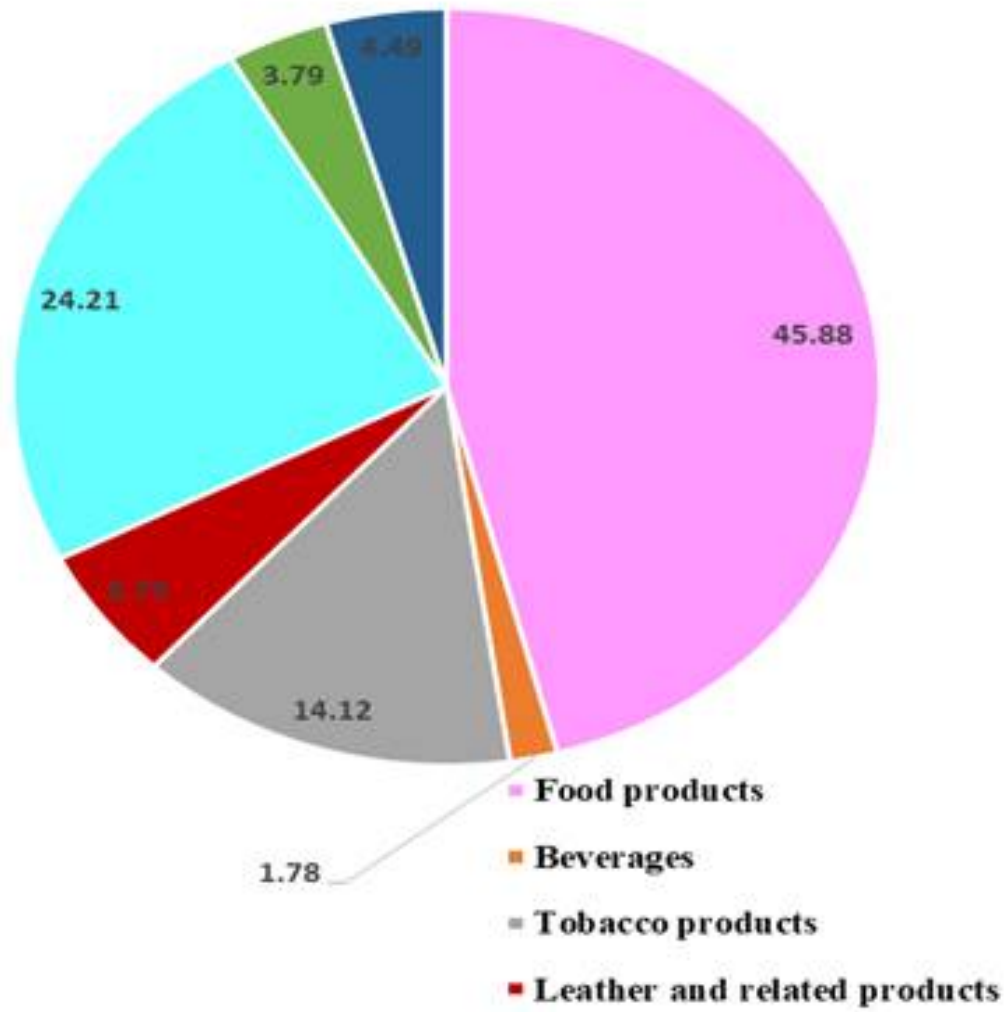


Fig 3.7 Percentage distribution of bioresources based (fully) factories in Kerala



- The total investment is also highest in the Food processing category (38%)
- 'Wood, Bamboo and Cane based industries' contribute 20% in total investment.
- The 'Wax products', 'Cashew other than nuts' and 'Herbal Wellness centres' having the lowest annual turnover is also having a low total investment comparatively.
- The number of employees is highest in 'Food processing' sector.
- "Textiles and handlooms' sector and 'Wood-based industries' sector comes next to 'Food processing' sector.
- 'Wax products' 'Marine products and seafoods' sector, 'Coir' sector and 'Ayurveda and Herbal cosmetic' sectors have a lower share in number of employees mainly because of less number of enterprises in these sectors.

3.2 BIO-RESOURCES BASED FACTORIES (FULL AND PARTIAL)

The manufacturing sector in Kerala is relatively small in size. The manufacturing sector accounted for a share of only 12.5 per cent of Kerala's Gross State Value Added (GSVA) (at constant 2011-12 prices) in 2019-20. In comparison, the manufacturing sector accounted for 17.4 per cent of India's GDP in 2019-20.

The share of manufacturing in Kerala's GSVA increased from 9.8 per cent in 2014-15 to 12.5 per cent in 2019-20 (Kerala State Planning Board, 2020). According to data from Annual Survey of Industries 2017-18, Kerala's share in gross value added by India's factory sector increased from 1.2 per cent in 2014-15 to 1.5 per cent in 2017-18. For the purpose of economic valuation of bio-resources, the factories were classified into fully bio-resources based and partially bio-resources based to clearly differentiate the contributions of bio-resources to the different types of factories. Each of the two categories mentioned above (fully and partially bio-resources based factories) were further classified according to the products being manufactured. This would aid in creating a more realistic account for the purpose of ABS estimation.

Table 3.3 Bio-resources based (fully) factories in Kerala

NIC Code	Description	Number of factories	Percentage of All Factories in Kerala (7596)
10	Manufacture of food products	1624	21.4
11	Manufacture of beverages	63	0.8
12	Manufacture of tobacco products	500	6.6
15	Manufacture of leather and related products	203	2.7
16	Manufacture of wood and products of wood and cork, except furniture ;manufacture of articles of straw and plaiting materials	857	11.3
17	Manufacture of paper and paper products	134	1.8
21	Manufacture of pharmaceuticals, medicinal chemical and botanical products	159	2.1
	Total	3540	46.7

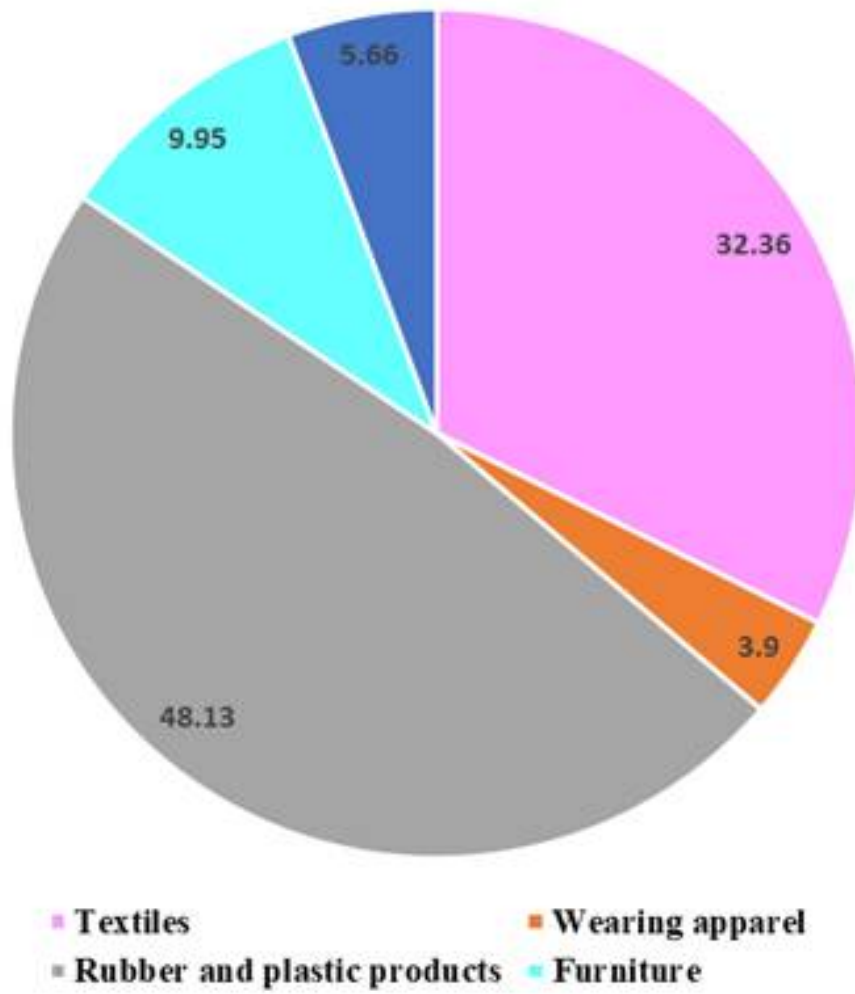


Fig 3.8 Percentage distribution of bioresource based (partially) factories in Kerala



Table 3.4 Bio-resources based (partially) factories in Kerala

NIC Code	Description	Number of factories	Percentage of All Factories in Kerala (7596)
13	Manufacture of textiles	423	5.6
14	Manufacture of wearing apparel	51	0.7
22	Manufacture of rubber and plastic products	629	8.3
31	Manufacture of furniture	130	1.7
32	Other manufacturing	74	1.0
	Total	1307	17.3

- Among the seven types of fully bio-resources based factories, the highest percentage of factories are those manufacturing food products (21.4%), followed by factories manufacturing wood products (11.3%). Factories manufacturing beverages constituted the lowest percentage (0.8%) of factories in Kerala. Among the five types of partially bio-resources based factories, the highest percentage of factories were those manufacturing rubber and plastic products (8.3%), followed by textiles (5.6%). Factories manufacturing wearing apparel formed the lowest percentage (0.7%) of factories in this category. The relatively high percentage of rubber manufacturing factories shows the importance of rubber trees and plantations of Kerala in providing value added manufactured products for the industry.
 - The industrial profile of each district showing some economic indicators such as fixed capital, total output and input, value added, net income and profit/loss of each type of factory (based on product manufactures) was analysed to understand the overall output of this sector. These indicators are important to know the total output and profit which are linked to the potential ABS estimate that can be collected from the factories. Within the category of fully bio-resources based factories, 12 districts except Kannur and Kottayam earned a net profit from their production. Among the partially bio-resources based factories, 8 districts suffered loss and 6 districts earned a profit. Hence, the fully bio-resource based factories are clearly more profit-making in the state comparatively.
 - Food products manufacturing factories mostly performed profitably in most districts, while wood products manufacturing factories gained profit in some districts and loss in others. It is interesting to note that textile manufacturing factories, which come under partially bio-resources based factories, suffered losses in most of the districts, while rubber and plastic products performed profitably in most districts. The structural and systemic issues in loss-making factories need to be addressed to bring about a positive change and create better outlook for bio-resource based factories.
- Based on total output from fully bio-resource based factories, the output value was highest from Ernakulam district (26.09%), which corresponds with this district having the highest percentage of factories (19.69%) in the state. The output from partially bio-resource based factories also was highest from Ernakulam district (64.65%) As the output value is linked to the ABS potential, such high output districts like Ernakulam, Alappuzha, Kollam etc. can be specifically focused on for collecting ABS from commercial utilisation of bio-resources in factories. Thrissur district contributed towards



the highest percentage output (35.31%) of pharmaceuticals, medicinal chemical and botanical products manufacturing. The presence of traditional medicine related pharmaceutical companies in Thrissur such as Oushadhi could be contributing to this high value. It is especially important since most of the traditional knowledge is utilised in the manufacture of these pharmaceutical products. High percentage of rubber and plastic products output from the central districts of Kerala such as Kottayam show the importance of rubber plantations in this district.

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In brief, the high value addition of manufactured products in factories provide the industrial growth from bio-resources which augment the economic value of these resources. This also provides opportunities for economic growth and employment in the state. The high output value factories may be focused on for collecting the ABS amount as per the BD act after proper assessment of its potential.

3.3 CASE STUDY - AYUSH INDUSTRY

Nearly about 500 classical preparations of ayush products are manufactured in Kerala. Apart from these proprietary/ patented medicines and other health care products/ OTC products, new gen products, nutraceuticals, cosmeceuticals etc. are produced by the Ayush manufacturing units in Kerala. Roughly about 50% of medicinal plants mentioned in this system of medicine are common to all four systems. Total there are 663 Ayurvedic manufacturing industries in the state, of which 40 are major (Turn over ≥ 3 crores), 60 were medium scale (1 to 3 Crores) and 563 are small scale (< 1 crore). Total 121 industries were sampled of which 10 were major, 21 were medium scale and 90 were small scale. A total of 578 medicinal plant species used in the 121 Ayurvedic manufacturing units (major/ key manufacturing unit, medium and small scale units) was noted and analysis was carried out based on the above data. The data collected from the sample units are projected to the totality according to the size (Major/key,



medium and small) of the industries. About 23,731.015 MT of raw herbs and 7118.510 MT of animal products are used for medicine manufacturing. The total quantity estimated is 25,516.6 MT. Out of top 100 with regard to quantity 60 species are consumed above 100 MT annually. Rest of 40 species is between 96.3 and 60.6 MT consumed by the manufacturing units. There are 15 medicinal plants with an average price/ per kilogram between Rs.24653 to Rs.1000 and rest of the medicinal

Table 3.5 Ayurveda industries in Kerala

Unit Size	Number of units sampled	Total number of units	% of sample
Major/ Key	10	40	25
Medium	21	60	35
Small	90	563	16
Total	121	663	18.3

Year	Total quantity(kg)	Total Price(in lakhs)
2015-16	4224723.29	3916.26
2016-17	3864852.77	3986.67
2017-18	4615867.4	46795.84
2018-19	11968611.81	56510.28
2019-20	5440135.155	29437.38

There is a high variation in prices of the raw materials among the ayurveda manufacturing units and through the period 2015-16 to 2019-20. Thus the medium price is taken as an average price. The quantities obtained from the sampled industries forecasted to the total respectively for each category (major/ key manufacturing units, medium and small) is given below.

Table 3.6 Annual projected consumption of raw drugs by Ayurveda industries

Unit Size	Estimated Quantity (MT)
Major/ key/ Medium	22366.3
Small	3150.3
Total	25516.6

- Out of top 100 with regard to quantity 60 species are consumed above 100 MT annually. Rest of 40 species between 96.3 and 60.6 MT is consumed by the manufacturing units.
- Out of the 189 species with codified threat status, 68 species are classified under threatened status (CR-4, EN-30, VU-31, R-3) and the other 111 species are classified under NT (12) and LC (99).
- Some of the conservation concern species have a projected demand of greater than 50 MT. These include Critically endangered species as *Saussurea costus* (67.5 MT), *Coscinium fenestratum* (79.2 MT) vulnerable species as *Bacopa monnieri* (410 MT), *Niligirianthus ciliatus* (230 MT), *Woodfordia fruticosa* (186 MT). Endangered species as *Oroxylum indicus* (152 MT), *Acorus calamus* (137 MT),

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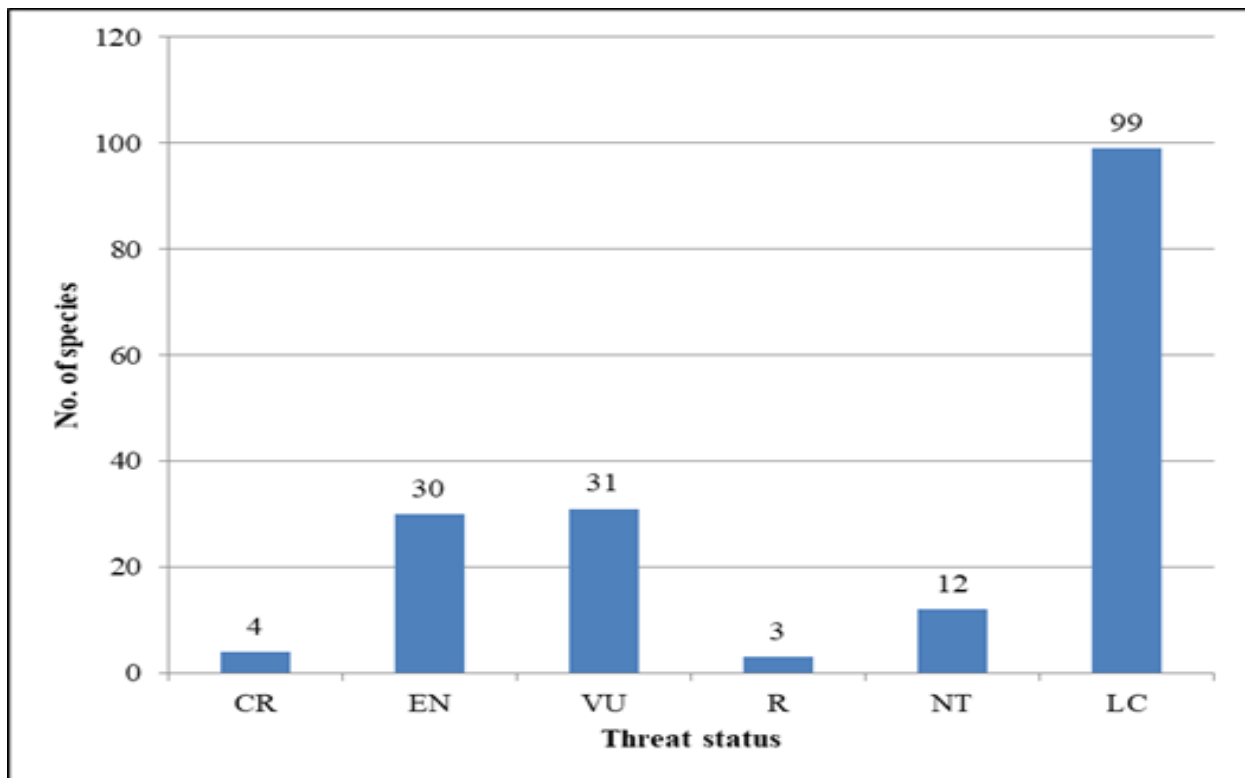


Fig 3.9 Threat status of species used in Ayurveda industry

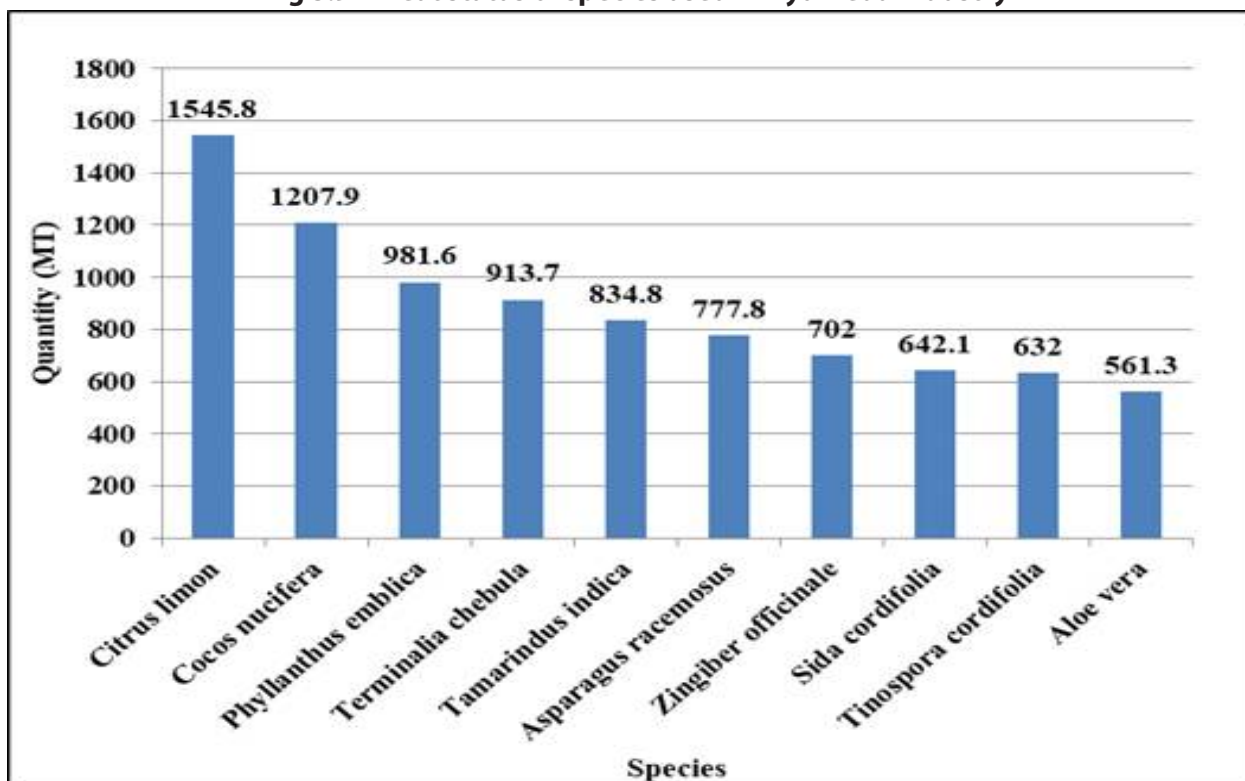


Fig 3.10 Top 10 high quantity bioresources utilised

- There are 15 medicinal plants with an average price/ per kilogram is between Rs.24653 to Rs.1000 and rest of the medicinal plant species is between Rs.989.00 and Rs.185.00.
- Citrus limon was the highest quantity bioresource species utilised with a total quantity of 1545.8 MT, followed by Cocos nucifera (1207.9 MT) and Phyllanthus emblica (981.6 MT).

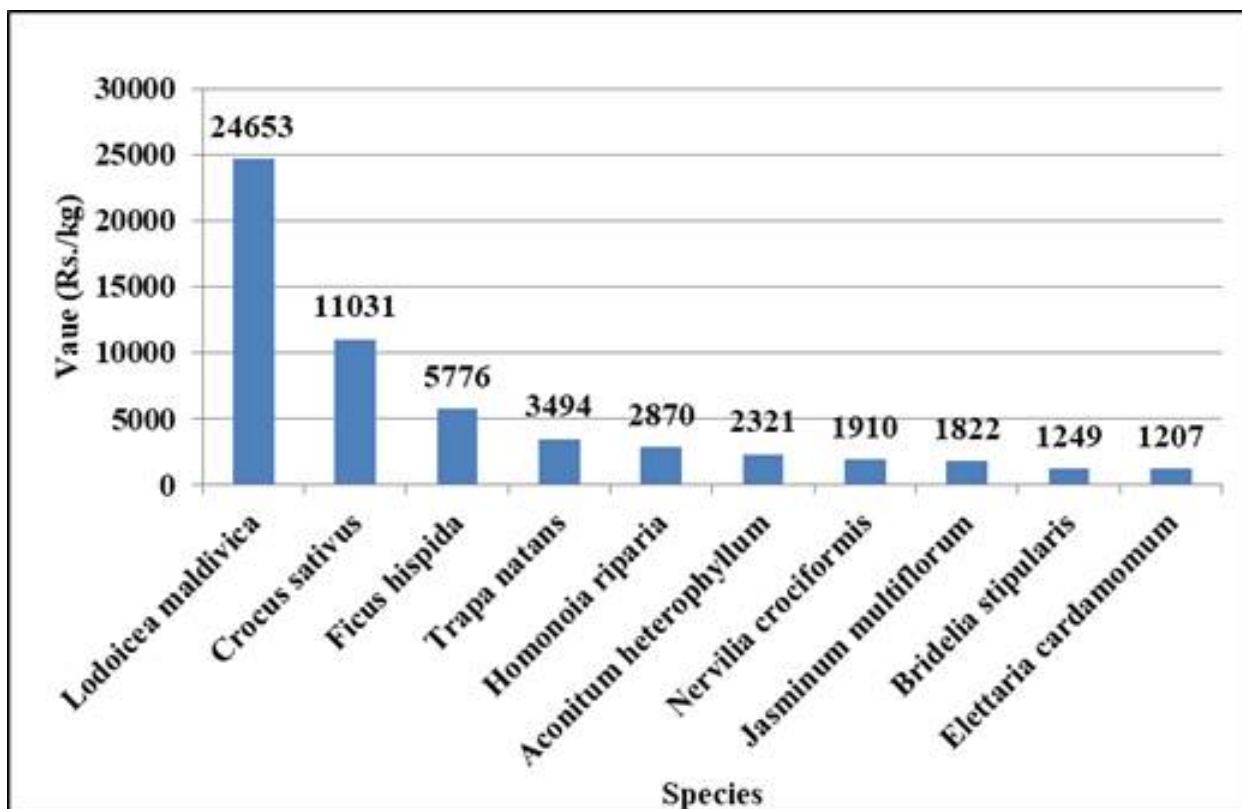


Fig 3.11 Top 10 High value medicinal plants

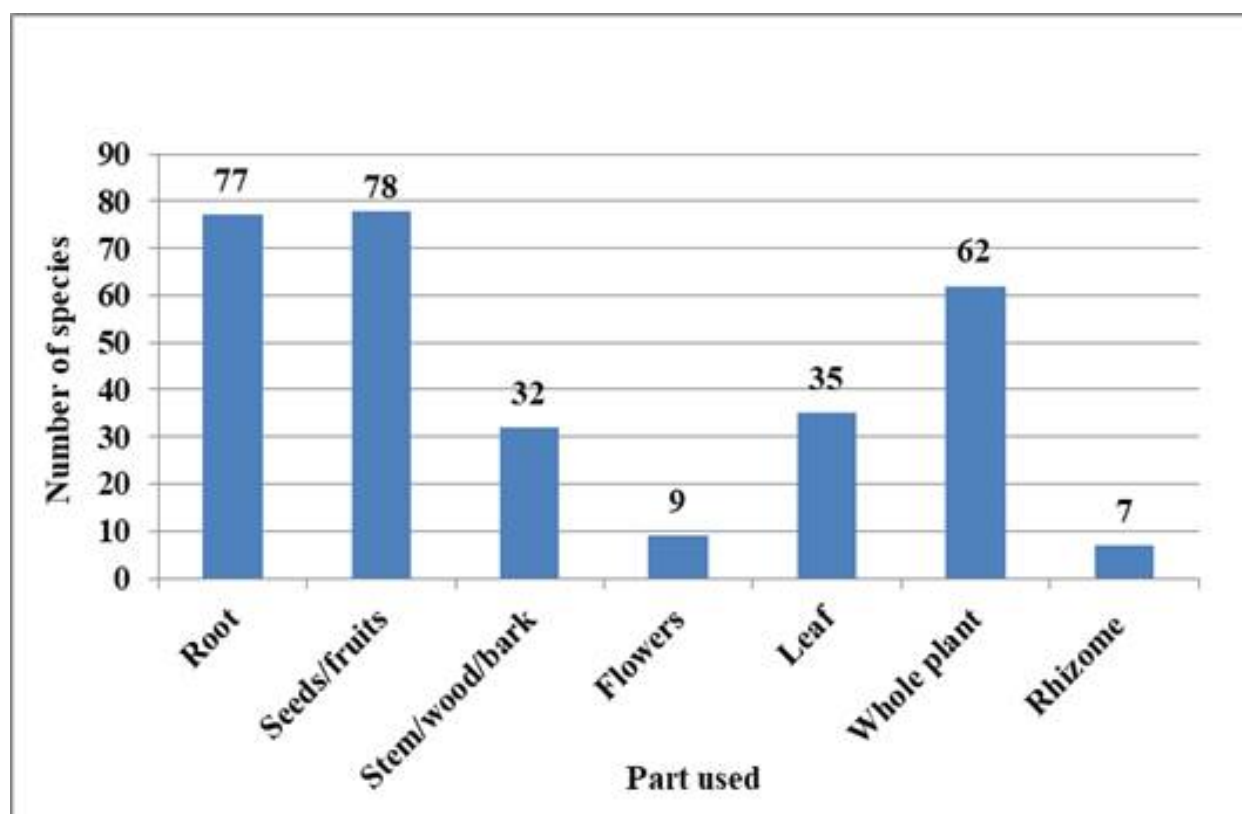


Fig 3.12 Threatened species of which roots, whole plant, rhizome or all of them are extracted

Table 3.7 Threatened species of which roots, whole plant, rhizome or all of them are extracted

Botanical Name	Part used	Threat status
<i>Aconitum palmatum</i>	Root	EN
<i>Coptis teeta</i>	Root	EN
<i>Merremia turpethum</i>	Root	EN
<i>Salacia oblonga</i>	Root	VU
<i>Saraca asoca</i>	Root	EN
<i>Valeriana jatamansi</i>	Root	VU
<i>Nymphaea nouchali</i>	Rhizome	EN

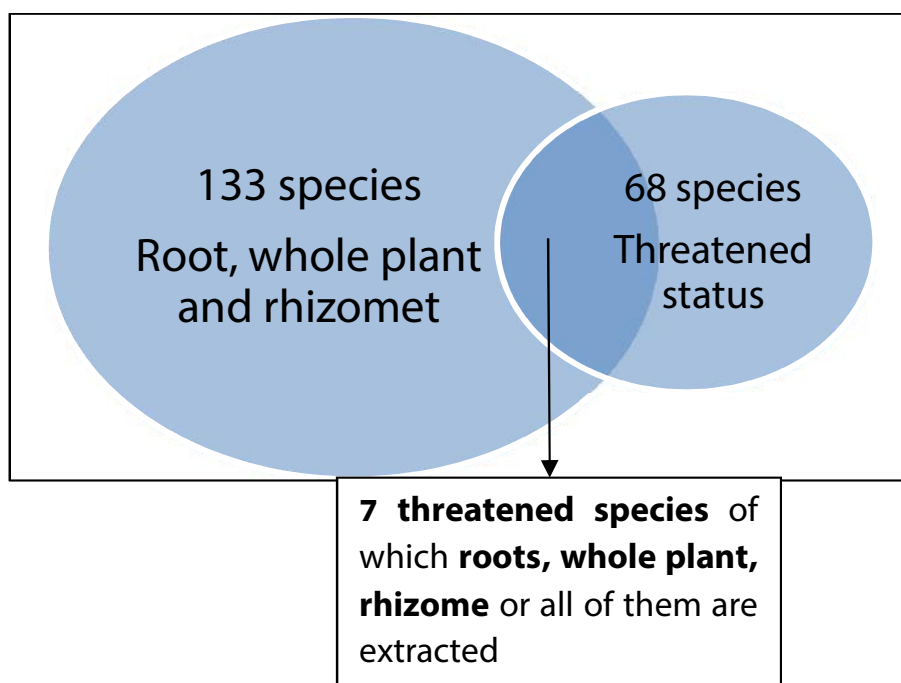


Figure 3.13 Convergence of threatened medicinal plant species with root, whole plant and rhizome usage

57.2 % of raw herbs are used in fresh form and the rest 42.80 % are used in dried form. The highest consumed plant parts are Fruits 20.64% and root, root tubers & rhizomes 21.86%. It can be observed from the analysis of RET (Rare, Endangered and Threatened) status that 7 species are in higher threat of extinction or extirpation due to their inclusion under threatened status as well as usage of their roots, rhizomes or whole plants which lead to their complete destruction during extraction.

