KERALA SOLID WASTE MANAGEMENT PROJECT (KSWMP)

ENVIRONMENTAL AND SOCIAL MANAGEMENT FRAMEWORK

VOLUME I

INTRODUCTION AND ENVIRONMENTAL ASSESSMENT

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SUCHITWA MISSION

GOVERNMENT OF KERALA

This is the DRAFT **Environmental and Social Management Framework (ESMF) – Volume I** for the proposed KERALA SOLID WASTE MANAGEMENT PROJECT (KSWMP) with financial assistance from the World Bank. This is hereby disclosed for comments/suggestions of the public/stakeholders. Send your comments/suggestions to SUCHITWA MISSION, Swaraj Bhavan, Base Floor (-1), Nanthancodu, Kowdiar, Thiruvananthapuram-695003, Kerala, India or email: sanitation.sm@kerala.gov.in

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List of Abbreviations

Abbreviation	*Expansion*
AEWA	African-Eurasian Migratory Water Birds
AMASR	Ancient Monuments and Archaeological Sites and Remains Act
APD	Assistant Project Director
ASI	Archeological Survey of India
BDW	Biodegradable Wastes
BMC	Biodiversity Management Committee
BMW	Biomedical Wastes
BOD	Biological Oxygen Demand
BOQ	Bill of Quantities
BP	Bank Procedures
BPL	Below Poverty Line
C&D	Construction and Demolition
CBD	Convention on Biological Diversity
CBMWTF	Common Biomedical Waste Treatment Facility
CBO	Community-Based Organization
CC	Climate Change
CKC	Clean Kerala Company Ltd.
CMS	Conservation of Migratory Species
COD	Chemical Oxygen Demand
CPCB	Central Pollution Control Board
CRZ	Coastal Regulation Zone
CVCA	Critically Vulnerable Coastal Areas
CWRDM	Centre for Water Resources Development and Management
D-ESDU	District Environmental and Social Development Unit
DLI	Development Linked Indicators
DPC	District Planning Committee
DPMC	District Project Management Consultant
DPMU	District Project Management Unit
DPR	Detailed Project Report
DTP	Directorate of Town Planning
DWMP	Disaster Waste Management Plan
EA	Environmental Assessment
EAP	Externally Aided Project
ECoP	Environmental Codes of Practice
EE	Environmental Engineer
EHS	Environmental Health and Safety
EIA	Environmental Impact Assessment
EIA	Environmental Impact Assessment
EIA	Environmental Impact Assessment
EMF	Environmental Management Framework
EMP	Environmental Management Plan
EPR	Extended Producer Responsibility
ESA	Environmentally Sensitive Areas
ESAR	Environmental Assessment Report
ESDU	Environmental and Social Development Unit
ESF	Environmental Framework

Abbreviation	*Expansion*
ESHS	Environmental and Social Health & Safety
ESMF	Environmental and Social Management Framework
ESZ	Eco-sensitive Zone
ETP	Effluent Treatment Plant
FAQ	Frequently Asked Questions
FAR	Floor Area Ratio
FGD	Focus Group Discussions
FSI	Floor Space Index
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GIIP	Good International Industry Practice
GIS	Geographic Information System
GoI	Government of India
GoK	Government of Kerala
GRC	Grievance Redressal Committee
Ha	Hectares
HCI	Health Care Institutions
HCU	Health Care Unit
HDPE	High-Density Poly Ethylene
HH	Households
HKM	Haritha Keralam Mission
HKS	Haritha Karma Sena
HL	Hazard Line
HR	Human Resources
HSS	Haritha Sahaya Sthapanam
HTL	High Tide Line
ICB	International Competitive Bidding
IDU	Internal Documents Unit (The World Bank)
IEC	Information Education Communication
IEE	Initial Environmental Examination
IFC	International Finance Corporation
IMA	Indian Medical Association
IMAGE	Indian Medical Association Goes Eco-Friendly
IPF	Investment Project financing
ISR	Initial Screening Report
IT	Island Territories
ITEWS	Indian Tsunami Early Warning System
IUCN	International Union for Conservation of Nature
KEIL	Kerala Enviro Infrastructure Ltd.
KGP	Knowledge, Governance and Policy
KIIFB	Kerala Infrastructure Investment Fund Board
KLSUB	Kerala State Landuse Board
KSBB	Kerala State Biodiversity Board
KSDMA	Kerala State Disaster Management Authority
KSIDC	Kerala State Industrial Development Committee
KSPCB	Kerala State Pollution Control Board
KSWMP	Kerala Solid Waste Management Project
LB	Local Body (Urban or Rural)
LDPE	Low-Density Poly Ethylene

Abbreviation	*Expansion*
LFG	Landfill Gas
LGI	Local Government Institution
LSGI	Local Self Government Institution
LTL	Low Tide Line
LULC	Land use and Land Classification
M&E	Monitoring and Evaluation
MA	Multilateral Agencies
MCF	Material Collection Facility
MoEFCC	Ministry of Environment, Forests and Climate Change
MPA	Multi-phase Programmatic Approach
MRF	Material Recycling Facility
NBDW	Non-biodegradable Wastes
NCB	National Competitive Bidding
NDZ	No Development Zone
NEP	National Environmental Policy
NGO	Non-Governmental Organization
NMA	National Monuments Authority
NOC	No Objection Certificate
NPDM	National Policy on Disaster Management
O&M	Operations and Maintenance
OD	Operational Directives
OHS	Occupational Health and Safety
OP	Operational Policies
PAF	Project Affected Family
PAP	Project Affected Person
PAP	Program Action Plan
PCB	Pollution Control Board
PCR	Physical Cultural Resources
PCRMP	Physical Cultural Resources Management Plan
PD	Project Director
PDO	Program Development Outcome
PIU	Project Implementation Agency
PMC	Project Management Consultant
PMU	Project Management Unit
POP	Persistent Organic Pollutants
PPP	Public-Private Partnership
PWD	Public Works Department
QA	Quality Assurance
RMP	Risk Management Plan
RRF	Resource Recovery Facility
SAPCC	State Action Plan on Climate Change
SBM	Swachch Bharat Mission
SDGs	Sustainable Development Goals
SEA	Strategic Environmental Assessment
SEC	Sensitive Environmental Components
SEIAA	State Environmental Impact Assessment Authority
S-ESDU	State Environmental and Social Development Unit
SHC	Stakeholder Consultations
SPMC	State Project Management Consultant

Abbreviation	*Expansion*
SPMU	State Project Management Unit
SPMU	State Project Management Unit
STP	Sewage Treatment Plant
SUP	Single Use Plastics
SW	Solid Waste
SWD	Storm Water Drains
SWM	Solid Waste Management
TA	Technical Assistance
TDS	Total Dissolved Solids
TOC	Total Organic Carbon
ToR	Terms of Reference
TPD	Tons per Day
TSDF	Treatment Storage and Disposal Facility (for Hazardous Wastes)
TSS	Total Suspended Solids
ULB	Urban Local Body
UNCED	United Nations Conference on Environment and Development
UNEP	United Nations Environment Program
UNFCCC	United Nations Framework Convention on Climate Change
UT	Union Territories (of the Government of India)
WB	The World Bank
WGEEP	Western Ghats Ecology Expert Panel
WLPA	Wildlife Protection Act
WTP	Water Treatment Plant

KERALA SOLID WASTE MANAGEMENT PROJECT (KSWMP)

ENVIRONMENTAL AND SOCIAL MANAGEMENT FRAMEWORK

CHAPTER 1. INTRODUCTION TO THE PROJECT

1.1 Program Description

The GoK (GoK) intends to utilize financial support from the World Bank KSWMP which aims to strengthen the institutional and service delivery systems for Waste Management services in urban areas in Kerala. The project will improve SWM service delivery of 87 Urban Local Bodies (ULBs) in Kerala in addition to supporting the development of regional Biomedical Wastes (BMW), and Construction and Demolition (C&D) Waste Management facilities. The proposed geographical coverage for SWM at this stage includes 87 municipalities (all ULBs except the 6 Municipal Corporations). The identified municipalities for SWM constitute approximately 65 percent of the urban population (approximately 10 million people) spread across the 14 districts of the State; while the project influence area is the entire State for Regional SWM, Construction and Demolition (C&D) Wastes and Biomedical Wastes (BMW) management facilities.

1.1.1 Proposed Project Components

In Kerala, SWM is currently being carried out in a decentralized manner wherein the treatment of biodegradables is being promoted at the waste generator's level (households, institutions, and community) by the use of micro bio-digestors and composting plants and a fragmented collection system involving various institutions (Haritha Karma Sena (HKS), Clean Kerala Company, and ULBs) is deployed for collection and recycling of non-biodegradables. However, 75-80percent of the biodegradable waste generated across ULBs i.e. 1300-1800 TPD is neither treated nor collected for any scientific processing and likewise, there is no system to treat and dispose-off the non-biodegradable waste due to lack of proper facilities. The state is currently also planning for 8 regional waste-to-energy treatment plants in bigger ULBs.

KSWMP would indicatively support the following interventions:

a) Strengthening and scaling up city-level SWM systems
b) Upgradation of existing household/institution decentralized treatment plants to scientific treatment such as bio-digestion
c) Scaling up the decentralized treatment by setting up improved community-level bio-degradable treatment plants
d) Providing necessary infrastructure (bins, collection vehicles) for primary collection.
e) Setting up the primary collection mechanism for untreated biodegradable waste (for households with no decentralized processing facilities) and left-overs/inert post decentralized processing.
f) Upgradation of existing Material Collection and Recycling Facilities (MCFs, MRFs) and Resource Recovery Facilities (RRFs)

g) Scaling up of necessary secondary collection infrastructure (such as MCFs, RRFs) based on holistic need assessment
h) Setting up Regional Treatment and Disposal Facilities for Solid wastes, biomedical wastes (BMW) and C&D wastes, and
i) Improvements to existing dumpsites.

The State is in its efforts to treat waste at source and parallelly set up facilities to dispose-off the rejects, inerts, and to upscale and recycle the recyclables. The project aims to support the State in this endeavor by providing solutions for disposal and recycle, improving existing systems to minimize and manage negative externalities.

1.1.2 Environmental Characteristics of the Project Location

Flanked by the Arabian Sea in the West, the towering Western Ghats in the East; Kerala is blessed with a unique set of geographical features, tropical climate, and rich biodiversity. The State located at the southwestern corner of the Indian Peninsula has a feature-rich coastline of around 570 km. The State is networked by 44 interconnected rivers, mostly originating from the Western Ghats and quickly emptying into the sea given the short distance and high slopes between origin and destination.

Lands of different elevations characterize the State namely; the low lands, the midlands, and the high lands; with urban and rural areas interspersed across as a rural-urban continuum; often referred to as ‘rurban’ owing to the minimal distinctions between these regions. Increasing the density of houses and settlements leads to physical and institutional structures that are essentially urban for collective provision of infrastructures such as water supply, streets, roads, sewerage, and drainage systems. The absence of key infrastructure for managing wastes, wastewater, and sewage is leading to the deterioration of the quality of its pristine environment.

Spread along the narrow strip of the State from North to South, it is expected that proposed project activities may result in positive and/or negative impacts on the environment of Kerala. Exact locations of proposed project investment activities are not known at this stage. However, considering the spread of small and medium ULBs of Kerala, it is understood that medium and small cities which would participate in this project are located in varied geographic regions; and have many geographically and environmentally sensitive features including hills, lakes, rivers, wetlands, forests, national parks, biodiverse areas, lakes, and coasts. Due to its physiography and high density of population housed in this narrow strip of land sandwiched between the mountains and the ocean; impacts of disasters like floods and cyclones are high. Given its geographical, environmental, and socio-economic characteristics, the provision of services must consider environmental sensitivities and disaster resilience. Towards ensuring this, it is important to undertake a strategic environmental assessment and prepare an environmental management framework to guide and ensure environmental and safeguards considerations in project development, implementation, and operations.

1.2 Need for an Environmental Management Framework

The State of Kerala is unique in its geographic features (including western coastal low-land extending north-south with parallel estuaries and wetlands, crisscrossing rivers and canals, steeply slopping, forested and biodiverse Western Ghats along the eastern side); climatic conditions (hot-humid, tropical with high rainfall) and environmental characteristics; and is disaster-prone. Its socio-economic peculiarities, of a rural-urban continuum with a spread of development, and highly dense coastal strip and midlands have resulted in the unavailability of appropriate land for public services. Lack of sanitation and waste management facilities has resulted in negative externalities on its environment, biodiversity, and society at large. It is hence important to devise sustainable options for environmental infrastructure and services well suited to Kerala and to improve institutional capacities to devise, plan, and manage these.

The proposed financing mechanism of the World Bank (Investment Project Financing) for KSWMP requires the application of World Bank safeguard policies for the project. To ensure comprehensive and sustainable solutions and integrated safeguard management at a regional/sectoral level it is proposed to undertake a SEA that could inform the preparation of an ESMF for effective safeguards management.

1.3 Overview of the Environmental Assessment and Framework

1.3.1 Purpose of the SEA and ESMF

SEA is a key means of integrating environmental considerations into policies, plans, and programs, particularly in sector decision-making and reform. It is defined as a systematic process for evaluating the environmental consequences of the proposed policy, program, or plan initiative and their alternatives to ensure they are fully included and appropriately addressed at the earliest suitable stage of the decision-making process. It consists of an assessment of policies, plans, projects, and programs from an environmental point of view.

The SEA aims to understand the baseline situation concerning environmental characteristics, National / State regulatory mechanisms, and institutional capacities for environmentally sound planning, design, and management of proposed interventions. It provides an understanding of the potential environmental issues associated with the urban sanitation sector in Kerala as a whole, and particularly those which might specifically arise directly or indirectly by varied project activities in urban areas under consideration. It highlights the gaps in the sustainability framework and formulates alternatives/recommendations and guidelines to assess and address these issues and weaknesses in institutional and governance aspects at various levels. It can strongly contribute to weaving in environmental sustainability principles into plans, programs, policies, and projects. It recommends the way forward to address the sectoral concerns considering the impacts, exploring potential synergies and opportunities for mainstreaming environmental considerations and safeguards into the project. Its findings will inform the sectoral policy, as well as the environmental strategy for urban planning, sanitation, and related activities to be undertaken as part of the project.

SEA does not substitute EIA at a project level, but it gives a basis for arriving at better-informed decisions on broader strategic aspects, like long term and range planning.

Here, SEA has been undertaken in a participatory manner through consultations with all stakeholders, using suitable quantitative and qualitative tools and prediction techniques. Mapping of key determining features of the State and review of technology used in urban sanitation, Demand – Supply Gap assessment, and the environmental opportunities and scope for various technological options are important. A review of all institutions/agencies/departments partnering in the project has also been undertaken.

The objectives of this SEA are twofold, namely:

At the sectoral level, (i) identify the positive and negative environmental impacts and the risks associated with proposed sectors/interventions (or any attempt to bridge the demand-supply gap), (ii) assess the policy, legal and institutional framework and capacity to manage these issues, (iii) to propose a set of actionable recommendations by which these issues can be addressed to enhance the environmental sustainability of proposed sectors/interventions continually; specifically focusing on regional environmental differentials, and

At the project level: (i) prepare a set of detailed environmental guidelines for use in project activities and related investments.

ESMF is an instrument that examines the issues and impacts associated when a project consists of a program and/or series of sub-projects, and the impacts cannot be determined until the program or sub-project details have been identified. Depending on the nature and location of the urban investment activities, the project initiatives are likely to contribute to limited environmental impacts on the project area during their construction and O&M phases. These impacts would assume importance when the project locations are in proximity to sensitive areas. Hence, there is a need for systematic safeguards management with a pre-defined framework for risk mitigation. As the project locations and activities are not finalized, to identify and manage associated environmental risks, it is required to prepare an ESMF for the project.

ESMF is used as a safeguards instrument when a project consists of a program and/or series of sub-projects, and the impacts cannot be determined until the program or sub-project details have been identified. ESMF manages potential adverse impacts through a guide consisting of a set of methodologies, procedures, and measures to facilitate adequate environmental management (risk management and impacts) related to the works financed under the project and whose specific location is unknown or may change during project implementation.

The purpose of the ESMF is to describe a framework or a step-wise process for the management of the environmental issues during the subproject; including (i) procedures for screening the environmental aspects related to the programs, (ii)

identification of impacts, regulatory mechanisms, and management/mitigation measures and monitoring needs, (iii) details on the institutional roles and responsibilities for environmental management (including contract provisions and budget), (iii) strategy and plan for capacity building of key stakeholders, (iv) plan for monitoring the implementation of environmental safeguards, (v) strategy for public consultation.

1.3.2 The ESMF process

The ESMF is prepared based on the type of subprojects and activities which are expected and probable impacts considering the activities and project locations. It also considers the existing institutional set up for safeguards management and suggests improvements/additions required to follow the ESMF process. ESMF outlines the process to be adopted during each stage in the project cycle, to ensure the preparation of adequate guidance for safeguards management based on the level of impacts and to agree and follow these during the implementation and Operation and maintenances stages.

1.3.3 Revision/Modification of the ESMF

The ESMF is a 'live document' enabling revision, as and when necessary to incorporate the changing project scenario. At a later date, with changing project contours and on-field necessities; it may deem necessary to incorporate certain provisions in the ESMF. In case of any such additional requirement or need for change in the future, it should be assessed, and appropriate management measures incorporated into the ESMF. Unexpected situations and/or changes in the project or sub-component design would, therefore, be assessed and appropriate management measures will be incorporated by updating this ESMF. Such revisions will also cover and update any changes/modifications introduced in the legal/regulatory regime of the country/ state. Also, based on the experience of application and implementation of this framework, the provisions and procedures would be updated, as appropriate in consultation with the World Bank and the implementing agencies/departments.

1.3.4 Structure of the ESMF Report

This report ESMF for KSWMP is presented in two Volumes; Volume I and Volume II.

Volume I: Volume I presents the Strategic Environmental Assessment, and Regulatory Assessment. It concludes with strategic directions to inform the long term strategy for SWM in Kerala and to guide the environmental aspects and safeguard requirements for KSWMP.

Volume II presents the Environmental Management Framework (EMF), Tribal Development Framework - Social Management Framework (TDF-SMF), and Resettlement Policy Framework (RPF). The EMF includes the assessment of probable impacts, process for carrying out subproject environmental screening, assessment, preparation of environmental management plan including mitigation measures, and monitoring plan. It also includes the Guidance Manual which presents the documentation formats to be used for screening of projects, sample Terms of

References (ToRs) for (i) Impact Assessment, (ii) Specialists to manage ESMF, and (iii) auditing/monitoring compliance to ESMF. It also provides guidance materials for licenses, permits, clearances under various regulations, and generic or indicative environmental and social management plans (ESMPs), and monitoring plans for typical types of projects. It also presents a comprehensive set of Environmental Codes of Practices (ECoPs) for guiding various project activities.

The layout of various chapters in the report is as follows:

VOLUME I: INTRODUCTION AND STRATEGIC ENVIRONMENTAL ASSESSMENT

CHAPTER 1. INTRODUCTION TO THE PROJECT: This presents the Program Description in terms of its Proposed Project Components and Environmental aspects associated with these.

CHAPTER 2. ENVIRONMENTAL CHARACTERISTICS OF KERALA REGION: Discusses the physiographical and environmental features of Kerala, at district and town level for sample towns. It also presents the existing institutional structure.

CHAPTER 3. ASSESSMENT OF EXISTING SOLID WASTE MANAGEMENT SYSTEM: presents the project influence area, review of past efforts on SWM in the State, the role of urban planning in the State viz a viz waste management efforts, risks opportunities and gaps in a sustainability framework. It presents recommendations and the way forward in ensuring better SWM services.

CHAPTER 4. REGULATORY FRAMEWORK: discusses applicable National / State regulations and applicable WB Safeguard policies

VOLUME II (PART A): ENVIRONMENTAL MANAGEMENT FRAMEWORK

CHAPTER 1. ASSESSMENT OF PROBABLE IMPACTS DUE TO SUBPROJECTS: presents expected impacts of proposed subprojects

CHAPTER 2. ENVIRONMENTAL MANAGEMENT FRAMEWORK (EMF): discusses the framework to be adopted for Sub-project Identification and Initiation, Screening, and Categorization of the Projects, Mechanism for Assessment of Impacts during project preparation, preparation of mitigation and monitoring measures

CHAPTER 3. INSTITUTIONAL FRAMEWORK AND BUDGET FOR ESMF ADOPTION discusses the role and responsibilities of various institutions in safeguards management

CHAPTER 4. GRIEVANCE REDRESS MECHANISM, CONSULTATIONS, AND INFORMATION DISCLOSURE Discusses mechanisms for grievance redressal, consultations, and disclosure of information on Environmental Safeguards

It also includes an EMF GUIDANCE MANUAL with:

a) Documentation formats to be used for screening of projects
b) Sample terms of references, for Impact Assessment and Specialists to manage ESMF and for auditing compliance to ESMF

c) Guidance materials for licenses, permits, clearances under various regulations, site selection, public consultation, and consensus, indicative Environmental Management Plans, and monitoring plans for typical types of projects, grievance management.

Volume II (PART B): TRIBAL DEVELOPMENT FRAMEWORK - SOCIAL MANAGEMENT FRAMEWORK

VOLUME II (PART C): RESETTLEMENT POLICY FRAMEWORK

This Report is the Volume I of the ESMF for the KSWMP Project.

CHAPTER 2. ENVIRONMENTAL CHARACTERISTICS OF KERALA REGION

KSWMP will be implemented in Urban Local Bodies of Kerala, spread across the State. To understand the profile of the project areas; a review of the environmental characteristics of the State was undertaken, analyzing available secondary data, primary surveys, and information collation exercises. The following subsections discuss State characteristics to set the regional context and deliberate the environmental characteristics of the towns under consideration within this. This would help set the stage for analysis of impacts due to proposed project activities.

2.1 Geographic Location

Figure 1: Geographical Location of the State of Kerala, India

God's Own Country, Kerala ((38,863 km²; 1.2percent of India's landmass) is a western coastal state of India's Tropical peninsular South. It lies between the northern latitude of 8°.17'.30" N and 12°. 47'.40" N and east longitudes 74°.27'47" E and 77°.37'.12" E. The state is bordered on three sides by the land, and the fourth by sea -- Arabian Sea (Lakshadweep sea) to the west, Tamil Nadu and the Indian Ocean to the South, the State of Karnataka on the North and North-East and State of Tamil Nadu to its East. The State has a total coastline of about 560 km.

Though Kerala forms the only 1.2percent of the total area of India; 3 percent of the country's population inhabits the State. The geographic location of the State at the southern tip of the country and less industrialization makes it a receiver of the consumer goods from producers mainly located to its north. This explains the higher quantities of packaging material and plastics which enter through its transport corridors and ports and gets accumulated here.

2.2 Demographics

2.2.1 Population Profile and Decadal Growth Rate

As per the Census of India 2011, the population of Kerala was 3,34,06,061 or 2.76 percent of India's population. Out of the State's total population, 52 percent are women and 48 percent are men. The decadal growth rate of Kerala's population was 4.9 percent, the lowest among the Indian States. Among the Districts of the State, Malappuram has the highest growth rate (13.4 percent), and Pathanamthitta has the lowest growth rate (-3.0 percent). Idukki also has seen a decline in population negative growth rate (-1.8 percent). The growth rate of the population is lower in six southern Districts (Idukki, Kottayam, Alappuzha, Kollam, Pathanamthitta, and Thiruvananthapuram) than in other districts of the State.

Total waste generated in the State is around 15000 tons per day at 450 grams per capita per day. It is expected that the future waste generation will be more in central and northern parts of the State; as compared to the Southern part.

2.2.2 Trends In Rural and Urban Classification of Population in Kerala

The State has now 52.30 percent of its population in rural areas as per the 2011 Census as against 74.04 percent in the 2001 Census. Near doubling (92.72 percent increase) of the urban population during the period 2001-2011 could be attributed squarely to the manifold increase in the number of Towns in the State during this time from 159 to 520. Around half (47.72percent) of the total population of Kerala is Urban. Ernakulam is the most urbanized district (68.07percent) and Wayanad (3.87percent) is the least urbanized district of the State. There are 93 Urban Local Bodies (ULBs) including 6 Municipal Corporations. The State is an 'urban-rural continuum' or has a 'rur-ban' character.

Impacts of waste generation in urban areas are obvious in and rural Kerala as well. While rural areas of highland Kerala generate around 380 grams per capita per day; those near towns generate more than 400; municipalities generate 419 and corporations generate around 545. The rur-ban pattern also reflects in a continuum of uncollected waste along its corridors running through cities and villages.

2.2.3 Child Population (0-6 Age Group)

The Census data presents an absolute decline in the number of children (0-6 years) in the State. As per the 2011 census, the total child population in Kerala was 34,72,955 (10 percent of the total population as against 13.1 percent for the country) while it was 37,93,146 (12 percent of the total population as against 15.9 percent for the country) as per the 2001 Census data. The child population of Kerala as a proportion of the total population was below the national average for Tamil Nadu (9.56 percent), Karnataka (11.21 percent) and Andhra Pradesh (10.21 percent) as per 2011 Census. The rural population in the age group 0- 6 was 10.01 percent which was higher than that of the same in urban (9.88 percent). The highest proportion of child population was in Malappuram District and the lowest proportion was in Pathanamthitta District. A decreasing trend in the proportion of child population is seen in all Districts of the State. The Southern Districts of Kerala

witnessed a two (2) percent decline except for Kollam, in which there was a decline of a percent in the proportion of child population, while the northern Districts in Kerala showed a percent decline in the proportion of child population. But Wayanad District had a decline of two (2) percent. This narrative supports the argument in *Section 2.2.2* that there is a decreasing trend in population in the State; more so in southern parts of the State. Sample Registration System compiled by Registrar General of India for 2017 estimates that Bihar has the highest Total Fertility Rates of 3.2, about twice that of Kerala (1.7) and Delhi (1.5), which scored the lowest; discussing a positive correlation between fertility rates and Literacy levels of Female Populace.

The decline in the child population is a pointer to decreasing population trends, and in turn, it's waste generation.

2.2.4 Sex Ratio (Females Per 1000 Males)

Kerala stands high in its socio-economic indices. The sex ratio (number of females per thousand males) of Kerala according to Census 2011 is 1,084 and has improved by 26 points since 2001. This increase was more than that experienced during the previous census years. This shall be compared with the sex ratio of Tamil Nadu at 996, Karnataka at 973, Andhra Pradesh at 993, and all India level at 943. All the Districts have sex ratios above 1,000 with Kannur having the highest sex ratio (1,136) followed by Pathanamthitta (1,132). Idukki has the lowest sex ratio (1,006). The sex ratio of Ernakulum is 1,027. The difference between the lowest (Idukki 1,006) and the highest (Kannur, 1,136) is 130 points. The child sex ratio in Kerala is 964 as per the 2011 Census data, which improved minimally from 960 in 2001. During the same time, the child sex ratio of India declined from 927 to 919.

A positive sex ratio is an indicator of better social status, preference for female members of the family, and better educational status. However, an unbalanced child sex ratio is a point of future concern. Better economic opportunities for women are hence necessary as it would enhance the social status and acceptability of women.

2.2.5 Literacy

Kerala has the highest proportion of literate persons in the population among the Indian States. The effective literacy rate is 93.91 percent as per Census 2011. In Kerala, 96.02 percent of men and 91.98 percent of women are literate as against 82.14 percent of men and 65.46 percent of women at the all India level. Among Districts, Kottayam tops in literacy with 97.2 percent followed by Pathanamthitta with 96.5 percent. Lowest literacy rates are in Wayanad and Palakkad with 89 percent and 89.3 percent respectively. Even the lowest literacy rate of Wayanad (89 percent) is higher than the national average. As compared to 2001, the literacy rate of all the Districts has improved.

According to data from the National Family Health Survey 2015-16, the infant mortality rate (per 1000 live birth) was 5 in rural Kerala. In comparison, infant mortality rates were 67 in rural Uttar Pradesh, 39 in rural Gujarat, and 46 in rural India as a whole. As per this data, 70.5 percent of all women in rural Kerala in the age group of 15 to 49 years had completed 10 years or more of schooling.

The literacy rate of Kerala is steadily at a high over the last two decades; giving it the coveted 100 percent literacy status. There is only a four (4) point literacy gap between females and males in the state. Kerala's citizens have the highest newspaper consumption in all of India, supporting the assertion that "literacy in a progressive and mobilized political environment also enhances political awareness" (Franke and Chasin 1994)[1]. Kerala's remarkable literacy rates are certainly an achievement of a remarkably far-reaching and engaging educational system. Even more important, however, is the fact that literacy in Kerala has a greater connotation, that it signals a well-informed populace, able to participate actively as citizens. This asserts that better awareness and participation levels could be achieved through well-developed campaigns and visual/print media.

2.2.6 Density of Population

The density of Population Kerala's density of population as per the 2011 census is 860 persons per sq. km; while the density of population in Tamil Nadu is 555, Karnataka 319, Andhra Pradesh 308, and that of India is 382. Thiruvananthapuram is the most densely populated District (1,508) while, Idukki is the least densely populated District (255). The density of population increased in all Districts between the Census of 2001 and 2011, other than in Pathanamthitta and Idukki. The density of the population of Kozhikode stands at 3464 persons per sq km; while that of Trivandrum Municipal Corporation is 4457 persons / sq km much higher than that of Bangalore city. The density of the population of Kochi Corporation is 7139 persons every sq km, marching fast to cross the 10000-mark like the large Indian cities of Ahmedabad and Pune.

Higher population densities indicate the pressure on land resources for the development of various infrastructure. This coupled with the spread-out homestead type of development pattern in the states and nearness to coasts and Ghats is the narrative for population pressure and lesser possibilities to make land available for infrastructure development.

2.2.7 Ethnicity

Kerala has a very small segment of tribal population accounting only for 1.14percent of the State's total population. The Scheduled Tribes (synonymous with tribal/indigenous people) are spread throughout the State mostly in the forested areas of the State; including districts of Wayanad, Idukki, and Kasargod and Palakkad. There are 36 tribal groups in the State, according to information provided by the Scheduled Tribes Development Department. Scheduled Castes and Tribes population of Kerala doubled during the period 1961 to 2011; while the total population also showed the same trend. Kerala has the highest levels in India retention for all children in school for pupils from the Scheduled Castes and Tribes [2]. Also, 15 percent of the students (numbering 48,503) enrolled for higher education programs (both graduate and postgraduate programs) in colleges of Kerala in the Arts, Science and Commerce streams belonged to the Scheduled Castes and Tribes (Scheduled Castes and Tribes, together, accounted for 10.94 percent of Kerala's population in 2011).[3]

[1] *Franke, Richard W., and Barbara H. Chasin. Kerala: Radical Reform as Development in an Indian State. Oakland, CA: Inst. for Food and Development Policy, 1994. Print.*
[2] *State Planning Board, 2019. Economic Review. GoK*
[3] *http://spb.kerala.gov.in/images/pdf/whats_new/ER_2019_Vol1_E.pdf. Pg. 45*

Better education levels and thus socioeconomic levels of scheduled tribes and castes in Kerala promises good involvement in State/town led programs and shows their ability to voice their concerns.

2.3 Population Distribution

2.3.1 Administrative Divisions

For Revenue purposes, the State of Kerala consists of 14 districts, 27 revenue divisions, and 77 taluks. The State of Kerala consists of 14 districts, 27 revenue divisions, 77 taluks, 1664 villages, and 520 towns.

Local Government set up in Kerala includes 14 District Panchayats, 152 Block Panchayats, 941 Grama Panchayats, 87 Municipalities, and 6 Municipal Corporations.

All 87 municipalities of Kerala are being considered under the project for various interventions in SWM.

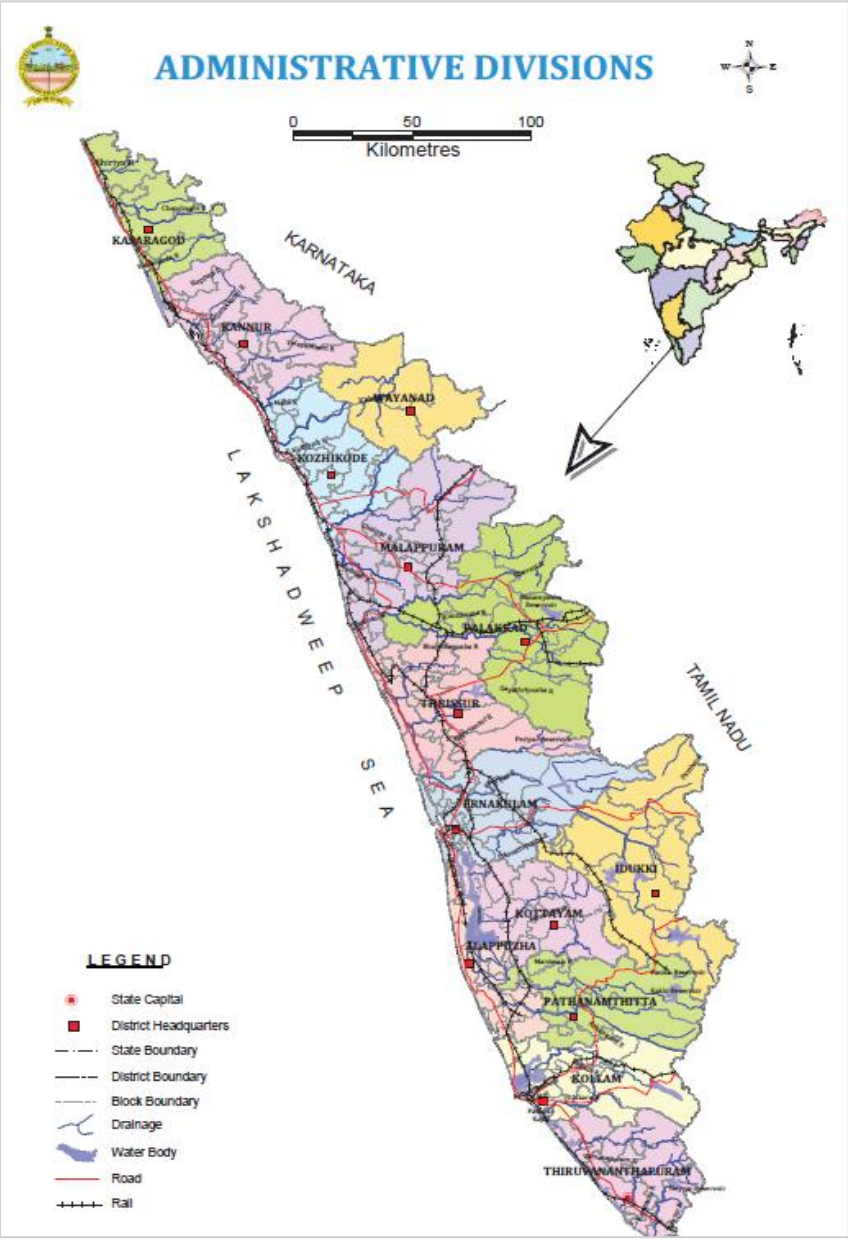


Figure 2: Administrative Divisions of Kerala

Source: 2011 Census

Waste generation rate per capita in municipalities varies from 364 grams/capita to 456 grams/capita. Low waste generation is noticed in ULBs in highland areas. Highly urbanized Municipalities generate above 450 grams/capita and the City Corporation generates around 545 grams/capita. Domestic waste contributes 55 to 65percent of total waste, while commercial establishment and markets are the second-highest generators of waste. The average waste generation rate in Municipalities works out to

419 gm/capita/day whereas, in Municipal Corporation areas it works out to 545 gm/capita/day. Based on this estimate, the total waste generation projection for 2020 for the 93 ULBs in the State is estimated at 3755 TPD.

2.3.2 Urbanization and Urban Agglomerations

The share of the urban population in Kerala was 47.7 percent of the total population, representing a decadal increase of 21.74 percent between 2001 and 2011. As many as 1,59,349,26 persons in the State were living in urban areas in 2011. The rural population was 1,74,711,35. The District in which the proportion of the urban population to the total population is highest in Ernakulum (68 percent). The share of the urban population is lowest in Wayanad (3.9 percent).

An Urban Agglomeration is a continuous urban spread constituting a town and its adjoining urban outgrowths, or two or more physically contiguous towns together and any adjoining urban outgrowths of such towns. In some cases, railway colonies, university campuses, port areas, military camps, etc., would have come up near a city or statutory town outside its statutory limits but within the revenue limits of a village or villages contiguous to the town. Each such individual area by itself may not satisfy the minimum population limit to qualify it to be treated as an independent urban unit but deserves to be clubbed with the towns as a continuous urban spread.

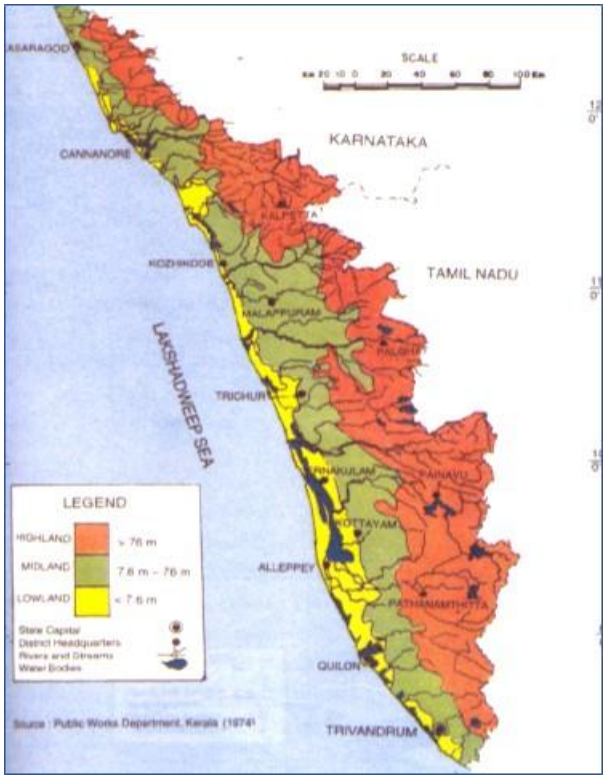
The following are the possible different situations in which urban agglomeration would be constituted:
A city or town with one or more contiguous outgrowth;

i) Two or more adjoining towns with their outgrowths;
ii) A city and one or more adjoining towns with their out-growth all of which form a continuous spread;
iii) The core town or at least one of the constituent towns should necessarily be statutory; and
iv) The total population of all the constituent units (i.e., towns and outgrowths of an urban agglomeration should not be less than 20,000) (as per the 2001 census).

There are 19 Urban Agglomerations in the State of Kerala in the 2011 census. Ottappalam (UA), Chalakkudy (UA), Kothamangalam (UA), Changanasserry (UA) and Kayamkulam (UA) are the five new Urban Agglomerations for 2011 census. The Urban Agglomerations Vadakara (UA) of the 2001 Census has been merged with Kozhikode (UA) for the 2011 Census. Similarly, Kodungallur (UA) and Guruvayur (UA) are merged with Thrissur (UA) for the 2011 Census.

Spatial Pattern of Urban Agglomerations along the length of Kerala from North to South explains the need for a clustered approach to major waste management infrastructure, common disposal facilities to reduce the footprint and to ensure economies of scale.

2.4 Physical Characteristics



2.4.1 Physiography and Terrain

The terrain of the state has three natural regions namely, lowlands, midland, highlands. The low land is adjacent to the coast and extends up to an altitude of 7.5 m MSL. The High land is on the eastern part consisting of the hills and mountains of the Western Ghats and it extends from 75 m MSL and above. In between the High lands and the Low lands is the Midland having an undulating topography which extends from 7.5 m MSL up to 75 m MSL.[4]

Figure 3: Physiography of Kerala

Around 48 percent of the total land area is occupied by the Western Ghats; also known as Sahyadri; from where most rivers originate. Midlands comprises of hills and valleys with many small towns and villages; covering 40 percent of the total land area of the state. This is the region where cultivation is mostly done. The remaining land, covering around 4000 sq km is the low lands; mostly in its coastal stretch interspersed with wetlands, estuaries, and lagoons. Soil is fertile, supporting paddy cultivation. All municipal corporations of Kerala fall in the low land region; in the coastal plain.

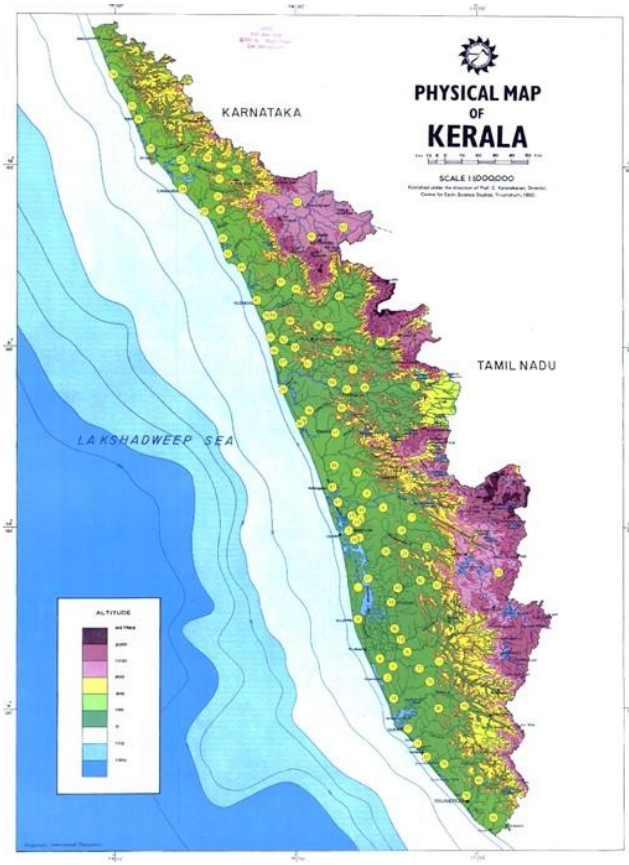


Figure 4: Distribution of KSWMP Towns in various Physiographical regions of Kerala

Table 1: Distribution of ULBs across various Physiographic Zones of Kerala

[4] *Source: State Perspective and Strategic Plan, Kerala State*

Physiographic Region	Number of ULBs	Percentage: ULBs' Distribution
Low land	22	24 percent
ULB's located in Lowland Thiruvananthapuram, Kollam, Kochi, Kozhikode, Kannur, Varkala, Paravur, Karunagappally, Alappuzha, Cherthala, Chavakkad, Kodungallur, Ponnani, Tirur, Thanur, Koyilandi, Payyannur, Payyoli, Thalassery, Kanjangad, Kasargod, and Vadakara		
Midland	55	60percent
ULB's located in Midland Angamali, Adoor, Anthur, Attingal, Aluva, Irinjalakkuda, Ettumanoor, Eloor, Ottappalam, Koothuparambu Koothattukulam, Kunnamkulam, Kalamasserry, Kayamkulam, Kottarakkara, Kondotty, Kottakkal, Guruvayur Changanasserry, Chalakkudy, Chittur-Thathamangalam. Chengannur, Cherpulasserry, Thrikkakkara, Thripunithura, Thaliparambu, Thirurangadi, Thiruvalla, Nileswaram, Nedumangadu, Neyyattinkara, North Paravur, Pattambi, Pandalam, Payyannur, Parappanangadi, Panoor, Piravom, Perumbavoor, Perinthalmanna, Faroke, Mukkam, Manjeri Mattannur, Malappuram, Muvattupuzha, Mavelikkara, Ramanattukara, Vadakkancherry, Valancherry, Vaikom, Sreekandapuram, Shornur, Harippad, Thrissur		
Highland	16	16percent
ULB's located in Highland Punalur, Pathanamthitta, Erattupetta, Kottayam, Kothamangalam, Thodupuzha, Pala, Kalpetta, Koduvally, Nilambur, Kattappana, Sultanbathery, Mannarkad, Manathavadi, Palakkad, Iritty		

It has been estimated that[5] waste generation rates are higher in the coastal belt, which is around 545 gm/capita/day in Municipal Corporation areas whereas, the waste generation rate in the midland belt is about 454 gm/capita/day and it is about 383 gm/capita/day in highland areas. Considering an average of small & big towns, the average waste generation is estimated as 419 gm/capita/day for Municipalities and 545 gm/capita/day for corporations. Following is the waste generation estimate for each physiographical divisions of Kerala:

Table 2: Waste Generation Estimates for ULBs in various Physiographic Regions of Kerala

Sl No:	*Geographical area*	*No: of Towns / Cities*	*Population of 2020*	*Per Capita Waste Generation per day*	*Projected Waste Generation (TPD)*	*Percentag of Tota Waste*
1	*Lowland (Coastal area)*	*22*	*4162180*	*419-545*	*2115*	*56.4*
2	*Mid Land*	*55*	*2941234*	*419-545*	*1275*	*34*
3	*High Land*	*16*	*872437*	*419*	*365*	*9.6*
	Total	*93*	*7975851*		*3755*	

This indicates the need for more infrastructure and land for SWM in dense lowland areas near the coast. These are vulnerable to flash floods and other hazards. However, the aerial distance between coast and highlands is only 40 – 80 km, highlighting the possibility for clustered critical infrastructure in the midland region, at an operationally manageable distance from ULBs in the coast.

[5] *UMC Global, 2019-20. SWM TA Kerala-Technology Assessment Report*

2.4.2 Climate

As per Koppen's classification, the climate of Kerala is tropical monsoon with seasonally excessive rainfall and hot summer except over Thiruvananthapuram district, where the climate as tropical savanna with seasonally dry and hot summer weather.

The year may be divided into four seasons. The period March to the end of May is the hot season, followed by the Southwest Monsoon season that continues till the beginning of October. From October to December is the Northeast Monsoon season and the two months January and February winter season. The State is extremely humid due to the existence of the Arabian Sea in the west of it.

The total annual rainfall in the State varies from 360 cm. over the extreme northern parts to about 180 cm. in the southern parts. The southwest monsoon (June-October) is the principal rainy season when the State receives about 70percent of its annual rainfall. Monsoon rainfall as a percentage of annual rainfall decreases from north to south and varies from 83 percent in the north most district of Kasargod to 50PERCENT south most district of Thiruvananthapuram. Northeast monsoon rainfall as a percentage of annual rainfall increases from north to south and varies from 9percent in the north most district of Kasargod to 27percent in the southernmost district of Thiruvananthapuram. The rainfall amount in the State decreases towards the south with a decrease in the height of Western Ghats. The southernmost district of Thiruvananthapuram where the Western Ghats are nearest to the seacoast and its average height is also least in the State receives a minimum amount of rainfall. The southwest monsoon sets-over the southern parts of the State by about 01 June and extends over the entire State by 05 June. June and July are the rainiest months, each accounting individually to about 23percent of annual rainfall. The thunderstorm rains in the pre-monsoon months of April and May and that of monsoon months (June to September) are locally known as 'EDAVAPATHI' while the rainfall during northeast monsoon season (October and November) is known as 'THULAVARSHAM' in the local language, Malayalam[6].

The state with Tropical warm Humid climatic conditions is under rains for almost six (6) months annually, which restricts the construction activities. Waste will be mostly wet, necessitating more attention on the segregation of waste at source, leachate, fly /odor/slurry management, and covered treatment and storage facilities for both dry and wet waste. Waste Collection bins, vehicles, and waste treatment premises shall be covered and needs cut-off drains and leachate / wash water treatment to prevent water pollution.

2.4.3 Geology and Soils

[6] *Source: ENVIS and Economic Review 2018*

Geologically 88percent of the State is underlain by crystalline rocks of Archaean age, which is a part of the peninsular shield. The crystalline complex of Kerala is composed of charnockites, gneisses, schists, migmatites, and rocks of the Wayanad supracrustals. Along the western portion of the State, the crystalline rocks are overlain by the sedimentary formations of Tertiary age and Recent alluvial formations. The Tertiary sequence of formations has been divided into four beds viz. Alleppey, Vaikom, Quilon, and Warkalli, the age of which ranges from Eocene to Lower Miocene. Laterites of Sub-recent age derived from the crystallines as well as sedimentary formations are seen all along the midlands. Along the coastal plains, sedimentaries and laterites are overlain by alluvium of Recent age. The existing level of information on the mineral resources of the state indicates rich deposits of heavy mineral sands along the coast and rich clay deposits. Other significant occurrences include bauxite, iron ore, graphite, limestone, and gold.

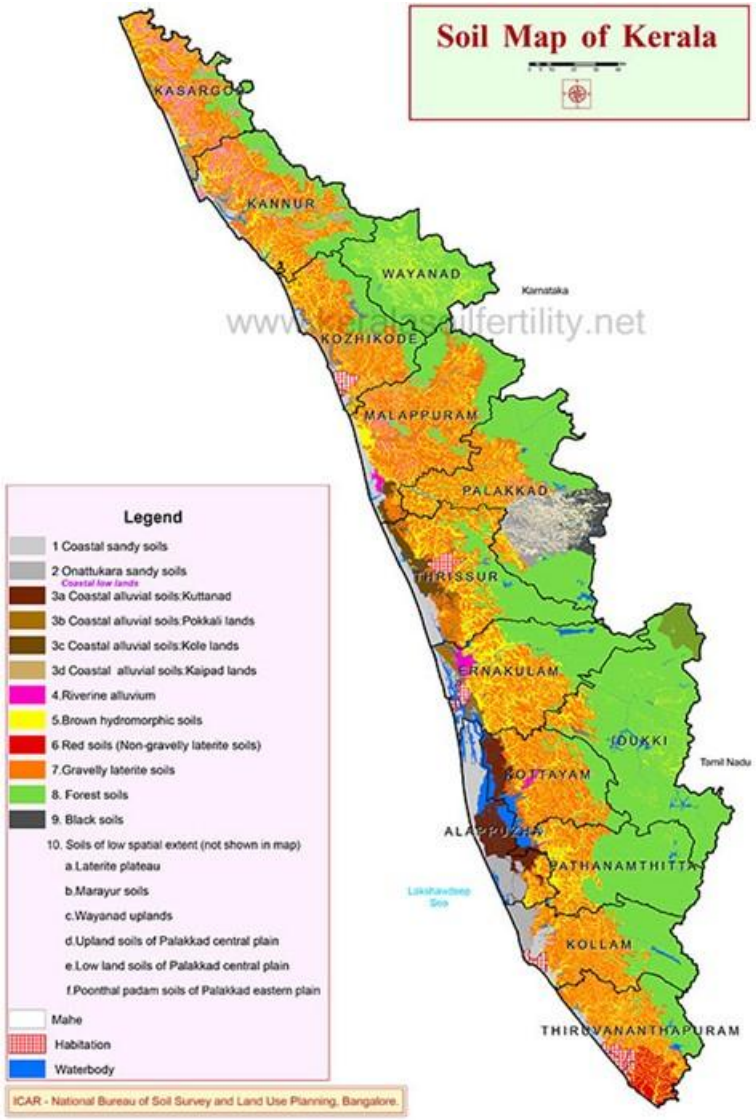


Figure 5: Soil Map of Kerala

The topo-litho sequence of Kerala along with variation in rainfall, temperature, and alternate wet and dry conditions particularly from the western coast to high ranges in the east and swift-flowing rivers lead to the development of different types of natural vegetation and soil. The soils of Kerala can be broadly grouped as follows (***Table: 3***).

Table 3: Soil types of Kerala and Suitability for SWM Infrastructure

Soil Types	***Distribution***	***Features & Land use***	***Suitability for SWM Infrastructure***
Coastal Sandy Soils (Coastal Plains)	Coastal areas of Thiruvananthapuram, Kollam, Alappuzha, Ernakulam,	Sandy soils of marine origin. Deep and well-drained. Low in organic matter, deficient in plant nutrients. Low capacity to retain water and nutrients. Rice in the lowlands and	Sandy Soils/coastal alluvium is not suitable for landfills as the soils are more of a sandy texture with good porosity and permeability. The leachate may mix with the groundwater and pollute the

Soil Types	***Distribution***	***Features & Land use***	***Suitability for SWM Infrastructure***
	Thrissur, Malappuram, Kozhikode, Kannur and Kasargod districts	vegetables during summer Coconut and tuber crops in uplands	groundwater regime of the region. Avoid CRZ zones/areas within hazard lines for waste disposal facilities (landfill). Existing dumps need immediate remediation.
Onattukara Sandy Soils (Onattukara Plains)	Kollam and Alappuzha districts	Sandy soils, very deep, well-drained, low in organic matter, deficient in plant nutrients. Seawater intrusion in coastal areas. Rice in the lowlands and vegetables during summer Coconut and tuber crops in uplands	Sandy Soils/coastal alluvium is not suitable for landfills as the soils are more of a sandy texture with good porosity and permeability. The leachate may mix with the groundwater and pollute the Groundwater regime of the region. Possibilities of seawater intrusion also pollute the region. Avoid CRZ zones/areas within hazard lines for waste disposal facilities (landfill). Existing dumps need urgent remediation.
Coastal Alluvium (Potential Acid Sulphate Soils- Coastal Lowlands	Occur in coastal lowlands in areas slightly below or above sea level in Alappuzha, Kottayam and Ernakulam districts	Soils formed from river alluvium and Sulphur rich marine sediments and are potential acid sulphate. They are extremely acidic and poorly drained. Salinity problem in coastal areas. Rice is the major crop, vegetables grown during summer months in upper reaches. Coconut and tuber crops in raised bunds Integrated farming system with components on livestock and fisheries are successfully practiced in some areas.	Sandy Soils/coastal alluvium is not suitable for landfills as the soils are more of a sandy texture with good porosity and permeability. The leachate may mix with the groundwater and pollute the Groundwater regime of the region. Possibilities of seawater intrusion also pollute the region. Avoid CRZ zones/areas within hazard lines for waste disposal facilities (landfill). Existing dumps need urgent remediation.
Pokkali Soil	Occur in coastal lowlands in areas slightly below or above sea level in Alappuzha, Ernakulam, and Thrissur districts	Soils formed from river alluvium and Sulphur rich marine sediments and are potential acid sulphate. Soils are extremely acidic and poorly drained. Salinity problem in coastal areas. Rice is the major crop followed by fish culture, Saline resistant 'Pokkali' variety is cultivated in mounds to overcome salinity hazards The monsoon rains wash away the salts from the mounds which are removed by tidal action. Fertilizers are not usually recommended	Sandy Soils/coastal alluvium is not suitable for landfills as the soils are more of a sandy texture with good porosity and permeability. The leachate may mix with the groundwater and pollute the Groundwater regime of the region. Possibilities of seawater intrusion also pollute the region. Avoid CRZ zones/areas within hazard lines for waste disposal facilities (landfill). Existing dumps need urgent remediation.
Kole Soil	Occur in coastal lowlands in areas slightly below or above sea level in Thrissur and Malappuram district	Soils formed from river alluvium and sulphur-rich marine sediments and some areas along the coast are potential acid sulphate. Soils are fertile and poorly drained. Salinity is a problem in coastal areas. Rice is the major crop, vegetables during summer months in upper reaches.	Sandy Soils/coastal alluvium is not suitable for landfills as the soils are more of a sandy texture with good porosity and permeability. The leachate may mix with the groundwater and pollute the Groundwater regime of the region. Possibilities of seawater intrusion also

Soil Types	***Distribution***	***Features & Land use***	***Suitability for SWM Infrastructure***
		Coconut and tuber crops in raised bunds	pollute the region. Avoid Kole soil for waste disposal facilities (landfill). Existing dumps need urgent remediation.
Kaippad Soil	Occur in coastal areas slightly above sea level in Kannur District	Soils formed from river alluvium and sulphur-rich marine sediments and are potential acid sulphate. Soils are extremely acidic and poorly drained. Salinity problem in coastal areas. Rice is the major crop saline resistant varieties cultivated, vegetables during summer months in upper reaches. Coconut and tuber crops in raised bunds	Sandy Soils/coastal alluvium is not suitable for landfills as the soils are more of sandy texture with good porosity and permeability. The leachate may mix with the groundwater and pollute the Groundwater regime of the region. Possibilities of seawater intrusion also pollute the region. Avoid CRZ zones/areas within hazard lines for waste disposal facilities (landfill). Existing dumps need urgent remediation.
Riverine Alluvial Soils (River Banks)	Along the river banks in all the districts	Very deep, acidic, well-drained, non-gravelly with varying texture(sandy loam to clay loam) formed from river alluvial deposits. Rice in low lands Coconut, tuber crops, banana, and vegetables in uplands	Not suitable for landfills as the soils are more of sandy texture with good porosity and permeability. The leachate may mix with the groundwater and pollute the Groundwater regime of the region. Possibilities of seawater intrusion also pollute the region. No area will be suitable for treatment/disposal (landfill) along with the riverine environment because the velocity of the flow of rivers will drag the leachates and pollutant load towards its flow path. Moreover, most of the stream and river banks are constantly affected by flood divulge. Hence, no site along the river/streams is suitable. Existing dumps if any need urgent remediation.
Brown Hydromorphic Soil	Foothills and valleys of the midland laterite terrain of all the districts	Acidic, deep, poorly drained, deficient in plant nutrients with a toxic level of iron. Rice is the major crop followed by tuber crops, banana, and vegetables. Coconut in raised bunds	If purely lateritic formation /lateritic soil, then it is not advisable as the laterite formation has more interconnected pores and the drainage will be very apt through the pore spaces until it reaches the lithomarge layer (viscous clayey layer found at the contact of laterite with beneath rock formation. Once the pollutant reaching the lithomarge layer, it starts flowing laterally along the slopes and affects the groundwater regime at the Downstream Side. The open well in the D/s will be polluted and even the bore wells too will get polluted, if it is in unconfined formation.

Soil Types	***Distribution***	***Features & Land use***	***Suitability for SWM Infrastructure***
			Sites are suitable for landfills only if the natural condition of the soil is clayey/ loamy. Moreover, liners are required provided at the bottom of the landfills, and the leachate flows under the influence of gravity need to be collected separately.
Red Non-Gravelly Laterite Soil	Southern parts of Thiruvananthapuram District	Very deep, non-gravelly, acidic, well-drained, clayey red soils. Absence of plinthite layer in lower layers. Coconut is major crop followed by banana, tuber crops, vegetables Rice is grown in lowlands	If lateritic soil/ laterite formation then Not suitable. The reason as mentioned above If purely lateritic formation /lateritic soil, then it is not advisable as the laterite formation has more interconnected pores and the drainage will be very apt through the pore spaces until it reaches the lithomarge layer (viscous clayey layer found at the contact of laterite with beneath rock formation. Once the pollutant reaching the lithomarge layer, it starts flowing laterally along the slopes and affects the groundwater regime at the Downstream Side. Liners are required provided at the bottom of the landfills and the leachate flow under the influence of gravity need to be collected separately.
Gravelly Laterite Soil	Midland terrain of all the districts	Gravelly, well-drained, strongly acidic, low water retention capacity, high phosphorus fixation, poor in bases. Good physical properties, but prone to erosion. Hard laterite pan in lower layers restricting root penetration. Coconut, Banana, vegetables, rubber, tuber crops Rice is grown in lowlands	If lateritic soil/ laterite formation then Not suitable. The reason as mentioned above. Changes of polluting the D/s wells and other drinking water facilities If landfills are developed, liners are required provided at the bottom of the landfills and the leachate flow under the influence of gravity need to be collected separately
Forest Soil	Forest areas in all the districts	Non-gravelly, deep, well-drained, acidic, loamy, or clayey, rich in organic matter. Soils are reddish-brown to dark brown, subsoils are clay loam to clay texture. Mostly forested areas	It may be possible to develop landfills; however, such a development is not allowed usually in forest areas considering disturbance to forests, impacts on wildlife, and landscape fragmentation. Due diligence on the downstream villages has to be carried out. Flash floods and forest fires may be big disasters.
Black Soil	Occur in nearly level plains of Chittoor Taluk in Palakkad District	Alkaline reaction, deep, non-gravelly, high activity clay soils with shrink-swell behavior, saturated with bases, and contains free calcium carbonate.	Black clayey soil will be a suitable one as the soil will behave like a natural liner. Though the black clayey soils are porous but not permeable. Hence, the leachate management can be worked out

Soil Types	***Distribution***	***Features & Land use***	***Suitability for SWM Infrastructure***
		Moisture deficit experienced for five months. Soils exhibit cracking on the surface during summer and poor workability. Rice in lowlands Coconut, vegetables, tuber crops and banana in raised bund	technically and not much of groundwater pollution is envisaged if it is pure black clayey soil. Additional Liners can be provided to arrest the infiltration and percolation of leachate/pollutants.
Special Group (Soils Of Limited Spatial Extent) Five Special Soil Groups Have Been Identified. These Soils Are Distributed In Patches And Are Of Limited Spatial Extent.			
Laterite Plateau	Malappuram, Kozhikode, Kannur and Kasaragod districts	Very shallow soils formed by severe erosion and exposure of plinthite layer found in nearly level plateau on the top of undulating hills. Exposed laterite forms ironstone by irreversible hardening Shallow soils. Not suitable for crop cultivation	If purely lateritic formation /lateritic soil, then it is not advisable as the laterite formation has more interconnected pores and the drainage is expected through the pore spaces towards the lithomarge layer (viscous clayey layer found at the contact of laterite with beneath rock formation. Once, the pollutant reaching the lithomarge layer, it starts flowing laterally along the slopes and affects the groundwater regime at the Downstream Side. The open will in the D/s will be polluted and even the bore wells too will get polluted, if it is unconfined formation.
Marayoor Soil (Lowhills And Rolling Lands)	Marayoor, Vattavada and Kanthalloor panchayats of Idukki District	Deep, near neutral, well-drained, loamy, non-gravelly soils, well supplied with plant nutrients. Slightly acidic soils, medium organic matter, high phosphorus, adequate in secondary and micronutrients except for boron. Mostly forested Cool season fruits & vegetables, potato, and sugarcane are cultivated	Suitable if artificial liners are provided and the design details have to be worked out in consensus with the Geology and Geomorphology of the terrain. Flood based disaster may also happen during heavy rainfall over the rolling Topography of the terrain.
Wayanad Upland Soil	Uplands of eastern parts of Wayanad District	Near neutral, red, deep, well-drained, loamy or clayey and well supplied with bases Slightly acidic, medium in organic matter, phosphorus, potassium, and deficient in boron. Coffee, tea, areca nut, and pepper in uplands. Rice and banana in lowlands	Suitable if artificial liners are provided and the design details have to be worked out in consensus with the Geology and Geomorphology of the terrain. Flood based disaster may also happen during heavy rainfall based on the rolling Topography of the terrain.
Upland Soils Of Palakkad Central Plains	Alathur, Kuzhalmannam, Nenmara Blocks and western parts of Chittoor Taluk in Palakkad District	Near neutral or slightly acid, red, deep, non-gravelly loam or clay, moderate nutrient, and water holding capacity. Slightly acid to slightly alkaline, medium in organic matter, phosphorus, potassium, and deficient in boron. Coconut is the main crop with intercrops of tuber crops, banana,	Clayey soil/clayey loam soil will be suitable as the soil will behave like a natural liner. Though the clayey soils are porous but not permeable. Hence, the leachate management can be worked out technically and not much of groundwater pollution is envisaged if it is a pure black clayey soil or Liners can be provided to arrest the infiltration and

Soil Types	Distribution	Features & Land use	Suitability for SWM Infrastructure
		and vegetables Rice in the lowlands	percolation of leachate/pollutants.
Low Land Soils Of Palakkad Central Plain	Lowlands of Alathur and Chittoor Blocks, Palakkad taluk and Palakkad municipality	Moderately acid, deep, imperfectly drained, loam, or clay, well supplied with bases. Moderate capacity to hold nutrients and water Slightly acid, medium in organic matter, phosphorus, potassium, and deficient in boron. Rice is the major crop.	Clayey soil/clayey loam soil will be suitable as the soil will behave like a natural liner. Though the clayey soils are porous but not permeable. Hence, the leachate management can be worked out technically and not much of groundwater pollution is envisaged if it is a pure black clayey soil or Liners can be provided to arrest the infiltration and percolation of leachate/pollutants
Poonthalpadams	Lowlands of Palakkad eastern plains Lowlands of Chittoor taluk in Palakkad District	Slushy soils with poor workability. Near neutral in reaction, base-rich fertile clayey soils and imperfectly drained Neutral reaction, medium in organic matter, and deficient in boron. Rice is the major crop	(Better for Agricultural use)

Large Landfills are not preferable in coastal sandy areas. It is advised to develop proper artificial liners, clay packing, leachate/gas management, and thorough monitoring before developing landfills (in coastal sandy and lateritic formations) to arrest the vertical infiltration and percolation of pollutants to the soil, water bodies and water sources (including groundwater shallow wells which are very common). It is also important to remediate existing dumps with leachate/gas management arrangements.

2.4.4 Land use and Landcover

Economic Review 2019[7] notes that "the major change the State witnessed over the years is in its land use; mainly the shift from cultivation of food crop to nonfood crops and increase in area under nonagricultural use. Changes in land use and cropping pattern in Kerala pose a challenge not only to food security but also to the ecological sustainability of the State." As per the land use data of 2017-18, out of a total geographical area of 38.86 lakh ha, the total cultivated area is 25.79 lakh ha (66 percent) and the net area sown is 20.40 lakh ha (52 percent).

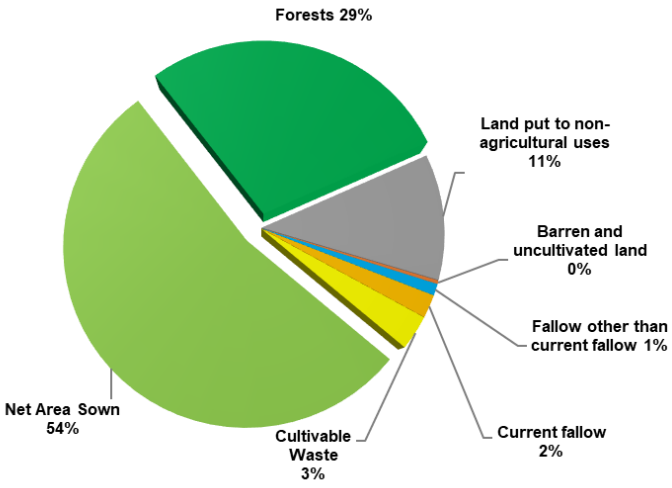


Figure 6: Land use of Kerala 2017-18

[7] *State Planning Board, 2019. Economic Review. GoK*

Source: Economic Review, 2018

Land put to non-agricultural use which stood at 11 percent in 2018; increased marginally to 12 percent in 2019. The area under forest area remains 28 percent during 2018 and 2019. The cultivable waste and current fallow constituted three (3) and two (2) percent respectively in 2018 and decreased by a percentage point the following year. As compared to 2016-17, there is a decline in area under barren and uncultivated land, cultivable waste, fallow other than current fallow and current fallow by eight (8) percent, five (5) percent, 11 percent, and 20 percent respectively. Food crops comprising rice, tapioca, and pulses accounted for just 10.15 percent of the total cropped area in 2018-19 while cash crops (cashew, rubber, pepper, coconut, cardamom, tea, and coffee) constituted 62.1 percent. The area under crops like rubber, coffee, tea, and cardamom was 27.7 percent of the total cropped area. Coconut occupies the largest area with 29.6 percent coverage followed by rubber with 21.5 percent. Rice comes third with 7.7 percent of the total cropped area. Rubber occupies the second largest area in the State next to Coconut with 21 percent of the gross cropped area. No considerable change concerning area and production is observed in the State in 2018-19 compared to 2017-18. Adverse weather especially, the impact of the excessive rains and floods, the consequent high level of incidence of Abnormal Leaf Fall disease, lack of skilled laborer, grower's reluctance in harvesting or poor maintenance of trees in response to the low prices offered for Natural rubber are the major constraints in rubber production in the State.

The shift to monoculture cash crops has affected land stability in many parts of the State. Around 30 percent of the land area of the State is under Forests. Most of the area sown is below sea level. Land under non-agricultural use is just around 11 percent of the total. Most of the area is occupied by water bodies including wetlands, rivers, and lakes; thus exerting pressure on available land for infrastructure development and keeping gross density high.

2.4.5 Hydrology and Rivers

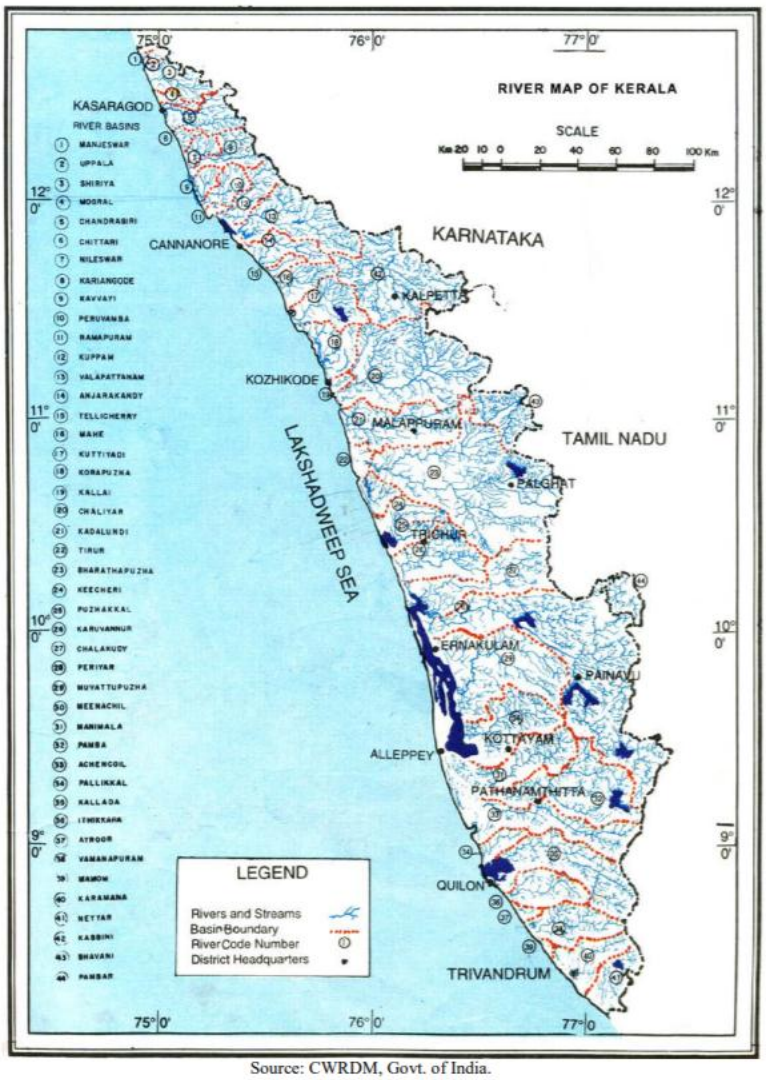
There are 44 rivers in Kerala. According to the national norm (Rao, 1979), there are no major rivers in Kerala, and only four rivers namely, Chaliyar, Bharathapuzha, Periyar, and Pamba fall under the medium river category. [8] Out of these 44 rivers, 41originate from the Western Ghats region on the east of the state and flow westward to join the Arabian Sea. The remaining three rivers (Kabini, Bhavani, and Pambar) originate from the Western Ghats and flow towards the east and finally join the Bay of Bengal, after flowing through the neighbouring states. Rivers are generally swift-flowing having very steep gradients in their higher reaches. The absence of major delta formations is a characteristic of the rivers of Kerala. The general drainage pattern of these rivers is dendritic, although at places they are trellis, sub-parallel, and radial. The segments of river courses are nearly straight, indicating structural control, coinciding with the prominent lineament directions (NW-SE and NE-SW). Many of the rivers do not have a continuous flood plain. The river flow is modulated by about 30 reservoirs, mostly located in highlands (KSLUB, 2002; CWRDM, 1995, and 1998). Apart from the 44 rivers, there are few streams with lengths falling short of the 15 km limit set for the categorization as a river (GoK, 1974; CWRDM, 1998).