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SUPPLY CHAIN (WITH VALUE ADDITION) ANALYSIS OF BIORESOURCES

A supply chain is a network between a company and its suppliers to produce and distribute a specific product to the final buyer. Trade of bioresources whether agricultural resources, medicinal plants, horticultural crops or aquatic products passes through a trade network of middleman from the farmers field or the wild till it reaches the industry. The transaction cost of the bioresources should be estimated through the hands it is transferred. Hence, the need to bring traders and collect information is important to unravel the entire supply chain. In the ABS context, our concern is the movement of bio-resources from the providers (local communities) to the end user (industry) for commercial utilization or product development. Generally, value addition for bioresources (raw) and bio-resources based products occurs either through transaction costs or / and processing or manufacturing costs. The ABS concern is whether the price spread is reasonable or not, and if not, what are the abnormalities, and how will it bounce back to the communities or providers of the resources.

As an initial attempt traders involved in raw drugs and plant nurseries were surveyed and an attempt for real value estimation of honey was undertaken.

4.1 RAW DRUG TRADERS

Kerala state Biodiversity Board (KSBB) initiated a study of the trade of raw drug through Raw drug shops in Kerala where raw drugs both dry & fresh medicinal spices, value added products, and also base materials like various oils, clarified butter (ghee), honey etc are sold. A separate study was conducted on supply chain network of raw drugs mainly used for the preparation of various classical Ayurvedic drugs, proprietary drugs, health care products etc., in the AYUSH industry. The present study excluded the consumption of raw drugs (Dry & Fresh) by the tribal/folk healers of Kerala. When the team started surveying with specific designed questionnaire initially there were lot of apprehension among the stakeholders and in many occasion they declined to interact with the survey team members because of their confusion related to imposing tax, and raising questions about the registrations, licensing etc.

Currently these shops are neither registered nor having license to trade the raw drugs because in the past it was considered only as a livelihood improvement for individuals who are engaged in the marketing of raw drugs locally known as Angadi Pachamarunnu Kada. Based on the annual turnover raw material shops are classified in to large, medium and small raw drug shops located in all districts of Kerala.

Present studies reveal that the total number of Angadi Pachamarunnukada in Kerala is approximately estimated as 1100 (large scale 10, medium scale, 50 and small scale 1040). One of the key observation noted based on the study after interacting with selected raw drugs dealers, is that the annual turnover is above 5 crore (Wholesale/retails), medium level sellers (wholesale and retails), is below 5 to 1 crore and small scale is limited to below one crore and varies from 1 lakh to 50 lakh, 50 to 75 lakh & 75 to 99 lakh. Total quantity of raw materials collected from all 7 districts was 1, 77,603 kgs and the trade generated about Rupees 2, 92, 94034. Chappangam/Pathimugam, Erukku, Ilavarngam are the raw drugs exported through Angadi Pachamarunnukada to Middle East countries to a rate of 2 fold (Rs 600 within India vs Rs1183 outside India). This reveals that we can identify more export potential plant species and

generate more income on regular basis. Ilavarngam was imported to Kerala from Sri Lanka because of the low price compared to the cinnamomum species available in Kerala. Karingali, Cheenikkaya, Incha, Vayambu, Kattarvazha, Chappangam, Kasthurimanjal and Nellikka species were traded above 3000 kgs per annum. 54 species such as Kunni, Vella Kunthirikkam, Thathiri etc were traded above 1000 kgs/annum. 188 species for example Chuuku, Kattinchi, Mullilam, Thumpoonalary, Amukkooram etc were traded below 1000 kgs/annum. Raw drugs such as Jathipathri, Jadamchi, Rakthachandanam, Sarppagandhi/amalppori, Chandhanam and Thakara represents high value species traded from Kerala.

Even though the marketing network is improved the physical and storage conditions have not improved much except the space of their warehouse. One of the important recommendation based on the study is Angadi pachamarunnu shops need a face lift and need to be converted in to smart Angadi Pachamarunnu shops in terms of its hygiene, storage conditions, introduction of good collection processing, storage and selling practise.

It is also highly essential to introduce a registration and license to the raw materials shop keepers, under the local administration. This will help to regulate and improve the present status of the raw material shop with a view to maintain the standards of raw materials and labelling the expiry date of each species and value added products they sold.

4.2 PLANT NURSERIES

A good number of nurseries have sprung up in the state during the past few years. As part of the present study total nurseries in the state has been identified as 1394. District wise Thiruvananthapuram -102, Kollam – 55, Pathanamthitta- 57, Kottayam -121, Alappuzha -41, Ernakulam-162, Idukki -43, Thrissur -202, Palakkad -101, Malappuram-188, Wayanad -59, Kozikode-104, Kannur-53, Kasaragod-106. In 2020, the survey results highlighted the impact of a year of flood and COVID-19 pandemic on the industry and its growth. The nursery survey was conducted in 760 plant nurseries in all the 14 districts of Kerala and a questionnaire with the help of 14 NCC cadets from one college of each district, the project fellows and 14 district co-ordinators of KSBB. The survey focused on the economic status, available plant resources, their cultivation, trade, supply chain and also the constraints and challenges faced in the industry.

Highlights from the 2020-21 survey include:

1. Seedlings self-propagated (14.2%), Self-propagated & purchased with in state from large dealers (19.1%), Self-propagated & purchased from Govt. institutes (23.6%), Self- propagated & purchased from Govt. institutes & large dealers (26.3%) & Self- propagated & purchased within & from other states (16.8%)
2. The total number of plant species/varieties available in the nurseries were 1725 numbers
3. Grower - wholesale only (13%), Grower retail &/or whole sale (28%), Retail sale only (30%), Landscaper /Interior sale only (6%) & Agri sale only (23%)
4. Woody plants (plantation, shade) (30%), annuals (22%), perennials (12%), aquatic plants (7%), Special green house plants (5%), High decorative plants bonsai (6%), Lower plants like ferns, pine (6%) , Special plants like orchid, Anthurium (12%).
5. Approximate income generated was between Rs 3 – 5 crores.
6. Economic status in terms of annual turnover: between less than Rs.1lakh (183 nos.), between 1-5 lakh (180 nos.), between 5-10 lakh (349 numbers) and above 10 lakh (48 nos.)
7. Species/ varieties which are highly priced / traded in high quantity was also recorded district-wise. In Thiruvananthapuram nearly 65 species were high priced eg. Bonsai Adenium yellow (Rs.2640), Araucaria, Chinese doll & Golden bachmarali palm valued at Rs.2000. Kollam had 11 species and Foxtail fern priced at Rs 1400/- was one of the highest. Only 3 species with high value was recorded from Pathanamthitta, 25 in Ernakulam district with highest price of Rs.3000 for miracle fruit plant.

Idukki had 9 high priced items among which, *Crystostachys renda* and *Howea forsteriana* were Rs.800, Thrissur 11 items with *Durio ziberthinus* having highest price of Rs.3000, Malappuram with 25 items of which cactus variety was noticed to be the highest with around Rs.4000. 8 items in Wayanad and Jade plant worth Rs.1500, was highest. Kozhikode with 6 items and the highest price was recorded for Durian fruit Rs.1300. Kannur with 12 items among which Birth star plant of Rs.1000 was highest. In Kasargode, Kepel worth Rs.1800 was the most highly priced variety among the 8 items.

8. In Thiruvananthapuram, 29 plant items were sold in large volume, among which Rubber RRI 105 and Rubber RRI 600 were sold in volume of around 45000 numbers annually. In Kollam, 101 plant items are traded of which rose variety was in high demand with over 12700 numbers sold / year. 27 plant items in Alappuzha and among them nandhiar vattom recorded the maximum with 1300 numbers sold yearly. In Pathanamthitta, 20 items with the maximum of 2550 numbers of *Tabernaemontana divorticata* sold / year. While, in Kottayam 156 items with 5600 numbers of rose varieties were sold annually. In Ernakulam *Aglonima* was sold about 2300 numbers in a year. In Idukki, 95 items and coconut was sold in bulk with 6500 numbers in a year. Thrissur with 14 items, Palakkad, 20 items with 2374 for *bougainvillea*. In Malappuram, 110 items with *Santalum paniculatum* was sold of 400055 numbers per year. In Wayanad, 44 items with pepper being sold around 40000 yearly. In Kozhikode 6 items and banana (*njalippovan* variety) was sold in large volume of 6500 numbers.
9. Some of the major concerns raised by the nursery owners includes change in economy (28.9%), labour (27.6%) high costs (11.8%) and competition (9.2%), finding reliable skilled employees, weather/climate change, fund flow, pest & diseases, government support
10. The sector employed nearly 32,000 individuals as full and part time laborers
11. The species recommended for revenue generation in the state were plantation crops like Rubber, coconut, pepper, banana varieties, ornamentals including rose varieties, *aglonima*, *bougainvillea*, bonsai of *ficus*, *anthurium*, orchids, etc.
12. Plantation crops represent the maximum number of species/varieties in most of the nurseries in the state i.e., with 678 numbers, followed by leafy ornamentals 198 numbers and orchids 178. Total number of species/varieties recorded in the state was 1632 numbers. Most of the nurseries from Thrissur recoded trade of orchids and plantation crops. In Kottayam plantation crops, while in Trivandrum the ornamental species topped the list. Other popular items were Shade trees (43) and Shrubby forms (89). Ernakulam nurseries are also known for ornamental species and also for lawn grasses



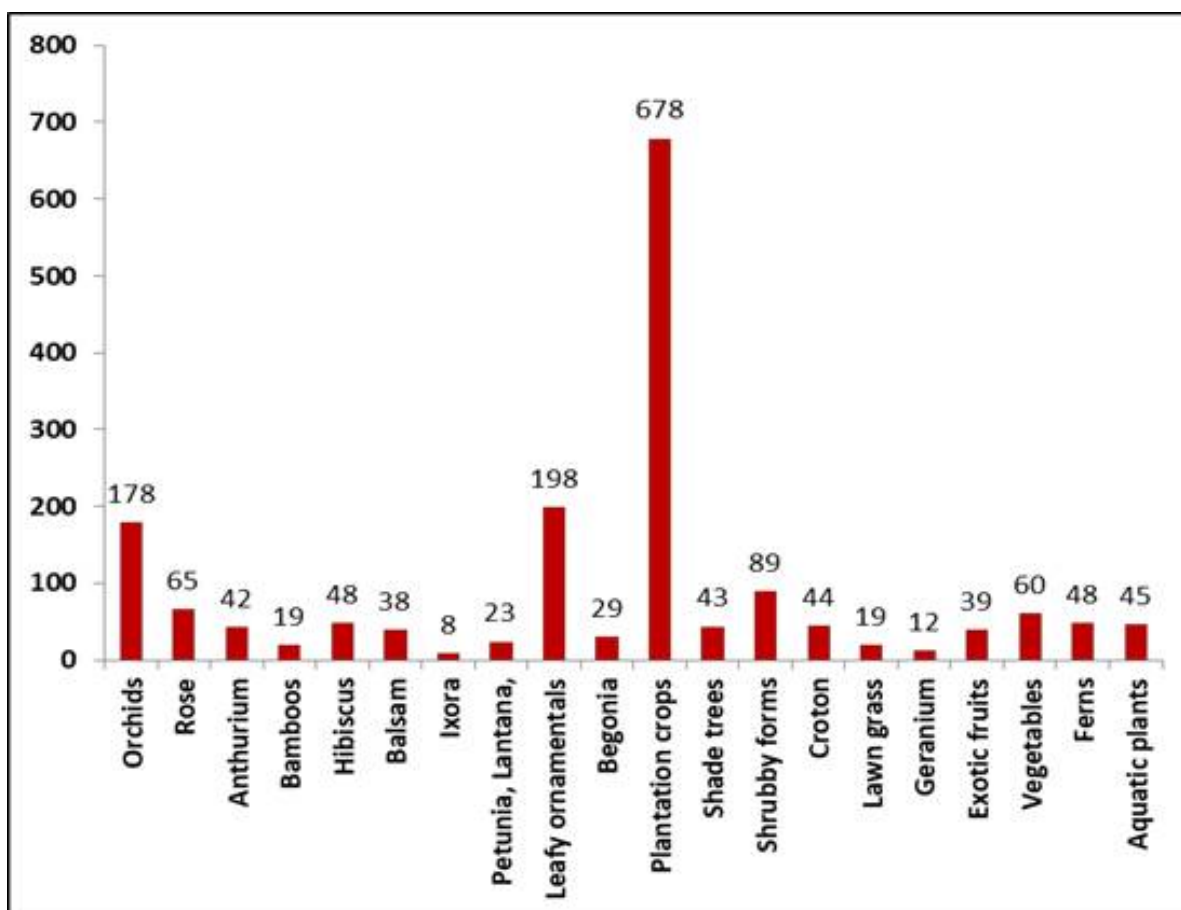


Fig 4.1 List of categories of plant species / varieties

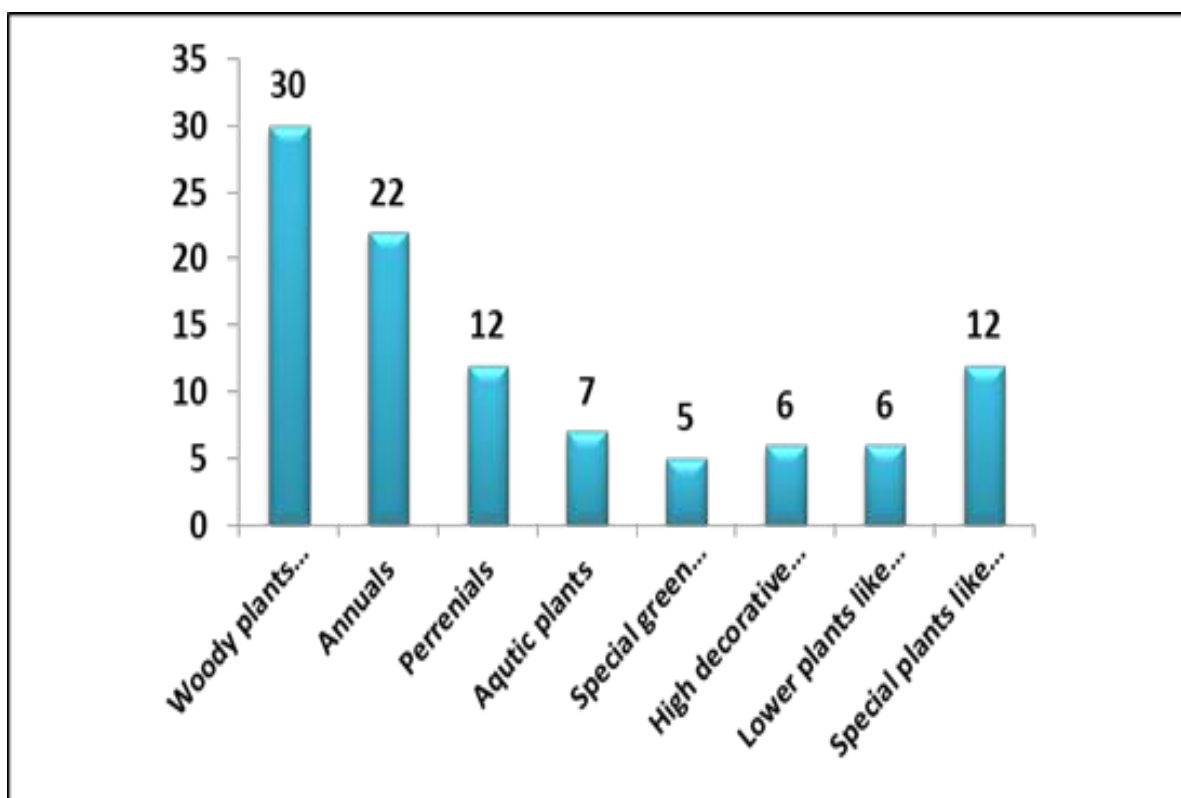


Fig 4.1 List of categories of plant species / varieties

4.3 WILD FOREST HONEY (CHERUTHEN) AND ITS SUPPLY CHAIN: VANASREE UNIT

Honey harvesting is a major means of livelihood of the tribals in the forests of Kerala. Under the Vana Samrakshana Samithies (VSS) and Eco-Development Committees (EDC), the honey collectors have been trained in the last four years in the non-destructive collection of honey and value addition by a process called ultra filtration. It is marketed through Forest Development Agencies (FDA) in attractive bottles. The cheruthen's value addition is examined in 2 stages. At the first stage, the Cheruthen collection is by the tribal community and supplied to Vanasree and the second stage is the processing by vanasree and preparing the honey to be supplied in the market.

Table 4.1 Supply chain (with value addition) of Cheruthen

Stage 1: Tribal to Vanasree Unit (1kg – Rs. 900): Value Addition Steps			
S No	Cost Component	Cost (Expenditure) in Rs.	Total (cumulative) Cost in Rs.
1	Travelling Expenditure	40.00	40
2	Food Expenditure	100.00	140
3	Work Knowledge	100.00	240
4	Manpower (Physical effort)	180.00	420
5	Transportation of Honey to Vanasree Unit	15.00	435
	Total collection cost	435.00	
6	Amount given to VSS	50.00	485
	Total Cost	485.00	
	Total price of 1 Kg honey (vss)	900.00	
	Net Benefit (Value of nature in honey)	(900-485) 415.00	
Stage 2: Processing Cost of Cheruthen (in Vanasree)			
1	Transportation cost	2.00	2
2	Cost of bottle	32.00	34
3	Cost of Bottle cap	7.50	41.50
4	Cost of label	3.50	45
5	Labour charge	12.00	57
6	Machine rate	4.00	61
7	Electricity Charge	30.00	91
8	Cost of Management	30.00	121
9	Rent	20.00	141
10	Tax	40.00	181
	Total processing cost	181.00	
	Cheruthen from tribal (Charge)	900.00	
	Processing charge + Cost of Cheruthen	(181+900)=1081.00	
	Market Price	1350.00	
	Profit	(1350.00-1081) = 269.00	

CHAPTER-5

EXTERNAL TRADE

Kerala has 17 ports including 1 major port (Cochin), 3 intermediate ports (Beypore, Alappuzha and Neendkara) and 13 minor ports (Kovalam- Vizhinjam, Valiyathura, Thankasseri, Kayamkulam, Munambam/ Kodungalloor, Ponnani, Vadakara, Thalasseri, Kannur, Azhikal, Neeleswaram, Kasaragod and Manjeswaram). SEZ Cochin account for 61 % and Cochin sea more than 31 % of total exports from Kerala. In several agro-based products, Kerala has a major share in India's overall exports. Kerala is the largest exporter of natural rubber in India, with a share of 63.6 % in India's total exports during 2018-19. Kerala is also the largest exporter of cashews in the country, with a share of 47.2 % in India's total exports. Other major commodities exported include floor coverings of jute (share of 56.9% in India's overall exports), jewellery made of gold or other precious metals (45.3 %), vegetable oil (15.5 %), coir and coir products (15.4 %), spices (13.4 %), tea (13.0 %) and marine products (12.7 %). Kerala is one of the top exporters of coir, and coir products and geo-textiles in India, accounting for more than 98 % of the total exports from the country.

5.1 EXPORT OF KEY BIO-RESOURCES/ BIO-RESOURCES BASED PRODUCTS

The overall export of bio-resources/ bio-resources based products from Kerala during the years 2019-2020 and 2020-2021 from different ports of Kerala to multiple destinations was studied. The export value (Rs crores) of major commodity groups was considered for the analysis. The data is collected from the Directorate General of Commercial Intelligence and Statistics (DGCIS), Govt of India.

The major commodity groups covered/selected in the analysis include:

1. food products
2. marine products
3. textiles and fabrics
4. rubber and rubber products
5. wood and wood products
6. essential oils
7. medicinal and other pharmaceutical products
8. ayush and herbal products
9. floriculture products
10. tobacco manufactured
11. leather and leather products and
12. Others.

Food products are further classified to spices, tea, cashew, fruits and vegetables, coffee, cereals and cereal preparations, vegetable seeds and oils, milled products, meat/diary/poultry products, alcoholic beverages, sugar, cocoa products and pulses. Similarly, textiles are further categorized to cotton manufactures, coir and coir manufactures, jute manufactures, handloom products, silk manufactures and wool manufactures. Due to the lack of adequate data on export quantity, the analysis made here is exclusively based on export value. A large number of the natural base ingredient manufacturers are based in Kerala, as seen in the Table below.

Table 5.1 Major natural ingredient manufacturers in Kerala

SL No	Company	HQ	FY16 revenue (USD mn)	5-year CAGR	Product range
1	Sharp Mint	Delhi	254	6%	Mint
2	Synthite	Kerala	203	15%	Spices Oleoresins and others
3	Plant Lipids	Kerala	134	18%	Spices Oleoresins and others
4	Privi Organics	Mumbai	93	9%	Aroma Chemicals
5	Eternis Fine Chemicals	Mumbai	73	8%	Aroma Chemicals
6	Kancor Ing. (Mane)	Kerala	70	14%	Spices Oleoresins and others
7	KV Aromatics	Noida	65	27%	Mint
8	Camphor & Allied	Mumbai	54	NA	Aroma Chemicals
9	AVT Natural	Kerala	49	6%	Spices Oleoresins and others
10	Anthea Group	Mumbai	46	NA	Aroma Chemicals

Table 5.2 : Export value of major commodity groups during the years 2019-2020 and 2020-2021 from Kerala

Sl. No	Commodity	2019-2020		2020-2021		Average Value (Rs Crores)	%
		Value (Rs Crores)	%	Value (Rs Crores)	%		
1	Food products	9144.50	43.31	10547.14	47.07	9845.82	45.25
2	Marine products	5060.21	23.97	5052.47	22.55	5056.34	23.24
3	Textiles and fabrics	4286.46	20.30	4594.08	20.50	4440.27	20.41
4	Rubber and rubber products	1489.71	7.06	1556.71	6.95	1523.21	7.00
5	Wood and wood products	876.13	4.15	306.78	1.37	591.46	2.72
6	Essential oils	106.63	0.51	187.93	0.84	147.28	0.68
7	Medicinal and other pharmaceutical products	41.81	0.20	80.26	0.36	61.04	0.28
8	Ayush and herbal products	35.61	0.17	38.03	0.17	36.82	0.17
9	Floriculture products	22.81	0.11	25.29	0.11	24.05	0.11
10	Tobacco manufactured	33.01	0.16	10.95	0.05	21.98	0.10
11	Leather and leather products	13.40	0.06	5.06	0.02	9.23	0.04
12	Others	3.51	0.02	1.58	0.01	2.55	0.01
	Total	21113.78	100.00	22406.27	100.00	21760.03	100.00

- Food products are the most important export commodity during the years 2019-2020 and 2020-2021 from Kerala.
- The export value of food products increased from 9144.50 crores during 2019-2020 to 10547.14 crores during 2020-2021 with a percentage share of 43.31% and 47.07% respectively in total commodities.