[8] https://www.soppecom.org/pdf/Groundwater-Resource-and-Governance-in-Kerala.pdf

Table 4: Catchment wise Key Local Bodies of Kerala

Sl. No	*Name of River*	*Main Municipalities / Panchayats in the catchment area of the river*	*Watershed Area(Km2)*
West Flowing			
1	Neyyar	Poovar, Kovalam, **Neyyattinkara**, Kattakada	499.996
2	Karamana	**Nedumangad**, Kovalam, **Thiruvananthapuram**, Kazhakoottam	689.593
3	Mamom	Koothuparamba, Thirunelli, Mananthavady, Nadapuram, Vadakara, **Thalassery**	57.1075
4	Vamanapuram	Kilimanoor, Kallar, Ponmudi, Chirayinkeezhu, **Attingal**, Paripally, **Varkala**, Venjaramoodu, Palode	766.9
5	Ayiroor	**Paravoor**, Paripally, Chavarkode, Boothankulam, Edava	124.288
6	Ithikkara	**Kollam**, Anchal, Parippally	659.716
7	Kallada	Chavara, **Kollam**, **Kottarakkara**, Adoor, Pathanapuram, **Punalur**, Kulathoopuzha, Ponmudi	1615.56
8	Pallikkal Thode	Bharanikavu, Sasthamkotta, **Karunagapalli**, Ochira, Krishnapuram	326.64
9	Achencovil	Haripad, **Kayankulam**, **Adoor**, **Pathanamthitta**, Konni, **Mavelikkara**	1340.4
10	Pampa	**Alappuzha**, Ambalappuzha, **Chengannur**, Pathanamthitta, Ranni, Chittar, **Thiruvalla**, Sabarimala, Kuttikanam, **Haripad**	2082.8
11	Manimala	Kuttikanam, Manimala, **Changanassery**, Thiruvalla, Kanjirapally	1063.16
12	Meenachil	**Ettumanoor, Kottayam, Erattupetta**, Kuruvilangadu, Pampady, **Pala**, Vagamon	1208.11
13	Muvattupuzha	Wagamon, Idukki, **Thodupuzha**, **Kothamangalam**, **Koothattukulam,** Kuruvilangadu, **Muvattupuzha**, **Vaikom**, **Cherthala**, Kadayirippu, Puthenkurishu, Kakkanad, Pallikkara, Thiruvankulam, **Thripunithura**, **Piravom**	2675.08
14	Periyar	Idukki, **Kattappana**, Kumily, Vagamon, Konnathady, Munnar, Chithirapuram, Mankulam, Neriyamangalam, Thattekad, Kuttampuzha, **Perumbavur**, Nedumbassery, **Aluva**, Kalady, **Angamali**, **Eloor, Kalamassery, Thrikkakkara,** Karukutti, **N Paravur**, Varapuzha, Vypin, Chennamangalam, **Kodungallur**, **Kochi**	5029.03
15	Chalakkudy	**Chalakkudy**, Meloor, Korakutty, karukutty, Alathur, Parakkadavu,	1118.32
16	Karuvannur	**Iringalakkuda**, Varandarapally, Triprayar	956.945
17	Keecheri	**Thrissur**, **Vadakkanchery**, Vadanapally, **Kunnamkulam**, **Guruvayur**, Parappur, Adatt	769.787
18	Kanjiramukku	Kunnamkulam, Changaramkulam, Edappal, Kunnamkulam, Kuttippuram	353.741
19	Bharathapuzha	Alathur, Vadakkanchery, **Mannarkad**, Alathur, **Chittur – Thatthamangalam**, **Cherupulassery**, Kuzhalmanam, Lakkidi, **Palakkad**, Mundur, **Ottappalam**, Valanchery, Anakkara, Thiruvanvaya, Kolathur, Elapully, Kuttipuram,	3852.04

Sl. No	*Name of River*	*Main Municipalities / Panchayats in the catchment area of the river*	*Watershed Area(Km2)*
		Ponnani, **Pattambi, Valanchery, Shornur**	
20	Tirur	**Tirur**, Thiruvnavaya, **Thanoor**, Thalakkad, Purathur, Puthoor	203.144
21	Kadalundi	**Malappuram**, **Parappanangadi**, **Kottakkal**, **Perinthalmanna**, Pandikkad, **Thirurangadi**	1264.01
22	Chaliyar	Pullangode, Vandur, Thiruvambady, Thamarassery, Kunnanangalam, **Mukkom**, Raroth, Areekode, **Manjeri**, Karuvarakundu, **Nilambur**, Edavanna, **Kondotti, Ramanattukara**	2539.82
23	Kallai	Kunnamangalam, **Kozhikode**	87.5233
24	Korapuzha	Thamarassery, Kunnamangalam, Kozhikode, **Koduvally**, Balussery, **Koyilandy**, Uliyeri,	657.596
25	Kuttiyadi	Perambra, **Vatakara**, **Payyoli**	665.83
26	Mahe	Nadapuram, **Vatakara**, Mahe, Panoor	421.045
27	Thalassery	Cheruvanchery, Pattyam, New Mahe, Thalassery, Chokli, Pinarayi, Dharmadam, Palayadu, Kathirur, **Panoor**	157.591
28	Anjarakandi	Edakkad, Shivapuram, **Mattannur**, **Koothuparambu**	423.763
29	Valapattanam	Periya, Kottiyoor, Aralam, **Iritty**, Chemberi, Mattannur, Parassinikadavu, Azheekode, **Kannur**, **Srekandapuram**	1341.27
30	Kuppam	Kuppam, Pazhayangadi, **Thaliparamba**, **Anthur**	440.06
31	Ramapuram	Ettikkulam, Pazhayangadi, Madayi, Ezhimala	57.5121
32	Peruvamba	Peringome, Pariyaram, Kunnhimangalam, **Payyannur**, Thrikkaripur, Cheruvathur	298.148
33	Kavvayi	Thrikkarippur, Chetuvathur, Padanna	164.758
34	Karingote	Cheruvathur, Peringome	442.019
35	Nileswaram	**Nileswaram**, Mungottu	204.38
36	Chittari	**Kanhangad**, Ambalathara, Pallikkarare	101.319
37	Chandragiri	**Kasargod**, Bekal,	615.353
38	Mogral	Mogral, Madhur, Nirchal, Kudlu, Seethamgoli	119.997
39	Shiriya	Badiyadukka, Mulleria, Kumbala, Manjeshwaram, Mangalpadi, Angadi mogar	367.386
40	Uppala	Uppala, Bamgramanjeshwar, Meenja, Chippar	99.7847
41	Manjeswar	Manjeswar, Pravoor, Bamgramanjeshwar	49.8757
East Flowing			
1	Pambar	Vattavada, Koyilkadavu, Gundumalai, Kanthalloor, Marayur	381.576
2	Kabani	**Sulthan Bathery**, **Kalpetta**, Vythiri, Wyanad, **Mananthavadi**, Pulpally, Thirunelly	1934.5
3	Bhavani	Attapadi, Agali, Sholayar	603.266
	* *Those in Bold letters are among the 87 municipalities under this project*		



Source: CWRDM, Govt. of India.

The total annual yield of all these rivers together is 78.041 Million Cubic Meters (MCM) of which 70,323 MCM is in Kerala. The peculiarity of the rivers flowing across Kerala is a short length of the river and the elevational difference between the high and the low land leading to the quick flow of water collected from the river basin and quickly discharged into the Lakshadweep sea, the state has not been able to utilize the river water sources to a major extent. The major portion of the runoff through the rivers takes place during the monsoon seasons. 67.29percent of the surface water area of 3.61 lakh hectares is constituted by brackish water lakes, backwaters, and estuaries.

Figure 7: River Network of Kerala

"A large number of environmental issues continue to demand attention, ranging from river pollution by sewage, waste generated by urban and rural settlements, intense noise pollution, etc. Such a wide range of issues demand concretive attention by regulatory authorities." [9]…" Kerala State Pollution Control Board is monitoring water quality at 65 stations in 42 rivers, 3 freshwater lakes, 7 in Rivulets/ Tributaries, 6 in Reservoirs, eight in Estuarine lakes, three in canals, two in ponds and 34 stations in Groundwater. Central Pollution Control Board has evolved a concept of Designated Best Use (DBU) to define the level of wholesomeness of the different water bodies to be maintained or restored, according to the primary use of the water body. Based on the monitoring data generated during the year 2018, the classification of river stretches has been done as per CPCB criteria. Among the water bodies monitored, Pookode lake in Wayanad District is the only one satisfying the 'Class A' criteria. The major problem associated with river water is bacterial contamination and 80 percent of the water bodies monitored under the National Water Quality Monitoring Program

[9] *State planning board, 2019. Economic Review, GoK, pg: 115*

(NWMP) and State Water Quality Monitoring Program (SWMP) fall into B or C category, only because of the increased bacterial population. The quality of well water monitored under NWMP shows the presence of Coliform bacteria in small counts. River Pamba, during Sabarimala festive seasons and the downstream of River Karamana, Periyar, Bharathapuzha, Vamanapuram, and Kadalundi is having higher BOD values, Coliform counts at Munnattumukku in Karamana River, Kallayi bridge in Kallayi River, Pamba River, Purakatteri in Korapuzha river, Thodupuzha river and Munnar river are reported very high.

Most of the towns in Kerala are in the catchment of major rivers. Around 30 percent of the towns are near where the rivers empty into the sea. These areas are more vulnerable to flooding. The flow is quick due to the elevation difference between the start to the end of rivers. In the absence of any centralized mechanism to treat various type of wastes or wastewaters including drainage, wastewater from residences, industrial, commercial and institutional land uses, sewage and solid wastes, into its primary, secondary and tertiary water channels, all ultimately emptying into the wetlands or the sea and contributing to varied forms of pollution and health/flood impacts.

2.4.6 Groundwater Scenario

Kerala is abundant in its water resources and rainfall, and yet face water scarcity during summers. [10] "The occurrence and availability of groundwater vary considerably from place to place within the State depending on the prevailing climatic, geomorphological, and hydrogeological conditions. About 88 percent of the total geographical area of the State is underlain by crystalline rocks devoid of any primary porosity, with limited groundwater prospects. In the alluvial formations having multiple aquifer systems, quality is sometimes a constraint in the optimal development of available resources. Groundwater has been the mainstay for meeting the domestic needs of more than 80percent of rural and 50percent of the urban population besides, fulfilling the irrigation needs of around 50percent of irrigated agriculture. [11]

The groundwater potential of Kerala is very low as compared to that of many other states in the country. The estimated groundwater balance is 5590Mm³. Dug wells are the major groundwater extraction structure in Kerala. They dug wells have a maximum depth of about 10 to 15 meters and have a diameter of about 1 to 2 meters in the coastal region and 2 to 6 meters in the midland and high land. The open well density in Kerala is perhaps the highest in the country-200 wells per sq.km in the coastal region, 150 wells per sq.km in the midland, and 70 wells per sq.km in the high land. The groundwater level receding drastically during the summer months and drying up of wells are common features of the groundwater levels in many parts of Kerala. The midland area sustains medium-capacity dug wells. Borewells tapping deeper fractured aquifer are feasible along with potential features in the midland and hill ranges. As per the 2011 census, 65 percent of rural and 59 percent of urban households have wells.

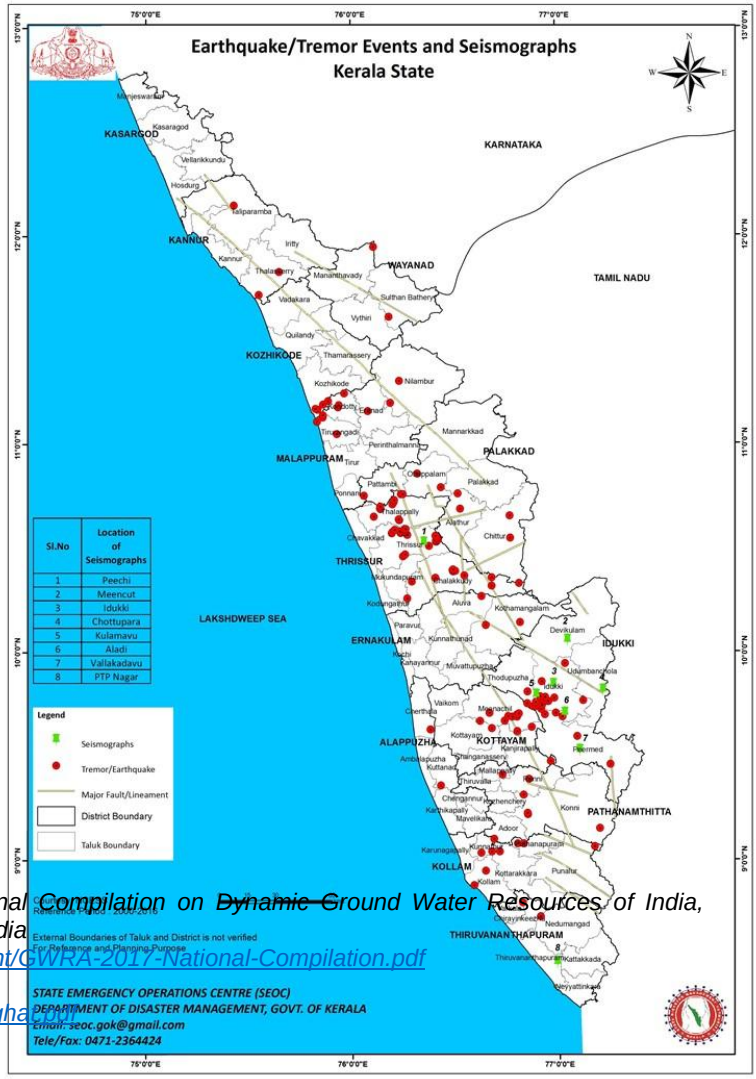
[10] *Groundwater Resource and Governance in Kerala: Status, Issues and Prospects;2017*
[11] http://www.kerenvis.nic.in/Database/WATER_820.aspx

In 2017, the groundwater estimation committee[12] estimated that of the 152 assessed groundwater units in the State, one block is 'overexploited' (Chittoor), two blocks are 'critical' (Malampuzha, Kasargod) while 30 are 'semi-critical'. The rest of the blocks are 'safe' with respected to groundwater exploitation.

Increasing population, rapid urbanization, and industrialization have resulted in increased use of groundwater resources over the last few decades in the State. Recently the problems of decline in the water table, contamination of groundwater, and seawater intrusion are being reported at many places. Among the 87 municipalities under consideration, Chittoor Thathamangalam, Mannarkad, Palakkad, Ottapalam, Pattambi areas in Palakkad district[13] , and Kasargod, Kanhangad, Manjeshwar towns of Kasargod District will have a low level of groundwater availability and extraction of water may be controlled. Key towns in Idukki, Kannur, Malappuram, and Thiruvananthapuram also falls in the critical category. There is an urgent need to conserve water quality ad ensure availability by restoring and protecting available sources from over-extraction and pollution due to waste discharge.

2.4.7 Extreme Events

The location and terrain of Kerala – being sea cost and with a steep gradient along the slopes of Western Ghats makes the state susceptible and vulnerable to disasters (both natural and anthropogenically triggered). A total of 39 types of disasters have been identified as important by the Kerala State Disaster Management Plan. Kerala is one of the most densely populated Indian states (860 persons per square kilometers) makes it vulnerable to damages and losses on account of disasters. The most common form of the natural hazard that the state is prone to flooding. Close to 14.5percent of the state's area is prone to floods with some districts having flood-prone areas as high as 50percent. The western ghat regions comprising of Wayanad, Kozhikode, Idukki, and Kottayam districts are prone to



[12] *Central Ground Water Board, 2019. National Compilation on Dynamic Ground Water Resources of India, Ministry of water Resources, Government of India. Available at: http://cgwb.gov.in/GW-Assessment/GWRA-2017-National-Compilation.pdf Assessed on: March 01, 2020*

[13] http://cgwb.gov.in/District_Profile/Kerala/Palghat.pdf

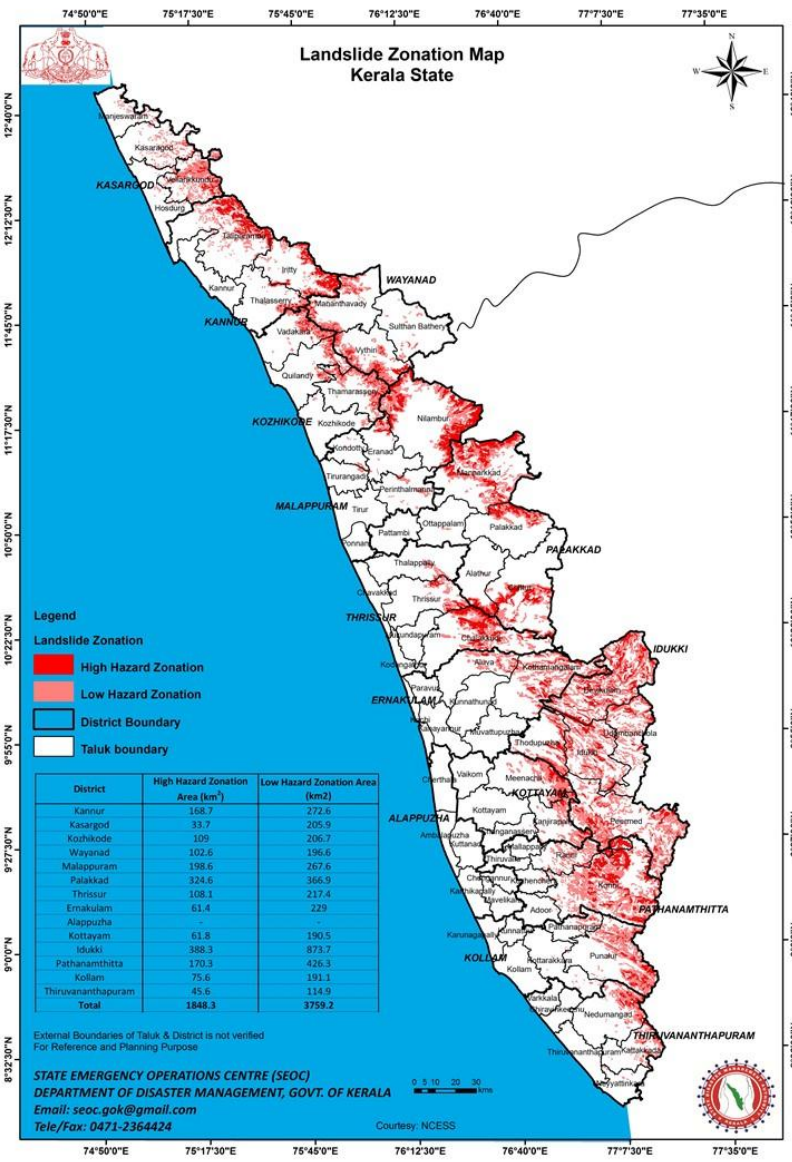
Landslides. Other major natural hazards are lightning, forest fires, soil piping, coastal erosion, and high wind speed. The state also lies in seismic zone III.

Figure 8: Earthquake events and Lineaments of Kerala

The development of treatment facilities and landfills near the coast shall consider the possibilities of flooding and heavy rains. Planning / locating landfills and other critical infrastructure need to consider lineaments connecting Kottayam and Thrissur in the midlands, Palakkad and Wayanad in the mid - highlands and Chalakkudy – Aluva to Idukki.

2.4.7.1 Landslides

The highlands of Kerala experience several types of landslides, of which debris flows are the most common. They are called 'Urul Pottal' in the local vernacular. The characteristic pattern of this phenomenon is the swift and sudden downslope movement of highly water-saturated overburden containing a varied assemblage of debris materials ranging in size from soil particles to boulders, destroying and carrying with it everything that is lying in its path. The west-facing Western Ghats scarps that run the entire extent of the mountain system is the most prone physiographic unit for landslides. These scarp faces are characterized by thin soil (regolith) cover modified heavily by anthropogenic activity. The highlands of the region experience an annual average rainfall as high as 5000 mm from the south-west, north-east, and pre-monsoon showers. The majority of mass movements have occurred in hill slopes >20° along the western ghats scarps, the only exception being the coastal cliffs. All except 1 of the 14 districts in the state are prone to landslides. Wayanad and Kozhikode districts are prone to deep-seated landslides while Idukki and Kottayam are

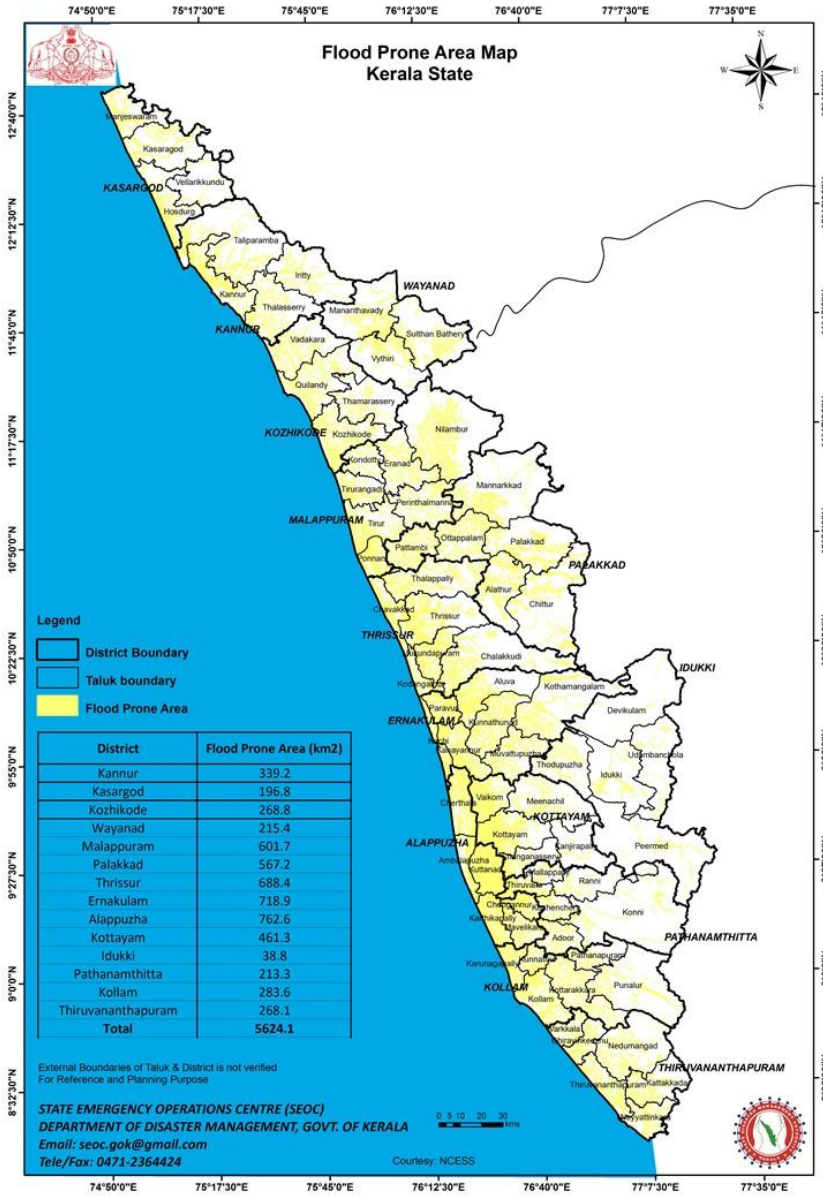


District	High Hazard Zonation Area (km²)	Low Hazard Zonation Area (km2)
Kannur	168.7	272.6
Kasargod	33.7	205.9
Kozhikode	109	206.7
Wayanad	102.6	196.6
Malappuram	198.6	267.6
Palakkad	324.6	366.9
Thrissur	108.1	217.4
Ernakulam	61.4	229
Alappuzha	-	-
Kottayam	61.8	190.5
Idukki	388.3	873.7
Pathanamthitta	170.3	426.3
Kollam	75.6	191.1
Thiruvananthapuram	45.6	114.9
Total	1848.3	3759.2

prone to shallow landslides.

Figure 9: Landslide Zonation Map of Kerala

Highlands of the districts along the western ghats are prone to landslips and soil piping phenomenon. Soil/slope stability in this critically vulnerable area is further compromised by extensive uprooting of indigenous tropical vegetation/tree cover which got replaced for years with cash crops like rubber with less slope binding characteristics. Location of critical SWM infrastructure such as landfills in such areas needs careful planning including vegetative buffers to ensure resilience.



District	Flood Prone Area (km2)
Kannur	339.2
Kasargod	196.8
Kozhikode	268.8
Wayanad	215.4
Malappuram	601.7
Palakkad	567.2
Thrissur	688.4
Ernakulam	718.9
Alappuzha	762.6
Kottayam	461.3
Idukki	38.8
Pathanamthitta	213.3
Kollam	283.6
Thiruvananthapuram	268.1
Total	**5624.1**

2.4.7.2 Flooding

In Kerala state, incidences of floods are becoming more frequent and severe. The latest among them was the 2018 Kerala floods. The continuous occurrence of high-intensity rainfall for a few days is the primary factor contributing to the extreme floods in the State. Other factors include wrong land-use practices and mismanagement of the water resources and forests. Increasing floodplain occupancy results in increasing flood damages to road networks also. It is estimated that about 25percent of the total geographical area accommodating about 18percent of the total population of the State is prone to floods.

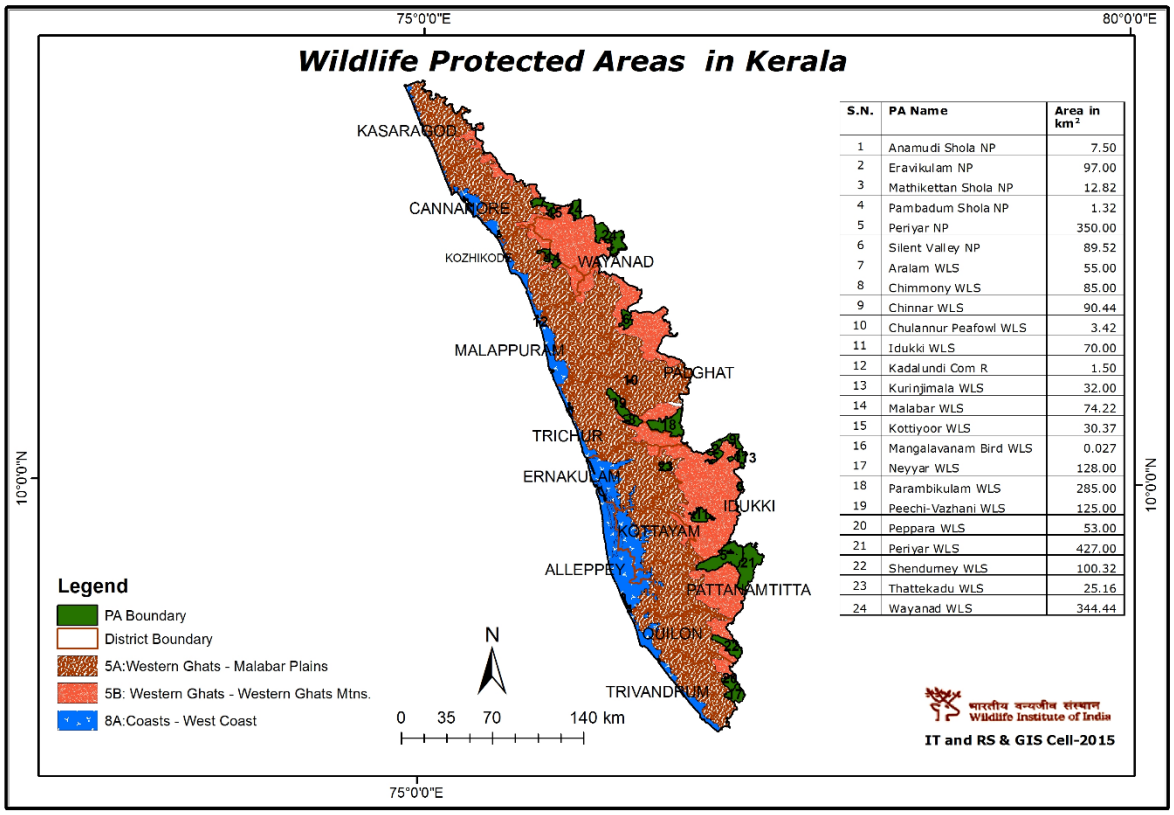
Figure 10: Flood-prone areas of Kerala

Recent floods in the State (2018, 2019) created a complete lockdown of most parts of the except its southern (Thiruvananthapuram) and northern (Kasargod) parts. Most affected were the areas abutting the coasts, rivers, and wetlands. Drainage planning and management and design of infrastructure to allow quick flood water evacuation is important.

2.4.8 Sensitive Ecosystems

2.4.8.1 Protected Areas notified under Wildlife Conservation Act, 1972

n the State, 3213.24 Km^2 of the forest is under its Protected Area Network (under Wildlife Conservation Act, 1972). The protected areas of Kerala include 5 National Parks, 17 sanctuaries, and 1 Community Reserve. ***Figure 11*** shows the location of Wildlife Protected Areas of Kerala.



S.N.	PA Name	Area in km^2
1	Anamudi Shola NP	7.50
2	Eravikulam NP	97.00
3	Mathikettan Shola NP	12.82
4	Pambadum Shola NP	1.32
5	Periyar NP	350.00
6	Silent Valley NP	89.52
7	Aralam WLS	55.00
8	Chimmony WLS	85.00
9	Chinnar WLS	90.44
10	Chulannur Peafowl WLS	3.42
11	Idukki WLS	70.00
12	Kadalundi Com R	1.50
13	Kurinjimala WLS	32.00
14	Malabar WLS	74.22
15	Kottiyoor WLS	30.37
16	Mangalavanam Bird WLS	0.027
17	Neyyar WLS	128.00
18	Parambikulam WLS	285.00
19	Peechi-Vazhani WLS	125.00
20	Peppara WLS	53.00
21	Periyar WLS	427.00
22	Shendurney WLS	100.32
23	Thattekadu WLS	25.16
24	Wayanad WLS	344.44

Figure 11: Wildlife Protected Areas of Kerala

Cities and towns in highlands of Thiruvananthapuram, Pathanamthitta, Idukki, Palakkad and Wayanad and lowlands of Malappuram fall near Protected areas. Mandatory guidelines for development near the protected areas shall be followed for any treatment and disposal facilities here.

2.4.8.2 Ramsar Sites

The Ramsar Convention is an international treaty for the conservation and sustainable utilization of wetlands, recognizing the fundamental ecological functions of wetlands and their economic, cultural, scientific, and recreational value. Vembanad-Kole, Ashtamudi, and Samsthamkotta are the three designated Ramsar sites of Kerala. Besides, Kottuli and Kadulandi wetlands are also identified under the National Wetland Conservation Program. List and Location Map of Ramsar Sites of the state showing project ULBs are provided in ***Table 5*** and ***Figure 12*** respectively.

Table 5: Ramsar Sites of Kerala and ULBs located nearby

Name	Area (Ha)	Designation Date	District	ULBs nearby
Vembanad-kol Wetland	151,250	19-08-2002	Alappuzha (Alleppey), Kottayam and Ernakulam	Cherthala, Alappuzha, Vaikom, Maradu, Thrippunithura, Kochi, Paravoor, Kodungallur
Ashtamudi Wetland	6,140	19-08-2002	Kollam	Kollam
Sasthamkotta Lake	373	19-08-2002	Kollam	-

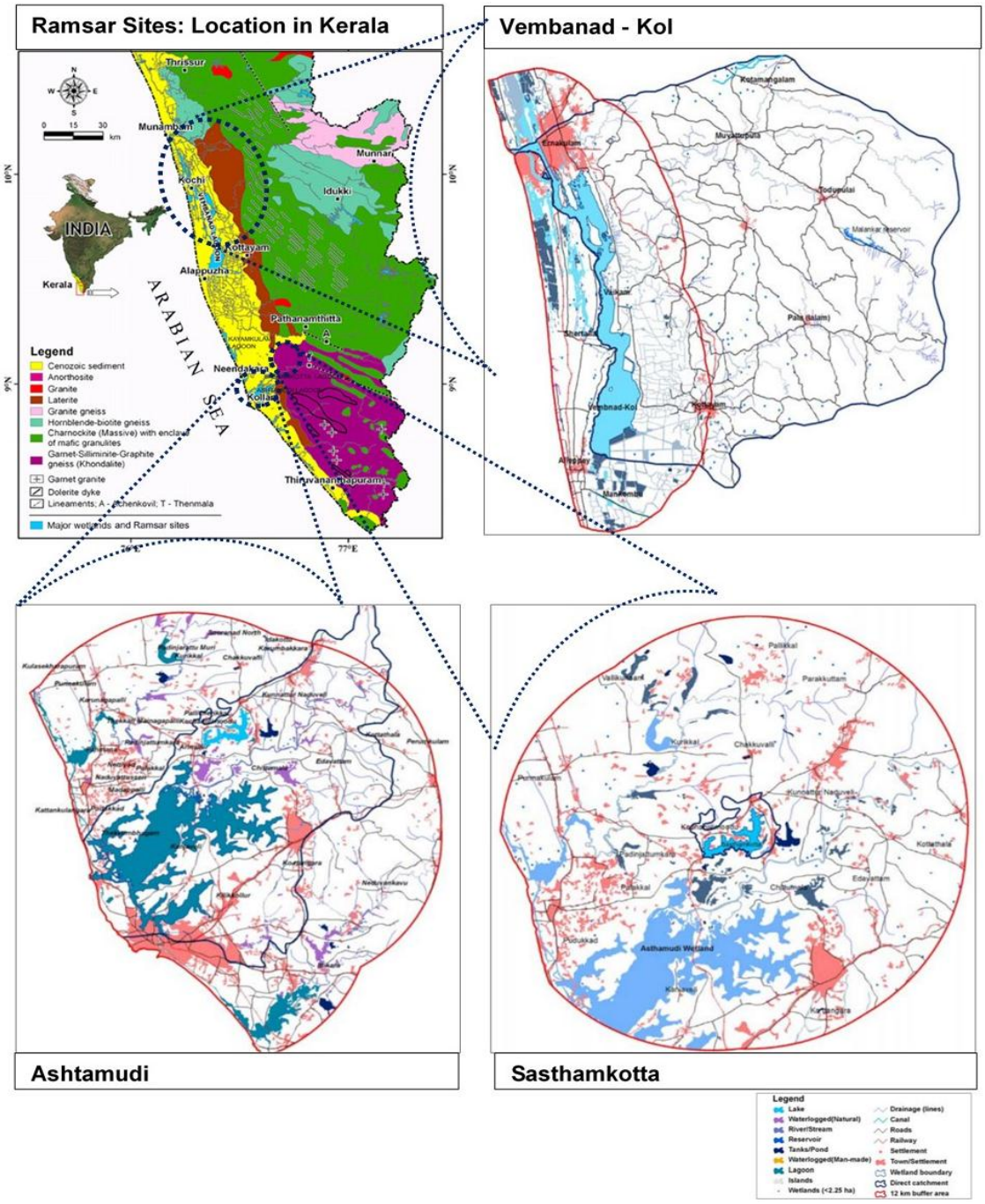


Figure 12: Ramsar Sites in Kerala

Source: Kumaran *et al* [14], SAC (ISRO) 2013[15]

[14] *Kumaran etal, 2014. Vegetation Response and Landscape Dynamics of Indian Summer Monsoon Variations during Holocene: An Eco-Geomorphological Appraisal of Tropical Evergreen Forest Subfossil LogsVL - 9 10.1371/journal.pone.0093596.,*
Available at: https://www.researchgate.net/figure/Location-of-major-wetlands-in-Southwestern-India-showing-geological-formations-rock-type_fig1_261609010
Accessed on : March 03, 2020

[15] *Space application Centre – Indian Space Research Organization, National wetlands Atlas, 2013, Ministry of environment and Forests, Government of India*

National Environmental Policy recognizes the need to stop waste dumping in wetlands. It discusses…the reduction in the economic value of their [wetlands] environmental services due to pollution, as well as the health costs of the pollution itself, are not taken into account while using them as a waste dump (National Environment Policy, 2006)[16].

Existing guidelines suggest that landfills shall not be located in wetlands. [17]*All projects in or near wetlands and Ramsar sites shall be carried out after undertaking proper environmental due diligence. Further stability of large infrastructure in wetlands also needs careful consideration. Vembanad Lake is identified as a Critically Vulnerable Coastal Area (CVCA) as per Coastal Regulation Zone Notification 2019 of Ministry of Environment and Forests, Government of India. Integrated Management Plans (IMPs) for CVCAs shall include critical infrastructure such as waste treatment. Such areas will be managed with the involvement of the coastal communities including fisherfolk. Any development proposed in areas near Vembanad should be part of IMPs with the involvement of the communities and impact zero negative.*

2.4.8.3 Mangroves

Mangroves of Kerala are highly fragmented and confined mostly to the estuaries of major rivers, lagoons, backwaters and creeks along the coastal belt. A recent study estimates the total extent of mangroves in Kerala as 19.531 sq km. It has also been highlighted that out of 10 districts studied, Kannur had the highest mangrove cover (38.22 percent), followed by Ernakulam (31.5percent), Kozhikode (6.18 percent), Kasaragod (5.65 percent), Alleppey (5.32 percent), Kottayam (5.04 percent), Kollam (2.71 percent), Thrissur (2.08 percent), Malappuram (1.88 percent) and Trivandrum (1.41percent). Diversity studies revealed the existence of 15 true mangrove species falling under 9 genera and 6 families.[18]

Table 6: Distribution of Mangroves in Kerala

District	Particulars
Kasargod	13.4 ha mangrove plantation (planted in 2003) is present in the backwaters near to the forest range office. Species: mainly *Rhizophora apiculata* and *Kandelia candel.* Another moderately dense patch of mangrove forest is present near NH-17, just 15 km before Mangalore. This area exhibits different species: *Avicennia officinalis, Avicennia marina, Kandelia candel, Excoecaria agallocha ,* and *Rhizophora apiculata* in an area of 56.6 ha. In Kanhangad range the mangrove forest is present at few areas, namely, Eadaillakad, Madakkal, and Thalankara. The mangrove species present are *Avicennia officinalis, Avicennia marina, Rhizophora apiculata* and *Acanthus ilicifolius* ranging from 10-70 percent density.
Kannur	The majority of the mangrove forests of the Kannur division lie in the Vallapatnam bridge area where the mangroves are present in a vast area in very good condition. The species present in the area are mainly *Avicennia officinalis* and *Rhizophora apiculata* with 40 to 70 percent density. In the same area, 5000 seedlings were planted by the forest department in 2006. In the Vellikkel area a mixed patch of *Avicennia officinalis, Avicennia marina, Excoecaria agallocha, Kandelia candel, Rhizophora apiculata, Sonneratia alba,* and *Acrostichum aureum* is present with 40 to 70 percent density.

[16] *Ministry of Environment and Forests and Climate Change, 2006. National Environment Policy. Government of India*

[17] *Central Pollution Control Board April, 2017. Guidelines on the Provision of Buffer Zone Around Waste Processing and Disposal Facilities*

[18] *Pillai and Harilal 2018. Inventory on the Diversity and Distribution of Mangroves from the Coastal Ecosystems of Kerala State, India, International Journal of Recent Scientific Research Vol. 9, Issue, 2(D), pp. 24002-24007, February, 2018*
Available at: http://recentscientific.com/sites/default/files/9961-A-2018.pdf
Accessed on: March 03, 2020

District	Particulars
	Flourishing mangrove forests can be seen all along the Pattuvam and Pariyangadi rivers. In the Pattuvam river area, pure patches of *Rhizophora apiculata* along the creek and dominant *Avicennia marina* on the inner side are present. In the same area community of *Sonneratia alba, Avicennia officinalis, Avicennia marina, Rhizophora apiculata, Myriostachya wightiana* and *Kandelia candel* are also present with 40 to 70 percent density. In the Dahlil and Cherukkunu village areas a 6 km long stretch of mixed mangroves (*Avicennia officinalis, Avicennia marina, Rhizophora apiculata, Bruguiera parviflora, Acanthus ilicifolius* and *Excoecaria agallocha*) is present along the Pariyangadi river. Moderately dense mangrove is present at a place known as Koduvelli near Kottiyur. The mangrove species present in this area are *Avicennia officinalis*, *Avicennia marina, Sonneratia alba* and *Rhizophora apiculata* ranging from 40- 70 percent density.
Kozhikode	In Kozhikode district mangroves are present in Kadalundi area where *Avicennia officinalis* is the dominant species. Other mangrove species present in the area are *Avicennia marina, Acrostichum aureum* and *Kandelia candel* with 40-70 percent density.
Ernakulam	In Ernakulam, mangroves are present mainly in three locations viz., Pithuvypin, Mangalvanam Bird Sanctuary, and Kundannur area. High-density mangrove patches on one side and completely degraded mangroves on the other side are visible here. The cause of the degradation is the construction work going on in the area by the BPCL and LNG Petronet Project (Central Govt. Project). The construction work has cutoff the saltwater supply to the mangroves, thereby, causing complete deterioration. *Avicennia marina* and *Avicennia officinalis* are the dominant species in the high-density mangrove patches. *Rhizophora apiculata* is also present though less common. In the Mangalavanam Bird Sanctuary near the Kerala High Court, 2.74 ha area is occupied by mangrove flora with good height, but the patches are sparsely dense. The species present in this area are *Avicennia officinalis, Rhizophora mucronata, Acrostichum aureum, Acanthus ilicifolius* and *Bruguiera parviflora*. In the Kundannur area a very small mixed patch of *Avicennia officinalis, Bruguiera sexangula* , and *Acanthus ilicifolius* is present with 10 to 40 percent density.
Kottayam	In this district, mangroves are present at Kumarakom (The species present in the area are mainly *Avicennia marina* with some trees of *A. officinalis* in degraded form. The density of the mangrove patch is around 0 to 10 percent.) and Pathiramal Island in Vembanad Lake
Kollam	In this district, mangroves are present at three places, namely, Adventure Park Ashramam (Ashtamudi lake area), Mandroruth islands and Kumbalam area. At Adventure Park, big trees of mangrove species are present, but very few in numbers and mixed with other vegetation. The place had dense mangrove patches in the past but because of human intervention, it got degraded. The mangrove species present in the area are *Sonneratia caeseolaris, Bruguiera parviflora,* and *Thespsia populnea*. Only two mangrove and mangrove associate species namely, *Excoecaria agallocha* and *Acrostichum aureum* are present and that too with sparse density in Munroe thuruthu.
Alappuzha	Mangroves of the Alappuzha district are mainly concentrated in Aroor, Eramalloor, Arattupuzha, Pathiramanal, Kodamthuruthu, and Valiazheekkal and other locations. the extent of mangrove areas in Alleppey district was estimated to be 1.038 km2 (5.32percent) with 0.487 km2 of homogenous and 0.551 km2 of heterogeneous mangrove patches. Eramalloor and Perumpally have been noticed as the areas with higher and lower mangrove patches with 0.286 km2 and 0.0001 sq km, respectively

Source: ENVIS Centre: Kerala State of Environment and Related Issues; FSI – Mangrove Cover, 2017

Mangroves are identified as among the Eco-sensitive CRZ I areas of India's CRZ Notification 2019 as they play a role in maintaining the integrity of the coast. Any proposed development near Mangroves (in case of mangrove area more than 1000 square meters, a buffer of 50 meters along the mangroves shall be provided and such area shall also constitute CRZ–I A); shall need CRZ I clearance at the National level. These areas are ecologically most sensitive and generally, no activities shall be

permitted to be carried out in the CRZ-I A area. In the mangrove buffer, only such activities shall be permitted like laying of pipelines, transmission lines, conveyance systems or mechanisms and construction of road on stilts, etc. that are required for public utilities. Construction of roads and roads on stilts, by way of reclamation in CRZ-I areas, shall be permitted only in exceptional cases for defense, strategic purposes and public utilities, subject to a detailed marine or terrestrial or both environmental impact assessment, to be recommended by the Coastal Zone Management Authority and approved by the Ministry of Environment, Forest and Climate Change and subject to safeguards. The development of sanitary landfills in eco-sensitive areas is prohibited by SWM rules.

Infrastructure development for SWM shall avoid Sensitive ecosystems (and their buffers) such as mangroves which play an important role in maintaining the integrity of the coast.

2.4.8.4 Western Ghat: Biodiversity Hotspot, UNESCO World Heritage Site, and Proposed Eco-sensitive Area

Western Ghats - stretching through States namely, Gujarat, Maharashtra, Goa, Karnataka, Kerala, and Tamil Nadu across north-south is one of the two (2) Biodiversity Hotspots of India among the 35 biodiversity hotspots across the globe. The site's high montane forest ecosystems influence the Indian monsoon weather pattern. It also has an exceptionally high level of biological diversity and endemism and is recognized by UNESCO a World Heritage Site. The forests here include some of the best representatives of non-equatorial tropical evergreen forests anywhere and are home to at least 325 globally threatened flora, fauna, bird, amphibian, reptile and fish species.

MoEFCC has also issued a draft notification in exercise of the powers conferred by section 3 of the Environment (Protection) Act, 1986 (29 of 1986), and sub-rule (3) of rule 5 of the Environment (Protection) Rules, 1986 for declaring Western Ghat an Eco-Sensitive Area. As per the draft notification, the Western Ghat Eco-sensitive Area is proposed for 56,825 square kilometers which are spread across six states, namely, Gujarat, Maharashtra, Goa, Karnataka, Kerala, and Tamil Nadu. In the State of Kerala, it is spread over an area of 9993.7 square kilometers which includes 9107 square kilometers of forest area and 886.7 square kilometers of non-forest area.

The Western Ghats Ecology Expert Panel report details (i) categorization of the Western Ghats into three zones of varied ecological sensitivity (ii) broad sectoral guidelines for each of these zones, and (iii) a broad framework for the establishment of the Western Ghats Ecology Authority. Western Ghats Ecology Expert Panel (WGEEP) has designated the entire Western Ghats as an Ecologically Sensitive Area (ESA) and, assigned three levels of Ecological Sensitivity to different regions of it termed as Ecologically Sensitive Zone 1 (ESZ1), Ecologically Sensitive Zone 2 (ESZ2) and Ecologically Sensitive Zone 3 (ESZ3).

WGEEP advocates a graded or layered approach, with regulatory as well as promotional measures appropriately fine-tuned to local ecological and social contexts within the broad framework of (1) Regions of highest sensitivity or Ecologically Sensitive Zone 1 (ESZ1), (2) Regions of high sensitivity or ESZ2, and the (3)

Regions of moderate sensitivity or ESZ3 and guidelines has been formulated for each sector. The overall planning and development of the extensive Western Ghats region would have to be placed within the framework of the proposed Ecologically Sensitive Zones.

Proposed guidelines and summary recommendations for sector-wise activities in the WGEEP report [19] includes the following relevant to KSWMP:

- Road and other infrastructural expansion plan to be submitted for EIA scrutiny by the ULB / Local Planning Authority before the execution of projects, especially assessing the cost-benefits considering ecological costs and public benefits for ESZ1 and 2.
- Building codes which will be prepared by Authority shall include green considerations for Waste treatment
- Local authorities should be made responsible for developing regional systems for handling hazardous, toxic, biomedical wastes as well as recyclable materials. In ESZ 1 and 2: No hazardous or toxic waste processing units are permitted. In ESZ 3: Recycling and waste processing and units compliant with PCB regulations should be sited in ESZ3 areas (or outside the WG region) and should cater to nearby ESZ1 and 2 areas
- In ESZ 1 and 2: No new polluting (red and orange category) industries; for existing industries switch to zero pollution by 2016 and be subject to strict regulation and social audit. For ESZ 3: No new polluting (red and orange category) industries; for existing industries switch to zero pollution by 2016 and be subject to strict regulation and social audit New industries may be set up under strict regulation and social audit.
- Strict regulation on waste management for Tourism industries in ESZ 1. Careful planning for the management of waste, regulations for the use of plastics.

Developments on the Western Ghats region shall follow the guidelines of the WGEEP. Many among the towns considered for KSWMP including Kalpetta, Mananthavady, Sulthan Bathery, Mannarkad, Palakkad, Chittur-Thathamangalam Kattappana, Nilambur, Thodupuzha, Neyyattinkara, Nedumangad, Kottarakkara, Punalur, Pandalam, Adoor Erattupetta, Pala, Muvattupuzha falls in or near Western Ghats region and developments proposed here need guidance from concerned authorities.

[19] http://www.keralabiodiversity.org/images/pdf/wgeep.pdf

2.4.9 Forest Cover

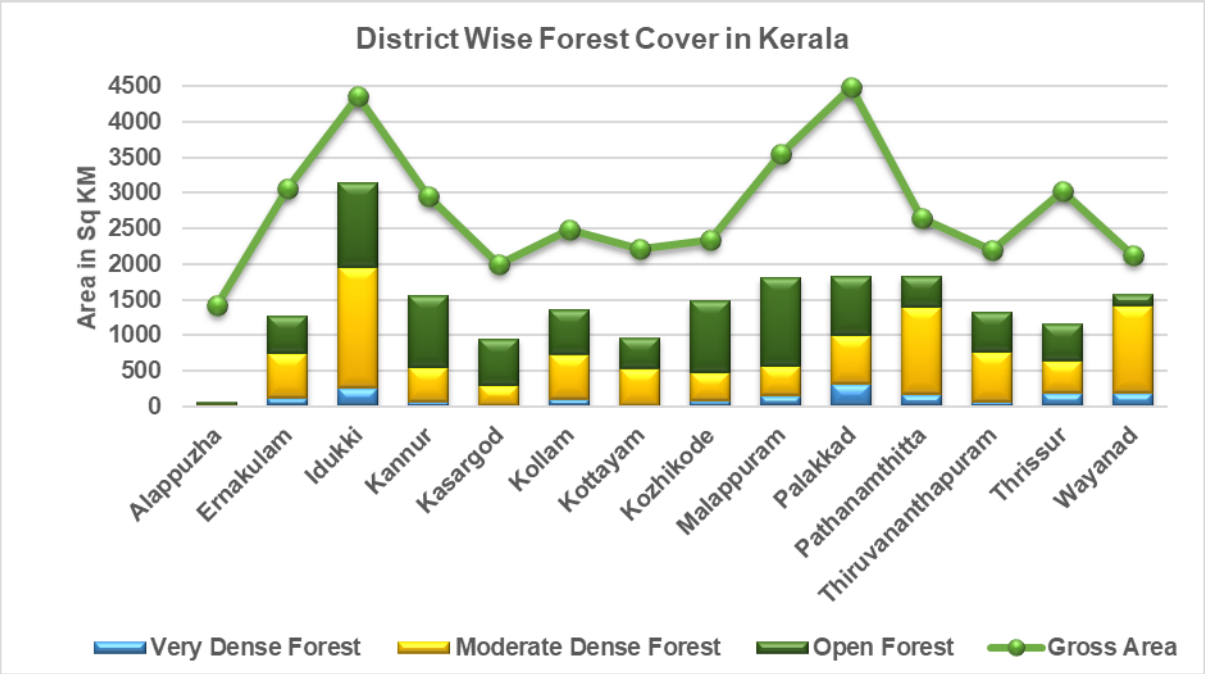


Figure 13: District wise Forest Types of Kerala

Source: Forest Survey of India, 2017

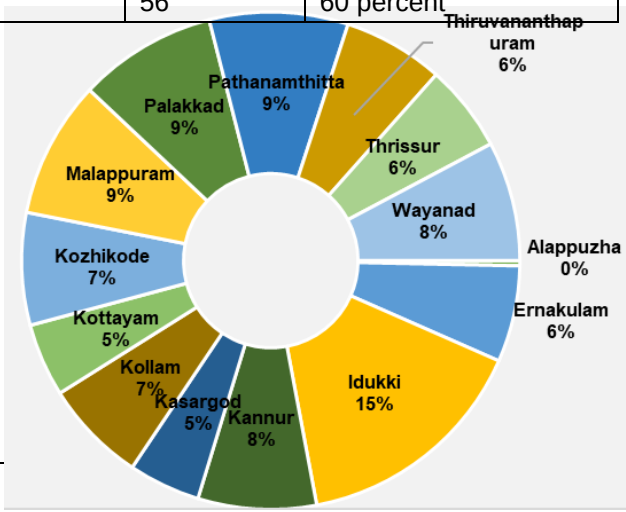
According to the State of Forest Report, 2017 by FSI the forest cover in Kerala state is 20,321 sq km constitutes 52.30percent of its total geographical area. However, the recorded forest area of the state is 11,309 km2 which is 29.11percent of the state's geographical area. All the recorded forest in the state is of Reserved Forest Category.

Figure 14: Distribution of Forest Cover in various Districts of Kerala

Based on the assessment, the distribution of ULBs across various forest type zones of Kerala is presented in ***Table 7***.

Table 7: Ramsar Sites of Kerala and ULBs located nearby

Sl. No	Type of Forest Zones	ULBs (Nos)	ULBs (Percentage of total)
1	Very Dense & Moderately Dense Forest Zones	10	11 percent
2	Open Forest & Scrub Forest	56	60 percent



3	Non-Forest	27	29 percent

Infrastructure development in ULBs near forested areas shall not result in the conversion or degradation of forest resources. In case any component of the proposed development is near forested areas the project shall incorporate capacity building elements to manage forest resources from disturbance and project preparation, appraisal, and supervision arrangements shall include appropriate environmental expertise to ensure adequate design and implementation of mitigation measures.

2.5 Infrastructure and Services

2.5.1 Transportation

Major transport infrastructure of the State consists of 2.73 lakh km of road, 1588 km of railways, 1687 km of inland waterways, and 18 ports with 585 km coastal route and 4 airports. Roads play a prominent role in public transportation visa-vis-other modes of transportation owing to the geographic peculiarities of Kerala with a comparatively lesser rural-urban divide and limited geographical area of 38,863 Sq. km.

The roads/highways are the dominant mode of transport in Kerala with about 75 percent of freight and 85 percent of passenger share. Kerala has a dense road network, roughly three times the national average. The road network though the predominant mode of transport in all the ULB's faces severe constraints due to the increase in urban population and the associated unplanned ribbon development. The traffic levels at most stretches exceed the road capacity.

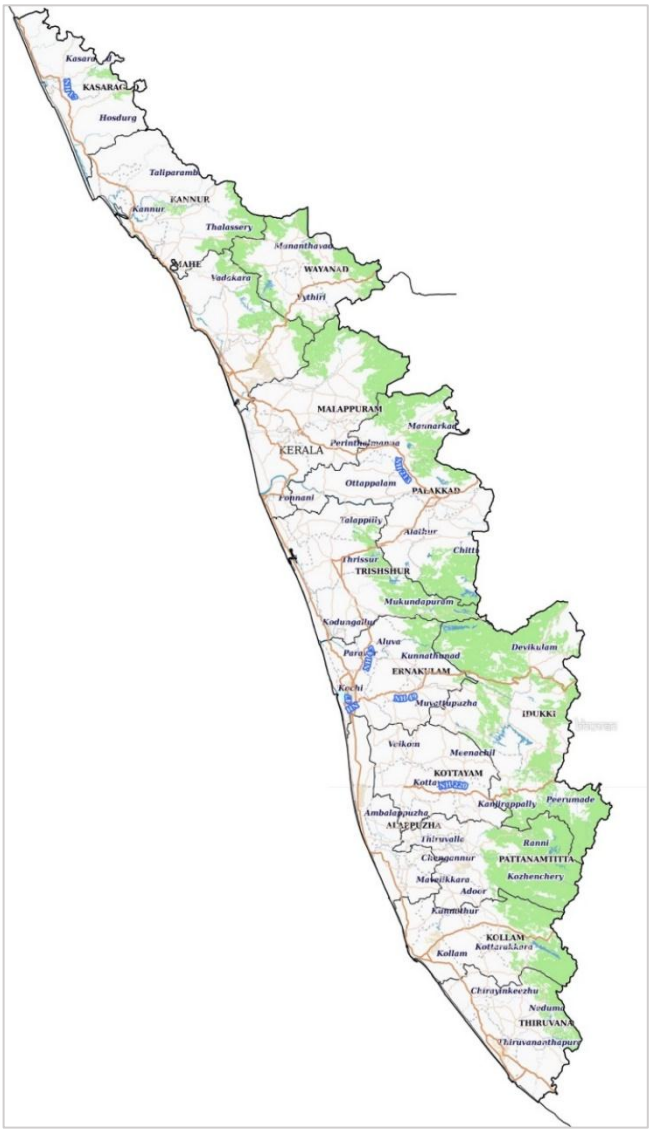


Figure 15: Road Network of Kerala

Total road length in Kerala in 2017-18 is 2,29,349.21 km. Road density in the State is 590.14 km/100 sq. km and it is far ahead of the national average of 387 km/100 sq. km. The length of the road per lakh population is 686.55 km and almost 90 percent of

the road network is single lane.20 National Highways in Kerala is only 2.3percent of the total National Highway length spread over 1525.570 KM in India. National Highways of the State offers North-south Connectivity Kasargod – Kochi and Palakkad – Thiruvananthapuram in addition to providing east-west major routes, connecting the north-south spines to eastern boundaries reaching cities across Karnataka or Tamil Nadu – Coimbatore, Pollachi, Theni. The major road network of Kerala, though well connected, faces severe constraints due to the urban sprawl and the haphazard ribbon development all along the routes. The existing traffic levels at most stretches are excessive and beyond the road capacity. The traffic on roads is steadily increasing at a rate of 12 to 14 percent a year. Capacity augmentation of existing roads is beset with problems relating to a limited right of way and land acquisition. Kerala has 133.34 lakh registered motor vehicles as of March 2019. For the last two decades, it has experienced a compounded annual growth rate of above 10 percent. The number of vehicles per 1,000 populations for Kerala as of March 2018 is 383 (number of vehicles per 1,000 populations in India is 18).

Kerala - East-West and North-South Connectivity is good in though network narrow and congested. A clustered approach focusing on Regional level infrastructure development hence is a possibility. Since the state is narrow east-west with a maximum 80 km distance; developing north, south, and central common facilities like landfill along the midlands will be operationally justified. Intracity connectivity is good with well-topped roads in most residential/commercial areas of towns. Width of roads, high traffic most of the motorized modes, and specificities of origin – destinations shall be considered while selecting the vehicles for Collection Transportation and Fleet and movement planning.

2.5.2 Water supply

According to Census 2011, the majority of people (62percent) use wells as their main drinking water source, while 29percent of the population has access to piped water supply. The use of wells as the primary source of drinking water is explained by the high-water table in most parts of Kerala and the dependency on the groundwater for drinking purposes. Ernakulam is the only district where piped water supply is the predominant source of the drinking water (around 60percent of the drinking water supply is through piped water). Whereas in Kannur district, groundwater constitutes 82percent of the drinking water supply. In terms of accessibility, on an average 78percent of households of the ULB's have a water source within the premises, and 14percent of households use water sources near the premises.

Main sources of water supply for the towns: ponds, rivers, canals, and wells are polluted mainly by solid waste deposits. This is one of the receptacles of the waste generated in towns and cities; though the State claims decentralized waste management as an option.

2.5.3 Sanitation

Kerala achieved Open Defaecation Free (ODF) status in 2016. State sanitation coverage, based on Census 2011 showed that 67percent of households had water-sealed toilets, and 95percent had a toilet facility within the premises. Although, around 50percent of the households were reported to have a septic tank – comprising of either watertight septic tanks or soakage (leach) pits; there was no

[20] http://www.kerenvis.nic.in/Database/RoadNetworkKerala_2284.aspx

institutionalized fecal sludge management system in place to manage the sludge after emptying of the septic tanks.

Suchitwa Mission, the technical arm under the LSGD, is the key stakeholder driving sanitation strategies focused on the community and individual households. Centralized piped sewerage systems with treatment plants are under the purview of the KWA, but these only cover Kochi and Thiruvananthapuram towns and have low coverage across the state. Currently only a considerably small part of CBD of Kochi and Thiruvananthapuram is covered under sewage network and treatment system. Most of the toilets, septic tanks have drains or canals as their outlets. There is also no fecal sludge treatment system. Private tankers suck and collect sewage from septic tanks as and when demanded by the house owner. There are many reports of clandestine dumping of this waste collected in rivers and water bodies.

Lack of centralized sewage treatment and disposal facilities add to the increased pollution of water sources and land. Combining solid and liquid waste treatment options shall be considered an integrated solution to the pollution issues the state is facing today.

2.5.4 Solid Waste Management (Including Marine Plastics)

As per the Twelfth Schedule[21] of the Constitution of India, Solid Waste Management is the responsibility of the Local Governments (Urban and Rural). The GoK came out with a Solid Waste Management Policy, 2018, and has also created institutions at the state level to support service delivery. Besides, the state government has converged livelihood improvement programs also linked to the SWM sector to ensure the supply of manpower for the collection of waste and treatment. As part of the SWM Policy 2018, the GoK has charted “My Waste My Responsibility” philosophy and has also stipulated Extended Producer Responsibility. These have been laid down with a focus on creating a circular economy around solid waste, domestic treatment of biodegradable waste, reducing the overall waste generation, and improving societal consciousness towards the environment.

The waste quantification and characterization were carried out based on sample surveys undertaken in 5 select cities covering all geographic regions of the State. A total of 180 household samples and 144 non-domestic establishment samples were drawn for 3 consecutive days to assess the current waste generation rate and composition of MSW at the household, commercial, and institutional level. Also, a survey of 12 ULBs (out of 90 ULBs comprising 87 municipalities and 3 non-major Corporations) to be covered under KSWMP (excluding the 3 major Corporations) was carried out. The survey covered three (3) sectors – Household; Commercial and Institutional who represent the bulk waste generators of the State. Also, existing dump yards of around 40 ULBs were studied with detailed inspection on 18 of them. In-depth assessment of the situation on the ground, besides review of secondary data made available by the state. For the purpose, the team visited 6 cities/towns in the State namely Attingal, Punalur, North Paravur, Alappuzha, Kollam, and Thodupuzha towns. Thus, in total around 30 percent of the ULBs were visited and surveyed for preparing the details on SWM in Kerala.

[21] *Twelfth Schedule of the Indian Constitution presents the powers, authority and responsibilities of Municipalities. This schedule has 18 items. Twelfth Schedule was added by the 74th Amendment Act of 1992.*

2.5.4.1 Waste Quantification

Waste generation rate per capita in municipalities varies from 364 grams/capita to 456 grams/capita. Low waste generation is noticed in ULBs in highland areas. Highly urbanized Municipalities generate above 450 grams/capita and the City Corporation generates around 545 grams/capita. Domestic waste contributes 55-65percent of total waste, while commercial establishment and markets are the second-highest generators of waste. The average waste generation rate in Municipalities works out to 419 gm/capita/day whereas, in Municipal Corporation areas it works out to 545 gm/capita/day.

2.5.4.2 Waste Generation Projections for Different Geographical Regions

There are 3 broad categories of geographical regions namely lowland, midland & highland. It has been observed that the waste generation rates are different for different regions. The waste generation rates are higher in the coastal belts, which is around 545 gm/capita/day in Municipal Corporation areas whereas, the waste generation rate in the midland belt is about 454 gm/capita/day and it is about 383 gm/capita/day in highland areas. If we take an average of small & big towns, the average waste generation comes to 419 gm/capita/day for Municipalities and 545 gm/capita/day for corporations. Based on this, the waste generation in the State works out as shown in ***Figure 16.***

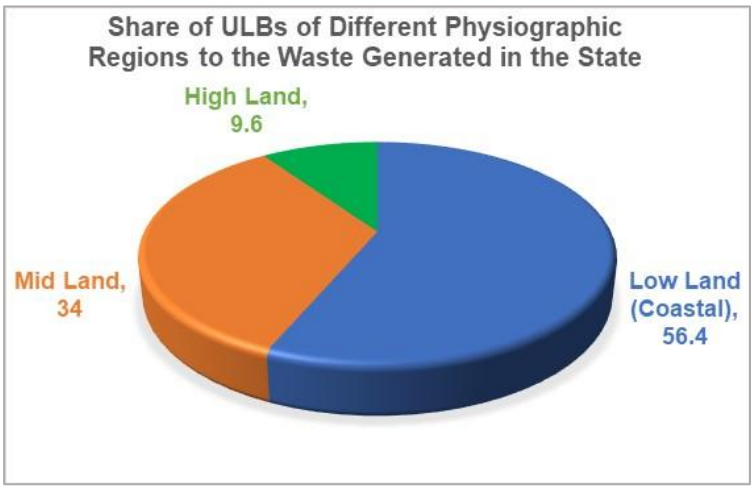


Figure 16: Comparison of Waste Generated by ULBs in various Physiographic Regions

2.5.4.3 Segregation at Source

Segregation at source was found to be diverse across ULBs. Around 75percent of respondents practice segregation (80percent by HHs and 64percent commercial). In 5 ULBs (Aluva, Feroke, Guruvayoor, Kothamangalam, and Perinthalmanna), segregation levels were more than 80percent. Source segregation between 60percent to 80percent was observed in 4 towns (Alappuzha, Attingal, Thalassery & Varkala) and below 60percent in the remaining 2 towns. In contrast to commercial generators, segregation is practiced in >80percent of institutional generators across all ULBs.

2.5.4.4 Segregation Categories

Typically, HHs practice 2 broad forms of segregation – BDW & NBDW (48percent) and BDW, NBDW & Recyclables (52percent). ULBs such as Aluva, Attingal, Guruvayoor, and Varkala indicate the most willingness for three-way segregation,

whereas Kalpetta, Alappuzha, and Perinthalmanna two-way segregation. The other towns equally indicate both types of segregation practices. Among commercial and institutional establishments, a similar pattern and level of source segregation were also observed. Results point to the need for providing compartmentalized transportation of collected waste after setting up treatment and disposal facilities at the ULB level.

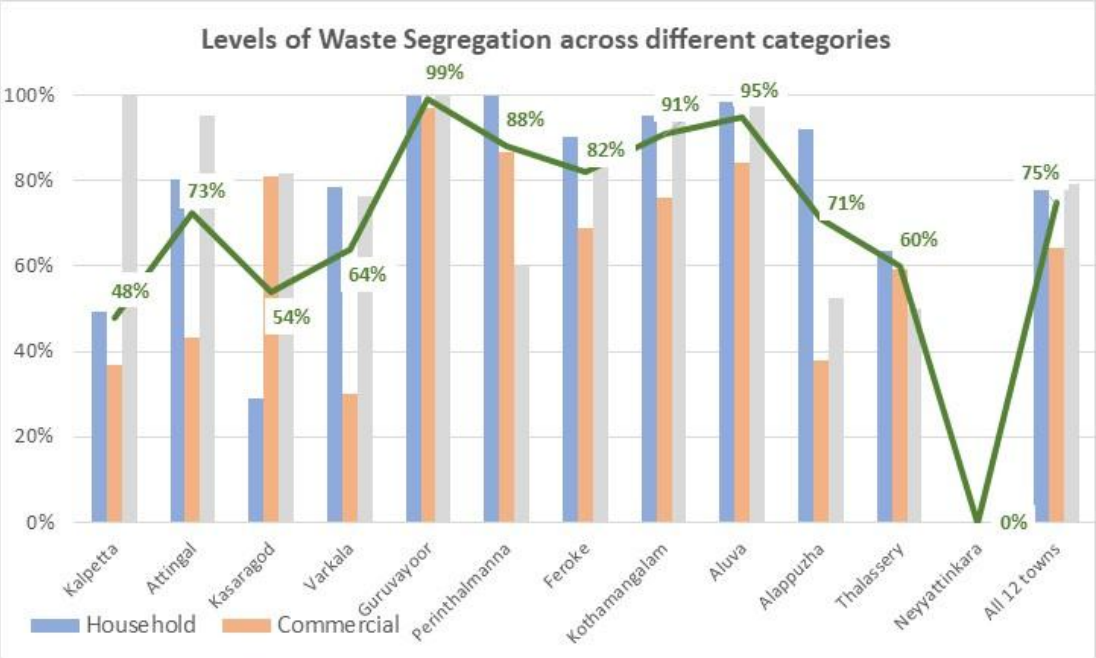


Figure 17: Waste Segregation in Sample ULBs (Generator type-wise)

2.5.4.5 Management of Biodegradable waste

This practice is assessed among generators who indicated they segregate BDW. At least 50percent of the HHs across the ULBs manage BDW within the premises through garden use, composting, or as animal feed. Perinthalmanna, Feroke, and Kothamangalam had the highest usage of BDW in the garden among HHs. Composting among HHs across ULBs is only at 12percent. More than 20percent of surveyed HHs in Feroke, Kothamangalam, and Kasaragod practice composting. The practice of handling over BDW to ULBs / community groups is observed across all generators (16percent among HHs to 28 percent in institutions) in all the towns. Among all ULBs, the centralized collection is highest in Aluva with more than 50percent of respondents indicating disposal to the ULB collection system. Around 5percent of all generators indicate dumping into public bins /outside premises/pits. Kalpetta and Thalassery appear to have the highest respondents engaged in disposal practices that are considered unacceptable in terms of compliance with SWM Rules.

2.5.4.6 Management of Recyclable Wastes at the Household level

Two prominent actions were observed across all generators who segregated and recovered saleable waste from the Non-Biodegradable Waste volume generated; Disposal to scrap dealers or handing over to ULB appointed collection agency (36percent among HHs, institutions and 25 percent in commercial establishments).

Feroke, Attingal, and Varkala indicated the highest percent of HHs selling wastes to scrap dealers. This is probably due to the presence of a strong ecosystem of waste collectors/ recyclers in these ULBs. Aluva, Guruvayoor, Varkala, and Attingal have a system of collection of recyclables by ULBs. However, it important to note that the ULB driven collection system presently focuses on recyclables. Overall, 2percent of all respondents gave away recyclables for free while about 3percent reported burning such wastes due to lack of collection and disposal arrangement. There is a significant need for daily collection of NBDW (not restricted to plastics only).

2.5.4.7 Management of Non-bio degradable (NBDW) Non - recyclable Wastes at Household level

Three key practices were observed across all ULBs for the NBDW include (a) burning/burying of waste (b) dumping of waste in open spaces (c) handing over to the ULB designated agency. Some of the respondents reported dumping wastes into open waste spaces or at street corners or into community bins and in some cases water bodies. 1/3rd of the respondents reported handing over to ULB designated agency. Several respondents indicated that they were compelled to process the waste themselves. Survey results point to the need for access to scientific waste management systems of NBDW (non-recyclables).

2.5.4.8 Marine Plastics in Kerala

Kerala has a long coastline extending from North to South of the State. All 41 of its 44 rivers empty into the sea along its western coast. Some empty first into the Vembanad and Ashtamudi Wetland (Ramsar Sites) before entering the sea. Loads of plastics and other wastes carried by these rivers empty into these lakes first; as depicted by higher loads of microplastics in the Lake waters.

Microplastics are emerging pollutants of increasing environmental concern with a particle size of <5 mm, which originate from the successive degradation of larger plastic debris or are manufactured as small granules and used in many applications.

The impact of the plastic waste on oceans is quite substantial in the context of Kerala which has 560kms long coastline and an extensive network of water bodies. A recent study estimated that close to 1.70 billion plastic pieces weighing approximately 1057 tonnes are currently littering along the coast of Kerala. The average litter index (the number of plastic litter in a plot divided by the area of the respective plot) in the coastal region of the state is 1660 pieces per km compared to the global average litter index of 573 pieces per km. The proportion of each type of plastic material in the estimated plastic litter along the coast includes Low-density polymer (LDPE) – 23%, High-Density Polymer (HDPE) – 18%, MLP's – 17%, Expanded polymers – 16%, Undesignated – 26%. Further, 53% of the total plastic litter along the coasts is of Single-Use Plastic (SLP). In addition to the impacts on the coastal ecosystem, plastic pollution is also significantly impacting the waterbodies in Kerala.

Marine Litter in Vembanad Lake:

A study [22]examined the occurrence of microplastic particles in the Vembanad Lake, through samples collected from ten sites and processed for microplastic extraction through density separation and identification of the polymer components using micro Raman spectroscopy. MPs were recovered from all sediment samples, indicating their extensive distribution in the lake. The abundance of MPs recorded from the sediment samples is in the range of 96-496 particles m(-2) with a mean abundance of 252.80 ± 25.76 particles m(-2). Low-density polyethylene has been identified as the dominant type of polymer component of the MPs. As clams and fishes are the major source of protein to the local population, the presence of microplastics in the lake becomes critically important, posing a severe threat of contaminating the food web of this lake.