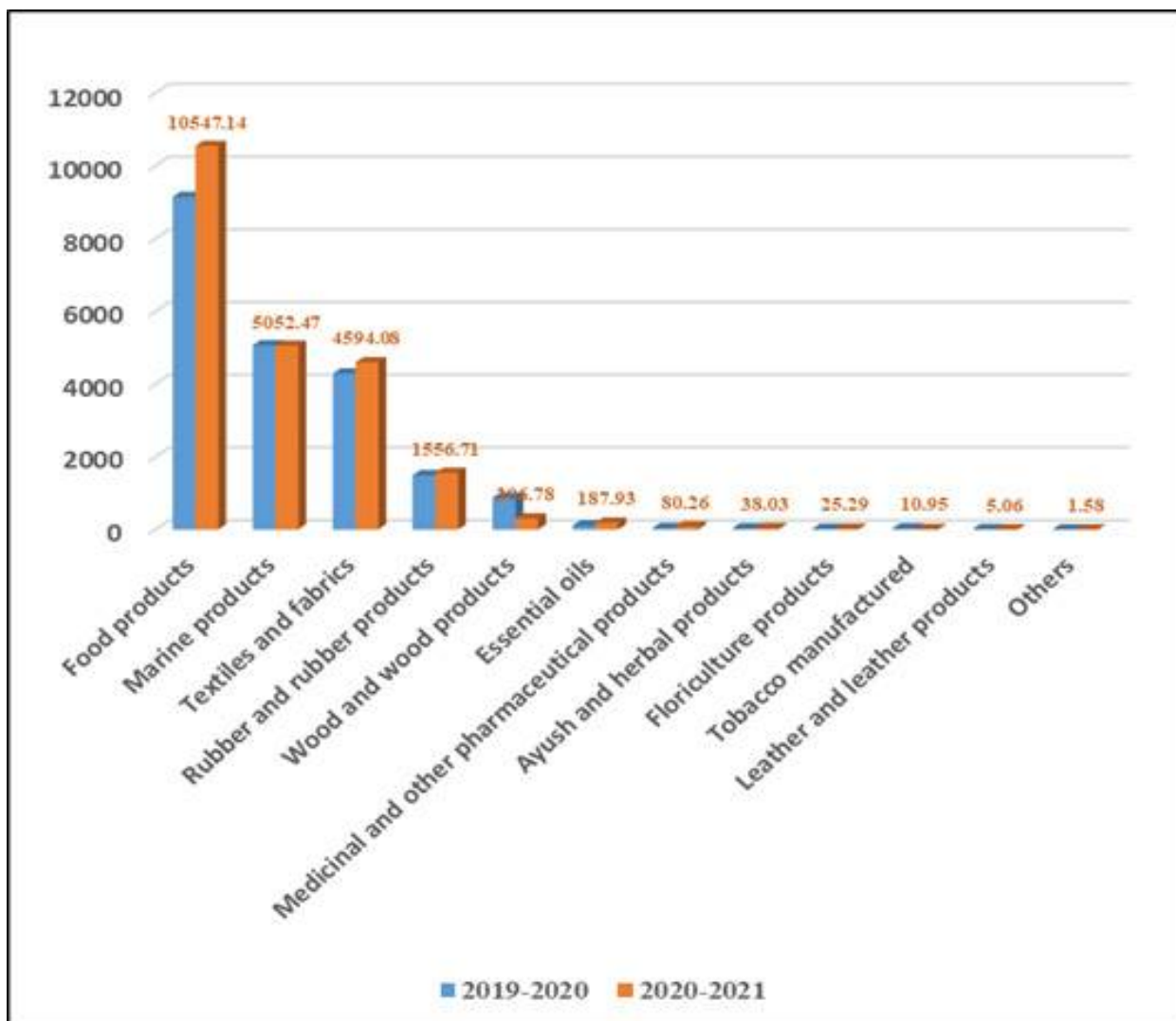


Fig 5.1 Export value of major commodity groups 2019-21 value in crores



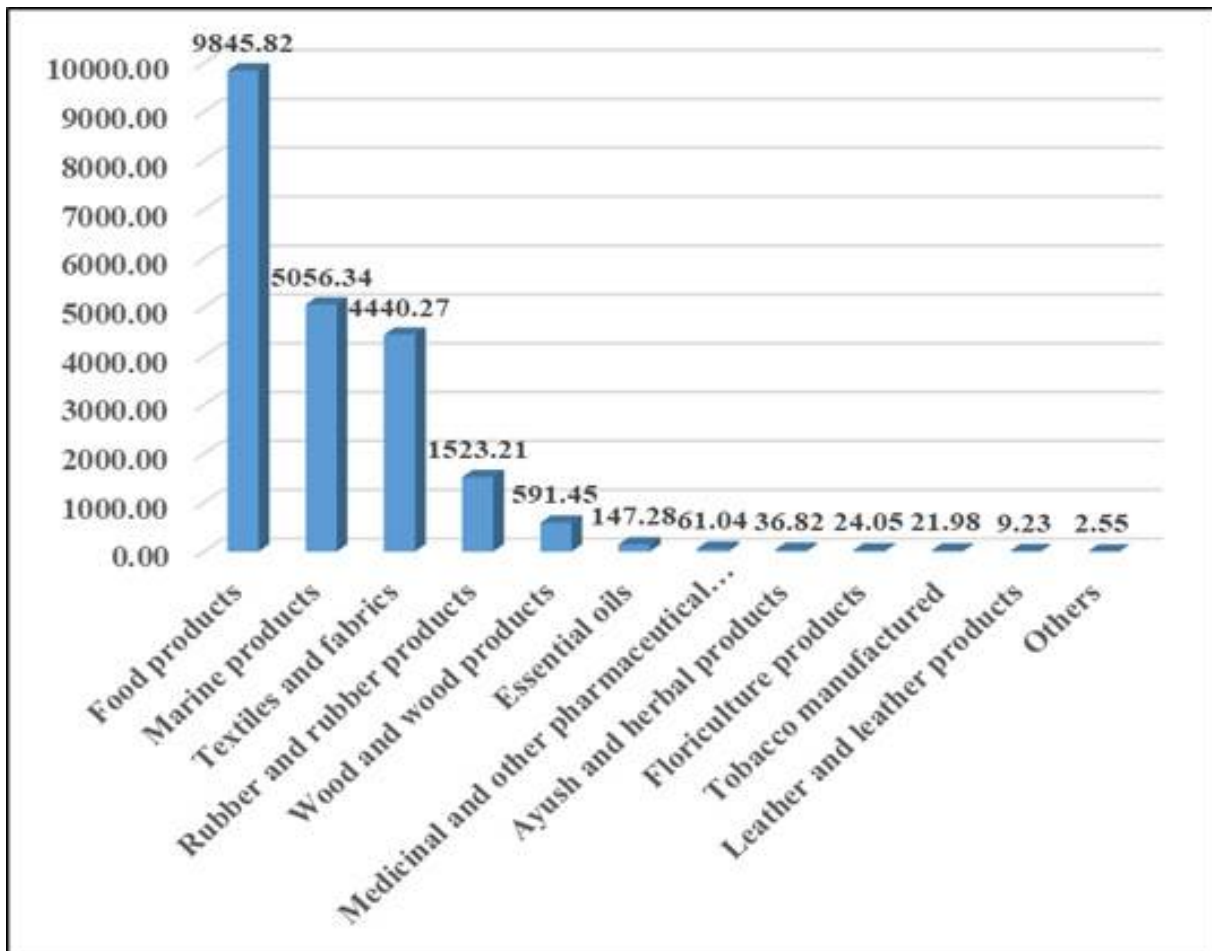


Fig 5.2 Export value of major commodity groups 2019-21 value in crores

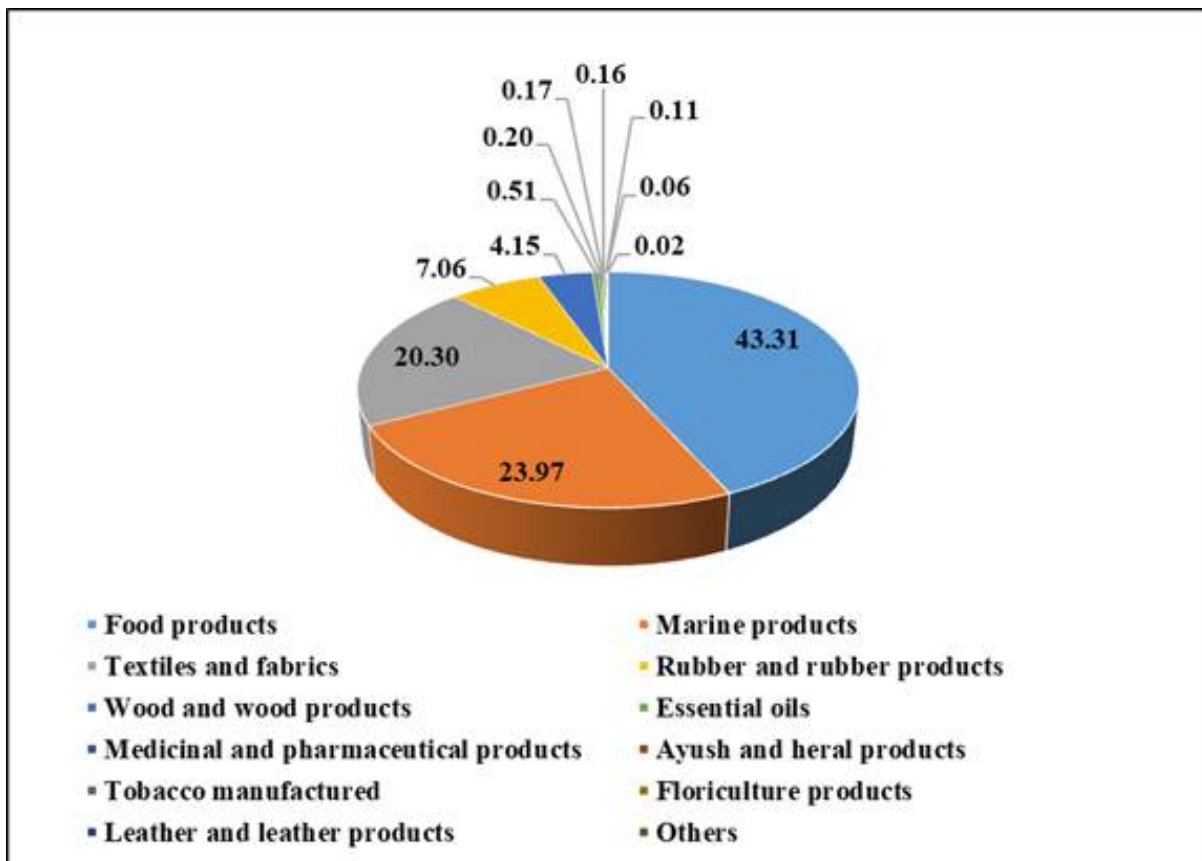


Fig 5.3 Export value of major commodity groups 2020-21 value in crores Percentage share

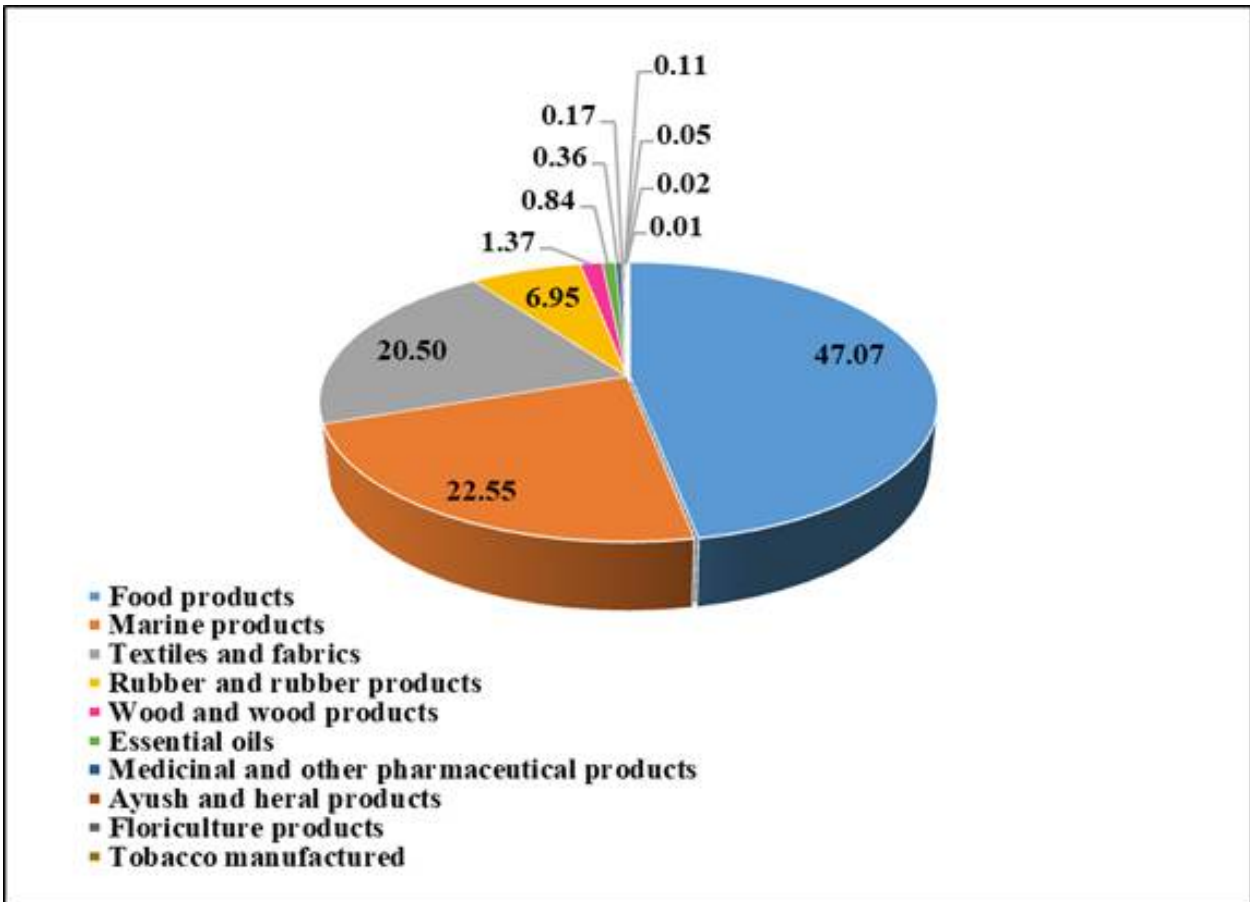


Fig 5.4 Export value of major commodity groups 2019-20 value in crores Percentage share

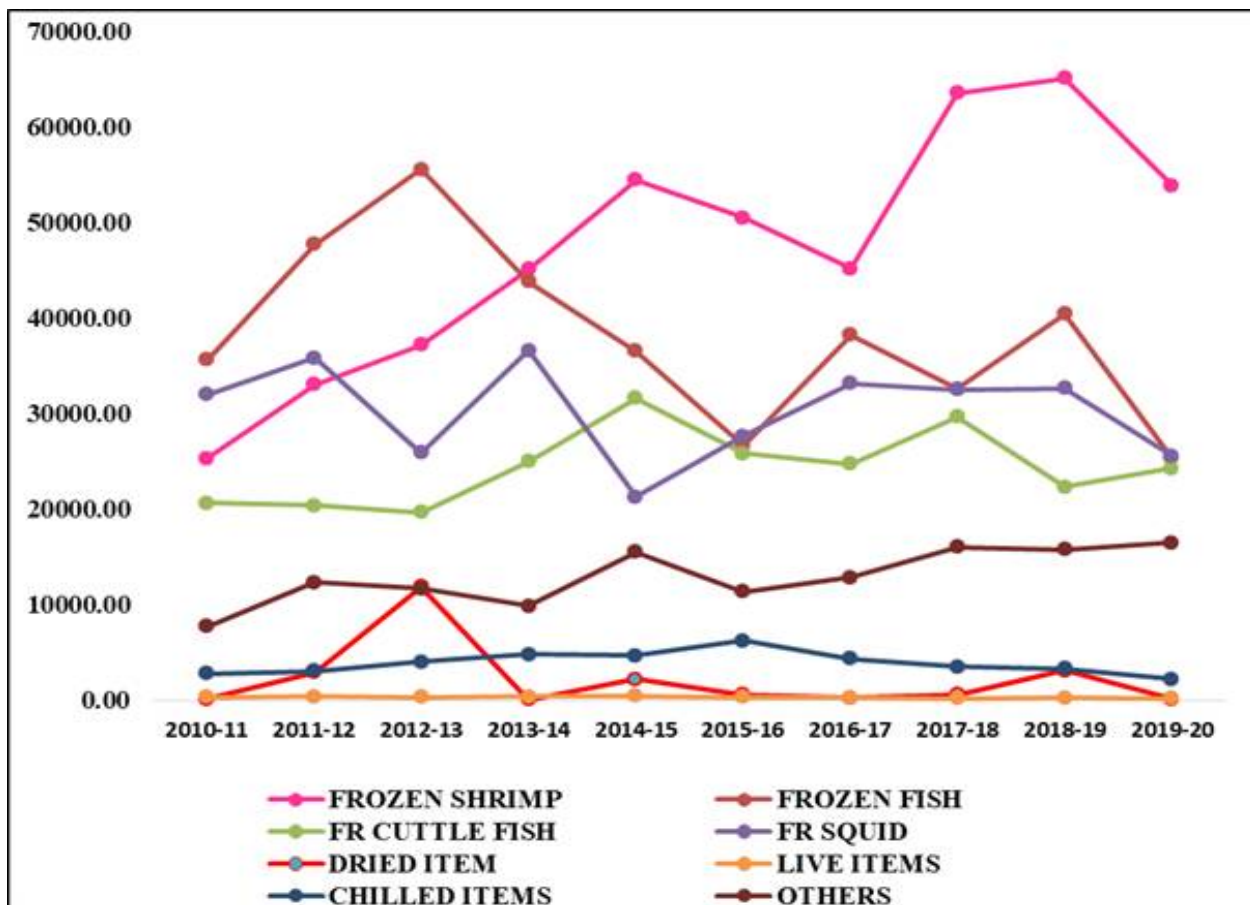


Fig 5.5 Trend of export of marine products from Kerala ports during 2010-20 qty in tonnes

As per our analysis based on data collected from DGCIS, the export value of major bioresources based products from Kerala during 2020-21 was Rs 22406.27 crores. Food products with a value of Rs 10547 crores is the principal commodity which contributed to about 47 % of total value. Among food products spices (Rs 4597.06 crores, 44%), Tea (Rs 1573.29 crores, 15%) and Cashew (Rs 1461.58 crores , 14%) are the principal commodities exported.

Pepper is one of the major spices exported from Kerala, in 2019-20, export of pepper was 14,198.2 MT valued ₹471.3 crore. Cardamom (small) valued at ₹242.3 crore was exported from Kerala through Cochin and Thiruvananthapuram ports in 2019-20 . Export of chilli was 26,460 MT valued at ₹469.68 crore. Export of curry powder/mixture in 2019-20 was 11,208 MT valued ₹251.9 crore.

Table 5.3 Export of food products during the years 2019-2020 and 2020-2021 from Kerala

Sl. No.	Commodity	2019-2020		2020-2021		Average Value (Rs Crores)	%
		Value (Rs Crores)	%	Value (Rs Crores)	%		
1	Spices	3309.9	36%	4597.06	44%	3953.48	40%
2	Tea	1498.64	16%	1573.29	15%	1535.97	16%
3	Cashew	1798.02	20%	1461.68	14%	1629.85	17%
4	Fruits and vegetables	949.69	10%	972.25	9%	960.97	10%
5	Coffee	575.86	6%	647.25	6%	611.555	6%
6	Cereals and cereal preparations	427.4	5%	593.82	6%	510.61	5%
7	Vegetable seeds and oils	152.15	2%	226.24	2%	189.195	2%
8	Milled products	105.61	1%	144.4	1%	125.005	1%
9	Meat/Diary/Poultry products	98.79	1%	107.96	1%	103.375	1%
10	Alcoholic beverages	97.61	1%	48.33	0%	72.97	1%
11	Sugar	23.83	0%	37.66	0%	30.745	0%
12	Cocoa products	24.42	0%	12.81	0%	18.615	0%
13	Pulses	1.1	0%	7.29	0%	4.195	0%
14	Others	81.46	1%	117.09	1%	99.275	1%
	Total	9144.48	100%	10547.13	100%	9845.805	100%

Export of major commodities 2019-20 and 2020-21

A total quantity of 9574982 kg of oleoresins valued ₹1,894.1 crore are exported from Kerala with oleoresins from Pepper and Garcinia occupying the major share during 2019-20. Kerala is also a major producer and exporter of nutraceuticals including turmeric extract, Omega 3, boswella, amla extracts etc. Arjuna naturals is the only manufacturer of high-purity Omega-3 fish oil in India and BCM – 95 is one of the few USD 15mn+ nutraceutical ingredient brands in India (Singh and Bhattacharyya 2016) . Kerala accounts for nearly 80% of the country's Rs 2,281-crore coir product exports. In 2019-20, a total of 2,17,390 MT of coir and coir products were exported through Cochin Port.

According to estimates, Kerala has an untapped merchandise export potential of nearly US\$ 6.7 billion. Currently, cereals such as rice are important export items for the state, but exports of high value-added cereal preparations are low. Existing export of cereal products largely comprise semi/wholly milled rice, diversification of exports towards high value-added cereal preparations like snacks, ready to cook/ ready to eat products including rice pasta and noodles, fermented rice flour, puffed or flaked rice items can earn greater exports from the state.

In 2019-20 cashew kernel export from Kerala was 30,478 MT valued at ₹1,798 crore. The share of Kerala in export of cashew kernel from India was 45.05% in terms of quantity and 45.06% in terms of value. India imported 9.38 lakh tonnes of raw cashewnut worth ₹8861 crore of which import to Kerala was 13202 metric tonnes worth ₹125.5 crore (Directorate of Cashewnut and Cocoa Development, CEPCL). Export of cashew from the state is mostly in the form of cashew kernels. In addition to cashew kernels, focus could also be on exporting cashew butter, which is increasingly gaining popularity as a substitute for peanut butter and is being used in confectioneries, snack and bakery products. Exporting processed spices, in the form of spice oleoresins is another emerging opportunity for the state. Export earnings can be enhanced by product diversification and value addition. The state can focus on greater processing of spices, marine products and rubber. Kerala is among the top producers of agro-based products such as spices, coconut, tea, as well as marine products in the country. There is need for well-developed cold storage and warehousing facilities in the state. In addition the state can also diversify the countries to where the products are being exported by focussing on value addition and ensuring better quality.

Kerala has a total of 31 Geographical Identifications (GI) across agriculture (19) and handicraft sector (11) . The GI tags can be marketed to obtain better export earnings. More products including Kodungallur Snap Melon, Vativada Garlic and Onattukara Sesame are in various stages of evaluation for GI certification. India exported fresh & dried pineapple worth 2.68 million US \$ during 2020-21 in which around 44% share is from Kerala. Pineapple produced in the Vazhakulam area of Kerala received GI tag in 2009 due to its delicious taste, unique aroma and flavour. APEDA promoted the export of the first consignment of GI Tagged "Vazhakulam Pineapple" from Vazhakulam, Ernakulam, Kerala to Dubai & Sharjah, UAE virtually on 2022. This will promote GI farmers of Vazhakulam to get better income in global market.

No doubt that the future scope of bio resources and bio resources based products export from Kerala is enormous. What is more important is to come up with diversified and value added products having more demand in the overseas market

5.2 MARINE PRODUCTS EXPORT FROM KERALA: ANALYSIS OF MPEDA DATA

The marine bio-resources exports as a separate category of exports are handled by MPEDA. The secondary data from MPEDA was analysed to estimate this important bio-resource export to various countries across the globe. As a part of this study, the item-wise, market wise and port wise marine bio-reosource export from Kerala, the trend of marine products exports based on past 25 years data (1995 -2020) and the different items of marine products export during 2019-20 to 2020-21 have been analysed. The analysis of marine products export trend from Kerala's ports showed that it has significantly increased over the last 25 years (1995- 2020) in both quantity (14.39% during 1995-2000 to 27.81% during 2015-2020) and total value (7.54% during 1995-2000 to 42.66% during 2015 to 2020).

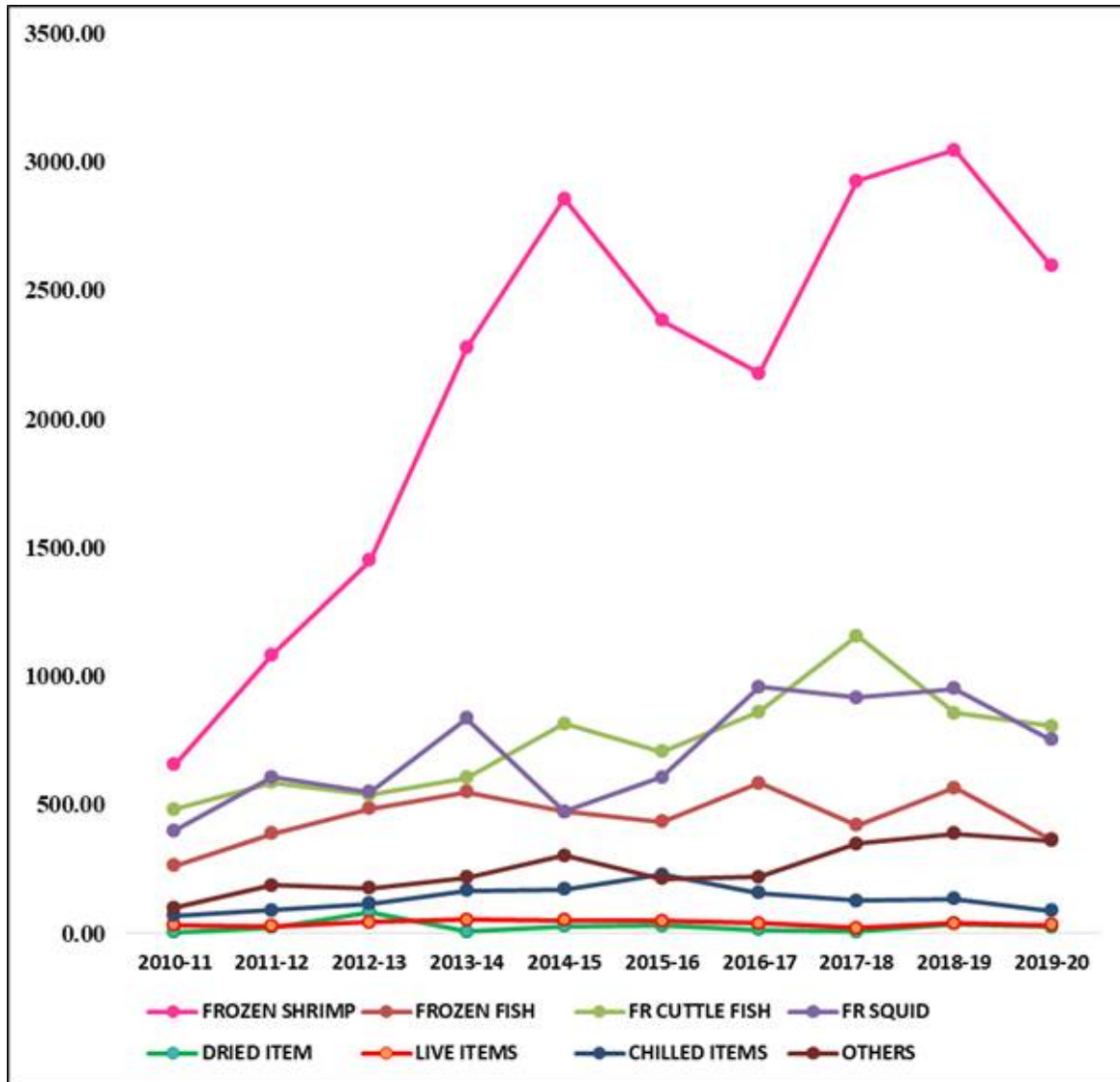


Fig 5.6 Trend of export of marine products from Kerala ports during 2010-20 value in crores



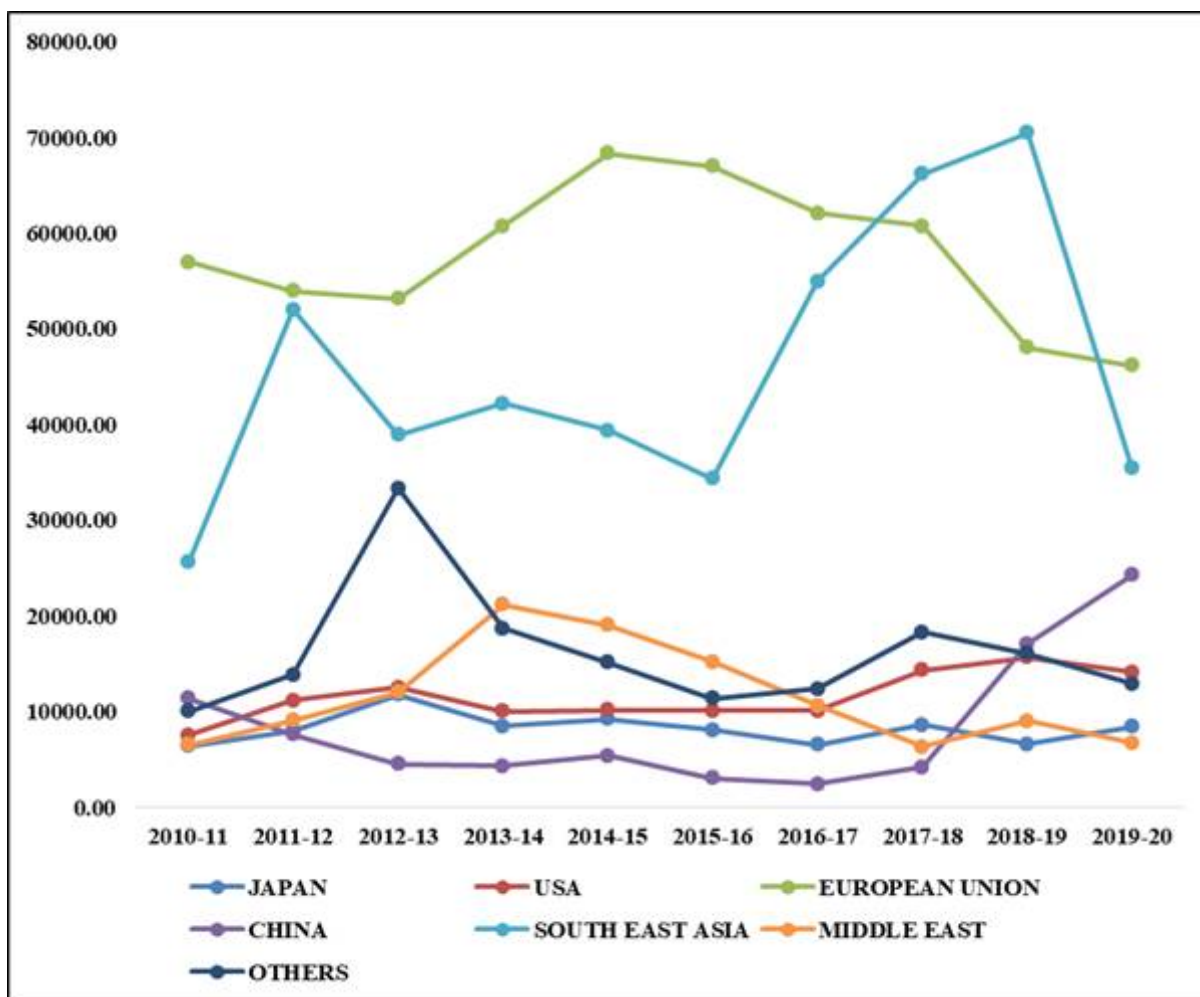


Fig 5.7 Trend of market wise export of marine products from Kerala 2010-2020 Qty in MT

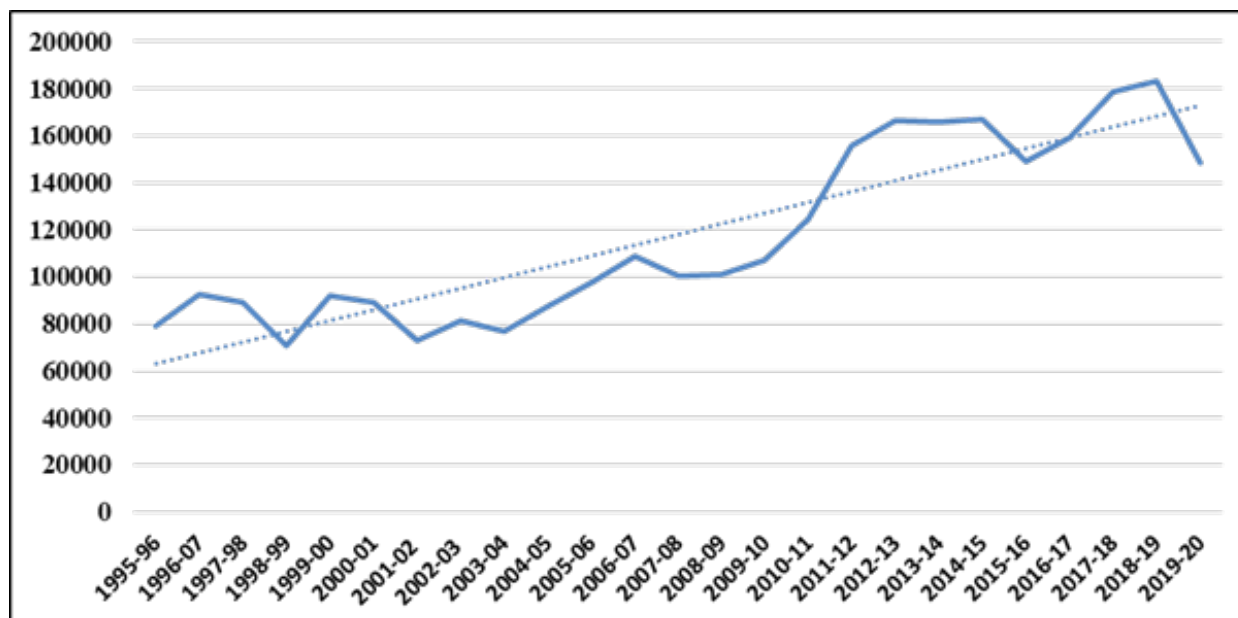


Fig 5.8 Trend of export of marine products from Kerala 1995-2020 Qty in MT

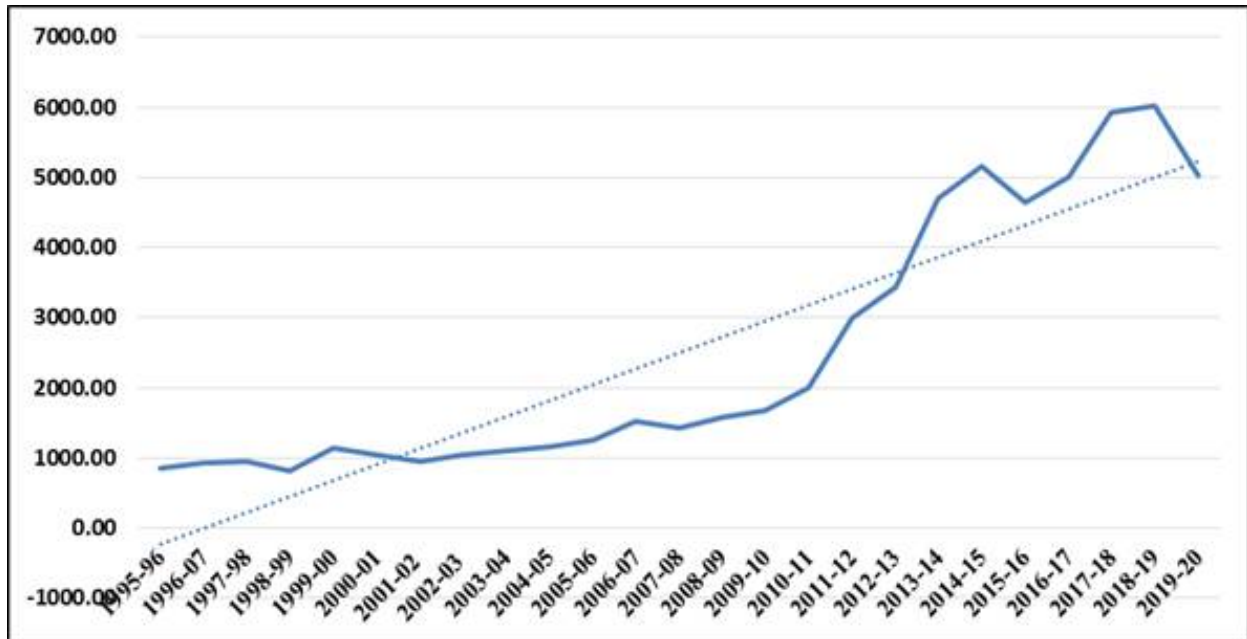


Fig 5.9 Trend of export of marine products from Kerala 1995-2020 value in Rs crores