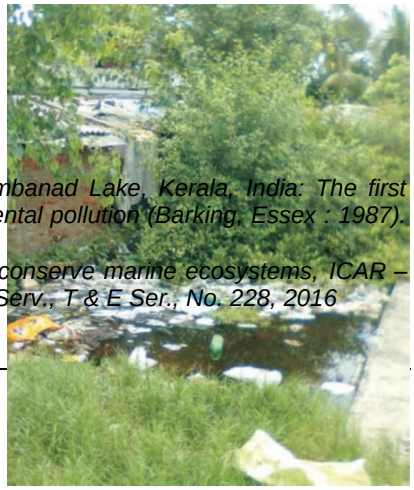
Another study [23] on litter spread in the Lake presents the following:

Bottom litter: All through the Vembanad Lake, litter is present on the substrate, but the highest quantity is in Cochin backwaters and bar mouth region. Along the sides, the spread of litter is to the height of 50 cm and more.

Column litter: It has been estimated that during low tide, about 135 tonnes of litter passes through the columns in a year towards the bar mouth. Some of these can also be flushed back during high tide. The survey has indicated that plastic flex, cloth, bottles, plastic-coated sacks, thermocol pieces/ sheets, footwear, etc are common.

Floating litter: About 75 to 100 kg of litter (wet weight) floats on the surface waters (less than half a meter) and passes through the Cochin backwaters to the Arabian Sea during low tide per day. This can settle near the bar mouth region or float away from the coast.

In bivalve fishing areas of Vembanad Lake, especially where the clams are handpicked from intertidal/subtidal areas, fishers have indicated that broken glass pieces are a threat to their health and plastic covers and other debris have led to low catch per hour of fishing. The trapping of assorted type and size debris in fishing nets has been found to affect fishermen as removing these from the nets is time-consuming. In small stake nets where shrimp is the major catch, fishermen have to engage extra labor to remove the debris from the catch. In a study conducted on stake nets in Vembanad Lake, shrimp caught in the net ranged from 0.525 to 1.36 kg while the average weight of litter in these nets ranged between 1.87 to 13.8 kg per day per net. Experimental fishing conducted along Central Kerala has indicated the growing threat to fisheries with the material collected in the nets from nearshore areas having huge quantities of trash especially plastics and pieces of nets. Entanglement of debris including fabrics and ghost nets on the propellers and blocking of intake pipes of the fishing vessels



[22] Sruthy, Shini & Ramasamy, E.V. (2016). Microplastic pollution in Vembanad Lake, Kerala, India: The first report of microplastics in lake and estuarine sediments in India. Environmental pollution (Barking, Essex : 1987). 222. 10.1016/j.envpol.2016.12.038.

[23] Kripa K etal, 2016. A National Marine Debris Management Strategy to conserve marine ecosystems, ICAR – Central Marine Fisheries Research Institute, Kochi, 2016. Mar. Fish. Infor. Serv., T & E Ser., No. 228, 2016

have considerable impacts on fishing time and maintenance costs.

Figure 18: Wastes dumped in Water bodies: Ashtamudi Lake and a Canal

Research by Kerala University of Fisheries & Ocean Studies (KUFOS) in Nov 2019, revealed that the water flow in Vembanad Lake had decreased by around 50 percent due to plastic waste & silt and in many areas of the lake & warned that the decrease would increase the intensity of floods. Earlier the study had found sharp depth shrinkage of the lake from 8 to 9 meters in the 1930s to the present 1.6 to 4.5 meters. Another alarming finding of the study was the presence of around 4276 tonnes of plastic garbage in the bottom sediments of the Alappuzha regions. The lake area in these regions is 76.5 sq.km. This amounts to 55.9 tonnes per sq km of plastic garbage. It is known that in Kochi regions also there is a similar situation.[24]

Municipalities/local governments should invest further in waste and wastewater treatment infrastructure to manage plastic accumulation in Lakes and seas effectively. This can help to prevent marine litter at source. Targetted programs to remove plastic litter from lakes and prevent further deposition would improve health and resilience. However, adequate waste treatment and disposal arrangements are necessary before starting such programs so that waste removed from lakes do not end up polluting another place.

2.5.4.9 Common Centralized Treatment and Disposal Facilities

Around 14percent of the households have treatment facilities, and those too are partially functioning in several cases. The study conducted in 2019-20 estimates the gap in biodegradable wastes at the city level as 71 percent in small towns and 97.5 percent in large ULBs. All 28 centralize facilities in the State could treat only 10 percent of the wastes (bio), while around 80 percent of the biodegradable wastes are untreated at the city level.

2.5.5 Biomedical Waste Management

The quantum of waste generated in India is estimated to be 1-2 kg per bed per day in a hospital and 600 gm per day per bed in a clinic. About 85% of hospital waste is non-hazardous, 15percent is infectious/hazardous. Mixing of hazardous wastes with others results in contamination and makes the entire waste hazardous. Hence there is a necessity to segregate and treat. Improper disposal increases the risk of infection; encourages recycling of prohibited disposables and disposed drugs; and develops resistant microorganisms.

[24] https://sandrp.in/2020/03/03/ramsar-wetlands-in-crisis-south-india/

2.5.5.1 Biomedical Wastes in Kerala

Economic Review 2017[25] of GoK reports that Kerala has the highest number (about 27 percent) of health care institutions in India. The total bed strength of hospitals in Kerala is 1,13,530 of which 43,273 are in the Government sector, 2,740 in the co-operative sector, and 67,517 in the private sector (CPCB, 2011). It is estimated that each bed generates about 1.5 to 2 kg/day of solid waste and 450 liters per day of liquid waste. Around 85 percent of the solid waste is non-hazardous, 10 percent is infectious and 5 percent is toxic. Recent estimates show that 60 percent of the wastes generated in the State is being handled by a facility established by the Indian Medical Association.

2.5.5.2 Existing Biomedical Waste Management System in Kerala

The entire Bio-medical Waste generated in the State of Kerala is managed by the IMAGE (IMA Goes Eco-friendly) initiative of IMA Kerala State Branch. The biomedical waste segregated at source is collected, transported, and scientifically treated by IMAGE as per the Rules and Regulations stipulated by the Biomedical Waste Management Rules 2016 (Amended in 2018).

IMAGE Project was launched on 21st October 2001 by the Indian Medical Association, Kerala State Branch and the IMAGE Plant, the Common Biomedical Waste Treatment and Disposal Facility (CBMWTF) established at Kanjikode, Palakkad was commissioned on December 14, 2003, for the scientific management of biomedical waste generated from health care facilities in Kerala. IMAGE was conceived and launched to support the healthcare providers to overcome the challenges of disposal of hospital waste following the provision of the Biomedical Waste (Management and Handling) Rules 1998 with the approval of Kerala State Pollution Control Board. Initially, the affiliation fee was Rs 1000; while treatment charges were Rs 3.50 per bed per day.

Management

Under the auspices of IMA Kerala State, IMAGE is managed by a Management Committee consisting of Chairman, Secretary, Treasurer, Vice Chairman, Joint Secretaries and District Representatives. Apart from this, there is a Purchase Committee, Vigilance Committee & Committee for upcoming Projects These Office-bearers are elected/nominated from among the IMA Members who regulate and manage all the activities through IMAGE Administrative Office functioning at IMA Head Quarters, Thiruvananthapuram.

BMW Treatment Plant

is situated amid 23 acres of land at Manthuruthy, Kanjikode, Palakkad. There are 5 main Buildings & few small buildings for the plant with a total plinth area of more than 60,000 sq.ft. IMAGE is now the largest CBMWTF in India which can treat more than 40 tons of Bio-medical waste per day. The plant machinery includes 5 huge Incinerators(equipped with Online Continuous Stack Emission Monitoring System (O-CEMS), 5 Autoclaves, 4 Shredders, 150 meters long scrap sorting Conveyor belt

[25] *State Planning Board, 2017. Economic Review. Government of Kerala*

system, 3 scrap grinders with washing equipment, 2 Hydraulic bundling machines, 2Bottle sorting machines, and two 125 KVA Generators and one 380 KVA Generator. There is a vehicle wash area of 2000 sq. ft. and a modern Effluent Treatment Plant (ETP) with the capacity to handle 4.5 lakh liters per day for disinfecting all the effluents coming out during treatment of the waste. Surveillance Cameras, (64 in number) are recording the activities within the plant, which is available for monitoring 24 hours a day. IMAGE has multiple rainwater harvest systems including Micro-Watershed Based Rain Harvesting. There is a huge Green-belt surrounding the plant. IMAGE is operated by about 500 staff working together for IMAGE, GJ Multiclav, Scrap dealers & Security agency. Segregation of Bio-medical Waste at the source: Colour coded bags and containers are provided to Health Care Institutions (HCIs) through IMA PEPS authorized dealers for segregation and collection of waste at source. Special training is imparted to hospital staff regarding segregation, collection& transportation to the common storage area within the HCI.

Transportation of Biomedical Waste

GPS installed covered vehicles - 53 (Fifty-Three) numbers - are arranged for the collection of biomedical waste within 24 hours from the entire length& breadth of Kerala, which are specially designed as per the Biomedical Waste Management Rules and approved by the Pollution Control Board, which ply a total distance of 12,000 km per day. Out of which 30 vehicles reach to image plant; Each vehicle-crew includes a driver, a sanitary worker, and a supervisor. Each vehicle collects segregated biomedical waste daily and is taken to the district transfer stations, from there directly to the plant at Palakkad taking all safety measures. All these vehicles are monitored through GPS Satellite Monitoring using AVL View Software Application. The movements of waste collection vehicles are monitored through GPS and the waste collection is monitored through the mobile application system. Barcode based biomedical waste management has been implemented by IMAGE to monitor each waste bag from the collection source until the scientific treatment at the plant.

The approach road to IMAGE CBMWTF is through 1.1 Kilometer (Forest-area from Anakkal Road to IMAGE Plant) is in a very dilapidated condition with lots of potholes and big rubbles which made it impossible for transport as mentioned above 30 Bio-medical collection vehicles reaching our plant every day and also staff transporting vehicles, Plant Ambulance is running through this road.

Estimation of Waste Treated

On an average, about 40 Tonnes of biomedical waste reaches the IMAGE plant daily, of which 20 Tonnes are Incinerable waste (collected in Yellow bags), 14 Tonnes are Autoclavable waste (collected in Red bags), 5 Tonnes are Glass-wares & Metals (collected in Blue Boxes) and 1 ton is Sharps (collected in white puncture-proof containers). This 40 tons of biomedical waste is collected from 14830 healthcare centers across the state of Kerala within 24 hours of its generation.

Affiliation Details as of 2018:

- Private Health Care Institutions: 13599
- Government Healthcare Institutions: 1103
- ESI & Other Healthcare Institutions: 61
- Private Non-healthcare Institutions: 67

- TOTAL 14830

As per Biomedical Waste Management Rules, 2016 (BWM Rules, 2016), a facility can treat wastes only within 75kms of its location. If this is applied this facility can transport and treat wastes only from Trissur and Palakkad districts of Kerala.

2.5.5.3 Other Proposals

a) IMA proposed to construct another biomedical Wase Management Plant of 20 TPD capacity in a 7 acre Plant at Peringamala in Palode, Thiruvananthapuram in 2014. However, the residents objected to the Plant as the proposed site is in the eco-sensitive area. The locals and NGOs pointed out that the location is a unique Myristica swamps ecosystem[26] and tribal habitats. Hence, this project is on hold now. The proposed CBMWTF at Palode, Thiruvananthapuram is designed to serve all health care establishments in a 150Km radius from Thiruvananthapuram. The service area for the proposed CBMWTF at Palode will bring all Health Care Facilities (HCF) viz., Hospitals, Nursing homes, Research stations, Medical Institutions, Clinics, Laboratories, Drug stores, etc., in five revenue districts namely, Thiruvananthapuram, Kollam, Pathanamthitta, Alappuzha, and Kottayam. At present, there about 75784 listed beds and other services like Diagnosis centers, research laboratories, Drug stores, etc., which are available in the identified service area of the proposed facility. Hence, the proposed CBMWTF is planned to have treatment, processing, and disposal implements to manage 30T of regulated BMW per day for a capital outlay of Rs 20 crores.
b) Kerala Enviro Infrastructure Limited proposes to set up a Common Bio-medical Treatment Facility at Ambalamedu (16 TPD; with an investment of Rs 4.9 crores), within FACT CD Campus. They have a hazardous Waste Management facility nearby. The proposed project of setting up the Common Biomedical Waste Treatment Facility includes Incinerator, Autoclave, Shredder, and Effluent Treatment Plant. The present proposal is to utilize 3.5 acres of land a part of the Hazardous Waste Treatment, Storage, and Disposal Facility (TSDF) site for setting up of CBMWTF. The extent of land earmarked for the CBMWTF will be kept apart from the remaining land of TSDF.

   Proposed Capacity of CBMWTF: Incinerator 250-300 kg /hr - 2 no:s; Autoclave 250 liters - 2 no:s, Shredder 350 kg / hr - 1 no:, Effluent Treatment Plant 50 m3 / day – 1 no:. The estimated cost of the project is about Rs. 4.9 crores.

The State needs to have Common Biomedical Waste Treatment and Disposal Facilities at the regional level, one in Central and one in Southern region of Kerala; in addition to the one near North Kerala in Palakkad. As per Biomedical Waste Management Rules

[26] *Myristica Swamps is an endangered evergreen forests ecosystem. It can be called a freshwater swamp forest predominantly composed of species of Myristica. These are found in two regions in India - in the Uttara Kannada district of Karnataka State and in the southern parts of Kerala State. The swamps occur on either side of first order streams. The swamp boundary can be seen distinctly in the field due to the stilt roots. They have adapted to inundation by way of stilt roots and knee roots. Major species of trees found in the swamps in Kerala are Gymnocranthera canarica, Myristica fatua, Mastixia arborea, Semecarpus travancorica, Hopea whitiana, Lophopetalum whitiana, Holigarna grahami, Sysygium laetum, etc. Myristica fatua is a dominant tree seen in most sample plots studied here. Reptiles and amphibians are abundant in the swamps. Many of the animals and trees / plants documented belong to red list and endemic categories.*

(BMWM Rules, 2016), facilities shall cater to a distance of 75 km radius or catering to 10,000 beds, and no Biomedical Waste shall be stored for more than 48 hours at the source. Collection and safe disposal of generated biomedical waste from households and health Care Units during emergencies like COVID 19 need close coordination between ULBs and BMW Management service providers for cleaning and disinfection of premises, collection and transport of wastes to the facility and increasing the capacities for treatment and disposal of biomedical wastes.

2.5.6 E-Waste Management

E-Waste Collection Centre

Kerala Enviro infrastructure Limited (KEIL) has an authorized collection center for E-Waste approved by Kerala State Pollution Control Board in Cochin. KEIL has tie-ups with authorized and registered recyclers for recycling and disposal of E-Wastes collected. E-waste is managed as per E-Waste management and handling rule 2016. KEIL has installed a tube light breaking machine with sulphur impregnated carbon catalyst for adsorbing mercury vapor generated. The Carbon catalyst when saturated is disposed-off in the landfill after encapsulation.

E-Waste Refurbishing & Dismantling Facility

KEIL has also put up an authorized E-Waste Refurbishing & Dismantling Facility as per consent to establish from Kerala State Pollution Control Board.

2.5.7 Hazardous Waste Management

The engineered landfill at KEIL is approved for a capacity to dispose of 10,00,000 MT for 20 years. TSDF of KEIL is the only facility in Kerala to collect, transport, treat, and dispose-off hazardous waste as per Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016.

Hazardous waste collected from waste generators is subjected to pre-treatment (Stabilisation) if found necessary based on the analysis in KEIL Laboratory and disposed-off in a secured landfill constructed as per guidelines issued by the central pollution Control Board. Waste disposal is undertaken in compliance with the provisions of Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016, and its revisions.

KEIL currently caters to the waste disposal requirements of more than 1000 industrial units including 500 individual members and four associations having more than 500 members. Some of the specific industrial processes to whom KEIL is offering its waste treatment and disposal service are include Metallurgical Industries, Petroleum and Petrochemical, Fertilizer industry, Choloralkali industry, Catalyst manufacturing units, Food industry, Coir, and Paper industry, Effluent treatment plants, Pesticide Industry, Plywood manufacturing Units, Garment manufacturing units, and Shipbuilding industry. Any industry intending to dispose-off their waste in KEIL needs to take membership in KEIL. The ash generated from the CBMWTF is currently handled at the TSDF of KEIL.

Secured landfills

The secured landfill at KEIL is constructed in phases as per requirement. Each cell of the landfill on filling up with waste is capped as per guidelines issued by Central Pollution Control Board. Engineered landfills are built as per drawings approved by IIT, Delhi, and Kerala State Pollution Control Board. Each cell is inspected by the Independent Consultant before disposal of waste. Currently, KEIL has constructed six cells for waste disposal out of which four cells are capped and presently waste is disposed-off in 5th and 6th Cells. As of November 2019, KEIL has received and disposed-off a total quantity of 4.62 Lakhs MT waste in the secured landfill. Given the climatic and soil conditions at the site, a double composition liner system is adopted for the construction of a landfill in KEIL. KEIL is required to maintain the landfill and monitor for its satisfactory performance for 30 years after closure.

Leachate collection system

Leachate is collected by a slope in the landfill bottom liner, which eventually flows into a collection sump. The collected leachate is pumped out and is transferred to a leachate treatment system. The Leachate treatment system includes a Multiple effect evaporation plant and a Reverse Osmosis Plant.

Transportation

The transportation of the hazardous and other waste is undertaken following the provisions of rules made by the Central Government under the Motor Vehicles Act, 1988, and the guidelines issued by the Central Pollution Control Board.

KEIL uses its own as well as hired dedicated vehicles for the transportation of hazardous waste from waste generators.

Manifest system (Form 10) is used for the transportation of hazardous waste following the provisions of Hazardous and Other Wastes (Management and Transboundary Movement) Rules.

Godown and Stabilisation

- Godown of 900 sq.m and 900 sqm physical treatment area are built in KEIL for catering to the waste storage and treatment to make it harmless or less hazardous. The waste stabilization is undertaken in a specially designed pit equipped with suction hood and scrubbing system to ensure a clean environment in the stabilization area.
- 4800 sq.m Monsoon Shed is built to store waste received during the monsoon season in Kerala. The bottom of the Shed is a landfill pit constructed as per Central Pollution Control Board guidelines for landfill construction. Submerged pumps are installed to extract leachate collected at the collection sump for further treatment.

Escrow Account for Post Closure Monitoring

- KEIL is maintaining an Escrow account jointly with Kerala State Pollution Control Board, and State Bank of India, Ambalamedu Branch as an Escrow operating agent. Account No: 38988517478.
- The Escrow account is maintained as per the directive of the Ministry of Environment, Forest & Climate Change (Order No: 23-1/2008-HSMD dated 16-04-2009). 5.0percent of the annual turnover from landfillable waste is

deposited in the Escrow account to take care of Post Closure monitoring and also to take care of any unforeseen exigencies with approval from Kerala State Pollution Control Board.

- An amount of Rs.2,60,45,415/- is deposited in the Escrow account for the period from April 2009 to 31 March 2019

2.5.8 Pollution of Rivers, Forests and Sensitive Areas

There are many exports on polluted tourist spots of the State; near sensitive areas. A most important contributor to such pollution is solid and liquid wastes from hotels, other commercial and residential units. The land is polluted due to the dumping of wastes, resulting in local opposition against solid waste dumping; which has translated into “Not in my Backyard” syndrome against any waste treatment or disposal facility. Due to this, the state has no commendable solid waste treatment mechanisms except some decentralized treatment units in a few cities/towns and few household level units. These treat just around 18 percent of the total waste; leaving a huge gap of untreated waste. Most importantly, the rejects/inerts from these decentralized units are also mostly seen piled up around such facilities, land disposed or disposed-off in water bodies, adding to pollution, eutrophication, visual blight, odor and fly menace.

The major water quality problem associated with rivers of Kerala is bacteriological pollution. The assessment of rivers such as Chalakudy, Periyar, Muvattupuzha, Meenachil, Pamba, and Achenkovil indicates that the major quality problem is due to bacteriological pollution and falls under B or C category of CPCB classification. There are local level quality problems faced by all rivers especially due to the dumping of solid waste, bathing, and discharge of effluents. Industries discharging hazardous pollutants like phosphates, sulphides, ammonia, fluorides, heavy metals, and insecticides are also contributing to the problem of river pollution. The river Periyar and Chaliyar have been identified to be polluted from industrial effluents. It is estimated that nearly 260 million liters of trade effluents reach the Periyar estuary daily from the Kochi industrial belt.[27]

Water quality characteristics of groundwater sourced from wells in Kerala are found to be affected by chemical and biological contaminants. The groundwater quality problems in the coastal areas are mainly because of the presence of excess chloride. The chloride concentration >250mb/l was detected in the well water samples of Azhicode, Kakkathuruthy, Edathinjil, Kadalundi, Chellanum, Mankombu, and Haripad. in Alappuzha district, fluoride concentration in the pumping wells was observed to be high. In the midland region, concerning ionic concentration, the concentration of fluoride iron and chloride were found to be on the higher side. The fluoride content was observed to be beyond the permissible limit of 1 mg/1.Deep wells in Chittur taluk and Kanjikode areas of Palakkad district are found to contain fluoride concentration greater than 1mg/l.

The Study Report on Status of Water Resource, prepared by Kerala State Literacy Mission Authority,[28] covered 3606 water sources including 495 in capital district

[27] http://www.kerenvis.nic.in/Database/Waterpollution_834.aspx
[28] https://www.teriin.org/library/files/Enviro_Monitor_November2017.pdf

Thiruvananthapuram, 318 in Ernakulam, the commercial hub of the state, and 194 in northern Kozhikode district. The study points out that “26.90 percent of water sources in Kerala is "completely" polluted. As many as 46.10 percents of over 3000 water sources including ponds, canals, river, and backwater stretches, and public wells, surveyed in 2003 wards across the southern state, is partly polluted”. The study points out that solid waste accounts for 53 percent of pollution of water sources, liquid waste 16.97 percent, household waste 23.24 percent, and encroachment seven percent. Among solid waste, hotel waste accounted for 40 percent of pollution while plastic and glass 20 percent and other wastes 30.55 percent.
Kerala has in 2019, banned the use of single-use plastics in the State.

Main sources of water supply for the towns: ponds, rivers, canals, and wells are polluted mainly by solid waste deposits. This is one of the receptacles of the waste generated in towns and cities; though the State claims decentralized waste management as an option. Studies confirm that the gap in the treatment of solid wastes is 80 percent, while the gap in the disposal of rejects and inerts is 100 percent, It is important to devise systems not just to treat the wastes, but also to dispose-off the rejects and inerts to save water and land.

2.6 Economic Activities

2.6.1 Employment

To understand the employment profile we look at the number of workers and the workforce participation rate (employed as a share of the total population). The worker participation rate in Kerala ranges from 26percent (in the district of Malappuram) to 47percent (in the district of Idukki). While the workforce increased from 102 lakh persons from 1983 to 131 lakh in 2005, it declined to 127 lakh in 2012. This is mainly due to the increased enrolment in the education of women in the age group 15–24 years. Part of it was also caused by the withdrawal of women from the labor market due to the migration of their spouses to Gulf countries.

Kerala is a state which reports a high rate of unemployment. At the same time, it has a migrant workforce of 34.85 lakh from other states that is equivalent to 25percent of its labor force. On the other hand, it has an immigrant workforce (mostly in Gulf countries) of 22–24 lakh that is equivalent to 16percent–18percent of its labor force. Kerala's younger generation has higher educational attainments: so much so that the proportion of those who have at least a secondary school pass in the age group 15–40 years in the labor force is 51percent for males and 69percent for females as against the national average of 39percent and 24percent respectively (as of 2012). This has led to a shift in preference in the kind of work sought, leading to a situation of educated unemployment. It is this phenomenon that has given rise to in-migration of labor (mainly young men) from outside the state, predominantly for casual manual work. There is no reason to believe that this scenario has changed. However, there could be a segment of 'discouraged women' who are not seeking work, and hence, are not counted in the labor force. Also, some women combine domestic work with economic activities but describe themselves as 'housewives', and hence, are not counted in the labor force. This was evident in a study on Kudumbashree where 54percent of women Kudumbashree members reported as 'engaged in an economic activity' but their average hours of work per day varied between only 3 to 5 hours. This is roughly 14 percentage points above the work participation rate for a similar age group as per NSS 68th Round (2011–12). But the percentage engaged in 'any economic activity' among the Scheduled Castes and Scheduled Tribes was 69percent and 64percent respectively, indicating a comparatively poorer economic condition.

Figure 19: Women's Self Help Group (Kudumbashree) involved in Waste Collection and Transport

Source: Umalekshmi R., 2019.[29]

Involvement of women task force in Kudumbashree and Haritha Karma Sena, involved in SWM services is notable. Better work standards, opportunities for improving their capacities to manage and operate, financial support and work conditions would encourage more women into this sector. Due to high levels of education, their skills in financial management, office automation, and better overall management (including safeguards management) will be supportive of the program. Training, and capacity building activities under the project shall focus on better professional development and financial management capabilities as well; in addition to supporting to initiate collection transportation services and micro-enterprises. State Poverty Eradication - Kudumbashree - Mission can also provide training to women's groups to monitor and service decentralized waste management facilities, developing and mass-scale production of alternatives to plastics, and for sale of compost from

[29] *Umalekshmi R, 2019. Report of the study conducted at the Construction Field at Chengannur block (from 12-04- 2019 to 12-05-2019) Alappuzha, Submitted to KUDUMBASHREE State Poverty Eradication Mission, Thiruvananthapuram.*
Available at: http://kudumbashree.org/storage//files/p51zh_internshipreport_uma.pdf
Accessed on: March 04, 2020

decentralized units after polishing; which will create a unique support group for the sustenance of SWM services in Kerala.

2.6.2 Agriculture

Approximately 5.5percent of the total main workers are cultivators and 9.9percent of the total main workers are agricultural laborers according to the 2011 Census. As of 2017-18, the total cultivated area is 25.79 lakh ha (66percent of the total geographical area of 38.86 lakh ha,) and the net area is sown is 20.40 lakh ha (52 percent)[30]. Agriculture and allied sectors make up 10.04percent of Kerala's GVA[31].

The staple crop of the State is paddy with over 600 varieties grown here. Next to it is Tapioca which is cultivated in the drier regions and mostly in the mid-highlands.

Kerala produces a variety of cash crops. These include spices such as cardamom, cinnamon, clove, turmeric, nutmeg, and vanilla. The state produces 96percent of the national pepper output[32]. Other cash crops include tea, coffee cashew, pulses, areca nut, ginger, and coconut. Kerala exports 9.29percent of India's total exports of spices by the quantity and 23.1 percent of India's total exports of spices by value. The state produces 91percent of the national output of rubber[33]. Banana is another plantation crop that is grown extensively.

Coconut, its husk and shell, leaves and trunks; and other garden waste which is trimmed before monsoons mostly; also form bulk garden waste in Kerala. Collection Transportation and disposal arrangements for Solid Waste Management shall also consider this bulky waste as a part of the stream. Coconut shell, Coir, Rubber, other parts of coconut and areca nut trees (areca nut leaf spathes called 'pala'), Banana trunk and leaves, and much other broad foliage widely occurring in the State are usually thrown away as wastes though they were reused in the past. There are few attempts to utilize some of these as durable alternatives to plastics. This would contribute to realizing the 4R principle of Waste Management: Recover, Reduce, Reuse, Recycle.

2.6.3 Fisheries

Three percent of the state's economy is attributed to fisheries. Kerala exports 12.97 percent of India's total marine exports by quantity and 13.12percent of India's total marine exports by value with Frozen shrimp and frozen fish making up a majority of the market share[34]. In a recent study[35], researchers who surveyed six beaches in Kerala for debris found that not only is plastic the main culprit, but in beaches with a high intensity of fishing activities, most of the debris comes from the fishing industry. And seasonally, more plastic fishing debris was found after the monsoon season.

Waste from fish processing/seafood industries dotting the coast is mostly deposited in the sea. There should be strict regulations and mechanisms to treat and dispose-off such wastes in an eco-friendly

[30] *Economic Review 2018, Kerala State Planning Board*
[31] *Ibid*
[32] *ENVIS Centre: Kerala, State of Environment and Related Issues*
[33] *Ibid*
[34] *Economic Review 2018, Kerala State Planning Board*
[35] *Daniel etal 2017. Assessment of fishing-related plastic debris along the beaches in Kerala Coast, India. Elsevier*
Available at: https://www.sciencedirect.com/science/article/pii/S0025326X19308525
Accessed on: 04 March 2020

manner. Fish and meat Markets in the state generates well-segregated fish/meat waste which could be treated at the source itself; ie. preferably in biogas plants within the market premises; thus reducing transportation cost. There should be efforts to prevent waste deposition into the sea and to arrest, collect, and dispose-off marine debris along with dry waste; in coastal cities. SWM plan for coastal towns shall address this critical aspect.

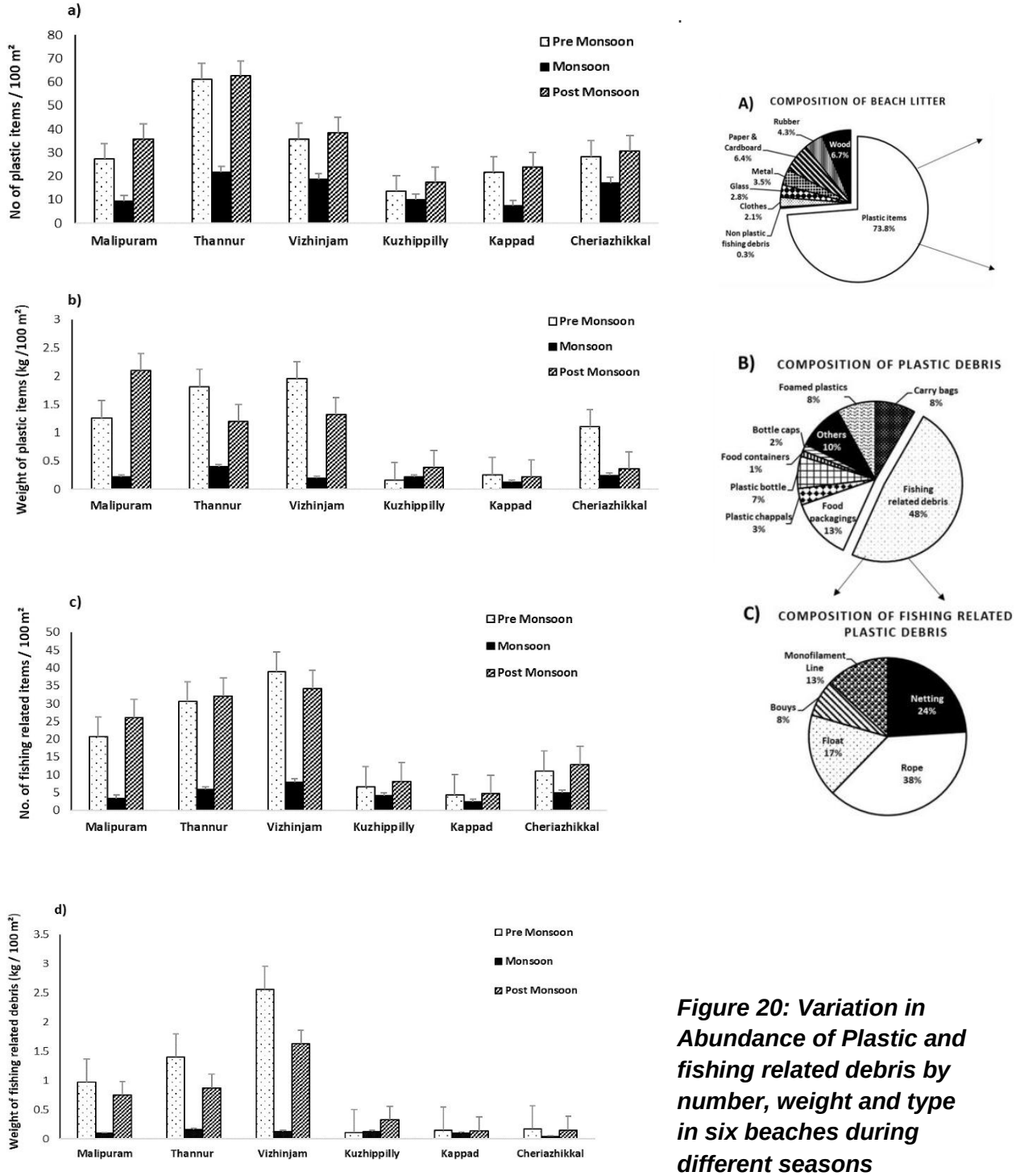


Figure 20: Variation in Abundance of Plastic and fishing related debris by number, weight and type in six beaches during different seasons

Source: Daniel *et al*. 2017. Op.cit

2.6.4 Tourism and recreation

Kerala has seen sustained growth in tourism. The share of Kerala in the country's tourism was 10.73percent as of 2017. There was a 7percent increase in international tourists from 2016 to 2017. The maximum inflow of tourists is in November and December. Only four (4) percent of international tourists visited Northern Kerala while 49percent of international tourists visited central Kerala (2017). In the case of domestic tourists, 23.75percent, 25.22percent, and 51.01percent visited southern, northern, and central Kerala respectively (2017). Kerala is well known for its beaches, backwaters in Alappuzha and Kollam, mountain ranges and wildlife sanctuaries. Other popular attractions in the state include the beaches at Kovalam, Varkala, Kollam and Kappad; backwater tourism and lake resorts around Ashtamudi Lake, Kollam; hill stations and resorts at Munnar, Wayanad, Nelliampathi, Vagamon and Ponmudi; and national parks and wildlife sanctuaries at Periyar, Parambikulam and Eravikulam National Park. The "backwaters" region—an extensive network of interlocking rivers, lakes, and canals that center on Ashtamudi Lake, Kollam, also see heavy tourist traffic. Heritage sites, such as the Padmanabhapuram Palace, Hill Palace, and Mattancherry Palace, are also visited. The city of Kochi ranks first in the total number of international and domestic tourists in Kerala. The surveys conducted under this assignment [36]revealed that during religious festivals and tourism seasons, waste quantity estimated could be 26 percent higher than during the normal days. Daily generation from temples with normal daily pilgrim visitation maybe around 2 Tonnes (such as Guruvayur). However, this may be much higher in the case of seasonal pilgrimages/events (such as Sabarimala) where very high concentration is observed across just one-two months.

SWM infrastructure and services shall consider contingency arrangements for higher than peak loads during festive / tourism seasons. For special wastes from Temples (flowers, segregated bio-waste) and festivals it may be possible to consider waste upcycling or treating near the source. Special considerations or arrangements might be necessary for the collection and transportation of the wastes during occasions and functions.

2.6.5 Industries

Kerala is mainly dominated by handloom, handicraft, bamboo, coir, khadi & village, cashew, tourism, etc. The key industrial sectors in Kerala include:

- Agriculture & Livestock - Kerala is mainly involved in the production of cash crops such as pepper, natural rubber, tea, cashew, spices, coffee, coconut. Plantations were made by individuals, private parties, and public enterprises clearing large tracts of land mainly in mid – highlands (Eg: Rubber, Cashew and Oil Palm Plantations of Plantation Corporation of Kerala, large tracts of private plantations in Kanjirapally, Pala, Wayanad, Kozhikode regions). All its agricultural production is sent across the country. It produces various types of spices including vanilla, cardamom, nutmeg, cinnamon. Kerala has a huge workforce for all these tasks. The state is also known for its huge varieties of rice.

[36] *PricewaterhouseCoopers Private Limited 2020.* ***City Level Sectoral Assessment (Activity II)****-City Level Assessment of service delivery, institutional, policy, financial and governance system for Solid Waste Management, Submitted to the World Bank, Unpublished.*

- Tourism - Tourism is one of the major industries in Kerala. The state has various tourist places that attract tourists from all across the world. Some of the most visited areas are Kovalam, Fort Kochi, Munnar, Ponmudi, Nelliampathi, Kozhikode, Alappuzha, Thrissur. The major tourist attractions are coastal areas, mountains, temples, wildlife sanctuary, etc.
- Oil Refining and Petrochemicals - The city is also having oil refining and petrochemical industry in the city of Kochi. It has one of the leading state-owned refinery in India with a huge production capacity. Its oil refinery is referred to as Kochi Refinery which was formerly named Cochin Refineries Ltd. Kochi Refinery is engaged in the refining and marketing of petroleum products.
- Ship Building - Ship Building is one of the major industries in Kerala. The state has the largest shipbuilding facility in India. Cochin Shipyard was started in the year 1972 as fully owned by the Government of India company. The yard is involved in building and repairing of the largest vessels in India. It is also building Shipyard for the Indian Navy. Recently Cochin Shipyard won a major repair order from Oil and Natural Gas Corporation of India.
- Energy - India's largest floating solar power plant set up on the Banasura Sagar reservoir in Wayanad, Kerala.
- Chemical Industry - Aluva is one of the leading industrial belts in Kerala. The industrial belt is the manufacturing of a wide range of chemical products including pesticides, rubber processing chemicals, zinc/ chromium compounds, rare-earth elements, and leather products.
- Handloom - Handloom is one of the leading sectors in Kerala. The industry is mainly concentrated in Thiruvananthapuram and Kannur districts. Each region of Kerala boats of a specific type of handloom industry: Balaramapuam in Thiruvananthapuram (South), Chedamangalm in Ernakulam (Central) and Kuthambulli in Palakkad (North).
- Handicrafts - Handicraft is one of the major industries in Kerala. It is also contributing to the generation of employment into that state. The handicrafts products include coconut shell carving, bamboo and reed weaving, bell metal casting, straw picture making, mat weaving, ivory carving, etc. Handicrafts Development Corporation and Artisans Development Corporation are the major promotional agencies of the industry.
- Bamboo Industry - Bamboo is mainly used in the State for the manufacture of pulp for making paper, bamboo ply, and in the traditional bamboo industry. The Kerala State Bamboo Corporation has created a new product Flattened Bamboo Board which is going to hit the market along with bamboo ply.

The state strategy shall utilize existing opportunities for alternate materials for plastic covers through using its regional handloom/machine loom clusters; linking it with micro-medium enterprises. Other alternate materials like Bamboo, plantation, and other broad leaves, areca leaves spathes, etc can be upscaled as effective alternatives to plastics.

Kerala has a centralized biomedical waste treatment facility for wastes from hospitals across the State in Palakkad. Most of the hospitals send their biomedical wastes (only) to this facility operated by Indian Medical Association – IMAGE. The State has a Hazardous Waste TSDF developed by Kerala Enviro Infrastructure Limited (KEIL) through Public-Private Partnership (PPP) in Ambalamughal which was a boon during the 2018 floods. Large industries send their hazardous wastes to TSDF. However, the wastes from small clinics, laboratories, multiple small scale industries, and

repair/servicing shops including boat repairs in fishery hubs; finds its way to municipal streams, dumping yards, or water bodies.

The state strategy needs to adapt a whole cycle approach leveraging on circular economy and Extended Producer Responsibility mandated by-laws for all dry waste streams and effective treatment/disposal and value-added options for products of biowaste and plastics/recyclables. This includes considerations for household hazardous and biomedical wastes as well; as these would otherwise find its way into the otherwise benign solid waste.

2.7 Institutional Baseline

Solid waste management (SWM) is the responsibility of the Urban Local Bodies (ULBs) as in the twelfth schedule (Article 243) of the Indian Constitution. The Kerala Municipality Act, 1994 (KMA1994), promulgated in line with the 74th Constitutional Amendment, provides the legal framework which enables the ULBs to function as the third tier of government.

The 'as-is' functional mapping of the institutions involved in various aspects of SWM service delivery is provided here:

Figure 21: Institutions involved in various aspects of SWM Service Delivery

2.7.1 Local Self Government Department (LSGD) and other State Departments

LSGD is responsible for the formulation of policies, oversight of various service delivery, and regulatory agencies associated with decentralized governance and monitoring the performance of local governments in respect of their regulatory and service delivery functions. The department ensures standardization of planning

processes, technical norms, and financial integrity through guidelines issued from time to time.

Functions Related to SWM

State Policy, Strategy, and Action Plan - SWM Rules 2016 requires the Secretary in charge of Urban Development (LSGD, in case of Kerala) to prepare a state policy and strategy. This was prepared in September 2018 and published as Government Order No.(P) 65/2018/LSGD dated 13th September 2018 (KSP2018). It also contained a Strategy containing some 20 action points. Subsequently, National Green Tribunal, vide order dated 22.12.2016 directed that State Governments 'shall prepare an action plan in terms of Rules of 2016 and the directions in this judgment, within four weeks from the date of pronouncement of the judgment'.

LSGD requires specialized staff on SWM to aid and advise the decision-makers. Specialization in relevant areas like sanitation, town planning, and urban development is expected to be located in line departments and agencies such as Suchitwa Mission, Clean Kerala Company Limited, or Town Planning and Development. Many of these agencies have been created to deliver a specific mandate and are temporary, working in a mission mode with limited contractual staff and not necessarily having the required technical skill sets.

Functions related to C&D Waste Management

The state has; in its policy on SWM 2016; directed the citizens to store separately the construction and demolition waste, as and when generated, within the premises and inform the local government for its disposal as per C&D Waste Management Rules 2016.

Today, Kerala has no C&D waste management facility. However, C&D waste rules suggest the following actions be undertaken at the State level.

- The Secretary in-charge of development in the State Government or Union territory administration shall prepare their policy document on the management of C&D waste following the provisions of these rules within one year from the date of final notification of the rules. This is the responsibility of LSGD.
- The concerned department in the State Government dealing with the land shall be responsible for providing suitable sites for setting up the storage, processing, and recycling facilities for construction and demolition waste.
- The Town and Country Planning Department shall incorporate the site in the approved land use plan so that there is no disturbance to the processing facility on a long term basis.
- Procurement of materials made from construction and demolition waste shall be made mandatory to a certain percentage (say 10-20percent) in municipal and Government contracts subject to strict quality control.

Functions related to Biomedical Waste Management

Implementation of BMW management in the State is overseen by a State Level Advisory Committee headed by the State Health Secretary which shall monitor its implementation every six months.

2.7.2 Urban Local Bodies

Functions related to Solid Waste Management

Standing Committee on Heath manages SWM programmes. The Standing Committee for Health of the Municipal Council deal with the matters of public health and health services, sanitation, control of dangerous and offensive trade.

The Standing Committee for Works of the Municipal Council shall with matters of public works, housing, town planning including regulation of building constructions, environment, electricity, water supply, drainage, and sewerage.

Steering Committee consisting of the Municipal Chairman and council approves and oversees all activities. Every municipality above 100000 population will have ward committees and ward sabhas which coordinate the preparation of projects / detailed works, budget in its ward. The councillor who represents the ward shall be the convener of that ward sabha. The ward sabha shall meet at least once in three months at a specified place and every meeting of the ward sabha shall be presided over by the chairperson or in his absence, deputy chairperson, or any standing committee chairman authorized by the chairperson or in their absence by the convenor. The convenor of the ward sabha shall convene an extraordinary meeting of the ward sabha within fifteen days when a request is made in writing by not less than ten percent of the electors in the ward for discussing the matters raised in the request, provided that such special meeting shall be convened only once during the period between two ordinary meetings.

For every Municipality, there shall be a Secretary appointed by the Government, in consultation with that Municipality, who shall be an officer of the Government borne on such cadre, as may be prescribed, and shall be the Executive Officer of the Municipality and the other officers and employees of the Municipality shall be subordinate to him.

Engineering section (mostly comprising of Executive Engineer and two or three Assistant Executive Engineers and Assistant Engineers, and supervisors) works on plan preparation and approvals for all projects (mostly small projects), while Health section looks at a street sweeping and though ULBs in Kerala are mandated to provide SWM services, but lacks adequate capacity to handle the complete collection and transport of waste as per the national SWM rules.

Ward committee or ward sabha as the case may be shall prepare every year in such form, as may be prescribed, a development plan for the ward along with an estimate of the expenditure, therefore, for the next year and after finalizing it in a meeting held three months before a financial year, submit the same to the Municipality concerned. Every municipality shall prepare every year a development plan for the succeeding year considering the development plans submitted by the ward committees or ward sabhas of the municipality in the prescribed manner for that municipal area and submit the same to the District Planning Committee before such date as prescribed. For this section "development plan" means a development plan for economic development, social justice, Improvement of living conditions, creation of employment opportunities and increase of production capacity concerning matters enumerated in

the Twelfth Schedule to the Constitution including the matters to which the administrative power vests in the Municipality under the provisions of this Act or any other law. Every Municipality shall prepare a master plan for its development in the 276 prescribed manner with a focus on scientific spatial planning taking into account its resources and as per the fiscal investment and submit the same to the District Planning Committee. The municipality shall have the power to prepare and implement detailed town planning schemes as per the laws relating to Town Planning for the time being in force subject to the master plan approved by the Government.

The Government has the power to act in case of default by the Municipality. The Government may, with the consent of a municipality, undertake on its behalf the construction of water supply, drainage or any other work, appoint any officer or person to carry out the construction of such works and direct that the expenses including the pay and allowances of such officers be paid from the municipal fund in priority to any charges except charges for the service of authorized loans.

SWM in Kerala is regulated by the Municipal Act (1994), the Operational Guidelines and Policy issued by GoK in 2017 and 2018 respectively, and by the SWM Rules issued by MoEF/GOI in 2016. ULBs functions well in the most democratic manner through their Chairman, Council, Secretary – Executive Officer, Standing Committees, officials in various sections, workers including contingent workers, ward sabhas and committees where public participates effectively. Though democratic decentralization transferred power to ULBs; they lack suitable manpower and technical skills to rise to the needs of the day in terms of planning and preparing for disasters and environmental management to provide integrated environmental management services or undertake long term planning. Though Engineering and Health sections function effectively within their respective functional areas and budgets, they are not aided to decide and implement the best approaches.

Functions related to Biomedical Waste Management

Though ULBs had no role in biomedical waste management in their respective area as per BMW Management Rules, 2016; during COVID 19, GoK issued various guidelines to ULBs for managing waste-related due to home quarantine and sanitation and hygiene of public places; thus making them a very important institution in biomedical waste management in the local area.

Functions related to Construction and Demolition Waste Management

Today, local bodies have no facilities or plan to manage C&D Wastes. The recent demolition of the apartment complexes which violated the CRZ Rules generated a huge amount of C&D wastes. Large private agencies or recycling contractors were engaged to manage and recycle the wastes generated. The state is in dire need of a C&D waste strategy and plans for the management of C&D wastes; preferably at the cluster level.

As per C&D Waste Management Rules, 2016; each local body has to:

- issue detailed directions about proper management of construction and demolition waste within its jurisdiction following the provisions of these rules and the local authority shall seek detailed plan or undertaking as applicable, from the generator of construction and demolition waste;

- chalk out stages, methodology and equipment, the material involved in the overall activity and final clean up after completion of the construction and demolition ;
- seek assistance from concerned authorities for safe disposal of construction and demolition waste contaminated with industrial hazardous or toxic material or nuclear waste if any;
- shall make arrangements and place appropriate containers for the collection of waste and shall remove at regular intervals or when they are filled, either through own resources or by appointing private operators;
- shall get the collected waste transported to appropriate sites for processing and disposal either through own resources or by appointing private operators;
- shall give appropriate incentives to the generator for salvaging, processing and or recycling preferably in-situ;
- shall examine and sanction the waste management plan of the generators within one month or from the date of approval of building plan, whichever is earlier from the date of its submission;
- shall keep track of the generation of construction and demolition waste within its jurisdiction and establish a database and update once in a year;
- shall device appropriate measures in consultation with expert institutions for the management of construction and demolition waste generated including processing facility and for using the recycled products in the best possible manner;
- shall create a sustained system of information, education and communication for construction and demolition waste through collaboration with expert institutions and civil societies and also disseminate through their website;
- shall make provision for giving incentives for use of material made out of construction and demolition waste in the construction activity including in non-structural concrete, paving blocks, lower layers of road pavements, colony, and rural roads.
- As per C&D Waste rules 2016, each generator shall store C&D wastes when generated within own premises and inform local authority for its disposal. District Collector shall facilitate available land for setting up treatment and disposal facilities. Local bodies shall transport C&D wastes for treatment, disposal, and recycling. KSPCB shall enforce the provision of C&D Waste Rules, 2016, and provide monitor, and review authorization provided for treatment and disposal facilities and guide the local body on the safe handling of wastes. C&D Waste Rules, 2016 applies to everyone who generates C & D waste. Generators shall segregate C&D waste and deposit it at the collection center or hand over to the authorized processing facility.
- Bulk generators of C&D waste (20 tons or more per day or 300 tons per project in a month) shall get prior approval from ULB for their waste management plan. The Secretary UDD in the State Government shall prepare a policy for management of C&D waste within one year of the notification of these rules. SPCB shall grant authorization to the operator of the processing/re-cycling facility on terms and conditions under the rules and monitor the implementation of the rules.

2.7.3 District Planning Committee

Kerala Legislature envisaged the provision for District Planning Committee (DPC) within the Municipalities Act according to the constitutional framework. DPC has jurisdiction over both panchayat raj and nagarapalika institutions.

The Government has constituted in every district, a DPC at the district level to consolidate the plans prepared by the panchayats and the municipalities in a district and to prepare a draft development plan for the district as a whole.

The committee consists of fifteen members of whom;

- twelve members are elected, in such manner as may be prescribed, by and from amongst the elected members of the panchayats at the district level and of the municipalities in the district in proportion to the ratio between the population of the rural areas and the urban areas in the district;
- the president of the district panchayat in that district;
- one is a person having considerable experience in administration and planning, nominated by the Government;
- the district collector concerned an ex-officio member in DPC.

The members are elected under the guidelines, supervision, and control of the State Election Commission; while the president of the district panchayat mentioned is the chairman of the committee; and the district collector is the secretary of the committee. The district-level officers of the departments of the Government in the district shall be the joint secretaries of the committee.

The members of the House of the People (Lok Sabha) and the members of the legislative assembly of the State, representing any area comprised in a district shall be permanent invitees of the DPC of that district, provided that where the area which a Member of the House of the People (Lok Sabha) or a member of the Legislative Assembly of the State represents, comprises partly in one district and partly in another district, he shall be a permanent invitee to the DPC of both the districts in which the area he represents is comprised. A member of the Council of States (Rajya Sabha) representing the State shall be a permanent invitee to the DPC of the district in which he is registered as an elector in the electoral roll of any municipality or panchayat. A member nominated to the Legislative Assembly of the State shall be a permanent invitee to the DPC of the district in which he ordinarily resides. Where a member of parliament or a member of the legislative assembly of the State is appointed as Minister or elected as a speaker or deputy speaker or appointed as the Government Chief Whip or recognized as Leader of the Opposition, he may nominate a person from the area he represents as Member to represent him in the DPC/s of the district/s to which he was a permanent invitee.

The committee consolidates the plans prepared by the panchayats and the municipalities in the district and prepare a draft development plan for the district as a whole and perform such other functions relating to district planning, as may be assigned to it by the Government, from time to time, by notification in the gazette. The committee shall, in preparing the draft development plan.

- have regard to,

- matters of common interest between the panchayats and the municipalities including spatial planning, sharing of water and other physical and natural resources, the integrated development of the infrastructure and environmental conservation; and
- the extent and the type of available resources, whether financial or otherwise;
- consult such institutions and organizations as the Governor may, by order specify.

The chairman shall forward the development plan, as recommended by the committee, to the Government for approval. The Government shall while preparing the state plan to consider the proposal and priorities included in the draft development plans prepared for each district by the DPC. The DPC monitors the quantitative and qualitative progress, especially its physical and financial achievements, in the implementation of the approved district planning schemes and State plans relating to the district and it shall evaluate the action programs already completed.

DPC is a powerful committee with representation of who is who in each area which can plan and decide on the development of respective areas.

2.7.4 Suchitwa Mission

Suchitwa Mission (SM) key function is to serve as the Technical Support Group in the waste management sector under the LSG Department (LSGD). The vision of Suchitwa Mission is 'waste-free Kerala with the unpolluted environment, public hygiene, and cleanliness with a better quality of life leading to improved health and general well-being, economic gains, better aesthetic surroundings, and overall environmental improvement.

The Mission is expected to:

- Function as the technical support group for LSGIs in the waste management sector;
- Assist in achieving total sanitation coverage by LSGIs;
- Providing policy, strategy, planning, implementation and monitoring support for Solid and Liquid Waste Management;
- Organizing IEC campaigns and Capacity Building activities in Sanitation and Waste Management sector;
- Promotion of Green Protocol, compliance by individuals, institutions, and various tiers of Government.

Role in SWM:

The Mission is the nodal agency for implementing Swachh Bharat Missions (SBM - both urban and rural) which is a centrally sponsored sanitation scheme with 60 percent funding from the Government of India. Its objectives are - elimination of open defecation; eradication of manual scavenging; modern and scientific SWM; change of behavior for healthy sanitation practices; creation of an environment for private sector participation and capacity building.

2.7.5 Haritha Keralam Mission

Haritha Keralam Mission - HKM (*meaning* Green Kerala Mission) is an umbrella mission combining three submissions of sanitation and waste management; water

resources rejuvenation and conservation; and sustainable agriculture. The global objective of this umbrella mission is to regain Kerala's past glory and pride in its clean environment, ample water resources, and abundant farm supplies which were organic by default. Some of the goals set by HKM are:

- To sensitize the citizens about their duties and responsibilities under the SWM Rules 2016;
- Create a new sanitation culture in society by encouraging people to adopt responsible waste management methods;
- Make available to the local bodies, solutions for complex waste management problems;
- To ensure the sustainability of scientific waste management practices under the leadership of local governments;
- Encourage decentralized waste management at source; where it is not possible, to make available community-level facilities under the leadership of neighborhood groups and local bodies.
- Explore the recycling of Non-Biodegradable Wastes;
- Encourage decentralized liquid waste management where feasible; and
- In large cities like Thiruvananthapuram, Kochi and Kozhikode implement modern centralized waste management arrangements, alongside source processing.

For the sustenance of the SWM, ULB formulated Haritha Karma Sena (HKS); the Green Task Force which can either be drawn from the existing Kudumbashree units or any other self- help groups or any NGO/local entrepreneur. The selected group will be imparted training by Haritha Sahaya Sthapanam (HSS); the Green Facilitators who are selected for their technical competence. Apart from building the capacity of HKS, HSS is also expected to provide technical assistance in SWM to the ULBs for which they will maintain technical experts, trained technicians, and coordinators. HKM has the responsibility for

- Selection and deployment of HSS;
- Empanelment of agencies for waste management and organic vegetable farming;
- Evaluate the SWM activities based on reports received from the districts;
- Empanelment of service providers who will supply raw materials required for SWM;
- Assist ULBs in concluding contracts with Clean Kerala Company (CKC) for taking over the non-biodegradable waste from MCFs run by ULBs;
- Assisting ULBs in finding suitable locations for setting up RRFs in association with CKC.

2.7.6 Clean Kerala Company Limited (CKCL)

CKCL is mandated to address issues connected with the management of NBDW– more specifically plastic waste only. It has a leadership role in establishing Material Collection Facility (MCF) in Municipal wards/panchayats and Resource Recovery Facility (RRF) in Block Panchayats and Municipalities/Corporations. It helps by providing part finance and standardizing the equipment suppliers, rates, etc. so that local bodies can setup RRF by arranging shredding machines, baling machines, and dust removers; CKCL also organizes to train the workers who operate the machines;

ensures the maintenance of the machines and assists in marketing the products of RRF. CKS also has a mandate for E-Waste Collection and Management.

2.7.7 State Disaster Management Authority

Kerala Disaster Management Authority (KSDMA) was established in May 2007 under the Disaster Management Act, 2005 which was enacted immediately after the Indian Ocean Tsunami of December 2004. After the 2018 floods, it is recognized that disaster has to be mainstreamed and sectors cannot work in silos and are closely interdependent.

The August 2018 floods demonstrated that SWM has impacted in the following manner:

- Large scale littering of non-biodegradable waste has led to clogging of drains, canals, and rivers thereby contributing to the sudden flooding of areas which had not known floods even during earlier extreme climate events;
- Post floods, the 'disaster waste' in the form of mattresses, furniture, clothes, and carcasses lead to public health problems unless addressed urgently and scientifically.

KSDMA functions as the apex body to facilitate, coordinate, review, and monitor all disaster-related activities in the state, including capacity building. In the Orange Book of Disaster Management [37] (Standard Operations Procedures and Emergency Support Functions Plan) of the GoK, KSDMA recognizes SWM as an important service to be arranged during disasters and mandates Urban Affairs Department, Rural Development Department and Local Self Governments with the primary responsibility to arrange waste management while secondary responsibility is allotted to Public Works Department, Public Health, Kerala Water Authority, Non-Governmental Organizations, and Industries and companies. However, there are no comprehensive guidelines on Disaster Waste Management (DWM) with contingency plans and preparedness, emergency protocols, and action plan for disasters or any periodic review of the arrangements for DWM.

District Disaster Management Authorities have been established to function as the district planning, coordinating and implementing body for disaster management. DDMA is headed by the District Collector. Not much progress has, however, been made in preparing City Disaster Management Plans. It was explained that the reconciliation between territorial boundaries (villages in the Revenue Department and wards in ULBs) is holding up the preparation.

2.7.8 Kerala State Pollution Control Board (KSPCB)

KSPCB currently monitors the compliance levels to environmental safety at various levels. KSPCB is the centrally authorized regulator responsible for monitoring under the SWMR2016. Monitoring Solid Waste Management - Section 16 of the Solid Waste Management Rules, 2016 lays down the scope and responsibility for monitoring by KSPCB. Key responsibilities include:

[37] https://sdma.kerala.gov.in/wp-content/uploads/2019/08/Orange-Book-of-Disaster-Management-1-2019.pdf

- Enforcement of these rules in the State through local bodies and review implementation at least twice a year in coordination with DUA/ LSGD;
- Monitor environmental standards and adherence to conditions specified in the rules;
- Issue authorization to a local body or an operator of a facility within 60 days, stipulating compliance criteria and environmental standards;
- Suspend for sufficient reason/renew the authorization for the next five years;
- Monitor the compliance of standards prescribed for treatment technology;
- Give directions to local bodies on safe handling and disposal of domestic hazardous waste;
- Regulate the inter-state movement of waste.
- In the case of new technologies, where no standards have been prescribed by CPCB or SPCB, KSPCB must approach CPCB for getting standards specified.

The stakeholder consultations indicated that the existing capacity both in terms of the manpower and the infrastructure needs to be enhanced for undertaking these activities.

Monitoring related activities performed

The broad areas of work where monitoring function is covered is presented below.

a. Database creation including:
- ENVICLEAN Mobile app to generate information on SWM (http://ksrec.in/enviclean/);
- Empanelment of recyclers of plastic bags / multi-layered sheets / plastic sheets – consent provided to 214 agencies across Kerala until Aug 2019;
- Maintaining databases of manufacturers/sellers of compostable carry bags/products as alternatives to existing products during plastic bans

b. Planning and design
- Inputs to various projects in terms of technologies and processes adopted, site selection for projects;
- Preparation of inventory of SWM systems;

c. Implementation of guidelines including:
- Guidelines for Disposal of Thermoset Plastic Waste including Sheet molding compound (SMC)/Fiber Reinforced Plastic (FRP) (As per Rule 5(c) of Plastic Waste Management Rules, 2016 dated 18 March 2016);
- Working with the tourism industry towards a reduction in consumption of PET bottles and commitment of Green Protocol in their operations; and
- Ban on supply, storage, transport, sale /distribution and use of plastic related items and thermocol type products in tourist destinations and religious centers (PCB/HO/EE4IPLASTIC RULES'20 I6/20I.8 dt. 11.10.2018); and
- Inputs to cement industries on modification of technologies.

d. Approvals
- Online Consent Management Systems (https://krocmms.nic.in/KSPCB/)
- Online Continuous Real-Time Monitoring Data (https://keralapcb.glensserver.com/public/)

e. Review of periodic reports from different treatment and processing units (as required by various Acts/ consents issued)

f. Ensuring Compliance

- Response to NGT orders related to Kerala (as a result the above-mentioned item
- Databases collected on specific themes, submitted along with Annual reports & periodic status reports;
- Monitoring ULB's compliance to CPCB Rules (Continuance of 2 bin rule for BDW in green bins, NBDW in blue bins and domestic hazardous wastes in separate bags as per Apex Monitoring Committee on SWM Rules Compliance)

Biomedical Wastes

As per BMW Management Rules, 2016 KSPCB shall implement these rules., including monitoring of compliance of various provisions and conditions of the authorization. District Level Monitoring Committees under District Collector shall monitor and submit half-yearly reports on compliance to the State Level Advisory Committee headed by the State Health Secretary which shall monitor implementation every six months.

2.7.9 Department of Environment, Forests and Climate Change

Environment Department is the nodal department for planning, promotion, co-ordination, and overseeing the implementation of Central and State environmental protection and conservation policies and programs. The Directorate also serves as the nodal agency in formulating climate change-related schemes, plans, programs, and their execution.

The main functions of Directorate are:

- Take up State level environment development programs and implement them in collaboration with appropriate agencies;
- Coordinate the programs for the revision and implementation of the State Action Plan on Climate Change (SAPCC), set up Climate Change Cell at various sectors;
- Exercise administrative control of all environmentally related authorities/institutes being established in State;
- Conduct environmental appraisal at the planning level related to the development schemes of the State Government;
- Coordinate the environmental awareness and incentive programs in education institutes and society to evoke the responsibility of individuals to respect, protect, and preserve the environment.
- Encourage environmental research and development to broaden the knowledge and to develop new sustainable novel technologies.

Department of Environment is also responsible for promulgating the EPR framework as well as is empowered to issue directions to implement the Plastic waste management rules, 2016. Consequently, the department of environment has issued government order banning the use of single-use plastic in the state of Kerala and for E-waste management in the State; among others.

Thus, ULBs have the mandate to provide SWM services, as per the 74th Constitutional Amendment. Currently, ULBs manage SWM activities – mainly collection of waste from limited households/institutions, management of dumping yard by spraying odor suppressants and bleaching

powder; dumpsite fire management or minimal improvements on a war footing when voiced by the host communities. Most essential environmental infrastructure – including planned SWM system, Sewerage system, and Storm Water Drainage are absent in ULBs.

Numerous state-level agencies have been created to support ULBs in SWM – upon realization of the importance of this sector in the current context - including Haritha Karma Sena (HKS) for primary collection of NBDW, Suchitwa Mission (SM) for monitoring and capacity building, and the Clean Kerala Company (CKC) for the storage and treatment of NBDW, namely recyclable materials. KSPCB is the regulator that stands between the SWM Rules 2016 on the side and Kerala's approach to decentralized Waste Management mooted by its SWM Policy. To get the best results, activities of these various institutions need to be better aligned and co-ordinated and support providing full value-chain services in the sector rather than fragmented services. There is a need for better planning, service delivery, and monitoring at both state and city levels.

Currently, there is overlap and duplication of functions of different agencies. The same set of agencies are involved in service delivery and monitoring. ULB is mandated with the responsibility for all functional aspects but lacks sufficient staff strength and guidance to provide all services. Scope for private participation is limited and focus is not on integrated services. Capacities of key players in SWM need enhancement to take up the challenges of ever-increasing waste generation, increasing densities, and increasing pollution due to the dumping of wastes. Also, there is no Disaster Waste Management Plan or plan for the strategic strengthening of SWM during disasters or special situations.

Classic examples being the lack of preparedness and infrastructure to deal with COVID 2019 wastes[38] generated and 2018 and 2019 flood waste which was sent to the KEIL's TSDF though not hazardous.

[38] https://timesofindia.indiatimes.com/city/kochi/masks-gloves-kochi-corporations-waste-problem-just-got-messier/articleshow/74642711.cms

http://www.uniindia.com/covid-19-waste-collectors-keep-kochi-clean/south/news/1942663.html

CHAPTER 3. REGULATORY FRAMEWORK

Applicable National and State regulations and the World Bank Operational Policies need to be considered for effective management of Environmental aspects; including siting criteria, environmental pollution control requirements, need for institutional mechanisms, occupational health and safety requirements, resource utilization, and considerations for cultural and social aspects. This is an important part of the ESMF. The ESMF is "… an instrument that examines the risks and impacts when a project consists of a program and/or series of sub-projects, and the risks and impacts cannot be determined until the program or sub-project details have been identified. It sets out the principles, rules, guidelines, and procedures to assess environmental risks and impacts. It contains measures and plans to reduce, mitigate and/or offset adverse risks and impacts, provisions for estimating and budgeting the costs of such measures, and information on the agency or agencies responsible for addressing project risks and impacts, including on its capacity to manage environmental risks and impacts". A compilation of the key environmental regulations and guidelines applicable to various aspects under consideration in this project are presented here.

3.1 Environmental Laws / Regulations Applicable for KSWMP

There are several national/state-level regulations and policies potentially applicable to KSWMP subprojects exist. Following section details out regulatory framework applicable to KSWMP.

3.1.1 National Regulations

The need for protection and conservation of the environment and sustainable use of natural resources is reflected in the constitutional framework of India and also in the international commitments of India. The Constitution under Part IVA (Art 51A-Fundamental Duties) casts a duty on every citizen of India to protect and improve the natural environment including forests, lakes, rivers, and wildlife, and to have compassion for living creatures. Further, the Constitution of India under Part IV (Art 48A-Directive Principles of State Policies) stipulates that the State shall endeavor to protect and improve the environment and to safeguard the forests and wildlife of the country.

After the Stockholm Conference, the National Council for Environmental Policy and Planning was set up in 1972 within the Department of Science and Technology to establish a regulatory body to look after the environment-related issues. This Council later evolved into a full-fledged Ministry of Environment and Forests (MoEF), recently renamed as Ministry of Environment, Forests and Climate Change (MoEFCC).

MoEF was established in 1985, which today is the apex administrative body in the country for regulating and ensuring environmental protection and lays down the legal and regulatory framework for the same. Since the 1970s, several environmental legislations have been put in place. Today, MoEFCC and the Central and State Pollution Control Boards (CPCB and SPCBs) together form the regulatory and administrative core of the sector.

Some of the important legislations at National Level for environment protection are as follows:

- The Water (Prevention and Control of Pollution) Act, 1974 and Water Cess Act, 1977
- The Air (Prevention and Control of Pollution) Act, 1981
- The Noise Pollution (Regulation and Control) Rules, 2000
- Environment Protection (EP) Act, 1986
- National Green Tribunal Act, 2010
- Waste Management Rules under EP Act including;
    - Solid Waste Management Rules, 2016
    - Construction and Demolition Waste Management Rules, 2016.
    - Hazardous Waste (Management, Handling & Transboundary Movement) Rules, 2016
    - E-Waste (Management) Rules, 2016
    - Bio-medical Waste Management Rules, 2016
    - Plastic Waste Management (Amendment) Rules, 2018
    - Batteries (Management and Handling) Amendment Rules, 2010

These important environmental legislations have been briefly explained in the succeeding ***Table 8***, with a description of its relevance in this project, availability of technical guidelines for its implementation, institutional responsibility, and gaps when compared to Bank Polices.

Table 8: Applicable Environmental Regulations at National Level

Act /Rule / Guidelines	Relevance	Implementing / Responsible Agency
Regulations/Policies related to Environmental Conservation & Management		
National Environment Policy, 2006	The National Environment Policy by the MoEFCC aims at mainstreaming environmental concerns into all developmental activities. It emphasizes the conservation of resources and points out that the best way to aid conservation is to ensure that people dependent on resources obtain better livelihoods from conservation than from degradation of the resources. It argues that environmental degradation often leads to poverty and poor health outcomes among populations. The objectives of the National Environmental Policy are- • Conservation of Critical Environmental Resources • Intra-generational Equity: Livelihood Security for the Poor • Inter-generational Equity: ensure judicious use of environmental resources • Integration of Environmental Concerns in Economic and Social Development • Efficiency in Environmental Resource Use • Environmental Governance • Enhancement of Resources for Environmental Conservation	MoEFCC
The Environment Protection (Act) 1986 and The Environmental Protection Rules	The Environment (Protection) Act was enacted in 1986 to provide for the protection and improvement of the environment. It empowers the Central Government to establish authorities [under section 3(3)] charged with the mandate of preventing environmental pollution in all its forms and to tackle specific environmental problems that are peculiar to different parts of the country. The Act was last amended in 1991. This act was passed as an overall comprehensive act "for protection and improvement of environment". Under this act, rules have been specified for the discharge/emission of effluents and different standards for environmental quality. These include Ambient Noise Standard, Emission from Motor Vehicles, Mass Emission Standard for Petrol Driven Vehicles, General Effluent Standards, etc.in the exercise of the powers conferred under the Act, the following rules are devised • Environment Protection Rules 1986 • Solid Waste Management Rule 2016 • Plastic Waste Management Rules 2016 • E-Waste Management Rules 2016 • Batteries (Management and Handling) Rules 2001 • Construction and Demolition Waste Management Rules 2016 • Hazardous Waste (Management, Handling & Transboundary Movement) Rules 2016 • Biomedical Waste Management Rules 2016	MoEFCC, State Department of Environment & Forest CBCB, SPCB

Act /Rule / Guidelines	Relevance	Implementing / Responsible Agency
	• Noise Pollution (Regulation and Control) Rules 2000 This umbrella Act brings in capacities at the Central and State levels to monitor and regulate environmental performance. It also laid the foundation for sector/sub-sector-specific Rules and guidelines applicable to all States	
The Coastal Regulation Zone Notification, 2011, 2019	*As per the Act Central Government, to conserve and protect the unique environment of coastal stretches and marine areas, besides livelihood security to the fisher communities and other local communities in the coastal areas and to promote sustainable development based on scientific principles taking into account the dangers of natural hazards, sea-level rise due to global warming, declares the coastal stretches of the country and the water area up to its territorial water limit, as Coastal Regulation Zone (CRZ). The new notification came into force in 2019.* *To conserve and protect the coastal areas and marine waters, the CRZ area (as per 2019 notification) has been classified as CRZ I (further classified as IA & IB), CRZ II, CRZ III (further classified as IIIA & IIIB & CRZ IV (further classified as IVA & IVB) based on ecological sensitivity and zonation.* *Section 4 and 5 of the Act clarify prohibited activities and Regulation of permissible activities within the CRZ limit.* *Section 6 of the Act defines the procedure of securing CRZ clearance for permissible and regulated activities.* *Section 4 of the notification prohibits dumping of city or town wastes including construction debris, industrial solid wastes, fly ash for landfilling.* *As per the Notification, prior CRZ clearance will be applicable in case any facilities are proposed within designated CRZ.* *Section 7 of the notification defines the role of authorized concerned bodies for granting of CRZ Clearance.* *The following are prohibited activities in the CRZ areas.* • *Discharge of untreated waste and effluents from industries, cities or towns and other human settlements* • *Dumping of city or town wastes including construction debris, industrial solid wastes, fly ash for landfilling.* • *To safeguard the aquatic system and marine life, disposal of plastic into the coastal waters shall be prohibited and adequate measures for management and disposal of plastic materials shall be undertaken in the CRZ* *As per the CRZ 2019 Notification, 'Projects or activities which attract the provisions of this notification and the provisions of EIA notification, 2006, (including Common SWM projects) shall be dealt with for a composite*	MoEFCC/ KCZMA

Act /Rule / Guidelines	Relevance	Implementing / Responsible Agency
	Environmental and CRZ clearance under EIA Notification, 2006 by the concerned approving Authority, based on recommendations of the concerned Coastal Zone Management Authority. In the case of Category A projects, it would be the MoEFCC and in the case of Category B projects, it would be the State Environmental Impact Assessment Authority (SEIAA). *Any proposed development (including any SWM facilities or support activities) near Eco-sensitive CRZ I areas of India's CRZ Notification 2019 shall need CRZ I clearance at the National level. Construction of roads and roads on stilts, by way of reclamation in CRZ-I areas, shall be permitted only in exceptional cases for defense, strategic purposes and public utilities, subject to a detailed marine or terrestrial or both environmental impact assessment, to be recommended by the Coastal Zone Management Authority and approved by the Ministry of Environment, Forest and Climate Change and subject to safeguards.* *(As per SWM Rules, the Landfill site shall not be permitted within the flood plains as recorded for the last 100 years, the zone of coastal regulation, wetland, Critical habitat areas, sensitive eco-fragile areas)* *Till such time CRZ maps of States are not updated, 500 m from HTL will remain as CRZ Zone.* *CRZ 2011 notification, prohibits setting up or expansion of units or mechanisms for disposal of wastes in the High Tideline to 500m on the landward side along the seafront. Dumping of town wastes, including C&D wastes, industrial wastes, and fly ash to landfill shall be regulated and authority shall implement schemes for phasing out any existing practices.*	
Environmental Impact Assessment Notification, 2006	EIA notification 2006 and its subsequent amendments list out the type of project that requires Environmental Impact Assessment and Environmental Clearance from MoEFCC or State Environment Impact Assessment Authority before the commencement of any developmental work or project expansion. The notification gives stage-wise guidance for the processing of Environmental Clearance. The objective of the notification is to formulate a transparent, decentralized, and efficient regulatory mechanism to: • Incorporate necessary environmental safeguards at the planning stage • Involve stakeholders through the public hearing process • Identify developmental projects based on impact potential • Securing provision for mitigation efforts Some facilities/activities in the waste management sector that falls under the purview of EIA Notification and	SEIAA/MoEFCC

<table>
<tr><th>Act /Rule / Guidelines</th><th>Relevance</th><th>Implementing / Responsible Agency</th></tr>
<tr><td></td><td>relevant to Waste Management are listed below.
<table>
<tr><th>Sl. No.</th><th>Sectors as per EIA Notification</th><th>Remarks</th><th>Categorization</th></tr>
<tr><td>1</td><td>Common Municipal Solid Waste Management Facility (CMSWMF)</td><td>All Projects

As per the clarification given by MoEFCC vide letter dated 3rd July’2017 (DO No. 22-19/2017-IA-III) that, if the activities of incineration, RDF making and waste to energy plant are proposed along with the new site of solid waste disposal/landfill, it is advisable to obtain an integrated prior environmental clearance for these projects</td><td>Category B
General Condition Applies (check * below)</td></tr>
<tr><td>2</td><td>Thermal Power plant</td><td>Plants using municipal solid non-hazardous waste as fuel</td><td>Cat B: <20 MW
Cat A: > 20 MW
General Condition Applies (check * below)</td></tr>
<tr><td>3</td><td>Mining of Minor Minerals
(in case of material is required for construction /site preparation activity, landfill cover)</td><td>Environmental Clearance required for excavation of minor minerals like earth, sand, etc.</td><td>It can be Category A or B depending on Area, an intermediate distance of mining areas, and applicability of General Conditions of EIA notification.</td></tr>
<tr><td>4</td><td>Bio-Medical Waste Treatment Facilities</td><td>All Projects
MoEFCC notified amendment to the EIA Notification 2006 and published vide Notification of S.O. 1142 (E) dated April 17, 2015. According to this notification, the ‘bio-medical waste treatment facility’ is categorized under Item 7 (da) in the schedule, requiring ‘environmental clearance’. The CBMWTF operator is</td><td>Category B</td></tr>
</table></td><td></td></tr>
</table>

Act /Rule / Guidelines	Relevance	Implementing / Responsible Agency
	also required to obtain 'Environmental Clearance (EC)' for a. All new projects or activities on the bio-medical waste treatment facility; and b. Expansion and modernization with an additional treatment capacity of existing bio-medical waste treatment facility (excluding augmentation of incineration facility for compliance to the residence time as well as Dioxins and Furans without enhancing the existing treatment capacity). Any expansion or modification in the treatment capacity or relocation of the existing CBMWTF * ***General Conditions (Amended to 5 km in 2014):*** Any project or activity specified in Category 'B' will be treated as Category A, is located in whole or in part within 5 km from the boundary of (i) Protected Areas notified under the Wild Life (Protection) Act, 1972, (ii) Critically Polluted areas as identified by the Central Pollution Control Board from time to time, (iii) Eco-sensitive areas as notified under section 3 of the Environment (Protection) Act, 1986, such as Mahabaleshwar Panchgani, Matheran, Pachmarhi, Dahanu, Doon Valley, and (iv) inter-State boundaries and international boundaries: Provided that the requirement regarding the distance of 10 km of the inter-State boundaries can be reduced or completely done away with by an agreement between the respective States or U.Ts sharing the common boundary in case the activity does not fall within 5 km or 10 km of the areas mentioned at item (i), (ii) and (iii) above *MoEFCC has prepared Technical EIA Guidance Manual for Common Municipal SWM Facilities including technical details, siting guidelines, directions, and schedule for preparation and approval of SWM EIA to guide on clearing EIAs for such projects.*	
The Water (Prevention and Control of Pollution) Act, 1974 and The Water Cess Act 1977	The Act is enacted to prevent pollution of water sources through the industrial or any other construction activity and for maintaining or restoring of wholesomeness of water. The Act prohibits the discharge of pollutants into water bodies beyond a given standard and lays down penalties for non-compliance with its provisions. The act resulted in the establishment of the Central and State Level Pollution Control Boards whose responsibilities include managing water quality and effluent standards, as well as monitoring water quality, prosecuting offenders	*CPCB, SPCB*

<table>
<tr><th>Act /Rule / Guidelines</th><th>Relevance</th><th>Implementing / Responsible Agency</th></tr>
<tr><td></td><td>and issuing licenses for construction and operation of any facility. This will include the generation of liquid effluent during construction /civil engineering activities or from domestic activities in workers colony. Water (Prevention and Control of Pollution) Cess Act was enacted in 1977, to provide for the levy and collection of a cess on water consumed by persons operating and carrying on certain types of industrial activities. This cess is collected to augment the resources of the Central Board and the State Boards for the prevention and control of water pollution constituted under the Water (Prevention and Control of Pollution) Act, 1974. The Act was last amended in 2003.

Prior CTE and CTO may be applicable to establish Waste Treatment and Disposal Facilities which are usually classified; waste recycling and disposal facilities as well as for setting up of the construction camps. Consent to Establish & Operate / Authorization shall be obtained, before Establishing and commissioning the industry respectively, under the Water (Prevention and Control of Pollution) Act 1974, the Air (Prevention and Control of Pollution) Act 1981 and the relevant Rules under Environment (Protection) Act 1986.

Effluent and stormwater analysis report and flow details (once a week) and Water consumption returns (Monthly) shall be furnished to the District office of the State PCB. Industry Categorization of Kerala SPCB for SWM various facilities are furnished below:
<table>
<tr><th>Type of Facilities</th><th>Categorization by KSPCB</th></tr>
<tr><td>MSW processing facility (compositing, sanitary landfill sites/bio-methanation plant/waste to energy, etc.)</td><td>Red</td></tr>
<tr><td>Reprocessing of waste plastic</td><td>Orange</td></tr>
<tr><td>Power generation plant "Waste to Energy Plant"-</td><td>Orange</td></tr>
<tr><td>Ready-mix cement concrete</td><td>Green</td></tr>
<tr><td>Diesel Generator sets (15 KVA to 250 KVA)</td><td>White</td></tr>
<tr><td>Diesel Generator sets (250 KVA to 1 MVA</td><td>Green</td></tr>
<tr><td>Healthcare Establishment*</td><td>Red</td></tr>
<tr><td>CBMWTF *</td><td>Red</td></tr>
</table></td><td></td></tr>
<tr><td>The Air (Prevention and Control of Pollution) Act. 1981</td><td>The purpose of this act is to prevent, and control air pollution and preserve air quality. This act empowers Central and State Pollution Control Boards for managing air quality and emission standards, as well as monitoring air quality, prosecuting offenders and issuing licenses for construction and operation of any facility. Air quality includes noise levels also. This act has notified the National Ambient Air Quality Standard for different land uses.

Prior CTE and CTO may be applicable to establish waste recycling and disposal facilities as well as for setting up of the construction camps. Categorization of Facilities and requirements for CTE / CTO by KSPCB is provided in the</td><td>CPCB, SPCB</td></tr>
</table>

Act /Rule / Guidelines	Relevance	Implementing / Responsible Agency
	previous section. Emission analysis report and flow measurement (monthly) shall be submitted to the District office of Kerala SPCB.	
The Noise Pollution (Regulation and Control) Rule,2000	The Noise Pollution (Regulation and Control) rules are promulgated under the Environmental (protection) Act, 1986. The noise pollution rules lay down terms and conditions as are necessary to reduce noise pollution, including during night hours. The rule provides ambient noise level standards for various types of land uses. PCB can take action if the sound level exceeds the standards by 10 dBA. Noise standard for different zones. - Industrial zone- 75 & 70 dBA Leq during daytime and night-time respectively - Commercial zone- 65 & 55 dBA Leq during daytime & night-time respectively - Residential zone- 55 & 45 dBA Leq during daytime and night-time respectively - Silence zone 50 & 40 dBA Leq during daytime and night-time respectively *Construction vehicle/equipment, construction and operation, and management of waste processing/recycling units, biomining activity (any noise-generating activity) should comply with the standards as stipulated in the rule.*	CPCB, SPCB
The Wildlife Protection Act, 1972	The Wildlife Protection Act, 1972 has allowed the government to establish several Protected Areas like National Parks and Sanctuaries over the past 37 years, to protect and conserve the flora and fauna and their habitat. *Prior recommendation of National Board for Wildlife (NBWL) will be required* • *in case any subproject activity is proposed within the boundaries of Protected area* • *in case any project requiring Environmental Clearance (under the purview of EIA Notification 2006 and its subsequent amendments) is located within the eco-sensitive zone around a Wildlife Sanctuary or National Park or in absence of delineation of such a zone, within a distance of 10 km from its boundaries*	NBWL, SBWL
The Forest (Conservation) Act, 1980	The Indian Forest Act (1927) was amended in 1980 in an attempt to check the rapid deforestation occurring throughout India and the Forest (Conservation) Act, 1980 came into existence. At the state level, the government was empowered to declare reserves and protected forests and was also given the authority to acquire land for extension and preservation of the forests. Forest (Conservation) Rules, 2003 explain the procedure for procuring clearance for diversion of forest land for non-forest purpose. *Prior Forest Clearance under the purview of this act will be requiring in case use/diversion (for long term or short term) of forest land is involved in the project. Only the Central Government is authorized to permit diversion of forest land for non-forestry purposes. Therefore, the LSGs will have no role except in assisting forest conservation activities through schemes like the NREGA and enhancement of forest productivity activities through stipulated stakeholder groups. The provisions of the acts fall under the negative list as far as the proposed ESMF is*	State Forest Department, MoEFCC

Act /Rule / Guidelines	Relevance	Implementing / Responsible Agency
	concerned.	
The Wetlands (Conservation and Management) Rules, 2017	Wetlands (Conservation and Management) Rules, 2017 are promulgated under Environmental (protection) Act, 1986 for prohibiting reclamation and degradation through drainage and landfill, pollution (discharge of domestic and industrial effluents, disposal of solid wastes), hydrological alteration (water withdrawal and changes in inflow and outflow), over-exploitation of their natural resources resulting in loss of biodiversity and disruption in ecosystem services provided by wetlands by conservation of wetlands. As defined in the rule, 'wetland' means an area of marsh, fen, peatland or water; whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six meters, but does not include river channels, paddy fields, human-made water bodies/tanks specifically constructed for drinking water purposes and structures specifically constructed for aquaculture, salt production, recreation, and irrigation purposes. Whereas, 'wetlands complexes' means two or more ecologically and hydrologically contiguous wetlands and may include their connecting channels/ducts *The rules shall apply to the wetlands or wetlands complexes of following types-* *(a) wetlands categorized as 'wetlands of international importance' under the Ramsar Convention* *(b) wetlands as notified by the Central Government, State Government and Union Territory Administration* ***Section 4** of the rule elaborates Restrictions of activities in wetlands which includes solid waste dumping and any construction of a permanent nature*	
Regulations Related to Waste Management		
Solid Waste Management Rules, 2016	The Rules shall apply to every urban local body, other areas and to every domestic, institutional, commercial, and any other nonresidential solid waste generator except industrial waste, hazardous waste, hazardous chemicals, biomedical wastes, e-waste, lead-acid batteries, and radioactive waste. The rules define the duties of solid waste generators. The rules outline the responsibilities of line ministries, ULB's and other stakeholders; duty of the operator of Solid Waste Processing and Treatment Facility. This mandates the operator of the facility to secure necessary approvals from the State Pollution Control Board for the management of SW. The rule also mandates Urban Development in the States to prepare a state policy and SWM strategy in	MoEFCC, Waste Generators, CPCB, SPCB, various stakeholders at state/local level, operators of disposal facilities, etc.

Act /Rule / Guidelines	Relevance	Implementing / Responsible Agency
	consultation with concerned stakeholders. The SWM strategy should focus on waste reduction, reuse, recycling, recovery and optimum utilization of various components of solid waste to ensure minimization of waste going to the landfill and minimize the impact of solid waste on human health and environment. The rules also detail the Specifications for Sanitary Landfills. Which includes Criteria for site selection, development of facilities at the sanitary landfills, specifications for landfilling operations and closure on completion of landfilling, pollution prevention, and monitoring, etc. *SWM Plan, facilities for Segregation, Storage (Local level and MCF/RRF/MRFs), Collection, Treatment, Disposal of wastes (Wet and Dry waste including Plastics) shall follow SWM Rules 2016.*	
Construction and Demolition Waste Management Rules, 2016	Construction and demolition waste includes waste comprising of building materials, debris, and rubble resulting from construction, remodeling, repair, and demolition of any civil structure. As per rule- 1. Every waste generator shall prima-facie be responsible for the collection, segregation of concrete, soil and others and storage of construction and demolition waste generated, as directed or notified by the concerned local authority in consonance with these rules ((Rule 4 sub-rule (1)) 2. there should be no littering or deposition of construction and demolition waste to prevent obstruction to the traffic or the public or drains (Rule 4 sub-rule (4)) *Schedule I of the rule sets up Criteria for Site Selection for Storage and Processing or Recycling Facilities for construction and demolition waste.*	MoEFCC, C&D Waste Generators, CPCB, SPCB, various stakeholders at state/local level, Bureau of Indian Standards and Indian Roads Congress, etc.
Plastic Waste Management Rules, 2016	MoEFCC issued the Plastic Waste Management Rules, 2016 to give thrust on plastic waste minimization, source segregation, recycling, and disposal effectively. These rules shall apply to every waste generator, local body, Gram Panchayat, manufacturer, Importers, and producer. Section 6 and Section 8 of the rule explain the Responsibility of Local Body and Responsibility of waste generator respectively. Section 5 of the rule recommends- (b) '*local bodies shall encourage the use of plastic waste (preferably the plastic waste which cannot be further recycled) for road construction as per Indian Road Congress guidelines or energy recovery or waste to oil etc. The*	MoEFCC, Waste Generators, producers, Importers, Brand Owners, CPCB, SPCB, operators of disposal facilities

Act /Rule / Guidelines	Relevance	Implementing / Responsible Agency
	standards and pollution control norms specified by the prescribed authority for these technologies shall be complied with'. *(d) 'The inert from recycling or processing facilities of plastic waste shall be disposed of in compliance with the Solid Waste Management Rules.'* *'Section 17. Annual Reports' of the rule mandates annual reporting by Plastic Processors/recyclers, Urban Development Department, SPCB, and CPCB. CPCB shall prepare a consolidated annual report on the use and management of plastic waste and forward it to the Central Government along with its recommendations* *This applies to Plastic Waste Generated by Households, and other users.*	
Hazardous and Other Wastes (Management & Transboundary Movement) Rules, 2016	The rule dictates the entity generating hazardous wastes (as defined in the rule), to take all practical steps to ensure that such wastes are properly handled without any adverse effects, which may result from such wastes. It stipulates proper collection, reception, treatment, storage, and disposal of such wastes and provides for the process/mechanism to do so. Waste generators will need to obtain permission from the State Pollution Control Boards and other designated authorities for storage and handling of any hazardous material. **Schedule I** of the rule lists out of processes that generate hazardous wastes. **Schedule II** of the rule provide a list of waste constituents with concentration limits Chapter 2 Section 4 states *(3) The hazardous and other wastes generated in the establishment of an occupier shall be sent or sold to an authorized actual user or shall be disposed of in an authorized disposal facility.* *Chapter 2 Section 6 also states that every occupier of the facility who is engaged in handling, generation, collection, storage, packaging, transportation, use, treatment, processing, recycling, recovery, pre-processing, co-processing, utilization, offering for sale, transfer or disposal of the hazardous and other wastes shall be required obtain an authorization from the State Pollution Control Board*	MoEFCC, CPCB, SPCB, State Government/Administration,

Act /Rule / Guidelines	Relevance	Implementing / Responsible Agency
E-Waste Management Rule, 2016	These rules shall apply to every manufacturer, producer, consumer, bulk consumer, collection centers, dealers, e-retailer, refurbisher, dismantler and recycler involved in manufacture, sale, transfer, purchase, collection, storage and processing of e-waste or electrical and electronic equipment listed in Schedule I of the rule, including their components, consumables, parts, and spares which make the product operational. These rules are applicable Two categories of electrical and electronic equipment namely (i) IT and Telecommunication Equipment and (ii.) Consumer Electricals and Electronics such as TVs, Washing Machines, Refrigerators Air Conditioners including fluorescent and other mercury-containing lamps are covered under these Rules **Section 5** of the rule defines the responsibilities of the producer of e-waste. *This applies to E-Wastes reaching Municipal Stream and MCFs. ULBs should plan to follow E-Waste Rules for Household E-Wastes and those reaching MCFs / MRFs. SWM Plan should aim at reducing, Managing E-Wastes, and focus on EPR.*	MoEFCC, CPCB, SPCB
Bio-medical Waste Management Rules, 2016	To improve the collection, segregation, processing, treatment, and disposal of these bio-medical wastes in environmentally sound management thereby, reducing biomedical waste generation and its impact on the environment. These rules shall apply to all persons who generate, collect, receive, store, transport, treat, dispose, or handle biomedical waste in any form including hospitals, nursing homes, clinics, dispensaries, veterinary institutions, animal houses, pathological laboratories, blood banks, Ayush hospitals, clinical establishments, research or educational institutions, health camps, medical or surgical camps, vaccination camps, blood donation camps, first aid rooms of schools, forensic laboratories, and research labs. **Schedule I** provides guidelines for storage and disposal of various types of biomedical waste (including Liquid Waste) **Schedule II** defines Standards for Treatment and Disposal of Bio-Medical Waste i.e. incinerators, Plasma Pyrolysis or Gasification, Autoclaving, microwaving, deep burial, etc. **Schedule III** of the rule defines the responsibilities of Municipalities or Corporations, Urban Local Bodies, and Gram Panchayats along with other line ministries and concerned entities. *This applies to Biomedical Waste Management Facility, Health Care Unit, and Household biomedical wastes reaching Municipal Stream and MCFs. ULBs should plan to follow Biomedical Waste Rules for small levels of Biomedical wastes reaching Treatment / Disposal facilities and those reaching MCFs / MRFs*	MoEFCC, Waste Generators (HCUs, labs, HHs/others), CPCB, SPCB, CBMWTF operators

Act /Rule / Guidelines	Relevance	Implementing / Responsible Agency
Batteries (Management and Handling) Rules, 2001	MoEFCC under the provisions of the Environmental Protection Act, 1986 issued the Batteries (Management and Handling) Rules, 2001. The rules were enacted with the primary objective of ensuring the safe disposal of discarded lead-acid batteries. Rules mandate proper control and record-keeping on the sale or import of lead-acid batteries and recollection of the used batteries by registered recyclers to ensure environmentally sound recycling of used batteries. *ULBs shall in their SWM Plan discuss measures to prevent this from reaching the municipal stream.*	MoEFCC, CPCB, SPCB
The Motor Vehicle Act, 1988 & Motor Vehicles Rules, 1989	The Act regulates all aspects of road transport vehicles. It provides in detail the legislative provisions regarding licensing of drivers/conductors, registration of motor vehicles, control of motor vehicles through permits, traffic regulation, insurance, liability, offenses, and penalties, etc. *This act will be applicable for all construction equipment/plant and machinery including vehicles deployed during implementation. Motor Vehicles Rules, 1989 mandates Pollution Under Control (PUC) certificate for motor vehicles.*	CPCB, SPCB, State Transport Department
Other Regulations/Policies/Guidelines applicable to various construction/implementation activities		
The Building & Other Construction Workers (Regulation of Employment & Conditions of Service) BOCW Act, 1996	As per the Act, the employer is required to provide safety measures at the building or construction work site along with other welfare measures, such as canteens, first-aid facilities, ambulance, housing accommodation, etc. to the workers. *These are comprehensive guidelines for the Occupational Health and Safety of Laborers.*	Dept. of Labour; Govt. of Kerala
Ancient Monuments and Archaeological Sites & Remains Act 1958	This Act is to ensure the preservation of ancient and historical monuments and archaeological sites and remains of national importance and for the regulation of archaeological excavations and the protection of sculptures, carvings, and other like objects. According to this Act, areas within the radii of 100m and 300m from the "protected property" are designated as "prohibited areas" and "regulated areas" respectively. **No development activity is permitted in the "prohibited areas"**. Development activities are not permitted in the "regulated areas" without prior permission from the Archaeological Survey of India (ASI) if the site/remains/ monuments are protected by ASI or the State Directorate of Archaeology. *If any facility is proposed within regulated areas of protected monuments, prior permission will be required from ASI. Pertinent to state that the act doesn't allow to develop any facility within the limit of the Prohibited Area.*	Archaeological Survey of India, State Dept. of Archaeology
Indian Treasure Trove Act, 1878	Whenever any treasure (anything of any value hidden in the soil, or anything affixed thereto) exceeding in amount or value ten rupees is found, the finder shall intimate District Collector in writing as soon as practicable.	Archaeological Survey of India, State Dept. of Archaeology; District

Act /Rule / Guidelines	Relevance	Implementing / Responsible Agency
	The Act gives direction about the process to be followed in case of the chance finds.	Collector

3.1.2 Role of National Green Tribunal

National Green Tribunal vide order dated 22.12. 2016 stipulated as that:

1. *Every State and Union Territory shall enforce and implement the Solid Waste Management Rules, 2016 in all respects.*
2. *The directions contained in this judgment shall apply to the entire country. All the State Governments and Union Territories shall be obliged to implement and enforce these directions without any alteration or reservation.*

GoK vide gazette order No.65/2018/LSGD dated 13th September 2018 published Kerala State Policy on Solid Waste Management.

Kerala SWM

The Honourable National Green Tribunal (NGT) had passed an Order (O.A. No.606/2018) highlighting serious deficiencies in the implementation of waste management initiatives, non-compliance with the Solid Waste Management Rules 2016, lack of preparation of local Action Plans through an earlier NGT Order in Dec 2016.

Subsequently, GoK submitted details of actions taken based on the aforementioned Orders to the NGT in April 2019. NGT, in pursuance to the GoK response, further passed specific directions requiring an accelerated compliance action plan wherein selected local bodies would be required to make an earnest and demonstratable endeavor to ensure compliance to environmental norms within six months and the remainder of the State within one year from date of issuance of directions.

Directions on Dumpsite Improvements

Following CPCBs guidance that a) capping of dumpsites is not advisable for the country, as it would generate more leachate and methane/ Landfill Gas which would further contaminate the already contaminated groundwater, b) Gas extraction is very difficult and inefficient when attempts are made to insert suction pipes into dumped wastes as against before dumping begins; NGT has in its hearing on disposal of 'legacy' waste dumped[39] at Bhalswa, Ghazipur and Okhla dumpsites in Delhi, discussed Biomining and Bioremediation as the improvement option for existing Dumpsites. It suggests going with the Indore Model of Bioremediation for all dumpsites. NGT ordered New Delhi Municipal Corporation to relook at Bhalaswa DPR to include: (a) Bio-mining should be undertaken to the maximum extent possible without having significant adverse environmental impacts on the adjoining population. (b) Bio-remediation/decontamination of surface, groundwater, and soil should also be undertaken in the affected areas. The following dumpsites in Kerala were in the list of sites ordered to be bioremediated: Kalamassery (Kalamassery Municipality), Laloor (Thrissur Corporation), Theruvusala (Malappuram Municipality), Vilappilsala (Thiruvananthapuram Corporation), Chelora (Kannur Corporation), Kureepuzha

[39] *Original Application No. 519/2019 WITH Original Application No. 386/2019*

(Kollam Corporation). NGT ordered that "Remediation work on all other dumpsites may commence from 01.11.2019 and completed preferably within six months and in no case beyond one year. Substantial progress is made within six months".

3.1.3 Technical Guidelines on SWM, C&D and Biomedical Waste Management at National Level

Central Government agencies have has issued various guidelines for various aspects of SWM. Refer to ***Table 9*** below:

Table 9: Available Guidelines for Solid Waste and C&D Waste Management at National Level

Agency	Guidelines	Particulars
Central Public Health and Environmental Engineering Organisation (CPHEEO), Ministry of Urban Development	Government of India Swachh Bharat Mission Municipal Solid Waste Management Manual	The Structure of the Revised Manual Part I: An Overview: Provides the salient features of the MSWM Manual for decision-makers, elected representatives, and bureaucrats at different levels of governance. It provides decision-makers with guidance on the key issues of MSW management and promotes understanding of challenges and opportunities thereby guiding them in initiating necessary processes to achieve the goals. Part II: The Manual: This is the main body of the manual, primarily for the senior management, financial and technical heads of department at ULB level, health officers, technical staff, and private operators. This part comprises seven chapters providing detailed designs of requirements on planning framework, adoption of several operating mechanisms, and appropriate technologies for all aspects of MSWM. The manual also discusses the management of domestic hazardous waste including special waste streams that get mixed with municipal solid waste but need to be treated separately. This part provides a holistic approach towards technical, operational, institutional, and financial management including PPP leading to sustainable MSWM. Part III: The Compendium: Comprises of national rules and guidelines, international practices on waste minimization, detailed designs of compost plant and landfill. The part is mainly for the operational staff, private operators, experts, and training institutes for facilitating informed decisions.
Central Public Health and Environmental Engineering Organisation (CPHEEO) Ministry of Housing and Urban Affairs	Advisory on On-Site and Decentralized Composting of Municipal Organic Waste, June 2018	Methods to treat organic wastes, reduce, recycle, reuse, Waste to Compost systems: Waste to Compost systems for Individual Households, Small Communities, Apartments, etc. up to 10 Household; Waste to Compost systems for Medium-Sized Communities, Apartments, RWAs - for 11 – 300 Households; medium-sized Offices, medium Hotels, Resorts, medium Schools, Canteens, Marriage Halls; Waste to Compost systems for large Communities, Apartments, RWAs, high rise buildings for 301 - 1000 Households; Large Offices, Large Hotels, Large Schools, Waste to Compost systems for Decentralized plants for more than 1000 Households operated by ULBs / Institutions / Outsourced agencies
Ministry of Environment, Forests and Climate	Technical EIA Guidance Manual for Common Municipal Solid Waste Management Facilities	Technologies for SWM, Operational aspects of EIA, including coverage of SWM under EIA notification, Screening, Scoping, EIA, SIA, Risk assessment, Mitigation measures, EMP, Reporting, Consultations, Appraisal, Decision Making, post Clearance

Agency	Guidelines	Particulars
Change		Monitoring, Stakeholders Roles and Responsibilities
Central Pollution Control Board	Guidelines on the provision of the buffer zone around waste processing and disposal facilities, April 2017; amended in March 2019	Recommends developing buffer zone around waste processing and disposal facilities; development of Green Belt (including species of trees to be planted); responsibilities of various stakeholders
Central Pollution Control Board	Selection Criteria for Waste Processing Technologies	Discuss suitability various kinds of waste processing technologies like Aerobic Composting, Vermi- Composting, Biomethanation/ Bio-waste Derived Fuel, Incineration, Plasma Pyrolysis, Pelletization/ RDF
Central Pollution Control Board	Guidelines for Disposal of Legacy Waste (Old Municipal Solid Waste), Feb'19	Covers Methodology, process, equipment requirement for Bio-remediation & Bio-mining of Old Municipal Dumpsite; the processing of accumulated waste; leachate management, Fire Control, and Safety management, etc.
Central Pollution Control Board	Guidelines for Management of Sanitary Waste, May'18	It covers possible waste management options for such kind of wastes. Role of various stakeholders etc.
Central Pollution Control Board	Guidelines for Co-processing of Plastic Waste in Cement Kilns, May 2017 (As per Rule '5(b)' of Plastic Waste Management Rules, 2016)	It evaluates plastic waste scenario in India, the possibility of coprocessing plastic wastes in cement kilns, Infrastructural Requirement for Plastics Co-processing, Feeding of plastic waste material for co-processing, Operating Conditions, Business Model for Success of Co-processing, and presents two case studies: Case Study-1: Case Study on Clean and Green Madukarai Town, Case Study-2: Case Study on Vapi Plastic Waste Co-processing
Central Pollution Control Board	Guidelines on Environmental Management of Construction & Demolition (C & D) Wastes	It discusses the Quantum & composition of C & D waste generation, Initiatives in promoting C & D waste products by GoI, C & D waste processing, Existing Guidelines on C & D waste management, Introduction to Guidelines on Environmental Management of C& D Wastes, Guidelines on Environmental Management of C & D Wastes – NOISE management, Guidelines on Environmental Management of C & D Wastes – DUST management, Guidelines on Environmental Management of C & D Wastes – Other issues Annexures on: Initiatives in C & D waste management in 69 cities (Literature Survey); Potential uses of C & D wastes, Global practices of the utilization of C & D wastes, Criteria for site selection of C & D waste processing facility Separate CPCB Guidelines: Guidelines on Dust mitigation measures in handling Construction material and C&D wastes Guidelines on Environmental Management of Construction & Demolition (C & D) wastes
Central Pollution Control Board	Environmentally Sound Management of Mercury Waste Generated from Health Care Facilities.	Considering the adverse health impacts due to possible spillages of mercury during the use of mercury-containing devices in Healthcare Facilities (HCFs) guidelines for ensuring proper management of mercury bearing waste generated from HCFs has been prepared

Agency	Guidelines	Particulars
Central Pollution Control Board	Revised Guidelines for Common Bio-medical Waste Treatment and Disposal Facilities	The guideline covers criteria for the development of a new CBMWTF; regulatory compliance required for establishing and operating such facilities; responsibility of operators; Treatment equipment to be installed for BMW treatment and disposal; requirement of infrastructural setup etc.
Central Pollution Control Board	Guidelines for Bar Code System for Effective Management of Bio-Medical Waste	Bio-medical Waste Management Rules, 2016 (and subsequent amendments) stipulates that every HCF must establish a bar code system for bags or containers containing biomedical BMW to be sent out of the premises or place for any purpose. Also, Rule 5 of the BMWM Rules, 2016 stipulates that every Operator of CBMWTF must establish a bar code system for handling bio-medical waste. These guidelines have been prepared to facilitate and provide guidance to both the Occupier as well as Operator of CBMWTF to establish a bar code system, thereby ensuring effective enforcement of the BMWM Rules, 2016.
Central Pollution Control Board	Guidelines for Management of Healthcare Waste in Health Care Facilities as per Bio-Medical Waste Management Rules, 2016	The document provides a detailed guideline for HCWs for the management of BMWs in accordance to Bio-medical Waste Management Rules, 2016 (and subsequent amendments). The guideline covers the classification of waste generated from HCFs; categorization of BMW and color-coding of the respective category; process for BMW management (segregation, storage, collection, treatment, and disposal)
Central Pollution Control Board	Guidelines for Handling of Biomedical Waste for Utilization	These guidelines guide Healthcare Facilities as well as the industry/vendors involved in the utilization of biomedical wastes in collection, sending, transportation, utilization, and disposal by ensuring adequate safeguards from the risk of spread of infection during handling of BMW.
Central Pollution Control Board	Guidelines for "Imposition of Environmental Compensation against HCFs and CBMWTFs"	Hon'ble NGT in the matter of O.A. No. 710 of 2017 filed by Shailesh Singh *vide* its order dated 12.03.2019 directed CPCB to undertake study and prepare a scale of compensation to be recovered from violators of Biomedical Waste Management Rules, 2016. Hon'ble NGT also directed that State Pollution Control Boards (SPCBs) can also recover compensation from the polluters by laying down their scale which should not less than the scale fixed by CPCB. As per the directions of Hon'ble Tribunal in the matter of O.A. No. 593 of 2017 (WP (CIVIL) No. 375/2012), CPCB had developed a methodology for assessing environmental compensation for noncompliance by HCFs and CBMWTF.
Central Pollution Control Board	Revision 2: Guidelines for Handling, treatment, and disposal of waste generated during treatment, diagnostics, and quarantine of COVID-19 patients	To deal with COVID-19 pandemic, State and Central Governments have initiated various steps, which include setting up quarantine centers/camps, Isolation wards, sample collection centers, and laboratories. The guidelines have been formulated for handling, treatment and disposal of COVID-19 waste at Healthcare Facilities, Quarantine Camps/ Quarantine-homes/ Home-care, Sample Collection Centers, Laboratories, SPCBs/PCCs, ULBs and CBMWTFs based on current knowledge on COVID-19 and existing practices in the management of infectious waste generated in hospitals while treating viral and other contagious diseases like HIV, H1N1, etc
Ministry of Health and Family Welfare	Covid-19: Guidelines on dead body management	This guideline is based on the current epidemiological knowledge about the COVID-19 for the management and disposal of the dead body of a suspect or confirmed case of COVID-19 patient. Standard

Agency	Guidelines	Particulars
		Precautions to be followed by health care workers while handling dead bodies of COVID cases are given in the guideline. The guideline also covers precautionary measures to be taken for transportation and cremation/burial.

CPCB has issued guidelines (Revision 2) for COVID 19 Waste Management. https://www.cpcb.nic.in/uploads/Projects/Bio-Medical-Waste/BMW-GUIDELINES-COVID_1.pdf

A list of Guidelines issued by CPCB for management of other kinds of wastes is as in ***Table 10*** below.

Table 10: Applicable Guidelines for Management of Other Wastes

Type of Waste	Guidelines
Plastic Waste	• *Guidelines for the Disposal of Non-recyclable Fraction (Multi-layered) Plastic Waste* • *Consolidated Guidelines for Segregation, Collection, and Disposal of Plastic Waste* • *Guidelines for Co-processing of Plastic Waste in Cement Kilns* • *A Document on Guidelines for Disposal of Thermoset Plastic Waste including Sheet molding compound (SMC)/Fiber Reinforced Plastic (FRP)*
E-waste	• *Guidelines for Producer Responsibility Organization (PRO) under E-Waste (Management) Amendment Rules, 2018* • *Final Guidelines on Implementation of E-Waste Rules 2016* • *Guidelines for Environmentally Sound Management of Electronic Waste*
Hazardous Waste	• *Guidelines on Co-processing in Cement/Power/Steel Industry*

3.1.4 State Regulations

The Constitution of India, through its 73rd and 74th Amendments in 1992, has enabled the Grama Panchayats and Municipalities to perform functions related to environmental management. The functions of Grama Panchayats related to environmental management. 1. Agriculture including agriculture extension. 2. Land improvement, implementation of land reforms, land consolidation, and soil conservation. 3. Minor irrigation, water management, and watershed development. 6. Social forestry and farm forestry 11. Drinking water 15. Non-conventional energy sources 23. Health and sanitation, including hospitals, primary health centers, and dispensaries. The following subjects related to environmental management in the 12th schedule of the Constitution are the functions of Municipalities. 1. Urban planning including town planning 2. Regulation of land-use and construction of buildings 3. Water supply for domestic, industrial, and commercial and SWM. 4. Public health, sanitation conservancy, and SWM. 5. Urban forestry, protection of the environment, and promotion of ecological aspects. 7. Provision of urban amenities and facilities such as parks, gardens, playgrounds. 9. Regulation of slaughterhouse and tanneries. Democratic decentralization and participatory planning initiated in Kerala during the last one and a half-decade have been made significant efforts to bring the issue of natural resource and environmental management in the

development politics of the state. The People's Planning Campaign realized the importance of natural resources and environment management for sustainable development of the state and for strengthening the primary production sectors and promoting the livelihood of the poor and the deprived sections of the society.

However, inadequate training/ capacity building of the staff on review and mitigation of environmental Impacts, and the absence of a framework approach to suit the environmental assessment of various projects. Most of the existing treatment facilities do not follow National guidelines for siting, development of facilities, or environmental considerations and almost all facilities lack Consent from Pollution Control Board for Establishment or Operation.

The State of Kerala has Prepared a State Policy on SWM, Operational Guidelines for Missions aimed at SWM, and many other Acts / Rules which may apply to Construction / Implementation of SWM facilities. Refer to ***Table 11***:

Table 11: Applicable Environmental and SWM Policy and Regulations at State Level

State-Level Policy and Regulations on Waste Management	
Kerala State Policy on SWM, 2018	The Solid Waste Management Rules, 2016 (SWMR2016) authorizes the State Pollution Control Board to enforce, review the implementation of the Rules, and monitor environmental standards prescribed in the Rules. Govt. of Kerala vide gazette order No.65/2018/LSGD dated 13th September 2018 published Kerala State Policy on SWM to ensure implementation of Solid Waste Management Rules, 2016 in the state. The specific goals of the policy are to • Generate awareness about the responsibility of citizen, institutions, and community to manage the waste generated by them • Bring about and sustain behavioral change to segregate waste at source based on its characteristics • Create awareness about the linkage of waste management with public health and environmental cleanliness • Promote the adoption of appropriate and state of the art technologies and practices for processing and managing putrescible waste at source and non-putrescible waste centrally • Ensure provision of community waste management facilities for those households and institutions having space, time and financial constraints to have individual facilities • Maximize the possibility of reduction, reuse and recycling the garbage generated • Encourage promotion of entrepreneurship in various aspects linked to waste management • Mainstream 'Planning and implementing measures related to waste management in all sectors as a cross-cutting issue • Strengthen the urban and rural local governments as well as public and private institutions and community to accord priority to waste management actions including planning, implementation, and operation & maintenance management of waste management installations • Ensure environmental, social, and safety linked safeguards for those involved in waste handling. • Facilitate the development and appropriate deployment of human resources
Kerala SWM Operational Guidelines, 2017 (Guidelines 2017)	Vide G.O (P) No. 41/2016/PEAD dated 28.9.2016, the GoK constituted four Development Missions in which the Haritha Keralam Mission is mandated to enable Sanitation & Waste Management, Water Conservation and Agricultural expansion giving thrust on organic practices in an integrated manner. The waste management activities have been brought as a Submission under it. Vide G.O (P) No. 10/2017/PEAD dated 10.4.2017, the Government

State-Level Policy and Regulations on Waste Management	
	issued detailed guidelines including the roles and responsibilities of various institutional structures. Accordingly, the objectives of the Mission included the strict implementation of sanitation and waste management rules as well as ensuring scientific waste management with people's participation. The Suchitwa Mission, the nodal agency of the Government for coordinating the activities of sanitation and waste management, has been made a Sub Mission of Haritha Keralam Mission. The guidelines also included the objectives set, strategies to be adopted, and activities envisaged for achieving the objectives by ensuring improved coordination and monitoring of the waste management activities of the state to comply with the SWM Rules, 2016. Vide G.O. No. 2420/2017/LSGD dated 15.7.2017, the Government brought out detailed operational guidelines for implementing campaigns on sanitation and waste management activities. Under the guidelines, the State is dominantly promoting a decentralized system of Solid Waste Management.
Other State Acts Related to General Construction / Implementation	
Kerala Municipalities Act 1994	Sections 315 to 492 of the Municipalities Act 1994 provides adequate powers and functions to the Municipalities for the prevention and control of environmental pollution. These provisions are similar to that of the Kerala Panchayat Raj Act 1994. The Kerala Municipalities Act provides powers on the Municipality and requires the public to do certain activities with utmost care without damaging the environment. The salient aspects of Kerala Municipalities (Act) 1994 are given below. Accordingly, the Municipalities are: The Municipality has been empowered to: o Contract with an owner or occupier for removal of rubbish or filth. o Introduce house to house collection of solid wastes and rubbish. o Provide final disposal of solid wastes considering that the rubbish and solid wastes are the property of municipality o Provide provision for processing of wastes. o Collect contribution from those responsible for the places of pilgrimage etc. for the facilities provided. o Remove the solid wastes, rubbish, etc. from non –residential premises. o Prohibit improper disposal of carcasses, rubbish, or filth. o Prohibit premises from keeping filth, disposal of skin, etc. o Prohibit outflow of sewage or filth. o Prohibit littering. o Prohibit the employees of the municipality from disposing of the waste in public places other than specified.
Kerala Panchayati Raj Act of 1994	The Kerala Panchayat Raj Act introduced in 1994 gives vast powers to the Local Self Governments (LSGs) for the protection of the environment. LSG shall as per section 219A, make arrangements for the o Removal of solid wastes generated in their area. o Sweeping and cleaning and keeping the streets, roads, etc. neat and tidy. o Collection and removal of solid wastes daily from private property. o Removal of solid wastes from bins and storage facilities daily. o Providing storage facilities or bin for the collection of wastes. o Providing covered transportation facilities for the removal of wastes. o Avoiding nuisance from the water handling facilities. o Providing facilities for final disposal directly or through operators o Providing specified storage facilities for the solid wastes generated and collecting the wastes therein. o Keeping the storage facilities neat and disposing off the waste as per the notice of the Secretary of respective LSGs. o Segregating and storing the waste as per the instructions of the Secretary for the convenience of the waste collector. o Delivering the waste so collected to the persons notified by the LSG or to community storage facilities. o Entering into with persons /establishment by the LSGs for removal of wastes from their property as per the agreed terms and conditions. o Providing a house-to-house collection system by the LSGs

State-Level Policy and Regulations on Waste Management	
	o Owning the solid waste generated as the property of the LSGs. o Notifying and acquiring suitable land for final disposal of solid wastes taking into account the environmental suitability o Providing facilities for the conversion of waste into fertilizer and its sale o Disposing the wastes unsuitable for conversion to fertilizer in a secured landfill. o Incinerating the bio-medical wastes generated in specified hospitals and hazardous wastes generated except industries o Providing recycling, treating, and disposal facilities by the LSGs through public-private participation. o Remove the solid wastes from premises other than residential areas. o Prohibiting storage of solid waste for more than 24 hours. o Prohibition of discharge of effluent or water into public places. o Restriction of storing skins and hides. o Prohibition on the transportation wastes in vehicles without covering. o Prohibition of creation of nuisance by open defecation. o Restriction on disposal of wastes by the Local Self Government staff in places other than notified for the purpose.
Kerala Preservation of Trees Act, 1986	The act states that No person shall, without the previous permission in writing of the authorized officer, cut, uproot or burn, or cause to be cut, uprooted or burnt, any tree as defined by the act. *Prior permission for tree felling to be secured in case the felling of trees (as defined in the act) is involved in the project.*
The Kerala Biological Diversity Rules, 2008.	At the state level, various approach papers and model bio-diversity registers have already been prepared. The Kerala State Biodiversity Board (KSBB) is in the process of setting up BMCs at all the local bodies in Kerala. The Biodiversity Monitoring Committees as and environmental knowledge group at the LSG level will strengthen the operationalization of the proposed ESMF during the screening and scoping process.
Kerala Conservation of Paddy Land and Wetland (Amendment) Act, 2018	The Kerala Conservation of Paddy Land and Wetland Act, 2018 is intended to conserve the paddy land and wetlands and restrict their conversion or reclamation, to promote growth in the agriculture sector and sustain the ecological balance. *Permission from State Govt. shall be requiring in case any facility is proposed on paddy land/wetlands (as documented in revenue records).*
Kerala State Disaster Management Rules 2007 and subsequent amendment in line with Disaster Management Act, 2005 National Policy on Disaster Management, 2009	Government of India (GoI) issued Disaster Management Act, 2005 envisaged the creation of the National Disaster Management Authority (NDMA), headed by the Prime Minister, State Disaster Management Authorities (SDMAs) headed by the Chief Ministers, and District Disaster Management Authorities (DDMAs) headed by the District Collector or District Magistrate or Deputy Commissioner as the case may be, to spearhead and adopt a holistic and integrated approach to Disaster Management. The vision of the policy is to build a safe and disaster resilient India by developing a holistic, proactive, multi-disaster oriented, and technology-driven strategy through a culture of prevention, mitigation, preparedness, and response. The primary responsibility for the management of disaster rests with the State Government concerned. The institutional mechanism put in place at the Centre, State, and District levels help states to manage disasters effectively. The National Policy on disaster management puts in place an enabling environment for all.
Kerala Municipality Building Rules, 2019 &Kerala Panchayat	This discusses the need for permission from ULB Panchayat before initiating any construction activity. Need to take permissions from concerned authorities of the proposed building is near any of these: Defence authority if the proposed building is 10m from Defense installation, Proposed high rise buildings within 500m from Defense Establishment or Telecommunication towers within 200m from Defense establishment, Proposed buildings

State-Level Policy and Regulations on Waste Management	
Building Rules, 2019.	within 30m from Railway track boundary or Telecommunication towers within 100m from Railway track boundary, Proposed site/buildings in areas declared, identified or advised by the Kerala Urban Arts Commission as possessing heritage value, Proposed buildings within any Security Zone, Proposed buildings/places for religious purpose or worship, Proposed fuel filling stations, Proposed crematoria or burning and burial grounds including cemetery and vaults, Proposed site/buildings in any area notified by the Government of India as a coastal regulation zone under the Environment Protection Act, 1986 (Central Act 29 of 1986) and rules made thereunder, Any activity as specified in the schedule to the Notification No. S.O. 1533(E) dated the 14th September 2006 and as amended from time to time, issued by the Ministry of Environment and Forests, Government of India, As per prevailing statutes of the Kerala State Pollution Control Board., Any activity within 300-meter distance from any protected monument/area notified by the Archaeological Survey of India among others. It guides on the Siting, Floor Area Ratio, Development Standards for each type of building occupancy, setbacks, streets, etc. CHAPTER XVI WASTE DISPOSAL: Every new residential building of a built-up area exceeding 300 sq. meters shall be provided with suitable systems such as biogas plants etc. For the disposal of biodegradable waste, unless there exists an organized system for collection and disposal of such waste. For all other occupancies waste management system as stipulated by Pollution Control Board shall be provided; Ensure that the debris, construction wastes or materials are safely and disposed
Environment Department -Ban on single-use plastic items in the State, wef. 1.1.2020- GO MS No 6, 2019 Envt dt:27.11.2019 and other related orders	Blanket Ban on sale, manufacture, transport, and storage of single-use plastic items in the State from 01.01. 2020. All carry bags except paper and cloth bags free from plastic coating could be used. Compostable bags, plastic sapling bags, and plastic-coated leaves also are banned. Flex / PVC hoardings are also banned. Plastic straws and other things associated with packaged products are exempt from ban as they come under EPR. Compostable bags are to be used for collecting biomedical wastes.[40]

3.1.5 Technical Guidelines on Waste Management at State Level

List of Technical Guidelines, Specifications, and Estimates issued by the State of Kerala - Suchitwa Mission for various decentralized facilities, MCFs, etc are listed in ***Table 12*** below.

Table 12: Available Guidelines for Solid Waste Management at State Level

Agency	Particulars

[40] http://sanitation.kerala.gov.in/wp-content/uploads/2019/01/GO-NO-4.pdf

Suchitwa Mission	Specifications for: - Different Options for Decentralized Waste Management - Rate and specification on portable pre-fabricated biogas plant-mixed culture fed-batch type with separate digester and gas holder. - Waste management technologies for Houses/Residential colonies/Schools - Indigenous technologies for waste management in houses, residential colonies /Schools. - Specification, unit cost, standards protocols, subsidy norms for solid waste treatment plants set up or promoted by Local governments - Specification, unit cost, standards, O&M protocols, subsidy norms for solid waste treatment plants set up or promoted by Local governments Model Estimates for - Bio Composter Bins, Kitchen Bin and Bio-Digester Pot - 50kg Biogas Plant - Aerobic Compost (Thumboormuzhi) – Ten Types (sizes) - Model Drawings and estimate: Material Recovery Facility (Three types) - Guidelines and Specifications: Indigenous technologies for waste management in house/residential colonies /Schools
Haritha Keralam Mission	SWM Implementation Guidelines - Household Biowaste Management - Haritha karma Sena – SW Survey using Mobile App, Training - Empanelling of Service Providers - Social Auditing - Need for EMP for Hospital Wastes Management - Green Protocol, Swap Shops, Repair Shops - Brief on Resource Recovery Facilities
	Suchitwa Malinya Samskarana Campaign - Description of various SWM programs of Government: Household Decentralised, Thumboormuzhi, Dry waste Collection, MRF, Swap Shops, Kiosks, Repair Shops - Removal of waste dumps Year 1 – 30 percent, Year 2 – 80 percent, Year 3- 10 percent - MRF deployment in ULB types - Clean Canals, Model Hospitals, Crematoriums, Slaughter House - Need to find land for 6 regional sanitary landfills in State. Year 1- District Panchayats to Find Land - Recycling Park, Septage Treatment Plants

Kerala State Pollution Control Board (20/03/2020) has published Guidelines for Management of Bio-Medical Waste Contaminated / Suspected to be contaminated with COVID-19. https://www.keralapcb.nic.in/cmsadmin/fileUploads/covid19.pdf https://www.keralapcb.nic.in/cmsadmin/fileUploads/covid19.pdf

Also, Kerala State – Suchhitwa Mission has public various do's and don'ts and guidelines to various agencies on COVID waste management from Health Care Units, Quarantine Centres / Homes, public spaces, and common areas. https://suchitwamission.com/covid19/

3.1.5.1 Essential Compliance Requirements

In the absence of compliance with existing regulations, environmental parameters are impacted. Current SWM Rules 2016 lays down mandatory actions to be followed to ensure an environmentally acceptable SWM system. To ensure avoidance, mitigation, and management of impacts, all proposed systems to upgrade existing SWM services must meet the compliance requirements. The following ***Table 13*** suggests the compliance requirements for SWM systems.

Table 13: Compliance Requirements for SWM Systems

Sr. No	Parameters for compliance	Details	Key Observations
1	Approval and consent for the technology	Composting and bio methanation is the recommended technologies for the processing of biodegradable waste. However, the processing facilities greater than >5TPD capacity require the following permissions: a) Authorization under SWM Rules, 2016 b) Permit under the Kerala Municipal Building Rules for the Plant c) Consent to Establish and Operate from	**The** authorization to establish and operate the facilities (needed only for >5 TPD capacity) is granted by the Pollution Control Board only on compliance with the terms & conditions. Due to the non-suitability of most of the sites, as they are proximal to water bodies, human habitations, and high water table areas, it is difficult to get the permissions. However, considering the land constraints, the Pollution Control Board issues conditional authorization. The majority of the facilities in the state
2	Segregation and Storage of biodegradable and non- biodegradable waste at source	As per Rule (4) of SWM Rules, 2016, waste segregation into biodegradable and non-biodegradable is mandatory for waste generators.	This practice is followed in Kerala in all the ULBs. More than 90percent compliance may be considered; thanks to ongoing efforts on awareness creation
3	Type of waste for composting/ biomethanation	The SWM Rule 15 specifies that the composting/biomethanation only should be done for treatment of the wet organic matter	In Kerala, wet waste only is used for composting and biogas plants at the household level, community level, and city-level as per the SWM Rules, 2016.

Sr. No	Parameters for compliance	Details	Key Observations
4	Monitoring requirements for processing plants	Monitor environment quality as per Rule 16 (b) of SWM Rules 2016: SWM Rules, 2016, schedule II specifies standards for composting and incineration and none for biomethanation. Necessary precautions have to be taken to minimize the nuisance of odor, flies, rodents, bird menace, and fire hazards from composting.	Composting at the household level, if not done properly may lead to odor, rodent, and fly nuisance. This was observed in many households of Kerala practicing home composting. The monitoring of decentralized community-level facilities or centralized plants is also not carried out. Hence, it can be inferred that monitoring is not being done or not done up to the desired level at any of the processing units/facilities in the entire State.
5	Leachate management	This is mandatory as per Schedule II (B) of Rule 16 of SWM Rules 2016. The Rules suggest leachate recirculation in case of composting. In case of disposal into surface water, sewer, or land, it is to be treated adequately before its disposal. (Schedule II A and B of SWM Rules, 2016)	At the household level, the leachate quantity is insignificant in case of composting. Leachate at the household level could be easily collected and used as manure. However, the community level composters (aerobins) need a proper system in place for leachate management. No proper site development and drainage; or leachate collection and treatment facility is set up in almost all the city level composting units.
6	Avoidance of contamination of air, ground, and water	Mandatory as per Schedule II (a, b & f) of SWM Rules, 2016. Measures to be taken for prevention and control of environmental pollution especially due to leachate during composting and emission of gases during incineration.	Rodent issue is faced by the pipe composting units at the household level. Leachate issue is faced by all of the community and city level composting facilities, where proper management is not available. Further, studies done by KSPCB reveals the pollution of water bodies near the compost plants. Odor nuisance and flies, windblown dry wastes from vehicles, and MCFs are indicators of poor environmental management.
7	Scientific disposal of inert/reject from waste processing	As per Schedule I, clause C ii, till the time waste processing facilities for composting or recycling or energy recovery are setup, the waste shall be sent to the sanitary landfill.	No operational Sanitary Landfill in any ULB. The municipal waste is therefore disposed-off at open dumpsites in an unhygienic manner polluting soil, air, and water resources.

Sr. No	Parameters for compliance	Details	Key Observations
8	Buffer zone requirements	As per Rule 11(l), The state Urban Development Department has to notify the buffer zone for the solid waste processing and disposal facilities> 5 TPD in consultation with the State Pollution Control Board.	Not complied in most compost plant sites. These sites were earlier Night Soil dumpsite/waste dumpsites. There is no proper setback distance/buffer zones or green belts.
9	Adequate storage area for the end product	As per SWM Manual 2016, the Compost facility should have adequate space for the management of waste and compost maturity and storage of compost in the Compost Plant.	It has been observed that most of the operators/ULBs are unable to sell/ utilize the end product to the maximum extent possible, resulting in the accumulation of the end product within the facility, beyond its capacity.
10	The work environment for the staff	As per Rule 15 (zd), the ULB shall ensure that the operator of a facility provides personal protection equipment including uniform, fluorescent jacket, hand gloves, raincoats, appropriate footwear, and masks to all workers handling solid waste and the same are	The staff engaged at any treatment facility or recycling facilities are not given adequate PPE as per the Rule. Further, the unhygienic conditions prevail in Compost plants due to excessive leachate generation, fly nuisance, and emission of bad odor.
11	Health and safety requirements	As per the Water Act, 1974 and the Air Act,1981, the ambient water quality and ambient air quality around the plant area should be maintained and the standards should be complied with.	Due to the nature of operations, excessive leachate generation, lack of sanitary landfill facility, and improper management of all decentralized/centralized plants, ambient air, and water quality are poor. The monitoring data published by KSPCB (2017) and NGT directions indicate this aspect.
12	Reporting to PCBs	As per SWM Rules, 2016 the operator of the plant (Local Body) should file Annual Report to KSPCB in the format given in the Rules, on the status of management of waste performed during the reporting period	There is no regular system of reporting of status/Annual Report to KSPCB. In response to repeated follow-ups by KSPCB, incomplete format/partially filled up formats are filed by the local bodies.

3.1.6 Key Statutory Clearances Required

A list of permits/clearances required for most of the subproject activities are presented here. This and additional permit requirements shall be assessed at subproject levels based on proposed activities, in discussion with LBs and relevant authorities. A detailed list is presented in the Guidance Manual.

3.1.7 International Treaties

At the global level, India has been proactive in contributing to international deliberations towards conservation and management of ecosystems, biological diversity, management of wastes, and sustainable utilization of resources. India is a signatory to various conventions related to the environment and in this context, India has also enacted and implemented appropriate legislation and action plans for carrying out its international commitments. Key features of India's International Environmental Agreements are presented in ***Annexure III***. Provisions and guidance on these shall be considered during EIA preparation.

3.1.8 Applicability of World Bank Operational Policies and Guidelines to KSWMP

Since KSWMP Project is funded under the Investment Project Financing (IPF) instrument of the World Bank, its operational policies (OPs) and bank procedures (BPs) are applicable for the project.

In addition to being an IPF, KSWMP also aims to use Development Linked Indicators (IPF + DLIs)[41] and as under regular IPF, Environmental requirements apply to all activities for which Bank support is sought by the Borrower[42], whether they are financed by the Bank or from another source.[43] The World Bank Standards also apply to 'associated activities' – defined as facilities or activities that are not funded as part of the project, but are 'directly and significantly related' to the project, carried out or planned to be carried out, contemporaneously with the project, and necessary for the project to be viable and would not have been constructed, expanded or conducted if the project did not exist.[44] Likewise, the scope of the environmental assessment includes the 'area of influence' of Bank-financed activities, which may span an entire sector or region. In each case, the Bank policies are applied and compliance with them is verified at the same level.

[41] *IPF-DLI is a form of Investment Project Financing (IPF) and the IPF Policy, Directive and Procedure apply to it, as they do to regular investment lending. An IPF-DLI operation is subject to the same procurement, financial management, environmental and social, and anti-corruption requirements that govern any regular investment operation.*

[42] *as defined in the project's legal agreement between the Borrower and the Bank*

[43] *The environmental and social requirements applicable to IPF operations with Concept Decision or equivalent before October 1, 2018, are set out in OPs 4.00, 4.01, 4.03, 4.04, 4.09, 4.10, 4.11, 4.12, 4.36, 4.37, 7.50 and 7.60. Those applicable to IPF operations with Concept Decision, or equivalent, on or after October 1, 2018, are set out in the Environmental and Social Policy and Environmental and Social Standards, or OP/BP 4.03, as appropriate, and OP 7.50 and 7.60. It is possible that environmental or social consequences might follow from an action supported under a DLI without being triggered by any underlying expenditures – for example, a change in legislation to allow the privatization of state-owned mines or industries. IPF environmental and social requirements apply in this case as they do to eligible expenditures.*

[44] *See ESS 1, paragraph 11.*

Project Concept Note Review for KSWMP was before 01 October 2018 and hence World Bank Safeguard policies apply to the project. World Bank's Environmental Framework (ESF) applies to all project financing prepared to post the 1st of October 2018.

In addition to being an IPF, KSWMP also aims to use Development Linked Indicators (IPF + DLIs)[45], and as per WB guidance note, in such cases, the scope of the environmental assessment includes the 'area of influence' of Bank-financed activities, which may span an entire sector or region. Hence, wider stakeholder consultations and sectoral analysis using the SEA approach shall be followed. This would help in developing the environmental management framework, policies, and projects of regional or sectoral importance; the outcomes of which are important for the overall success of the program.

Description of Applicable WB Safeguard Policies

The World Bank has a set of OPs relating to environmental, social, and legal aspects of projects. A policy is considered to have been triggered if the project activity relates to the content of any of the safeguard policies. Various actions and instruments to ensure that the requirements of those applicable policies will be satisfied in the further development of the project are guided through the ESMF.

KSWMP project is categorized as an Environmental **Category A** project based on the potential risks associated with project interventions at regional levels. While the overall program is environmentally beneficial as the major investments are aimed at improving waste management in Kerala, limited impacts during construction and operation stages will need to be mitigated across the detailed design and implementation phases of the investments. The following environmental safeguard policies apply to the KSWMP.

Table 14: World Bank Safeguard Policies Applicable to the Project

Sl No	WB Safeguard Policies	Safeguard Policies Triggered by KSWMP	
		Yes	No
1	Environmental Assessment (OP/BP 4.01)	√	
2	Natural Habitats (OP/BP 4.04)	√	
3	Pest Management (OP 4.09)	-	√
4	Physical Cultural Resources (OP/BP 4.11)	√	-
5	Forests (OP/BP 4.36)	-	√

[45] *IPF-DLI is a form of Investment Project Financing (IPF) and the IPF Policy, Directive and Procedure apply to it, as they do to regular investment lending. An IPF-DLI operation is subject to the same procurement, financial management, environmental and social, and anti-corruption requirements that govern any regular investment operation.*

Sl No	WB Safeguard Policies	Safeguard Policies Triggered by KSWMP	
		Yes	**No**
6	Safety of Dams (OP/BP 4.37)	-	√
7	Indigenous Peoples (OP/BP 4.10)	√	-
8	Involuntary Resettlement (OP/BP 4.12)	√	-

The World Bank Group's Environmental Health and Safety Guidelines

The World Bank Group's Environmental, Health, and Safety (EHS) Guidelines are technical reference documents with general and industry-specific examples of Good International Industry Practice (GIIP). EHS Guidelines are applied as required by their respective policies and standards. These industry sector EHS guidelines are designed to be used together with the General EHS Guidelines document, which guides users on common EHS issues potentially applicable to all industry sectors. The EHS Guidelines contain the performance levels and measures that are generally considered to be achievable in new facilities by existing technology at reasonable costs. Application of the EHS Guidelines to existing facilities may involve the establishment of site-specific targets, with an appropriate timetable for achieving them. The applicability of the EHS Guidelines should be tailored to the hazards and risks established for each project based on the results of an environmental assessment in which site-specific variables, such as host country context, the assimilative capacity of the region. Defined as the exercise of professional skill, diligence, prudence, and foresight that would be reasonably expected from skilled and experienced professionals engaged in the same type of undertaking under the same or similar circumstances globally. The circumstances that skilled and experienced professionals may find when evaluating the range of pollution prevention and control techniques available to a project may include but are not limited to, varying levels of environmental degradation and environmental assimilative capacity as well as varying levels of financial and technical feasibility. Applicability of specific technical recommendations should be based on the professional opinion of qualified and experienced persons. When host country regulations differ from the levels and measures presented in the EHS Guidelines, projects are expected to achieve whichever is more stringent. If less stringent levels or measures than those provided in these EHS Guidelines are appropriate, given specific project circumstances, a full and detailed justification for any proposed alternatives is needed as part of the site-specific environmental assessment. This justification should demonstrate that the choice for any alternate performance level is protective of human health and the environment.

The World Bank Group EHS Guidelines for SWM, Water and Sanitation, Health Care Facilities and General EHS Guidelines contain information on cross-cutting Environmental, health, and safety issues applicable to SWM, and construction / Decommissioning activities and can be downloaded via the following links.

https://www.ifc.org/wps/wcm/connect/29f5137d-6e17-4660-b1f9-02bf561935e5/Final%2B-%2BGeneral%2BEHS%2BGuidelines.pdf?MOD=AJPERES&CVID=jOWim3p

https://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/sustainability-at-ifc/policies-standards/ehs-guidelines

https://www.ifc.org/wps/wcm/connect/960ef524-1fa5-4696-8db3-82c60edf5367/Final%2B-%2BHealth%2BCare%2BFacilities.pdf?MOD=AJPERES&CVID=jqeCW2Q&id=1323161961169

CHAPTER 4. ASSESSMENT OF EXISTING WASTE MANAGEMENT SYSTEMS

This chapter discusses existing Solid Waste, C&D Waste, and Biomedical Waste Management Systems in Kerala.

4.1 Project Area and Spatial Boundaries

It is expected that 87 ULBs (of the total 93; all except the 6 municipal corporations) spreading across 14 districts of Kerala and few Grama Panchayats nearby are proposed to be covered under Kerala Solid Waste Management Project (KSWMP). The location of ULBs is depicted in the following ***Annexure I***. Detailed Baseline of each ULB including Physiography, administration, climate, area, population, density, socioeconomic aspects such as literacy and ethnic groups, presence of forests, rivers, lakes, watersheds, coastal areas, other sensitive features, archaeological importance, pilgrim areas, tourist spots, disaster proneness, waste quantities, treatment and disposal facilities is also presented in ***Annexure I***. A photo-walkthrough of the baseline Solid Waste Management system and highlighting its impacts are presented in the ***Annexure II.***

4.2 Studies and Surveys to Establish the Project Baseline

To understand the level of existing SWM services, 12 ULBs (out of 87 ULBs) were selected. The selection of ULBs is based on criteria to ensure the representativeness of ULBs and reflect the SWM conditions across Kerala.

a) Selected 12 ULBs are distributed across 9 out of 14 districts in Kerala, providing for significant spatial representation at 64percent.
b) Of the 12 ULBs sampled (13percent of the total ULBs in Kerala)
i) 5 are in North administrative zone, 4 in South, and 3 in Central zone1 respectively. Fourteen (14) districts of Kerala are grouped into 3 Administrative Zones; North (Kasaragod, Kannur, Wayanad, Kozhikode), Central (Malappuram, Palakkad, Thrissur, Ernakulam, Idukki) and South (Kottayam, Kollam, Thiruvananthapuram, Alappuzha, Pathanamthitta)
ii) 9 ULBs are local economic development centers catering to small and medium-scale industries, including trading and other service sectors like medical tourism.
iii) 5 ULBs have a strong heritage character (pilgrimage/religious tourism centers) with a significant floating population footprint.
iv) 4 ULBs are coastal towns; 5 spread across plains; 1 in flood plains and 2 in hill regions.
v) Peri-Urban Development: Rapid urbanization and peri-urban development in 4 ULBs can impact solid waste generation.
vi) Proximity to Regional Integrated SWM projects: 6 ULBs.
vii) Population: 5 towns with less than 50,000 population, 5 between 50,000 and 1 lakh population, and 2 above 1 lakh population.
viii) In terms of population coverage, this set covers ~11.5percent of the State's urban population (6.2 million excluding 3 major Corporations - Trivandrum, Kozhikode, Kochi) is covered by the sampled towns.

ix) 3 of the selected 12 ULBs, viz. Alappuzha, Kalpetta, and Kasaragod are district headquarters.

For sampling, the property tax assessment database of Information Kerala Mission (IKM) was used in consultation with ULB authorities. The purpose was to distribute different categories of establishments and the magnitude/ impact across the study towns. The 18 different assessment categories were finally were aggregated into three broad categories for analysis (viz. households, commercial and institutional) and presented below. In each ULB, at least 100 generators were identified and distributed across categories. In all, around 1222 generators were surveyed, amounting to nearly 0.5percent of the total generators in the 12 ULBs

Besides, to capture the present scenario of treatment and disposal of MSW and their impacts in the State, the following 6 cities were selected for study:
1. Attingal (18 TPD)
2. Punalur (18 TPD)
3. North Paravur (15 TPD)
4. Thodupuzha (22 TPD)
5. Kollam (228 TPD)
6. Alappuzha (79 TPD)

The selection of cities was made considering (1) Geographical location: coastal/midland/highland, (2) Size and population density: high, medium, and low-density ULBs and (3) Technologies in practice: cities having centralized/decentralized technologies.

The assessment covered the study of waste quantity and composition of waste, existing waste treatment/processing, and disposal technology/methods adopted and assessed the acceptance, appropriateness, adequacy, and deficiencies of the technologies adopted for the treatment of biodegradable waste and management of non-biodegradable waste.

Sampling Techniques and Methodology

Sampling points and methodology is primarily influenced by the techniques adopted for quantification of solid waste. Depending on the size of the city and resources available, there are varieties of techniques for estimating the quantity of waste generated by a community. Some of the important techniques are:

- Modeling Techniques that apply generic waste generation rates and other community features for predicting waste quantities;
- Physical Sampling Technique that use statistical methods to predict total waste stream quantity and composition by analyzing small volumes;
- Direct Measurement Techniques through pilot studies to collect type and volume of waste generated by the community; and
- Indirect Method through assessment and summing up of the quantities of waste (i) collected and transported; (ii) the backlog in collection and transportation; (iii) the waste separated for recycling; and (iv) the quantity disposed at source.

Since the Direct Measurement Technique provides more reliable information on waste quantity and characteristics, this technique was adopted for assessing the quantity of waste generated in all the 5 ULBs. These surveys involved the measurement of per capita waste generated from domestic sources and the unit generation trends of non-domestic sources. The measurements were carried out by collecting waste from carefully selected samples.

To assess the physicochemical characteristics of the waste, on-site physical analysis, and lab tests were carried out. The details of the surveys carried out and the results obtained are discussed in subsequent sections.

Assumptions: The following assumptions were made to estimate the quantity of waste generated from different sources

- Function halls: occupancy: 25- 30% in Municipalities, 40 to 50% in Corporations.
- Hospitals: Average daily waste generation is estimated based on the occupancy rate. The occupancy of beds in hospitals varies from 60-100%. Government Hospitals generally have higher occupancy. The estimation is done only for non–infectious waste.
- Offices & Institutions: Most of the offices & institutions work 6 days in a week. However, the calculation is based on all 7 days.
- Street sweeping: Major part of Street sweeping comprises of litter. This has been covered in the source study (littered waste). Other part such as leaves etc. falling from avenue trees is not estimated here.

The field survey was carried out for determining the unit rate of waste generated. The entire representative sample selection, consultations with health Inspectors, resident associations, hospital authorities, merchants, and traders was carried out. The field survey was carried out for selected sample sources for three consecutive days – Friday, Saturday, and Sunday to capture the weekend waste generation trends. Household Sampling: The above field surveys include household samples spread across 11 cities representing different socio-economic groups encompassing different income groups, the standard of living, family size, main occupation, etc.

Non-Domestic Source Sampling: In the case of other sources such as commercial establishments, hotels, markets, institutions, etc., first a field reconnaissance survey was carried out to assess and understand waste generation trends. Then samples from 6 different sub-categories were collected. The subcategories were based on capacity and nature/quantity of waste generation, to have a fair coverage of representative units. A three days survey of the 6 sub-categories was carried out.

4.2.1 Status of current waste management practice of Kerala

The detailed scenario of management practices of Solid Wastes, C&D Wastes, Biomedical Wastes, E-Wastes, and Hazardous Wastes Current has been presented in Volume I. In brief, current coverage of waste management in Kerala involves: mostly segregated storage of waste – biodegradable and non-biodegradable solid wastes (no further segregation if non-biodegradables); primary collection system covering few cities - mostly partly; transportation of waste only in Corporations and ULBs where there are centralized treatment facilities, few partially compliant centralized treatment facilities (which covers only part of respective city wastes), few cities with partially compliant decentralized community-level waste treatment units, variety of household-level units to treat waste few of which are effective and maintained. In most cities/towns and Panchayats, waste is dumped on available parcels of land and is many times seen openly dumped and burned along road verges and available open lands.

C&D wastes are usually seen mixed with solid wastes and dumped either in dumping yards or low lying areas like paddy fields, road verges, water bodies, and open/unused land. Private contractors also collect C&D wastes and transports for reuse or dumping.

- Presently, a formal system of C&D waste collection and processing/re-use is not followed in the ULBs studied.
- C&D waste handling is presently done by generators through private sector contractors and disposal of C&D waste is done through the filling of low-lying areas and basement/foundation filling in new construction.
- C&D waste handling and processing/re-use are not stipulated by ULB as part of construction and demolition permits issued.
- Increasing the cost of raw materials such as granular material for uses such as sub-grade/sub-grade or berm formation in road laying, daily cover in landfills (proposed) and at existing dumpsites is expected to spur the formation of C&D waste facilities across the State.

Biomedical wastes from many hospitals are being transported to the CBMWTF at Palakkad. There, it is being treated and disposed-off following regulations. E-wastes are collected mostly by ragpickers or certain agents (including Clean Kerala Company) who provides this to PCB approved recyclers. Hazardous wastes generated by the industries (minimum number) in the State are being transported for scientific landfilling to the TSDF at Kochi.

4.2.2 Waste Characterization & Quantity

4.2.2.1 Solid Wastes

Current waste generation rates and waste characterization details for the State as derived through the above-detailed studies and analysis is presented here (***Table 15***). Total solid waste generation in the State is around 8000 to 10000 TPD. The total waste generation for 2020 for the 93 ULBs (Municipalities plus Corporations) in the State is estimated at 3755 TPD.