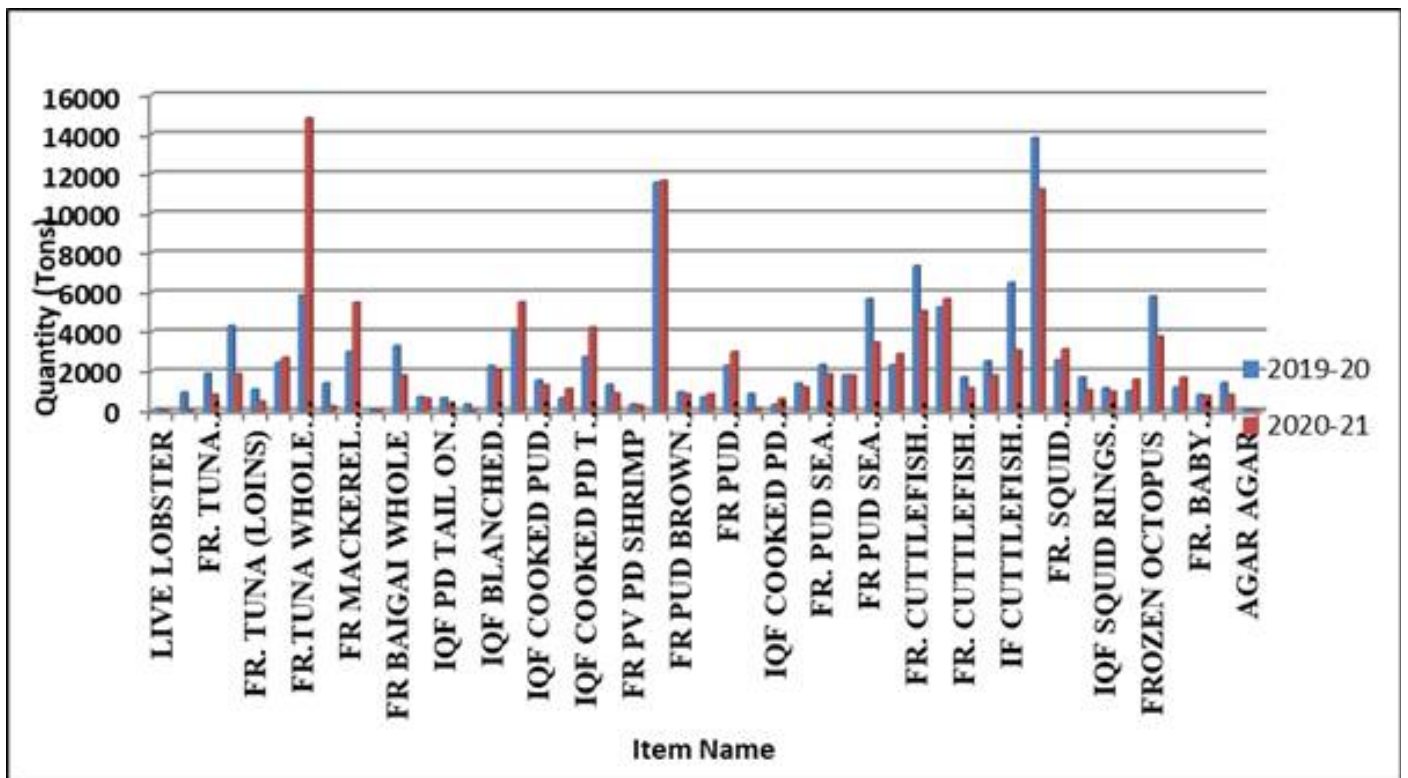


Fig 5.10 \Export of major species of marine products (qty) 2019-21

- ◆ The relatively low value items such as dried items and live items account for 1.39% and 0.21% respectively by quantity and 0.56% and 0.86% respectively by total value.
- ◆ Shrimp is the most important item in the export of marine products from Kerala. The export of shrimp from Kerala significantly increased both in quantity (20.30% in 2010 to 36.32% in 2020) and total value 32.73% in 2010 to 51.68% in 2020) over the last decade.
- ◆ The cuttle fish occupies second position after shrimp in terms of total value of exported items from Kerala and even though the total value of the cuttle fish exported declined (24.06% in 2010 to 16.04% in 2020), its quantity exported remained the same over years (16.55% in 2010 to 16.38% in 2020).
- ◆ The total value of frozen squid (15.69%) among the exported items during 2010 to 2020 showed that it is the third most important item in export items of Kerala. Both export quantity (25.66% in 2010 to 17.26% in 2020) and total value (19.95% in 2010 to 14.96% in 2020) of squid declined over years.
- ◆ Similarly, both export quantity (28.60% in 2010 to 17.13% in 2020) and total value (13.15% in 2010 to 7.26% in 2020) of frozen fish declined over years.
- ◆ Kerala's export share of marine products to major markets like Japan, USA, European Union (EU), China, South East Asia and Middle East during 2010-2020 were examined. The EU is the main destination of marine products from Kerala ports with 36.14% quantity and 39.45% total value of marine products exported when compared to other destinations. One among the major markets, South East Asia (28.78% in quantity; 21.61% in total value), is second in Kerala's marine products export market after EU (36.14% in quantity; 39.45% in total value). Over the last decade the marine product's export quantity (20.61% in 2010 to 23.96% in 2020) and the total value (10.75% in 2010 to 17.56% in 2020) from Kerala to South East Asia increased.

Kerala's export share of marine products to major markets like Japan, USA, European Union (EU), China, South East Asia and Middle East during 2010-2020 were examined. The EU is the main destination of marine products from Kerala ports with 36.14% quantity and 39.45% total value of marine products exported when compared to other destinations. One among the major markets, South East Asia (28.78% in quantity; 21.61% in total value), is second in Kerala's marine products export market after EU (36.14% in quantity; 39.45% in total value). Over the last decade the marine product's export quantity (20.61% in 2010 to 23.96% in 2020) and the total value (10.75% in 2010 to 17.56% in 2020) from Kerala to South East Asia increased.

- ◆ A decline in both quantity value of marine export from Kerala to EU (45.74% in 2020 to 31.15% in 2010 by quantity; 52% in 2010 to 33.14% in 2020 by total value) and Middle East (5.24% in 2010 to 4.57% in 2020 by quantity; 4.03% in 2010 to 3.27% in 2020 by total value) is reported during the last decade.
- ◆ In the case of Japan, no significant variation is reported in export quantity (5.16% in 2010 to 5.67% in 2020) and value (8.88% in 2010 to 8.74% in 2020), and showed a similar trend in export of marine products over the last decade.
- ◆ Interestingly, Kerala's share in marine exports to China (known for aquaculture and all*) increased significantly in quantity (9.15% in 2010 to 16.40% in 2020). However, it contributes only 5.28% share in export of marine products from Kerala to different markets/destinations. In case of total value, China accounts 5.25% share in export of marine products from Kerala to different markets. And, the export of marine products from Kerala to China increased in terms of total value with 8.16% in 2010 to 14.24% in 2020.
- ◆ Similarly, the export trend of marine products to USA from Kerala is increasing in both quantity (6.05% in 2010 to 9.54% in 2020) and total value (8.01% in 2010 to 17.03% in 2020) over the last decade. The USA shares 7.25% in quantity and 12.25 % in total value among all markets of Kerala's marine product export.



In 2019-20, India exported 12,89,651 MT of seafood worth Rs 46,662.85 crore (US\$ 6.68 billion). Frozen shrimp contributed 51.36 per cent in quantity and 74.31 per cent of the total dollar earnings. From Kerala more than 700 items are exported. Matsyafed produces a variety of value-added 'Ready-to-Fry' and 'Ready-to-Eat' seafood products of international quality. The Ready-to-Fry products include Fish Slices, PUD Prawns, Squid Rings, Cleaned Mussel Meat, Frozen Cutlets and the Ready-to-Eat products include Pickles and Curries. The delicacies like Ribbon Fish, Tuna, Spanish Mackerel, Crabs and Octopus are currently exported to countries like China, Korea, the Middle-East & Sri Lanka. Seabass, mud crab, freshwater prawn organic aquaculture products; prepared fish/ shrimp products such as ready to cook fish curries/ prawn curries; and fish oils have potential high value export value. Marine products such as frozen fishes, frozen shrimps, and live fishes such as shrimps, prawns, cuttle fish, squid, crabs, lobsters, tuna, mackerel, pomfret etc. are important exports from Kerala, and account for a share of 12.68 percent in India's total exports of marine products during 2018-19. Top markets for exports of marine products from Kerala primarily include Asian markets such as Vietnam, Thailand, and China, as also markets such as Spain, the USA, and Italy, among others. There exist opportunities for enhancing exports to other markets such as Japan, South Korea, and Russia for exports of frozen fish, and to countries like France, the Netherlands, Malaysia, Portugal for exports of cuttle fish and squid, as these are among the top importers of these products globally. In 2020-21, export of marine products from Kerala was 1, 44,700 tonnes valued at 5,039.89 crore. It accounts for 12.59 per cent in terms of quantity and 11.53 per cent in terms of value of the marine products export from India.

Frozen shrimp (29.61% by quantity and 47.75% by total value), frozen fish (23.94% by quantity and 10.07% by total value), frozen squid (18.98% by quantity and 15.69% by total value) and frozen cuttle fish (15.28% by quantity and 16.50% by total value) were the major export items from Kerala during 2010-2020. Shrimp is the most important item in the export of marine products from Kerala. Over the last decade, the export of shrimp from Kerala significantly increased both in quantity (20.30% in 2010 to 36.32% in 2020) and total value 32.73% in 2010 to 51.68% in 2020).

The principal channel through which export of marine products occurs is Kochi port in Kerala. The Kochi port accounts the export of marine products by 97.88% in quantity; 96.6% in total value, when compared to Trivandrum (1.81% in quantity; 3.08% in total value) and Calicut ports (0.31% in quantity; 0.33% in total value). The export of marine products through Kochi port have increased both in quantity and total value (97.54% in 2010 to 98.52% in 2020 and 94.51% in 2010 to 97.69% in 2020 respectively) over the last decade. This shows the significance of Kochi port which is a major port of India in the marine products export. It may be noted that marine products catch from other states may also be exported through the Kochi port due to its proximity with other state borders (Karnataka and Tamil Nadu), as well as the high activity of trade.



Table 5.4 Export diversification opportunities in Kerala

Sector	Existing Product	Prospective High Value-Added Exports	Comments
	Rice (Semi/wholly milled), Brown Rice	Processing of rice to high-value products like snacks, ready to cook/ ready to eat products such as rice-based noodles, fermented rice flour, puffed/flaked rice, products from GI crops	Largest markets for rice pasta and noodles are in Asia and Europe, with revenues in the APAC region expected to register a CAGR of 6 percent during 2019- 2025, to reach US\$ 855.2 million by 2025 ¹⁷ .
	Coconut, coconut oil	Processed coconut items like desiccated coconut, beverages such as packaged flavoured coconut water, coconut cream, coconut cakes, copra, ready to eat coconut chutney; shell- based products etc.	Global market for packaged coconut water is expected to reach US\$ 3.9 billion by 2025, registering a CAGR of nearly 16 percent during 2020-25 ¹⁸
Agriculture and Allied sector	Spices Pepper, Cardamom, Turmeric, chilli, nutmeg	Spice oleoresins, functional; food, Nutraceuticals, Natural flavors and fragrances	Globally, oleoresins market size stood at an estimated US\$ 1.4 billion in 2018, and is expected to register a CAGR of 4.7 percent during 2019- 2025 ¹⁹ .
	Cashew Kernels	Cashew butter; processed snacks made of cashews	Global nut butter market is expected to garner revenues of nearly US\$ 4 billion by 2024, registering a CAGR of 4 percent during 2019-2024, presenting significant opportunity ²⁰ .
	Marine products- frozen fishes, frozen shrimps, and live fishes such as shrimps, prawns, cuttle fish, squid, crabs, lobsters, tuna, mackerel, pomfret etc.	Prepared fish/ shrimp products such as ready to cook fish curries/ prawn curries; and fish oils (HS- 1504), squalene, omega 3 fatty acids etc	Organic aquaculture could fetch higher margins and garner greater revenues.
	Coir and Rubber products such as floor coverings. gloves and mittens. tyres.	High value-added rubber and coir products	There exists an estimated US\$ 0.18 billion of untapped potential for exports of rubber and plastic products from Kerala. Kerala could

	sheath contraceptives, non-cellular rubber. technically specified natural rubber etc.		tap markets such as ASEAN, China. Australia.
Textiles	Flax woven fabrics, coir yarn. jute yarn	Medical textiles, geo textiles. industrial textiles. homotech and protective clothing	The Indian technical textile market size is expected to increase from US\$ 16 billion in 2018-19 to US\$ 40 billion in 2023-24". while the global technical textile market is expected to reach US\$ 220 billion by 2022 ²²

(Adapted from Exim Bank Report 2020)

5. 3 IMPORT OF KEY BIO-RESOURCES /BIO-RESOURCES BASED PRODUCTS

The overall import of key Bio-resources /Bio-resources based products in Kerala during the years 2019-2020 and 2020-2021 from different countries was also studied in this report. The import value (Rs Crores) of major commodity groups was considered for the analysis. The data is collected from the Directorate General of Commercial Intelligence and Statistics (DGCIS), Govt. of India.

The major commodity groups covered/selected in this chapter are:

1. food products
2. marine products
3. textiles and fabrics
4. rubber and rubber products
5. wood and wood products
6. essential oils
7. medicinal and other pharmaceutical products
8. Ayush and herbal products
9. floriculture products
10. tobacco manufactured
11. Leather* and other leather products*.
12. Others

Table 5.5 Import of major commodity groups during the years 2019-2021 to Kerala

Sl. No.	Commodity	2019-2020		2020-2021		Average Value	
		Value (Rs. Crores)	%	Value (Rs Crores)	%	(Rs Crores)	%
1	Food products	2230.06	49.00	2459.80	57.52	2344.93	53.13
2	Marine products	145.60	3.20	138.38	3.24	141.99	3.22
3	Textiles and fabrics	396.43	8.71	215.88	5.05	306.16	6.94
4	Rubber and rubber products	568.34	12.49	579.29	13.55	573.82	13.00
5	Wood and wood products	1094.72	24.05	808.30	18.90	951.51	21.56
6	Essential oils	7.07	0.16	9.46	0.22	8.27	0.19
7	Medicinal and other pharmaceutical products	13.41	0.29	31.31	0.73	22.36	0.50
8	Ayush and herbal products	2.01	0.04	7.74	0.18	4.87	0.10
9	Floriculture products	0.00	0.00	0.00	0.00	0.00	0.00
10	Tobacco manufactured	75.69	1.66	20.46	0.48	48.08	1.09
11	Leather and leather products	5.76	0.13	1.92	0.04	3.84	0.09
12	Others	12.31	0.27	3.69	0.09	8.00	0.18
	Total	4551.40	100.00	4276.23	100.00	4413.83	100.00

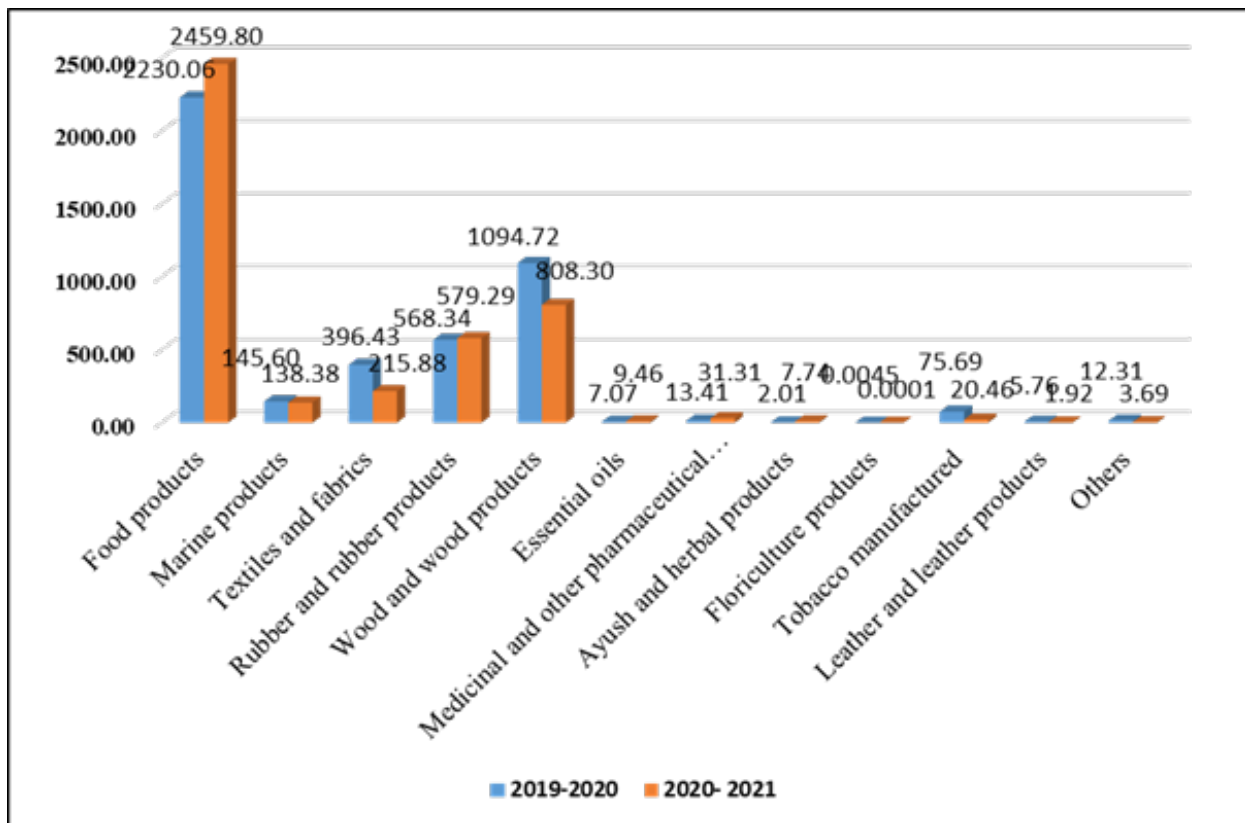


Fig 5.11 Import of major commodity groups 2019-21 in Rs crores

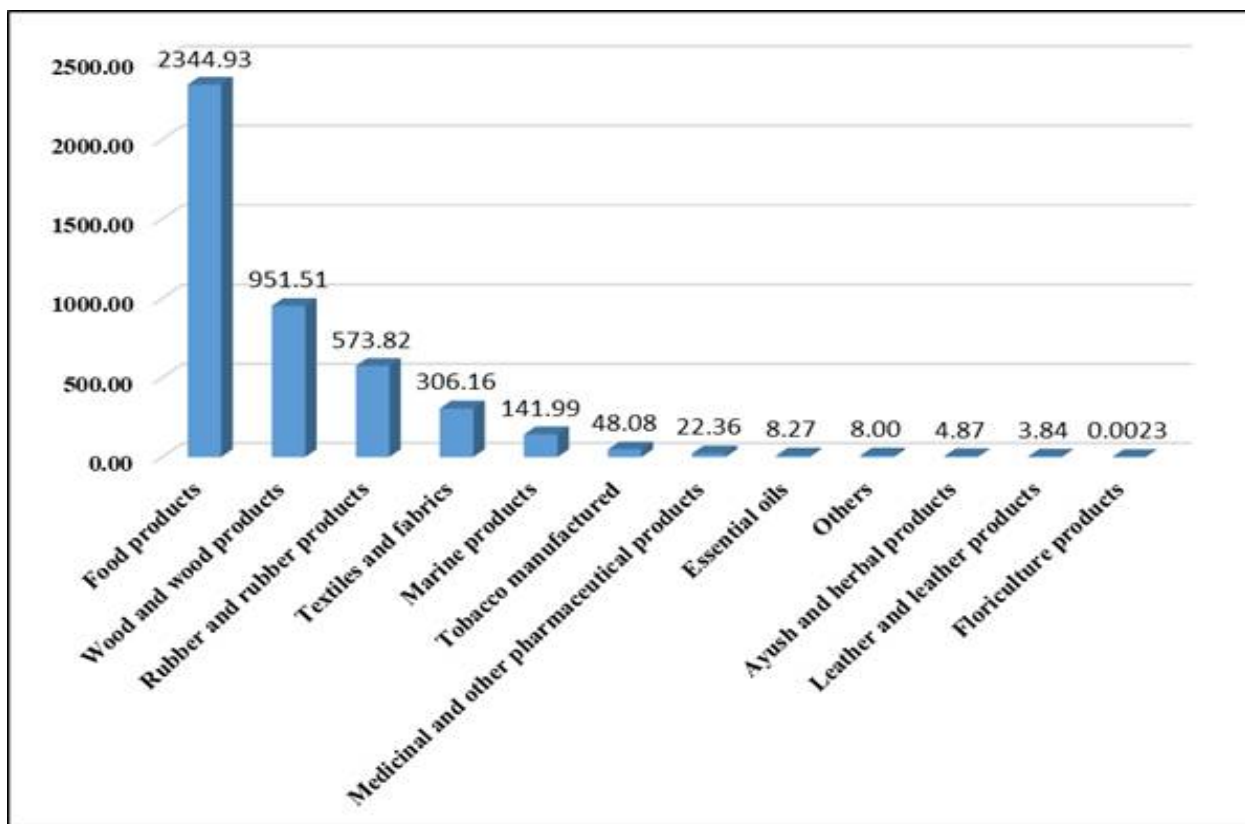


Fig 5.11 Import of major commodity groups 2019-21 in Rs crores

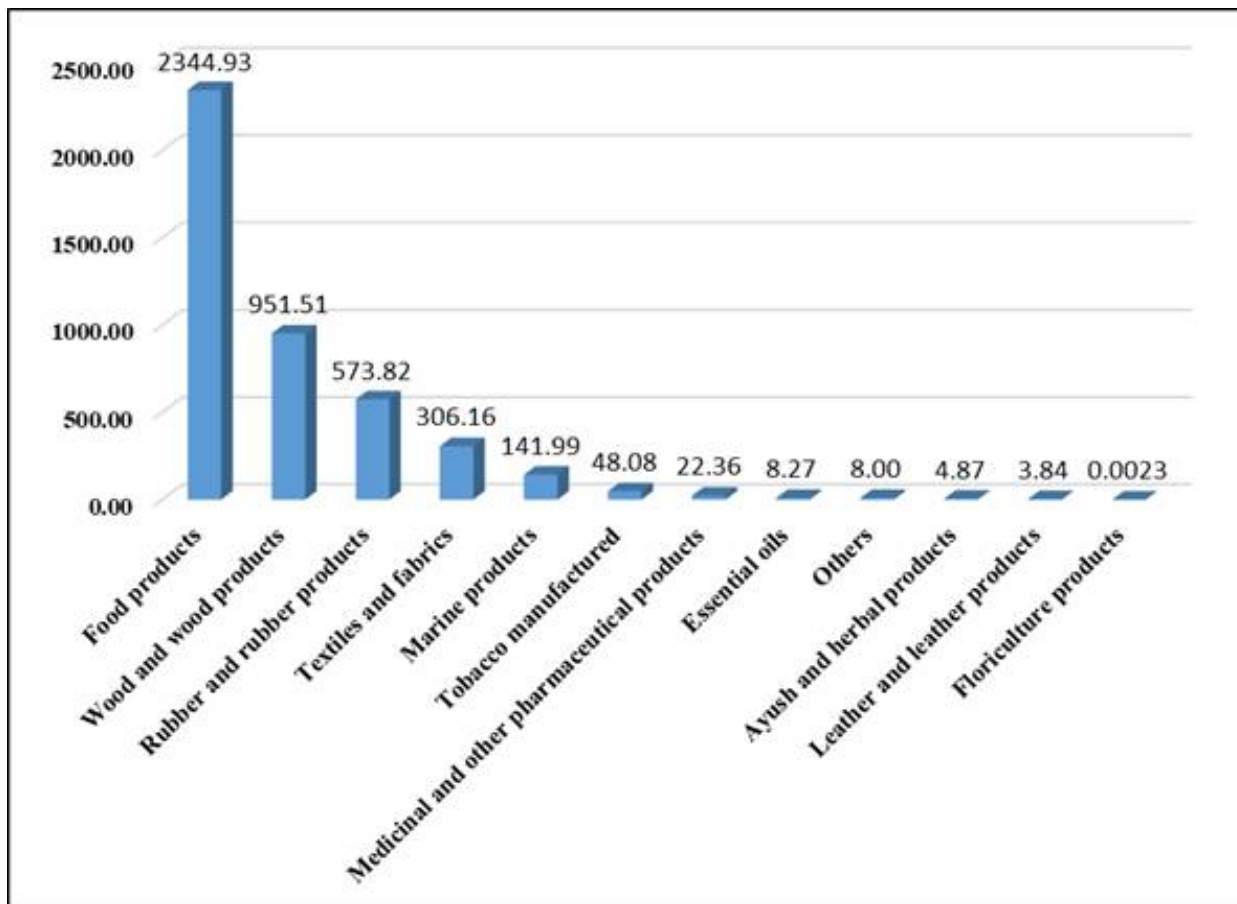


Fig 5.12 Import of major commodity groups during 2019-21 , Average value in Rs crore

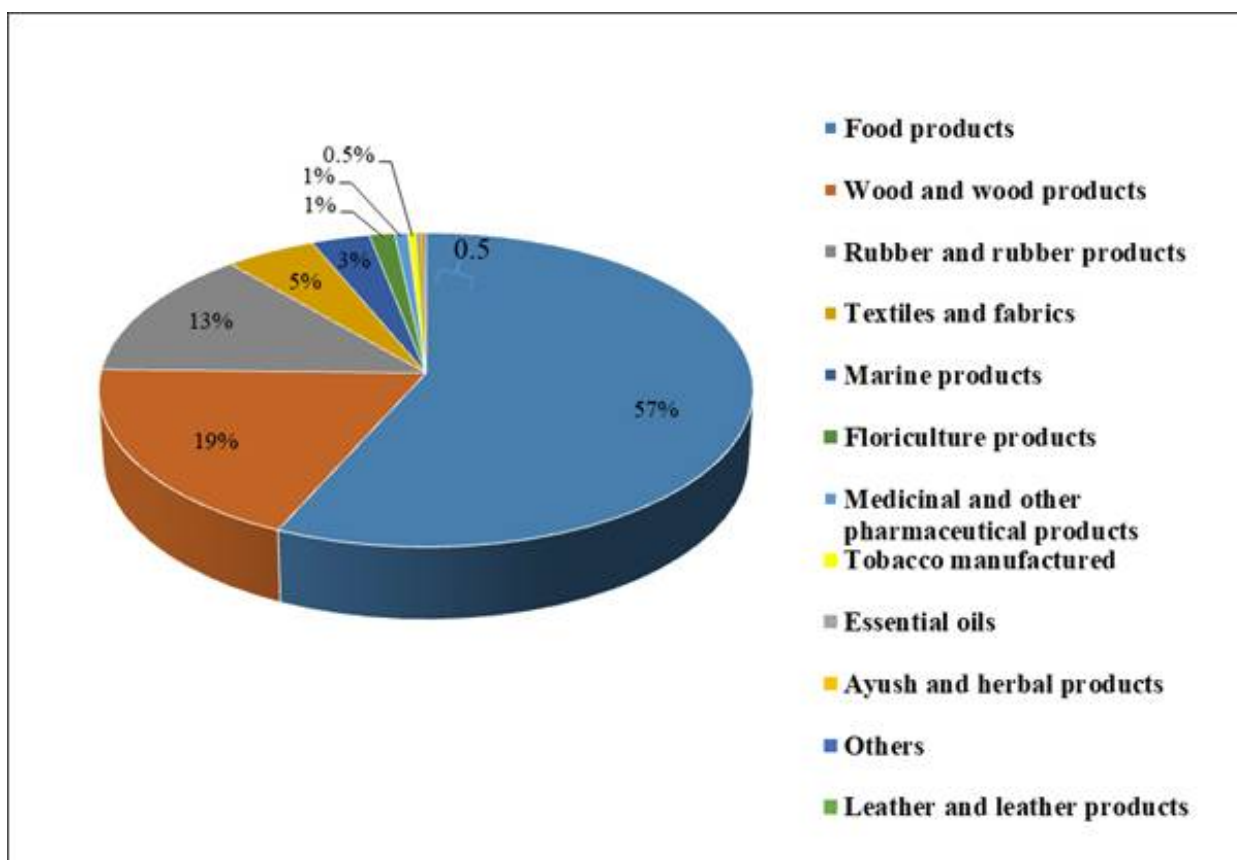


Fig 5.13 Import of major commodity groups during 2019-21 , value in Rs crore percentage share

Food products are the most important import commodity during the years 2019-2020 and 2020-2021 to Kerala. According to the data collected from the Directorate General of Commercial Intelligence and Statistics (DGCIS), Govt. of India regarding import values of the years 2019-20 and 2020-21, it was observed that there was a decline in import value from Rs. 4551.40 crore to Rs. 4276.23 crore.