Table 15: Source - wise Waste Generation

ULBs and Parameters	Household waste/ Capita	Shop waste /unit	Hotel waste/unit	Institution& Office waste/ unit	Market waste/ unit	Hospital waste/ Bed	Function halls waste/unit
Per Unit	0.28	1.16	23.94	1.65	977	0.68	62.74

Average per capita waste generation

Municipal towns: 419 grams/capita/day

Municipal Corporations: 545 grams/capita/day

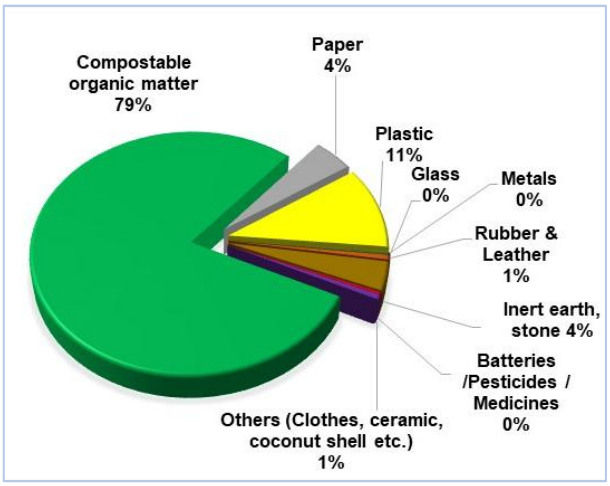


Figure 23: Waste Characteristics: Municipal Towns

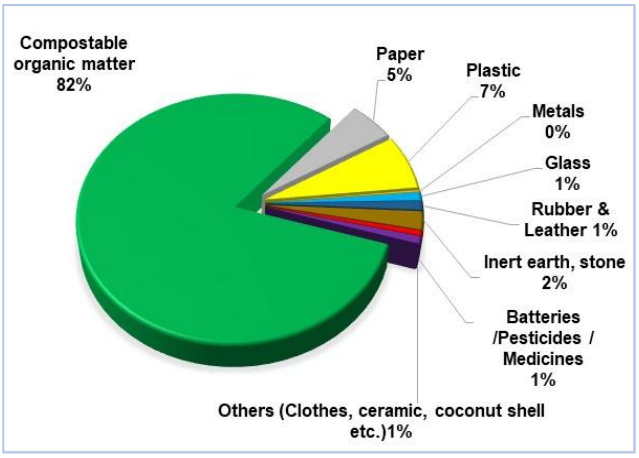


Figure 22: Waste Characteristics: Municipal Corporations

Solid Waste Composition

Total SW generation in Kerala is 4 Million Tons annually. Total waste generated by 87 municipalities is around 45 percent of the total waste generated in the State; while 15percent is generated by its 6 municipal corporations and the remaining (40 percent) by the Grama Panchayats.

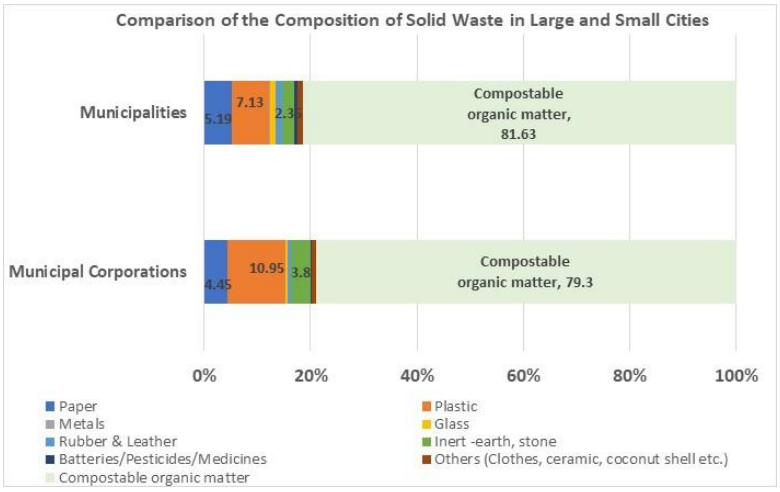


Figure 24: Composition of Solid Wastes in Kerala

Most of the solid wastes in Kerala comprises of organic matter.

The following ***Table 16*** presents the composition of wastes in dumping yards and collection points in various towns and cities of Kerala during October – November 2019.

Table 16: Composition of Solid Wastes in Kerala

Parameter	**Collection Point samples**				**Disposal Site samples**			
	Kollam	**Kochi**	**Thrissur**	**Kozhikode**	**Kollam**	**Kochi**	**Thrissur**	**Kozhikode**
Bulk Density, kg/m³	168.79	260.92	265.05	272.88	207.06	267.81	339.75	327.65
Paper %	3.32	3.36	4.87	3.10	5.71	2.74	4.42	4.38
Plastic %	2.05	2.46	4.83	2.95	2.36	2.26	4.10	4.39
Metals %	0.71	0.61	0.35	0.32	0.38	0.25	1.03	0.51
Glass %	1.85	1.36	1.06	0.76	0.68	0.47	2.04	1.06
Rubber and Leather %	1.50	2.17	1.50	0.84	0.93	1.31	1.42	1.53
Inert %	1.44	1.82	1.74	0.77	1.85	1.06	1.81	0.00
Ash and Fine Earth %	2.75	3.47	1.68	1.90	5.06	6.43	3.68	2.45
Compostable Organic Matter (%)	83.90	81.85	79.78	88.34	79.28	82.51	77.14	84.32
Batteries/Pesticides/Medicines (Hazardous) %	0.93	0.62	0.28	0.17	0.46	0.33	0.74	0.38
Others %	1.55	2.26	3.90	0.85	3.29	2.63	3.63	0.96

Though the presence of paper is less in collection point samples, some paper is finding its way probably from sources from where the collection is not organized like small industries. Bulk density is high in disposal site samples and so is the presence of ash and fine earth. C&D waste gets deposited in dumping sites. Compostable organic matter holds the major part of the solid waste at collection point as well as disposal point. A very small portion of Hazardous matter such as batteries, pesticides, and medicines also are detected at collection and disposal points which is important owing to its pollution potential albeit small quantities. There is a need for proper segregation and storage at source and responsible collection of segregated items separately; to avoid mixing.

The organic fraction is around 80% showing a decrease from the results of the study carried out by the Kerala Sustainable Urban Development Project (KSUDP) in 2006. While plastic fraction increased considerably, the increase in paper content is not to the same extent. A considerable reduction is seen in inert – stone, earth, etc. possibly due to improved conditions. North Paravur results show a comparatively lesser percentage of plastics, which may be due to plastic reduction promoted by the Municipality.

Chemical Composition

Chemical Properties such as Carbon, Nitrogen, and Calorific value were analyzed in the lab. This will help in selecting appropriate processing technologies. The KSUDP 2006 indicates moisture content in the range of 55 -77 from collection points, CN ratio in the range of 20-30. Calorific value (CV) is reasonably good considering the mixed nature of waste and high moisture content (<1600 kcal /kg), but with potential odor nuisance.

In 2019, as part of this study, samples were collected from secondary collection points of Thiruvanthapuram and landfill site samples of Attingal. The analysis was carried out in the National Institute for Interdisciplinary Science & Technology (NIIST), Thiruvanthapuram.

In 2019; average moisture content found high-75.68% probably as the samples were taken during heavy rains. CV is found much lower than the similar studies done earlier or those carried in other parts of the country. One of the reasons for low CV is that the waste overflowing out from sources contains a lesser fraction of HCV materials; indicating the prevalent formal/informal recycling activities.

Table 17: Chemical Characteristics of Solid Wastes in Kerala

Parameter	***Values***	
	Analysis -2019 (Monsoon)	***Analysis -2006 (Pre-monsoon)***
Moisture content	74.9	67.1
Volatile matter	19.80	65.7
Ash Content	4.5	29
CV	510.8	1755.9
Carbon	12.0	29
Nitrogen	0.6	1.3
CN ration	21.0	23.8

C/N ratio is a direct indicator of the suitability of waste for bioconversion of MSW. Calorific Value is the indicator for waste to energy technologies. CV here is indicative of anaerobic digestion or composting technologies than Waste to Energy options.

4.2.2.2 C&D Wastes

Waste comprising of building materials, debris & rubble resulting from construction, remodeling, repair & demolition of any civil structure are called the C&D Wastes. Like many other developing countries, India also generates huge quantities of C&D waste each year. In 2001, the Technology Information, Forecasting, and Assessment Council estimated the national annual C&D waste generation to be around 12 to 14.7 million tonnes. TIFAC estimated that demolition generates an average of 300-500 kg waste per sqm of construction; new construction generates 40-60 kg waste per sqm and renovation generates 40-50 kg waste per sqm. Per capita, C&D waste generation was estimated at 10 kg per annum.

Extrapolating the data as per expected urban population growth, it would appear that India will generate approximately 2.7 billion tonnes of C&D waste annually by 2041.

Characterization studies on C&D waste in India are minimal since it is usually collected and mixed with MSW. TIFAC's waste characterization study highlighted soil, sand, and gravel (fines); brick and masonry, and concrete as the three largest fractions accounting for 90percent of the waste. Similar studies were carried out in Delhi (IL&FS Ecosmart, 2005) and Coimbatore with bulky materials, jointly found to occupy 90percent and 91percent respectively. The remaining 10percent comprises of wood, metal, bitumen, plastics, etc.

KSUDP estimates 7.38 TPD of C&D waste generation in Kollam MC (4 percent of the total waste generated) in 2001; while the estimate for Thrissur was 13 TPD (8 percent of total solid waste generation). Corporation of Cochin has estimated the generation of C&D wastes as 6.93 percent of its total MSW; equivalent to 21 TPD in 2007. Ponnani Municipality had estimated that C&D wastes constitute 5.5percent of total solid waste generated in small towns like Ponnani amounting to 2.8 TPD in 2015.

Considering an average of 5 TPD of C&D wastes per town, total C&D waste generation for all 87 Municipalities (sans major corporations which are major C&D Waste generators) may be estimated as around 500 TPD. The state has no C&D Waste management facility today. Considering the C&D wastes from municipal corporations, it is feasible to start four facilities of 200-300 TPD capacity each.

4.2.2.3 Biomedical Wastes

According to a report by CPCB, Kerala has the highest number (about 27percent) of health care institutions in India. The total bed strength of hospitals in Kerala is 1, 13,530 of which 43,273 are in the Government sector, 2,740 in the cooperative sector, and 67,517 in the private sector. The waste generation rate in healthcare establishments ranges between 0.5 and 2.0 kg bed per day. The solid waste from the hospitals consists of bandages, linen, and other infectious waste (30-35percent), plastics (7- 10percent), disposable syringes (0.3-0.5percent), glass (3-5percent) and other general wastes including food (40-45percent). (The yellow bag which carries the Incinerable waste is 30-50percent of the total BMW. The Blue bag of contaminated plastics and rubber is 30-35percent plastics. The needle, scalpels, blades, and other sharps in white bags/boxes are 5-10percent. The Glass and metal body parts are assessed for 5-10percent). Thus the quantity of biomedical waste generated in whole Kerala is estimated to be around 50 – 60 tons per day. According to the Indian Society of Hospital Waste Management, The quantum of waste that is generated in India is estimated to be 1-2 kg per bed per day in a hospital and 600 gm per day per bed in a general practitioner's clinic. It is estimated that only 5 – 10percent of this comprises of hazardous/infectious waste (5 – 10kgs/day) This excludes the biomedical wastes produced by clinics, labs, and small nursing homes. Also, biomedical waste generated from emergencies like COVID 19 (including home quarantine) requires treatment and disposal facilities.

Currently, the IMAGE facility – CBMWTF in Kanjikode, Palakkad can handle around 40 tons of biomedical waste. This facility is unable to take care of entire biomedical waste generated at hospitals and health care institutions spread across the length and breadth of the state. There is a need to establish at least two more biomedical treatment facilities, one in the central part and others in the southern part of the State.

4.2.3 Description of Current Solid Waste Management Practices

4.2.3.1 Waste Segregation Practices

Typically, households (HHs) practice 2 broad forms of segregation – a) Bio-degradable wastes (BDW) and Non-Bio-degradable Wastes (NBDW) (48percent); and b) BDW, NBDW and Recyclables (52percent). ULBs such as Aluva, Attingal, Guruvayoor, and Varkala indicate the most willingness for three-way segregation, whereas Kalpetta, Alappuzha, and Perinthalmanna segregate only BDW and NBDW. The other towns indicate both types of segregation practices. Among commercial and institutional establishments, a similar pattern and level of source segregation were observed. Thus, almost 90 percent of the households practice segregation and is an indicator of their willingness to segregate; which is most important to ensure proper channelization of unmixed - segregated fractions for separate treatment/recycling of different fractions of wastes.

4.2.3.2 Waste Storage Practices

Plastic bags and covers and dedicated wastebaskets/bins covers are commonly used modes to store waste by all generators (60percent to 75percent). The use of plastics continues to be significant (> 30percent to 100percent) in nearly 50percent of the ULBs surveyed. Respondents in the other 6 ULBs use re-usable wastebaskets. Most households have at least two bins for segregated storage of wastes. For wet wastes / BDWs, covered bins were mostly used. In many ULBs people have been directed to use different colored bins for wet (usually green) and dry wastes (orange or blue in many places).

In around 80percent of the cases, waste storage containers were self-owned, except in Perinthalmanna where containers were provided to economically weaker sections / BPL households by the ULB. It was observed that the segregation level was 88percent in Perinthalmanna.

Around 23percent of HHs, 73percent commercial establishments, and more than 50percent of institutional respondents indicated that hazardous wastes were not being generated. There is a significant level of awareness towards segregated disposal of domestic hazardous wastes. However, 20percent of HH respondents were responded that they mix such wastes with other HH wastes in several of the ULBs (significantly higher ratio of above 80percent in Kalpetta and Kasaragod). There is a need to achieve higher levels of segregation in case of hazardous waste. There is no relationship observed between segregation levels and parameters such as the type and location of these towns.

Awareness towards segregated disposal of hazardous waste among all categories needs to be further promoted regularly and outcomes in terms of segregated collection and disposal need effective monitoring. The State needs to frame guidelines and implement the same, to enable segregation of household hazardous and biomedical and to collect it separately and transport to available hazardous waste / biomedical facilities in the State to avoid dangers of mixing these with other wastes.'
ULBs may support economically most deserving households / BPL households with separate containers for segregated storage of wastes. Other households can purchase their bins as a commitment/contribution to fulfill the responsibility of waste segregation.

4.2.3.3 Street Sweeping

- Street sweeping waste predominantly comprises horticulture type waste (leaves, twigs), inert materials (sand and grit), and NBDW from littering.
- Sanitary workers in ULBs use the collected wastes from street sweeping for purposes such as daily cover spread in the Thumboormozhi aerobic composting units.
- However, due to the limited capacity of the aforementioned community-level composting units, open burning of street sweeping wastes was also observed in several of the study ULBs.
- Inert materials from street sweeping pursuant to necessary screening can be used as daily soil cover supplements in proposed sanitary landfills.
- However, since SLFs do not exist, the only viable use that can be envisaged on an imminent basis in the ULBs is the spreading of collected and screened street sweeping waste on existing dumpsites to mitigate vector/bird/rodent nuisance.
- The development of a detailed system of street sweeping waste collection and processing systems can be performed only in conjunction with the development of a full-fledged community and centralized bio-degradable waste processing systems.

4.2.3.4 Collection and Transport of Waste

Households and institutions responded that wastes were collected from their premises every alternate day, whereas daily collection was being practiced for commercial establishments. Among HHs, Aluva, Attingal, and Guruvayur have a partially implemented BDW collection system while it is minimal/ absent in many other ULBs. Open dumping of waste was recorded among 18percent of respondents in Kasaragod and 25percent in Thalassery. About 20percent of household respondents in Varkala indicated the burning of all wastes including BDW. About 23percent to 30percent of respondents indicated that door-step collection for NBDW was performed through motorized vehicles while 6percent to 10percent of respondents indicated manual collection using gunny bags. Balance respondents indicated that the collection was performed using push-carts and tri-cycles. The following can be summarised regarding Collection and Transportation of solid wastes:

- ULBs in Kerala lack adequate land for the establishment of centralized waste processing and disposal. Therefore, a fully developed system of waste collection

and transportation including support for the collection of residual wastes from decentralized/ captive waste processing systems in both the residential and non-residential segments is found lacking in ULBs.

- Transport in waste collection services are two-pronged: a primary collection of NBDW involving lifting and removing such wastes from households, shops, offices, markets, hotels, institutions, etc. and transporting it to a point for further segregation or aggregation at the large storage location.
- Non-motorized vehicles (pushcarts, tricycles, wheelbarrows, etc.) are typically used for transport at the primary collection stage since the volume of wastes is minimal and frequency is staggered (monthly in residential and weekly in non-residential segments).
- In most towns, secondary collection involves collecting wastes from intermediate road-side locations such as markets, community bins, bus terminals and transport for further processing or disposal; using mechanized transport such as large tippers, trucks sometimes covered with tarpaulin sheets, closed carriers, compactors for bio-degradable waste handling at the bulk generation level and aggregation from the respective primary collection system.
- Since the nominal radial distance from the collection points to the existing community/ centralized facilities are less than 10 km, transfer stations are not mandated/ present in the study ULBs. Therefore, most transfers from primary to secondary collection vehicles occur en-route at road-side points using mostly manual transfer by the handling workers.
- Presently, ULBs in Kerala follow three types of collection and transport, viz. BDW only, NBDW only, and mixed waste (BDW & NBDW). Nearly two-thirds of study ULBs (12 nos.) collect and transport NBDW only.
- In ULBs with centralized waste processing facility(s), both wastes are collected. Pushcarts, tricycles are common vehicles used for primary collection and Light Commercial Vehicles (LCV) like Auto / TATA Ace type / APE / Mini Trucks / pick up vans, Trucks / Jeep / Tippers are used for transportation to dumping yards. Dumper placers / Tractor-trailer / Compactors are used in large ULBs for long haul transport to the centralized processing/ disposal facilities. In ULBs such as Guruvayoor and Perinthalmanna, primary collection also uses mechanized transport directly.
- In Aluva, Attingal, Kalpetta, Kothamangalam, and Neyyattinkara, overall collection (primary and secondary) is performed through 2 or 3 Tippers with the support of around 10 to 15 non-motorized vehicles (pushcarts, tricycles, etc.).
- Contract system of vehicle hire and maintenance is also followed in some ULBs wherein investment costs are avoided. However, hire costs are very high consuming a large part of the annual budget for SWM.

The frequency of collection of non-biodegradable waste is significantly low on either monthly basis or unscheduled where ULB appointed NGO agencies/ private sector perform such collection across all ULBs in the ‘household’ category. In the case of commercial and institutional categories, the collection is mostly weekly based. BDW is seen transported in open trucks or trucks covered with tarpaulin sheets. In many cases, Wastes overflows and dripping leachate from the trucks were observed.

Workers are not seen practicing any safeguards while dealing with various types of wastes.

Small winding roads, in steep gradients, may need pushcarts or tri-cycles for short distances. In remaining areas, separate auto three-wheelers or auto two-wheelers with separate containers for dry and wet wastes can be a good option. Since segregation is being practiced by many; it is important to ensure that the wastes are not mixed during collection and transport.

It is important to collect BDW every day from households and alternate day/weekly twice collection of NBDW and fortnightly collection of household hazardous/biomedical wastes. However, Household hazardous and biomedical wastes shall be collected through a separate system. It is important to have a proper transportation system for various segregated streams of wastes in closed vehicles; without waste overflows or leachate dripping. Collection and Transportation system shall ensure a) No direct handling of wastes by workers, b) no wastes on the ground during collection, transfer or tipping; and c) no manual handling of wastes even while transferring from one vehicle to another. Workers shall be trained to follow proper safeguards and use Personnel Protection Equipment (PPEs). There shall be proper vehicle parking, maintenance, and cleaning facilities.

4.2.3.5 Status of current Biodegradable waste Treatment and Disposal Practice

This subsection presents the existing practice of treatment of BDWs at centralized and decentralized levels.

Dumping of Wastes
Available / designated dumping yards (often referred to as 'landfills') are used to dispose of untreated wastes in most cities /. Panchayats in Kerala. In the absence of an efficient SWM system, waste is sometimes found along road verges, open plots, or seen deposited in water bodies, forests, low density, and low lying areas. Details of some of the dumping sites in ULBs are presented in ***Annexure III.***
None of the treatment units/cities/towns / Panchayats in the State have landfills for rejects/inerts which form 20 percent of the total waste reaching the Treatment facilities each day. These also finally reach the dumpsites/dumps or waterbodies.
Status of centralized treatment of waste facilities
Environmental issues and resultant closure of SWM facilities at Thiruvananthapuram: Vilappilsala, Kollam: Kureepuzha, Thrissur: Laloor, Alappuzha: Sarvodayapuram are famed in the history of SWM in Kerala. All these facilities had meager environmental management measures and were polluting - emitting leachate, odor, and piling up rejects and inerts around them; causing public upheaval against waste treatment in the State.
Of the 6 cities under the Strategic Assessment study, Kollam, Thodupuzha, and Alappuzha cities have closed down their centralized treatment facilities and are depending on decentralized options. Centralized composting facilities at Kochi, Kozhikode, Palakkad are not well-performing with environmentally sound practices. The treatment facility at North Paravur seemed better managed. Kozhikode Compost Plant was till recently managed well by IL&FS Environmental Infrastructure and Services Ltd. with a good market for compost.
Punalur town has temporarily shut the operations at the centralized site due to public protest. North Paravur and Attingal towns are both promoting the centralized treatment of biodegradable waste besides decentralized systems. The centralized composting facility in

North Paravur is under-utilized, whereas Attingal facility having windrow and vermicomposting and bio-methanation has been able to cover a large portion of waste generated by the city. The leachate is controlled by adding coir pith mixed with inoculum. Treatment facilities in North Paravur and Attingal though working well; need environmental up-gradation. Punalur Plant has leachate and odor issues that need to be mitigated.

Status of decentralized treatment facilities

All the cities /towns are partially promoting waste treatment at the source; both at the household level and community level.

a. Use of technologies at the household level

Household composting has been widely promoted in the State. IT has met with challenges especially in town areas where living space is limited. One major challenge has been the lack of a developed operation and maintenance ecosystem. In these circumstances, complaints regarding the odour have been received.

Biogas facilities at the household level

Portable Biogas units with the floating dome of 0.5 m3 capacity are found acceptable as they produce cooking gas for household use and reduces the cost of fuel. High capital cost and maintenance requirements are the issues cited by households.

Decentralized Waste Management facilities at Household Level in Sample cities/towns

Name of ULB	Total HH	No of HH having processing facilities	Coverage
Attingal	7500	312	4percent
Punalur	13237	6200 (partly used)	47percent
Alappuzha	42897	5300	12percent
Thodupuzha	12604	6440	51percent
Kollam	83800	2182 (60percent operating)	3percent
North Paravur	8954	3200 (50-60percent operating)	36percent

b. Community-level treatment

Aero bins

Aero bins are placed in some towns/cities. These are found acceptance in some parts of the State as community-level facilities as the aeration allows less odor. These facilities are highly underutilized as citizens are expected to deposit the waste at these facilities. The waste reaching this facility is limited as the generator has to follow the 'bring system'.

Rooftop bio-bin composting

Community-level facilities setup under community-level initiatives called "Clean City Movement" started by Confederation of Real Estate Developers Association of India (CREDAI) provide services to high-rise apartments, gated communities. The segregated biodegradable waste is treated at the rooftop and non-biodegradable material is transferred to recycling units. For an effective and speedy composting process, scientifically cultured soil bacteria are used as inoculums. The conversion time to compost is 30-40 days. The bins are placed on the terrace of the apartments. CREDAI in Kerala provides bins, supplies inoculums, and manages the composting process and markets the same. (CREDAI CLEAN CITY MOVEMENT METHODOLOGY: KOCHI MODEL). The compost is marketed in the highland areas of Kerala for plantation use.

The decentralized model of treatment is not common in Kochi and may be due to the availability of a centralized facility or lack of space for setting up such decentralized

facilities. Home composting is being done mainly by residents having Kitchen /Home gardens or where retired people live. The Community composting in high-rise buildings are being operated without issues as they are manned and supervised by CREDAI. There is no market in the city area for the compost produced from these facilities.

c. Institutional level treatment

Biogas units

Institutions are found to be preferring biogas plants. Biogas plants are seen set up in hotels, hospitals, slaughterhouses, markets, etc. There were 40 biogas plants in the 6 cities taken up for the study. Biogas units in the market were found working in all the sample cities except Kollam. The bio-methanation facilities operated in the Ernakulum market, Ayurveda Hospital, Mattanchery were found non-functional whereas similar facilities in Thodupuzha, Kollam, and North Paravur are found working.

Incineration plants

Incinerators provided in (North Paravur & Kollam) function halls and hospitals(for solid wastes) are not in compliance with SWM Rules, 2016. Mixed waste is burned mostly using large quantities of fuel, and ash is not disposed-off properly.

Marketing of compost

The marketing of compost is found to be a major issue. North Paravur is the only exception as it could build consumer confidence by producing good quality compost from unmixed organic waste.

Giving away food waste to pig farms

Pig/poultry farms situated in the peripheral area of towns/cities in highland and midland collects biowastes from towns. Many times rotten feeds (which may not be well segregated as well) are provided to the animals, which has the potential to create a public health issue.

Though most of the wastes generated are BDW, there is no proper system for its treatment (either at centralized or decentralized levels) and disposal of rejects which includes undigested fibers, silt and sand, soiled rags and other material, ash and coal, and other mixed fractions (as segregation is not full). Treatment facilities (though not fully compliant or efficient) are available in only 38 of the 93 ULBs. Among this, only 28 are functional as of date. This covers just around 20 percent of the total BDW generated here. The most common treatment systems are windrow composting and vermicomposting. Open windrows, odor/fly menace; leachate, and rejects have no community acceptance. Excessive monsoons necessitate good site drainage and full cover for treatment facilities. Fewer takers for final products (compost and slurry) and absence of disposal facilities for rejects results in piling of these in waste dumping yards.

All ULBs have waste dumping yards of areas ranging from 2 to 10 acres (or more for large ULBs) with legacy waste piled to a height of 2 to 8m (in case of Corporations only). Some duping yards have structures erected for working / defunct treatment facilities and compound walls. Dumpsite fires are common in Kerala raising air pollution and safety concerns. Though the Rules mandate ending open dumping municipalities are yet to find suitable solutions. Buffers around waste disposal facilities are mandatory as per the Rules. However, there are not notified or followed sometimes due to the high densities of the population around dumping yards. Land for waste treatment/disposal is not scientifically demarcated in the Town Development / Master Plans, and in case this is demarcated tit is not followed on the ground.

4.2.3.6 Status of current Non-Biodegradable Waste Management Practice

This subsection presents the existing practices of the treatment of Non-Biodegradable wastes in Kerala.

The State has taken a good initiative to setup MCF and RRF in all local bodies in the State to effectively manage non-biodegradable waste. However currently, the collection of dry waste is limited to plastic waste only in most of the cities other than Punalur. Plastic waste is brought to MCF/RRF facilities where it is sorted into higher and low-grade plastics. The low-grade plastic is shredded and baled at large MCF/RRF facilities and passed on for use in tar road construction through Clean Kerala Company. Whereas, high-grade plastic is directly disposed through private agencies for recycling. Non-plastic waste like cloth, domestic hazardous waste etc is collected on a monthly/quarterly basis.

Quantities to the tune of 39.54percent of the non-biodegradable mixed recyclable wastes are collected by the informal sector from the doorstep.

Upgrading MCF facilities in terms of SWM Rules, 2016 needs to be considered. North Paravur is disposing of the dry waste and e-waste through a private agency. Regional facility to upscale the dry waste especially plastic into granules and blocks is also worth considering its reuse and disposal possibilities.
In Punalur Municipality all types of non-biodegradable material are collected from decentralized points in the city, brought to MCF/RRF, segregated into different components, and sold to recyclers through monthly auction.

MCFs have come up in certain cities/towns to collect dry wastes. MCFs and MRFs are mostly in dense areas in the towns in the absence of any siting or deployment guidelines for the same though Suchitwa Mission has prepared typical design, specifications, and estimates for these. Most of the MCFs are overflowing with collected wastes and need better facilities for storage of wastes, fire safety, and environmental upkeep.

4.2.4 Baseline Environmental Parameters near Key Dump Sites

Baseline parameters of environmental components near some of the key dumpsites of Kerala are presented here.

Water Quality

A review of baseline surface water quality near some of the existing major dumpsites indicates objectionable odor and taste. pH is mostly in acceptable range; more towards acidic nature. TDS levels were found high in one sample. Fecal coliforms were present. DO levels were supportive of fishes and other aquatic species. Groundwater samples from the wells near the SWM sites also showed better quality of water (when compared to IS: 10500 (2012) for drinking water standards), except a slightly acidic nature and presence of coliforms (Total Coliform count). Water quality details of surface and groundwater sources near sample large SWM dumping yards in Kerala are presented in ***Annexure I***.

Air Quality

Maximum concentrations of all the air quality parameters near main SWM dumpsite (of Kerala, in Kochi) are well within the National Ambient Air Quality Standards (CPCB, NAAQS, 2009):

- PM10 ranged between 21.3 µg/m3 to 69.9 µg/m3. NAAQ stipulated standard for PM10 for 24 hr. the average is 100 µg/m3
- PM2.5 values varied from 11.7 µg/m3 to 39.1 µg/m3. NAAQ stipulated standard for PM2.5 for 24 hr. the average is 60 µg/m3
- SO2 ranged between 3.5 µg/m3 to 9.0 µg/m3. NAAQ stipulated standard for SO2 for 24 hr. the average is 80 µg/m3.
- NO2 ranged between 10.0 µg/m3 to 28.0 µg/m3. NAAQ stipulated standard for NO2 for 24 hr. the average is 80 µg/m3
- O3 ranged between 2.1 µg/m3 to 4.6 µg/m3. NAAQ stipulated standard for O3 for 8 hr. average is 100 µg/m3.
- CO, NH3, Pb, C6H6, BaP, As, and Ni was observed below detectable limits.

Noise

Kerala does not have many industrial locations. SWM operations are also not happening except open dumping and minimal treatment activities (mainly composting). Though located near the industrial area; for the main SWM dumping yard of Kerala, Brahmapuram in Kochi, the following are the noise levels.

Table 18: Noise Levels near SWM Dumping Yard at Kochi

S. No	Location	Noise level in dB(A) Leq		CPCB Standard		Environmental Setting
		Day	Night	Lday (Ld)	LNight (Ln)	
1	Brahmapuram (SW plant)	43.9	31.86	75	70	Industrial
2	Kakkanad (Heavy traffic - C&T route)	56.8	43.06	65	55	Commercial

Fauna / Flora

A variety of fauna/flora is observed near dumpsites; due to an abundance of organic contents. Mainly, dogs, rodents, and flies are observable in most dumping yards. Also, crow, egrets, and other birds are seen feeding on the wastes. Kadalundi Vallikkunnu Community Reserve has reported that animals wastes dumped into Kadalundi Puzha, the community eco-reserve of Kerala. When trapped in the mangroves animal wastes, emanates stench and pollutes the neighborhood. Scavenger birds like crows crowd around the waste and scare away the migrant species that are normally shy despite their larger size. Fishes and other aquatic species in the water bodies face the brunt of indiscriminate waste disposal, mainly plastics.

Leachate and Soil Quality in Municipal Dumping Yards

This section compiles the results of the studies on municipal dumping yards in Kerala to ascertain the soil and leachate characteristics.

Kalamasserry Dumping Yard[46]

The collected leachate samples (water samples from boreholes at varying distances from the dump) from solid waste dumping site at Kalamasserry, near an industrial area, were examined in the laboratory. The characteristics of leachate samples were compared with the standards of treated leachate. It was found that some of the chemical parameters of the leachate exceeded the specified permissible standards. Observed values of pH in the leachate samples were slightly acidic and within the standard range of pH of treated leachate. But parameters such as Total Dissolved Solids (TDS), Chemical Oxygen Demand (COD), and Biological Oxygen Demand (BOD) showed high values. The relatively high values of TDS in leachate samples indicate the presence of inorganic materials in the samples (nearness to the industrial area). The high levels of BOD and COD could create potential pollution problems to water bodies since they contain organic compounds that will require a large quantity of oxygen for degradation. High nitrate levels in the samples indicate the possible presence of other more serious residential, sewage, or agricultural contaminants.

Total Organic Carbon (TOC) in soil samples varied from 2805-24000 mg/kg with a higher concentration near the dump. The increased TOC level can be related to the presence of waste and decomposition. As the decomposition gets completed, TOC will get lowered. The results showed a decrease in TOC as the distance and depth increases are related to the completion of decomposition of waste. The parameters such as nitrates, copper, iron, lead, chromium, manganese, sulfate, etc. in the soil sample from the landfill site are within the allowable concentration in uncontaminated soil. The study shows that the concentrations of most of the chemicals in the soil are relatively high till 20 m and then decreases. This can be inferred that beyond 30 m the soil is not affected by the leachate. Using a software 'Visual MODFLOW', the transportation of pollutants through the soil was modeled and the flow of pollutants through soil is visualized. From the output, it is observed that the leachate plume was traveling a distance of 250 m to 300 m around the landfill area on continuous disposal of waste for 20 years and within 8 years after the closure of the landfill, the concentration of leachate on the dumping place may be found insignificant.

Chala Market Dumping Yard, Thiruvananthapuram[47]

TDS of samples were higher than the standards in pre-monsoon and post-monsoon. TDS and Electrical conductivity have a high positive correlation in pre and post-monsoon. The total hardness of all the stations near the dumping site was above the Indian standards for drinking water in both seasons. Nitrate concentration in samples near the MSW dumping site is found very high than the Indian standards (45mg/l).

[46] *George, Meril ad Beena KS, 2015. Studies on landfill leachate transportation and its impact on soil characteristics. Cochin University of Science and Technology (CUSAT)*
Available at: http://dyuthi.cusat.ac.in/purl/4948
Accessed on: March 05, 2020

[47] *Dipu S, Anju A Kumar, Vincent ST 2015. Effect of Municipal Solid Waste Leachate on Ground Water Quality of Thiruvananthapuram District, Kerala, India*
Available at: https://www.researchgate.net/figure/Leachate-characteristics-of-the-MSW_fig4_287207507
Accessed on: March 04, 2020

But in control stations, they were well within limits. In all the stations, fecal coliform exceeds the standards for drinking water which put the groundwater unfit for drinking but lack of other drinking water sources people are forced to drink the water. Water quality was poor in the samples near the dumping yard at Chalai Market.

Laloor Dumping Yard, Thrissur[48]

The relatively high values of EC and TDS indicate the presence of inorganic materials in the leachate samples in Laloor dumping yard. The leachate generated at the bottom of landfill carries numerous contaminants to the soil surface and adjacent areas. During the percolation of leachate through the soil, leachate undergoes various processes such as physicochemical decomposition process, ion exchange reactions, chemical alterations, oxidation, hydrolysis, etc. These reactions alter the soil original properties. The variation in soil chemical properties with varying concentration of leachate is presented below.

Table 19: Characteristics of Leachate Sample from Laloor Dumping Site, Thrissur

Sl No	Parameters	SWM Rules 2016: Standards for Leachate Disposal	Results of Leachate Samples from Dumping Yard
1	pH	5.5-9.0	6.8
2	EC	Not specified	5.97 ms/cm
3	COD	250 mg/L	1152 mg/L
4	BOD	30 mg/L	80 mg/L
5	TDS	2100 mg/L	2.56×10^6 mg/L
6	Iron (Fe)	-	4.094 mg/L
7	Sodium (Na)	200 mg/L	760 mg/L
8	Potassium(K)	-	1,525 mg/L
9	Sulphates	250 mg/L	20.63 mg/L
10	Chlorides	1000 mg/L	960 mg/L
11	Nitrates	-	103.55 mg/L

The study evaluated the effect of the solid waste dump on the engineering and some chemical properties of the underlying soil for the dumpsite at Lalur. The collected leachate sample from Laloor was examined in the laboratory and it was found that the physicochemical parameters of the leachate exceeded the specified standards for disposal into surface water bodies or sources. Various chemical parameters in the soil showed different trends with increasing leachate concentrations. The specific gravity and plastic limit showed an increasing trend upon the addition of leachate whereas the hydraulic conductivity and liquid limit decreased. It was thus inferred that solid waste dump reduced the overall soil strength and consequently its usefulness as foundation material, and also can result in pollution of groundwater sources.

[48] *Peter and Pillai, 2018. Soil Pollution near a Municipal Solid Waste Disposal Site in India. Conference Paper: International Conference on Biological, Civil and Environmental Engineering (BCEE-2014) March 17-18, 2014 Dubai (UAE), Dubai*

4.2.5 Review of Past (similar) efforts

For ULBs in the State of Kerala, Solid Waste Management is a huge challenge. Over a while, 38 centralized treatment facilities based on composting biogas technologies have been set up in the State. Of these, 10 facilities including major treatment plants in Thiruvananthapuram, Alappuzha, Kollam, and Thrissur, have been closed on account of public protest. Some of the key reasons for closure include:

1. Non-segregation of biodegradable and non-biodegradable waste
2. Improper site selection
3. Poor management of the processing facility
4. No treatment of leachate
5. No measures to control foul odor and visual blight during processing and transport
6. Absence of facility for disposal of residual waste
7. Issues with payment of tipping fee to the operator

In 2006-07, GoK tried to address SWM issues through Kerala Sustainable Urban Development Project (KSUDP). The project aimed at developing SWM facilities in major Municipal Corporations of the State. It supported Collection and Transportation of Waste in Kochi and Thrissur, Sanitary landfills, and treatment facilities in Trissur and Kollam and Sanitary Landfill and Leachate Collection system in Thiruvananthapuram.

The State government promoted decentralized systems for processing of waste at household, institution, and community level mainly in municipalities and panchayats. GoK through Suchitwa Mission extended subsidies ranging from 50 to 90percent of the cost of the plant, to households and institutions for setting up processing facilities. During the last 10 years, 8.78 lakh households and institutions in urban areas have been extended subsidies to set up such plants. However, sustenance of such plants depends on a multitude of factors ranging from land availability within the premises to use compost / rejects, fly and odor control related aspects, the interest of the households to maintain and operate such a facility, maintenance support for the facility created, and marketing support for compost.

The decentralized community-based facility which got acceptance in some parts of the State is mainly aero bin, which has slits/holes to let air into the compost bin. However, such an arrangement allows leachate from wet waste to flow out contaminating the environment. To control leachate and to make the process fast, enhanced microbes, cow dung spray, sawdust is used. Also, aero bins need to use much amount of dry leave cover for wet waste deposited. These activities reduce the available space in the bin, making it viable to treat only a minimal quantity of waste over a long duration of time. A multitude of such bins will be required to cover the entire town/city and for which, land availability and siting will be an issue. People find it inconvenient to bring wet waste to these facilities.

Currently, compost produced and rejects are many times disposed-off in duping yards or in the open. Leachate, odor, fly menace, storage, and availability of support materials, sale of compost, disposal of rejects, land availability to cover the whole city with decentralized units, proper management, and operation of facilities are key issues which limit adoption of these decentralized technologies for whole city coverage.

The state has got many accolades for such decentralized approaches. The State's efforts to treat waste at source are laudable. However, a review of the environmental condition of the state presents the need to develop facilities to dispose of rejects, inerts, and upscale and recycle the recyclables. It is important to improve existing systems to minimize and manage negative externalities.

4.3 Facility-wise Environmental sensitivities

Currently, the waste management system looking at the whole SWM value chain is non-existent. This results in leakages to the environment causing impacts.

4.3.1 Environmental Impacts of SWM in respective Local Area

The environmental impacts of each type of existing SWM facilities are being discussed here.

Centralized Facilities
Unsuitable site selection, no demarcation of the site for treatment and disposal in Development Plans / Land use Plans, improper site development, and management, odor nuisance, visual blight, pollution of air, land, water resources has led to peoples movement against dumping of solid wastes.
Non-compliance with SWM Rules 2016 and other applicable regulations and guidelines
Fragile environment, heavy monsoon, spread over more than 6 months, flooding & cyclones, the high water table in coastal cities, the low calorific value of waste
High moisture content leading to leachate generation, contamination of soil and surface water, odor nuisance. A large quantity of rejects due to mixed waste composting.
No segregation of biodegradable waste, low quality of end product due to improper treatment of waste, no market for such compost. Need marketing efforts to take the products to farmers and to link it with fertilizer companies.
No centralized processing facilities/options for plastics and other recyclable/high calorific value fraction of waste. Need proactive actions to complete the recycling value chain.
No collection of non-biodegradable waste from a source other than plastic leading to large dumps of recyclable materials and high calorific value waste. Potential to get revenue from the sale/ processing of recyclables is not adequately tapped.
No sanitary landfills in the State. Waste is disposed-off at open dumpsites. Dumpsites present air, land & water pollution and odor nuisance and visual blight. The environment is severely damaged leading to public objections. Dumpsites catch fire during summer.
None of the dumpsites are biomined/remediated or closed as per standard practice. Lack of biomining restricts retrieval of land for future development for upgrading SWM systems and technologies.
No training or technical guidance for biomining of existing dumpsites and closure/land retrieval for further use.

Lack of institutional capacity to construct, manage, operate, monitor centralized facilities. Less technical know-how and inadequate institutional structure at city and state levels.
Decentralized facilities
Low level of sustainable use of decentralized systems: though most people who have a yard readily accept it initially; they are not able to carry on with its sustained use; due to lack of a O&M ecosystem. This has led to complaints around fly / worms/odor nuisance and issues with leachate, slurry.
Several community/market level biogas plants are closed due to poor O&M. They are not designed to treat the expected amount of wastes without causing negative impacts on the environment and society. No leachate treatment facilities or disposal facilities for byproducts. No effective utilization of end products. Untreated slurry contaminates soil/water.
MCF and RRF are set up in the state for non-biodegradable waste; however, these facilities mainly focus on the collection of plastics. The arrangements are grossly inadequate to process the large quantity of dry waste arising from households, institutions, and commercial areas. Improper site selection and environmental/ safety concerns; with piles of uncleared wastes here. In many MCFs, hazardous wastes are also seen collected mostly as a result of poor segregation.
A huge quantity of shredded waste has only seasonal demand in road construction during summer months and hence gets piled up in MRFs. MRFs are turning into local dumps of recyclables. Fire hazard is visible at MCF and RRF. No arrangements for fire prevention or control.
A community-level aero bin system is under-utilized as people are required to carry waste at the aero bin site. They are not designed to treat the expected amount of wastes without causing negative impacts on the environment and society. No leachate treatment facilities or disposal facilities for byproducts. No effective utilization of end products. Untreated slurry contaminates soil/water. Rejects and inerts are seen piled around or dumped in common waste dumping yard.
Health Concerns
Kerala has some of the best health indicators in the country. However, there is a frequent outbreak of Dengue fever and other mosquito-related problems, gastroenteritis, respiratory diseases and, the emergence of diseases like rat fever, etc. which are directly linked to Air, Water, Sanitation and Solid Waste Management. In 1971, the National Environment Engineering Research Institute (NEERI) carried out studies on the health of refuse workers in Trivandrum which showed a higher incidence of parasites in workers handling waste than the population as a whole. It is also observed that sanitary workers and rag pickers have higher morbidity due to infections of the skin, respiratory, gastrointestinal tract, and multisystem allergic disorders. The people residing in the neighborhood of MSW dumping sites complain about air and water pollution and the incidence of diseases such as skin infections, respiratory diseases, allergic complaints, etc. A study carried out by the School of Environmental Sciences, Mahatma Gandhi University in and around the dumping yard at Vadavathur of Kottayam Municipality also indicated a correlation between groundwater pollution levels and nearness to the dumping yard. The waste clogged open drains in towns provides the ideal breeding ground of mosquitoes that are capable of transmitting malaria fever and dengue fever. The vector insects including house flies and rodents breed even in home composting facilities and can transmit various pathogenic agents. Flies have a flight range of about 10km so that they can spread their

influence over a wide area. People living around unsanitary waste management /disposal sites are the victims of poor waste management. More than this, fly and odor menace affecting schools, hospitals, and communities staying near dumping yards also calls for

4.3.2 Environmental Impacts of C&D Waste Management practices

Currently, there is no facility to recycle C&D wastes in Kerala. It is the responsibility of the local body to collect C&D wastes from the generators and suitably dispose it upon receipt of the request from the generators. In the absence of facilities to recycle or dispose-off C&D wastes, it becomes part of solid waste or is either reused for other construction activities (through secondary material markets in unorganized sectors Eg: window panes, frames, roof tiles, etc.) or used for raising sites or filling low lying areas. With its vibrant construction sector, owing to remittances from the Gulf, the State needs a C&D Waste Management facility.

Public Works Department (PWD) of GoK who is in charge of continuous road construction and maintenance activities is one of the major generators of such waste. PWD Manual recommends that the contractor stores C&D waste in a segregated manner in the site and dispose it appropriately in pre-identified disposal sites, after using usable fractions for filling[49]. However, in the absence of such a facility, much of the debris gets deposited in water bodies and low-lying areas, except a small fraction which is reused. The need for a C&D waste management facility is high given the vibrant architecture and construction industry in the State. Recently, KSPCB directed Maradu Municipality to manage 76000 MT of C&D waste (without polluting the environment) generated out of Maradu Flat demolition in response to CRZ Rule violation, following the Supreme Court's direction for implosion and demolition of the violating structures.

The demolition contractor had to arrange a temporary facility near Cherthala to segregate and recycle around 76000 MT of C&D wastes from three apartment complexes. The demolition contractor segregated steel for reuse and cut the remaining into 6mm to 20mm fractions using 'rubble master' and transported to the yard for reuse. During the segregation of materials, neighbors complained about air pollution due to lack of high wind curtains around the site, allergic reactions like breathing difficulties and itching for the children and the elderly, and dust covering their houses, curtains. The neighbors have invested in full plastic covering for their houses and masks to protect them from the emanating dust.

[49] *Excerpts from PWD Manual regarding C&D Waste Disposal during Road works: "The pre-identified disposal locations will be a part of Waste Disposal to be prepared by the Contractor in consultation and with approval of PWD. Location of disposal sites will be finalized prior to completion of the earthworks on any particular section of the road. The PWD will approve these disposal sites after conducting a joint inspection on the site with the Contractor. Contractor will ensure that any spoils of material unsuitable for embankment fill will not be disposed off near any water course, agricultural land, and natural habitat like grass lands or pastures. Such spoils from excavation can be used to reclaim borrow pits and low-lying areas located in barren lands along the project corridors (is so desired by the owner/community).All waste materials will be completely disposed and the site will be fully cleaned and certified by PWD before handing over. The contractor at its cost shall resolve any claim, arising out of waste disposal or any non-compliance that may arise on account of lack of action on his part."*
Public works Department, 2012. Kerala Public Works Department Manual Revised Edition 2012 (Revised as per G.O.(P)No.13/2012/PWD dated 01.02.2012), GoK
Available at: http://keralapwd.gov.in/keralapwd/eknowledge/Upload/manuals/1153.pdf
Accessed on March 04, 2020

4.3.3 Environmental Impacts of Biomedical Waste Management practices

As per BMW Rules, 2016; a CBMWTF can handle only wastes from 10000 beds within 75 km of its location. However, the only CBMWTF in Kerala treats wastes from many hospitals north to south of the State, traveling more than 12000 km in a day. This 40 T capacity facility is treating biomedical wastes from 14380 facilities. Performance audit by Comptroller and Auditor General of India[50] noted that only one CBMWTF existed against the four required and it was handling waste above its stated capacity leading to improper disposal of waste. The proposed facility at Palode is being opposed by Environmental Groups and the community siting that the location is in Myristica Swamps and near Tribal settlements.

As per BMW Rules, 2016; Bio-medical waste generated in households during healthcare activities shall be segregated as per these rules and handed over in separate bags or containers to municipal waste collectors. ULBs shall have to tie up with the common bio-medical waste treatment and disposal facility to pick up this waste from the MRF or the household directly, for final disposal. During COVID 19 emergency, it is reported that though quantities are less, biomedical waste from home quarantine is not collected or disposed of even though strict guidelines exist. Many of the PPEs and other wastes are burnt on the premises, releasing dangerous fumes. ULBs find it difficult to depute separate vehicles and workers to collect such wastes and store until it is collected by the Collection Vehicle to transport to CBMWTF. PPEs, adult diapers, dressing bandages, plaster casts, material contaminated with blood, catheters, and urine are observed mixed with solid wastes, contaminating this otherwise benign waste.

Biomedical waste remains a major challenge as the state has reached almost reached its maximum capacity for processing biomedical waste. Increasing state capacity to process BMW is an urgent requirement.

4.3.4 Regional Impacts of Existing Waste Management system

Possible impacts of existing / baseline SWM scenario (open dumps and household level waste management, collection of dry wastes and partial collection and dumping of wet wastes from some parts of ULBs) of Kerala are as follows:

- The release of methane gas from existing open dumps spread throughout the State (along roads and available open areas and dumping grounds of each local body) into the atmosphere as a greenhouse gas will contribute to the ambient air quality of the region, thus contributing to climate change.

"As environmentalists are quick to point out, unscientific garbage dumps do not automatically become landfills. Unfortunately, going by the requirements for proper landfilling, Kerala has never had landfills. However, it has several large and small dumping yards spread around its key towns and cities, which became massive sources of pollution, filling the air with toxic odors and methane gas, polluting the groundwater and making life impossible for those living near these sites." [51]

The Waste Sector comprising Municipal solid waste, domestic wastewater, and industrial wastewater contributed to about four percent of India's total GHG emission in 2015 (ref: http://www.ghgplatform-india.org/waste-sector). Disposal of MSW produces a significant amount

[50] *http://iced.cag.gov.in/wp-content/uploads/2014/02/3.-PA-on-Bio-Medical-WM-in-Kerala.pdf*
[51] *https://www.thenewsminute.com/article/afterlife-garbage-how-kerala-struggling-deal-its-landfills-83943*

of methane (CH4). In addition to CH4, solid waste disposal sites also produce biogenic carbon dioxide (CO2) and non-methane volatile organic compounds (NMVOCs) as well as smaller amounts of nitrous oxide (N2O), nitrogen oxide (NOx) and carbon monoxide (CO). There have been many studies to estimate the GHG emissions from the municipal solid waste of India. As per the Greenhouse gas platform India3, the GHG emissions from the waste of urban Kerala are estimated to be around 649380 tons for the year 2015. The estimate is based on IPCC first-order decay model. Total Methane Emission from Solid Waste Disposal for the ULBs under the project (for 2019) in Tonnes CH4 is 16331.84. (Global warming potential of CH4 being 21). Total GHG Emission from Solid Waste Disposal in the given Year is 342968.7 Tonnes CO2e. Likewise, total GHG emissions of around 3.9 million tons during the last 15 years are mainly due to non-processing of organic fraction of the waste and can be avoided through the treatment of waste to recover energy (bio methanation) or resources (compost – aerobic treatment).

- The visual impact and odor/fly menace due to numerous dumps of mixed wastes all along the length and breadth of the State; on road verges and open plots which might have an impact on the high-value tourism if unchecked.

"Kerala has found a place in world tourism map for its pristine environment and ethnic culture. However, over the years, the quantum of solid waste generated by different entities (Households, Commercial Centres, Institutions, Industries, etc.) increased in pace with the increase in population and associated activities. Dumping of solid waste in public places creates health and ecological problems."[52]

"The brand name of tourism in Kerala "God's Own Country" is an implicit invitation to enjoy the boundless natural beauty of the State. Therefore, adverse impacts on any ecosystem decelerate the growth of tourism in the State. Accumulation of waste at places, roads, and public places with waste litters, polluted water bodies, stagnant contaminants, eutrophication of lakes and waterways, etc adversely affect the aesthetic appearance and hygienic environment of locations. This, in turn, impacts the tourism destinations adversely." (SPB, 2017)[53]

"As one travels from north to south it is as though the whole landscape of Kerala is dotted with garbage hotspots. Kelugudde, Seethangoli, and Kollangana in Kasargod; Pettippalam and Chelora in Kannur; Njeliyaparamba in Kozhikode; Pirivusala in Palakkad; Lalur in Thrissur; Chakkukandam in Guruvayur; Brahmapuram in Ernakulam; Vadavathur in Kottayam; Fathimapuram near Changanassery; Kanaathupaara; near pala; Kozhenchery in Pathanamthitta; Kureepuzha in Kollam and Vilappilsala in Thiruvananthapuram are but a few of these hotspots where local resistance movements have sprung up against indiscriminate dumping of solid waste, including plastic and e-waste, the product of Kerala's relentless march towards urbanization. The state's idea of waste management all these years has had to do with the identification of a spot some distance away from urban centers and dumping of all the garbage there. All these places have now become flashpoints of struggle by people in their neighborhood who are no longer ready to bear the burden of waste generated by urban agglomerations." [54]

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[52] *Comptroller and auditor General of India, 2018. Compliance Audit No:2 of 2018 – Local Self Government Institutions, GoK. Government of India.*
Available at:
https://cag.gov.in/sites/default/files/audit_report_files/Chapter_4_Compliance_Audit_of_Report_No_2_of_2018_-_Local_Self-Government_Institutions_Government_of_Kerala.pdf
Accessed on: March 02, 2020

[53] *State Planning Board (SPB), 2017. Economic Review, GoK*
Available at: http://spb.kerala.gov.in/ER2017/web_e/ch71.php?id=7&ch=71
Accessed on: March 02, 2020

[54] *Harikrishnan G, 2014.*

Legacy waste accumulated in 93 ULBs of Kerala (7600000 (*present population of 93 ULBs*) x 0.2917 *(per capita legacy waste of 5 cities studied*)) = 2216920 MT.

- Increased traffic on roads due to the movement of trucks mostly without cover, during the carrying of wastes to dumping grounds.

- Impacts of leachate overflow from open dumps polluting the dumpsites distributed throughout the State and into the water bodies.

"The indiscriminate and increased discharge of organic wastes and fertilizer residues into water bodies are causing incessant weed growth and rampant eutrophication issues in Kerala. The huge BOD load and silt inflow are causative factors for the shrinkage of water bodies…." the water bodies of the State receives solid and BOD load of 3,150 tons and 2,100 tons respectively. The untreated solid waste around 4,100 TPD causes the generation of leachates to the tune of 2,200 m3/day or about 11 TPD of chemical oxygen demand. There are also localized water quality problems associated with excess iron, low pH, excess fluoride, and salinity intrusion. There is also pollution linked to the fertilizer and pesticide residues from agricultural activities and nutrient discharges from the solid and liquid waste streams. As a result, most of the water bodies in the State exhibit exorbitant growth of aquatic plants and subsequent eutrophication."[55]

Leachate generation is of the order 0.7 liters/kg of dumped waste (if exposed to rain); and 0.1 liters/kg (if covered) in Kerala. Leachate generated from unprocessed waste in Kerala is estimated at 1.944 MLD per day or 709.56 MLD per annum.

- Impacts due to open burning of wastes on a normal basis (In the absence of any disposal mechanism, this is the common practice for individual generators and also even as part of State-led campaigns on waste disposal). This leads to greenhouse gas emissions, emission of poisonous dioxins and furans, and other safety issues. The Hon'ble High Court of Kerala has banned the burning of plastics, rubber, and solid wastes vide Order WP (C) No 5636 of 2016, dated 10 June 2016.[56] The court has also banned the use of flex boards (single-use plastics) for election campaigns quoting the pollution impacts associated with these (choking of drainage and river systems, ingestion by stray animals, land, and water pollution, open burning, etc. Leading to adverse impacts on human health and the environment. Some of these plastics are Poly Vinyl Chloride (PVC) based, which produces toxic emissions on burning) vide Order WP (C) No: 7193 / 2019 (S); March 2019. [57]

At least 15 to 20 percent of the fires .. were instances of open waste burning by residents… This was especially common during holidays; sometimes these fires spread to nearby dry vegetation and grass cover…. [58]

The Kerala High Court …banned the burning of solid waste, including rubber and plastic articles, in public spaces and directed police to initiate criminal cases against those who violate the ban…Photographs showing unregulated open burning of plastics in various parts of the state were produced before the court by the petitioner. Scientific studies indicate that the burning of garbage and other materials is not only a source of pollution but forms 29.4 percent of the air

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http://www.ijrssh.com/images/short_pdf/Dec_2014_Harikrishnanpercent20Gpercent20Decpercent205.pdf

[55] *SPB, 2017. Op Cit*

[56] http://sanitation.kerala.gov.in/wp-content/uploads/2018/02/IMG_20180228_0005.pdf

[57] http://sanitation.kerala.gov.in/wp-content/uploads/2019/03/HC-Ban-_-Order.pdf

[58] https://www.thehindu.com/news/cities/Kochi/burning-of-waste-in-open-spaces-adding-to-citys-pollution-woes/article26194776.ece

pollution. Open burning of solid waste is impermissible as per law but local self-government institutions are not enforcing the law, contributing to the deteriorating situation, the petition said.[59]

"….Indiscriminate burning of plastic and rubber in any form results in a situation which leads to infraction of the Environment (Protection) Act, and the different rules framed thereunder as well as the different sister laws in that regime including those relating to water management and air management. we are also satisfied that the situation has an alarming negative impact on public health and is also a matter of nuisance and needs to be controlled to protect the health of the citizens by protecting and' improving the environment and preventing hazards to human beings and other living creatures, plants and properties."[60]

- Bio-waste is not treated to recover resources like compost. Reusables / Recyclables such as plastics are not effectively reused for resource utilization/recovery; resulting in them choking the water bodies and soil and harming fauna and flora.

Untreated recyclable plastics generated by ULBs in Kerala is estimated as 216 TPD per day; or 78820 TPD per annum. Leaving around 20 percent of the bio-waste which is treated; remaining 2418 TPD biodegradable waste can be treated either by decentralized or centralized means to recover resources and minimize impacts due to open dumping.

- Impacts of waste dumped into water bodies (resulting in 'disappearing wastes') and those leaking out into water bodies from the dumps during the heavy rain common in Kerala or flash floods, resulting in deteriorated water quality (many water bodies are direct or indirect sources of drinking water for communities), eutrophication and less water holding/flood retention capacity.

"The first-of-its-kind survey in Kerala, based on 58,463 households, has found that an alarming 73percent of water sources in the state is contaminated. Of the 3,606 water sources including rivers, streams, ponds, lakes, and wells covered by the survey, 26.9percent were found to be polluted. The survey was conducted by the Kerala State Literacy Mission Authority and its report 'status of water resources' was released … here on Sunday. According to the report, houses and hotels are the main sources of pollutants (55.2percent) followed by the washing of vehicles (20percent) and industrial establishments (11percent). Hotels were found to be the main source of solid waste contaminating water sources (40percent)… As per the report, solid waste, especially from hotels and restaurants, have polluted large water bodies in a big way, while water sources like ponds, wells, and streams became endangered largely due to lack of protection walls.." [61]

Scientific research institutions under Kerala State Council for Science Technology and Environment (KSCSTE) – led by Centre for Water Resources Development & Management (CWRDM) – monitored the water quality and pollution levels of all 44 rivers in Kerala from 2009 to 2017 and found that they were polluted and under threat…. environmental monitoring of water quality showed that pollution levels were increasing over the years and if the current rate of microbial contamination continues, rivers would be reduced to mere puddles of wastewater. "Increasing pollution is a result of lopsided urbanization and lack of SWM," he said, adding that researchers found solid waste in almost all rivers along with untreated sewage and industrial

[59] https://timesofindia.indiatimes.com/city/kochi/Kerala-HC-bans-open-burning-of-plastic-police-to-book-violators/articleshow/52692934.cms
[60] http://sanitation.kerala.gov.in/wp-content/uploads/2018/02/IMG_20180228_0005.pdf
[61] https://literacymissionkerala.org/en/73-of-keralas-water-sources-polluted-survey/

effluents. Nearly 500 samples were collected by his team during the pre and post-monsoon periods….[62]

Our surveys and analysis estimate that in 2020, after providing treatment and disposal, the rejects/inerts for sanitary landfilling is (20percent of 3755- current waste generation) = 751 TPD. In 2051, the waste generation is projected to be 6523 TPD, the waste going to SLF (20percent) = 1305 TPD. In the absence of a proper disposal facility, such an amount of rejects and inerts will find its way into water bodies or gets dumped openly/burned.

Lakes and water bodies are fast getting filled up with wastes. As discussed in Section 2.5.4.9; in Vembanad lake, litter spread at Bottom, Colum, and Surface are evident. Along the sides, the spread of litter is to the height of 50 cm and more. It has been estimated that during low tide, about 135 tonnes of litter passes through the columns in a year towards the bar mouth. Some of these can also be flushed back during high tide. The survey has indicated that plastic flex, cloth, bottles, plastic-coated sacks, thermocol pieces/ sheets, footwear, etc are common. About 75 to 100 kg of litter (wet weight) floats on the surface waters (less than half a meter) and passes through the Cochin backwaters to the Arabian Sea during low tide per day. Fishers have indicated that broken glass pieces are a threat to their health and plastic covers and other debris have led to low catch per hour of fishing. In a study conducted on stake nets in Vembanad Lake, shrimp caught in the net ranged from 0.525 to 1.36 kg while the average weight of litter in these nets ranged between 1.87 to 13.8 kg per day per net. Research by Kerala University of Fisheries & Ocean Studies (KUFOS) in Nov 2019, revealed that the water flow in Vembanad Lake had decreased by around 50 percent due to plastic waste & silt and in many areas of the lake and warned that the decrease would increase the intensity of floods. Earlier the study had found sharp depth shrinkage of the lake from 8 to 9 meters in the 1930s to the present 1.6 to 4.5 meters. Another alarming finding of the study was the presence of around 4276 tonnes of plastic garbage in the bottom sediments of the Alappuzha regions. The lake area in these regions is 76.5 sq.km. This amounts to 55.9 tonnes per sq km of plastic garbage. It is known that in Kochi regions also there is a similar situation.[63]

- Legacy waste dumps pose as unusable contaminated land, dotting the landscape. It is possible to recover 60 – 70 percent of this legacy dump site's land for further use.

Considering around 3 to 4 acres per ULB, total land thus recoverable by biomining (and eased of contamination by solid wastes) is around 200 acres.

These impacts not only affect the biophysical environment of local areas but the entire region; with largescale impacts on the health and safety of the people and the environment.

The State is moving ahead with its laudable efforts to treat waste at source to reduce the quantities for treatment and disposal; and parallelly improve existing conditions and set up facilities to treat remaining unattended wastes, dispose the rejects, inerts and to upscale and recycle the recyclables.

KSWMP aims to support the State in this endeavor by providing solutions for disposal and recycle, improving existing systems to minimize and manage negative externalities; as the waste quantities are increasing with natural growth in population and fast spreading over the landscape.

[62] https://timesofindia.indiatimes.com/city/kochi/quiet-die-the-keralas-rivers/articleshow/62878503.cms
[63] https://sandrp.in/2020/03/03/ramsar-wetlands-in-crisis-south-india/

4.3.5 Status of Compliance to Regulatory Requirements and Recommendations

SWM Rules 2016, target better SWM systems to minimize environmental externalities. Studies indicate that the existing systems are not following the National Regulations. An assessment of the existing system with respect to SWM Rules, SWM Policy of the State, and Regulatory requirements is carried out to outline the system components which would ensure improved environmental performance.

4.3.5.1 Current Service Delivery Gap Assessment

Currently, the SWM services in the State offer only partial and non-optimal coverage of the SWM value chain. ***Table 20*** presents the Gaps in current SWM service delivery in Kerala State.

Table 20: Gap Assessment of the Existing Components of SWM Service Delivery

Existing system	Relevant SWM Rules (Solid Waste Management Rules, 2016)	The situation in Kerala, in response to the State Policy on SWM	Gaps in Existing System	Remarks
Composting/Bio methanation at the household level	Rule 15 (q): The ULB is responsible to transport segregated biodegradable waste to the processing facilities like compost plant, bio methanation plant, or any such facility. Preference shall be given for onsite processing of such waste. As per Rule 15 (t): The ULB shall involve communities in waste management and promotion of home composting, biogas generation, decentralized processing of waste at the community level subject to the control of odor and maintenance of hygienic conditions around the	As per the State policy, processing of biodegradable waste at households is being supported through subsidies by State Government /Suchitwa Mission to setup household level composting and/or biogas plants. Most of the cities have not setup any city-level system for the collection and processing of biodegradable waste from households. The pollution impacts of existing facilities needs to be studied.	As per SWM Rules 2016, households are not mandated but encouraged to process biodegradable waste at source subject to the control of odor and maintenance of hygienic conditions. However, the ULB is mandated to collect biodegradable waste in a segregated manner and set up a common processing facility. This is important as it is quired to treat spill over wastes, wastes from establishments and households where there is no available space for setting up individual units, and wastes from common areas as well. This is not done by	By not providing door-to-door collection services and processing of Biodegradable waste at the city or regional level, the majority of the ULBs is not complying with the SWM Rules, 2016. This results in impacts on community health and the environment.

Existing system	Relevant SWM Rules (Solid Waste Management Rules, 2016)	The situation in Kerala, in response to the State Policy on SWM	Gaps in Existing System	Remarks
	facility.		most of the ULBs in the State with the results in biodegradable waste getting disposed-off untreated in the open spaces, water bodies, dumpsites, etc.	
Composting / Bio methanation by gated communities	As per Rule 4, clause 6, 7 & 8: All resident welfare and market associations, gated communities & Institutions, hotels, and restaurants are mandated to do the processing of biodegradable waste through composting/ bio methanation within their premises and handover rejects to the waste collector/agency as directed by the local body.	Some high-rise buildings in Municipal Corporation areas have installed composters on the rooftop of the buildings. A vast majority is however not treating the waste within the premises as mandated. There is an absence of any support by the ULBs for the collection and disposal of rejects. There is no monitoring of performance or pollution impacts of existing facilities.	Bulk generators are mandated to have an in-house system for processing of biodegradable waste. CREDAI model of processing of biodegradable waste on the rooftop of high-rise apartments is operational in select apartments of some cities successfully but the large majority of apartments have no such facility. Besides, absence support system by the ULBs for collection of rejects for its scientific disposal is absent	Compliance by bulk generators to process biodegradable waste within the premises as per SWM Rules is very low.

Existing system	Relevant SWM Rules (Solid Waste Management Rules, 2016)	The situation in Kerala, in response to the State Policy on SWM	Gaps in Existing System	Remarks
Composting /Biomethanation by Hotels & restaurants	As per Rule 4, clause 8: All hotels & restaurants are made responsible for the treatment of their biodegradable waste through composting/ Biomethanation within their premises as far as possible and rejects are to be handed over to the waste collector/agency as directed by the local body.	The hotels, restaurants are generally providing their waste to the private service providers for processing and disposal on payment basis. However, there is no record to verify/validate how and where the waste is treated. In some places, it is used as a feedstock in pig/poultry farms. In some cities, it is collected by the waste collectors and transferred to the community compost bins (aerobins) or directly deposited by hotels in aerobins. There is no monitoring of performance or pollution impacts of existing facilities.	Hotels are not processing biodegradable waste within their premises but handover to private agencies for treatment & disposal. There is no clear picture regarding treatment, disposal, or utilization of the end product (compost), in absence of any record-keeping system.	There is no compliance by Hotels & restaurants for the treatment of biodegradable waste within the premises. ULBs are also not providing any service of door-to-door collection & treatment of biodegradable waste except in a few cities such as Attingal, North Paravur. The supply of wastes to pig poultry farms is not monitored to ensure any harm or leakages as these may be detrimental to community health. Many hotels/restaurants have no space to treat wastes in their premises and have no
composting /Biomethanation at vegetable, Fish, and Meat markets	As per Rule 15 (m): The ULB is responsible to collect waste from vegetable, fruit, flower, meat, poultry, and fish market daily and promote setting up of decentralized compost plant or biomethanation plant at suitable locations in the markets or the vicinity of markets ensuring hygienic conditions.	As per the State policy, every market in each city has either aerobins (composters) or biogas plants to process the green waste of the markets. But most of these are not functional or are partly functional.	The compliance to the Rules in setting up decentralized processing plants is partial.	Partial compliance regarding the installation of decentralized processing facilities but poor compliance regarding maintaining hygienic conditions. There is an urgent need to upgrade existing facilities and arrange disposal of by-products, inerts, and rejects.

Existing system	Relevant SWM Rules (Solid Waste Management Rules, 2016)	The situation in Kerala, in response to the State Policy on SWM	Gaps in Existing System	Remarks
Dry Waste management facilities (MCF/RRF)	As per Rule 15 (h), the ULBs are required to setup MRF or secondary storage facilities with sufficient space to enable informal or authorized waste pickers and waste collectors to separate recyclables from the waste and provide easy access to waste pickers and recyclers for collection of segregated recyclable waste such as paper, plastic, metal, glass, textile from the source of generation or material recovery facilities	Kerala state has taken commendable measures for setting up MCF & RRF facilities throughout the State to facilitate the collection, segregation of nonbiodegradable waste. However, in practice, the Haritha Karma Sena and Kudumbashree workers collect only plastic waste from HH and deposit at MCF/RRF for its further segregation and sale of recyclables and use of poor grade plastic in road construction through Clean Kerala Company – a State Level agency.	This is a very good initiative of the Government and ULBs; and is gaining momentum. The state has established 380 MRF/RRF units for plastic recovery. However, there is no system for collection, recovery, recycling, or utilization of other non-biodegradable waste (dry waste) which is a huge component of waste.	Partial compliance terms of establishing MRF/ RRF for nonbiodegradable waste, but the system needs an upgrade to handle and manage the nonbiodegradable waste other than plastic waste in the state. MCF/RRF is being used to collect and utilize plastic waste only. Good plastic waste is given away for recycling and poor grade plastic is stored for more than 6 months, for use in road construction. However, siting and environmental performance need attention.

Existing system	Relevant SWM Rules (Solid Waste Management Rules, 2016)	The situation in Kerala, in response to the State Policy on SWM	Gaps in Existing System	Remarks
Processing of waste at city level	As per Rule 15 (v), the ULB is required to facilitate construction, O&M of solid waste processing facilities on their own or with private sector participation or through any agency for optimum utilization of various components of solid waste adopting suitable technology including such as a) Biomethanation, microbial composting, vermicomposting, anaerobic digestion or any other appropriate processing for stabilization of biodegradable wastes; b) Waste to energy processes including refused derived fuel for a combustible fraction of waste or supply as feedstock to solid waste based power plants or cement kilns. Preference shall be given to decentralized processing to minimize transportation cost and environmental impacts	Kerala's state policy has laid emphasis on decentralized system hence, the ULBs have not taken many initiatives to setup city level processing units for biodegradable waste, barring a few. The majority of the ULBs are therefore not concerned about door to door collection of wet waste. Recently, the State has taken an initiative to set up 7 regional WTE facilities and the tendering process for the same is under progress.	As per the latest reporting by Suchitwa mission, there are 38 City level Compost Plants, out of which only 28 are functional and 10 are not functional / under closure.	ULBs are yet to comply with SWM Rules,2016 for setting up biodegradable waste treatment facilities. This has resulted in biodegradable waste being disposed-off in open spaces, water bodies, dumpsites, etc. causing problems of health & environment. Also in those minimal number of ULBs which have centralized facilities; there is much scope for better environmental performance and safeguards, and the absence of facilities for leachate and reject management is visible.

4.4 Indicative Subprojects and Recommendations for Impact Management

Based on the comparative assessment of the existing system and technical study for potential technologies[64] considering the legal mandate under SWM Rules, 2016, local geographical and climatic conditions, and community acceptance, the following technologies are recommended at household, community/ institutional and city (centralized) level for treatment of Biodegradable and Non-Biodegradable solid wastes. Recommendations to manage the impacts of the proposed development are also highlighted. These impact descriptions will be used as the base for developing Indicative Environmental Management Plans for improving existing systems.

4.4.1 Recommendation for Treatment of Biodegradable waste

4.4.1.1 Recommendation for Decentralized treatment of Biodegradable waste

Household Level Treatment

The project continues to promote source-level treatment for interested households and establishments.

Composting technologies

1. Pot composting (including 3 pot composting)
2. Kitchen bin, Ring Compost
3. Bucket composting
4. Bio-composter
5. Bio-digester pot
6. Indoor vermicomposting

Biogas technology

Biogas plants of 0.5 m^3 and 1 m^3 Promotion of Biogas plant with mosquito net covering is strongly recommended.

Biogas units shall be placed in the raised plinth to protect from flooding/rains. All required pollution/safeguard aspects shall be considered including protection from rains, flood, leachate/slurry management, maintenance, compost and reject management, safety considerations. Improved biogas units in these lines shall be encouraged and there shall be a system of safety certification. monitoring, safety guidance, and maintenance support to household facilities are necessary to ensure its good management and environmental performance.

Institutional level treatment

As per Rule 4 (6, 7 & 8) of SWM Rules, 2016, it is mandatory for markets, hotels, restaurants, and all institutions and gated communities to have an area exceeding 5000 m^2 to treat biodegradable waste within their premises.

Biogas plants and/or **composting** facilities such as organic waste converters, covered vermicomposting units, bio-bins, aero bins, etc. depending on the quantity of waste generated within their premises are recommended.

[64] *Technology Assessment for Solid Waste Management in Kerala, Jan-20*

Institutions with available yard space may be motivated to set up processing facilities on priority within their premises under a covered area on a raised platform. Every establishment has to ensure that the treatment plant is protected from rains and floods. Care may be taken to prevent leachate, odor, fly, and rodent nuisance. It is most important to have a proper facility for the use of compost or other products, leachate, slurry reject / inert management. maintenance, compost and reject management, safety considerations. Improved biogas units in these lines shall be encouraged and there shall be a system of safety certification. Monitoring, safety guidance, and Maintenance support, of household facilities, is necessary to ensure its good management and environmental performance.
Community-level treatment
• The system of community-level composting using bio bins (currently practiced by CREDAI in Kochi and some other places in high-rise buildings) may be promoted in similar buildings and large housing complexes in the State. • Community-level aerobins at public places may also be promoted only when municipal authority introduces a door-to-door collection of biodegradable waste. The number of Cubicles may be suitably increased depending upon the waste quantity generated in the catchment area of the facility. These facilities need to be managed professionally. Leachate management and odor control may be ensured. • Processing facilities up to 5 TPD capacity could be promoted at a decentralized community level • *Community-level biogas plants may be promoted at suitable locations only where biogas could be utilized within the vicinity either for community kitchens or for slums, informal settlements, etc. The operation and maintenance of facilities and safety are important. Care may be taken to prevent leachate, odor, fly, and rodent nuisance. It is most important to have a proper facility for the use of compost or other products, leachate, slurry reject / inert management. maintenance, compost and reject management, safety considerations. Improved biogas units in these lines shall be encouraged and there shall be a system of safety certification. Monitoring, safety guidance, and Maintenance support, of household facilities, is necessary to ensure its good management and environmental performance.*

4.4.1.2 Recommendation for Centralized treatment of Biodegradable waste

Assumed that 25percent of total biodegradable waste will get treated at the household, institution, and community levels, rest 75percent biodegradable waste needs to be processed and disposed in a centralized manner or at a regional level by municipal authorities.

Technologies Not Recommended	Technologies Recommended
• Based on the experience, geographical conditions of the State, long & heavy monsoon spells, open windrow composting technology is not found suitable. • Further vermicomposting technology may not be promoted in coastal	• Aerated Static Pile Composting technology • In-vessel composting including Rotary Drum technology • Bio-methanation technology • Biogas to Compressed Biogas (CBG) technology • Biogas to Thermophilic High Solid

lowland areas, which are more prone to floods, heavy rains, and high water tables. • In those towns where such facilities are functioning to the satisfaction of the ULBs and the public, these must be audited and upgraded to for good environmental and operational standards.	AD technology • Biogas to Electricity generation technology • Co-processing of biodegradable waste with Septage technology *Siting considerations, buffer, greenbelt, and drainage to be ensured. For all facilities it is most important to have proper arrangements for use of compost or other products/ by-products, leachate, slurry, odor, reject / inert management. The operation and maintenance of facilities, safety, and workers' occupational and community health and safety are important.*

4.4.1.3 Co-processing of biodegradable waste along with septage

Co-composting of fecal sludge (a rich source of nutrients such as nitrogen, phosphorus, and potassium) with biodegradable waste seems to be a less expensive and sustainable treatment option compared to other available treatments currently practiced in India as it treats not only dewatered septage but also MW. Hence, the overall cost will be lower for co-composting compared to the available treatment technologies.

In-vessel co-composting of septage could be easily adopted in urban Indian households and communities due to lower footprint requirements and rapid production of hygienic and good quality compost.

Siting considerations, buffer, greenbelt and drainage, protection from floods /rains to be ensured. For all facilities it is most important to have proper arrangements for use of compost or other products/ by-products, leachate, slurry, odor, reject / inert management. The operation and maintenance of facilities, safety, and workers' occupational and community health and safety are important.

4.4.2 Recommendation for Management of Non - Biodegradable waste

Material Recovery Facility (MRF)

MRF is mandated under SWM Rules, 2016 and the State of Kerala has taken a lead in this area. The initiative to set up MRF facilities in the State is laudable, however, the facilitates are not compliant with the Rules.

Recommendations

- The State/municipal authorities should upgrade/setup MRF facilities to handle all types of nonbiodegradable waste instead of handling plastic waste only
- These facilities could be decentralized or centralized as may be convenient to the local authority. It would be desirable to go for decentralized MRF facilities, which could be operated in a local area engaging manual labor. However, location and number of MCFs and MRFs shall be optimized based on proper area/population-based planning exercise
- Such facilities could be manual, semi-mechanized or even automated based on the size of the city and the quantity of waste to be handled
- Services of Local ragpickers/informal recyclers may be deployed as per SWM Rules, 2016;

after providing proper training and ampacity development.
- Safety is important considering its deployment in the dense settlement pattern of Kerala towns

The waste segregated in MRF may be utilized as mentioned below:
- Recyclable material: Recyclable material segregated at the MRF may be passed onto the recycling industry.
- Non-recyclable Plastic: Non-recyclable plastic collected at the MCF/RRF could be shredded, baled, and sent for use in road construction (however environmental impacts of such use must be mitigated) or may only be baled without shredding and sent to cement plants for use in cement kilns. Disposal for inerts and safety during processing, transport, and disposal needs consideration.
- Combustible waste: Combustible waste could be utilized as RDF for use in cement kilns or as feedstock for centralized or regional WTE plants. Though the State is taking initiatives to set up Thermal WTE plants in many locations, it is essential to undertake a feasibility study before installing such facilities.

Siting considerations, buffer, greenbelt, protection from rains/floods, and drainage to be ensured for MRFs/MCFs/RRFs. For all facilities, it is most important to have proper arrangements for the management of material and use of other products/by-products and reject / inert management. The operation and maintenance of facilities, safety, and workers' occupational and community health and safety are important.

Setting up of sanitary landfills at a regional level

The state has no sanitary landfills. State-of-the-art regional sanitary landfills may be set up in the State covering clusters of cities and may be managed in a professional and environmentally acceptable manner.

Siting considerations, buffer, greenbelt, protection from rains/floods, and drainage to be ensured for landfills. For all facilities, it is most important to have proper arrangements for storage, housekeeping, gas and leachate collection, and other considerations as per guidelines. The operation and maintenance of facilities, safety, and workers' occupational and community health and safety are important.

Biomining, closure and safe disposal of residual waste

The State of Kerala is experiencing an acute shortage of suitable land for processing and disposal of waste. There are several old and existing dumpsites in the State where large amounts of legacy waste are deposited; occupying precious land. The Biomining of legacy waste is strongly recommended as per NGT Directions & Guidelines issued by CPCB.

Efforts may be made to bio mine and segregate various components of waste such as composted matter, a recyclable material, non-recyclable combustible waste, C&D waste & inert material. The segregated components may be recycled, converted to RDF, or used/upscaled for making bricks, tiles, paver blocks, etc. Depth to which the soil is contaminated shall be identified through bore logs. Lands contaminated with heavy metals may need longer and technically appropriate remediation; which may require a longer time than the duration of this project and hence may be suitably screened. Only the residual inert/reject material may be capped scientifically or deposited in a scientific landfill for safe disposal; thus retrieving the rest of the land for future use for developing treatment facilities, landfills, or MRFs. It may be targeted to recover 50 – 70percent of land for setting up improved SWM. For fresh waste, after due treatment through advanced composting or biomethanation technologies, the residual inert material (not exceeding 20percent)

may be disposed-off safely in a centralized or regional sanitary landfill or into an appropriate landfill cell prepared in the remediated area. *Site development with buffer, greenbelt (preferably high dense Miyawaki forests using less space and soil/compost recovered from biomining), site drainage/cut off stormwater drainage also should be arranged during the process. Protection from rains/floods / other disasters and proper site drainage to be ensured. Professional operation and maintenance of facilities, safety, and workers' occupational and community health and safety are important.*
Collection and Transportation of Waste
Door-to-door collection and transportation Non-Biodegradable waste to treatment/disposal facilities are important. This shall ensure safeguards and safety. Principles of "No waste on the ground" and "no double handling of wastes" shall be ensured. Services of Local rag pickers/informal recyclers may be deployed as per SWM Rules, 2016. *Safety and safeguards shall be adhered to for operations and management of the Collection and Transportation system. GPS based movement tracking of vehicle movement and complaint redressal, and disposal control measures are important.*

4.4.3 Recommendation for Biomedical Waste Management

The project aims to support new centralized (at regional level) CBMWTF in the State. This will follow BMW Rules, 2016.

Also, the project aims to support ULBs and the State Government in ensuring COVID Waste management and hygiene/sanitation/cleaning activities during this emergency. These will follow existing rules and guidelines. It is recommended to follow siting guidelines, regulatory requirements, and consent conditions to ensure proper environmental management.

4.4.4 Recommendation for C&D Waste Management

The project aims to support a newly centralized (at regional level) C&D Waste Management facility in the State. This will follow C&D Waste Management Rules, 2016. It is recommended to follow siting guidelines, regulatory requirements, and consent conditions to ensure proper environmental management.

4.4.5 Conclusions and Outputs of Strategic Assessment

Inferences of the Strategic Environmental Assessment are presented here:

4.4.5.1 Suggestions on Policy Level Interventions

Bridging the Gaps in Current SWM System

- Though the State's efforts on source level treatment are laudable; it is the need of the day to fill the missing links to ensure an end – to end SWM solution, which prevents waste and pollutants leakage into the environment. It is required to have a) Full-fledged primary collection system for fresh BDW, b) Effective treatment of wastes at decentralized systems without leaks and unattended wastes, c) facilities to dispose the residual waste from the decentralized system, d) improved dry waste collection

for all fractions of dry wastes, e) improved and safe and local level processing and recycling infrastructure, and f) use of saleable outputs from recycling and processing facilities g) Disposal facilities for rejects and inerts after treatment of waste.

- The State needs more coordinated approach at regional level - policy shall be evolved to strengthen the role of Districts in urban planning, project conception in a clustered manner for urban environmental services and their technically high level of implementation supervision ensuring co-ordinated services considering the State's geographical limitations and disaster proneness.

Land Strategies

- The state policy should recognize the limitations concerning making the right piece of land available for development. This means the focus should be on retrieving and reusing available dumping yards for SWM; which is the best option for already contaminated land parcels.
- The high density of the population exerts pressure on available land for infrastructure development. It is important to integrate land and environmental sensitivities into planning for infrastructure development. The best option to strategize this is by making this part of town plans/master plans and regional plans where best plots for such infrastructure could be identified using suitable tools. This tiered strategy of hierarchical and clustered approach would ensure facilities at all levels. The state shall enforce land identification, demarcation, and securing it, notifying for use only for such purpose. This is important for the long term and the schedule to identify and demarcate such parcels shall also be enforced.

Integrated Management of Waste-sheds

- In the absence of any centralized mechanism to treat various type of wastes or wastewaters including drainage, wastewater from residences, industrial, commercial and institutional land uses, sewage and solid wastes, into its primary, secondary and tertiary water channels, all ultimately emptying into the wetlands or the sea and contributing to varied forms of pollution and health/flood impacts. This suggests the need for an integrated waste-shed approach for long term waste management.
- Around 3755 TPD of wastes generated in its 93 ULBs shall be assumed to impact the environment along with the wastes from its 941 Grama Panchayats which are dispersed like an urban-rural continuum. This, if dispersed in the landscape without treatment for 75 percent of the wastes or any disposal option causes a huge cumulate impact. Large generators like ULBs shall be tackled at first, also encouraging clustered treatment or disposal of wastes with interested Panchayats.
- The policy shall aim at ensuring end- to – end facilities for all local bodies. Wastes shall be collected from sources in all local bodies of Kerala – including Grama Panchayats - and treated and disposed of properly. Wastes should not leak out into open dumps along roads, dumping grounds, or even burnt; which would surely result in long term irreversible environmental impacts. Many of the Rural local bodies will soon turn urban with the densities they are experiencing and hence would sooner or later need an effective strategy for managing the wastes.
- Spatial Pattern of Urban Agglomerations along the length of Kerala from North to South explains the need for a clustered approach to major waste management infrastructure, common disposal facilities to reduce the footprint and to ensure

economies of scale. Spatial development demands more SWM infrastructure and land in dense lowland areas near the coast which is vulnerable to flash floods. However, the aerial distance between coast and highlands is only 40 – 80 km, highlighting the possibility for clustered critical infrastructure in the midland region, at an operationally manageable distance from ULBs in the coast.

- In the high lands, ULBs generate fewer wastes. Here the density of the population is also less. In such areas, more attention can be on decentralized waste management considering high wet waste quantities; with proper disposal for rejects/inerts. ULBs in low and midlands surely need more attention to centralized facilities and disposal options.
- Kerala - East-West and North-South Connectivity is good in though network narrow and congested. A clustered approach focusing on Regional level infrastructure development hence is a possibility. Since the state is narrow east-west with a maximum 80 km distance; developing north, south, and central common facilities like landfill along the midlands will be operationally justified. Intracity connectivity is good with well-topped roads in most residential/commercial areas of towns.
- Lack of centralized sewage treatment and disposal facilities add to the impacts of wastes reaching the water sources and land. Combining solid and liquid waste treatment options shall be considered an integrated solution to the pollution issues the state is facing today.
- Municipalities/local governments should invest further in waste and wastewater treatment infrastructure to manage plastic accumulation in Lakes and seas effectively.
- Where possible to have service level unhindered integration, SWM efforts of nearby local bodies shall be integrated
- Targeted programs to remove plastic litter from lakes and prevent further deposition would improve health and resilience. However, adequate waste treatment and disposal arrangements are necessary before starting such programs so that waste removed from lakes do not end up polluting another place.
- Need mechanisms to stop wastes getting into rivers, lakes, wetlands. Upstream mechanisms to clear legacy dumps and effective SWM is one. There can be actions downstream at city outlets to these waterbodies – to capture and treat waste. However, this is possible only if the State has facilities to treat and dispose of such wastes.

Retrofitting Environmental Considerations

- Enforce stopping of waste dumping in Wetlands using existing Acts / Rules
- Collaborative actions at wetland/river waste sheds shall be the long term action for the State considering the regionality of impact spread through these sensitive features
- There is an urgent need to conserve water quality and ensure availability by restoring and protecting available sources – ponds, wells, lakes - from over-extraction and pollution due to waste discharge.

- All projects in or near wetlands and Ramsar sites, mangrove or other sensitive inland and coastal resources shall be carried out after undertaking proper environmental due diligence.
- Many among the towns considered for KSWMP including Kalpetta, Mananthavady, Sulthan Bathery, Mannarkad, Palakkad, Chittur-Thathamangalam Kattappana, Nilambur, Thodupuzha, Neyyattinkara, Nedumangad, Kottarakkara, Punalur, Pandalam, Adoor Erattupetta, Pala, Muvattupuzha falls in or near Western Ghats region and developments proposed here need guidance from concerned authorities.
- There shall be more streamlined guidelines on waste treatment, management (*not just confined to decentralized source-level treatment); also considering the regional aspects, population demands, and expected realistic growth.
- Waste from fish processing/seafood industries dotting the coast is mostly deposited in the sea. There should be strict regulations and mechanisms to treat and dispose-off such wastes in an eco-friendly manner.
- The state shall set up processing and recycling facilities for all types of wastes: Biomedical wastes and Hazardous Facilities shall be augmented to meet the needs. E-Waste Facilities and C&D waste facilities are necessary.
- Specifically scheduled Clean-ups near tourism destinations shall be made part of responsible tourism efforts; with the participation of tour operators, destination managers, hotels/resorts, and respective local bodies.
- State-level cleanup drives are important to ensure the removal of legacy wastes accumulated along roadsides, water bodies, and dumps. This shall be initiated and implemented regularly after establishing disposal facilities.
- Local governments shall be directed to enforce the law prohibiting open dumping and burning of wastes including plastics
- Disaster Waste Management Plan or plan for the strategic strengthening of SWM during disasters or special situations is necessary. Classic examples being the lack of preparedness and infrastructure to deal with COVID 2019 wastes and 2018 and 2019 flood waste which was sent to the KEIL's TSDF though not hazardous. This shall integrate existing ULB level facilities and plan for containment and spillovers
- Integrated Management Plans (IMPs) for CVCAs shall include critical infrastructure such as waste treatment. Such areas will be managed with the involvement of the coastal communities including fisherfolk. Any development proposed in areas near Vembanad or Ashtamudi should be part of IMPs with the involvement of the communities and impact zero negative.

Recycling / Reuse and EPR

- Recognizing that Kerala is a destination for materials and considering higher population densities it is essential to enforce EPR while encouraging a) recycling of products which can be easily upcycled and b) centralized facilities for handling the fractions which cannot be treated or disposed at individual generators.
- The state strategy shall utilize existing opportunities for alternate materials for plastic covers through using its regional traditional handloom/machine loom clusters; linking it with micro-medium enterprises. Other alternate materials like Bamboo, plantation, and other broad leaves, areca leaves spathes, etc can be upscaled as effective alternatives to plastics.

- The state strategy needs to adapt a whole cycle approach leveraging on circular economy and Extended Producer Responsibility mandated by-laws for all dry waste streams and effective treatment/disposal and value-added options for products of biowaste and plastics/recyclables. This includes considerations for household hazardous and biomedical wastes as well; as these would otherwise find its way into the otherwise benign solid waste.

Capacities for SWM and other Environmental Infrastructure and Services

- With democratic decentralization, it is important to have capacities at lower levels to raise the infrastructure and service standards keeping in view the disasters and emergencies the State faces. State policy should aim at strengthening the capacities of local bodies for segregation, recycling, and reuse of municipal solid wastes-recognizing inter-alia the positive impacts it may have on the welfare of SWM workers and for setting up and operating regional facilities and sanitary landfills, in particular through competitive outsourcing of solid waste management services. By encouraging each ULB to be fully equipped to manage its essential infrastructure and services the state can raise them to the true level of decentralized functioning.
- There shall be a comprehensive policy covering the health and insurance of all workers in waste management. Mapping of shadow/contract workers and integrating them regularly into the waste management system is important.
- Awareness towards segregated disposal of hazardous waste among all categories needs to be further promoted regularly and outcomes in terms of segregated collection and disposal need effective monitoring. The State needs to frame guidelines and implement the same, to enable segregation of household hazardous and biomedical wastes and to collect it separately and transport to available hazardous waste / biomedical facilities in the State to avoid dangers of mixing these with other wastes.'
- The state shall take efforts to regularize and streamline monitoring of all treatment and disposal facilities and overall SWM in all its local bodies through PCB. Sufficient staff and funding support shall be provided with laboratory facilities. Regular monitoring of the environment and health impacts of wastes is very important considering frequent disasters and health emergencies.

4.4.5.2 Inputs to improve Existing SWM facilities in the State

Dumpsite Remediation

- It is very important to remediate existing dumps and ensure leachate/gas management, proper management of accumulated wastes through bioremediation.
- Dumpsites near water-scarce areas need urgent attention to prevent impacts on available water sources
- Improvement of existing dumps near sensitive areas needs proper scrutiny in terms of the possibility for further contamination and impacts on the sensitive receptors. This hence shall be taken up as a sufficiently detailed technically robust intervention with longer-term implementation cycles and monitoring.
- All waste management areas shall be legally protected. There shall be proper security and fire control and escape provisions.

Improvements to Treatment Facilities

- Studies confirm that the gap in the treatment of solid wastes is 80 percent, while the gap in the disposal of rejects and inerts is 100 percent, It is important to devise systems not just to treat the wastes, but also to dispose-off the rejects and inerts to save water and land.
- All existing facilities shall be improved – household composters, Aerobics, existing compost plants, and bio methanation plants and devices need to be upgraded. This is to avoid or minimize impacts of leachate, flies, rodents, and other pests, odor, and material ad compost / other product management.
- There is a slight difference in the waste quantities generated by different local bodies. However, characteristics are mostly the same and so are the impacts. All local bodies can hence select from the range of promoted technologies – upgraded household composters, bio-methanation, upgraded Aero-bins. Compost produced by households may need polishing or may need marketing support.
- Even while creating regional facilities, It is important to have waste management facilities in each ULB, considering the possibility of losing regional connectivity in case of disasters and social emergencies.
- All treatment arrangements or linked activities near forested areas or near-natural habitats shall be audited for impacts and corrections for any perceived impacts on forests or natural habitats shall be incorporated in ULB SWM Plan.
- Coconut, its husk and shell, leaves and trunks; and other garden waste which is trimmed before monsoons mostly; also form bulk garden waste in Kerala. Collection Transportation and disposal arrangements for Solid Waste Management shall also consider this bulky waste as a part of the stream. Coconut shell, Coir, Rubber, other parts of coconut and areca nut trees (areca nut leaf spathes called ‘pala’), Banana trunk and leaves, and much other broad foliage widely occurring in the State are usually thrown away as wastes though they were reused in the past. There are few attempts to utilize some of these as durable alternatives to plastics. This would contribute to realizing the 4R principle of Waste Management: Recover, Reduce, Reuse, Recycle.
- Fish and meat Markets in the state generates well-segregated fish/meat waste which could be treated at the source itself; i.e. preferably in biogas plants within the market premises; thus reducing transportation cost. There should be efforts to prevent waste deposition into the sea and to arrest, collect, and dispose-off marine debris along with dry waste; in coastal cities. SWM plan for coastal towns shall address this critical aspect.
- SWM infrastructure and services shall consider contingency arrangements for higher than peak loads during festive / tourism seasons. For special wastes from Temples (flowers, segregated bio-waste) and festivals it may be possible to consider waste upcycling or treating near the source. Special considerations or arrangements might be necessary for the collection and transportation of the wastes during occasions and functions.
- The State needs to have CBMWTFs at the regional level, one in Central and one in Southern region of Kerala; in addition to the one near North Kerala in Palakkad. As per Biomedical Waste Management Rules (BMWM Rules, 2016), facilities shall cater

to a distance of 75 km radius from it and no Biomedical Waste shall be stored for more than 48 hours at the source.

Bioremediation of Legacy Sites

- Efforts may be made to bio-mine and segregate various components of waste such as composted matter, a recyclable material, non-recyclable combustible waste, C&D waste & inert material. The segregated components may be recycled, converted to RDF, or used/upscaled for making bricks, tiles, paver blocks, etc. Depth to which the soil is contaminated shall be identified through bore logs. Lands contaminated with heavy metals may need longer and technically appropriate remediation; which may require a longer time. Only the residual inert/reject material may be capped scientifically or deposited in a scientific landfill for safe disposal; thus retrieving the rest of the land for future use for developing treatment facilities, landfills, or MRFs. It may be targeted to recover 50 – 70percent of land for setting up improved SWM. For fresh waste, after due treatment through advanced composting or bio-methanation technologies, the residual inert material (not exceeding 20percent) may be disposed-off safely in a centralized or regional sanitary landfill or into an appropriate landfill cell prepared in the remediated area.

Collection and Transportation

- Collection and Transport of waste shall adopt a whole city approach – no part of the city shall be avoided even in case the households adopt household waste composting. This is considering the leakage of certain fractions of wastes into the environment and inadequate disposal of rejects and inerts.
- Waste segregation at source is mostly high and efforts shall be to ensure 100 percent segregation from all sources. All facilities shall consider leachate, fly /odor/slurry management, and covered treatment and storage facilities for both dry and wet waste. Waste Collection bins, vehicles, and waste treatment premises shall be covered and need cut-off drains and leachate / wash water treatment to prevent water pollution.
- ULBs may support economically most deserving households / BPL households with separate containers for segregated storage of wastes. Other households can purchase their bins as a commitment/contribution to fulfill the responsibility of waste segregation.
- Siting considerations, buffer, greenbelt, and drainage to be ensured. For all facilities it is most important to have proper arrangements for use of compost or other products/ by-products, leachate, slurry, odor, reject / inert management. The operation and maintenance of facilities, safety, and workers' occupational and community health and safety are important.

4.4.5.3 Directions for designing and managing facilities considering the regional environmental conditions

Planning for Integrated end to end SWM

- All ULBs shall prepare SWM Plan for improving their existing facilities and to plan facilities to fill the gaps in SWM. This shall be a long term plan considering regional linkages with other Local Bodies and cluster facilities, and this shall have 5-year action plans for proposed improvements over the project period
- Waste generated per person is much more than many large cities in India. It will soon touch the 700 g/day mark predicted for India for 2015. With less population growth; higher waste quantities per person essentially mean high generation rates; which might increase with a future increase in income levels. Hence systems to handle wastes in an integrated manner are essential; more so for wet wastes.

Regional / Clustered Facilities

- SWM facilities can be clustered along the length of the State – preferably North, Central, and South
- Large Landfills are not preferable in coastal sandy areas. It is advised to develop proper artificial liners, clay packing, leachate/gas management, and thorough monitoring before developing landfills (in coastal sandy and lateritic formations) to arrest the vertical infiltration and percolation of pollutants to the soil, water bodies and water sources (including groundwater shallow wells which are very common).
- Siting criteria for landfills, treatment systems shall be effectively used to find the right type of development in each region. This is more important considering the eco-fragility and disaster prone-ness of the State.
- The state with Tropical Warm Humid climatic conditions is under rains for almost six (6) months annually, which restricts the construction activities.
- Land stability of high and midlands needs to be considered while locating and designing large landfill facilities here.
- The development of treatment facilities and landfills near the coast shall consider the possibilities of flooding and heavy rains. Planning / locating landfills and other critical infrastructure need to consider lineaments connecting Kottayam and Thrissur in the midlands, Palakkad and Wayanad in the mid - highlands and Chalakkudy – Aluva to Idukki.
- Highlands of the districts along the western ghats are prone to landslips and soil piping phenomenon. Soil/slope stability in this critically vulnerable area is further compromised by extensive uprooting of indigenous tropical vegetation/tree cover which got replaced for years with cash crops like rubber with less slope binding characteristics. Location of critical SWM infrastructure such as landfills in such areas needs careful planning including vegetative buffers to ensure resilience.
- Most affected were the areas abutting the coasts, rivers, and wetlands. Drainage planning and management and design of infrastructure to allow quick flood water evacuation is important.
- Cities and towns in highlands of Thiruvananthapuram, Pathanamthitta, Idukki, Palakkad and Wayanad and lowlands of Malappuram fall near Protected areas. Mandatory guidelines for development near the protected areas shall be followed for any treatment and disposal facilities here and in such other areas.
- Infrastructure development for SWM shall avoid Sensitive ecosystems (and their buffers) such as mangroves which play an important role in maintaining the integrity of the coast.

- Developments on the Western Ghats region, CRZ areas shall follow the applicable guidelines and shall get permissions as required from respective authorities.
- Infrastructure development in ULBs near forested areas shall not result in the conversion or degradation of forest resources.

Collection and Transportation, of Wastes

- Width of roads, high traffic most of the motorized modes, and specificities of origin – destinations shall be considered while selecting the vehicles for Collection Transportation and Fleet and movement planning.
- Waste will be mostly wet, necessitating more attention on the segregation of waste at source, leachate, fly /odor/slurry management, and covered treatment and storage facilities for both dry and wet waste. Waste Collection bins, vehicles, and waste treatment premises shall be covered and need to cut off drains and leachate / wash water treatment to prevent water pollution.
- Small winding roads, in steep gradients, may need pushcarts or tri-cycles. In remaining areas, separate auto three-wheelers or auto two-wheelers with separate containers for dry and wet wastes can be a good option. Since segregation is being practiced by many; it is important to ensure that the wastes are not mixed during collection and transport. It is also important to follow proper safeguards for collection and transport.
- It is important to collect BDW every day from households and alternate day/weekly twice collection of NBDW and fortnightly collection of household hazardous/biomedical wastes. However, Household hazardous/biomedical wastes shall be collected through a separate system and shall not be construed as part of the ULBs SWM system. It is important to have a proper transportation system for various segregated streams of wastes in closed trucks; without waste overflows or leachate dripping. Collection and Transportation system shall ensure a) No direct handling of wastes by workers, b) no wastes on the ground; and c) no manual handling of wastes even while transferring from one vehicle to another. Workers shall be trained to follow proper safeguards and use Personnel Protection Equipment (PPEs). There shall be proper vehicle parking, maintenance, and cleaning facilities.
- Safety and safeguards shall be adhered to for operations and management of the Collection and Transportation system. GPS based movement tracking of vehicle movement and complaint redressal, and disposal control measures are important.

Dry Waste Collection and Recycling Facilities

- MCFs have come up in certain cities/towns to collect dry wastes. MCFs and MRFs are mostly in dense areas in the towns in the absence of any siting or deployment guidelines for the same though Suchitwa Mission has prepared typical design, specifications, and estimates for these. Most of the MCFs are overflowing with collected wastes and need better facilities for storage of wastes, fire safety, and environmental upkeep.
- All waste management facilities including and more specifically dry waste facilities shall have all proper fire control ad management provisions like escape exit route planning, vehicle and pipe route, dedicated water storage for fire, extinguishers, green belt to prevent the spread of fire, and other provisions as per regulations.

BDW Waste Treatment Facilities

- It is required to fill the gaps in the current SWM system – by supporting the State in its endeavor to increase segregation and source-level composting; and providing solutions for disposal and recycling, improving existing systems to minimize and manage negative externalities; as the waste quantities are increasing with natural growth in population.
- Biogas units shall be placed in the raised plinth to protect from flooding/rains. All required pollution/safeguard aspects shall be considered including protection from rains, flood, leachate/slurry management, maintenance, compost and reject management, safety considerations. Improved biogas units in these lines shall be encouraged and there shall be a system of safety certification. Monitoring, safety guidance, and Maintenance support, of household facilities, is necessary to ensure its good management and environmental performance.
- Institutions with available yard space may be motivated to set up processing facilities on priority within their premises under a covered area on a raised platform. Every establishment has to ensure that the treatment plant is protected from rains and floods. Care may be taken to prevent leachate, odor, fly, and rodent nuisance. It is most important to have a proper facility for the use of compost or other products, leachate, slurry reject / inert management. maintenance, compost and reject management, safety considerations. Improved biogas units in these lines shall be encouraged and there shall be a system of safety certification. Monitoring, safety guidance, and Maintenance support, of household facilities, is necessary to ensure its good management and environmental performance.
- Community-level biogas plants may be promoted at suitable locations only where biogas could be utilized within the vicinity either for community kitchens or for slums, informal settlements, etc. The operation and maintenance of facilities and safety are important. Care may be taken to prevent leachate, odor, fly, and rodent nuisance. It is most important to have a proper facility for the use of compost or other products, leachate, slurry reject / inert management. maintenance, compost and reject management, safety considerations. Improved biogas units in these lines shall be encouraged and there shall be a system of safety certification. Monitoring, safety guidance, and Maintenance support, of household facilities, is necessary to ensure its good management and environmental performance.
- Siting considerations, buffer, greenbelt and drainage, protection from floods /rains to be ensured for existing and new facilities – treatment facilities, MRFs, RRFs, MCFs. For all facilities it is most important to have proper arrangements for use of compost or other products/ by-products, leachate, slurry, odor, reject / inert management. The operation and maintenance of facilities, safety, and workers' occupational and community health and safety are important.
- Site development with buffer, greenbelt (preferably high dense Miyawaki forests using less space and soil/compost recovered from biomining), site drainage/cut off stormwater drainage also should be arranged during the process. Protection from rains/floods / other disasters and proper site drainage to be ensured. Professional operation and maintenance of facilities, safety, and workers' occupational and community health and safety are important.

- Reuse of wastewater or leachate is important as many parts of the State reals under water stress (though rainfall is very high)

4.4.5.4 Inputs to Institutional Strategy

Regional Facilities: Co-ordination and Planning

- Instuitional support and monitoring is required not just at ULB level as the waste-shed and impacts are regional
- Wastes are leaking more into regional infrastructure and resources – like lakes, rivers, roads. Thus the waste is becoming not just the issue affecting just the ULB where it is generated – it is attaining a regional dimension. Institutions to manage and supervise at regional cluster levels through the state thus becomes important; more so, to consider environmental sensitivities and safeguards.
- Institutions to ensure collaborative action across local bodies is essential. The district as a planning unit, with Revenue authorities whose mandate spans across local body boundaries, shall be partnered in for regional coordination efforts.

Professional Development of Women's Groups for SWM Services

- Better work standards, opportunities for improving their capacities to manage and operate, financial support and work conditions would encourage more women into this sector. Due to high levels of education, their skills in financial management, office automation, and better overall management (including safeguards management) will be supportive of the program. Training, and capacity building activities under the project shall focus on better professional development and financial management capabilities as well; in addition to supporting collection transportation services and micro-enterprises. State Poverty Eradication - Kudumbashree - Mission can also provide training to women's groups to monitor and service decentralized waste management facilities, developing and mass-scale production of alternatives to plastics, and for sale of compost from decentralized units after polishing; which will create a unique support group for the sustenance of SWM services in Kerala.
- Women in the neighborhood are most accepted by the people for door-to-door collection. NGOs, Private operators may also be used for C&T services. However, this shall be the choice of the community.
- Drawing from Kudumbashree and Haritha Karna Sena's experiences, it is important to ensure more support to women's groups for 'professionally' managing the waste collection and upcycling efforts. They shall be handheld – with more financial and professional / capacity-building support (on all aspects of the business) to deliver the best quality services.

Awareness and Participation

- Better awareness and participation from citizens could be achieved through well-developed campaigns and visual/print media. This can be used to inform the citizens about the downstream environmental impacts and make them participate in an effective SWM system.

- Continuous awareness generation attempts for all sections of the community on environmental aspects and safeguards can be effective through print and visual media
- Institutions shall effectively engage with citizens during all stages of development and operation of the proposed system
- Poor, marginalized and indigenous communities participation can be ensured through awareness and capacity building efforts, thanks to their better education levels

Monitoring of SWM Infrastructure and Services

- ULBs in Kerala are mandated to provide SWM services but they lack adequate capacity to handle the complete collection and transport of waste as per the national SWM rules
- To support ULBs, numerous state-level agencies have been created or tasked to strengthen the sector including HKS for primary collection of NBDW, Suchitwa Mission (SM) for monitoring and capacity building, and the Clean Kerala Company (CKC) for the storage and treatment of NBDW, namely recyclable materials. However, there is no full integration amongst these agencies and each of them has limited capacity to scale-up the existing system. Institutional fragmentation for planning and service delivery at both state and city levels to be curbed
- ULB is mandated with the responsibility for all functional aspects but lacks sufficient staff strength and guidance to provide all services. Scope for private participation is limited and focus is not on integrated services. Capacities of key players in SWM need enhancement to take up the challenges of ever-increasing waste generation, increasing densities, and increasing pollution due to the dumping of wastes.

Linking Physical Planning to Infrastructure Development

- It is important to link physical development with the land. For this, there should be an integrated institutional system. Though Town Planning is part of LSGD and so are ULBs, there is no enforcement of development plans. The practice of referring to well-developed physical plans and incorporating its guidance into physical development is very important, institutions and DPC shall take steps in this direction.
- As local bodies have service delivery responsibility, it is important to strengthen municipal cadres by deploying required human resources of high technical / co-ordination skills to select and implement environmentally most appropriate interventions at the local level.
- Ensure technical support for ULBs in the planning process for the formulation of multi-year projects of large capital outlays.

Effective Partnership with other Agencies

- It is important to strengthen the monitoring network to ensure services are professional and environment friendly; with greater role and support for PCB to enforce SWM Rules 2016.
- Disaster Management authorities shall establish a working relationship with ULB waste management; possibly through a coordinating agency at State Level – like

LSGD. Though responsibility for SWM lies with ULBs, regional and State coordination hence becomes important.

- Involvement of the Environment Department, KSBB, and other relevant agencies are important for long term SWM Planning and management, considering the sensitivities of the State.
- In case any component of the proposed development is near forested areas the project shall incorporate capacity building elements to manage forest resources from disturbance and project preparation, appraisal, and supervision arrangements shall include appropriate environmental expertise to ensure adequate design and implementation of mitigation measures.
- Disaster Management and Fire Rescue teams shall be familiar with waste management facilities (wet and try) in each ULB. Regular drills shall be conducted to ensure fire safety and to familiarize communities and workers with procedures for fire and rescue.
- Collection and safe disposal of generated biomedical waste from households and health Care Units during emergencies like COVID 19 need close coordination between ULBs and BMW Management service providers for cleaning and disinfection of premises, collection and transport of wastes to the facility and increasing the capacities for treatment and disposal of biomedical wastes.
- Training and cross-learning on integrating environmental considerations during planning and implementation and safeguards management are important to handhold the State towards better environmental effects.

These inferences inform the project design and the preparation of the ESMF for KSWMP which is presented as Volume II (A). The following ***Figure 25*** represents these inferences:

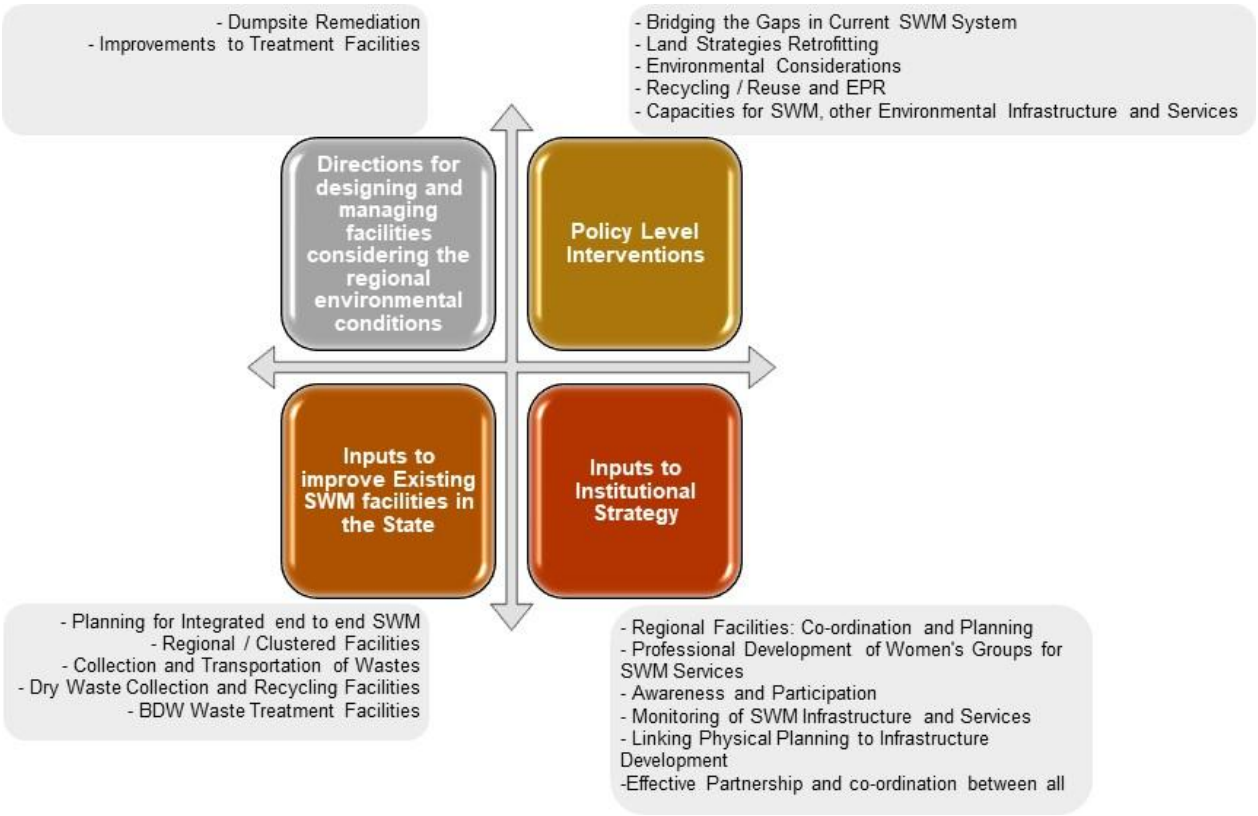
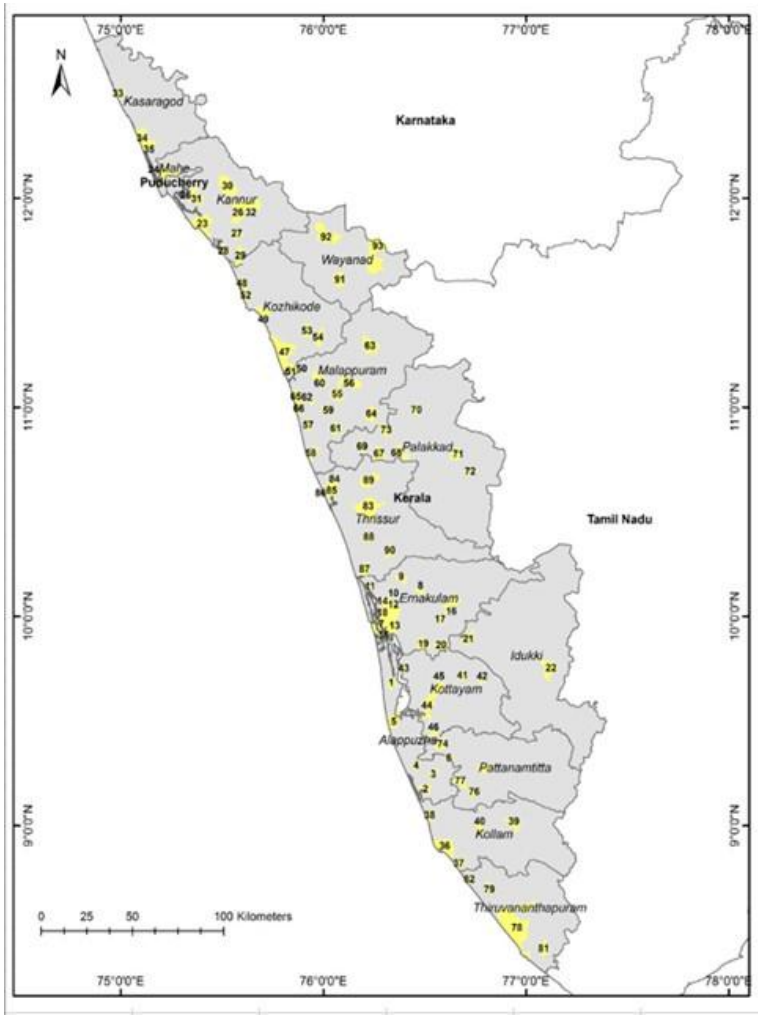


Figure 25: Inferences of the Strategic Environmental Assessment

ANNEXURES

Annexure I: Detailed Baseline Environmental Setting of ULBs

Detailed baseline Environmental setting of the Project ULBs is presented here. The ***Figure 26*** presents the Map of Project ULBs in Kerala.



LEGEND

ID	ULBs	District	ID	ULBs	District
1	Cherthala (M)	Alappuzha	48	Vadakara (M)	Kozhikode
2	Kayamkulam (M)	Alappuzha	49	Koyilandi (M)	Kozhikode
3	Mavelikkara (M)	Alappuzha	50	Ramanattukara (CT) (M1)	Kozhikode
4	Harippad (CT) (M1)	Alappuzha	51	Faroke (CT) (M1)	Kozhikode
5	Alappuzha (M+OG)	Alappuzha	52	Payyoli (Rural) (M1)	Kozhikode
6	Chengannur (M)	Alappuzha	53	Koduvally(M1)	Kozhikode
7	Kochi (M Corp.+OG)	Ernakulam	54	Mukkam	Kozhikode
8	Perumbavoor (M)	Ernakulam	55	Malappuram (M+OG)	Malappuram
9	Angamali (M)	Ernakulam	56	Manjeri (M)	Malappuram
10	Aluva (M)	Ernakulam	57	Tirur (M)	Malappuram
11	Paravoor (M)	Ernakulam	58	Ponnani (M)	Malappuram
12	Kalamasserry (M)	Ernakulam	59	Kottakkal (CT) (M)	Malappuram
13	Thripunithura (M)	Ernakulam	60	Kondotty (CT) (M)	Malappuram
14	Eloor (CT) (M1)	Ernakulam	61	Valancherry (CT) (M1)	Malappuram
15	Maradu (CT) (M1)	Ernakulam	62	Thirurangadi (CT) (M)	Malappuram
16	Kothamangalam (M)	Ernakulam	63	Nilambur (CT) (M1)	Malappuram
17	Muvattupuzha (M)	Ernakulam	64	Perinthalmanna (M)	Malappuram
18	Thrikkakkara (Rural) (M1)	Ernakulam	65	Parappanangadi (Rural) (M1)	Malappuram
19	Piravom (Rural) (M1)	Ernakulam	66	Thanur (Rural) (M1)	Malappuram
20	Koothattukulam (Rural) (M1)	Ernakulam	67	Shornur (M)	Palakkad
21	Thodupuzha (M)	Idukki	68	Ottappalam (M)	Palakkad
22	Kattappana (Rural) (M1)	Idukki	69	Pattambi (CT) (M1)	Palakkad
23	Kannur (M)	Kannur	70	Mannarkad-I (CT) (M)	Palakkad
24	Payyannur (M)	Kannur	71	Palakkad (M)	Palakkad
25	Thaliparambu (M)	Kannur	72	Chittur-Thathamangalam (M)	Palakkad
26	Mattannur (M)	Kannur	73	Cherpulasserry (Rural) (M1)	Palakkad
27	Koothuparambu (M)	Kannur	74	Thiruvalla (M)	Pathanamthitta
28	Thalassery (M)	Kannur	75	Pathanamthitta (M)	Pathanamthitta
29	Panoor (CT) (M)	Kannur	76	Adoor (M)	Pathanamthitta
30	Sreekandapuram (Rural) (M1)	Kannur	77	Pandalam (Rural) (M1)	Pathanamthitta
31	Anthur	Kannur	78	Thiruvananthapuram (M Corp.+OG)	Thiruvananthapuram
32	Iritty (M1) (Urban)	Kannur	79	Attingal (M)	Thiruvananthapuram
33	Kasaragod (M)	Kasaragod	80	Nedumangad (M)	Thiruvananthapuram
34	Kanhangad (M+OG)	Kasaragod	81	Neyyattinkara (M)	Thiruvananthapuram
35	Nileswaram (Urban) (M1)	Kasaragod	82	Varkala (M)	Thiruvananthapuram
36	Kollam (M Corp.+OG)	Kollam	83	Thrissur (M Corp.)	Thrissur
37	Paravur (M)	Kollam	84	Kunnamkulam (M)	Thrissur
38	Karunagappally (CT) (M1)	Kollam	85	Guruvayur (M)	Thrissur
39	Punalur (M)	Kollam	86	Chavakkad (M)	Thrissur
40	Kottarakkara (CT) (M1)	Kollam	87	Kodungallur (M+OG)	Thrissur
41	Pala (M)	Kottayam	88	Irinjalakkuda (M)	Thrissur
42	Erattupetta (CT) (M1)	Kottayam	89	Wadakkanchery (CT) (M1)	Thrissur
43	Vaikom (M)	Kottayam	90	Chalakkudy (M)	Thrissur
44	Kottayam (M)	Kottayam	91	Kalpetta (M)	Wayanad
45	Ettumanoor (CT) (M1)	Kottayam	92	Manathavadi (Rural) (M1)	Wayanad
46	Changanasserry (M)	Kottayam	93	Sulthan Bathery (Rural) (M1)	Wayanad
47	Kozhikode (M Corp.+OG)	Kozhikode			

Figure 26: Map of Project ULBs in Kerala

Table 21: Baseline Description of Project ULBs

Sl NO	Town	Physiography	Population (Census 2011)	Area of Town	Population density (per SqKm)	Forests (%)	Rivers, streams	Major Lakes, Water bodies	Coastal Area	Important ecological and other features	Physical / Cultural resources	Disaster proneness	Name of Existing Dumping Ground	Area of Existing Dumping Ground	Approx. Waste (Tonnes per day)
1	Thiruvananthapuram	Low Land	889635	213.21	3576	0	Karamana, Parvathy Puthanar (waterway)	314.48 ha, Akkulam Lake, Veli Lake, Padmanabha swamy temple pond - Padmatheertham, srivaraham pond, many canals, Parvathy puthanar (TS canal part)	Part of ULB likely located within CRZ Limit	Airport, Akkulam Lake, Kannammoola thodu, Kadinamkulam wetlands, Museum / Zoo Compound, Padyfields-Kesavadasapuram	Vetti Muricha Kotta, Napier Museum, LMS, Palayam, many historic buildings and Palaces near Palayam area, East & West Fort area	Flood,Drought (Moderate), Erosion (High), Storm Surge, Tsunami Innundation	Vilappilshala abandoned due to protests. Small dumping yard Erumakkuzhi in Chala Market. (Area given here)	0.35 acres	450.0
2	Kollam	Low Land	380091	71.85	4873	1.27 ha of scrub/degraded (0.02 %)	Kallada, Ithikkara	Asthamudi (Rivers, water bodies=7.5%)	Part of ULB located within CRZ Limit	Ashtamudi Lake, numerous islands	Fort Remains (Thangassery), Sreevidyadhiraja Chattambi Swami Monument, Railway Station,other city monuments, Lighthouse	Earthquake, Flood,Drought (Severe), Erosion (High),Tsunami Innundation	Kureepuzha	16 acres	200.0
3	Kochi	Low Land	602046	97.71	2808	-	Many canals including market canal, Thevara Perandoor Canal	Vembanad	CRZ all zones, mangroves, Intertidal, sea, coast, creek	Islands of North Kochi - Vallarpadom, Vypin, Pezhelam Kadamakkudy etc; Kochi Refineries (indl), NWW 3, many canals, Mangalavanam Bird Sanctuary near high court, Vembanad, Pokkali fields	Mattancherry Palace, St. Francis Church, Synagogue, many temples, churches, mosques, Palaces, Pallippuram fort, Ariyittuvazhcha Kovilakom	Flood,Drought (Moderate),Erosion (High),Storm Surge,Tsunami Innundation	Brahmapuram	110 acres	175.0
4	Kozhikode	Low Land	636,061	119.44	4608	scrub	Korapuzha, Kallai, Chaliyar	Connolly Canal, Mananchira Lakes and Tanks, 3% of landuse	Part CRZ II	Kottuli wetlands, tanks and lakes, coast, mangroves (0.48 sqm), mudflats	History of travellers from across the Globe; Kappad Beach; Samoothiri Kingdom, English Church, pazhassi Raja Museum, cuisine	Flood,Drought (Moderate),Erosion (High),Storm Surge,Tsunami Innundation	Kozhikode-Two sites & compost yard	16 acres	345.0
5	Thrissur	Low Land	315957	99.72	3168	No Reserve Forests, some rubber plantations	Keecheri, Karuvannur	103.82 Ha (less)	Nil	Peechi-Vazhani WLS (Adjoining)	Vadakkumnatha temple, Thrissur Pooram, many churches temples, Sakhtan Palace	Earthquake,Flood,Drought (Moderate),Landslide (Low)	Laloor	5 acres	172.2
6	Kannur	Low Land	56823	81.22	700	-	Valapattanam, Anjarakandi, Talassery	0.8% of landuse	part CRZ-sea, creek, mangroves, inter tidal	paddy fields - kaipad nearby; mangrobes of valapattanam	Fort St. Angelo, light house, arakkal museum, artforms	Flood,Dought (Slight)	Chelora	15 acres	30.0
7	Adoor	Mid Land	29171	20.83	1400	0	Achankovil	-	Nil	near Ranni Forest	Megalithic dolmens nearby	Flood,Drought (Moderate)	Kaimalapara; ward 2	0.05 acre	20.0
8	Alappuzha	Low Land	174176	45.18	3855	Nil	Pamba	Vembanad, 0.5 percent - of landuse is waterbodies; NWW No:3 passes through here	Part of ULB located within CRZ Limit-along the seacoast, and along creek, crz iv	Deltaic coastal plain, canals and waterways, Vembanad, Kuttanad paddy fields, flouride in ground water	Ambalapuzha temple, karumadi Kuttan nearby	Flood,Drought (Moderate),Erosion (High),Storm Surge	Sarvodayapuram (Closed)	12 acres	100.0
9	Aluva	Low Land	22428	6.64	3380	-	Periyar	10% of landuse	Nil	Periyar banks, Uliyannoor and Ealapadom fields; near Airport	Palace, Shivarathri Manappuram	Flood,Drought (Moderate)	Nalam mile & Municipal Market		20.0

Sl NO	Town	Physiography	Population (Census 2011)	Area of Town	Population density (per SqKm)	Forests (%)	Rivers, streams	Major Lakes, Water bodies	Coastal Area	Important ecological and other features	Physical / Cultural resources	Disaster proneness	Name of Existing Dumping Ground	Area of Existing Dumping Ground	Approx. Waste (Tonnes per day)
10	Angamaly	Mid Land	33465	20.97	1596	-	Periyar	1.3% o landuse	Nil	Near Airport	Old Kacheri Malika-UC College, Kalady Shankara Madom near by	Flood,Drought (Moderate)			20.0
11	Anthoor	Low Land	28228	24.52	1151	-	Valapattanam, Kupam	-	parts CRZ-creek, mangrove, inter tidal		-	Flood,Drought (Slight)			20.0
12	Attingal	Low Land	39031	17.66	2115	0	Vamanapuram, Mamom River	temple ponds	Part in CRZ II	Vamanapuram basin	Anchuthengu fort - 10 kms	Flood,Drought (Moderate)	Chudukad (sanitary landfill facility being developed at Chudukad)	4 acres	18.0
13	Chalakkudy	Mid Land	49525	25.04	1978	No Reserve ForestsSome rubber plantations	Chalakudi	45 ha	Nil	River rich in fauna, flora - endangered, Airport 20km	Kanakamala, many temples, churches	Flood,Drought (Moderate)	near take and break	0.6 acres	30.0
14	Changanassery	Low Land	47685	14.23	3351	nil	AC canal	1.7% of total landuse is waterbodies; Chitrakulam lake, Poovakkattuchira	Vembanad Lake CVCA	Vembanad Lake CVCA, Kuttanad	NSS Head quarters, temples, churches	Flood,Drought (Moderate)	Fathimapuram	0.4 acres	30.0
15	Chavakkad	Mid Land	39098	13.09	2987	No Reserve ForestsSome rubber plantations	-	25.86 ha	Part is CRZ II	Beach, Mangroves, mudflats	Chettuvakotta, Koottungalangadi, Kadalaayi mana nearby	Flood,Drought (Moderate),Erosion (High)	Chavakkad	0.21 acres	25.0
16	Chengannur	Low Land	23466	12.74	1843	Nil	Pamba	4.6% watrerbodies	Nil	Kuttanad Paddy fields, Pamba	Narasimha temple Chathankulangara nearby	Flood,Drought (Moderate)			20.0
17	Cherpulassery	Mid Land	34899	27.46	1271	nil	-	1.4% of landuse	Nil	Sacred groves	Olappamanna Mana, other old houses	Earthquake,Flood,Drought (Moderate)			20.0
18	Cherthala	Mid Land	45827	18.61	2462	Nil	Puthenthodu AS Canal	Vembanad - 0.8 p% of total landuse is waterbodies	Part of ULB located within CRZ Limit - along creek and crz iv	Coastal plain, Vembanad; Arappad wetland	Thyckal maritime archaeological site nearby	Flood,Drought (Moderate)			25.0
19	Chittur-Thathamangalam	mid and High Land	32298	15.01	2151	nil	Bharathapuzha-Kannadipuzha	3% of landuse-Shokanasini River	Nil	Agricultural areas/fields	Municipal office, other buildings, agraharam, art forms	Flood,Drought (Severe)			20.0
20	Eloor	Low Land	31468	13.5587	2321	-	Periyar	7.3% of landuse	Some parts CRZ (riverine)	Paddy fields, Industrial area-FACT, IOC etc.Some mangroves	Varapuzha heritage - latin Christian settlement nearby-	Flood, Drought (Moderate)			20.0
21	Erattupetta	Mid Land	34814	7.38	4714	nil	Meenachil	Aruvithura	nil	Hillocks, monolithic rocks	Churches: Aruvithura, Valiyachanmala and Temples	Earthquake, Flood, Drought (Slight)	Thevarrupara	0.35 acres	20.0
22	Ettumanoor	Mid Land	26993	27.48	982	nil	Meenachil	Villukulam, Chirakkulam, temple tanks	nil		Ettumanoor Mahadeva Temple and Ezharaponnana, Mural Art Centre	Earthquake, Flood, Drought (Moderate)			20.0

Sl NO	Town	Physiography	Population (Census 2011)	Area of Town	Population density (per SqKm)	Forests (%)	Rivers, streams	Major Lakes, Water bodies	Coastal Area	Important ecological and other features	Physical / Cultural resources	Disaster proneness	Name of Existing Dumping Ground	Area of Existing Dumping Ground	Approx. Waste (Tonnes per day)
23	Feroke	Low Land	32122	13.23	2428	-	Chaliyar	Mankuzhi Kottapadam, Temple tanks- 14.5 percent of landuse is waterbodies	Part CRZ II	Mangroves-0,7 sqkm, Kadalundi MPA - mangroves, mudflat, bird sanctuary nearby (7km), Beypore beach, IOC plant	Feroke bridge, Kadavath Masjidh, Commonwealth tile factory, Kadavanthiruty Kadavu	Earthquake,Flood,Drought (Moderate),Erosion (High),Storm Surge,Tsunami Innundation			20.0
24	Guruvayur	Mid Land	20510	29.42	697	No Reserve Fotrests, some rubber plantations	Keecheri	87 ha	Part is CRZ II	Mangroves, mudflats	Guruvayur Temple	Flood, Drought (Moderate)	Choolpuram (having SWM plant)	5 acres	15.0
25	Haripad	Low Land	15588	9.95	1566	Nil	Achankovil	1.2% of landuse is waterbodies	Small part of ULB - 0.001sqkm located in CRZ II (2011) along the creek	4 kms to NTPC Kayankulam	Subramanya Temple - cultural / literary importance	Flood, Drought (Moderate)			15.0
26	Iringalakkuda	Low Land	28741	22.51	1277	No Reserve Forests, some rubber plantations	Karuvannur	57.29ha	Nil		Koodalmanikyam temple, Koodiyattom	Flood, Drought (Moderate), Landslide (Low)	Mangadikunnu Porathissery	5.52 acres	20.0
27	Iritty	High Land	35676	48.32	738	20% (Evergreen/ Semi Evergreen+ Forest Plantation)	Iritty River	-	Nil	Paithalmala nearby	Steel Girder Bridge	Flood, Drought (Slight), Landslide (Low)	Athithattu	0.075 acre	20.0
28	Kalamassery	Low Land	71038	39.42	1802	-	Periyar, Muttar	0.6% of landuse	Some parts CRZ (riverine)	HMT area-Birds	-	Flood,Drought (Moderate)	Kalamassery (Appolo tyres)	2.7 acres	40.0
29	Kalpetta	High Land	31580	38.16	827	10% (Evergreen/ Semi Evergreen+Forest Plantation+Scrub Forest)	Yes	Lakes	Nil	Chambra, Near Forests	12km to Pookode Lake	Flood,Drought (Slight),Landslide (High)	Vellaramkunnu	9 acre	15.0
30	Kanjangad	Low Land	73342	40.43	1814	8% is land with crub- no forests	Nileswar River, many streams- 2 % of total landuse is waterbodies	0.25% of total landuse	Part in CRZ II - sea coast and creek	Turtle nesting site 0.23 km2, mud flats, swales, semi critical groundwater zones	Bakel, Hosdurg Fort, Hanuman mandir, Madiyan Kovilakam. Chirutheyi caves	Flood, Drought (Moderate)			40.0
31	Karunagapally	Low Land	25336	17.86	1419	0	Pallikkal	Kayamkulam Kayal	Part of ULB located within CRZ Limit	coast, fishing villages	Buddha Image	Flood,Drought (Moderate),Erosion (High),Tsunami Innundation			15.0
32	Kasargod	Low Land	54172	17.51	3094	-	Chandragiri, 20% is waterbodies, Ananthapuram lake	21% of landuse	Part in CRZ II-sea creek	Critical groundwater zone	theyyam	Flood,Erosion (High),Storm Surge,Tsunami Inundation	Kelugudde (Closed-2.5 acres); Vidya Nagar MRF site kolangana - oppostionms (5.47acres)	0.25 acre	30.0

Sl NO	Town	Physiography	Population (Census 2011)	Area of Town	Population density (per SqKm)	Forests (%)	Rivers, streams	Major Lakes, Water bodies	Coastal Area	Important ecological and other features	Physical / Cultural resources	Disaster proneness	Name of Existing Dumping Ground	Area of Existing Dumping Ground	Approx. Waste (Tonnes per day)
33	Kattappana	High Land	42646	57.62	740	25% (Forest Plantation)	Periyar nearby	Idukki reservoir nearby anchuruli	Nil	Idukki WLS (Adjoining), Mannans of Kanchiyar, Vallayamkudi settlement	Megalithic artifacts	Earthquake, Flood, Drought (Moderate), Landslide (Low)	Puliyanmala	1 acre	20.0
34	Kayankulam	Low Land	68634	21.40	3208	Nil	Karipuzha thodu	Kayamkulam Kayal, national waterway no:3 passes	Small part in CRZ - along creek	Coastal plain, 4.48 ha of wetlands, near NTPC Kayankulam	Krishnapuram palace, Buddha image	Flood, Drought (Moderate)	Murukkummoodu	0.8 acres	40.0
35	Kodungalloor	Low Land	60190	29.68	2028	No Reserve Forests, some rubber plantations	Periyar	Vembanad-417.19 ha- almost one-fifth of total landuse	Part is CRZ II	Mangroves - 0.403Sqkm	Siva Temple Complex (Tiruvanchikulam), Kodungalloor Valiya Thamburam Kovilakam Kottaram	Flood, Drought (Moderate)	Pullut Chapara tks puram- 1.6 acre	5 acres	40.0
36	Koduvally	Mid Land	30787	22.27	1383	-	Koduvally river	Ponnoor River, 1.5% of landuse	-	30 kms to kadalundi MPA	Mosques elated buildings	Flood, Drought (Moderate)			20.0
37	Kondotty	Mid Land	28794	31.60	911	-	Kadalundi	-	Nil	Arimbra hills	Pazhayangadi Mosque, Mappilapattu, Peot Moyinkutty memorial, Nerunkaithakotta at Vallikunnu	Flood, Drought (Moderate), Landslide (Low)			20.0
38	Koothattukulam	Mid Land	17253	22.87	754	-	Muvattupuzha, Uzhavoor river	Lakes, ponds	Nil	River, canal	Oil Lamp in St Jude Church	Flood			15.0
39	Kothamangalam	Mid Land	38837	39.55	982	dense and open scrub, near forests	Periyar, Kaliyar Muvattupuzha	0.3% of landuse	Nil	Thattekadu WLS (Adjoining)	Kallil Rock cut (Jain), Cheramala - Megalithic Urns chance found during road construction	Flood, Drought (Slight)	Kumbettumuri	2.3 acres	25.0
40	Kottackal	Mid Land	44382	20.38	2178	-	Kadalundi	-	Nil	Changuvetty kundu, herbal garden, nearby Atteeri padam	epigraphs on Ayurveda ad health; Sri Venitta thevar temple kottackal	Flood, Drought (Moderate)			25.0
41	Kottarakkara	Mid Land	29788	17.65	1688	0	Pulamon Thodu	Temple ponds, (Rivers, waterbodies=13.4%),	Nil	forests nearby, saasthamkotta ramsar site - 21 kms	Palaces, museum, cultural history of Ramanattom, Krishnanattom art forms, nearby Kottukal Rock cut temple (Ithiva village)	Flood, Drought (Moderate)			20.0
42	Kottayam	Mid Land	55374	56.08	987	nil	Meenachil, Meenanthara river, Kodoor river, Manimala river	Vembanad, 4% of landuse is waterbodies	Vembanad Lake CVCA	Vembanad Lake CVCA, Kuttanad	Thazhathangadi Heritage area, Thaliyilkotta, Cheruyapali, Valiyapalli and others	Flood, Drought (Moderate)	Vadavathur	5.1 acres	30.0
43	Koyilandi	Low Land	71873	29.18	2463	scrub	Korapuzha-Akalapuzha	Canal, temple ponds-0.4% of total landuse	Part CRZ II	mud flats, mangroves (0,06 sqkm); Kanayamkode-Nelliyadi; 50kms to Kadalundi MPA	Mangrove museum-Anelapuzha, fishing harbour, Heritage museum	Flood,Drought (Moderate),Erosion (High)	below bridge	0.012 acre	40.0
44	Kunnamkulam	Mid Land	54071	19.68	2747	No Reserve Forests, some rubber plantations	Keecheri, Kanjiramukku	0.66 Ha (less)	Nil	Hills, Ponds: Enjhankulam', 'Ayyamkulam', and 'Madhurakulam'	Roman coins of Eyyal; Burial Cave (Kakkad), Chovvannur cave, line houses (angadi pura (veeducal)	Flood, Drought (Moderate)	Kunnamkulam	5 acres	30.0
45	Koothuparambu	Mid land	29619	17.40	1702	-	-	Anjarakandi, Talassery	Nil	near Kannur Airport (15km), Cantonment of British Raj	Performance area of Koothu under British	Flood, Drought (Moderate), Landslide (Low)	Palaparamba	3.5 acres	20.0

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46	Malappuram	Mid Land	101386	33.11	3062	nil	Kadalundi	waterbodies-3.3%, of total landuse	Nil	Kadalundi puzha, other streams, quarries nearby	Jain temple at Oorakam hill	Flood, Drought (Moderate), Landslide (Low)	Puliyettummal, Inkel city ward 38	3.2 acres	55.0
47	Mananthavady	High Land	34663	80.69	430	20% (Evergreen/ Semi Evergreen)	Kabini River	Kabini River	Nil	Wayanad WLS, Kottiyoor WLS (Adjoining), Pazhassi Park	Tomb of Pazhassi Raja, colonial town, Thazheangadi, Pazhassi Memorial	Flood, Drought (Moderate), Landslide (High)			20.0
48	Manjeri	Mid Land	97102	52.66	1844	nil	Kadalundi	less-0.1%	Nil	Kavalangad Thodu, other streams, Ponds, Quarry	Dolmens, Rockcuts, Poonkudil Mana and other traditional houses nearby (5-7kms)	Flood, Drought (Moderate), Landslide (Low)	Vettekodu	5 acres	55.0
49	Mannarkkad	Mid Land	34839	15.42	2260	Near around 50% is forests	Kunthipuzha	pavadikulam, nellipuzha less-0.4% of landuse	Nil	Nearby Reserve Forests, 30 Km to Attappadi Tribal area	Tribal areas	Flood, Drought (Moderate), Landslide (Low)			20.0
50	Maradu	Low Land	44704	12.46	3588	-	-	Vembanad; 18.4% of total landuse is waterbodies	Some parts in CRZ zones_mangroves, Intertidal, along creek	Valanthakkad, some mangroves, pokkali rice cultivation	Maradu temple fireworks	Flood, Drought (Moderate)			25.0
51	Mattannur	Mid land	47078	54.05	871	30% (Forest Plantation)	Valapattanam, Anjarakandi	1.3% of landuse	Nil	near Kannur airport	-	Flood, Drought (Moderate), Landslide (Low)	Karithurparamba	0.4 acre	30.0
52	Mavelikkara	Low Land	26421	14.19	1861	Nil	Achankovil	1.7% of total landuse is waterbodies	Nil	Honeybee flora park in horticorp, upper Kuttanad area, Karingalil Punja	Buddha idol and Saradha Mandiram, Sthamba vilakku in Krishna Temple, Kottakkakom, Dhalva madom	Flood, Drought (Moderate)			15.0
53	Mukkom	Mid Land	40670	31.50	1291	scrub	Iruvanjippuzha - chaliyar	1.6% of landuse	-	crushers, quarries, airport - 30km, NIT 7kms; 40kms to Kadalundi MPA	Muslim orphanage, literary heritage, Sri Thrikkudamanna Temple	Flood, Drought (Moderate)			25.0
54	Moovattupuzha	Mid Land	30397	11.53	2637	dense and open scrub, near forests	Muvattupuzha Ar, Kothayar, Killiyar	3.4% of total landuse	Nil	Quarries, fields	Marth Mariam Church (1000 yrs)	Flood, Drought (Slight)	Kurianmala	6 acres	20.0
55	Nedumangad	Mid Land	60161	33.06	1820	0	Karamana	temple ponds	Nil	Valiyamala (ISRO/VSSC-PSLV)	Koyikkal palace	Flood, Drought (Moderate)			35.0
56	Neyyattinkara	Low Land	70850	28.70	2469	0	Neyyar	temple ponds, Chengal Valiyakulam 6km from Neyyattinkara,	Nil - sea is 10 kms	neolithic Pandavanpara (Caves) in nearby panchayat Perumkadavila	Amaravila CSI church, Balaramapuram nearby - for handloom, Anantha Victoria Marthandan Canal	Flood, Drought (Severe)			40.0
57	Nilambur	Mid Land	46366	55.63	834	15% (Forest Plantation+Deciduous+Evergreen/ Semi-Evergreen)	Chaliyar	Chaliyar Rver, Kuthirapuzha-3% of total water bodies	Nil	Teak plantations	Puthiyakovilakom, Connolly's plot, Teak museum, Dolmens, Rock Cuts	Earthquake,Flood,Drought (Moderate),Landslide (Low),			25.0
58	Neeleshwaram	Low Land	122747	26.56	4622	12.6% is land with scrub	Karingode, Nileswaram; 8% of total landuse is waterbodies	0.88% of landuse	Part in CRZ II sea and coast	Turtle nesting site 0.14 km2, swale	cultural town	Flood,Drought (Moderate),Erosion (High),Storm Surge,Tsunami			75.0