The import value of food products increased from 2230.06 crores during 2019-2020 to 2459.80 crores during 2020-2021 with a percentage share of 49.00% and 57.52% respectively in total commodities. Wood and wood products, the second most important imported commodity, marked a slight decline in total import value from 2019-2020 (1094.72 crores; 24.05%) to 2020-2021 (808.30 crores; 18.90%).

Among the food products imports under study, it was observed that Spices were the most important commodity among food products and its import value increased from 121.40 crores during 2019-2020 to 199.64 crores during 2020-2021. Spices contributed to 52.61% of the total commodities during 2019-2020 and 63.94% of the total commodities during 2020-2021.

5.4 BALANCE OF TRADE

Balance of Trade or commercial balance is known as the Net Export. It is the difference between the money value of a nation's export and import over a time period. In this respect the balance of trade of various bio-resources based raw-materials and products of Kerala was estimated based on the export and import data collected from DGCIS for the period of 2019-20 and 2020-2021 as well as for the average of the two years.



Table 5.6 Average balance of trade of major bio-resources based commodity groups 2019-2021 from Kerala (Rs in crores)

Sl. No	Commodity	Average Export Value	Average Import Value	Balance of Trade
1	Food products	9845.82	2344.93	7500.89
2	Marine products	5056.34	141.99	4914.35
3	Textiles and fabrics	4440.27	306.16	4134.11
4	Rubber and rubber products	1523.21	573.82	949.39
5	Wood and wood products	591.46	951.51	-360.05
6	Essential oils	147.28	8.27	139.01
7	Medicinal and other pharmaceutical products	61.04	22.36	38.68
8	Ayush and herbal products	36.82	4.87	31.95
9	Floriculture products	24.05	0.002301	24.05
10	Tobacco manufactured	21.98	48.08	-26.10
11	Leather and leather products	9.23	3.84	5.39
12	Others	2.55	8	-5.45
	Total	21760.05	4413.8323	17346.22

- The balance of trade of any economy, whether at the state level or at the country level is a significant indicator of its self sufficiency in terms of manufacturing potential and ability to fulfill domestic demand as well as produce enough surplus to export goods and earn valuable foreign exchange.
- Although the balance of trade for merchandise (secondary sector) on a whole for India is negative ie India suffers a trade deficit in merchandise products (-20.88\$ Billion) according to Economic Division, Department of Commerce (2022), the encouraging finding from this study was the positive trade balance by Kerala in the domain of bio-resource products (DGCIS, 2021).
- The study was conducted for 2 consecutive financial years ie. 2019-20 and 2020-21, to maintain consistency with the studies on import and export. This analysis found that the balance of trade was around Rs. 16562.39 crore in 2019-20, which increased to around Rs. 22406.28 crore in 2020-21.
- The highest average sector-wise balance of trade value was also estimated, in which food products obtained the highest value (Rs. 7500.89 crore) followed by Marine products (Rs. 4914.35 crore) and Textiles (Rs. 4134.11 crore). A trade deficit was observed in 3 sectors namely, Wood products, tobacco products and others of which wood products showed highest deficit (Rs. -360.05 crore).

CHAPTER-6

BIORESOURCES WITH ABS POTENTIAL AND ESTIMATION OF ABS POTENTIAL OF KERALA

6.1 ESTIMATION OF ABS POTENTIAL

The rich biodiversity of Kerala provides number of ecosystem services as well as source of income/livelihood for millions of poor. The genetic/biological resources of Kerala are raw-materials for manufacturing different consumer products or the benefit/profits options for large number of bio-entrepreneurs. As per the "Guidelines on Access to Biological Resources and Associated Knowledge and Benefit Sharing Regulation – 2014", Access and Benefit Sharing (ABS) can be availed of from the biological resources based industries either:

(a) Based on the biological resources' purchased price by the industries, based on the raw-material cost, prescribed as 3% to 5 %.

or

(b) Based on the ex-factory sale value of the product minus government taxes, where biological resources are involved in production fully or partially (0.1% to 0.5%).

The following methodology for working out the ABS potential of the state was worked out based on detailed discussions with several experts working in this area.

6.1.1 ABS POTENTIAL BASED ON ANNUAL TURNOVER OR OUTPUT VALUE OF BIO-RESOURCES BASED MANUFACTURING IN KERALA

The analysis of data on bio-resources based Micro, Small and Medium Enterprises (MSMEs) (MSMEs and Factories) in Kerala carried out in the previous sections derived the sector wise annual turnover. In the MSMEs' case the ABS potential is estimated to be 0.2% of turnover, as its overall investment is relatively small compared to the large industries or factories (Table 14.2).

Table 6.1 ABS potential of Bio-resources based enterprises (MSMEs)

Sl. No.	Category	Number of Enterprises		Annual Turnover (Rs. Lakh)	ABS Potential (0.2% of turnover)	
		Number	%		Amount (Rs. lakh)	%
1	Ayurveda and Herbal cosmetics	586	1.23	43648.74	87.29	1.90
2	Food Processing	15927	33.50	1287608.39	2575.22	53.62
3	Cashew products other than nuts	207	0.44	10554.00	21.11	0.44
4	Marine products and Sea foods	174	0.37	224992.61	449.98	9.24

5	Textiles and Handlooms	9964	20.96	125492.73	250.98	5.23
6	Coir products	1159	2.44	76682.40	153.36	3.19
7	Wood, Bamboo and Cane based industries	9629	20.25	238901.98	477.80	9.95
8	Herbal Wellness Centres	3245	6.83	20844.79	41.69	0.87
9	Paper based products and printing	3317	6.98	88400.70	176.80	3.68
10	Rubber based products (Tyres, Foot wares etc.)	2023	4.26	226636.84	453.27	9.44
11	Wax products	254	0.53	1220.08	2.44	0.10
12	Others	1056	2.22	56211.11	112.42	2.34
	TOTAL	47541	100.00	2401194.36	4802.39	100.00

As per the estimation, the ABS potential of all the bio-resources based enterprises (MSMEs) in the State is Rs. 4802.39 lacs. In this, the Food processing industries play a significant role with Rs. 2575.22 lakh (53.62%) followed by Wood, Bamboo and Cane based industries (Rs.477.80 lakh - 9.95%), Rubber based products - Tyres, Foot wares etc. - (Rs.453.27 lakh - 9.44%), Marine products and Sea foods (Rs.449.98 lakh - 9.24%), Textiles and Handlooms (Rs.250.98 lakh - 5.23%), and Paper based products and printing (Rs.176.80 lakh - 3.68%). Other industrial units' ABS potential is relatively small.

For the factories (major/large industries) the ABS potential is estimated to be 0.5% of the turnover, as its overall investment is high.

Table 6.2 ABS potential of Bio-resources based factories in Kerala

NIC Code	Factory / Description	Factories		Total Output/Turnover		ABS Potential (0.5% of turnover)	
		Number	%	Value (Rs. Lakh)	%	Amount (Rs lakh)	%
A. Fully Bio-resources based							
10	Manufacture of food products	1624	45.88	3525681	80.38	17628.41	80.38
11	Manufacture of beverages	63	1.78	122299	2.79	611.495	2.79
12	Manufacture of tobacco products	500	14.12	16083	0.37	80.415	0.37
15	Manufacture of leather and related products	203	5.73	238422	5.44	1192.11	5.44

16	Manufacture of wood and products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	857	24.21	153492	3.50	767.46	3.50
17	Manufacture of paper and paper products	134	3.79	77944	1.78	389.72	1.78
21	Manufacture of pharmaceuticals, medicinal chemical and botanical products	159	4.49	252214	5.75	1261.07	5.75
	Total	3540	100	4386135	100	21930.68	100
B. Partially Bio-resources based*							
13	Manufacture of textiles	423	32.36	426913	11.81	2134.56 (1067.28*)	11.81
14	Manufacture of wearing apparel	51	3.90	81120	2.25	405.6 (202.80*)	2.24
22	Manufacture of rubber and plastic products	629	48.13	1054283	29.17	5271.41 (2635.71*)	29.17
31	Manufacture of furniture	130	9.95	48089	1.33	240.44 (120.22*)	1.33
32	Other manufacturing	74	5.66	2003717	55.44	10018.59 (5009.29*)	55.44
	Total	1307	100	3614122	100	9035.305	100.00
	Grand Total (A+B)	4847		8000257		30965.98	

Source: Estimated based on Annual Survey of Industries 2017-18

Note: * Partially Bio-resources based industries, 50% of total output value only considered for ABS amount estimation

The estimation of the ABS potential of factories in the State focuses Fully on bio-resources based factories and Partial bio-resources based factories. In the fully Bio-resources based factories the estimated ABS potential is Rs. 21930.68 lakh. Out of this, the manufacture of food products plays a significant role with Rs. 17628.41lakh (80.38 %) followed by manufacture of pharmaceuticals, medicinal, chemical and botanical products (Rs. 1261.07 lakh - 5.75%) and manufacture of leather and related products (Rs. 1192.11lakh - 5.44%). Other factories' ABS potential is relatively small.

In the partial bio-resources based factories case, as per the 2-digit NIC classifications, along with biological resources, the non-biological resources based factories have also been taken in to account.

Hence, only 50% of the total output value is considered for the ABS amount estimation. Accordingly, the partial bio-resources based factories total ABS potential is Rs. 9035.30 lakh. The following table provides a comprehensive picture about the ABS potential of the State based on the manufacturing of products by industrial units, and the amount is around Rs. 357 crore.

Table 6.3 Consolidated ABS potential from bio-resource based Manufacturing or Industrial Units

S No	Bio-resource based Manufacturing	ABS Amount (Rs. Lakh)
1	MSME	4802.39
2	Large factories	30965.98
	Total	35768.37

Table 6.4 Bioresources based industries in Kerala

Type of Industries	No of Units	Annual Turnover (Rs. in Crore)
MSMEs	47541	24,011.94
Factories		
(a) Fully bioresource based	3540	43,861.35
(b) Partially bioresource based	1307	36,141.22
Total	52,388	1,04,014.51

6.1.2 BIOLOGICAL RESOURCES' PURCHASED PRICE BASED ABS ESTIMATION

Access and Benefit Sharing (ABS) can be also availed of, based on biological resources' purchased price by the industries or based on the raw-material cost. Unfortunately we are not in a position to get this information from each industry either through the secondary data or through the primary sources. Hence, an ecosystem based approach has been followed with certain specific assumptions which have been approved by the experts. The base for this analysis is the ecosystem wise tradable bio-resources database (quantity of the resources and their economic or market value) we generated as part of the RKI project.

1. High value bio-resources (sandalwood and other timbers)

Kerala's forest ecosystem is rich with timber (wood) and Non Timber Forest Products (NTFPs). The Marayoor sandalwood has a high demand even in international markets. As per the estimation, the ABS Potential of Timber both from the forests and outside (Based on Auction Value) is Rs 1319 Lakh per year.

The data on timber sourced from different areas like forest, plantations and private lands has thus been studied in a comprehensive manner through quantitative analysis and this has given a broad idea about the contributions of timber bioresources and provides a roadmap for studying the scope of extracting ABS from the commercial sales of timber.

Table 6.5 ABS potential of Timber (based on auction value)

Timber	Mode of Estimation	Quantity (M ³ /Kg)	Value (Rs. Lakh)		ABS potential Value (Rs. Lakh)	
			Value	%	Value	%
FOREST						
27 Timber Depots	Cumulative Annual Average (2015-2020)	26422.07 (M ³)	15395	73.45	76.97 (0.5% of total value)	23.42
KFDC	Cumulative Annual Average: (2015-16 to 2019-20)	9684.30(M ³)	590	2.81	2.95 (0.5% of total value)	0.90
Marayoor Sandalwood	Cumulative Annual Average (2015-2020)	72,991 (Kg)	4975	23.74	248.75 (5% of total value)	75.68
Forest (Total)			20,960	100.00	328.67	100
Timber outside Forest						
Outside Forest (Total)	Annual total (2014-15)	22,56,219 (M ³)	1,98,134		990.67 (0.5% of total value)	100
Grand Total			2,19,094		1319.34	

2. Non Timber Forest Products (NTFPs)

Some of the NTFPs, particularly the medicinal plants and aromatic plants from Kerala's forests have high ABS potential. Out of the cumulative annual average value of the NTFPs we have arrived at (Rs. 423.3 Lakh), we assumed that around 50% goes for domestic (non commercial) purposes and traditional practices. As per the Biological Diversity Act, the bio-resources used by the local people and communities, including growers and cultivators of biodiversity, and v aids and hakims, who have been practicing indigenous medicine, are exempted from the provisions of the Act. Hence, only Rs. 211.6 (50% of the total value) is considered for ABS projection. The benefit sharing ratio considered for ABS estimation is 3% of the value. Accordingly, the ABS potentials of the NTFPs of Kerala amount to Rs. 6.35 Lakh per year.

Table 6.6: ABS Potential of NWFPs in Kerala

Method / Year	Quantity (Kg)	Total Value (Rs. Lakh)	Value considered for ABS (50% total value)	ABS Potential (Rs. Lakh)
Cumulative Average (2015-19)	826573.9	423.3	211.6	6.35 (3% of the value)

3. Fisheries Sector:

Both the marine and inland fisheries in Kerala can contribute substantially to ABS. Some of the fish species available in the State have high commercial potential and export value. Fish processing industries located in Kerala as well as in neighbouring states use the fish landed or cultured in Kerala as raw material. Since a large volume of fish in the State is used for domestic or local (non commercial) consumption, only 50% of the total value of fisheries sector is considered for ABS potential estimation. The benefit sharing ratio taken into account is 0.5% of the total value for both the marine and inland sectors. Accordingly, the total ABS potential of fisheries sector in the State is Rs.3039 Lakh per year, which includes Rs Rs.2079 Lakh from Marine and Rs.960 Lakh from inland sectors.

Table 6.7 ABS potential of fisheries

Method / Year	Quantity (MT)	Total Value (Rs. Lakh)	Value considered for ABS (50% total value)	ABS Potential (RS. Lakh)
Marine Fisheries				
Cumulative Average (2015-19)	518783	831666.47	415833.2	2079.17 (0.5% of the value)
Inland Fisheries				
Cumulative average (2015-19)	197086.2	384071.40	192035.7	960.18 (0.5% of the value)
Total	715869.2	1215737.87	607868.9	3039.35

4. Agriculture Sector

For the agriculture sector 26 major crops items of Kerala were considered for estimating the net value which comes to Rs. 23,61,407 Lakh. Out of this, only 30% (Rs. 7,08,422 Lakh) is considered for ABS estimation as most of the crop items are used for household purposes or domestic consumption. Further, considerable volumes of agriculture produce are under NTC (Normally Traded as Commodities). The benefit sharing ratio considered for estimating the ABS is 0.5% of the value. In brief, the ABS potential of Kerala's agriculture sector is Rs. 3542 Lakh per year.

Table 6.8 ABS Potential of Agriculture

Year	Production (MT)	Value (Rs. Lakh)	Value (Rs. Lakh) (30% of the value)	Potential ABS value (Rs. Lakh)
2018-19	5213126.3	23,61,407	7,08,422	3542.11 (0.5% of the total value)

5. Livestock Sector

The total value generated from the livestock sector of Kerala is Rs. 28,91,650 Lakh. As most of the livestock products are used in domestic sectors, we considered a limited percentage of the value for ABS estimation (30% for milk, 10% for egg and meat). The benefit sharing ratio considered in the livestock sector is 0.5%. The projected ABS in the livestock sector in Kerala is Rs. 2693 Lakh per year, which includes Rs. 1872 Lakh from milk; Rs. 65 Lakh from egg and Rs. 756 Lakh from meat.

Table 6.9 ABS Potential of Livestock

Livestock Product	Production	Value (Rs. in Lakh)	Reduced Value (Rs. in Lakh)	Potential ABS value (Rs. Lakh)	%
Milk	24560.38 (Lakh Ltrs)	1247905.42	374371.6 (30%)	1871.86 (0.5% of 30% of total value)	69.49
Egg	218.00 Crore Numbers	130950.00	13095 (10%)	65.47 (0.5% of 10% of total value)	2.43
Meat	4690 (Lakh Kg.)	1512816.90	151281.7 (10%)	756.41 (0.5% of 10% of total value)	28.08
Total		28,91,650	538748.3	2693.74	100.00

In Brief, the bio-resources based ABS potential of Kerala would be Rs. 10599 Lak.

Table 6.10 Bio-resources based ABS potential of Kerala

S No	Sectors	ABS potential (Rs. Lakh)
1	Forest	1325
	Timber	1319
	NTFPs	6
2	Fisheries	3039
	Marine	2079
	Inland	960
3	Agriculture	3542
4	Livestock	2693
	TOTAL	10599

6.1.3 ECOTOURISM

Biodiversity, at the species and ecosystems level provides an important foundation for tourism. The intrinsic and scenic beauty of biodiversity attracts large number of tourists; hence, these spots are having a huge scope for eco-tourism and can also be developed for biodiversity education and research. According to the CBD (2004), tourism is one of the world's fastest growing industries. In recent decades, tourism has emerged as significant economic activities, which occupy attractive landscapes and rich biodiversity spots. However, it is also a source of increasing stress on fragile ecosystems and their biodiversity.

Use Values is one of the major components of the Total Economic Value of an ecosystem or biodiversity. In the Use Values, the Direct Values are the ecosystem's marketed/traded goods such as: fish, timber, medicines, fodder, grains, cereals, milk, etc. and the marketed services such as recreation. Hence in our report, valuation of bio-resources emphasised recreation (tourism) services of biodiversity also along with various biodiversity goods (bio-resources) such as fish, timber, NTFPs, agricultural products, and livestock. In the analysis tourism including the ecotourism's revenue (direct and indirect) generated is considered as the recreation value of the biodiversity / ecosystem in the State. Revenue or earnings from tourism have shown a steady growth over the last five years. In 2019, Kerala has earned Rs.10271.06 crores as foreign exchange from tourism against Rs.8764.46crores in the year 2018 showing a growth of 17.19 %.

Eco-Tourism Destinations

The eco-tourism in forest areas is implemented through Forest Development Agencies. At present there are 60 eco-tourism destinations functioning in the State.

Table 6.11 Eco-Tourism- Wildlife Sanctuaries and National Parks

Sl. No	Districts	No. of destination
1	Thiruvananthapuram	6
2	Kollam	3
3	Pathanamthitta	5
4	Alappuzha	0
5	Idukki	9
6	Kottayam	2
7	Ernakulam	3
8	Thrissur	2
9	Palakkad	6
10	Malappuram	3
11	Kozhikode	5
12	Wayanad	12
13	Kannur	3
14	Kasaragod	1
	Total	60

Source: Kerala Tourist Statistics (2019)

During 2018-19, the income from Ecotourism activities to the Forest dept. is as follows:

1. A total amount of Rs 1067.23 lakh has been generated in ecotourism activities in 22 territorial divisions in the state.
2. An amount of Rs 2595.27 lakh has been generated from National Parks and wildlife sanctuaries in wildlife division



Fig 6.1 Earnings (cumulative average) from Tourism: 2015-2019 (Rs. crores)

Table 6.12 Earnings from Tourism (cumulative average 2015-2019 Rs. in crores)

Years	Foreign Exchange Earnings	Earnings from Domestic Tourist	Total revenue generated from Tourism (Direct & Indirect)
2015-2019	8,425	18,211	34,200

It is very clear that Ernakulam and Thiruvananthapuram are the major foreign tourists arrived districts followed by Alappuzha, Idukki and Kottayam. The foreign exchange earning of the state has increased from Rs. 8764.46 crores (2018) to Rs. 10271.06 crores (2019).

Table 6.13 Revenue from Ecotourism (Forest Department): 2018-19

S. No	Source	Revenue (Rs. In Crores)
1	22 territorial divisions	10.67
2	National Parks and wildlife sanctuaries in wildlife division	25.95
	Total	36.62

The total revenue generated by the Forest Department through eco-tourism during 2018-19 was Rs. 36.62 crore. Out of it, Rs. 10.67 crore was obtained from 22 territorial divisions and Rs. 25.95 crore through national parks and wildlife sanctuaries in the Wildlife Divisions.

Table 6.14 Total Value of Tourism and the Share of Biodiversity / Ecosystem Attributes (2019 in Crores)

S. No	Source	Amount	Biodiversity Attributed Share
1	Revenue from General Tourism (Direct and Indirect)	45,011	39,160 (87% of 45011)
2	Revenue from Ecotourism	37	37
	Total	45,048	39,197

The Share of Biodiversity / Ecosystem Attributes value of tourism out the total revenue of tourism is estimated based on the 2019 data and it comes to Rs. 39,197 Crores.

In this regard, the 'Guidelines on Biodiversity and Tourism Development' developed by the CBD is promising, and the State Government should follow the principle in it. The guidelines aim at making tourism and biodiversity more mutually supportive, engaging the private sector and local and indigenous communities, and promoting infrastructure and land-use planning, based on the principles of conservation and sustainable use of biodiversity. The guidelines provide a framework addressing

what the proponent of a new tourism investment or activity should do to seek approval, how the authorities should manage the approval process, and how to sustain the transition to sustainable tourism through education and capacity building (CBD, 2004).

Further, the Guidelines are conceived as a practical tool providing technical guidance to policy makers, decision makers and managers with responsibilities covering tourism and/or biodiversity, whether in the national or local government, the private sector, indigenous and local communities, non-governmental organizations and other organizations, on ways of working together with key stakeholders involved in tourism and biodiversity. To ensure their effective implementation, the Guidelines should be supported by long-term public education and awareness-raising campaigns to inform both professionals and the general public about the impacts of tourism on biological diversity and about good practices in this area, and capacity building activities.

No doubt that the guideline is extremely significance for the Tourism Department as well as the key policy makers of the Government of Kerala. It really facilitates in enhancing the tourism glory of the 'God's own country/state' in more biodiversity friendly manner.

6.2 BIORESOURCES BASED EMPLOYMENT GENERATION

We have seen that Biodiversity related sectors of the state play a significant role in manufacturing different consumer products, mobilizing state income, and generating employment opportunities and livelihood enhancement. About 10% of the population of Kerala is directly dependant on Biodiversity, in addition a considerable number of people are dependent on trade of bio resources, manufacturing different products at small scale and large scale, handicrafts, supply and value addition of bioresources, biodiversity related tourism etc. The following table provide a compilation of the biodiversity / bio-resources based sectors employment generation.



Table 6.1 5 Annual employment generated

S. No	Sectors	Employment (Numbers)
1	Agriculture	
	(a) Cultivators (Main and Marginal)	6,70,253
	(b) Agriculture labourers (Main and Marginal)	13,22,850
	Total	19,93,103
2	Fisheries (Active fishermen),	
	(a) Inland	92,124
	(b) Marine	2,47,849
	Total	3,39,973
	Fish Vendors	25,395
4	Forest (Forest statistics, 2019)	
	1. VSS	
	(a) SC (7,062x4)	28,248
	(b) ST (15,225x4)	60,900
	(c) Others (36,798x4)	1,47,192
	VSS Total	2,36,340
	2. EDC	
	(a) SC (3,462x4)	13,848
	(b) ST (3,868x4)	15,472
	(c) Others (5,088x4)	20,352
EDC Total	49,672	
3	Livestock – (Dairying only Poultry)	3,78,773
6	Tourism (Eco-tourism) only	4,50,000
	Total	34,73,256

6.3 ABS POTENTIAL OF KERALA

The contribution of Kerala's biodiversity in the form of biological resources and tourism (direct use-values) is significant. Besides, the State's biodiversity / ecosystems also provide a number of non-marketed services, but their valuation is not under the scope of the RKI project. In the industrial sector of Kerala, bioresources based industries play a major role at the Micro, Small and Medium Enterprises (MSMEs) as well as the big factories (which are assessed fully and partially.). There are 52,388 bioresources based manufacturing (industrial) units in the State, which generate an annual turnover to the tune of Rs. 1,04,014 crore. There is no doubt that a substantial share of the bioresources used by these industrial units, as raw-materials, originates from Kerala. Further our research / study clearly revealed that the bioresources originated from Kerala are used by the industrial units in other States as well as abroad.

Table 6.16 Quantity and value of different Bioresources of Kerala

Ecosystems / Sectors	Bioresources	Mode of Estimation	Quantity (M³/Kg)	Value (Rs. Crore)
Forest	Timber (27 Timber Depots)	Cumulative Annual Average (2015-2020)	26422.07 (M ³)	153.95
	Timber (KFDC)	Cumulative Annual Average: (2015-16 to 2019-20)	9684.30 (M ³)	5.90
	Timber (Marayoor Sandalwood)	Cumulative Annual Average (2015-2020)	72,991 (Kg)	49.75
	NTFP	Cumulative Average (2015-19)	826573.9 (Kg)	4.23
	Forest (Total)			
Land outside Forest	Timber (outside forest)	Annual total (2014-15)	22,56,219 (M ³)	1,981.34
Marine	Fish	Cumulative Average (2015-19)	518783 MT	8,316.66
Inland	Fish	Cumulative average (2015-19)	197086.2MT	3,840.71
Agriculture	crops	2018-19	5213126.3 MT	23,614.07
Livestock	Milk	Annual total (1919-20&2017-18)	24560.38 (Lakh Ltrs)	12,479.05
	Egg	Annual total (1919-20&2017-18)	218.00 (Crore Nos.)	1,309.50
	Meat	Annual total (1919-20&2017-18)	4690 (Lakh Kg.)	15,128.16
	Livestock (Total)			
GRAND TOTAL				66,883.11



The total annual value of the bioresources at their origin is Rs. 66,883.11 Crore, which indicates the magnitude of the contribution of biodiversity (in the form of bioresources) in the State. The bioresources coming from the forests, marine, and freshwater ecosystems (those are common properties) are purely the gift of nature. Since, biodiversity has recreational value (which is considered as direct use value of the biodiversity like bioresources) the tourism related value - revenue of tourism –was also estimated, which comes to Rs. 39,197 Crores.