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												Innundation			
59	N Paravur	Low Land	32822	8.55	3685	-	Periyar	Vembanad; 2.9% of landuse	Some parts in CRZ	Mudflats	Two of the Seven and half churches by St Thomas, Chennamangalam nearby, Muziris nearby, Uliyannur, Vaippikotta, Gothuruthu	Flood, Drought (Moderate)	Vermi Compost yard, dump site	-	15.0
60	Ottapalam	Mid Land	53792	32.71	1644	6.6% of total landuse	Bharathapuzha	3%of landuse	Nil	Chulannur Peafowl WLS (Adjoining)	Anangan mala, varikkasseri mana, Tholppava koothu	Earthquake, Flood, Drought (Moderate), Landslide (Low)	Panamanna	1 acre	30.0
61	Pala	Mid Land	22056	16.39	1346	nil	Meenachil	Lalam thodu, 4% of landuse is waterbodies	nil	Forested highlands nearby, quarries, & Riverine ecosystem	Traditional Christian cuisine, churches, temples	Earthquake, Flood, Drought (Slight)			15.0
62	Palakkad	Mid Land	130955	27.07	4837	nil	Bharathapuzha	2% of landuse	Nil	Near the Western Ghats	Palakkad fort, Kalpathi & Ratholsavam, Ahalia Heritage village, Puthur music dance festival	Flood, Drought (Moderate)	BPL Junction, Koottupatha, Kodumba	8.28 acres Kanjikode WTE 20 acres)	75.0
63	Panthalam	Mid Land	22635	28.83	785	0	Achankovil	0.30%	Nil	Karingali Puncha near Pandalam	Palace and nearby Temples	Flood,Drought (Moderate)	near RRF	0.1 acre	20.0
64	Panoor	Low Land	17438	29.33	595	-	Mahe	0	part CRZ - creek, mangrove, intertidal	near Mahe	near Mahe, Tellichery	Flood, Drought (Moderate)			15.0
65	Parappanangadi	Low Land	35243	22.88	1540	nil	Kadalundi	-	Part CRZ II, also along the creek	Kadalundy river passes through 4 wards, turtle nesting alungal-parappanangadi beach, 10km to MPA, wetland	Parappanad clan	Flood,Drought (Moderate),Erosion (High),Tsunami Innundation			20.0
66	Paravur	Low Land	37245	19.88	1873	0	Ithikkara	Paravur Lake, Nadayara Lake (Rivers, waterbodies21%)	Part of ULB located within CRZ Limit	Cliffs, Backwaters, Mayyanad village, Paddy fields, sacred groves	History of Pennarasunadu, Pozhikkara Sasanam	Flood,Drought (Severe),Erosion (High),Tsunami Innundation			20.0
67	Pathanamthitta	Mid Land	37538	28.04	1339	0.00%	Achankovil	0.10%	Nil	Fisheries, national seed farm, perunad heliport	Thrikkakkudy rockcut cave temple nearby (20km)	Flood, Drought (Moderate), Landslide (Low)	Mini stadium	0.25 acre	25.0
68	Pattambi	Mid Land	28632	16.91	1693	nil	Bharathapuzha	3.6% is waterbodies	Nil	Hills	Siva Temple (Netrimangalan)	Flood, Drought (Moderate)			20.0
69	Payyannur	Low Land	72111	53.45	1349	-	Kavvayi, Peruvamba	6.7% of landuse	parts CRZ-creek, mangrove, intertidal	paddy / kaipad in villages nearby	Pavithraketty ring, Heritage areas, Ezhmala nearby, Payyannur pattu, Theyyam, Handlooms	Flood, Drought (Moderate)			40.0
70	Payyoli	Low Land	23576	22.62	1042	-	Kuttyadi, Korapuzha	10% of landuse	Part CRZ II	Mangroves - 0.02 sqkm, Olive Risley Turtle nesting - Payyoli & Kolavi palam beach; mudflats	Kunjalimarakkar museum - Iringal - 3km	Flood,Erosion (High),Storm Surge,Tsunami Inundation	Moorikkovval	1.1 acre	20.0

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71	Perinthalmanna	Mid Land	49723	38.29	1298	14% forest plantation, some deciduos scrub	-	Choorakkadu	Nil	Hills	Thirumandhamkunnu Bhagavathi Temple and Tali Mahadeva temple are located at Angadipuram, Poonthanam Illam nearby, Valluvanad	Flood, Drought (Moderate), Landslide (Low)	Thekkinkodu, kunnappalli	14, 10 acres	30.0
72	Perumbavur	Mid Land	28110	11.49	2447	-	Periyar	1.2% of landuse is waterbodies	Nil	Iringole Kavu at 2.5kms-sacred grove, Migrant labour camps	Kallil Rock cut (Jain)	Flood, Drought (Moderate)			15.0
73	Piravam	Mid Land	27229	29.54	922	-	Muvattupuzha	3.1% of landuse	-	river hills, paddy fields	Pazhur Peryumthrikovil, Churches	Flood			15.0
74	Ponnani	Low Land	90491	24.80	3649	mangroves-littoral swamp - 24.97 ha	Bharathapuzha	Beeyem Canal, Kanoli Canal-12%	Part CRZ II, also along creek	Kole wetands /fields, Biyyem kayal, Beach, Mangroves, mud flats, swales, spit	Perumpadappu Valiya Kinar, Jamaat Mosque	Flood,Drought (Moderate),Erosion (High),Storm Surge,Tsunami Innundation			50.0
75	Punalur	Mid Land	48717	34.46	1355	5% (Forest Plantation)	Kallada	(Rivers, waterbodies=0.22%)	Nil	plantations	Hanging / Suspension Bridge across Kallada river, Kollam Shegottai Rail	Flood,Drought (Moderate)	-	-	20.0
76	Ramanattukara	Low Land	35937	11.95	3007	-	Chaliyar, Neelithodu	Neelithodu, temple ponds	Part CRZ II	airport-10kms, paddy fields, plantations, Thottungal hill; bird sanctuary - Kadalundy - 9kms	Groves canals	Earthquake, Flood, Drought (Moderate)			20.0
77	Shornur	Mid Land	43533	31.85	1367	6% of total landuse	Bharathapuzha	5% of landuse	Nil	fields, hillocks	Kavalappara palace nearby	Earthquake, Flood, Drought (Moderate)			25.0
78	Sreekandapuram	High Land	17630	70.15	251	-	Valapattanam	1.4% of landuse	Nil		Kunnathur Padi , Ammakkoottam mahadevi temple, vishnu temple - Tipu sulthan fame; Vayakkara kavu (sacred grove)	Flood, Drought (Slight), Landslide (Low)			10.0
79	Suthan Bathery	High Land	23333	127.87	182	70% (Evergreen/ Semi Evergreen)	-	-	-	Wayanad WLS (Completely)	Jain Temple	Flood, Drought (Moderate), Landslide (Low)			25.0
80	Thanoor	Low Land	44973	24.56	1831	forest-mangroves - littoral swamp 7.68 ha	Kadalundi	Kanoli Canal	Part CRZ II, also along creek	Beach,Vattappara accident zone of NH, turtle nesting, Mangroves	Keraladeshpuram Temple 3 km other temples, mosque, Vettakkorumakan Temple at Rayirimangalam	Flood,Drought (Slight),Erosion (High),Tsunami Innundation			25.0
81	Thalassery	Low Land	92558	20.16	4590	-	Talassery, Mahe	4.4% of landuse	part CRZ-sea, creek, mangrove, inter tidal	near Mahe	Tellicherry fort, Herman Gunderts history	Earthquake,Flood,Drought (Slight),Erosion (High),Storm Surge,Tsunami Innundation	Kadalpaalam/Poonool Pettipaalam (Closed)	10 acres	50.0
82	Thaliparambu	Mid Land	72465	16.76	4324	-	Kuppam, Valapattanam	6.7% of landuse	parts CRZ-creek, mangroves, inter tidal	paddy / kaipad in villages nearby	Perinchalloor Brahmin settlement, Temples, mosques	Flood, Drought (Slight)			40.0

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83	Thiruvalla	Low Land	52883	25.71	2057	0.00%	Manimala	waterbodies-3.6%, market canal,Lakes, temple ponds	Nil	has wetland of 4.95ha Ramanchira Wetlands	Inscriptions, monuments, rock-cut caves, Thrikkakkudy rock-cut cave temple nearby (6km)	Flood, Drought (Moderate)			30.0
84	Thodupuzha	Mid Land	54317	27.97	1860	-	Muvattupuzha	1.2% of landuse is waterbodies	Nil	ridges, hills, mounts	Karikode mosque, fort relics, Annamalai temple, Megalithic artifacts, sub registrar office	Flood, Drought (Slight)	Parakkadavu	1.2 acre	22.0
85	Trikkakkara	Low Land	77319	15.57	4965	-	Chitrapuzha	2% of landuse	Some parts CRZ (riverine), some mangroves	Rivers, water bodies, CUSAT	Thrikkakkara Vamanamoorthy Temple (Onam fame)	Flood, Drought (Moderate)			50.0
86	Thiroor	Low Land	56058	17.28	3244	nil	Tirur	Thirurpuzha- CRZ - 3%of total landuse is waterbodies	Part CRZ II, also along creek	Thunjanparambu (sand, tree), mudflats, swales	Thunchan Parambu, Thrippangode Maha shiva kshethram, Thirunavaya - Mamankom	Flood, Drought (Slight)	Ottilathara trenching ground	4 acres	35.0
87	Thripunithura	Low Land	69390	29.62	2343	-	Chitrapuzha	Vembanad; 7.5% of landuse	Some parts in CRZ II, some mangroves	Pokkali fields, Mudflats	Hill Palace, Many palaces in Fort, Poornathrayeesa Temple	Flood, Drought (Moderate)	Brahmapuram (waste treatment plant)	-	40.0
88	Thiroorangadi	Low Land	56632	17.62	3214	nil	Kadalundi	-	Part CRZ II, also along creek	Mangroves, ponds. Streams, agriculture plantations	Willam John Dunckown Rawls Tomb, Tirurangadi Taluk Office and Sub-registrar office Building, Mampuram mosque	Earthquake,Flood,Drought (Moderate),,			30.0
89	Vatakara	Low Land	75295	21.09	3571	-	Kuttyadi-Kottackal river, Moorad river	5% of landuse	Part CRZ II	Mangroves - 0.1 sqkm, Turtle nesting grounds on beaches, Rivers, borders Mahe (Interstate)	Capital of Kurumbanad - Kadathanad, Vadakkanpattu, Lokarnarkavu (5km) Chendamangalam temple, neyyamrut madom, near Iringal - Munjalimarakkar museum, craft centre	Flood,Drought (Slight),Erosion (High),Storm Surge,Tsunami Inundation			50.0
90	Vaikom	Low Land	23234	12.72	1827	nil	Muvattupuzha	Vembanad; kariyar,28% of total landuse is waterbodies	Vembanad Lake - CVCA Parts CRZ II-0.49sqkm; rivers/ tributeries-5.75sqkm; mangroves - 0.01sqkm, ITZ-2.71	CVCA, many sluices/regulators, Kuttanad	Vaikom Temple, Vaikom Satyagraha of Independence Struggle fame	Flood, Drought (Slight)			15.0
91	Valanchery	Mid Land	40318	22.37	1802	nil	-	Thamarakkulam, temple ponds, lakes	Nil	Mankeri kunnu, fields	Pookkaattiri other temples, vendallur temple	Flood,Drought (Moderate),			25.0
92	Varkala	Low Land	40048	15.59	2569	0	Ayirur	Varkala tunnel of TS canal; Kappil lake, temple ponds	Part of ULB within CRZ Limit- CRZ IA-Beach, cliffs	Cliffs, waterway - TS canal part Varkala tunnel	Anjengo fort (14km), Janardhan swamy complex (2000yrs),	Flood,Drought (Moderate),Erosion (Moderate)	Kanvashramam	1.5 acres	25.0

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									etc						
93	Wadakkanchery	Mid Land	15674	51.95	302	15% (Forest Plantation+Deciduous)	Keecheri	16.64 Ha	Nil	Peechi-Vazhani WLS (Adjoining)	Siva temple (Pallimanah)	Earthquake, Flood, Drought (Moderate)	Kumbalangad	6.3 acres	15.0

Table 22: Baseline Surface Water Quality near Major SWM Dumpsites

Parameter	Unit	Surface Water Limits as per IS 2296 Class - C	CPCB Standards: Propogation of Wildlife and Fisheries	Near TSDF site (Lake)	Kalamassery (Stream)	Brahmapuram (Lake, Kochi)	Kadambrayar (River near Brahmapuram, Kochi)	Chitrapuzha (River near Brahmapuram, Kochi)	Ashtamudi-Kureepuzha (Lake near Kureepuzha, Kollam)
Colour (CU)	CU	300		2	2	50	60	40	
Odour	--			Aggreable	Aggreable	Objectionable	Agreeable	Objectionable	
Taste	--					Objectionable	Agreeable	Objectionable	
Turbidity NTU	NTU					4.14	5.48	5.7	3
PH	--	6.5 to 8.5	6.5 to 8.5	6.84	6.79	6.3	6.42	6.36	7.18
Temperature (oC)	OC			28	27	23.4	25	24.2	
Electrical conductivity µ mhos/cm	µ mhos/cm			0.09	3.8	80	147	65	120
Salinity	mg/l					0.022	0.045	0.027	
Total solids	mg/l			123	2581	64	126	58	
Total Hardness as CaCO3	mg/l					30	60	20	
Total Alkalinity	mg/l					20	30	10	
Iron as Fe	mg/l	<50		0.14	BDL (DL=0.1)	<0.04	<0.04	<0.04	
Chlorides as Cl	mg/l	600		10.3	1163	12.5	25	15	25400
Residual free chlorine	mg/l					<0.01	<0.01	<0.01	
Total dissolved solids	mg/l	1500		110	2570	55	102	44	
Calcium as Ca	mg/l			4	24.2	6	12	4	308.62
Magnesium as Mg	mg/l			2.4	13	3.6	7.2	2.4	9.23
Copper as Cu	mg/l	1.5		BDL (DL=0.01)	BDL (DL=0.01)	<0.001	<0.001	<0.001	
Manganese as Mn	mg/l			BDL (DL=0.01)	BDL (DL=0.01)	<0.001	<0.001	<0.001	
Sulphate as SO4 mg/L	mg/l	400		0.04	125	1.3	7	<0.01	
Nitrates as NO3 mg/L	mg/l	50	1.2 mg/L or less	0.82	0.57	<0.01	<0.01	<0.01	
Fluorides as F mg/L	mg/l			BDL(DL=0.1)	0.8	<0.004	<0.004	<0.004	
Sodium as Na	mg/l			17.7	177.5	3.7	5.1	4.8	
Potassium as K	mg/l			6.6	16.1	<0.01	0.2	<0.01	
Total Nitrogen	mg/l			BDL(DL=2)	BDL(DL=2)	<01	<01	<01	
Total phosphorous	mg/l			0.9	6.2	<0.1	<0.1	<0.1	
Free Ammonia as NH4	mg/l					<0.1	<0.1	<0.1	
Phenolic compounds asC6H5OH)	mg/l	0.005		BDL (DL=0.001)	BDL (DL=0.001)	<0.001	<0.001	<0.001	
Biochemical oxygen demand (BOD)	mg/l	<03		BDL(DL=2)	17.8	4	6	6	
Chemical oxygen demand (COD)	mg/l			3.8	41.9	10	20	16	
Dissolved oxygen	mg/l	4	>4mg/l	6.1	4.2	5.3	5.2	5	5
Mercury as Hg	mg/l			BDL (DL=0.001)	BDL (DL=0.001)	<0.0002	<0.0002	<0.0002	
Cadmium as Cd	mg/l	0.01		BDL (DL=0.01)	BDL (DL=0.01)	<0.001	<0.001	<0.001	
Selenium as Se	mg/l	0.05				<0.005	<0.005	<0.005	
Arsenic as As	mg/l	0.2		BDL (DL=0.01)	BDL (DL=0.01)	<0.001	<0.001	<0.001	
Nickel	mg/l	--		BDL (DL=0.01)	BDL (DL=0.01)	<0.1	<0.1	<0.1	
Cyanides as CN	mg/l	0.05		BDL (DL=0.02)	BDL (DL=0.02)	<0.001	<0.001	<0.001	
Lead as Pb	mg/l	0.1		BDL (DL=0.01)	BDL (DL=0.01)	<0.001	<0.001	<0.001	
Zinc as Zn	mg/l	15		BDL (DL=0.01)	BDL (DL=0.01)	<0.001	0.014	<0.001	
Anionic detergent (MBAS)	mg/l	1				<0.001	<0.001	<0.001	
Chromium as Cr6+	mg/l	0.05		BDL (DL=0.01)	BDL (DL=0.01)	<0.001	<0.001	<0.001	
Total coli forms	MPN/100ml	5000		5.6	40	280	240	300	108
Faecal coli forms	MPN/100ml	--		Present	Present	60	50	70	Present
Test Period				Pre-monsoon 2019	Pre-monsoon 2019	Post monsoon 2017	Post monsoon 2017	Post monsoon 2017	Jul-15
				EIA/EMP for TSDF, KEIL	EIA/EMP for TSDF, KEIL	EIA for GJEP_SWM WtE Plant, Kochi	EIA for GJEP_SWM WtE Plant, Kochi	EIA for GJEP_SWM WtE Plant, Kochi	Fate of landfills on Kurepuza report

Table 23: Baseline Ground Water Quality near Major SWM Dumpsites

Parameter	**Standards: IS: 10500 (2012) for drinking water**		**Brahmapuram**	**TSDF**	**Kalamassery**	**Brahmapuram**
	Permissible limits	Desirable limits				
Colour	15	5	1	1	1	<01
Odour	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
Taste	Agreeable	Agreeable				Agreeable
Turbidity	5	1	1.9	1.1	0.9	1.24
pH Value	No relaxation	6.5-8.5	6.09	5.79	6.2	6.69
Temperature	NS	NS				24.6
Electrical Conductivity	NS	NS	71	49	230	442
Salinity	Not Specified	Not Specified				0.018
Total Solids	Not Specified	Not Specified				314
Total Hardness (as CaCO3)	600	200	10.1	10.1	25.1	
Total Alkalinity (as CaCO3)	600	200	68	76	76	120
Iron (as Fe)	No relaxation	0.3	BDL (DL=0.1)	BDL (DL=0.1)	BDL (DL=0.1)	0.1
Chloride (as Cl)	1000	250	30.9	43	12.1	45
Residual Free Chlorine	1	0.2				<0.01
Total Dissolved Solids	2000	500	242	128	122	312
Calcium(as Ca)	200	75	2	2	6	32
Magnesium (as Mg)	100	30	1.2	1.2	2.4	12
Copper (as Cu)	1.5	0.05	BDL (DL=0.01)	BDL (DL=0.01)	BDL (DL=0.01)	<0.001
Manganese (as Mn)	0.3	0.1	BDL (DL=0.01)	BDL (DL=0.01)	0.13	<0.001
Sulphate(as SO4)	400	200	BDL(DL=1)	BDL(DL=1)	BDL(DL=1)	29.4
Nitrate (as NO3)	No relaxation	45	1.2	1.4	1.4	3.7
Fluoride(as F)	1.5	1	BDL(DL=0.1)	BDL(DL=0.1)	BDL(DL=0.1)	0.28
Sodium	Not Specified	Not Specified	13.1	20.1	21.9	38.1
Potassium	Not Specified	Not Specified	3.3	5.7	8	1.9
Total Nitrogen	Not Specified	Not Specified	BDL (DL=2)	BDL (DL=2)	BDL (DL=2)	<01
Total Phosphorous	Not Specified	Not Specified	BDL	0.04	0.03	<0.1
Free Amonia NH4	Not Specified	Not Specified				<0.1
Phenolic Compounds(as C6H5OH)	0.002	0.001	BDL (DL=0.001)	BDL (DL=0.001)	BDL (DL=0.001)	<0.001
BOD	Not Specified	Not Specified				<02
COD	Not Specified	Not Specified				<04
Mercury (as Hg)	No relaxation	0.001	BDL (DL=0.001)	BDL (DL=0.001)	BDL (DL=0.001)	<0.0002
Cadmium(as Cd)	No relaxation	0.003	BDL (DL=0.01)	BDL (DL=0.01)	BDL (DL=0.1)	<0.001
Selenium as Se	No relaxation	0.01				<0.005
Nickel (Ni)	0.05	0.01	BDL (DL=0.01)	BDL (DL=0.01)	BDL (DL=0.01)	<0.1
Total Arsenic(as As)	No relaxation	0.05	BDL (DL=0.01)	BDL (DL=0.01)	BDL (DL=0.01)	<0.001
Cyanide (as CN)	No relaxation	0.01	BDL (DL=0.02)	BDL (DL=0.02)	BDL (DL=0.02)	<0.001
Lead (as Pb)	15	5	BDL (DL=0.05)	BDL (DL=0.05)	BDL (DL=0.05)	<0.001
Zinc (as Zn)	1	0.2	BDL (DL=0.01)	BDL (DL=0.01)	BDL (DL=0.01)	0.054
Anionic detergent	No relaxation	0.05				<0.001
Total Chromium(as Cr)	Shall not be detectable in any 100 ml sample	Shall not be detectable in any 100 ml sample	BDL (DL=0.01)	BDL (DL=0.01)	BDL (DL=0.01)	<0.001
Total Coliform	Shall not be detectable in any 100 ml sample	Shall not be detectable in any 100 ml sample	<1.8	<1.8	<1.8	Nd
E- Coli	Shall not be detectable in any 100 ml sample	Shall not be detectable in any 100 ml sample	Absent	Absent	Absent	Nd
NH3(as Total ammonia-N)	No relaxation	0.02	BDL(DL=0.5)	BDL(DL=0.5)	BDL(DL=0.5)	
Dissolved Oxygen			6.1	5.9	6.2	
Oil & Grease			BDL (DL=1)	BDL (DL=1)	BDL (DL=1)	
Sampling Period			Pre-monsoon 2019	Pre-monsoon 2019	Pre-monsoon 2019	Post monsoon 2017
Source			EIA/EMP for TSDF, KEIL	EIA/EMP for TSDF, KEIL	EIA/EMP for TSDF, KEIL	GJ Ecopower: EIA for Kochi Waste to Energy Plant

Table 24: Baseline Ground Water Quality near ULB Dumpsites

(Source: CPCB Water Quality Monitoring, 2016)

Station Code	Station Name	Temperature ⁰ C		pH		Conductivity (µmhos/Cm)		B.O.D. (Mg/L)		Nitrate-N + Nitrite-N (Mg/L)		Faecal Coli Form (Mpn/100ml)		Total Coli Form (Mpn/100ml)	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Water Quality Criteria				**6.5-8.5**				**<3 Mg/L**				**<2500mpn/100ml**		**<5000mpn/100ml**	
1587	Kalamassery Ernakulam Distt.	27	28.4	6.3	6.6	229	343	0.8	0.9	6.8	7	0	21	26	30
1589	Malapuram	30	30.5	6.1	6.5	224	288	1.4	1.6	0	5.5	20	88	32	120
1591	Kannur (Municipality) Kannur Disttm	28	29	4.7	4.9	104	111	0.5	0.9	4.5	7.9	180	1200	480	1400
1592	Payyannur, Kannur Distt.	28	29	6	6.3	242	250	0.5	0.8	0.9	2.5	30	212	1000	250
2308	Fathimapuram (Changanassery)	27	28	6.1	6.5	183	220	0.3	0.5	4.8	6	500	1600	1100	2800
2311	Vadavathoor (Kottayam)	27	27	5.3	5.8	124	136	0.2	0.7	5.9	7.3	0	100	100	350
2313	Sarvodapuram, Alappuzha	28	29	7.6	8	262	540	0.9	1.2	0.1	0.2	0	0	110	120
2314	Kureepuzha (Kollam)	24	25	7.3	7.3	146	158	1.2	1.2	1	1.6	140	280	360	680
2316	Chellora Trenching Ground (Kannur)	27	27	5.1	5.5	41	88	0.7	1.3	1	1.4	4	440	112	950
2317	Punnalpettippalam (Tellicherry Municipality)	27	28	5.8	6.6	350	431	0.7	0.9	5.4	13	48	288	350	480
2321	Laloor (Thrissur)	29	30	6.7	7.9	360	422	0.3	1	2.8	4.8	40	180	260	310
2323	Brahmapuram M.S.W. Dumpark (Ernakulam)	27.6	28.4	6	6.4	270	272	0.5	0.6	0.4	3.6	12	90	20	160
2324	Hazardous Waste Dump (Ambalamughal)	29.2	30.3	5.6	8.1	118	2229	1	1.8	0.6	5.4	26	520	40	1080

Annexure II: Photo-walkthrough of Baseline SWM system

Treatment Facilities

Aero bins with rejects and inerts piled up

Windrow Composting Plant: Poor housekeeping, odour and leachate

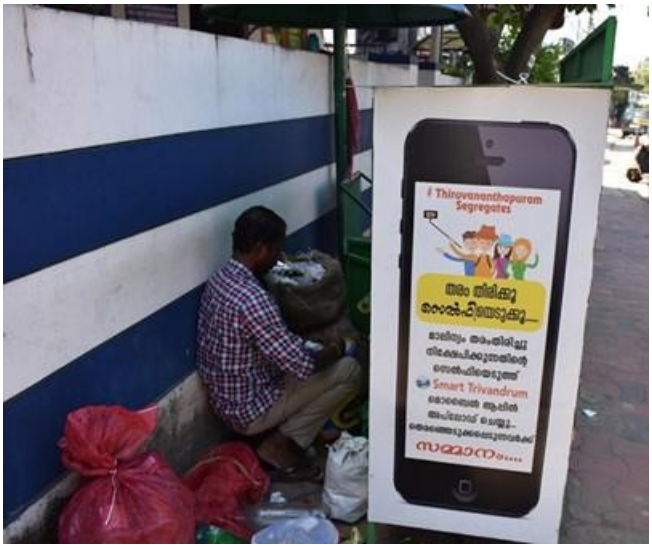
Leachate menace at Dumping and Treatment Yard

Wading through Dry waste: MCF Facility in a ULB in Kerala

Material Collection Facilities

MRF with wastes tied up in sacks: Risk of Fire, Occupational Health Hazards

Material Collection and Recycling Facilities



Still a lot to Segregate: Dry wastes being segregated manually at / near MCF

Segregated Waste Collection Hub

Resource Recovery Facility

Waste Dumping

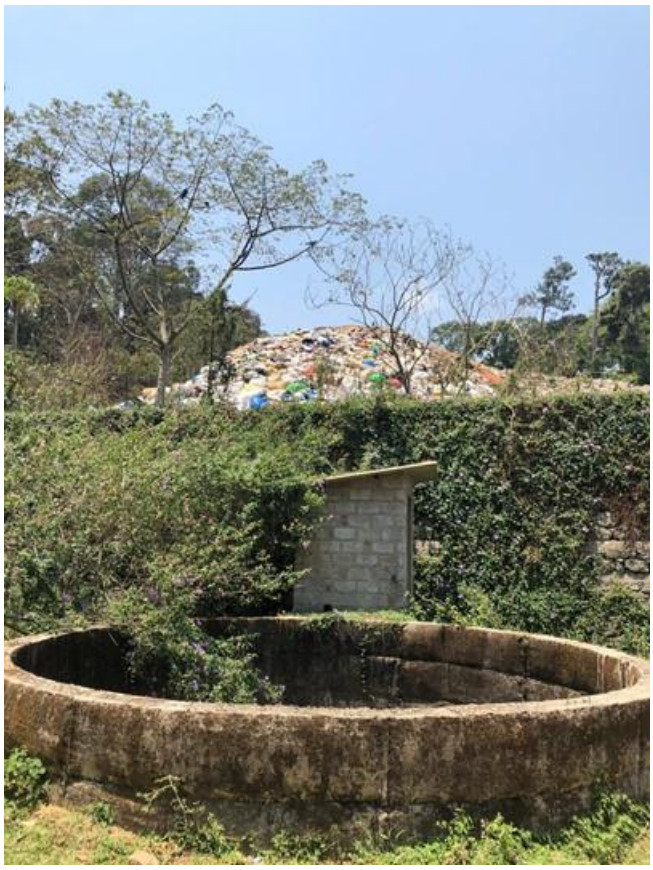
Yards

Waste all around a ULB Dumping Yard in Kerala

A Waste dumping Yard next to a River (used for bathing)

A Waste Dumping yard and neighboring Shallow well (See Close up of Well Water)

Waste Duping Area of Brahmapuram (Ernakulam) on Fire (Image Courtesy Manorama news: https://www.theweek.in/news/india/2019/02/23/kochi-fire-brahmapuram-plant-residents-blanket-smoke.html



Institutional Campus

Flood Wastes

Waste Generated during Floods 2018 from

Waste collected from near Bridges during the Kerala Floods 2018

Waste awaiting segregation

Waste Dumping Sites of Various ULBs

Wet and Dry – Fresh Mixed Wastes

Burnt wastes

Putrefied and Burnt Mixed waste

Dumped Plastics

Mixed wastes

Decentralized – Household and Community Level Waste Treatment Facilities

Aero bins for Minimal Wastes and no leachate management

Pipe Composting

Pit Composting

Pot composting

Household Biogas Unit

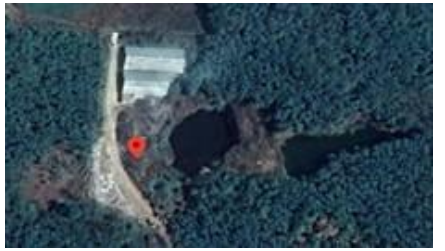
Annexure III: Details of Dump Sites of Sample ULBs

Sl No:	*City*	*Name of Dumpsite*	*Area*	*Waste Qty*	*Remarks*	*Photos*
1	Kalpetta	Vellaramkunnu	9 acres	16000cum	Surrounded by rubber plantations, receives mixed waste and is just dumped randomly. No compaction or daily cover is provided.	 
2	Perinthamanna	Thekkinkodu	14 acres	10000cum	The site is surrounded by farms, houses and railway line. This site has no public protest issues and can be an ideal ISWM site. The site RRF has been burnt and plastic waste is accumulating at site; the site also operates a windrow composting unit of 1.5 TPD capacity.	 
3	Guruvayoor	Choolapuram	5 acres	36000cum	The site is surrounded by houses, highway and paddy fields, no public protest issues. The site has a RRF for processing about 350 Kg/d of plastics; the site also operates a 2.5 TPD windrow composting unit drinking water wells around the site have foul-smelling water and the water is not potable.	 

Sl No:	City	Name of Dumpsite	Area	Waste Qty	Remarks	Photos
4	Kothamangalam	Kumbetamuri	6 acre	30000 cum	The site is surrounded by rubber plantation. This site has no public protest issues and can be developed into a proper SWM site. The site has an RRF machinery for processing of plastics but not installed. The site has no other processing facilities.	 
5	Alappuzha	Sarvodayapuram	12 acres	48500 cum	Owner-ULB (since 1950), habitation-adjacent, flood-No, Groundwater-4m BGL, Compound wall-Yes, Present dumping- No(2015), MSW-100%, Land reclamation possibility - > 70%, SLF and Processing plant can be developed here after having a 10m green belt inside. Possibility of having buffer shall be explored	

Sl No:	City	Name of Dumpsite	Area	Waste Qty	Remarks	Photos
6	Kasargod	Vidya Nagar Indl estate - MRF site	0.25 acre	30T	Within the City for MCF/ RRF facility; established in 2004. Receives 3TPD of street sweepings and plastic waste for shredding. The incinerator is not functioning properly and hence releases pollutants; ULB has no funds to repair. More than 30 Tons of accumulated mixed waste on-site as Plastic take off by CKCL or contractors is poor.	
7	Thalassery	Puttipalam	10acres	240000cum	A 10 acres site located adjacent to New Mahe Panchayat. Originally used for disposal of night soil (during British era) and then for garbage over several decades till dumping was stopped in 2008. It has 140 years of waste and sewage deposit; next to the ocean and should be restored. The use of the site for waste management is not advised as it is in CRZ.	
Sample Sites Reviewed for Possibility to Biomine and retrieve land						

Sl No:	City	Name of Dumpsite	Area	Waste Qty	Remarks	Photos
8	Iringalakkuda	Mangadikunnu, Porathissery	5.52 acres	42370 cum	Owner-ULB (since 1941), Buffer zone-No, but possible outside, Green Belt-No, habitation- No, flood-No, Groundwater-3m BGL Compost plant -adjacent(ULB), Sloping site, Compound wall-Yes, Present dumping-No(stopped 1/3/2020 due to new compost plant) Rejects being dumped, MSW- 100%, Land reclamation possibility > 70%, Biomining can be done to reduce the pollution, SLF and Processing plant can be developed	
9	Kalamassery	Kalamassery NH	2.7 acres	30000cum	Owner-ULB (since 1980), Buffer zone-No, Green Belt-No, Groundwater- < 2m BGL, GW is polluted, habitation-factory, crematorium, cemetery, godown, flood-2018-19, Airport- 12 Km, Present dumping- Yes (4TPD) rest all the waste goes to Kochi site, SW- 100%, Land reclamation possibility > 70%, MCF/ RRF can be developed here after precautionary measures, May not be	

Sl No:	City	Name of Dumpsite	Area	Waste Qty	Remarks	Photos
					possible to develop SLF here	
10	Kodungalloor	Pullut, Chapara	1.24 acres	11025 cum	Owner-ULB (since 1984), Buffer zone-No, Green Belt-No, habitation-few houses and school, flood-No, Groundwater- 3m BGL, Wetlands are 27 m away, Present dumping- No(2013), HT Line, Compost plant exists adjacent, MSW- 100%, Land reclaim - > 70%, SLF is not feasible here; can be used for MCF/ RRF	
11	Kothamangalam	Kumbalathumuri	2.3 acres	49000cum	Owner-ULB (since 1995), Buffer zone - No, Green Belt - No, habitation - adjacent, flood - No, Groundwater- <2m BGL, Processing plants – exists, Present dumping- No, MSW - 100%, Land reclamation possibility > 70%, SLF can be developed here, with 10m greenbelt	

Sl No:	City	Name of Dumpsite	Area	Waste Qty	Remarks	Photos
12	Kottayam	Vadavathur	5.1 acres	25900 cum	Owner-ULB (since 1947),Buffer zone - No, Green Belt - No, habitation - adjacent, flood - No, Groundwater- 50m BGL, Processing plants – exists, Present dumping-No (idle since 2013), MSW - 100%, Land reclamation possibility > 70%, SLF can be developed here after demarketing green belt inside.	 
13	Kunnamkulam	Kunnamkulam	5 acres	34170 cum	Owner-ULB (since 1955), Buffer zone - No, Green Belt - No, habitation - adjacent, flood - No, Groundwater- 6m BGL, Present dumping- 1.5 TPD since 3 years, MSW - 100%, Land reclamation possibility > 60%, SLF and Processing plant can be constructed after having a 10m green belt inside.	  
14	Muvattupuzha	Kurianmala	6 acres	42000 cum	Owner-ULB (since 1995), Buffer zone - No, Green Belt - No, habitation - adjacent, flood – yes (2018), Groundwater- < 2m BGL, compound wall – yes masonry, Canal – adjacent, Processing plants – exists,	

Sl No:	City	Name of Dumpsite	Area	Waste Qty	Remarks	Photos
					Present dumping- 1.5 TPD, MSW - 100%, Land reclamation possibility > 60%, SLF can be constructed hereafter precautionary measures against flooding.	
15	Palakkad	BPL Junction, Koottupatha, Kodumba	8.28 acres	161880 cum	Owner-ULB (since 1950), Buffer zone - No, Green Belt - No, habitation – NO only godown on the north side, flood - No, Groundwater- 6m BGL, Present dumping- 6 TPD, HT Line, MSW - 100%, Land reclamation possibility > 70%, SLF can be developed hereafter proving a 10m green belt	
16	Thiruvananthapuram	Erumakkuzhi, Chala Market	0.35 acres	8496 cum	Owner-by TRIDA (since 2000), Buffer zone - No, Green Belt - No, habitation – In the center of the city, commercial, shops, godown, flood - No, Groundwater- 6m BGL, Airport – 4.5 Km, Present dumping- NO (since 2017), MSW - 100%, Land reclamation possibility 100%, Shall just clear the site to prevent	

Sl No:	City	Name of Dumpsite	Area	Waste Qty	Remarks	Photos
					pollution	
17	Wadakkanchery	Kumbalangad	6.3 acres	4000 cum	Owner-ULB (since 1999), Buffer zone - No, Green Belt - No, but plantation all around, habitation – NO, flood - No, Groundwater- 8m BGL, Present dumping- Stopped since May 2019, but small qty still is dumped, MSW - 100%, Land reclamation possibility > 70%, Possible to develop SLF after providing a 10m green belt inside.	

Annexure IV: Details of International Treaties

Table 25: India's International Environmental Agreements

International Treaties	Details
The Ramsar Convention on Wetlands of International Importance, 1971	The Ramsar Convention is an international treaty for the conservation and sustainable utilization of wetlands i.e. to stem the progressive encroachment on and loss of wetlands now and in the future, recognizing the fundamental ecological functions of wetlands and their economic, cultural, scientific and recreational value. According to the Ramsar List of Wetlands of International Importance, As of February 2019, there are 27 Ramsar Sites in India which are required to be protected. Activities undertaken in the proximity of these wetlands should follow the guidelines of the convention.
Vienna Convention for the Protection of the Ozone Layer	Adopted in 1985, convention sets the framework for efforts to protect the globe's ozone layer through systematic observations, research, and information exchange on the effects of human activities on the ozone layer and to adopt legislative or administrative measures against activities likely to have adverse effects on the ozone layer.
Montreal Protocol on Substances that Deplete the Ozone Layer (a protocol to the Vienna Convention for the Protection of the Ozone Layer)	The original Montreal Protocol was agreed on 16 September 1987 and entered into force on 1 January 1989. It is designed to protect the ozone layer by phasing out the production of numerous substances that are responsible for ozone depletion. This treaty also requires controlling emissions of substances that deplete ozone (like GHG).
United Nations Framework Convention on Climate Change (UNFCCC (1992))	This framework came into force on 21 March 1994 and aims to achieve stabilization of greenhouse gas (GHG) concentrations in the atmosphere at a level low enough to prevent dangerous anthropogenic interference with the climate system.
Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (1989)	This convention came into force in 1992 and aims to reduce the amount of waste produced by signatories and regulates the international traffic in hazardous wastes.
Stockholm Conference on the Human Environment	Intergovernmental Working Group on marine pollution, 1972 (set up by the United Nations General Assembly) Pollution at Sea due to land discharge of wastes and disposal from Ships.
Stockholm Convention on Persistent Organic Pollutants (POPs)	Treaty to protect human health and the environment from chemicals that remain intact in the environment for long periods, become widely distributed geographically, accumulate in the fatty tissue of humans and wildlife, and have harmful impacts on human health or on the environment. Signed in 2001 and effective from May 2004
Rotterdam Convention on Prior Informed Consent (PIC) for certain Hazardous Chemicals and Pesticides in International Trade	To promote shared responsibility and cooperative efforts among Parties in the international trade of certain hazardous chemicals to protect human health and the environment from potential harm; covers pesticides and industrial chemicals that have been banned or severely restricted for health or environmental reasons.
UNEP Minamata Convention on Mercury	Adopted on 10 October 2013, this global treaty aims to protect human health and the environment from the adverse effects of mercury.

International Treaties	Details
Strategic Approach to International Chemicals Management (SAICM)	SAICM's overall objective is the achievement of the sound management of chemicals throughout their life cycle so that by the year 2020, chemicals are produced and used in ways that minimize significant adverse impacts on the environment and human health.
Convention on Biological Diversity (CBD), commonly Biodiversity Convention (including EIA procedures)	The international legally binding treaty opened for signature at the United Nations Conference on Environment and Development (UNCED) in 1993. The objectives of this Convention, to be pursued following its relevant provisions, are the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources.
Convention on the Conservation of Migratory Species (CMS or Bonn Convention)	The intergovernmental treaty, concluded under the aegis of the UNEP, concerned with the conservation of wildlife and habitats on a global scale. It is the only global convention specializing in the conservation of migratory species, their habitats and migration routes. The treaty aims to conserve terrestrial, aquatic, and avian migratory species throughout their range. India entered the force of CMS on 1.11.1983.
Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA)	An independent international treaty developed under the auspices of the UNEP's Convention on Migratory Species. India is a party to this agreement. Aims to establish coordinated conservation and management of migratory waterbirds throughout their entire migratory range. It covers 255 species of birds ecologically dependent on wetlands for at least part of their annual cycle.
Convention concerning the Protection of the World Cultural and Natural Heritage	WHC sets out the duties of States Parties in identifying potential sites and their role in protecting and preserving them. By signing the Convention, each country pledges to conserve not only the World Heritage sites situated on its territory, but also to protect its national heritage. The States Parties: integrate the protection of the cultural and natural heritage into regional planning programs, set up staff and services at their sites, undertake scientific and technical conservation research and adopt measures which give this heritage a function in the day-to-day life of the community. It explains how the World Heritage Fund is to be used and managed and under what conditions international financial assistance may be provided. States Parties to report regularly to the World Heritage Committee on the state of conservation of their World Heritage properties and to strengthen the appreciation of the public for World Heritage properties and to enhance their protection through education and information programs Date of Adoption was 16 Nov 1972 This came into force on 17 Dec 1975 India signed the convention on 14 Nov 1977

Annexure V: Stakeholder Consultations for ESMF Preparation

A) State Level Public Consultations

Table 26: Participation in State Level Public Consultations

Kerala Urban Service Delivery Project (KUSDP)

State Level Consultation Workshop on Solid Waste Management in Kerala

ATTENDANCE SHEET

Venue: Padmam Hall, IMG,Thiruvananthapuram **Date: 05/02/2020**

Sl No	Name	Designation	Mobile No	Email id	Signature
1	P.U. ASHRAF	CHAIRMAN UMC Global (World Bank)	9375263464	pucnome@umc-global.com	
2	G.M Tendulkar	UMC Global	9890616547	tgmendulkar@gmail.com	
3	K. Sreenivas	PwC	9971144799	aareialty@gmail.com	
4	Poonam Ahluwalia Khanijo	World Bank	9810737263	pahluwaliakhanijo@worldbank.org	
5	Riddhiman Saha	WB	9836855065	rsaha1@worldbank.org	
6	Deepthi Pradheep	PwC	8754926358	deepthi.pradheep@pwc.com	
7	Sureshan. M	Municipal Secretary	9447648897	sureshbavil42@yahoo.com	
8	Biju S	Municipal Secretary Kasergod	9447348363		
9	Sreejith G.P.	Dist Coordinator Suchitwa Mission Idukki	9447294818		
10	Litty Mathew	Dist Planning Office Ernakulam	9446094381		
11	Isha PA	Town Planner Kozhikode	9846247448		
12	Shanty ML	Project Manager IMPACT Kerala	9496277933		
13	Vinayan K.P.	RJD, Kozhikode	9447360258		
14	A.L. Charles	Dy Mission Director AMRUT	9447387079		
15	Salila S.	District Suchitwa Mission Coordinator Thiruvananthapuram	9446134804		

Kerala Urban Service Delivery Project (KUSDP)

State Level Consultation Workshop on Solid Waste Management in Kerala

ATTENDANCE SHEET

Venue: Padmam Hall, IMG,Thiruvananthapuram **Date: 05/02/2020**

16	D. Saju	Secretary Karsom Arpara	9847241011	[illegible] @ gmail.com	[signature]
17	Sathyaprakash.S	Dist. planning officer, KSGD	9446273844		[signature]
18	V.V. Ramesan	Chairman	9446010322		[signature]
19	Girija. K.S.	Chief Town Planner	7012112964	ctpkerala@gmail.com	[signature]
20	SARANYA. V. RAJ.	Suchitwa Mission	7034094534		[signature]
21	Satyajit Ray	PwC	9712067494	Satyajit.r.ray@pwc.com	[signature]
22	Preetish Biswal	PwC	"		[signature]
23	Ajaya Kumar. P	Technical Officer Haritha Keralam	9447201655	ajayanhkm@gmail.com	[signature]
24	ANIL KUMAR. P	Town Planner, Pathanamthitta	9446330594	anil.dytp@gmail.com	[signature]
25	Jayakumari. P.V	Co-ordinator, DSM, Alappuzha	9446303278	lscalapuzha@gmail.com	[signature]
26	Anu R.S	Regional Joint Director Kochi	9447964514	duaz.kochi@gmail.com	[signature]
27	Uri Raich	World Bank		[illegible]@worldbank.org	[signature]
28	K.V. Abdul Malik	IMPACT Kerala Ltd	9447193838	pd.impact@kerala.gov.in	[signature]
29	M.L. Rosy	THRISSUR CORPORATION	9495226006		[signature]
30	SUMITHA G.K.	Project Manager, IMPACT Kerala Ltd	8281240809	sumithagk@gmail.com	[signature]

Kerala Urban Service Delivery Project (KUSDP)

State Level Consultation Workshop on Solid Waste Management in Kerala

ATTENDANCE SHEET

Venue: Padmam Hall, IMG,Thiruvananthapuram **Date: 05/02/2020**

31.	A. Noushad.	M. Secretary Chittur-Thathamangalam	9495882910	advnoush@gmail.c	[signature]
32	T.K. Sujith	Secretary Koduvayur Mty	9846042841	tksujith@gmail.com	[signature]
33.	Beena. S. Kumar	Secretary Anganaly Municipality	8281596183	beenasivakumar@gmail.com	[signature]
34	K.K. Manoj	Municipal Secretary Kunnamkulam	9946692902	Kunnamkulam secretary@gmail.com	[signature]
35	Neelakantan. B	Secy Pandalam Mty	9946527234	[illegible]	[signature]
36.	Indu Vijayavalli	Town Planner Alappuzha	9497636279	induharanbabu@gmail.com	[signature]
37	Bharath Babu. M	Technical Consultant Thiruvananthapuram Suchitwa Mission	9447821816	bharathbabu32@gmail	[signature]
38	Joseph. A.D.	Asst. Dt. planning officer, Thrissur O/o DPO, Thrissur	9446230187	adjosephad@gmail.com	[signature]
39	Abhilash Kunnath	Secretary	Thiruvalla	9447789924	[signature]
40	Karthikeya P	Consultant		9052033370	[signature]
41	AMALAN. A.	Consultant		9840737474	[signature]
42	C.K. Ramachandran	Consultant		9447170828	[signature]
43	Sabari Raja M	Consultant		8903017702	[signature]
44	Lakshmi Narayanan	Consultant		9677133763	[signature]
45	Mustafa. A.M	Secretary	Pathanamthitta	9447118032	[signature]
46	Ramachandran A	Town Planner Wayanad.		9495627946	[signature]

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47	HAREESH N.K.	Municipal Secretary Muvattupuzha	9961116374	hareeshnkamath@gmail.com	
48	J. Muhammed Shafi	Municipal Secretary Alappuzha Municipality	9846093249	secretaryalappuzha@gmail.com	
49	G. Sudhakaran.	Dt. Co-Ordinator Suchitwa Mission Kollam.	7025861463	tsckollam@gmail.com	
50	TOBY THOMAS	MUNICIPAL SECRETARY ALUVA	9496141437	advtoby@gmail.com	
51	P.S. Shibu	Municipal Secretary Thrikkakara	9447900282	adwaithmshibu@gmail.com	
52	Joy Elamon	Director KILA	9446521312	director@kila.ac.in	
53	Harikumar. K	RJD Kollam	9947264804	vakkeel@gmail.com	
54	V.Vinodkumar	Dy. Director State Planning Board. Tvm	9442761470	vinodvspb@gmail.com	
55	B.K. BALARAJ Joint Director	Urban Affairs Dept Thiruvananthapuram	9447653725	duatvpm@gmail.com	
56	Dr. Lakshmi P.H Asst. Scientist	Directorate of Envt & Climate Change	9486076132	environmentdirectorate@gmail.com	
57	Dhanya. M.S. Technical Consultant Suchitwa Mission, Ekm	Suchitwa Mission Ernakulam	8589074437	tscekm@gmail.com	
58	Suma Balakrishnan Mayor Kannur Corporation		9847023021		
59	P.Kesavan Nair	MD, CKCL	9497886600		
60	G. Unni	HS.	8547009386	Corporation office.	
61	Resmi P.S LWM Expert Suchitwa Mission	Suchitwa Mission	9497360907	aeresmi@gmail.com	
62	Thottathil Raveendran	MAYOR Kozhikode.		KKD	
63	HONEY			05/02/2020	
64	Deepu S	Research Assistant Kerala State Planning Board	9562346497	5/2/2020	
65	Jagajeevan.N.	Consultant Haritha Keralam Mission	9447172295 jagajeevan65@gmail.com		
66					

Table 27: Details of Consultations with Institutional Stakeholders

S. No.	Stakeholders Consulted	Name of Officials & Designation	Key Outcome of the discussion
1.	Kerala State Pollution Control Board (KSPCB) Date: 5th October 2019	Chairman Secretary and other Officials of PCB, KSWMP officials, Pricewaterhouse Coopers Ltd (PwC) (Consultant)	• Discussed various provisions of SWM Rules. • ULBs are only interested in collecting recyclable waste, which can fetch a market value. ULBs have the obligation to collect all waste whether it has a value or not. • **Waste to Energy:** It is not suitable for Kerala's mixed waste as it is due to near 60percent water content. This would additionally need fuel to run the process and generate energy. However, waste to energy is acceptable as an option for waste disposal or management even though its viability in Kerala is still uncertain at this point of time • PCBs provide directions to Municipalities and is powered to charge penalties in case of a serious violation (concerning SWM rules) observed or reported. • There are plans for setting up 8 – 9 treatment plants in Kerala. However, the local bodies resist in the name of local protest. It is the ward councilors who are driving such protests. • Formation of Kerala State Level Authority for Waste Management: Modern treatment plants are technology-intensive and expensive. The management of such modern plants is beyond the capacities of the local bodies. Moreover, such plants may have to cater to the waste collected from multiple municipalities – clusters need to be formed. This would require a technically competent agency for management. • KSPCB institutional requirements: a. Needs staff strengthening for monitoring activities b. Training requirement c. Digitalization of office procedures d. More staff requirement at field level
2.	Suchitwa Mission Date: 10th October 2019	Mr. J.S. Jayakumar, Sanitation Specialist, other Suchitwa Mission Officials; KSWMP officials, Pricewaterhouse	• There is no difference as such **between SWM Rules and State Policy**. In the state, where source composting is not possible, HKS is also involved in the collection of BDW. Regarding the collection of waste within each local body, local bodies can create their bye-laws. • KSPCB insists on the door to door collection. It is due to lack of awareness of ground realities that this is not followed here. At instances of setting up a treatment plant for handling less than 5 TPD, PCB insists on taking Authorization. But as per the norms, for plants less than 5 TPD

S. No.	Stakeholders Consulted	Name of Officials & Designation	Key Outcome of the discussion
		Coopers Ltd (PwC) (Consultant)	capacity, PCB authorization is not necessary. • **Waste to energy plants:** Have serious apprehensions about the success of W2E. Dry Waste is more suitable for W2E. Around 70percent of the waste generated in Kerala is wet waste. Drying of the waste generated consumes a lot of energy which is not taken into consideration. • Haritha Karma Sena (HKS) has been formed in all local bodies, but they are functional only in some of the local bodies. However, there are no recorded details on how many HKS are functioning successfully. • **The role of Haritha Keralam Mission** is to integrate the various institutions. They are more involved in the water bodies reclamation. They should ideally coordinate the supply of compost from HH level or decentralized plants to organic farms. However, it is not carried out.
3.	Swachh Survekshan (Suchitwa Mission) Date: 09th November 2019	Mr. Jayakumar, Swachh Survekshan, KSWMP officials, Pricewaterhouse Coopers Ltd (PwC) (Consultant)	• Criteria for Swach Survekshan: The survey is based on the implementation of door to door collection and a centralized system of waste management which is not practiced in the state. • Process of Swach Survekshan: The local bodies need to update data monthly on the SBM MIS. The evaluation is based on this updated information on the MIS. Additionally, the team would also conduct inspections in these local bodies. In Kerala, municipalities have not been keen on this survey, since Kerala, following the decentralized system there is no chance to fall under the top rankings. In such a scenario they show resistance in dedicating staff time in updating of MIS. • Role of private agencies in the SWM value chain: private agencies are involved in the collection of waste and operation of plants in the ULBs. Privatization of the whole value chain has not been possible since the local bodies do have a certain number of employees engaged in these areas including street sweeping. The privatization of the whole value chain would result in protests from these workers. • Removal of compost at decentralized plants: Govt. should ideally engage the Krishi Officers to ensure collection of compost generated from BDW.
4.	Kerala Institute of Local Administration (KILA)	Dr. Joy Elamon, Director General (DG), KSWMP officials, Pricewaterhouse Coopers Ltd (PwC)	• HKS does not seem to be a sustainable model. HKS does not get adequate income to be sustainable. They work a day; that too the job of waste collection and what they take back home is Rs. 2000 – 3000 a month. If Kudumbasree is functioning well in a certain area, there's no point in disturbing the system or altering it as HKS • KILA handholds and supports Municipalities in preparation of city sanitation plans. Have prepared sanitation plans for 37 ULBs. For the purpose, KILA appoints one person for each ULB.

S. No.	Stakeholders Consulted	Name of Officials & Designation	Key Outcome of the discussion
	Date: 16th December 2019	(Consultant)	Yearly trainings are provided to health supervisors and inspectors. The training covered various aspects like Green rules, Municipal Rules, Penalisation applicable in various cases • The sector-related trainings are conducted as per the instructions of Suchitwa Mission and the funds are from Swachh Bharat Mission (Urban) • SWM Training is provided to 4 categories: Health Standing Committee, Elected Representatives, HKS, Residents Welfare Association • Institutional strengthening required a. Requires strengthening in terms of the extent of technology tie-ups, for eg: KILA had an association with IIT Bombay recently b. Requires a few more in-house faculties to lead the various programs
5.	Local Self Govt. Department Date: 10th October 2019	Mr. T K Jose IAS, Additional Chief Secretary, KSWMP officials, Pricewaterhouse Coopers Ltd (PwC) (Consultant)	• The main source of waste is the waste from commercial establishments, hotels, institutions, marriage halls, etc. and these lead to the piling up of waste. There need to be advanced technologies to handle this, like technology to convert hotel waste into nutritional output for farming, etc. in around 8 hours or so • **Difference between SWM Rules and State policy**: Door to door collection as mentioned in the rules is carried out wherever necessary particularly in apartments and bulk generators. However, collection (especially BDW) does not cover all the households in all ULBs due to the lack of facilities to handle the collected waste. • **Waste to Energy projects**: ULBs worrying about not being able to produce enough waste is a misconception or misunderstanding. If there is a proper collection system adequate waste will be available for the W2E projects. ULBs want to evade the responsibilities of waste collection. • **Role of HKS**: Initially Kudumbasree waste collection system was existing. HKS is formed as a system to ensure supplementary job to weaker sections of society, without developing a tendency to demand permanent employment. It is not expected to be the means of main income for the HKS members and will be a source of supplementary income only. HKS came into effect during the decentralization move in SWM.
6.	Local Self Govt. Department	Mr. K Biju, IAS, Special Secretary, KSWMP officials, Pricewaterhouse	• The state requires regional waste processing facilities and landfills in large isolated land parcels (near 100 acres per facility). Centralized facilities in each ULB does not work out. • The land for the regional facilities to be identified and transferred to the State Government. The state government shall own regional facilities.

S. No.	Stakeholders Consulted	Name of Officials & Designation	Key Outcome of the discussion
	Date: 03rd March 2020	Coopers Ltd (PwC) (Consultant)	• The state requires a proven technology; W2E does not seem to be viable. • The door to door collection of waste needs to be carried out by the respective ULBs. Clear demarcation of areas and assigning of responsibility of each of these areas to specific ULB staff should be done. • The state may continue decentralized mechanisms, but a survey of households/commercial/institutional establishments to understand their desire to either participate in the collection system or treat waste at source needs to be carried out by the ULBs. There should be proper monitoring and supervision of decentralized processing of waste if practiced
7.	Kerala State Industrial Development Corporation Ltd. (KSIDC) Date: 09th October 2019	Mr. Harikesh, Director and other officials of KSIDC, Waste to Energy Project, KSWMP officials, Pricewaterhouse Coopers Ltd (PwC) (Consultant)	• In the first phase, 7 projects W2E were planned in Calicut, Trivandrum, Kannur, Kollam, Palakkad, Malappuram, Trichur • In Calicut and Trivandrum, considering the quantity of waste generated, which is over 300 TPD, insulation type waste to energy treatment plants are planned, which produces power. In other places, waste generation being around 200 TPD, organic processing, or RDF based waste to energy treatment is more feasible. Such plants produce some form of fuel or energy source but not power. • Segregation and collection of waste for W2E- The waste needs to be segregated at source. Segregation is essential as organic waste cannot be burnt. • Guarantee on power generation: There is no guarantee on the power generation- KSIDC is seeing it only as a waste management technique and not a means of power generation. Kerala generates 7,000 TPD waste, of which only 3000 TPD is being handled. The remaining could be floating waste, which needs to be addressed. Hence this is seen more as a social need. The generated power whatsoever will be given to KSEB. • Some of the waste to energy plants might need a landfill in the site which may require an EIA. The setting up of just the plant would not require EIA if the generated power falls under 50 MW of energy.
Municipalities			
8.	Kalpetta Municipality	Ms. Sanitha Jagadish, Chairperson,	• 36 Haritha Karma Sena (HKS) workers are employed to collect wet waste from the 12 town wards. User charges are collected based on the weight of waste disposed. HKS workers are collecting plastic waste from all the 28 wards.

S. No.	Stakeholders Consulted	Name of Officials & Designation	Key Outcome of the discussion
	Date: 20th November 2019	Mr Harris, Ward Councilor Mr Sathyan, Health Inspector Mr Rayees, Junior Health Inspector Mr Vipin, IKM person KSWMP officials, Pricewaterhouse Coopers Ltd (PwC) (Consultant)	• There is a 10 acres land (on top of a hill) located at Vellaramkunnu, which is used as a dumping site. Collected plastic waste from all 28 wards are dumped at one corner of the site, which is not yet segregated • During the 2018 and 2019 flood, accumulated waste was brought from several parts of the district to Vellaramkunnu and dumped based on an order issued by District Collector. Entire waste (without any segregation) is piled up at this site. • There are no plastic shredding machines available with the municipality. • Ward number 23 (Chenamala) is prone to landslide. 12 families staying in this locality are rehabilitated in another area within the municipality. • There are 53 tribal colonies in Kalpetta. Under PMAY, 800 houses are planned. Out of this, 600 houses are completed and handed over to the beneficiaries. • There are 200 plus landless families in the Kalpetta Municipality area. • The market which was functioning inside the town area was shut down, based on PCB instructions. • Tourist spots within the Municipal area are Gandhi Museum at Chulliar Mala (ward 7), Jain Temple (ward 7), Mailadippara (ward 8)
9.	Neyyattinkara Municipality (Taluk Headquarter) Date: 17th September 2019	Ms W.R. Heeba, Chairperson Ms. Sukumari, Chairperson, Health Standing Committee Mr Saji S, Secretary (Mob: 701 250 8329) Mr Sasi Kumar, Health Supervisor (Mob:	• Neyyattinkara Municipality was part of JnNURM's KSWMP (solid waste project). However, this project did not take place and was abruptly closed. As part of this project, the municipality had acquired some vehicles and no other action was taken under this project. • There was a proposal to implement solid waste plants (including providing biogas plants to households). This DPR is vetted by 2 Self Government Department (LSGD) and the same is approved. • Neyyattinkara Municipality (NM) had supplied (at subsidized rate) 110 biogas plants to households within the municipal area. • There is no door-to-door waste collection in Neyyattinkara Municipality. In most of the places, people are disposing-off bio-degradable waste onto their land (as fertilizer to a coconut tree,

S. No.	Stakeholders Consulted	Name of Officials & Designation	Key Outcome of the discussion
		8086927074) Mr Madhu Kumar, Health Inspector (Mob: 8848717271) Mr. Lijo, Junior Health Inspector (Mob: 97444 81812) KSWMP officials, Pricewaterhouse Coopers Ltd (PwC) (Consultant)	banana plant, etc.). There is a provision for people to go and hand over the non-degradable waste to selected collection centers earmarked by the municipality. • In Vazhimukku (ward number 44), a pilot project on solid waste is commenced from July 2019. In this project, the Municipality has permitted a private operator to collect degradable waste from every house. The operator collects these waste and transports to nearby Tamil Nadu districts (Kanyakumari and Tirunelveli) and sells to pig farm owners. This degradable waste is food for pigs. In the same ward, ie. in Vazhimukku, Haritha Karma Sena is collecting plastic waste from every household. The municipality is in the process of processing the plastic waste once the proposed plant inside their office premise is commissioned. Aerobic compost plant ("Thumboormoozhi" model plant) is implemented within the municipal office complex. The municipality had built a 1-ton biogas plant in the town market, however, it's not operational.
10.	Guruvayur Municipality Date: 18th November 2019	Ms Revathy VS. Chairperson Mr KP Vinod, Vice Chairman Mr TT Shivadasan, Former Chairman Ms. Rethi M, Chairperson, Health Standing Committee Mr Shenil TS, Chairman, Works Standing Committee Mr Vivid, Chairman, Welfare Standing	• Kudumbashree people, working directly under Municipality's Health Department, collect wet waste from 12 town area wards (including waste from Sree Krishna temple, Mammiyoor temple, marriage halls, hotels, auditoriums) regularly. • The waste collected by Kudumashree is transported to a waste treatment plant located at Choolpuram. The wet waste is processed at Choolpuram plant using windrow composting technology. The fertilizer made in this plant out of degradable waste is sold to farmers. The current capacity of this plant is 5 TPD. According to Municipal officials, they require a plant of 15 TPD capacity. • Haritha Karma Sena (HKS) is collecting plastic waste from the entire Municipal area either once in a week or fortnight. At times, they collect more than once in a week (during peak seasons). There is a plastic shredding machine installed at Choolpuram plant and is working. HKS people are finding it difficult to store the collected plastic waste (including what is shredded and packed). According to HKS, there are no buyers for the plastic waste. • The land located at Choolpuram (measuring 5 acres) has the following components [a] gas-operated crematorium; [b] wet waste processing plant – comprises of one old shed and one new shed under construction; [c] two sheds filled with collected plastic waste [d] their shed in which shredder machine is installed and this shed is almost full with collected plastic waste. There is an abandoned incinerator within this piece of land. Choolpuram is the only SW plant located within

S. No.	Stakeholders Consulted	Name of Officials & Designation	Key Outcome of the discussion
		Committee Mr Shrikant, Municipal Secretary And other staff KSWMP officials, Pricewaterhouse Coopers Ltd (PwC) (Consultant)	Guruvayur Municipality.
11.	Perinthalmanna Municipality Date: 19th November 2019	Mr Mohammed Salim M, Chairman, Ms Nishi Anilraj, Vice-Chairperson, Mr Abdul Sajeem S, Secretary, Mr Dileep Kumar K, Health Inspector Mr Rajiv, Junior Health Inspector, Mr Jayan, Jeevanam CEO KSWMP officials, Pricewaterhouse Coopers Ltd (PwC) (Consultant)	• Perinthalmanna municipality had initiated a project called "Jeevanam" (in 2013) for handling solid waste collection and processing. Under the Jeevanam project, they have supplied bio-bins, pipes for composting to households. • They are collecting plastic waste from all the wards. They have developed an "App" which monitors the vehicles on the move, employees in the field, status of collection from every customer. A bar code (with customer serial number) is issued to every house and the same bar code is stuck at the gate of the respective house. A Jeevanam green technician who goes to collect waste from a particular house has to mandatorily use the bar code reader and scan the bar code of that particular house. Any sorted plastic waste which can be sold to the scrap dealers, are sold from time to time. After selling some of the items, whatever is leftover (which is rejected material) is given away to vendors by paying them for removal of such waste from the dumping site. • There is no legacy waste in this dumping site. In 2018, there was a major fire that broke out during one of the nights and it took almost a week to douse the fire. The sheds, accumulated plastic waste, plastic shredding machine, etc., all were gutted in this fire accident. • Jeevanam green technicians are collecting wet waste from all the commercial establishments, flats and other gated communities (hotels, hospitals – other than medical waste, restaurants, marriage halls, shops, etc.). This waste is transported to a dumping site located at a place called "Thekkinkodu" located at the outskirts of Perinthalmanna town. They treat the wet waste by using windrow composting and manure/compost is given away free of cost to the local farmers. • Jeevanam's green technicians visit all the households once in three months to collect other dry

S. No.	Stakeholders Consulted	Name of Officials & Designation	Key Outcome of the discussion
			waste (other than plastic) like chappal, bag, used tube lights, used electric bulbs, etc. based on a schedule. • 5 TPD wet waste is collected in this municipality. A Bangalore based organization has come up with a new proposal to the municipality. In this, a mini W2E would be implemented. At the moment, the Municipality has plans to use this power to run their facilities in the dumping site. • Features of Dumping site at Thekkinkodu: ✓ This is a 14 acre land on a hilltop ✓ Around 2 to 3 acre of land has sheds ✓ The old sheds which were destroyed in the 2018 fire are left as it is ✓ Huge pile of collected plastic waste (mostly not sorted) are dumped in an open ground ✓ There is a shed with a proper roof for processing the wet waste ✓ The land has a compound wall, fencing and a gate which can be locked ✓ There are houses in the nearby area ✓ The road leading to this site is very narrow, hence it is not easy for big lorries to move (especially when another vehicle comes from the opposite direction)
12.	Kasaragod Municipality Date: 22nd November 2019	Ms. Beefathima Ibrahim Beevi, Chairperson Mr LA Mahamood, Vice Chairman Ms Sameena Mujeeb, Health Standing Committee Chairperson Mr Damodaran, Health Supervisor Mr. Rajeev, Health	• The municipality earlier had a dumping site at Kelugudde, which was used for 3 years. This had been closed down due to public protest. However, the people around the area have destroyed the compound wall to the site in certain areas and continue to dump their HH waste. • 23 member HKS collects plastic waste from HH • BDW treated at source: municipality has provided 8000 ring compost units to the community • Open compost pit is also a successful model here for BDW community • 670 pipe compost units were given • 3 Thumboormozhi model composting units, each consisting of 4 units at a single place. • 13 biogas units provided by the municipality • There is one incinerator at Vidhya Nagar, which lacks proper maintenance; but continued to be used. • Food waste from hotels are utilized in pig farm as fodder • Local poultry, Goat farms have taken initiatives to produce compost made from meat stall waste, unhatched eggs from the poultry farm waste, etc. Such firms also collect around 5 T of waste

S. No.	Stakeholders Consulted	Name of Officials & Designation	Key Outcome of the discussion
		Inspector Ms. Amitha, Superintendent – General Section Mr Santhosh, Accountant KSWMP officials, Pricewaterhouse Coopers Ltd (PwC) (Consultant)	from hotels in and around Kasaragod
13.	Calicut Municipal Corporation Date: 21st September 2019	Concerned ULB staffs KSWMP officials, Pricewaterhouse Coopers Ltd (PwC) (Consultant)	• This Corporation provides a pointer to the institutional and behavioral changes which follow the adoption of new technologies. The Corporation has successfully implemented the door-to-door collection model with the help of Kudumbasree workers in most of its wards. In most cases, there is a source-level segregation. Biodegradable waste is collected daily and non-biodegradables at durations ranging from a fortnight to a month. Haritha Karma Sena is being organized to relieve Kudumbasree of this function, although many Kudumbasree volunteers have been absorbed in the HKS. • Recently, the Corporation has decided to install a plant for Waste to Energy (WTE) and the commissioning of the plant is underway. With the commissioning of the plant, there will be a fundamental change in the disposal pattern of solid waste in the Corporation. The plant is understood to adopt a combination of methanation and combustion and can, therefore, utilize both biodegradable and non-degradable waste. The apprehension of those connected with the plant under construction is that available unsegregated waste may not be sufficient and waste will have to be imported from neighboring ULBs with whom negotiations are in progress.
14.	Feroke Municipality Date: 23rd September 2019	Concerned ULB staffs KSWMP officials, Pricewaterhouse Coopers Ltd (PwC)	• This ULB, adjacent to Calicut Corporation, has introduced a door-to-door collection of non-degradable waste only partially, as HKS is still to be fully made functional. But the ULB presents a picture of policy uncertainty leading to the pursuit of conflicting objectives. • Based on the advice of Clean Kerala Company (CKC), the ULB has set up a shed for installing a plastics shredding machine. KSIDC has approached the ULB and signed an agreement to

S. No.	Stakeholders Consulted	Name of Officials & Designation	Key Outcome of the discussion
		(Consultant)	receive the entire output of solid waste of the Municipality for utilization in the WTE plant of Calicut which is located only five kilometers from Feroke.
15.	Alappuzha Municipality Date: 6th November 2019	Mr. Jayakumar, Jr. HI Mr. Habib, Health Officer in charge KSWMP officials, Pricewaterhouse Coopers Ltd (PwC) (Consultant)	• There is no health supervisor post in Alappuzha Municipality. It is a health inspector and the Health officer posts that exist. • No training is particularly given to municipality in decentralized treatment facilities. • HKS conducts the collection of plastic waste. Currently, 50 HKS workers; 70 are required. • Only 30percent of the population drops waste at the decentralized units. Another 30 – 40percent practice home composting. • The main problem is the plastic waste management. There is no one in need of single-use plastic. It is accumulated in the collection points. E-waste and mattress waste (from the flood) is another major problem. CKCL should collect shredded plastic. They don't do it. • **Old dumping yard (Sarvodayapuram):** The dump yard is not being used for the past 7 years due to public protest. The dump yard had 3 sheds covering a total area of 20,000 sq. ft. All kinds of waste were dumped in these sheds. By now, BDW would have been degraded, plastic would be the major waste still lying in these sheds. New machinery for segregation was bought and installed. However, the facility was operated only for a year and left the project midway. Intermediately, there were plans to start farming practices in the site with the involvement of Kudumbasree members. However, any attempt to clean up or carry out any activity on the site saw a huge protest. This prohibited any sort of activity on the site. • **Decentralized Thumboormozhi model Units (Kummady Ward):** There are 30 such units in the municipality with a total of 295 bins. The units are approximately placed at a distance of 1 km. The bins (4ft x 4 ft) follow the Thumboormozhi model of waste composting. The process followed is the first layer of dry leaves – then inoculum- then food waste- inoculum- dry leaf – food waste and so on. The decentralized unit, additionally, has a shed for the storage of plastic/NBDW waste. The individual household waste needs to be dropped in the collection bins at these units by the user/customer. The units are mostly built on any piece of land found suitable (*purampokku land*) as temporary structures. Only 3 such units are located on the Municipality's own land.
16.	Kothamangalam Municipality	Ms. Kavitha S Kumar, Municipal Secretary	• HKS: The municipality has formed an HKS team comprising of 28 members. HKS is involved in the collection of BDW and NBDW only from commercial establishments; Household waste isn't a major problem yet in Kothamangalam.