Table 6.17 Marine and Inland bioresources

Sl.No	Scientific name	Common name
	Crustaceans	
1	<i>Penaeus indicus</i> H. Milne Edwards, 1837	Indian prawn
2	<i>Penaeus monodon</i> Fabricius, 1798	Tiger prawn
3	<i>Penaeus semisulcatus</i> (de Haan, 1844)	Green Tiger Prawn
4	<i>Penaeus japonicus</i> (Bate, 1888)	Kuruma prawn
5	<i>Melicertus canaliculatus</i> (Olivier, 1811)	Local Witch prawn
6	<i>Metapenaeus dobsoni</i> (Miers, 1878)	Kadal shrimp
7	<i>Metapenaeus affinis</i> (Milne- Edwards, 1837)	Jinga Prawn
8	<i>Metapenaeus monoceros</i> (Fabricius, 1798)	Brown/Speckled Shrimp
9	<i>Parapenaeopsis stylifera</i> (Milne- Edwards, 1837)	Kiddi Prawn

10	<i>Litopenaeus vannamei</i> (Boone, 1931)	White leg prawn, Vannamei prawn
11	<i>Heterocarpus woodmasoni</i> Alcock, 1901	Indian Nylon Shrimp
12	<i>Heterocarpus gibbosus</i> (Spence Bate, 1888)	Tomato shrimp
13	<i>Parapandalus spinipes</i> (Bate, 1888)	
14	<i>Plesionika ensis</i> (Milne-Edwards, 1881)	Gladiator striped shrimp
15	<i>Aristeus alcocki</i> Ramadan, 1938	Arabian red shrimp
16	<i>Exhippolysmata ensirostris</i> (Kemp, 1914)	Hunter shrimp
17	<i>Solenocera hextii</i> (Wood-Mason & Alcock, 1891)	Deep-sea mud shrimp
18	<i>Solenocera crassicornis</i> (Milne-Edwards, 1837)	Coastal mud shrimp
19	<i>Solenocera choprai</i> Nataraj, 1945	Ridgeback shrimp
20	<i>Acetes indicus</i> Milne-Edwards, 1830	Jawla paste shrimp
21	<i>Acetes erythraeus</i> Nobili, 1905	Tsivakihini paste shrimp
22	<i>Acetes johni</i> Nataraj, 1947	Paste shrimp
23	<i>Macrobrachium idella</i> (Hilgendorf, 1898)	Slender river prawn
24	<i>Macrobrachium rosenbergii</i> (de Man, 1879)	Giant freshwater prawn
26	<i>Portunus pelagicus</i> (Linnaeus, 1758)	Flower crab
27	<i>Portunus sanguinolentus</i> (Herbst, 1783)	Three spot swimming crab
28	<i>Scylla serrata</i> (Forskål, 1775)	Mud crab
29	<i>Scylla tranquebarica</i> (Fabricius, 1798)	Mangrove crab
30	<i>Scylla olivacea</i> (Herbst, 1796)	Orange mud crab
31	<i>Charybdis feriata</i> (Linnaeus, 1758)	Crucifix crab
31	<i>Charybdis smithii</i> (Fabricius, 1798)	Indian ocean swimming crab
32	<i>Charybdis lucifera</i> (Fabricius, 1798)	Yellowish brown crab
33	<i>Charybdis natator</i> (Herbst, 1789)	Ridged swimming crab
34	<i>Thenus unimaculatus</i> Burton & Davie, 2007	
35	<i>Panulirus homarus</i> (Linnaeus, 1758)	Scalloped Spiny Lobster
36	<i>Panulirus ornatus</i> (Fabricius, 1798)	Ornate Rock Lobster
37	<i>Panulirus polyphagus</i> (Herbst, 1793)	Spiny Lobster

38	<i>Panulirus versicolor</i> (Latreille, 1804)	Painted Rock Lobster
39	<i>Puerulus sewelli</i> Ramadan, 1938	Arabian whip lobster
40	<i>Nephropsis stewarti</i> Wood-Mason, 1872	Indian Ocean lobsterette
	Molluscs	
41	<i>Lamellidens marginalis</i> (Lamarck, 1819)	Freshwater mussel
42	<i>Saccostrea cucullata</i> (Born, 1778)	Hooded oyster
43	<i>Crassostrea madrasensis</i> (Preston, 1916)	Indian Backwater oyster
44	<i>Meretrix casta</i> (Gmelin, 1791)	Backwater hard clam
45	<i>Meretrix meretrix</i> (Linnaeus, 1758)	Asiatic hard clam
46	<i>Perna perna</i> (Linnaeus, 1758)	Brown mussel
47	<i>Perna viridis</i> (Linnaeus, 1758)	Asian Green Mussel
48	<i>Pinctada margaritifera</i> (Linnaeus 1758)	Black-lip pearl oyster
49	<i>Paphia malabarica</i> (Dillwyn, 1817)	Short neck clam
50	<i>Villorita cyprinoides</i> (Gray, 1825)	black clam
51	<i>Sepia aculeata</i> (Van Hasselt, 1835)	Needle Cuttle fish
52	<i>Sepia pharaonis</i> (Ehrenberg, 1831)	Pharaoh cuttlefish
53	<i>Sepilla inermis</i> (Van Hasselt, 1835)	Spineless cuttlefish
54	<i>Uroteuthis duvauceii</i> (d'orbigny, 1835)	Indian Squid
55	<i>Octopus vulgaris</i> (Cuvier, 1797)	Common octopus
56	<i>Cistopus incidus</i> (Raap, 1835)	Pouched Octopus
	Fishes	
57	<i>Chiloscyllium indicum</i> (Gmelin, 1789)	Slender Bamboo Shark
58	<i>Alopias pelagicus</i> (Nakamura, 1935)	Pelagic Thresher Shark (Whiptail Shark)
59	<i>Alopias vulpinus</i> (Bonnaterre, 1788)	Common Thresher (Thresher
60	<i>Carcharhinus dussumieri</i> (Müller & Henle, 1839)	Whitecheek Shark
61	<i>Carcharhinus limbatus</i> (Müller & Henle, 1839)	Blacktip Shark
62	<i>Rhizoprionodon acutus</i> (Rüppell, 1837)	Milk Shark
63	<i>Scoliodon laticaudus</i> (Müller & Henle, 1838)	Spadenose Shark

64	<i>Sphyrna zygaena</i> (Linnaeus, 1758)	Smooth hammer head
65	<i>Pristis microdon</i> (Latham, 1794)	Large-tooth Sawfish
66	<i>Himantura bleekeri</i> (Blyth, 1860)	Bleeker's Whip Ray
67	<i>Himantura uarnak</i> (Gmelin, 1789)	Honeycomb Stingray
68	<i>Hippocampus kuda</i> (Leach, 1814)	Spotted Seahorse (Yellow Seahorse)
69	<i>Hippocampus trimaculatus</i> (Hamilton, 1822)	Longnose Seahorse (Three-spot Seahorse)
70	<i>Rachycentron canadum</i> (Linnaeus, 1758)	Cobia (King Fish)
71	<i>Parastromateus niger</i> (Lacepède, 1801)	Black Pomfret
72	<i>Scomberoides commersonianus</i> (Forsskål, 1775)	Talang Queenfish
73	<i>Scomberoides lysan</i> (Cuvier, 1832)	Double-Spotted Queenfish
74	<i>Coryphaena hippurus</i> (Bloch & Schneider, 1801)	Common Dolphinfish
75	<i>Lutjanus malabaricus</i> (Bloch, 1790)	Malabar Blood Snapper
76	<i>Nemipterus japonicus</i> (Bleeker, 1853)	Japanese Threadfin Bream
77	<i>Johnius dussumieri</i> (Mohan, 1976)	Sin Croaker
78	<i>Mugil cephalus</i> (Bleeker, 1853)	Flathead Mullet
79	<i>Siganus javus</i> (Valenciennes, 1835)	Streaked Spinefoot
80	<i>Lepturacanthus savala</i> (Klunzinger, 1884)	Savalai Hairtail
81	<i>Trichiurus lepturus</i> (Cuvier, 1832)	Large head Hairtail
82	<i>Auxis rochei</i> (Lacepède, 1800)	Bullet Tuna
83	<i>Auxis thazard</i> (Cantor 1849)	Frigate Tuna (Frigate Tuna)
84	<i>Euthynnus affinis</i> (Rüppell 1836)	Kawakawa (Mackerel Tuna)
85	<i>Katsuwonus pelamis</i> (Cuvier, 1816)	Skipjack Tuna (Skiy Jack)
86	<i>Rastrelliger kanagurta</i> (Temminck & Schlegel, 1844)	Indian Mackerel
87	<i>Scomberomorus commerson</i> (Bloch & Schneider, 1801)	Narrow-Barred Spanish Mackerel (King Seer)
88	<i>Scomberomorus guttatus</i> (Kishinouye, 1915)	Indo-Pacific King Mackerel (Spotted Spanish Mackerel)
89	<i>Scomberomorus lineolatus</i> (Bonnaterre, 1788)	Streaked Seer

90	<i>Istiompax indica</i>	Black Marlin
91	<i>Thunnus albacares</i> Bleeker, 1851	Yellow Fin Tuna
92	<i>Thunnus tonggol</i> (Bleeker, 1851)	Longtail Tuna (Longtail Tuna)
93	<i>Pampus argenteus</i> (Euphrasen, 1788)	Silver Pomfret
94	<i>Pampus chinensis</i> (Günther, 1860)	Chinese Silver Pomfret
95	<i>Parastromateus niger</i> (Bloch, 1795)	
96	<i>Cynoglossus puncticeps</i> (Day, 1877)	Speckled Tonguesole
97	<i>Epinephelus malabaricus</i> (Bloch & Schneider, 1801)	Malabar Grouper
98	<i>Sardinella longiceps</i> (Valenciennes, 1847)	Indian Oil Sardine
99	<i>Chanos chanos</i> (Forsskal 1775)	Milk fish
100	<i>Lates calcarifer</i> (Bloch 1790)	Barramundi
101	<i>Epinephelus diacanthus</i> (Valenciennes 1828)	Spinycheek grouper
102	<i>Epinephelus areolatus</i> (Forsskål 1775)	Areolate grouper
103	<i>Lutjanus argentimaculatus</i> (Forsskål 1775)	Mangrove red snapper
104	<i>Carinotetraodon travancoricus</i> (Hora & Nair, 1941)	Dwarf pufferfish
105	<i>Dawkinsia arulius</i> (Jerdon, 1849)	Arulius barb
106	<i>Garra hughi</i> (Silas, 1955)	Cardamon garra
107	<i>Hypselobarbus kurali</i> (Menon & Rema Devi, 1995)	Kooral
108	<i>Sahyadria denisonii</i> (Day 1865)	Denison barb
109	<i>Sahyadria chalakkudiensis</i> (Menon, Rema Devi & Thobias, 1999)	Chalak barb
110	<i>Batasio travancoria</i> (Hora & Law, 1941)	Travancore batasio
111	<i>Glyptothorax housei</i> (Herre, 1942)	
112	<i>Mesonoemacheilus remadevii</i> (Shaji, 2002)	Devi's Loach
113	<i>Anguilla bengalensis</i> (Gray, 1831)	Indian mottled eel
114	<i>Barilius bakeri</i> (Day, 1865)	
115	<i>Barilius gatensis</i> (Valenciennes, 1844)	River-carp baril

116	<i>Channa striata</i> (Bloch, 1793)	Striped snakehead
117	<i>Danio rerio</i> (Hamilton, 1822)	Zebra fish
118	<i>Dawkinsia filamentosus</i> (Valenciennes, 1844)	filament barb
119	<i>Devario malabaricus</i> (Jerdon, 1849)	Malabar danio
120	<i>Pseudetroplus maculatus</i> (Bloch, 1795)	Orange chromidae
121	<i>Etroplus suratensis</i> (Bloch 1790)	Green chromidae
122	<i>Horabagrus nigricollaris</i> (Pethiyagoda & Kottelat, 1994)	Black collared catfish
123	<i>Horabagrus brachysoma</i> (Günther, 1864)	Sun cat fish
124	<i>Laubuca fasciata</i> (Silas, 1958)	Malabar Hatchet Chela
125	<i>Macrognathus aral</i> (Bloch & Schneider, 1801)	one-stripe spiny eel
126	<i>Mastacembelus armatus</i> (Lacepède, 1800)	zig-zag eel
127	<i>Nandus nandus</i> (Hamilton, 1822)	Gangetic leaf fish
128	<i>Nemacheilus guentheri</i> (Day, 1867)	Gunther's Loach
129	<i>Mesonemacheilus triangularis</i> (Day, 1865)	Stone loach
130	<i>Osteochilichthys nashi</i> (Day, 1869)	Nash's barb
131	<i>Parambassis thomassi</i> (Day, 1870)	Western Ghat glassy perchlet
132	<i>Pethia conchoni</i> (Hamilton, 1822)	Rosy barb
133	<i>Pethia ticto</i> (Hamilton, 1822)	Ticto barb
134	<i>Travancoria elongata</i> (Pethiyagoda & Kottelat, 1994)	Periyar loach
135	<i>Channa diplogramma</i> (Day, 1865)	Malabar snakehead
136	<i>Channa marulius</i> (Hamilton, 1822)	Great snakehead
137	<i>Channa striata</i> (Bloch, 1793)	Striped snakehead
138	<i>Heteropneustes fossilis</i> (Bloch, 1794)	Stinging catfish
139	<i>Wallago attu</i> (Bloch & Schneider, 1801)	Wallago
140	<i>Tor khudree</i> (Sykes, 1839)	Deccan mahseer
141	<i>Tor malabaricus</i> Jerdon, 1849	Malabar mahseer
142	<i>Amphiprion percula</i> (Lacepède, 1802)	Clown anemone fish
143	<i>Amphiprion ocellaris</i> Cuvier, 1830	False clown anemone fish

144	<i>Amphiprion sandaracino</i> Allen, 1972	Yellow sunk clown
145	<i>Amphiprion frenatus</i> Brevoort, 1856	Tomato clown
146	<i>Amphiprion clarkia</i> (J.W. Bennett, 1830)	Clark's Anemone fish
147	<i>Amphiprion nigripes</i> Regan, 1908	Maldives Anemone fish
148	<i>Premnas biaculeatus</i> (Bloch, 1790)	Maroon clown
149	<i>Pseudochromis dielectus</i> Lubbock, 1976	Redhead dottyback
150	<i>Dascyllus trimaculatus</i> (Rüppell, 1829)	Three spot damsel
151	<i>Dascyllus aruanus</i> (Linnaeus, 1758)	Stripped damsel
152	<i>Pomacentrus caeruleus</i> Quoy & Gaimard, 1825	Blue damsel
153	<i>Neopomacentrus nemurus</i> (Bleeker, 1857)	Yellow tail damsel
154	<i>Chrysiptera cyanae</i> Quoy & Gaimard, 1825	Sapphire devil
155	<i>Chrysiptera unimaculata</i> (Cuvier, 1830)	One spot damsel
156	<i>Chromis viridis</i> (Cuvier, 1830)	Green chromis
	SPONGES (shown here to give emphasis on bio-active compounds)	
157	<i>Spongia officinalis</i> Linnaeus, 1759	Bath sponge
158	<i>Xestospongia</i> sp.	
159	<i>Zezya fuliginisa</i>	
160	<i>Eurysspongia</i>	
161	<i>Dactylospongia elegans</i> (Thiele, 1899)	
162	<i>Tridemnum</i> sps.	
163	<i>Tethyacrypta</i>	
164	<i>Echinodactylum</i> sps.	
165	<i>Discodermia dissolute</i>	
166	<i>Lissodendorys</i> sps.	
167	<i>Verongia aerophoba</i>	
168	<i>Theonella</i> sp.	
	ASCIDIAN	
169	<i>Lissodinium bistratum</i>	

	SEA WEEDS	
170	<i>Gracilaria corticata</i>	Agar
171	<i>Gracilaria foliifera</i>	Agar
172	<i>Gelidiopsis variabilis</i>	Agar
173	<i>Gelidium pusillum</i>	Agar
174	<i>Sargassum wightii</i>	Algin
175	<i>Sargassum duplicatum</i>	Algin
176	<i>Sargassum tenerimum</i>	Algin
177	<i>Stoechospermum marginatum</i>	Algin
178	<i>Dictyota dichotoma</i> and <i>Padina</i>	Algin
179	<i>Padina</i> sp.	Algin
180	<i>Hypnea musciformis</i>	Carangineen
181	<i>Hypnea valentiae</i>	Carangineen
182	<i>Grateloupia filicina</i>	Carangineen
183	<i>Hypnea musciformis</i>	Carangineen
184	<i>Hypnea valentiae</i>	Carangineen
185	<i>Grateloupia filicina</i>	Carangineen
186	<i>Grateloupia lithophila</i>	Carangineen
187	<i>Gracilariopsis lemaneiformis</i>	Carangineen



Table 6.18 Floral Bioresources- Medicinal Plants

Botanical Name	Local Name	Part Used	Threat Status
<i>Nervilia crociformis</i>	Orilathamara	Rhizomes	NT *
<i>Abies spectabilis</i>	Thalisapathram	Leaves	NT or LR **
<i>Abrus precatorious</i>	Kunnikkuru	Seed	NT *
<i>Acacia catechu</i>	Karingali	Wood	LC **
<i>Acacia nilotica</i>	Karivelappatta	Bark	LC **
<i>Achyranthes aspera</i>	Valiyakadaladi	Roots	
<i>Aconitum ferox</i>	Valsanabhi	Tuberous root	EN *
<i>Aconitum heterophyllum</i>	Athividayam	Tuberous root	CR *
<i>Acorus calamus</i>	Vayambu	Rhizome	EN *
<i>Actiniopteris dichotoma</i>	Nanmughapullu	Leaves	Rare ^
<i>Justicia beddomei</i>	Cheriyadaalodakam	Roots, Leaves	CR *
<i>Adiantum lunatum</i>	Kozhikkalin veru	Roots	NT **
<i>Aegle marmelos</i>	Koovalam	Roots, Leaves, Fruits pulp	NT **
<i>Aerva lanata</i>	Cheroola	Whole plant, Roots	
<i>Ageratum conyzoides</i>	Kattappa veru	Roots	
<i>Alangium salviifolium</i>	Ankolathin	Roots	LC **
<i>Albizia lebbek</i>	Nenmenivaka	Bark, Roots	LC **
<i>Aloe vera</i>	Kattarvazha	Leaves	
<i>Alpinia officinarum</i>	Chuvannaratha	Roots	
<i>Alstonia scholaris</i>	Ezhilampala	Bark	LC **
<i>Amomum subulatum</i>	Perelam	Fruits	DD **
<i>Amorphophallus paeoniifolius</i>	Kattuchena	Corm	LC **
<i>Anacyclus pyrethrum</i>	Akkikkaruka	Roots	
<i>Andrographis paniculata</i>	Kiriyath	Whole plant	VU *
<i>Anethum graveolens</i>	Shathakuppa	Fruits	
<i>Anisomeles malabarica</i>	Karinthumpa	Whole plant	
<i>Aquilaria agallocha</i>	Karakil	Wood	EN *
<i>Argemone mexicana</i>	Erumakkalli	Whole plant	
<i>Aristolochia bracteolata</i>	Attukottappala	Roots	VU *
<i>Aristolochia indica</i>	Garudakkodi	Roots	VU *
<i>Asparagus racemosus</i>	Shathavari	Tuberous root	EN *
<i>Azadirachta indica</i>	Aryavepp	Roots, Leaves, Fruits, Bark, Wood	LC **
<i>Azima tetraacantha</i>	Eshankin	Roots	LC **
<i>Bacopa monnieri</i>	Brahmi	Whole plant	VU *
<i>Baliospermum montanum</i>	Nagadanthi	Roots	NT*
<i>Bauhinia variegata</i>	Chuvanna mandaram	Bark	LC **
<i>Biophytum sensitivum</i>	Mukkutti	Fruits	
<i>Boerhavia diffusa</i>	Thazhuthama	Whole plant, Roots	
<i>Borassus flabellifer</i>	Panavazha	Flowers	EN **
<i>Brassica alba</i>	Velutha kaduk	Fruits	LC **
<i>Brassica nigra</i>	Karuthakaduk	Fruits	LC **
<i>Bridelia stipularis</i>	Kannikottam	Roots	LC **
<i>Butea monosperma</i>	Plash	Bark	LC **
<i>Caesalpinia sappan</i>	Pathimugham	Wood	LC **
<i>Caesalpinia bonduc</i>	Kazhanchi	Roots, Seed	LC **
<i>Callicarpa macrophylla</i>	Njazhal	Flowers	LC **
<i>Calophyllum inophyllum</i>	Punna	Flowers	
<i>Calotropis gigantea</i>	Erukk	Roots, Leaves	
<i>Calycopteris floribunda</i>	Pullani	Leaves, Fruits	
<i>Cardiospermum halicacabum</i>	Uzhinja	Whole plant	LC **
<i>Caryota urens</i>	Panamkula	Inflorescence	LC **

<i>Cassia fistula</i>	Kannikonna	Leaves, Bark	LC **
<i>Cassia tora</i>	Ponnanthakara	Seed	
<i>Cedrus deodara</i>	Devatharam	Wood	LC **
<i>Celastrus paniculatus</i>	Cherupunnayari	Seed	EN *
<i>Centella asiatica</i>	Muthil	Whole plant	LC **
<i>Centratherum anthelminticum</i>	Kattujeerakam	Seed	
<i>Chenopodium album</i>	Cherucheera	Whole plant	
<i>Chonemorpha fragrans</i>	Perumkurumba	Roots	EN *
<i>Chrysopogon zizanioides</i>	Ramacham	Roots	LC **
<i>Cinnamomum malabattrum</i>	Sheema Elavankam	Bark	LC **
<i>Cissus quadrangularis</i>	Changalamparanda	Whole plant	
<i>Citrullus colocynthis</i>	Kattuvellari	Roots	VU *
<i>Cleome gynandra</i>	Adunarivelaveru	Roots	
<i>Clerodendrum serratum</i>	Cheruthekk	Roots	EN *
<i>Clitoria ternatea</i>	Shankupushpam	Whole plant, Roots	
<i>Coleus aromaticus</i>	Panikoorkka	Leaves	
<i>Coptis teeta</i>	Peetharohini	Tuberous root	EN **
<i>Coriandrum sativum</i>	Kothambalayari	Fruits	
<i>Coscinium fenestratum</i>	Maramanjil	Bark	CR *
<i>Costus speciosus</i>	Naruchanna	Tuberous root	VU *
<i>Crateva magna</i>	Neermathalam	Roots, Bark	
<i>Crocus sativus</i>	Kunkumapoovu	Stigma & Style	
<i>Cullen corylifolium</i>	Karkokilari	Fruits	LC **
<i>Cuminum cyminum</i>	Jeerakam	Seed	
<i>Curculigo orchioides</i>	Nilappana	Tuberous root	
<i>Curcuma aromatica</i>	Kasthurimanjal	Rhizomes	VU *
<i>Curcuma longa</i>	Pachamanjal	Rhizomes	
<i>Cyathula prostrata</i>	Cherukadaladi	Whole plant	
<i>Cyclea peltata</i>	Padakizhang	Tuberous root	LC *
<i>Cymbopogon citratus</i>	Chonapullu	Leaves	
<i>Cymbopogon martini</i>	Poothunakkappullu	Leaves	
<i>Cynodon dactylon</i>	Karuka	Leaves	
<i>Cyperus rotundus</i>	Muthanga	Tuberous root	LC **
<i>Datura metel</i>	NeelaUmmam	Whole plant, Fruits, Leaves	LC **
<i>Desmodium gangeticum</i>	Orila	Roots	
<i>Desmodium triflorum</i>	Nilamparanda	Whole plant	LC **
<i>Desmostachya bipinnata</i>	Attudarbha	Roots	LC **
<i>Dolichos biflorus</i>	Pazhyamuthira	Fruits	
<i>Eclipta prostrata</i>	Kanjuni	Leaves	LC **
<i>Elaeocarpus serratus</i>	Rudhraksham	Fruit	LC **
<i>Elettaria cardamomum</i>	Elakka	Fruits	
<i>Embelia ribes</i>	Vizhalari	Seed	VU **
<i>Erythrina variegata</i>	Murikk	Bark, Leaves	
<i>Euphorbia ligularia</i>	Kalli	Roots	
<i>Euphorbia neriifolia</i>	Kalliyila	Leaves	LC **
<i>Euphorbia trigona</i>	Kallikazhuth	Leaves	
<i>Ficus benghalensis</i>	Peral	Roots, Flower bud, Bark	
<i>Ficus hispida</i>	Kattathi veru	Roots	LC **
<i>Ficus microcarpa</i>	Ithimottu	Flowerbud, Bark	LC **
<i>Ficus racemosa</i>	Athi	Flowerbud, Bark	LC **
<i>Ficus religiosa</i>	Arayal	Flowerbud, Bark	
<i>Garcinia gummi-gutta</i>	Kudambuli	Leaves	LC **
<i>Glycyrrhiza glabra</i>	Irattimadhuram	Roots	LC **

<i>Gmelina arborea</i>	Kumizhin veru	Roots, Fruits	LC **
<i>Gossypium herbaceum</i>	Paruthi	Fruits	
<i>Gymnema sylvestre</i>	Chakkarakolli	Leaves	EN *
<i>Hedyotis pruinosa</i>	Parppadakapullu	Whole plant	
<i>Heliotropium indicum</i>	Thekkada	Roots	
<i>Hemidesmus indicus</i>	Naruneendi	Tuberous root	
<i>Holarrhena pubescens</i>	Kudakappala	Bark, Seed	LC **
<i>Holoptelea integrifolia</i>	Avil patta	Bark	
<i>Holostemma ada-kodien</i>	Adapathiyan kizhangu	Tuberous root	EN *
<i>Homonoia riparia</i>	Attuvanchi	Roots	LC **
<i>Hordeum vulgare</i>	Yavam	Seed	LC **
<i>Hugonia mystax</i>	Karthotti	Roots	
<i>Hygrophila auriculata</i>	Vayalchulli	Roots, Fruits	LC **
<i>Hyoscyamus niger</i>	Kurashani	Fruits	EN *
<i>Ichnocarpus frutescens</i>	Parvalli	Tuberous root	
<i>Illicium verum</i>	Thakkolapottil	Flowers	
<i>Imperata cylindrica</i>	Dharbha	Roots, Leaves	LC **
<i>Indigofera tinctoria</i>	Neelayamari	Roots, Leaves	
<i>Inula racemosa</i>	Pushkaram	Roots	
<i>Ipomoea turbinata</i>	Vattapoonthaliyari	Fruits	
<i>Ipomoea mauritiana</i>	Palmuthukk	Tuberous root	NT *
<i>Ipomoea marginata</i>	Thiruthali	Twinnings	NT *
<i>Ipomoea pes-tigridis</i>	Pulichuvadi	Whole plant	
<i>Ixora coccinea</i>	Thechi	Roots, Flowers	
<i>Jasminum grandiflorum</i>	Pichakam	Roots, Leaves, Flower bud	
<i>Jasminum multiflorum</i>	Kurukkuthimulla	Roots	
<i>Kaempferia galanga</i>	Kachooram	Rhizomes	DD *
<i>Kaempferia rotunda</i>	Chengazhineer	Tuberous root	
<i>Lagenaria siceraria</i>	Churayila	Leaves	
<i>Lens culinaris</i>	Chanam payar	Seed	LC **
<i>Lepidium sativum</i>	Ashali	Seed	
<i>Leucas aspera</i>	Thumba	Flowers	
<i>Limonia acidissima</i>	Blankay	Fruits	VU *
<i>Linum usitatissimum</i>	Agashi	Fruits	
<i>Lodoicea maldivica</i>	Aklari Thenga	Fruits	EN **
<i>Madhuca longifolia</i>	Eruppa	Flowers, Wood matter	VU *
<i>Magnolia champaca</i>	Champakam	Flower bud	LC **
<i>Mallotus philippensis</i>	Kambipala	Bark	LC **
<i>Merremia emarginata</i>	Elicheviyan	Whole plant	LC **
<i>Merremia tridentata</i>	Prasarani	Whole plant	
<i>Mesua ferrea</i>	Sheemanagapoovu	Flowers	EN **
<i>Mimusops elengi</i>	IlANJI	Flowers	LC **
<i>Momordica dioica</i>	Kaippakka	Fruits	
<i>Monochoria vaginalis</i>	Karimkoovalam	Rhizomes	LC **
<i>Mucuna pruriens</i>	Naykkaruna	Roots, Kernel	LC **
<i>Mukia maderaspatana</i>	Mushumushukk	Whole plant	
<i>Myristica fragrans</i>	Jathipathri	Flowers, Fruits	DD **
<i>Myristica malabarica</i>	Pashupashi	Flowers	VU **
<i>Myxopyrum smilacifolium</i>	Chathuramulla	Whole plant	
<i>Nardostachys Jatamansi</i>	Jadamanji	Roots	CR **
<i>Nelumbo nucifera</i>	Thamaravalayam	Twinnings, Flowers, Rhizomes, Seed	DD **
<i>Neolamarckia cadamba</i>	Kadambin	Roots	
<i>Nerium oleander</i>	Karaveeram	Roots, Bark	LC **

<i>Nigella sativa</i>	Karimjeerakam	Fruits	LC **
<i>Nilgiranthus ciliatus</i>	Karimkunjiri	Whole plant, Roots	VU **
<i>Nymphaea nouchali</i>	Naithal	Rhizomes	EN **
<i>Ocimum kilimandscharicum</i>	Karpoorathulasi	Roots	
<i>Ocimum gratissimum</i>	Kattuthulasi	Roots	VU *
<i>Ocimum tenuiflorum</i>	Thulasi	Flowers, Roots, Leaves	
<i>Operculina turpethum</i>	Kuzhalkonna	Roots	EN **
<i>Oroxylum indicum</i>	Palakapayyani	Roots	EN *
<i>Orthosiphon glabratus</i>	Kuzhimundan	Whole plant	
<i>Oxalis corniculata</i>	Puliyaral	Whole plant	
<i>Pandanus odorifer</i>	Pookaitha	Roots	LC **
<i>Papaver somniferum</i>	Vella kashakasha	seed	LC **
<i>Paspalum scrobiculatum</i>	Varakinari	Seed	LC **
<i>Phoenix dactylifera</i>	Enthappazham	Fruits	LC **
<i>Phoenix pusilla</i>	Chittenthal	Roots	
<i>Phyllanthus amarus</i>	Keezharnelli	Whole plant	
<i>Phyllanthus emblica</i>	Nellikka	Fruit rind, Fruits	VU *
<i>Physalis minima</i>	Njottanjodiyam	Whole plant	LC **
<i>Picrorhiza kurroa</i>	Kadukurohini	Roots	EN **
<i>Pinus roxburghii</i>	Charalam	Wood matter	EN **
<i>Piper betle</i>	Vettila	Leaves	
<i>Piper attenuatum</i>	Kattumulak	Roots	
<i>Piper cubeba</i>	Valmulak	Fruits	
<i>Piper longum</i>	Kattuthippali	Roots, Fruits	NT **
<i>Piper betle</i>	Vellila	Twiners	
<i>Pistacia chinensis</i>	Karkkidaka Shrinki	Fruits	LC **
<i>Plectranthus hadiensis</i>	Sheema Iruveli	Roots	LC **
<i>Plumbago zeylanica</i>	Koduveli	Tuberous root	VU **
<i>Plantago ovata</i>	Thumboonalari	Seed	
<i>Pogostemon cablin</i>	Sheemapachila	Leaves	LC *
<i>Pongamia pinnata</i>	Ung	Roots, Kernel, Bark, Fruits	EN **
<i>Portulaca oleracea</i>	Kozhuppa	Whole plant, Leaves	LC **
<i>Pothos scandens</i>	Paruvakkodi	Twiners	
<i>Premna serratifolia</i>	Munja	Roots	LC **
<i>Prunus avium</i>	Elavalukam	Fruits	LC **
<i>Prunus dulcis</i>	Badham	Kernel	LC **
<i>Pseudarthria viscida</i>	Moovila	Roots	VU *
<i>Pterocarpus marsupium</i>	Venga	Wood	NT **
<i>Pterocarpus santalinus</i>	Rakthachandanam	Wood	EN **
<i>Punica granatum</i>	Mathala Naranga	Fruits, Leaves	LC **
<i>Quercus infectoria</i>	Mayakk	Fruits	LC **
<i>Catunaregam spinosa</i>	Malankaram	Seed	
<i>Raphanus sativus</i>	Mooleri	Tuberous root	
<i>Rauwolfia serpentina</i>	Amalpori	Roots	EN *
<i>Rhaphidophora pertusa</i>	Athithippali	Fruits	
<i>Ricinus Communis</i>	Avanakk	Roots	
<i>Rotula aquatica</i>	Kalloorvanchi	Roots	LC **
<i>Rubia cordifolia</i>	Manchatti	Roots	LC **
<i>Saccharem bengalens</i>	Amaveru	Roots	
<i>Salacia oblonga</i>	Ekanayakam	Roots	VU **
<i>Santalum album</i>	Chandanam I	Wood	VU **
<i>Saraca asoca</i>	Ashokam	Bark	VU **
<i>Sarcostemma brevistigma</i>	Somavalli	Twiners	EN *
<i>Saussurea costus</i>	Sheemakottam	Roots	CR **

<i>Semecarpus anacardium</i>	Cherkkuru	Seed	LC **
<i>Senna occidentalis</i>	Ponnaveeram	Roots	LC **
<i>Senna tora</i>	Vattathakara	Fruits	
<i>Setaria italica</i>	Thina	Seed	
<i>Sida cordifolia</i>	Kurunthotti	Roots	
<i>Smilax china</i>	Cheenappavu	Tuberous root	
<i>Solanum anguivi</i>	Putharichunda	Roots	LC **
<i>Solanum virginianum</i>	Kandakari	Whole plant	
<i>Solanum trilobatum</i>	Thoothavela	Roots	
<i>Solena amplexicaulis</i>	Njerinjampuli	Rhizomes	
<i>Soymida febrifuga</i>	Churutturohini	Tuberous root	
<i>Spandlas pinnate</i>	Ambazhathila	Leaves	
<i>Spermacoce hispida</i>	Tharthaval	Whole plant	
<i>Sphaeranthus indicus</i>	Adakkamaniyan	Roots	LC **
<i>Spondias pinnata</i>	Ambazhatholi	Bark	
<i>Sterculia foetida</i>	Peenari	Wood matter	
<i>Stereospermum chelonoides</i>	Pathiri	Roots	NT **
<i>Strychnos nux-vomica</i>	Kanjiram	Leaves, Seed	
<i>Strychnos potatorum</i>	Thettambaral	Seed	
<i>Symplocos cochinchinensis</i>	Pachotti	Leaves, Bark	
<i>Syzygium aromaticum</i>	Karayambu	Flowerbud	
<i>Syzygium caryophyllatum</i>	Njara	Tender Leaves, Bark	EN **
<i>Syzygium cumini</i>	Njaval	Kernel, Bark	LC **
<i>Tectona grandis</i>	Thekk	Tender Leaves, Bark	EN **
<i>Terminalia arjuna</i>	Neermaruth	Bark	LC **
<i>Terminalia bellirica</i>	Thanniyila	Leaves, Bark, Roots, Kernel, Fruits rind	LC **
<i>Terminalia chebula</i>	Kadukka	Fruits	LC **
<i>Tinospora cordifolia</i>	Chittamruth	Stem	
<i>Trachyspermum roxburghianum</i>	Ayamodakam	Seed	
<i>Tragia involucrata</i>	Koduthoova	Roots	LC **
<i>Trapa natans</i>	Vankottakizhang	Fruits	LC **
<i>Tribulus terrestris</i>	Njerinjil	Fruits	LC **
<i>Trichosanthes lobata</i>	Kattupadavalam	Whole plant, Leaves	
<i>Trichosanthes tricuspidata</i>	Kakkathondi	Roots	
<i>Valeriana wallichii</i>	Thakaram	Roots	VU *
<i>Vateria indica</i>	Velutha kunthirikkam	Wood	VU **
<i>Ventilago maderaspatana</i>	Thakittuvembada	Bark	VU **
<i>Vitex altissima</i>	Arenukam	Fruits	
<i>Vitex negundo</i>	Karinochi	Roots, Leaves	
<i>Withania somnifera</i>	Amukkuram	Roots	DD **
<i>Woodfordia fruticosa</i>	Thathiri	Flowers	LC **
<i>Wrightia tinctoria</i>	Dhandhappala	Leaves	LC **
<i>Xylia xylocarpa</i>	Eravool	Wood	DD **
<i>Zizyphus mauritiana</i>	Lanthakkuru	Seed	

*ENVIS

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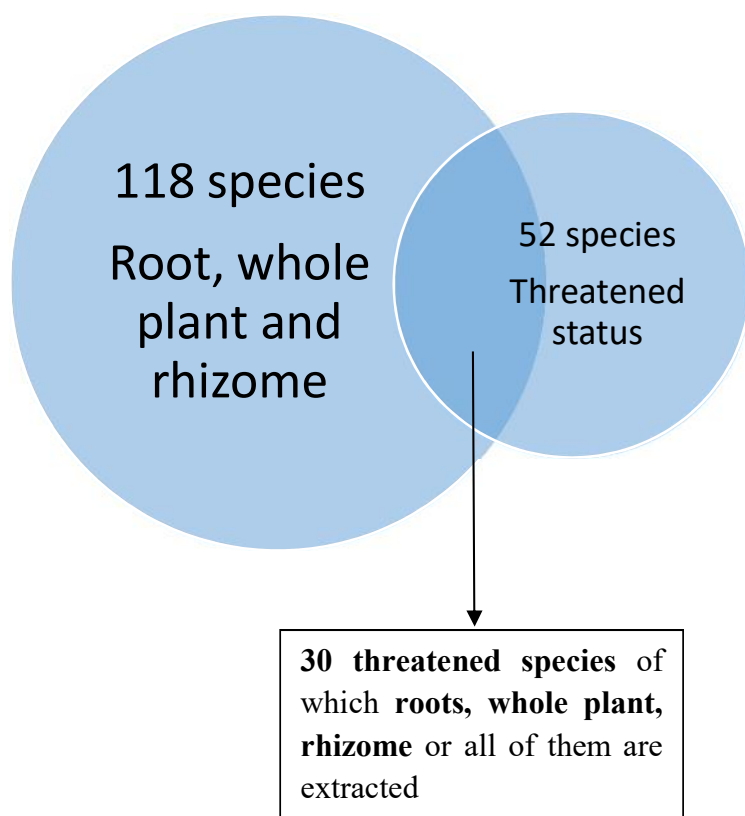


Table 6.19 Threatened species of which roots, whole plant, rhizome or all of them are extracted

Sl No.	Botanical Name	Common Name	Part used	Threat status
1.	<i>Aconitum ferox</i>	Valsanabhi	Tuberous root	EN *
2.	<i>Aconitum heterophyllum</i>	Athividayam	Tuberous root	CR *
3.	<i>Acorus calamus</i>	Vayambu	Rhizome	EN *
4.	<i>Justicia beddomei</i>	Cheriyadaalodakam	Roots, Leaves	CR *
5.	<i>Andrographis paniculata</i>	Kiriyath	Whole plant	VU *
6.	<i>Aristolochia bracteolata</i>	Attukottappala	Roots	VU *
7.	<i>Aristolochia indica</i>	Garudakkodi	Roots	VU *
8.	<i>Asparagus racemosus</i>	Shathavari	Tuberous root	EN *
9.	<i>Bacopa monnieri</i>	Brahmi	Whole plant	VU *
10.	<i>Chonemorpha fragrans</i>	Perumkurumba	Roots	EN *
11.	<i>Citrullus colocynthis</i>	Kattuvellari	Roots	VU *
12.	<i>Clerodendrum serratum</i>	Cheruthekk	Roots	EN *
13.	<i>Coptis teeta</i>	Peetharohini	Tuberous root	EN **
14.	<i>Costus speciosus</i>	Naruchanna	Tuberous root	VU *

15.	<i>Curcuma aromatica</i>	Kasthurimanjal	Rhizomes	VU *
16.	<i>Holostemma ada-kodien</i>	Adapathiyan kizhangu	Tuberous root	EN *
17.	<i>Nardostachys Jatamansi</i>	Jadamanji	Roots	CR **
18.	<i>Nilgiranthus ciliatus</i>	Karimkuringi	Whole plant, Roots	VU **
19.	<i>Nymphaea nouchali</i>	Naithal	Rhizomes	EN **
20.	<i>Ocimum gratissimum</i>	Kattuthulasi	Roots	VU *
21.	<i>Operculina turpethum</i>	Kuzhalkonna	Roots	EN **
22.	<i>Oroxylum indicum</i>	Palakapayyani	Roots	EN *
23.	<i>Picrorhiza kurroa</i>	Kadukurohini	Roots	EN **
24.	<i>Plumbago zeylanica</i>	Koduveli	Tuberous root	VU **
25.	<i>Pongamia pinnata</i>	Ung	Roots, Kernel, Bark, Fruits	EN **
26.	<i>Pseudarthria viscida</i>	Moovila	Roots	VU *
27.	<i>Rauwolfia serpentina</i>	Amalpori	Roots	EN *
28.	<i>Salacia oblonga</i>	Ekanayakam	Roots	VU **
29.	<i>Saussurea costus</i>	Sheemakottam	Roots	CR **
30.	<i>Valeriana wallichii</i>	Thakaram	Roots	VU *



CHAPTER-7

CONCLUSIONS, RECOMMENDATIONS AND LESSONS LEARNT

The project has produced a body of knowledge including numerous best practises and policy recommendations. All the objectives as envisaged in the project has been met. The tentative ABS potential of the State was worked out, based on the norms prescribed in the 'Guidelines on Access to Biological Resources and Associated Knowledge and Benefit Sharing Regulations, 2014'. The Criteria were: (a) turnover / output value of the bioresources based manufacturing sectors in the State as well as (b) the value of bioresources use as input (raw-material) in manufacturing. The estimated ABS through the turnover / output value of the bioresources based manufacturing sectors in the State is Rs. 357.68 crore.

RECOMMENDATIONS AND POLICY SUGGESTIONS

1. FOREST BIORESOURCES

As a part of the study a detailed analysis of trends in collection of NWFP by primary collectors and marketing through various agencies as SC/ST federation, Vanasree and TRIFED was done. As a supplementary source of income, NWFP is important to the tribal people of Kerala and Kerala Forest department has put in place a collection and marketing mechanism through Vansree including procurement; semi processing, packing, branding and labelling and marketing. Existing marketing network starting right from the primary collectors (Girijan Cooperative society), SC/ST Federation and their selling network involved different agencies as Ayurvedic manufacturing units/ companies as Oushadhi, Ayurdhara, and others, TRIFED etc. It is also observed that the forest department is maintaining the data related to forest bioresources and the team of RKI project collected division wise data, collection and sales of NWFP through Federation and marketing through Vanasree.

1. The existing collection and marketing network of NWFP and value added products through Vanasree, TRIFED etc. need to be reviewed thoroughly and strengthened to ensure a functioning network in a more transparent and effective manner so that the stakeholders involved in the process should get benefit sharing as envisaged in Biological Diversity Act 2002 and Guidelines of Access and Benefit Sharing.
2. Considering resources such as wild honey (Big, honey small and other classifications of the honey made by the tribes like poottu then, thodu then, ngdial then etc.) and other products traded in large quantities, an in-depth study on supply and value chain of the forest bioresources and the possibility of developing value added products has to be framed out to strengthen the marketing network.
3. Training and capacity building programme shall be extended exclusively to the tribal communities who are currently engaged in collection of NWFP and other bioresources to introduce good collection, processing, storage, and selling practices and value addition of forest bioresources especially on medicinal and aromatic plants, food plants with a view to improve their livelihood.
4. Developing entrepreneur capacity building programme of the target groups and marketing the raw materials and value added products without intermediary to ensure maximum profits will ensure better returns to the tribal community.
5. Location specific policy shall be framed in terms of conservation, cultivation of medicinal and aromatic plants in the suitable forest areas or fringe areas.
6. Medicinal plants identified as threatened due to over extraction, unauthorized collection has to be restricted and regulated through implementing/ declaring of species level conservation sites of the medicinal plants through the in situ and ex situ conservation. A list of commercially utilized resourced in threatened category is provided in Table 6.19

Table 7.1 Medicinal plants recommended for cultivation in Kerala

Sl.No.	Botanical Name	Sanskrit Name	Local Name	No. of Ayurvedic formulations (approx.) in which the plant is used
1.	<i>Acorus calamus</i>	Vacha	Vayambu	85
2.	<i>Adhatoda beddomei</i>	Vasa	Adalodakom	60
3.	<i>Aegle marmelos</i>	Bilva	Koovalum	120
4.	<i>Aloe vera</i>	Kumari	Kattar vazha	15
5.	<i>Alpinia galanga</i>	Rasna	Chittaratha	150
6.	<i>Andrographis paniculata</i>	Bhunimba	Kiriyathu	50
7.	<i>Aristolochia indica</i>	Isvari	Garudakodi	20
8.	<i>Asparagus racemosus</i>	Sathavari	Sathavari	85
9.	<i>Azadirachta indica</i>	Nimba	Vepu	100
10.	<i>Baliospermum montanum</i>	Danti	Nagadanti	27
11.	<i>Bacopa monniera</i>	Brahmi	Brahmi	50
12.	<i>Boerhaavia diffusa</i>	Punarnava	Thavizhama	80
13.	<i>Cassia fistula</i>	Aragwada	Kanikonna	50
14.	<i>Celastrus paniculata</i>	Jyotishmati	Kattadinayakam	15
15.	<i>Centella asiatica</i>	Mandooka parni	Kudangal	20
16.	<i>Coleus amboinicus</i>	Himasagara	Njavara	25
17.	<i>Coscinium fenestratum</i>	Harichandana	Maramannhal	80
18.	<i>Cyclea peltata</i>	Pata	Pata	60
19.	<i>Cyperus rotundus</i>	Musta	Muthanga	70
20.	<i>Desmodium gangeticum</i>	Saliparni	Orila	60

21.	<i>Eclipta alba</i>	Bringaraja	Kaithonni	40
22.	<i>Embelia ribes</i>	Vidanga	Vizhal	60
23.	<i>Emblica officinalis</i>	Aamalaki	Nelli	180
24.	<i>Evolvulus alsinoides</i>	Vishnukranthi	Vishnukranthi	40
25.	<i>Gloriosa superba</i>	Langali	Menthonni	6
26.	<i>Gmelina arborea</i>	Kasmari	Kumbil	70
27.	<i>Hemidesmus indicus</i>	Sariba	Naruneendi	70
28.	<i>Holarrhena antidysenterica</i>	Kutaja	Kutakappala	40
29.	<i>Holoptelea integrifolia</i>	Chrivillwa	Avil	30
30.	<i>Holostemma adakodien</i>	Jeevanthi	Adapathian	30
31.	<i>Indigofera tinctoria</i>	Neeli	Neela amari	5
32.	<i>Ipomoea mauritiana</i>	Kshiravidari	Palmudukku	15
33.	<i>Kaempferia galanga</i>	Sati	Kacholam	25
34.	<i>Moringa oleifera</i>	Sigru	Muringa	55
35.	<i>Murraya koenigii</i>	Kaidaryam	Karivepu	25
36.	<i>Myristica fragrans</i>	Jathiphal	Jathi	40
37.	<i>Ocimum sanctum</i>	Tulsi	Tulsi	60
38.	<i>Operculina turperhum</i>	Trivrit	Thrikolppakonna	40
39.	<i>Oroxylum indicum</i>	Syonaka	Palakapayyani	70
40.	<i>Phyllanthus fraternus</i>	Bhumiamalaki	Keezha Nelli	20
41.	<i>Piper longum</i>	Pippali	Thippali	240
42.	<i>Plumbago zeylanica</i>	Chitrak	Koduveli	120
43.	<i>Pongamia pinnata</i>	Karanja	Pongu	70
44.	<i>Psoralea corylifolia</i>	Bakuchi	Karkokil	25
45.	<i>Punica granatum</i>	Dadima	Mathalam	35
46.	<i>Ricinus communis</i>	Eranda	Avanakku	70



47.	<i>Rubia cordifolia</i>	Manjista	Manjatti	40
48.	<i>Salacia reticulata</i>	Ekanayakomus	Ponkarandi	10
49.	<i>Santalum album</i>	Chandana	Chandanam	40
50.	<i>Saraca indica</i>	Asoka	Asokam	16
51.	<i>Semecarpus anacardium</i>	Bhallataka	Cheru	22
52.	<i>Sesbania grandiflora</i>	Agasthi	Agathi	20
53.	<i>Sida rhombifolia</i>	Bala	Kurunthotti	180
54.	<i>Solanum indicum</i>	Brihati	Chunda	45
55.	<i>Strychnos potatorum</i>	Kathaka	Thettamparal	25
56.	<i>Strobilanthes neilgherrensis</i>	Sahachara	karimkurinji	60
57.	<i>Terminalia bellerica</i>	Vibhitaka	Thanni	160
58.	<i>Terminalia chebula</i>	Hareetaki	Kadukka	150
59.	<i>Tinospora cordifolia</i>	Guduchi	Chittamruthu	260
60.	<i>Tribulus terrestris</i>	Gokshura	Njerinnil	120
61.	<i>Trichosanthes cucumerina</i>	Tikthaphala	Kattu padavalam	55
62.	<i>Vetiveria zizanioides</i>	Useera	Ramacham	60
63.	<i>Vitex negundo</i>	Nirgundi	Karinochi	50
64.	<i>Woodfordia fruticosa</i>	Dhataki	Thathiri	30

Source: Handout published 'Resource Augmentation, sustainable harvesting and value addition to medicinal plants resources through Biodiversity Management Committee (BMC), KSBB publication 2015

Table 7.2 Plants with export potential

Sl.No	Local name	Scientific name
1.	Asokam	<i>Saraca asoca</i>
2.	Koovalam	<i>Aegle marmelos</i>
3.	Palakappayani	<i>Oroxylum indicum</i>
4.	Kumizh	<i>Gmelina arborea</i>
5.	Kanikkonna	<i>Cassia fistula</i>
6.	Nellikka	<i>Phyllanthus emblica</i>
7.	Neelayamari	<i>Indigofera tinctoria</i>

8.	Iruveli	<i>Plectranthus vettiveroides</i>
9.	Adapathiyam	<i>Holostema ada-kodien</i>
10.	Kattupadavalam	<i>Trichosanthes lobata</i>
11.	Nannari	<i>Hemidesmus indicus</i>
12.	Naikkuranam	<i>Mucuna pruriens</i>
13.	Kattarvazha	<i>Aloe vera</i>
14.	Kacholam	<i>Kaempferia galangal</i>
15.	Brahmi	<i>Bacopa monnieri</i>
16.	Kachooram/Manja koova	<i>Curcuma zedoaria</i>
17.	Sathavari	<i>Asparagus racemosus</i>
18.	Aratha	<i>Alpinia galanga</i>
19.	Paalmuthakku	<i>Ipomoea mauritiana</i>
20.	Vellakkunni	<i>Abrus precatorius</i>
21.	Nagadanthi	<i>Baliospermum montanum</i>
22.	Trikolpakonna	<i>Operculina turpetum</i>
23.	Chittaadalodakam	<i>Justicia beddomei</i>
24.	Vayambu	<i>Acorus calamus</i>
25.	Pooppal	<i>Lichen sp.</i>
26.	Chandhanam	<i>Santalum album</i>
27.	Raktha chandanam	<i>Pterocarpus santalinus</i>
28.	Maramanjil	<i>Coscinium fenestratum-</i>
29.	Pathimugham/Chappangam	<i>Caesalpinia sappan</i>
30.	Elam	<i>Elettaria cardamomum</i>
31.	Grampoo	<i>Syzygium aromaticum</i>
32.	Kurumulaku	<i>Piper nigrum</i>

In the tradable bioresource survey, 29 species found outside forest have been prioritized with good economic value and commercially utilized in the industries, nurseries for ornamental, wood, essential oils etc. The list have been compiled with inputs from JNTBGRI, KFRI and other research institutes of Kerala.

Table 7.3 Species with commercial potential

Sl. No	Binomial	Common name	Use
1	<i>Nelumbo nucifera</i> Gaertner	Sacred Lotus, Thamara, Chenthamara, Venthamara	Flower & Tuber
2	<i>Ocimum americanum</i>	Common basil, Kattuthulasi	Oil
3	<i>Cymbopogon citratus</i>	Lemongrass, Thyilapullu, Vasanappullu	Oil
4	<i>Cymbopogon martini</i>	Palmarosa, Sambarapullu	Oil
5	<i>Chrysopogon zizanioides</i>	Vetiver, Ramacham	Oil
6	<i>Cymbopogon flexuosus</i>	Ginger grass, Inchipullu	Oil

7	<i>Pogostemon cablin</i>	Pacholi	Oil
8	<i>Mentha piperita</i>	Pepper mint	Oil
9	<i>Pelargonium hirsutum</i>	Geranium	Oil
10	<i>Ocimum basilicum</i>	Basil, Kattuthrithavu, Tirunetru	Oil
11	<i>Tribulus terrestris</i>	Njerinjil, Mulluringi, puncture vine	Medicinal
12	<i>Sida cardifolia</i>	Country Mallow, Anakurunthoti, Kattooram, Kurunthotti, Vellooram, Velluppan	Medicinal
13	<i>Gmelina arborea</i>	Kumbil, White Teak, Coomb Teak	Medicinal
14	<i>Pterocarpus marsupium</i>	Karavenga, Venga	wood
15	<i>Monarda fistulosa</i> L.	Bergamot	wood
16	<i>Gravelia robusta</i>	Silky oak	wood
17	<i>Terminalia elliptica</i>	Black murdah, Indian laurel, Matthi, Karimaruthu	wood
18	<i>Xylia xylocarpa</i>	Burma Iron-wood, Irumullu, Kadamaram, Pangal	wood
19	<i>Pterocarpus indicus</i>	Red Sandalwood	wood
20.	<i>Dipterocarpus indicus</i>	Vella-ayani, Karanjili	wood
21	<i>Nauclea diderrichii</i>	Bilinga, badi	wood
22	<i>Peltogyne purpurea</i>	Violet wood, Amaranth, purple heart	wood
23	<i>Terminalia alata</i>	taukkyan wood	wood
24	<i>Lagerstroemia lanceolata</i>	Nandi tree, venthekku	wood
25	<i>Albizia lebbeck</i>	Indian siris, Womans tongue, Nenmenivaka, Kattuvaka, Vaka	wood
26	<i>Albizia odoratissima</i>	Ceylon rosewood, Mellivaka, Nellivaga, Pulivaka	wood
27	<i>Terminalia tomentosa</i>	Crocodile bark tree, black murdah	wood
28	<i>Terminalia paniculata</i>	Flowering murdah, Maruthu, Manjamaruthu, Theempaav	wood
29	<i>Bridelia retusa</i>	Spinous Kino Tree, Mulkaini, mulluvenga	Bark and root

2. AGRICULTURE AND HORTICULTURE RESOURCES

As part of the project extensive consultations were held with farmers and FPOs and some of the major recommendations include :

Fixing base price for commercially important crops, Increasing the storage capacity through godowns, cold storage facilities etc, Survey to identify farmer-preferred species and focused research programme on such species; Improved practices for nursery and plantations (optimum spacing, fertilizing, enrichment planting, and other methods of restoring natural forest cover, fire control techniques, etc.) and the preparation of technical manuals; Improved agro-forestry/land use planning, Wood technology practices to promote rational utilization of plantation products; Demonstration plots using improved

seeds, mixed cropping, inter-cropping of shorter rotation trees etc were some of the suggestions.

Promoting development of value added products from tea, coffee, cocoa, areca nut, rubber, coconut etc. at each district through a consortium of small scale plantation crop farmers, Promoting small scale industries connected with bioresources of spices, dye, medicinal plants, Promoting farm tourism, Promoting GI crops like Navara rice which is nutraceutical and develop value added products via small scale industries that will provide additional income to farmers has also been suggested.

Registration of all the plant nurseries via BMC of the panchayat, Promoting indigenous species especially high volume and high priced wild species than exotic species. Promoting nurseries of Lotus and other ornamental plants which is high priced with minimal investments. Promoting society level tissue culture biotech labs for producing economically important high priced ornamental and medicinal species like Orchids, Anthurium, Croton etc. has been stressed.

Model nurseries especially at high altitude areas like Wayanad, Idukki districts to promote wild edible cultivated plant species used by tribal population such as Leafy greens (107 species), Tuber and roots (46), Fruits and seeds (105 species) will promote employment opportunities to tribal people.

Agro and Fruit Processing Companies, Fruit/Horti farms at Wayandu and Idukki like at Nelliampathy can be promoted.

Raw drugs are widely being exported from Kerala and a list of some important species with export potential that can be grown in Kerala is given below.

3. AQUATIC BIORESOURCES

3.1 Inland Biodiversity

The inland water bodies of 117,122 ha and coastal wetlands of 40,876 ha (Wetland Atlas of Kerala, 2011) offer immense scope for production of fish and shellfish. The potential of inland water resources for fish production is yet to be utilized optimally in Kerala.

Major issues confronting the sector are the following:

1. Biodiversity of inland aquatic systems are poorly recorded and urgent measures are necessary to document the fauna.
2. Inland fish catch data is scanty, unsustainable and illegal fishing methods catching of brooder fishes and other organisms is a very serious problem and with the present regulations, it is difficult to control also.
3. Dwindling area of wetlands (including rice fields), both freshwater and brackish water is a major concern.
4. Less diversified culture practices: Cage culture in reservoirs should be encouraged with native high range fishes and prawns with good growth traits. Introduction of fishes like tilapia in reservoirs for purpose of aquaculture creates problems need to be regulated.
5. Pollution of wetlands is steadily increasing. It is causing damage to biota, polluting the open water source, aquifers and ground water. Brackish water aquaculture mainly concentrating on shrimps, high stocking density, heavy feeding lead to increased ammonia in water, ultimately resulting in pollution and degradation of inland wetlands
6. Encouraging value added product development and marketing is needed. At present storage facilities for storing produce in the inland sectors is limited. Government owned storage facilities will help to control adulteration of fish and fishery products.

3.2 Marine fisheries sector

Capture fisheries face multiple pressures as a result of overfishing, habitat modification and pollution. Major issues in the marine sector include increased fishing pressure in the coastal areas- stocks decline, overcapitalization and unwarranted capacity overload – more vessels, more powered and over exploitation of resources in the inshore waters. Discards/indiscriminate exploitation of juveniles/sub

adults mainly by trawlers, biodiversity decline due to habitat destruction and damage to the benthos and benthic ecosystem, often destroying the food web of commercial species – mainly by bottom trawling, ornamental fish trade are also some of the issues flagged. The sector is also burdened by increasing fishing cost and diminishing returns and inefficient domestic marketing system. There is a need to fix floor price and development of storage facilities under government as the product is highly perishable, this will also address the issues of adulteration. Nutraceutical, probiotic, bioactive compound production at industrial levels are still in its infancy stage. The higher diversity of fish and shellfish resources available in Kerala coast offers better prospects for diversification, especially with regard to development of new products and value addition.

Adoption of code of conduct for Responsible Fisheries (CCRF) is necessary and this includes taking measures to control open access by strict enforcement of a system of licenses (authorization to fish) in traditional, motorized and mechanized sectors. Since the Coastal Regulation Zone (CRZ) notification of February 1991 and Coastal Management Zone (CMZ) notification of 2011 are in vogue, 200 meter width of coastal areas are to be statutorily earmarked as no development zones, except for utilizing it for fishery related activities of the coastal fisher folk. Ecosystem services of the critical coastal and marine habitats have to be analysed specifically through integrated inclusive research so as to prepare Integrated Coastal Zone Management Plans and for identifying hotspots for conservation and sustainable management. Mudflats, coastal wetlands, reefs, mangroves, sand dunes and shoals should be categorised as ecologically sensitive areas and conserved.

Periodically revalidating maximum sustainable yield of resources in the existing fishing grounds and determine fishing units in each category for sustainable harvesting of resources is needed. Promotion of selective fishing gear and practices, which include (i) Optimum mesh size in trawl cod ends, (ii) Optimum hook size and shape for lines, (iii) Square mesh windows in trawls, (iv) By-catch reduction devices in trawls, (v) Turtle Excluder Devices in trawls, (vi) Juvenile Excluder Devices in trawls, (vii) Trawl designs with improved resource specificity, (viii) Optimum mesh size for gill nets, (ix) Optimum mesh size for purse seines, and (x) Escape windows in fish and lobster traps will enable to conserve biodiversity to a large extent and promote its sustainable use.

A major portion of the coastal areas of Kerala are protected by construction of sea wall. Alternate bio-engineering technologies need to be explored. Restoration of beaches and protection of sea shore through natural shields such as mangroves and typical coastal vegetation have to be promoted with the participation of coastal communities. In addition to mangroves, cultivation of economically valuable plants such as various species of Pandanus, Calophyllum inophyllum (beach touriga/ Indian doomba oiltree Punna/Avanakku) and Morinda citrifolia (Indian mulberry/noni) can be promoted in the littoral zone of coastal areas of the State. Coastal tree shield with indigenous coastal vegetation of a minimum of 30 m width should be promoted in areas of human settlements, with the participation of local communities. Planting of vegetation and deriving benefits from these resources should also be promoted as an alternate employment opportunity to the local population. Since coastal zone has a dense population in the State and local communities are least adapted for facing the climate vagaries, there is an urgent need for strengthening coastal protection methods with the participation of local communities, especially by promoting coastal bio-shields wherever ecologically feasible.

Considering the unabated increase in the quantity of marine debris, especially plastics in the coastal waters along Kerala coast, urgent interventions are required to manage plastic wastes in oceans and strengthen monitoring plastic debris. 'Suchitva Sagaram' (clean ocean) project launched by the fisheries department of Kerala in Kollam to remove plastic waste from the ocean with the help of fishers (and use the plastics collected for the construction of roads) should be extended throughout Kerala. Local bodies should take urgent measures to control the solid waste generation and take eco-friendly measures for proper recycling or disposal of the wastes. Specific programmes should be launched for the effective awareness on marine debris issue in Kerala coast, monitoring and management with the

involvement of local communities and citizen scientists. Ocean acidification problems currently facing is very serious and adequate planning on a multi layer model has to be adopted. Number of houseboats in backwaters should be strictly limited, based on carrying capacity studies. Strict rules and regulations for waste management, especially in backwater tourism using house boats, shall be formulated and enforced.

One of the pre-requisites for conservation is a strong quantitative and qualitative data base on the living marine resources of Kerala coast in order to frame conservation and management plans. Data base on coastal and marine biodiversity should be prepared with the help of researchers and made available in the public domain. The maximum sustainable yield of the commercially exploited species should be determined in coastal and brackish water habitats and harvesting should be regulated accordingly. Sustainable harvesting of resources should be ensured by strictly adhering to the existing rules such as Kerala Marine Fishing Regulation Act (1985) and by assessing the maximum permissible limit of mechanised fishing vessels. Mandatory registration and licensing of all motorized and mechanized boats, review of licensing every year, cancellation of registration of vessels violating fishing regulations, and temporary moratorium for further sanction of mechanized vessels for inshore waters should also be considered to reduce fishing pressure. Minimum legal size should be imposed on all commercially exploited fishery items of Kerala coast. By-catch reduction devices should be made mandatory in trawl nets to reduce the loss of biodiversity, especially the destruction of Rare, Endangered and Threatened (RET) species. Stake nets are found to be highly destructive in the sustenance of brackish water fishery resources of the State and therefore, may be removed in a phased manner.

Implementation of an integrated national conservation strategy involving in situ and ex situ and in vitro and in vivo methods for all marine Rare, Endangered and Threatened (RET) species has also become imperative. The sea ranching programme needs to be strengthened in India in order to replenish stocks, especially that of overexploited and threatened species. At present there is no concerted effort to make the coastal communities aware of the present ecological status of the ocean ecosystem and impacts due to the depletion of biodiversity. Fishery co-operatives, self-help groups in coastal areas, NGOs and religious institutions should be networked along with government systems for this purpose. Similarly, conservation efforts should be strengthened taking clues from the rich traditional knowledge of the local fishing communities. Such technological knowledge of the local fisher folk remains to be documented. Considering the skills of marine fishers in Kerala, their services may be fully utilized in coastal biodiversity monitoring, climate change adaptation and for disaster management programmes of the State. The traditional method of integrated farming system practiced in Kuttanad, with salt and flood tolerant rice varieties at below sea level would serve as a model to plan adaptation strategies elsewhere.

Knowledge base has to be strengthened for better understanding of the impact of climate change on fish stocks in our coastal waters with proper modelling studies as the first step towards planning and framing better management strategies. Adaptation measures for the communities' reliance on fisheries for food and income should also consider options such as education, entrepreneurial training, training in tourism and aquaculture to prevent potential deterioration of social conditions in fisher communities associated with climate change. Value-addition to products and improved market access through eco-certification and other mechanisms should support not only better utilization of resources, but also ensure its effective management and responsible handling of resources. The fish processing sector in Kerala is managed predominantly by the women workforce and the efficiency and productivity are likely to be improved by ensuring that the rights and responsibilities of women are recognised in their employment conditions and their sustainable income is ensured.

The Biological Diversity Act has provision to notify threatened species for regulation of trade under Section 38. A total of 30 species has been suggested for inclusion under Section 38 of Biological Diversity Act for Inland water bodies of Kerala which includes Reptiles – 5, Frogs- 8, Fishes 17, Odonates 2, Fresh water crabs- 4, Fresh water prawns- 7 species.





4. MANUFACTURING SECTOR

Extensive consultations were held with Ayurveda industry representatives and the major issue flagged was the non-availability of quality raw materials and the price rise of raw materials effecting the profitability. The necessity of a common facility center centralized lab facility for quality check, centralized collection centre of bioresources at least on each centre/ district were suggested. Lack of quality raw materials including honey, jaggery, oil etc is also one of the major issues flagged. Most of the raw material are accessed form traders and they do not have any registration or license or mechanism for quality checking. Frequently raw materials are maintained in different grades with different price which effects quality of the finished products.

Sustained supply of raw materials is a challenge to the Ayurveda industry as more than 75% of medicinal plants are sourced from forest area and 75% these are harvested in destructive ways. Lack of scientific validation/ standardization of raw materials (adulterant, substitute) is an issue. It was suggested that prioritized species for cultivation shall be identified, start ups should be encouraged in this sector and a minimum support price to major commercially important medicinal plants shall be fixed. Unscientific/ unauthorized collection and over extraction of medicinal plants shall be restricted and regulated. An improvement of the standard of entire value and supply chain is needed.

Innovation by the Ayurvedic drug manufacturers for the development of diverse scientifically validated products including Ayurvedic/herbal/nutraceutical/cosmiceutical/vriksha ayurvedic products based on the raw materials available in the different geographic zone of Kerala is needed.

Establishment of cooperation between Ministry of Ayurveda and related agencies (Directorate of General of foreign trade (DGFT), Business information system (BIS) Export inspection council (EIC) and Ministry of Small and Medium Enterprises (MSME) and institutions at National and International level to develop appropriate policy is necessary.

5. TRADERS- Angadikada (raw material shops) medicinal plants fresh and dry

According to the studies carried out based on Angadikada it is strongly recommended that appropriate policy decision shall be taken to register all Angadikada large- whole sale and retail, medium and small scale currently functioning in the state. Policy decision shall also be taken to issue license to all Angadi kada in Kerala under the LSGs

Based on the present study that the hygienic condition of raw material shops and storage places are not up to the mark policy decision shall be taken to issue appropriate directions to the department of AYUSH, Dy. Drug Controller of Ayurveda to provide necessary guideline, regulations, restriction for improving the present condition.

At present there is no expiry date for the raw drugs, this is to be studied scientifically (shelf life of each items) and there should be a guide line for fixing an expiry date for each raw drugs. It is desirable to design a policy for introducing "Smart Angadi kada" under the startup programme so that the materials can have greater acceptability during export.

Introduce necessary register/develop a data base for maintaining the records including quantity and price of buying and selling of the raw materials, Value added products and source of materials collected (Local/ state/ outside the state/outside the country)

6. ENFORCEMENT OF ACCESS AND BENEFIT SHARING (ABS)

As Kerala is rich in biodiversity, the commercial potential of bio-resources is very high. Forest resources and medicinal plants, marine resources, agriculture / crops based entrepreneurs have high commercial significance. There is no doubt that Kerala is having high ABS potential and the concerned authorities need to identify it. For enforcing the ABS mechanism in Kerala, the following steps were proposed:

1. Identification of the industries and traders: The State Biodiversity Board has to collect data (details of ABS potential industries and traders) from the industries' licensing authorities such as: Industrial Departments, Department of Drugs and Cosmetics, Pollution Control Board etc., and segregated the biological resources based units in the state. Further Board can give a series of advertisements related to the Biological Diversity Act and ABS in the news papers and industrial magazines and encourage the bio-resources based manufactures and traders in comply the provisions of the Act.
2. Enforcement: After identifying the comprehensive sector specific bio-resources based industries and traders list in the state, the Board need to issue notices to the industries and traders. Further

- Boards' continuous engagement and negotiations with the industries and convincing them about their responsibility related to the Biological Diversity Act is needed. Board also need to organize a number of consultation meetings for bio-resources manufactures and traders at different locations.
3. As biological resources are predominant from forests, negotiations with the Forest Department is required for the benefit sharing from the amount mobilized through the NTFPs and economically significant forest resources such as sandalwood and industrial wood auctions, which might be a huge amount. Generally, through the sale of forest products, the Forest Department is mobilizing huge amount. The resources are transferred to the companies (users) through traders and or exports. The ABS possibility of these bio-resources is huge.
 4. Criteria for Benefit Sharing: Based on the Guidelines on "Access to Biological Resources and Associated Knowledge and Benefit Sharing Regulation – 2014", the Access and Benefit Sharing (ABS) can be availed of from the biological resources based industries either: based on the biological resources' purchased price by the industries, based on the raw-material cost, prescribed as 3% – 5 % or based on the ex-factory sale value of the product minus government taxes, where biological resources are involved in production fully or partially (0.1% to 0.5%).
 5. However, there is a huge difference in the ABS shares based on the above two criteria for different types of biological resources based industries. When the value addition is low, the turnover based ABS estimation prefers the companies. On the other hand, if the value addition is high the bio-resources' purchased price is the criterion they prefer. The fact is that the bio-resources based industries revealed different input-output ratios.
 6. Mutually Agreed Benefit Sharing Approach: In the ABS amount fixation a mutually agreed and negotiable approach is required from the users and providers of bio-resources. Hence a reliable amount (within the purview of the ABS guidelines) needs to be considered by the SBBs.
 7. Involvement of Line Departments: Involvement of the services of the line departments in the ABS process is significant. As ABS is a complicated task, the involvement of line departments such as: forest, agriculture, fisheries etc. is important. For example; the Madhya Pradesh SBB established an ABS Cell in all the Divisional Forest Offices (DFOs) in the state and involved the Forest Officials in the ABS collection process.
 8. Bio-resources tracking Mechanism: Most of the industries are claiming that they are not utilizing the bio-resources available in Kerala. Bio-resources are coming from different part of the country and or even from abroad. However, for the effective implementation of the ABS, especially the conservation of biodiversity, the origin of the bio-resources should be identified and the benefit sharing amount to be channelized there.

7. STATE MISSION ON BIO-ECONOMY

The above analysis clearly signifies the biological resources (bio-wealth) of Kerala, and their contribution to the production of multiple consumer products, employment and income generation and export earnings. Bioresources play a significant role in shaping Kerala's economy. In this context, the newly emerging concept of "Bio-economy" is extremely relevant for Kerala and it is proposed to designate a "State Mission on Bio-Economy". Further, through the strict enforcement of ABS, the State can mobilise a considerable amount for the conservation of its bio-wealth. Bio-economy consists of all economic activities (production, distribution / trade, consumption) of bio-resources based goods and services in a given geographical area. The components of bio-economy include: : (a) technology approach, focusing on biotechnology applications in primary production, health, and industry; (b) status of biotechnologies and R&D expenditures; (c) the roles of R&D funding, human resources, intellectual property, and regulation in bio-economy, and (d) the possible developments that could influence emerging business models.

The concept of bio-economy covers the agricultural industry and all manufacturing sectors and their respective service areas, which develop, produce, process, reprocess or use them in any form biological resources such as plants, animals and microorganisms. Thus, it achieves a variety of industries such

as agriculture, forestry, horticulture, fisheries and aquaculture, plant and animal breeding, food and beverage, wood, paper, leather, textile, chemical and pharmaceutical industries up to branches of energy industry. The European Union & OECD came up with their approach on Bio-economy, which might be a torch bearer for the mission on Bio-economy for Kerala. Europe is setting the course for a resource-efficient and sustainable economy, with the goal of: (a) more innovative and low-emissions economy, (b) reconciling demands for sustainable agriculture and fisheries, (c) food security, and (d) the sustainable use of renewable biological resources for industrial purposes, while ensuring biodiversity and environmental protection. To achieve this, the European Commission has set a “Bio-economy Strategy and Action Plan” which focuses on three key aspects: (1) developing new technologies and processes for bio-economy; (2) developing markets and competitiveness in the bio-economy sectors; and (3) pushing policy makers and stakeholders to work more closely together. (European Commission, 2020).

Hence, in the light of the bio-economy concept developed and implemented by the European Union and the OECD, the Kerala Government needs to start the initiative considering the following issues and questions:

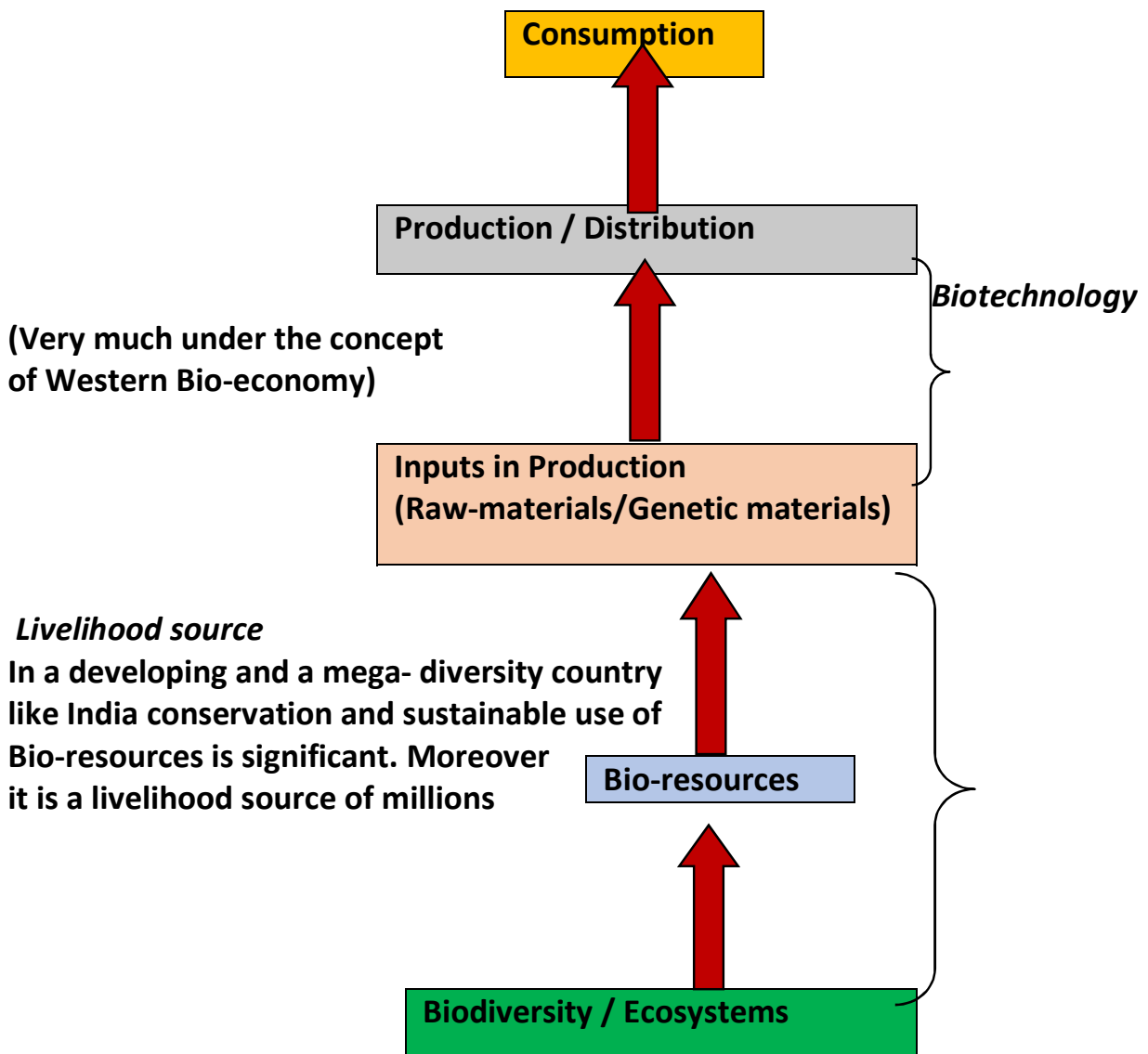
Bio-resources are renewable resources and exist in both public and private lands. Since the property rights of private lands is assigned with a person or entity, the management decisions related to the biodiversity and biological resources are purely individual. In this regard, what might be the conservation strategy?

1. However, most of the biological resources of the state may be in the public lands (ocean, forests, wetlands etc.), which face huge governance challenges. Even if the property rights of this land are with the government, public or local communities have user rights. When more demand arises for certain resources which are endemic and scarce, the possibilities for over-extraction of those resources may be high (free rider and the tragedy of the commons) and may lead to species' extinction. In this case what are the management and conservation measures to be taken?
2. Biological resources, particularly those available in the public land need to undergo periodical assessment and an understanding of their status such as: depletion rate, regeneration rate, stocks etc. needs to be made.
3. Through the above process, one can find out whether a particular bio-resource is scarce or plenty. This may generally depend on the demand for each bio-resource and the volume of its availability.
4. Appropriate policy actions may be required on Rare / Endangered / Threatened plants or animal conservation or its sustainable use.
5. If any species' over-extraction or extinction is noticed the appropriate Government agencies need to take strict action against it. Further special attention is also required for its conservation.
6. The Biological Diversity Act provides the power to BMCs to levy a fee from the users who collect biological resources from areas under their jurisdiction. If this is introduced the local bodies can mobilise adequate money for conserving the bio-resources.
7. Bio-resources' trade should be promoted through the supervision of BMCs.
8. ABS compliance in commercial sectors / industries in the state are also a pre-condition for bio-economy.

Broadly, compared to the developed countries, developing countries are biodiversity rich but technologically weak. In a developed country, bio-economy may primarily depend on the development of biotechnology. They are also involved in the production of the products from bio-resources and genetic materials, where biotechnology application is extensive. Developed countries normally transfer the technology to the developing countries, where bio-resources based mass production will take place. On the contrary a rich biodiversity country like India (Kerala) needs to focus more on the conservation and sustainable use of its biodiversity / biological resources (see Fig 15.1).



Bio-economy Pyramid



In brief, in a developing State like Kerala, the fundamental objective of bio-economy would be the utilization of its bio-resources efficiently and preventing the loss of biodiversity or the ecosystem, which is the base for food and health security as well as options for many other economic developments. Further, biodiversity is the source for employment and livelihood for millions of poor people. It is important to consider these aspects on a priority basis and develop an appropriate management strategy with the stakeholders' participation. If this platform is stabilized, bio-economy will step-up towards sustainable development and a social system: harmony with nature.

In brief, the analysis carried out in the report with respect to bioresources collection (quantity and value) at its origin, its commercial utilization (manufacturing) with supply chain / value addition, trade, and the overall ABS potential signifies the importance as well as the need for conservation of the biodiversity / bio-wealth of Kerala and its sustainable utilization.

Way foreword

Recommendation 1: It is recommended to ensure that all technical reports produced by the project be available to the public after the end of the project.

Recommendation 2 : Bioeconomy can be seen as a knowledge-based production and use of natural/ biological resources, that allow providing economy goods and services in an environmentally-friendly way and shall be promoted.

Recommendation 3: The species proposed for regulation under Section 38 of Biological Diversity Act may be recommended to MOEFCC for gazette notification

Recommendation 4: A separate study / project to explore the complete supply chain (with value addition) of key bio-resources of the State, which ensure a lot of inferences for the KSBB in taking many policy decisions related to the ABS may be taken up

Recommendation 5: Data gaps has been pointed out specifically in data pertaining to Aquatic resources sourced from rivers of Kerala, the available data pertains to resources landed from reservoirs only. Hence a separate project can be taken up in this.

Recommendation 6: Sustainable utilization of bioresources and promotion of bioresources based entrepreneurs for better livelihood options at local level is proposed. Since Biodiversity provides livelihood to millions of people start up initiatives has been proposed which may be taken up as separate project. KSBB can function as an incubator for

Recommendation 7 : Biodiversity cum Knowledge portal

KSBB shall maintain a Biodiversity knowledge portal incorporating new species discoveries, updating tradable bioresources data bank, soft copy of related thesis, publications etc. Such a system shall enable government to take informed decision for promoting a sustainable bioeconomy. Due to the lack of sufficient funds the same was not taken up as part of this project, and the results for the last five years are available as reports.

CHAPTER-8

IMPACT OF PROJECT, OUTCOMES vs OUTPUTS AND RESULTS

The project covered the key mandates of KSBB namely Biodiversity conservation, Sustainable use of biodiversity, stakeholder / community participation and awareness, development of policies, legislation and regulations that support Biodiversity conservation, estimation of ABS potential and promotion of livelihood/ bioeconomy,

Biodiversity conservation

1. Data of bio-resources of commercial use and quantity traded along with collection locality for Flora and fauna included. Bioresources being unsustainably utilized were identified.
2. Policy recommendations that support biodiversity conservation sector wise incorporated in the individual report.
3. Threat status of major resources and demand and availability has been documented.

Sustainable use of biodiversity

1. Inventory of bio-resources based industries in the state: This inventory contains key economic indicators of each industry including investment, gross fixed assets, raw-materials used and their costs, annual turnover, products manufactured, marketing, value of the products, export etc. The following sectors were covered: Ayurvedic, Cosmetic, Food processing, Textiles, Wood products, Aquatic products, Coir and Rubber etc.
2. Major traders/ raw drug dealers/ Aquaculture farms has been identified

Livelihood/ Bioeconomy

1. The study has identified major resources and value added products which can be developed from the bio-resources
2. Supply chain (value addition) analysis of selected bio-resources representing major ecosystems of the State and identification of its true / real economic value were done.
3. Transport of bio-resources from their collection or cultivation site/source (providers) to traders to sellers and to the manufacturers (end users) was captured for selected bioresources with the price-spread or value addition.
4. Export value of bioresources and sectors having potential for export identified.
5. An attempt has been made to identify the Access and Benefit sharing potential of the state (funds which can be generated for biodiversity conservation as ABS through the commercial utilization of bioresources)
6. Start-up initiatives for improved livelihood of local community through utilizing bio resources sustainably has been identified.

Stakeholder / community participation

1. Government sector : Extensive consultation with Kerala Forest Department, Industry & commerce, Department of Ayush, Agriculture department, Fisheries department, JNTBGRI, KFRI, CMFRI, CIFT, NIPHAT, ZSI, Kerala State Federation of SC /ST, Tribal Cooperative Marketing Development Federation of India (TRIFED), Drugs Controller, Matsyafed, Marine Products Export Development Authority (MPEDA), Kerala Forest development Corporation, District Industrial Centres, Kerala Agriculture University, NBPGR, Bamboo corporation, Malabar Botanic Garden Central Tuber Crop

Research Institute, Central Plantation Crop Research Institute, Coconut Development Board, Spices Board, Tea Board of India, Coffee Board, Kerala Cashew Board, NABARD etc were held

2. Industry : Ayurvedic manufacturing units, Ayurveda Medical Association, Ayurvedic Manufactures Association, Aquatic product based industries, Coir , Rubber industries and Other Industries
3. For the collection of primary data, extensive field surveys (with a predesigned questionnaire) among the farmers who cultivate and manage agro-biodiversity, tribes who gather the resources from the forests and also have knowledge on sustainable extraction, fishermen engaged in fishing in inland water bodies and sea were done. Further, information was also collected from bio-resources traders, wholesalers, and industries that use bioresources as raw-materials in manufacturing.

The stakeholders covered included:

1. 250 raw drug dealers
2. 800 plant nurseries
3. 138 marine landing centres
4. 4000 fishermen
5. 150 industries
6. 27 forest timber depots
7. Community organizations: Forest development Agencies (Vana Samrakshana Samithies (VSSC). Eco Development Committees, EDC) , Kudumbasree, Fishermen community, Farmer Producer Companies

Improvement of awareness among producers, users

1. A series of workshops and regional meeting were held with stakeholders
2. A state level Conference on Bioresources and Commercial utilization- Trends, Supply chain and Sustainability was conducted

Development of policies, legislation and regulations that support Biodiversity conservation and utilization

1. Rare and endangered species which need to be conserved and whose trade need to be regulated under section 38 of Biological Diversity Act through Gazette notification identified
2. Start-up initiatives based on bioresources and other initiatives required for sustainable use of bioresources has been outlined.

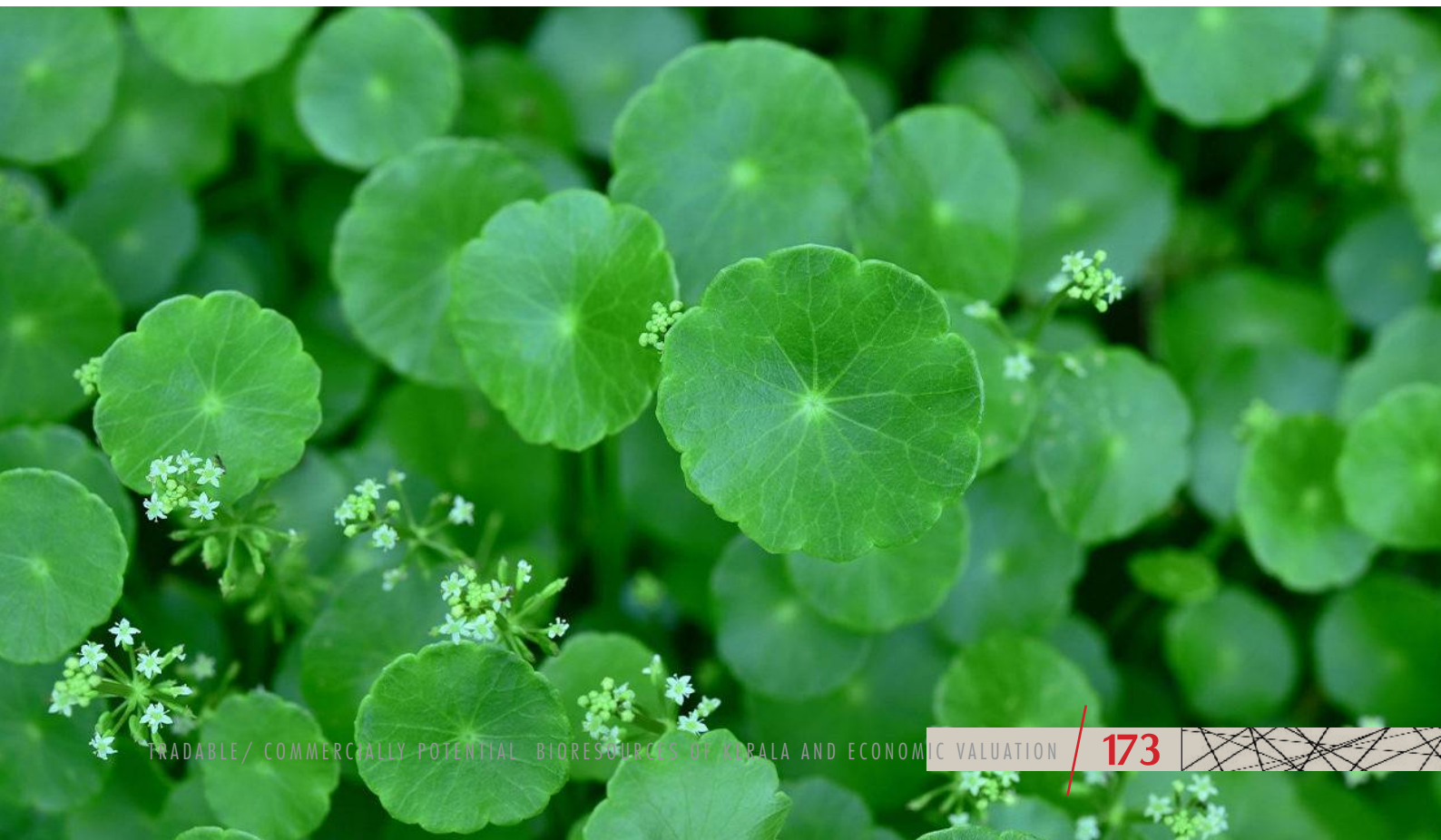


Table 8.1 Project outcomes vs outputs and results

Outcome	Output	Results achieved
<p>Enhanced knowledge base of sustainability of traded bioresources</p>	<ul style="list-style-type: none"> • Documentation of floral and aquatic faunal bioresources which are traded/ commercially utilized and their threat status • Documentation of volume of trade/ volume of use in commercial sectors/ industries • Documentation of the manner of utilization of bioresource, eg direct use, value added product, resources used in industrial production 	<ul style="list-style-type: none"> • Commercially used/ potential bioresources in Forest, Agriculture and Horticulture, Plantation and Agroforestry, Marine and Inland identified • Volume of trade in the above sectors during 2015-2020 identified • Major Value added products and by products identified
<p>Identification of the nature of trade, bioresources based industries, market within Kerala or export, or both</p>	<ul style="list-style-type: none"> • Database of Industries (both export and domestic market) in following sectors Ayurvedic, Cosmetic, Nutraceutical, Food processing, Traditional industries, Aquatic products etc with key economic/trade indicators in the state developed • Database of major traders in raw drugs/ornamental plants/ spices etc • Data of bioresources export and import and balance of trade 	<ul style="list-style-type: none"> • Checklist of industries in Ayurveda, herbal cosmetics, Food, Traditional industries as Coir, Cashew, Aquatic resources etc compiled • Export and import data of Food products, Marine products, Textiles and fabrics, Rubber and rubber products, Wood and wood products, Essential oils, Medicinal and other pharmaceutical products, Ayush and herbal products, Floriculture products, Tobacco, Leather and leather products, and Others (12 categories) compiled for past two years
<p>Enhanced knowledge of bio-resource value both at the ecosystem stage from which it is extracted and at</p>	<ul style="list-style-type: none"> • Economic valuation of bioresources sourced from forest, agricultural sector, animal husbandry, marine and inland • Economic valuation of industries fully dependent / partially dependent on Biodiversity • Supply chain (value addition) analysis of selected bio-resources representing major ecosystems of 	<ul style="list-style-type: none"> • Total Value of bioresources from Forest, Agriculture, Livestock, Marine and Inland calculated for last 5 years • Economic indicators of fully bioresource based and partially bioresource based industries such as fixed capital, total output and input, value added, net income and

<p>the commercial stage where value addition and manufacturing is done.</p>	<p>the State and identification of its true/real economic value</p>	<p>profit/loss of each type of factory (based on product manufactures) analysed</p> <ul style="list-style-type: none"> Supply chain analysis of Honey completed in detail. Supply chain of different resources as timber and other forest produce as NWFP conducted.
<p>Develop mechanism to implement the Biological Diversity Act, 2002 and Access and Benefit Sharing Provisions.</p>	<ul style="list-style-type: none"> Major ABS potential bio-resources of Kerala and its commercial utilization within the State and trading (exporting) to other States Estimation of the ABS potential of High value bio-resources, such as sandalwood Estimation of the sector specific ABS potential of the State. 	<ul style="list-style-type: none"> ABS potential of Kerala estimated based on purchase price form industries ABS potential of Kerala estimated based on ex factory sale value of industries. Sector specific ABS potential estimated.
<p>Institutional mechanism for regulation of unsustainable harvesting of bioreources</p>	<p>Identification of species of commercial importance and of conservation value for notification under section 38 of Biodiversity</p>	<p>Species for regulation of collection proposed based on volume of extraction and identified threat status</p>
<p>Bringing out necessary changes and in the practices and regulatory</p>	<p>Policy recommendations that support biodiversity conservation sector wise</p>	<p>Policy recommendations that support biodiversity conservation sector wise incorporated in the individual report</p>



<p>mechanism in order to promote long-term sustainability of priority species</p>		
<p>Strengthened awareness about commercial potentials in biodiversity business.</p>	<p>Best practices identified Promotion of Bioresources based livelihood</p>	<p>Best practises identified in different areas Start up initiatives proposed in selected sectors</p>





TRADABLE/ COMMERCIALY
POTENTIAL
BIORESOURCES OF KERALA AND
ECONOMIC VALUATION
EXECUTIVE SUMMARY

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