S. No.	Stakeholders Consulted	Name of Officials & Designation	Key Outcome of the discussion
	Date: 7th November 2019	Mr. Sunil, Health Inspector Mr. Latheef, Health Supervisor KSWMP officials, Pricewaterhouse Coopers Ltd (PwC) (Consultant)	• The agreement with Haritha Sahaya Sthapanam has not been finalized yet. Haritha Sahaya Sthapanam is believed to provide adequate training to the HKS. The Municipality also had an understanding that the HSS would help in the removal of plastic waste from the municipal area and would provide supervisory assistance. • Municipal vehicles are provided for collection of waste • No current system for the collection of plastic. • The Municipality has plans for distributing bins for the collection of biodegradables and sacks for the collection of dry waste. • Dump Yard: There is only a dump yard available for the Municipality and no treatment facilities are functioning there. The dump yard is situated on a hill in the middle of an estate. Mixed waste is just dumped there without any treatment facilities. Intense bad smell inside the dump yard. It was also mentioned that the dump yard is located at a place where natural groundwater spring is available- dump yard causes contamination of water. • Shredding machines were purchased using Municipal fund through CKCL, but it is not functioning now • Disaster Management: A disaster management committee has been formed comprising of police, fire force, and hospital representations.
17.	Thalassery Municipality Date: 21st November 2019	Mr. Manohar K, Secretary, other Municipal Staff KSWMP officials, Pricewaterhouse Coopers Ltd (PwC) (Consultant)	• There is no system for the collection of wet waste by the Municipality, neither from households nor commercial establishments. This is attributed to the lack of space in the municipal area to handle the wet waste if collected. • The Municipality earlier had a dumping site in Kadalpaalam, the place also known as Pettipaalam. The site was closed 7 years back due to huge public protests. Slaughter wastes in plastic bags are continued to be disposed-off around Kadalpaalam/ Pettipaalam. • Currently, it was informed that households are managing wet waste at home using bin compost facility, pipe composting, or open composting. Around 5000 HH have been already provided with bio-bins and pipe composts. There are plans for providing 16000 more home composting bins, of which only 700 has been distributed so far. • Wet waste from commercial establishments is collected by various agents (organized by pig farm owners) and sent to piggeries. The municipality does not interfere with the collection at all and there isn't any check carried out by the Municipal staff on these piggeries or as to where these

S. No.	Stakeholders Consulted	Name of Officials & Designation	Key Outcome of the discussion
			collected wastes are being taken. • Municipal Town Hall has a waste composting facility (Thumboormozhi model) for handling the waste generated from the functions organized at the Townhall. • Plastic wastes are collected by HKS from households and establishments (only plastic wastes are collected, other NBDW like bags, shoes, glass bottles, tube lights, etc. are not collected). The collected plastic wastes are sorted and shredded at a shredding unit at Kandikkal – an industrial area having minor plastic scrap dealing industries. The shredding units at Kandikkal are currently not functioning (machines not functioning) due to a fire outbreak in one of the neighboring plastic processing centers which damaged the electrical cabling to these shredding machines. The Municipality faces challenges in the selling of the shredded plastic from this unit. The Municipality mentioned that the role and help offered by CKCL have been very limited in this regard.
18.	Thripunithara Municipality Date: 23rd September 2019	Mr. Ajith, Health Inspector, other Municipal Staff including JHIs, KSWMP officials, Pricewaterhouse Coopers Ltd (PwC) (Consultant)	• Municipality organizes daily door to door collection of segregated waste by engaging its sanitary workers only from institutions and commercial establishments. These biodegradable waste after collection and proper segregation are sent to Brahmapuram Plant. • For household BDW management, the Municipality promotes the management of waste at individual households. For the same purpose, the municipality is promoting the sale of bucket compost and self-composting units at subsidized rates. However, the acceptance of such source-level composting units is limited. • Public protests and lack of suitable land pose challenges in setting up composting plants or processing centers. • Two of the wards in the municipality arranges collection of waste from households (around 300 houses in 2 wards). The collection is organized by the ward members and associations (without the involvement of ULB) with the help of self-help groups and other private agencies. The collected waste is sent for composting at the composting plants set up within each of the wards. • ULB organizes daily plastic waste collection from commercial establishments and occasional non-biodegradable waste collection from households based on requirements raised by the residential associations. The collected plastic waste is sent to KEIL (Kerala Enviro Infrastructure Limited) which deals with waste processing and engineered landfills. It was understood from the municipality officials that KEIL uses plastic waste in some sort of engineered landfills which are later landscaped with green lawns.

S. No.	Stakeholders Consulted	Name of Officials & Designation	Key Outcome of the discussion
			• Monitoring of probable dump sites on streets and other public areas is facilitated by CCTV networks and special squads. • E wastes: No system in place for the management of e-waste.

A) Local Body / Community Level Public Consultations and Surveys

Various surveys, focus group and individual discussions were conducted during September to December 2019 as part of KSWMP preparation to understand the waste characteristics and quality, environmrntal isses, willingness to pay etc.

List of stakeholders who participated in these consultations / surveys are as follows:

Table 28: Community Level Statkeholders of ULBs who participated in Surveys and Consultations

ULB	Ward	Category of Property	Address	Name	Designation
Alappuzha	Mullackal	Other Commercial Stores	1042, RR Nagar, Mullackel, Iron Bridge, Alappuzha	Murukan	Proprietor / Owner
Alappuzha	Mullackal	Other Commercial Stores	Venkiteshwara Agencies, Mullackkal, Iron Bridge P.O, Alappuzha	Chandrashekharan	Proprietor / Owner
Alappuzha	Mullackal	Other Commercial Stores	Eastern Electricals, Church Road,Mullackal Alappuzha	Raju Joseph	Proprietor / Owner
Alappuzha	Mullackal	Other Commercial Stores	1568, Parambathoor Building, Mullackkal, Alappuzha	Akhilesh	Proprietor / Owner
Alappuzha	Mullackal	Other Commercial Stores	Sarvar Milma store,Mullackkal, Alappuzha	Jayaprakash	Proprietor / Owner
Alappuzha	Mullackal	Other Commercial Stores	Ashoka Bakery, Boat Jetty Road Alappuzha	S Prince	Proprietor / Owner
Alappuzha	Vazhicherry	Other Commercial Stores	24/106 Near CARD Bank Vazhicherry, Iron Bridge, Alappuzha	CL Lonan	Proprietor / Owner
Alappuzha	Vazhicherry	Other Commercial Stores	Juicy Hub, Pathirappally, Alappuzha	Prahladan	Proprietor / Owner
Alappuzha	Vazhicherry	Other Commercial Stores	Annukittu, Shop No.5 Muncipal Pvt Bus stand, Vazhicherry Alappuzha	Abhilash	Proprietor / Owner
Alappuzha	Vazhicherry	Vegetable & Fruits Markets	A N Plantain Merchant, Vazhicherry	Afsal	Employee / worker
Alappuzha	Vazhicherry	Other Commercial Stores	Vazhicherry Market	Jamal	Proprietor / Owner
Alappuzha	Vazhicherry	Vegetable & Fruits Markets	Edathil Plantain, Dara Market, Vazhicherry	Tony	Proprietor / Owner
Alappuzha	Vazhicherry	Meat Market	Dara Meat Stall, Dara Market, Vazhicherry, Alappuzha	Vincent	Proprietor / Owner
Alappuzha	Vazhicherry	Fish Market	Dara Market	Kasim	Proprietor / Owner
Alappuzha	Vazhicherry	Fish Market	Dara Market	Rajesh	Proprietor / Owner
Alappuzha	Vazhicherry	Other Commercial Stores	NR Pooja Store, Vazhicherry	Satheeshan	Proprietor / Owner
Alappuzha	Vazhicherry	Fish Market	SH Halal Chicken, Dara Market	Nahas S	Proprietor / Owner
Alappuzha	Sea View	Other Commercial Stores	Sea View Ward, Vazhicherry, Alappuzha	Sanoop	Proprietor / Owner
Alappuzha	Vazhicherry	Other Commercial Stores	Clemx Car detailing, Vazhicherry, Alappuzha	Afsal	Proprietor / Owner

ULB	Ward	Category of Property	Address	Name	Designation
Alappuzha	Vazhicherry	Other Commercial Stores	ICICI, Alappuzha Branch	Antony	Security / house keeping staff
Alappuzha	Vazhicherry	Other Commercial Stores	CNN Petrol pump, pichu ayyar jn, Vazhicherry, Alappuzha	Dominic	Employee / worker
Alappuzha	Vazhicherry	Other Commercial Stores	Alleppy Urban Cooperative Bank, Pichu Iyer Junction, vazhicherry, Alappuzha	Ganesh	Security / house keeping staff
Alappuzha	Mullackal	Other Commercial Stores	City Union Bank, Alappuzha Branch	Uthaman	Security / house keeping staff
Alappuzha	Civilstation	Other Commercial Stores	Alappuzha Coirfed	Sunoj	Employee / worker
Alappuzha	Civilstation	Other Commercial Stores	Swaraj Tea Stall, Civil station ward, Alappuzha	Kabeer	Proprietor / Owner
Alappuzha	Civilstation	Other Commercial Stores	Kannan Worky palam, civil station Alappuzha	Jijesh	Proprietor / Owner
Alappuzha	Civilstation	Other Commercial Stores	Mars Autocare , Civil station ward, Alappuzha	Muhammed Zameer Ali	Proprietor / Owner
Alappuzha	Civilstation	Stationery	Novalty new bazar alappuzha	Hussain	Proprietor / Owner
Alappuzha	Civilstation	Other Commercial Stores	Redarketting, new bazar, Alappuzha	Hassim	Proprietor / Owner
Alappuzha	Mullackal	Household	Tharalayam,Mullackal, Iron Bridge Alappuzha	Thara babu	Self
Alappuzha	Mullackal	Household	RR, Nagar 57, Mullackkal, Mullackkal P.O, Alappuzha	Rajeswari	Self
Alappuzha	Mullackal	Household	RR Nagar 45, Iron Bridge, Mullackel, Aalappuzha	Venkittaraman	Self
Alappuzha	Mullackal	Household	Gayathri, RR Nagar 47, Mullackal, Alappuzha	Santhi	Self
Alappuzha	Mullackal	Household	Rajeswari Vilas, RR Nagar 50 , Shankaramannar Compound, Mullackal, Alappuzha	Rajalakshmi amma	Self
Alappuzha	Mullackal	Household	Sreenivas Shankara Mannar Compound Mullackal Alappuzha	Sreenivasan	Self
Alappuzha	Mullackal	Household	Saraswathy Sadan, Mullackal Alappuzha	Ashok V	Self
Alappuzha	Mullackal	Household	Illickkal, Mullackkal, Alappuzha	Raju	Self
Alappuzha	Mullackal	Household	Thaiyil Chirayil Mullakkal, Alappuzha	Joseph Mathew	Self
Alappuzha	Mullackal	Household	Vazhappally Kalathil, Mullaakkal, Alappuzha	VV Thomaskuttu	Self
Alappuzha	Mullackal	Household	Polakkad,West of KSRTC, BJ Road Alappuzha	Sreeprakash	Self
Alappuzha	Vazhicherry	Household	Kuthirakkqran Parambu, YMCA, HPO, Alappuzha	Tomichan	Self
Alappuzha	Vazhicherry	Household	Puthan Puraykkal YMC, South of CARD Bank, Alappuzha	Marykkutti John	Self
Alappuzha	Vazhicherry	Household	Kappamoottil Near CARD Bank, YMCA	Ida	Self

ULB	Ward	Category of Property	Address	Name	Designation
			Junction, HPO, Alappuzha		
Alappuzha	Vazhicherry	Household	Valekkal House CARD Bank Lane, Alappuzha -1	VA Chacko	Self
Alappuzha	Vazhicherry	Household	Kankali House, East of Chain Bridge, HPO, Alappuzha	R Chandran	Self
Alappuzha	Vazhicherry	Household	Arackel House, Near Chain Bridge	Sebastian A K	Self
Alappuzha	Vazhicherry	Household	Neat CARD Bank, Alappuzha	Shamsudeen	Self
Alappuzha	Vazhicherry	Household	Vazhicherry, Chavadipparamb, Alappuzha	Safeer	Self
Alappuzha	Vazhicherry	Household	Puthanparambil House, YWCA Lane, Vazhicherry, Alappuzha	John George	Self
Alappuzha	Vazhicherry	Household	Chembakasheril, YWCA Lane, Vazhicherry Alappuzha	Dhanesh	Self
Alappuzha	Vazhicherry	Household	Parambil House, Near Market, Vazhicherry,	Nazeer	Self
Alappuzha	Vazhicherry	Household	Parambil, Near Market, Vazhicherry, Alappuzha	Sadique	Self
Alappuzha	Sea View	Household	Thumbayil, Vazhicherry, Sea View, Alappuzha	Vargheese	Self
Alappuzha	Sea View	Household	Thumbayil, Sea View Ward, Alappuzha	Thomas	Self
Alappuzha	Sea View	Household	Kizhakkeveettil, Sea View Ward, Alappuzha	Paul K K	Self
Alappuzha	Sea View	Household	Bethel, Vazhicherry, Sea View ward, Alappuzha	Lissi Raji	Self
Alappuzha	Sea View	Household	Kattunkal House, Vazhicherry, Alappuzha	Haris	Self
Alappuzha	Sea View	Household	Panavalli, Sea view Ward, Alappuzha	Ashraf	Self
Alappuzha	Sea View	Household	Kinaruvilayil, Sea View,Alappuzha	Sajeev	Self
Alappuzha	Sea View	Household	Vazhathoppil ARS Villa, Sea view, Alappuzha	Antony	Self
Alappuzha	Sea View	Household	Maha mansil, sea view, Alappuzha	Muhammed Haneef	Self
Alappuzha	Sea View	Household	Vadasseri House, Sea view, Alappuzha	Philip Thomas	Self
Alappuzha	Sea View	Household	RS Mansil, Sea view, Alappuzha	Sherif	Self
Alappuzha	Sea View	Household	Panavalli, Sea view, Alappuzha	Siyad	Self
Alappuzha	Sea View	Household	Panavalli purayidam, Sea View ward, Alappuzha	Sainulabdeen	Self
Alappuzha	Vazhicherry	Household	MK Manzil, Vazhicherry, Alappuzha	M K Sudheer	Self
Alappuzha	Vazhicherry	Household	Spot Villa, Vazhicherry, Alappuzha	David	Self
Alappuzha	Vazhicherry	Household	Thengummootiil, Vazhicherry, Alappuzha	Paul Chakko	Self
Alappuzha	Vazhicherry	Household	Bhagavathy Bhavanam, Vazhicherry, Alappuzha	Swami	Self

ULB	Ward	Category of Property	Address	Name	Designation
Alappuzha	Vazhicherry	Household	Irattappulikkal, Vazhicherry, Alappuzha	Joy Varghese	Self
Alappuzha	Vazhicherry	Household	Thaipparambil, Vazhicherry, Alappuzha	Antony Thomas	Self
Alappuzha	Vazhicherry	Household	Baithal Hafis, Vazhicherry, Alappuzha	Safarulla	Self
Alappuzha	Vazhicherry	Household	Palathinkal, Vazhicheri, Alappuzha	Nirmala Philip	Self
Alappuzha	Vazhicherry	Household	Kandathil veedu, Vazhicheri ward Alappuzha	Sharada	Self
Alappuzha	Vazhicherry	Household	Edathil, Vazhicherry, Alappuzha	Joshy	Self
Alappuzha	Vazhicherry	Household	Mendez villa, Vazhicherry, Alappuzha	Wilston Mendez	Self
Alappuzha	Vazhicherry	Household	Nidhi, Vazhicherry, Alappuzha	Vaman	Self
Alappuzha	Vazhicherry	Household	Chirayil, Vazhicheri, Alappuzha	Ratheesh	Self
Alappuzha	Vazhicherry	Household	Chirayil, Vazhicherry, Alappuzha	Surendran	Self
Alappuzha	Vazhicherry	Household	R Shankara iyer, Cullen Road, vazhicheri, Alappuzha	Shankara Iyer	Self
Alappuzha	Civilstation	Household	Kannittapparamb Civil Station Ward, Alappuzha	Iqbal	Self
Alappuzha	Civilstation	Household	KMK Villa, Civil Station ward, Alappuzha	K M Kabeer	Self
Alappuzha	Civilstation	Household	Darul Nazar, Civil Station, Alappuzha	Sayed	Self
Alappuzha	Civilstation	Household	Valuparambil House, Civil Station	Ajeeb	Self
Alappuzha	Civilstation	Household	Panakkad Housil, Civil Station ward, Alappuzha	Nazer	Self
Alappuzha	Civilstation	Household	Kannupparambil, Civil Station, Alappuzha	James	Self
Alappuzha	Civilstation	Household	Jari Manzil, Civil Station Ward, Alappuzha	Abubakkar	Self
Alappuzha	Civilstation	Household	Kadarparamb, Civil station Ward, Alappuzha	Sajitha beegam	Self
Alappuzha	Civilstation	Household	Kafarparamb , Civil station	Abdul Hafeez Khan	Self
Alappuzha	Civilstation	Household	Asalam, Civil Station Ward, Alappuzha	P A Asalam	Self
Alappuzha	Mullackal	Household	Syamal dadanam, church road, Alappuzha	Syamala	Self
Alappuzha	Mullackal	Educational	Anandapradayani Vayanashala mullackkal, Alappuzha	Jose Mathew	Proprietor / Owner
Alappuzha	Mullackal	Others	Matha Tourist Home, Boat Jetty Road, Iron Bridge, Alappuzha	Prasannan	Proprietor / Owner
Alappuzha	Mullackal	Restaurants / Hotels	Yuvaraj Hotel, Near KSRTC Bus station, Mullakkal	Anil Kumar	Employee / worker
Alappuzha	Mullackal	Others	KTC, West of KSRTC Bus Station, Mullakkal, Alappuzha	Thomas	Proprietor / Owner
Alappuzha	Vazhicherry	Others	Kerala State Coir Corporation P B no. 191, Vazhicherry Ward	Chako	Security / house keeping staff

ULB	Ward	Category of Property	Address	Name	Designation
Alappuzha	Vazhicherry	Others	Nandilath Godown CCNB Road, Vazhicherry	Mani	Employee / worker
Alappuzha	Mullackal	Restaurants / Hotels	Food Paradise,cullan road, Mullackkkal, Alappuzha	Sudeesh Kumar	Proprietor / Owner
Alappuzha	Civilstation	Educational	Govt TTI, near Civil Sation Alappuzha	D Pushpalatha	Employee / worker
Alappuzha	Civilstation	Educational	Govt Muhammadans HS Alappuzha	Kochurani William	Employee / worker
Alappuzha	Civilstation	Others	Kottaram Resort, Opposite Civil Station	Rajesh Kumar	Proprietor / Owner
Alappuzha	Civilstation	Educational	Civil Station Ward, Collectrate PO	Nazeera M	Employee / worker
Alappuzha	Civilstation	Government Offices	District Forms Store, Civil Station ward, bazar P.O, Alappuzha	Victor J D Joy	Employee / worker
Alappuzha	Civilstation	Others - Industry	Kanjoopparambil, Civil Station Ward Alappuzha	James Sakharaia	Proprietor / Owner
Alappuzha	Civilstation	Government Offices	Alappuzha south police station, Covil ststion ward, alappuzha	Jomon	Employee / worker
Alappuzha	Vazhicherry	Religious	Marthoma Church Alappuzha	Antony	Employee / worker
Alappuzha	Vazhicherry	Community Hall	Dr. Abraham Memmorial Community Hall, Lappuzha	Antony	Employee / worker
Alappuzha	Mullackal	Religious	Sri Selvi Vinayakar Kovil, Mullackkal, Alappuzha	Gopala Krishnan	Employee / worker
Alappuzha	Mullackal	Religious	Rajarajeswari Temple Mullackkal, Alappuzha	Raghavan	Employee / worker
Alappuzha	Mullackal	Community Hall	Karmel Hall Alappuzha, Opposite Mar sleeva Church, Alappuzha	Biju	Employee / worker
Aluva	Oomankuzhithadam	Stationery	Pulickaparampil House, Janatha road, Aluva, 683101	Moly	Employee / worker
Aluva	Oomankuzhithadam	Stationery	Biju stotes, Seenath junction, Aluva, 683101	Biju	Proprietor / Owner
Aluva	Oomankuzhithadam	Stationery	Babu stores, Seenath junction, Aluva, 683101	Babu	Proprietor / Owner
Aluva	Oomankuzhithadam	Stationery	K K stores, Seenath Junction, Aluva, 683101	Nisam	Proprietor / Owner
Aluva	Manglapuzha Seminary	Restaurants / Hotels	Mizaj Biriyani Mahal, Aluva, 683102	Abdulla	Proprietor / Owner
Aluva	Manglapuzha Seminary	Vegetable & Fruits Markets	Al saj bakery, Aluva, 683102	Riyas	Proprietor / Owner
Aluva	Desam Kadavu	Stationery	Punnoorkode house, Aluva, 683108	Muhammed Ramees	Proprietor / Owner
Aluva	Kadathukadavu	Other Commercial Stores	Kings Family Beauty Saloon, Bridge Road,	Babu	Employee / worker

ULB	Ward	Category of Property	Address	Name	Designation
			Aluva, 683101		
Aluva	Kadathukadavu	Other Commercial Stores	Mukkathu Automobiles, Aluva 683101	Velayudhan	Employee / worker
Aluva	Desam Kadavu	Other Commercial Stores	Asha Curtain Shop Aluva 683101	Suresh Kumar	Proprietor / Owner
Aluva	Kadathukadavu	Vegetable & Fruits Markets	Desi Cuppe Aluva 683101	Salhidheeen	Proprietor / Owner
Aluva	Kadathukadavu	Other Commercial Stores	Camry Systems Aluva 683101	Ajay	Employee / worker
Aluva	Kadathukadavu	Vegetable & Fruits Markets	Juicy shop Aluva 683101	Riya	Employee / worker
Aluva	Desam Kadavu	Other Commercial Stores	HDFC bank Aluva Bridge Road 683101	Shashi	Employee / worker
Aluva	Kadathukadavu	Other Commercial Stores	C C medicals Bridge Road Aluva 683101	Riyas	Employee / worker
Aluva	Kadathukadavu	Restaurants / Hotels	Sivas Fast food By pass junction Aluva 683101	Shivan	Proprietor / Owner
Aluva	Kadathukadavu	Vegetable & Fruits Markets	Buhari Special Juice, By pass Junction Aluva 683101	Rahim	Employee / worker
Aluva	Kadathukadavu	Other Commercial Stores	Akbar Travels Bypass Junction 683101	Ajeesh	Employee / worker
Aluva	Kadathukadavu	Other Commercial Stores	Chai Kada Aluva metro station 683101	Sheeja	Employee / worker
Aluva	Kadathukadavu	Vegetable & Fruits Markets	Fruit wagon Metro station Aluva 683101	Riyas	Employee / worker
Aluva	Kadathukadavu	Other Commercial Stores	By pass Junction Aluva 683101	Seena	Employee / worker
Aluva	Madhavapuram	Stationery	Sathar shop Aluva	Shaji	Proprietor / Owner
Aluva	Kadathukadavu	Other Commercial Stores	Smartech solutions Bypass road Aluva	Riyas	Employee / worker
Aluva	Kadathukadavu	Fancy Store	Mens park Bypass junction Aluva 683101	Rithu	Employee / worker
Aluva	Kadathukadavu	Other Commercial Stores	Bypass Junction Aluva 683101	Rajesh	Security / house keeping staff
Aluva	Kadathukadavu	Household	Bye pass road Kadathukadvu	Afsar	Self
Aluva	Kadathukadavu	Household	Kadathukadavu	Shameem	Self
Aluva	Oomankuzhithadam	Household	Kalakkashery Janatha road Aluva 683101	Dheepa	Self
Aluva	Oomankuzhithadam	Household	Priya line Seenath Junction 683101	Shiva Kumar	Self
Aluva	Oomankuzhithadam	Household	Geetha Bhavan Priya line Aluva 683101	Sarojini	Grand-Parents
Aluva	Oomankuzhithadam	Household	Pallikkattil house Priya line Aluva 683101	Sofiya	Spouse
Aluva	Oomankuzhithadam	Household	Koonamthettayil Priya line Aluva 683101	Sheela	Spouse
Aluva	Oomankuzhithadam	Household	Indhu Nivas Priya line Aluva 683101	Suma	Spouse
Aluva	Oomankuzhithad	Household	Kottakkal house Priya line Aluva 683101	Reena Jenson	Spouse

ULB	Ward	Category of Property	Address	Name	Designation
	am				
Aluva	Oomankuzhithadam	Household	Thalachirayil Janatha road Aluva 683101	Sree Hari	Son / Daughter
Aluva	Oomankuzhithadam	Household	Mammsrayillath house Janatha road Aluva 683101	Nasar	Self
Aluva	Oomankuzhithadam	Household	Kalluppurakkal house Janatha road Aluva 683101	Manjusha	Spouse
Aluva	Madhavapuram	Household	Ara77 Azzizi road Aluva 683101	Fathima	Spouse
Aluva	Madhavapuram	Household	Green house Azzezi stop Aluva 683101	Rasheeja	Spouse
Aluva	Madhavapuram	Household	Nedungadan House Azzesi road Aluva 683101	Johny	Self
Aluva	Madhavapuram	Household	Maveli house Azzezi line Aluva 683101	Jibi	Self
Aluva	Madhavapuram	Household	Koduvilaparambil Azzezi road Aluva 683101	Fijoy Joy	Self
Aluva	Madhavapuram	Household	AMC XVII/ 213 Azzezi road Aluva 683101	Usha	Self
Aluva	Madhavapuram	Household	Mattappalli House Azzeezi Line Aluva 683101	Shaji M P	Self
Aluva	Madhavapuram	Household	Oliyil House Vayanassala Kanal road Aluva 683101	Rekha Unni	Self
Aluva	Madhavapuram	Household	Mekkattu veed Azzezi road Aluva 683101	Girija Babu	Self
Aluva	Madhavapuram	Household	Ullanassery Azzezi road Aluva 683101	Radha	Self
Aluva	Madhavapuram	Household	Akshaya Shalom street Azzezi road Aluva 683101	Premarajan	Self
Aluva	Madhavapuram	Household	Palaparambil Azzeezi road Aluva 683101	Latha rajan	Self
Aluva	Manglapuzha Seminary	Household	Manakkal hous Aluva 683102	Geetha Gracen	Self
Aluva	Manglapuzha Seminary	Household	Vattaparambil Alimattam road Aluva 683102	Alby V P	Self
Aluva	Manglapuzha Seminary	Household	Alamuttathu house Aluva 683102	Rasheedha	Self
Aluva	Manglapuzha Seminary	Household	Alamuttathu House Aluva 683102	Shamja Shaji	Spouse
Aluva	Manglapuzha Seminary	Household	Pallathu House Alamuttathu road Aluva 683102	Ramlath	Spouse
Aluva	Manglapuzha Seminary	Household	Kodath House Alamattam road Uc college Po683102	Santhosh Babu	Self
Aluva	Desam Kadavu	Household	Velikkakathu House Makkar Manzil GCDA by line No 1 Karottakaadu 683108	Azad	Self

ULB	Ward	Category of Property	Address	Name	Designation
Aluva	Desam Kadavu	Household	Punnoorkode house GCDA road Thottakattukara Aluva 683108	Muhammed Farise	Son / Daughter
Aluva	Desam Kadavu	Household	Punnoorkoot house Aluva 683108	Sajana	Spouse
Aluva	Desam Kadavu	Household	Ambattu 87/GCDA colony Thottakattukara Aluva 683108	Primna	Spouse
Aluva	Desam Kadavu	Household	Thalakkau House GCDA Thottakattukara Aluva 683108	Jinsa	Spouse
Aluva	Desam Kadavu	Household	Allimangalathu GCDA road Aluva 683108	Anjana	Spouse
Aluva	Desam Kadavu	Household	113/ GCDA road Thottakattukara Aluva 683108	Jyothsana	Spouse
Aluva	Desam Kadavu	Household	Mangalappally Thoattukutti 12 Thottakattukara Aluva 683108	Abdul Kareem	Self
Aluva	Desam Kadavu	Household	Prashanthi GCDA road Aluva 683108	Anitha	Spouse
Aluva	Kadathukadavu	Household	10A Uni Homes, Uni Midtown Aluva 683101	Shaji	Self
Aluva	Kadathukadavu	Household	20B Brodge road Aluva 683101	Athul Krishna	Son / Daughter
Aluva	Desam Kadavu	Household	No 67 Mnzil Ahlan Va Sahlan 683108	Rukya	Spouse
Aluva	Desam Kadavu	Household	Kolangarakudi house Aluva 683108	Mohan	Other Relatives
Aluva	Desam Kadavu	Household	No 64 Puzhayoram	Sheela shankar	Spouse
Aluva	Desam Kadavu	Household	Plot no 61 Gcda road 683108	Sathar	Other Relatives
Aluva	Desam Kadavu	Household	Plot no 60 Gcda road Aluva 683108	Laila Jose	Spouse
Aluva	Desam Kadavu	Household	House No 59 GCDA road aluva 683108	Vimala George	Spouse
Aluva	Desam Kadavu	Household	Plot no 78 Aluva 683108	K J Antony	Self
Aluva	Kadathukadavu	Household	Pokkari Pallath Aluva 683108	Laiju	Spouse
Aluva	Desam Kadavu	Household	Pokkari Pallath Gcda road Aluva 683108	Sanal Kumar K	Self
Aluva	Oomankuzhithadam	Household	Janatha road Aluva	Ali	Self
Aluva	Oomankuzhithadam	Household	14/287/1 Janatha road	Abdul Hameed	Self
Aluva	Oomankuzhithadam	Household	Thadathil House Janatha road Aluva	Biju	Self
Aluva	Oomankuzhithadam	Household	Kavalanchary house Janatha road683101	Sheeba	Spouse
Aluva	Oomankuzhithadam	Household	Thaiparambil House Janatha Road Aluva	Omana	Spouse
Aluva	Madhavapuram	Household	plackal House Madhavapuram Aluva	Ramanan	Self

ULB	Ward	Category of Property	Address	Name	Designation
Aluva	Madhavapuram	Household	Karakkayathu veedu Aluva	Raju	Self
Aluva	Madhavapuram	Household	Raviz villla Aluva	Sheela Vijayan	Spouse
Aluva	Manglapuzha Seminary	Household	Puthishery House Aluva 683102	Moly Joseph	Spouse
Aluva	Manglapuzha Seminary	Household	Mambaraparambil House Aluva 683102	Aisha beevi	Spouse
Aluva	Manglapuzha Seminary	Household	Sreehari Mangalappuzha seminary Aluva	Umaibha	Spouse
Aluva	Madhavapuram	Household	Kuzhiveli Azzeezi road Aluva 683101	Any Babu	Self
Aluva	Manglapuzha Seminary	Household	35 Seminary road Aluva 683102	Anu roop	Son / Daughter
Aluva	Municipal Office	Community Hall	Namboori madam Paravoor kavala Uc college Aluva	Najeeb	Proprietor / Owner
Aluva	Madhavapuram	Educational	Azzizia anganavadi Madhavapuram 683101	Soudhamini	Employee / worker
Aluva	Manglapuzha Seminary	Educational	Thottakattukara Aluva 683108	Pushpa Joseph	Employee / worker
Aluva	Kadathukadavu	Others-Hospital/Clinic	Arogyalayam Aluva 683101	Satheesh	Employee / worker
Aluva	Kadathukadavu	Educational	Prudent Academy Bye Pass Road Bank Junction Aluva 683101	Jackson	Proprietor / Owner
Aluva	Kadathukadavu	Restaurants / Hotels	Cheng Chopsticks By pass junction Aluva 683101	Rithu	Employee / worker
Aluva	Kadathukadavu	Educational	A2Z English Academy By Pass Road Aluva 683101	Anto	Employee / worker
Aluva	Desam Kadavu	Others-Hospital/Clinic	Government Ayurvedha Hospital Aluva 683108	Sajana	Employee / worker
Aluva	Oomankuzhithadam	Educational	Janatha road Aluva 683101	Sridhevi	Employee / worker
Aluva	Kadathukadavu	Religious	Salafi mazjid Aluva	Shihab	Security / house keeping staff
Aluva	Manglapuzha Seminary	Religious	Mangalapuzha seminary Aluva 683102	Binu	Employee / worker
Aluva	Kadathukadavu	Restaurants / Hotels	By pass Junction Aluva 683101	Rasim	Employee / worker
Attingal	Town	Fancy Store	Sridevi Textile Kacheri Junction Town Attingal-695101	M.Babu	Proprietor / Owner
Attingal	Kochuvila	Household	Mini house Kuchivila Thootakadu post Attingal-695102	B.Susila	Spouse

ULB	Ward	Category of Property	Address	Name	Designation
Attingal	Kottiyode	Restaurants / Hotels	Anamthara River View Resort Attingal-695101	M.V.Kiran	Employee / worker
Attingal	Townhall	Others	Katchery Junction Main Road ,Attingal - 695101	Vishnu G. Ramachandran	Employee / worker
Attingal	Townhall	Other Commercial Stores	Siva Shankar`s Flower Mart Katchery Junction opposite Kalyan Silks Attingal-695101	B.Santhosh	Employee / worker
Attingal	Kacheri	Household	S.S. Building Near Amar Hospital KSRA Attingal-695101	S.Sankara Pilla	Self
Attingal	Kacheri	Household	Mangalya Flat No-2, Near Amar Hospital Kacheri Attigal-695101	S.Maya	Spouse
Attingal	Kacheri	Household	Mangalya Flat No-6, Near Amar Hospital Kacheri Attingal-695101	F.Shafana	Spouse
Attingal	Kacheri	Household	Mangalya Flat No-1, Near Amar Hospital Kacheri Attingal-695101	E. Thulasi	Spouse
Attingal	Kacheri	Household	Ambadi Near Amar Hospital Kacheri Attingal-696101	G.Pradeepa	Spouse
Attingal	Town	Vegetable & Fruits Markets	M.R. Fruits Opposite South Indian Bank Attingal--695101	E.Murugan	Proprietor / Owner
Attingal	Town	Restaurants / Hotels	Attingal Tourist Home Opposite Municipal Office Main Road Attingal-695101	Sudhakaran Nair.T	Employee / worker
Attingal	Town	Vegetable & Fruits Markets	Shaiju Fruits Opposite Municipality Main Road Attingal -695101	A.J. Mercy	Proprietor / Owner
Attingal	Town	Other Commercial Stores	Sudhir Tea shop Opposite Municipal Office Main Road Attingal-695101	D.Sudhir	Proprietor / Owner
Attingal	Town	Vegetable & Fruits Markets	Fruit shop Near Private Bus stand Town Attingal-695101	E.Chaerman	Employee / worker
Attingal	Town	Vegetable & Fruits Markets	M.J.A Vegetables Near KSRTC Bus stand Attingal-695101	J.Asgar	Proprietor / Owner
Attingal	Attakkulam	Household	No-532, Kaniyavilagam Attakulam Attingal-695101	M.R. Santhiya	Spouse
Attingal	Attakkulam	Household	No--18/368-1, Sriyam Parvathipuram Gramam Near Attakulam Attingal-695101	Bhaskara Pillai	Self
Attingal	Attakkulam	Household	Gopika PRA 60 Paravoorkonam Gramam Attingal-695101	Lithika Gopinathan	Self
Attingal	Attakkulam	Household	Foot No-6, Shemo Plaza Attakulam Attingal-695101	H.S Sri Hari	Son / Daughter

ULB	Ward	Category of Property	Address	Name	Designation
Attingal	Attakkulam	Household	Flot-5, Shemo Plaza Attakulam Attingal-695101	M.Asha	Spouse
Attingal	Palace	Others	Childrens Park Kollampuzha Attingal-695104	M.Saleem	Employee / worker
Attingal	Kacheri	Government Offices	Civil Station Kacheri Junction Attingal-965101	R.Padmini	Employee / worker
Attingal	Kacheri	Government Offices	Taluk Supply Office Katchery Junction Attingal-695101	S.Sajina	Employee / worker
Attingal	Kacheri	Government Offices	Employment Office Katchery Junction Attingal-695101	A.Navas	Employee / worker
Attingal	Kochuvila	Household	M.A.R House, Kochivila Alamcode Post Attingal-695102	S.Rasi	Son / Daughter
Attingal	Kochuvila	Household	M .P. M Mansion Kochivila Alamcode Post Attingal-695101	S.Naseela	Spouse
Attingal	Kacheri	Household	Siva Karunyam Virunthiyodu Kachri Attingal-695101	V.E. Sivaprasad	Self
Attingal	Kochuvila	Household	Siras Mansion Kuchivila Alamcode Attingal-695102	S.P Abdul Kadhar	Self
Attingal	Kochuvila	Household	Geethanjali, Kuchivila, Alamcode Post Attingal -695102	D. V .Ragul	Son / Daughter
Attingal	Kochuvila	Household	Parakattil house Kochivila Alamcode Aattingal-695102	M.Abdul Karim	Self
Attingal	Kochuvila	Household	Parakattil house Alamcode Post Attingal-695102	N.Bushra	Spouse
Attingal	Kacheri	Household	Sabari Near Amar Hospital Kacheri Attingal-695101	A. Jiji	Spouse
Attingal	Townhall	Fancy Store	AEB Ladies Steaching Centre Thulasi Complex Attingal-695101	J.Santhiya	Proprietor / Owner
Attingal	Town	Fancy Store	Neela Textiles Kacheri Junction Town Attingal-695101	S.Chitra	Proprietor / Owner
Attingal	Town	Fancy Store	Opposite Civil Station Mullasery Building Attingal--695101	D.Jophy	Employee / worker
Attingal	Town	Other Commercial Stores	Community Pharmacy Opposite Civil Station Kacheri Nada Attingal-695101	S.S. Sholaman	Employee / worker
Attingal	Town	Other Commercial Stores	Parkline Footwear Main Road Attingal-695101	G.Radhakrishnan	Proprietor / Owner
Attingal	Town	Other Commercial Stores	Opposite Mini Civil Station Kacheri Junction Attingal--695101	J.S.Biju	Proprietor / Owner

ULB	Ward	Category of Property	Address	Name	Designation
Attingal	Town	Fancy Store	Tampa Agencies opposite Treasury Attingal---695101	A.Aneesh	Employee / worker
Attingal	Town	Vegetable & Fruits Markets	G.S.K. Vegetables Attingal---695101	V.R.Anitha	Proprietor / Owner
Attingal	Town	Other Commercial Stores	Honey Backery Mullachery Complex Attingal--695101	V.Sunilkumar	Proprietor / Owner
Attingal	Seevelikonam	Community Hall	Ganga Auditorium Mamam Attingal--695101	Gnaga Auditorium	Employee / worker
Attingal	Town	Fancy Store	Dolphin Gift and Fancy Store near Private bus stand Attingal-695101	S.Sureshkumar	Proprietor / Owner
Attingal	Town	Meat Market	Arafa Halal Chicken Cutting Stall Near Market Town Attingal--695101	C.Sreenivasan Nair	Employee / worker
Attingal	Town	Meat Market	Vishnu Halal Chicken Attingal-695101	K.Jammal	Employee / worker
Attingal	Town	Provision	Neznas Near market Attakulam Attingal-695101	M.Nazerdeen	Proprietor / Owner
Attingal	Town	Other Commercial Stores	F.S Footwear Kacheri Junction Town Attingal-695101	R.Sudhir	Proprietor / Owner
Attingal	Town	Other Commercial Stores	Opposite Treasury Attingal--695101	R.Pradeep	Proprietor / Owner
Attingal	Town	Fancy Store	Mrs.Kerala Opposite Treasury Attingal---695101	V.S.Bindhu	Employee / worker
Attingal	Town	Fancy Store	Universal Towers Main Road Attingal-695101	L.B. Lima	Employee / worker
Attingal	Attakkulam	Household	Kailasam Bhavan Parvathipuram Gramam Attingal-695101	B.Matheswaran Pilla	Self
Attingal	Town	Other Commercial Stores	VGP Electricals Main Road Attingal--695101	R.Anup	Proprietor / Owner
Attingal	Kochuvila	Household	A.J Nivas Kuchivila Alamcode-695102	S.Anusri	Spouse
Attingal	Townhall	Restaurants / Hotels	Thulasi Hotel, Thulasi Complex Kacheri Junction Attingal--695101	S.Arun	Proprietor / Owner
Attingal	Townhall	Others	Vishnu Program Agency Thulasi Complex Attingal-695101	B.Vijayakumar	Proprietor / Owner
Attingal	Karichiyil	Household	Velaiyil Veedu Karichil Attingal	D.Rajan	Self
Attingal	Karichiyil	Household	No-271,Chariulanputhan Veedu Cherimanurkonam Attingal-695101	P.K.Mallika	Spouse
Attingal	Karichiyil	Household	No-427,Chariulanputhan Veedu Karichil Attingal-695101	S.Shrija	Spouse
Attingal	Karichiyil	Household	Kilathil Veedu Cherumannur Karichil Attingal-695101	V.S.Vini	Spouse
Attingal	Karichiyil	Household	No-243,Ganagalayam Karichil Attingal-695101	C.Savithiri	Spouse

ULB	Ward	Category of Property	Address	Name	Designation
Attingal	Karichiyil	Household	No-244,Kunnal Veedu Karichil Attingal-695101	C.Sukumari	Spouse
Attingal	Karichiyil	Household	No-245,Kunnal Veedu Karichil Attingal-695101	T.Thangamani	Spouse
Attingal	Karichiyil	Household	No-294, Uses Thumbikottukonam Karichil Attingal-695101	P.Usha Devi	Self
Attingal	Karichiyil	Household	No-293, Vilaiyil Veedu Karichil Attingal-695101	D.Vaisala	Spouse
Attingal	Karichiyil	Household	No-290,Panan Vila Veedu Karichil Attingal-695101	A.Rema	Spouse
Attingal	Avanavancheri	Educational	GLPS Paravoorkonam Avanavanchery post Attingal-695103	R.J.Rejitha	Employee / worker
Attingal	Karichiyil	Educational	Government HS Avanavanchery post Attingal-695103	G.L. Nimi	Employee / worker
Attingal	Avanavancheri	Educational	Government HS Primary School Avanavanchery Attingal -695103	R.M Seenath	Employee / worker
Attingal	Valiyakunnu	Household	No-252, Chariulanputhan Veedu Valliyakunnu Kizhuvilam Post Attingal-695104	G.Leela	Self
Attingal	Valiyakunnu	Household	No-248,Usha Bhavan Valliyakunnu Attingal-695104	C.Chellamma	Parents
Attingal	Valiyakunnu	Household	No-254, Chariulanputhan Veedu Kizhuvilam Post Valliyakunnu Attingal-695104	R.Neethu	Spouse
Attingal	Valiyakunnu	Household	No-214, Rohini Kizhuvilam Valliyakunnu Attingal-695104	J.Srikandan	Self
Attingal	Valiyakunnu	Household	No-242,Madhava Vilasam Kizhuvilam Post Valliyakunnu Attingal-695104	M.Ragul	Son / Daughter
Attingal	Valiyakunnu	Household	No-206, Chariulanputhan Veedu Kizhuvilam Post Valliyakunnu Attingal-695014	T.S. Meena	Spouse
Attingal	Valiyakunnu	Household	No-209, Tiruvonam Sreevelikonam Valliyakunnu Attingal-695104	V.Gopala Krishnan	Self
Attingal	Valiyakunnu	Household	No-216, Chariulanputhan Veedu Sreevelikonam Mamam Valliyakunnu Attingal-695104	R.Vijayamma	Parents
Attingal	Valiyakunnu	Household	No-208, Cherivilaputhan Veedu Sreevelikonam Valliyakunnu Attingal-695104	D.Vimala	Spouse
Attingal	Valiyakunnu	Household	No-87,S.J Bhavan Valliyakunnu Attingal-695104	K.Soman	Self
Attingal	Valiyakunnu	Household	No-79, Sunu Mandiram Kizhuvilam Post	K.S.Sunu	Spouse

ULB	Ward	Category of Property	Address	Name	Designation
			Valliyakunnu Attingal-695104		
Attingal	Valiyakunnu	Household	No-80, Cherivilaputhan Veedu Kizhuvilam Post Valliyakunnu Attingal-695104	M.Sindhu	Spouse
Attingal	Valiyakunnu	Household	No-83, Chariulanputhan Veedu Kizhuvilam Valliyakunnu Attingal-695104	M.Abish Mohan	Self
Attingal	Valiyakunnu	Household	No-82, Cherivilaputhan Veedu Kizhuvilam Post Valliyakunnu Attingal-695104	M.Akesh Mohan	Son / Daughter
Attingal	Valiyakunnu	Household	No--261, Chariulanputhan Veedu Kizhuvilam Post Valliyakunnu Attingal-695104	S.Sujitha	Spouse
Attingal	Seevelikonam	Others	Ganga Cini House Mamom Attingal-695101	M.K. Dilip	Employee / worker
Attingal	Seevelikonam	Community Hall	Sun Auditorium Munumukku Attingal-695101	J.Usha	Employee / worker
Attingal	Seevelikonam	Others	Pooja Convention Centre Mamam Attingal-695104	N.Sajina	Employee / worker
Attingal	Seevelikonam	Others	Dreams Theatre Mamom Attingal-695104	S.Neeraj	Proprietor / Owner
Attingal	Town	Restaurants / Hotels	Hotel Aramam Shams Complex Attingal-695101	S.Santhoshkumar	Proprietor / Owner
Attingal	Town	Other Commercial Stores	Boots & Boots S.S. Plaza Town Attingal-695101	S.Naseem	Employee / worker
Attingal	Town	Malls	M.A and Sons Badabazar Near KSRTC bus stand Attingal-695101	Mohamed Azharudein	Employee / worker
Attingal	Town	Others	Dr, Moly Memorial Trust (VV Clinic) Attingal-695101	V.Vijayakumari	Employee / worker
Attingal	Town	Household	No-696, Aswathy Near VV Clinic Attingal-695101	G.Thangamani	Parents
Attingal	Town	Household	No-694, Salina Near VV Clinic Attingal-695101	T.Vijayakumari	Parents
Attingal	Town	Household	No-17/226, Moly Villa Attingal-695101	M.Veena	Spouse
Attingal	Town	Household	No-657, Aadharsh Villa Near VV Clinic Attingal-695101	S.Indhukala	Spouse
Attingal	Town	Household	No-652, Thiruvathira Near VV Clinic Attingal-695101	M.S Jeni	Spouse
Attingal	Town	Others	Modern Dental Clinic VV Clinic Road College junction Attingal-695101	A.R.Babu Raj	Employee / worker
Attingal	Town	Provision	Kerala Ships Attingal---695101	M.Abdulsala	Employee / worker
Attingal	Town	Stationery	United Stationary Main Road Attingal-695101	A.K.Philaming	Employee / worker

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Attingal	Town	Other Commercial Stores	Light House KMS Complex Main Road Attingal-695101	K.Hariprasad	Proprietor / Owner
Attingal	Town	Others	IInd Floor Universal Tower Attingal-695101	R.Narayana Kutty	Proprietor / Owner
Feroke	Petta South	Fish Market	15/743, Haque fish merchant, petta, feroke, beypur circle, Kozhikode, 673631	Moosa Koya	Employee / worker
Feroke	Petta South	Vegetable & Fruits Markets	Petta, feroke, Kozhikode, 673631	Yoonas	Proprietor / Owner
Feroke	Petta South	Stationery	M.K store, petta, feroke, Kozhikode, 673631	M.K Abdutty	Proprietor / Owner
Feroke	Petta North	Meat Market	Adil beef stall, petta, feroke	Salaam	Proprietor / Owner
Feroke	Petta North	Vegetable & Fruits Markets	Armandin vegetables, petta, Kozhikode, 673632	Subair	Employee / worker
Feroke	Petta North	Other Commercial Stores	Mobile solution, petta, feroke,673632	Jishan	Employee / worker
Feroke	Petta North	Other Commercial Stores	Hot chips backery, petta,kozhikode	Sidiq	Proprietor / Owner
Feroke	Petta North	Meat Market	Armandin beef stall, petta, feroke, 673632	Armandin	Proprietor / Owner
Feroke	Petta North	Stationery	M.R store, petta, feroke	Marakkar	Proprietor / Owner
Feroke	Chandakadavu	Other Commercial Stores	HP , chandakadavu, 673631	Ganesh	Employee / worker
Feroke	Chandakadavu	Other Commercial Stores	C.A motors, Chandakadavu, Calicut, 673631	Suresh	Employee / worker
Feroke	Chandakadavu	Vegetable & Fruits Markets	Chandakadavu, feroke, calicut,673631	Arun	Proprietor / Owner
Feroke	Feroke Town	Other Commercial Stores	Western pharmacy, feroke town, calicut, 673631	Salaam	Employee / worker
Feroke	Feroke Town	Other Commercial Stores	Karuna footwear, feroke town,calicut	Saime	Employee / worker
Feroke	Feroke Town	Other Commercial Stores	Lavanya textiles,feroke, Kozhikode	Mubeen	Employee / worker
Feroke	Feroke Town	Fancy Store	Aayishas fancy and gift house, feroke,calicut	Shuhaib	Proprietor / Owner
Feroke	Feroke Town	Other Commercial Stores	Preethi hypermarket, feroke, Calicut,673631	Saina	Employee / worker
Feroke	Feroke Town	Other Commercial Stores	Chinju hair styles, feroke town, Calicut	Gunasekhaaraan	Proprietor / Owner
Feroke	Feroke Town	Other Commercial Stores	Cosmos studio, feroke, Kozhikode	Sivan	Proprietor / Owner
Feroke	Feroke Town	Other Commercial Stores	Door no. 4/481, 2nd floor, sedeer arcade, feroke, p.o. 673631, Kozhikode	Farook	Proprietor / Owner
Feroke	Feroke Town	Other Commercial Stores	Pranavam silks,feroke, 673631, Kozhikode	Sreejith	Employee / worker
Feroke	Feroke Town	Other Commercial Stores	Sona backery, feroke town, 673631, kozhikode	Gireesh	Proprietor / Owner
Feroke	Feroke Town	Other Commercial Stores	Royal bake house,main road, feroke, 673631	Shakeer	Employee / worker
Feroke	Chandakadavu	Stationery	Naseeb stores, Chandakadavu, Calicut	Abu	Proprietor / Owner
Feroke	Chandakadavu	Restaurants / Hotels	Nachoos hot & cool, chandakadavu, Calicut	Niyas	Proprietor / Owner
Feroke	Chandakadavu	Stationery	PC stores, chandakadavu, Calicut	Faisal	Employee / worker
Feroke	Chandakadavu	Other Commercial Stores	Iritty timbers and furnitures , chandakadavu, calicut	Aneefa	Employee / worker

ULB	Ward	Category of Property	Address	Name	Designation
Feroke	Chandakadavu	Stationery	C.v store, chandakadavu, Calicut	Jabir	Proprietor / Owner
Feroke	Chandakadavu	Stationery	KM stores, chandakadavu, Calicut	Mohammed Basheer	Proprietor / Owner
Feroke	Chandakadavu	Provision	Milma booth, chandakadavu, Calicut	Khader	Proprietor / Owner
Feroke	Chandakadavu	Other Commercial Stores	Kannu`s photostat, chandakadavu, Calicut	Nisha	Proprietor / Owner
Feroke	Petta South	Other Commercial Stores	Sky non woven bags, petta, Calicut	Shahul Hameed	Proprietor / Owner
Feroke	Petta North	Household	Isahakintakath house, petta North, Kozhikode	Kunhalikutti E.K	Self
Feroke	Petta North	Household	Machilakath house, petta north	Muhammed Shafi	Self
Feroke	Chandakadavu	Household	Chandakadavu, feroke p.o, 673631, calicut	P K Kammu	Self
Feroke	Chandakadavu	Household	Kozhippally house, chandakadavu, calicut	Mustafa	Self
Feroke	Chandakadavu	Household	Al Noor, chandakadavu, feroke, Calicut	Muhammed Sulfeeqer	Self
Feroke	Chandakadavu	Household	Kalathingal house, chandakadavu, Calicut	Jiffry	Self
Feroke	Chandakadavu	Household	Pandikkashala house, chandakadavu, Calicut	Kamnavas	Self
Feroke	Chandakadavu	Household	Kalathingal house, chandakadavu, Calicut	Ismail	Self
Feroke	Chandakadavu	Household	Sadique Bhavan, chandakadavu, Calicut	Sadique V	Self
Feroke	Chandakadavu	Household	Mangatt house, chandakadavu, Calicut	Mohammed Ismail K.V	Self
Feroke	Chandakadavu	Household	Kuttiyil house, chandakadavu, Calicut	Moosa M	Self
Feroke	Chandakadavu	Household	Kakkattu house, chandakadavu, Calicut	Saithalavi	Self
Feroke	Chandakadavu	Household	Cheruvarancheri parambu, chandakadavu, Calicut	Kunjalikutti K	Self
Feroke	Chandakadavu	Household	Maliyekkal house, chandakadavu, Calicut	Muhammed Kutty	Self
Feroke	Chandakadavu	Household	Thayyil house, chandakadavu, Calicut	Koya T	Self
Feroke	Chandakadavu	Household	Erinhikkal house, chandakadavu, Calicut	Abdul Aziz	Self
Feroke	Chandakadavu	Household	Karukulangara house, chandakadavu, Calicut	Sudha	Self
Feroke	Feroke Town	Household	Chemmanattil house, feroke, Calicut	Manasi	Self
Feroke	Feroke Town	Household	Psk apartment, feroke, Calicut	Shahid	Son / Daughter
Feroke	Feroke Town	Household	Psk apartment, feroke, 673631, Calicut	Ranjith	Self
Feroke	Petta South	Household	Padikkaveettil house, petta, Calicut	Shafeeque K P	Self
Feroke	Petta North	Household	Palliyalil house, petta, Calicut	Rasheed P.C	Self
Feroke	Petta North	Household	Palliyalil house, petta, Calicut	Seijal P C	Self
Feroke	Petta North	Household	Palliyalil house, petta, Calicut	Nefeesa	Self
Feroke	Petta North	Household	Kalathingal house, petta, Calicut	Riyas	Self
Feroke	Petta North	Household	Avittathil house, petta, Calicut	Abdul Azeez	Self
Feroke	Petta North	Household	Vailatt house, petta, calicut, 673631	Ahammed	Self
Feroke	Petta North	Household	Zenith house, petta, Calicut	K Muhammed Layik	Self

ULB	Ward	Category of Property	Address	Name	Designation
Feroke	Petta North	Household	Palliyalil house, petta North, Calicut	Mahsoom P	Self
Feroke	Petta South	Household	Parekkatt house, petta, Calicut	Fathima	Son-in-law / Daughter-in-law
Feroke	Petta South	Household	Parakkatte house, petta, calicut	Mohammed Sekeer P	Self
Feroke	Petta South	Household	Chaliyil house, petta south, Calicut	Sekeena	Self
Feroke	Petta North	Household	Maliyekkal house, petta , Calicut	Mohammed Latheef	Self
Feroke	Petta North	Household	Shahla nivas, petta, calicut	Ithalu K	Self
Feroke	Petta North	Household	Nivas manzil, petta, calicut	Hassan Kutty	Self
Feroke	Petta South	Household	Valiyaparamb,petta, Calicut	Abdul Gafoor	Self
Feroke	Petta North	Household	Valiya paramb, petta, calicut	Ayisha Beevi	Self
Feroke	Petta South	Household	Veliyaparamb house, petta, Calicut	Jameela	Self
Feroke	Petta South	Household	Kulathil house, petta,calicut	Khadeeja	Self
Feroke	Feroke Town	Household	Psk apartments, feroke town, Calicut	Malika	Self
Feroke	Feroke Town	Household	PSK apartments, feroke town, calicut, pin. 673631	Sreedevi	Self
Feroke	Feroke Town	Household	PSK apartments, feroke town, Calicut	Sreejesh	Self
Feroke	Feroke Town	Household	Paikuttiyil house, feroke town, Calicut	Praveen	Self
Feroke	Feroke Town	Household	Kadambil house, feroke town, calicut	Riyas	Self
Feroke	Feroke Town	Household	KM house, feroke town, Calicut	Ahammed	Self
Feroke	Feroke Town	Household	Padannakkott house, feroke town, Calicut	Muhammed	Self
Feroke	Feroke Town	Household	Parengal house, feroke town, Calicut	Beeran	Self
Feroke	Feroke Town	Household	Sreejilla house, feroke town, Calicut	Sreedharan	Self
Feroke	Feroke Town	Household	Hira house, feroke, calicut	Abdul Saleem	Self
Feroke	Feroke Town	Household	Kaduvakkulam house, feroke, Calicut	Musthafa	Self
Feroke	Feroke Town	Household	Thekkedath house, feroke town, Calicut	Sunil Kumar	Self
Feroke	Feroke Town	Other Commercial Stores	Century hotel, 5/536, feroke p.o, beypore circle, Kozhikode-673631	Subair	Proprietor / Owner
Feroke	Chandakadavu	Others - Industry	T.K wood industry, chandakadavu,673631	Shahul Hameed	Proprietor / Owner
Feroke	Feroke Town	Restaurants / Hotels	Chaliyar hotel, feroke, Kozhikode, kerala	Nasar	Employee / worker
Feroke	Feroke Town	Others	Nazah medical centre, feroke town, Kozhikode	Dr Fibin Thanvir	Employee / worker
Feroke	Chandakadavu	Restaurants / Hotels	Kadavu hotel, chandakadavu, calicut	Baby	Employee / worker
Feroke	Chandakadavu	Government Offices	Govt taluk hospital, chandakadavu, Calicut	Superintendent- Dr. Lalu	Employee / worker
Feroke	Chandakadavu	Educational	Kid`s own Pre school (English medium) gmup school, chandakadavu, feroke, calicut	Rameshan	Proprietor / Owner
Feroke	Chandakadavu	Government Offices	Chandakadavu, feroke, Calicut	Ramesh Babu	Employee / worker

ULB	Ward	Category of Property	Address	Name	Designation
Feroke	Chandakadavu	Others-Lab	Baba laboratory, chandakadavu, Calicut	Jamsheep P	Proprietor / Owner
Feroke	Chandakadavu	Religious	S30/82, chandakadavu, Calicut	Surendran	Employee / worker
Feroke	Chandakadavu	Others	Life medicals, chandakadavu, calicut	Niyas	Proprietor / Owner
Feroke	Chandakadavu	Restaurants / Hotels	Janakiyam mess, chandakkadavu, calicut	Gireesh Babu	Proprietor / Owner
Feroke	Chandakadavu	Government Offices	Ration store, chandakadavu, calicut	V Mansoor	Proprietor / Owner
Feroke	Petta South	Others	Medicare polyclinic, petta, feroke, Calicut	Siraj	Proprietor / Owner
Feroke	Petta North	Educational	Winston LP school, petta, Calicut	Fathima Moidheen	Proprietor / Owner
Feroke	Petta South	Educational	Autism centre, petta house, Calicut	Safa	Employee / worker
Feroke	Petta South	Government Offices	Sub registrar, sub registrar office, petta, feroke, Calicut	N.M Jayarajan	Employee / worker
Feroke	Feroke Town	Government Offices	Mukhya post office, feroke, Calicut, pin.673631	Prakash	Employee / worker
Guruvavoor	Gurupavanapuri	Household	Rohini house, krishna nagar, guruvayur po.	Narayanan nair	Self
Guruvavoor	Gurupavanapuri	Household	Narayana kripa ho, krishna nagar	Sibi haridas	Spouse
Guruvavoor	Gurupavanapuri	Household	Kalindi house, krishna nagar, guruvayur po.	Vk kunchu	Self
Guruvavoor	Gurupavanapuri	Household	Pathmaragam house, krishna nagar	Divakaran	Self
Guruvavoor	Gurupavanapuri	Household	Vaishnavam house, krishna nagar, guruvayur	Soman	Self
Guruvavoor	Gurupavanapuri	Household	Edavana house, guruvayur	Sheela	Spouse
Guruvavoor	Gurupavanapuri	Other Commercial Stores	Outer ring road	Mohanan	Proprietor / Owner
Guruvavoor	Gurupavanapuri	Fancy Store	Vadakkenada. Guruvayur	Jayan	Employee / worker
Guruvavoor	Gurupavanapuri	Other Commercial Stores	Vadakkenada, guruvayur	Chandra sekharan	Proprietor / Owner
Guruvavoor	Gurupavanapuri	Stationery	Vadakkenada . Guruvayur	Anil	Employee / worker
Guruvavoor	Gurupavanapuri	Other Commercial Stores	North inner ring road. Akshaya building. Guruvayur	Jithin	Employee / worker
Guruvavoor	Gurupavanapuri	Others	Veeramani building . Inner ring road vadakkenada.	Rameesha	Employee / worker
Guruvavoor	Gurupavanapuri	Stationery	Vadakkenada , guruvayur po	Paramesworan nari	Employee / worker
Guruvavoor	Gurupavanapuri	Household	Panthayi ho, guruvayur po	Shibu	Self
Guruvavoor	Gurupavanapuri	Household	Pulikkathara house, panthayi. Guruvayur po	Stella	Self
Guruvavoor	Gurupavanapuri	Stationery	Vadakkenada. Guruvayur po	Anitha	Employee / worker
Guruvavoor	Gurupavanapuri	Fancy Store	Manjira road vadakke nada guruvayur po	Muraleedharan	Employee / worker
Guruvavoor	Gurupavanapuri	Stationery	Vadakkenada Guruvayoor po	Dhevika	Proprietor / Owner
Guruvavoor	Gurupavanapuri	Other Commercial Stores	Vadakkenada, guruvayur	Rajan	Proprietor / Owner
Guruvavoor	Gurupavanapuri	Stationery	Vadakkenada guruvayur	Rajan	Employee / worker
Guruvavoor	Gurupavanapuri	Restaurants / Hotels	Inner ring road .kizhakkenada	Mohanan	Proprietor / Owner
Guruvavoor	Chakkumkandam	Household	Ambalathinkal house, mamabazar,	Sivan	Self

ULB	Ward	Category of Property	Address	Name	Designation
			chakkamkandam po.		
Guruvavoor	Chakkumkandam	Household	Valiyedath house, mamabazar, chakkamkandam po.	Aishabi	Spouse
Guruvavoor	Chakkumkandam	Household	Valamambath ho,chakkamkandam po.	Suni	Spouse
Guruvavoor	Chakkumkandam	Household	Karuthedath house, chakkamkandam po.	Vijayan	Self
Guruvavoor	Chakkumkandam	Household	Valiyakath house,chakkamkandam po.	Nahas	Self
Guruvavoor	Chakkumkandam	Others	Kayalkadavu. chakkamkandam po.	Shereef	Proprietor / Owner
Guruvavoor	Chakkumkandam	Household	Eracham veettil ho,chakkamkandam po.	Aaminu	Self
Guruvavoor	Chakkumkandam	Household	Peyam veedu ho, chakkamkandam po.	Selvam	Spouse
Guruvavoor	Chakkumkandam	Household	Puthuveetti ho,chakkamkandam po.	Badusha	Self
Guruvavoor	Chakkumkandam	Household	Karpam veettil house. Chakkamkandam	Noushad	Self
Guruvavoor	Chakkumkandam	Household	Ambalath veettil pukikkal, po	Faizal	Self
Guruvavoor	Gurupavanapuri	Stationery	Outer ring road , vadakkenada, guruvayur	Shaiju	Proprietor / Owner
Guruvavoor	Gurupavanapuri	Other Commercial Stores	Kairali junction, guruvayur	Joshi	Proprietor / Owner
Guruvavoor	Chakkumkandam	Household	Ambalathinkal house chankum kandam po mama bazar	Chandran	Son / Daughter
Guruvavoor	Chakkumkandam	Household	Koonampurath house chakkumkandam po	Ramakrishnan	Son / Daughter
Guruvavoor	Chakkumkandam	Household	Valiyakath panakkal chakkumkandam po	Shareef	Son / Daughter
Guruvavoor	Chakkumkandam	Household	Theruvath house Chakkumkandam po	Airunnisa	Self
Guruvavoor	Chakkumkandam	Household	Ambalathu veetil pulikkal Chakkumkandam po	Shajahan	Self
Guruvavoor	Chakkumkandam	Household	Pothuveetil chakkamkandam po	Noushad	Self
Guruvavoor	Chakkumkandam	Household	Kannunayikkal chakkumkandam po	Jose	Self
Guruvavoor	Chakkumkandam	Household	Pothuveetil karakkad house	Aashiq	Self
Guruvavoor	Chakkumkandam	Household	Karakatil hosue Chakkamkandam	Ashokan	Self
Guruvavoor	Chakkumkandam	Household	Chittamburath chakkumkandam po	Rajan	Self
Guruvavoor	Gurupavanapuri	Fancy Store	Kairali Junction guruvayur	Priya ragesh	Proprietor / Owner
Guruvavoor	Gurupavanapuri	Fancy Store	Kousthubam buliding road Gurupavanapuri	Sandhosh	Employee / worker
Guruvavoor	Gurupavanapuri	Fancy Store	East nada, guruvayur po	Sujith	Employee / worker
Guruvavoor	Gurupavanapuri	Vegetable & Fruits Markets	East nada, guruvayur po	Shahul	Proprietor / Owner
Guruvavoor	Highschool	Household	Hariprasadam ho ,west nada guruvayur	Sobha	Spouse
Guruvavoor	Highschool	Household	Sreepadam ho, west nada	Sheeba	Spouse
Guruvavoor	Highschool	Household	Vijaya nivas west nada	Vijayalakshmi	Self

ULB	Ward	Category of Property	Address	Name	Designation
Guruvavoor	Highschool	Household	Noopuram house, west nada guruvayur	Govind das	Self
Guruvavoor	Highschool	Household	Sreegovindham ho mallissery paramb west nada Guruvayoor	Mohana krishnan	Self
Guruvavoor	Highschool	Household	Karippurath house West nada Guruvayoor po	Narayanankutty	Spouse
Guruvavoor	Highschool	Household	Geetha nivas West nada Guruvayur	Saraswathi amma	Self
Guruvavoor	Highschool	Household	Rohith nivas, kalpaka street, west nada	K. Valsalan	Self
Guruvavoor	Highschool	Household	Kovilakm apartment west nada	Valsala	Self
Guruvavoor	Highschool	Household	Kovilakam apartment	Venu gopal	Self
Guruvavoor	Highschool	Household	Narayaneeyam , 1209	Sobha	Self
Guruvavoor	Highschool	Household	Sreepathmam, westnada	Pathmakumar	Self
Guruvavoor	Highschool	Household	Sreepsthmam gardens	Ravi	Self
Guruvavoor	Highschool	Household	Sreepsthmam apartments, s3	Anu r nair	Self
Guruvavoor	Highschool	Household	Sreepathmam apartments f9	Prasanna sreekumar	Self
Guruvavoor	Gurupavanapuri	Household	Achyutha apartment A9 south nada guruvayur	Ambika	Self
Guruvavoor	Gurupavanapuri	Household	Achyutha apartment A4 south nada guruvayur	John	Self
Guruvavoor	Gurupavanapuri	Household	Achyutha apartment A19 south nada guruvayur	Saradha nair	Self
Guruvavoor	Gurupavanapuri	Household	Achyutha apartment B1 south nada guruvayur	Chandrika	Self
Guruvavoor	Gurupavanapuri	Household	Achyutha apartment b7 south nada guruvayur	Achutha menon	Self
Guruvavoor	Gurupavanapuri	Household	Achyutha apartment c2 south nada guruvayur	Krishna	Self
Guruvavoor	Thaikkad	Government Offices	Village office Thaikkad	Rose	Proprietor / Owner
Guruvavoor	Thaikkad	Government Offices	110 kv station Thaikkad Guruvayur	Mena chandran	Employee / worker
Guruvavoor	Thaikkad	Restaurants / Hotels	KSBC thaikkad chuvallor padi	Rajeesh nair	Proprietor / Owner
Guruvavoor	Thaikkad	Educational	Appu memorial hss Thaikkad po	Sathee devi	Proprietor / Owner
Guruvavoor	Thaikkad	Educational	St Theresa`s ghs Thaikkad po	Sister Lcpa	Proprietor / Owner
Guruvavoor	Thaikkad	Others	Ayurvedha Government hospital thaikkad po	Dr mahaligeswara bhatt	Proprietor / Owner
Guruvavoor	Thaikkad	Government Offices	Agricultural office Nenmini po Thaikkad	Sanoj	Employee / worker
Guruvavoor	Thaikkad	Others	veterinary hospital Thaikad po Guruvayur	Amrita susan	Proprietor / Owner
Guruvavoor	Thaikkad	Community Hall	Community Chittattukara po	Kunjimuhammed	Proprietor / Owner
Guruvavoor	Thaikkad	Religious	Thiruvenkitachalapathi temple Thiruvenkidam Guruvayur po	Manger Raghavan nair	Proprietor / Owner
Guruvavoor	Thaikkad	Others	Dental hospital Neelankavil tower Thaikad po	Bastian warkey	Proprietor / Owner
Guruvavoor	Thaikkad	Community Hall	Thandanassery Thaikkad po Guruvayur	Abdul raheem	Proprietor / Owner
Guruvavoor	Gurupavanapuri	Household	Marangattumana , sudharma , guruvayur	Ms namboothiri	Self

ULB	Ward	Category of Property	Address	Name	Designation
Guruvavoor	Highschool	Religious	Mallissery parambu Highschool Guruvayur	Sreekumar	Employee / worker
Guruvavoor	Gurupavanapuri	Restaurants / Hotels	East nada guruvayur	Dileep	Employee / worker
Guruvavoor	Gurupavanapuri	Restaurants / Hotels	Inner ring road east nada guruvayur	Reji	Proprietor / Owner
Guruvavoor	Gurupavanapuri	Restaurants / Hotels	East nada guruvayur	Jyothish	Employee / worker
Guruvavoor	Gurupavanapuri	Others	South nada guruvayur	Suresh	Employee / worker
Guruvavoor	Thaikkad	Others	West nada guruvayur	Sunil	Employee / worker
Guruvavoor	Kotta North	Others	Kotta north guruvayur	Edward	Proprietor / Owner
Guruvavoor	Substation	Vegetable & Fruits Markets	Substation	Bindhu	Employee / worker
Guruvavoor	Gurupavanapuri	Other Commercial Stores	Near municipality guruvayur	Bahuleyan	Employee / worker
Guruvavoor	Substation	Fancy Store	Near substation , thaikkad	Abdul razaq	Employee / worker
Guruvavoor	Substation	Other Commercial Stores	Near substation, thaikkad	Viswombaran	Proprietor / Owner
Guruvavoor	Substation	Other Commercial Stores	Near substation, thaikkad	Santhosh	Employee / worker
Guruvavoor	Substation	Meat Market	Chollurpadi	Nishad	Proprietor / Owner
Guruvavoor	Substation	Fish Market	Chollurpadi, thaikkad	Shihab	Proprietor / Owner
Guruvavoor	Substation	Fancy Store	Chollurpadi thaikkad	Favas	Employee / worker
Guruvavoor	Gurupavanapuri	Restaurants / Hotels	Food tazza Guruvayur po	Nazeer	Proprietor / Owner
Guruvavoor	Gurupavanapuri	Other Commercial Stores	East nada Guruvayur	Akram	Employee / worker
Guruvavoor	Gurupavanapuri	Other Commercial Stores	East nada, guruvayur	Subha	Employee / worker
Guruvavoor	Gurupavanapuri	Restaurants / Hotels	East nada, guruvayur	Shanmukhan	Employee / worker
Guruvavoor	Gurupavanapuri	Other Commercial Stores	East nada guruvayur	Raju	Employee / worker
Kalpetta	Emily Thadam	Household	Mundode house Kalpetta post Emily thadam	Aasiya	Spouse
Kalpetta	Emily	Vegetable & Fruits Markets	Emily Kalpetta	Abdhulla	Proprietor / Owner
Kalpetta	Maniangode	Household	Parakundil House, Nedunilam, kalpetta	Abeesh B	Self
Kalpetta	Nedungode	Household	Shruthilayam, Maniyangode, Nedumgode, Kalpetta	Abhijith	Parents
Kalpetta	Municipal Office	Other Commercial Stores	Near Municipality, Kalpetta	Ajeesh	Employee / worker
Kalpetta	Nedungode	Household	Pottithodu House, Munderi	Ajith	Parents
Kalpetta	Emily Thadam	Other Commercial Stores	Emily, Kalpetta	Amaljith M N	Employee / worker
Kalpetta	Nedungode	Household	Shreyas House, Nedumgod, Kalpetta	Aneesh	Parents
Kalpetta	Municipal Office	Other Commercial Stores	Near Municipality, Kalpetta	Anil kumar	Employee / worker
Kalpetta	Maniangode	Household	Padinjathara house Nedunilam Maniangode post	Anitha	Spouse
Kalpetta	Nedungode	Household	Vinaya nivas house no 16 Maniangode post	Arathy	Parents
Kalpetta	Emily	Fancy Store	Arankodan house Emily Kalpetta	Ayisha	Proprietor / Owner

ULB	Ward	Category of Property	Address	Name	Designation
Kalpetta	Emily	Household	Kadavuthodi house Mythri nagar Kalpetta	Babu	Self
Kalpetta	Emily	Household	Mythri nagar Kalpetta	Sukumar	Self
Kalpetta	Municipal Office	Other Commercial Stores	Near Municipality, Kalpetta	Babu	Proprietor / Owner
Kalpetta	Nedungode	Household	D D nivas Maniagode post Nedungode	Balakrishnan	Self
Kalpetta	Emily	Household	Hillview 263 Fathima nagar Emily	Beena	Spouse
Kalpetta	Emily	Household	House no 734 Emily Kalpetta	Bindhu	Self
Kalpetta	Maniangode	Household	Rishi House, Kalpetta	Bindhu C K	Spouse
Kalpetta	Maniangode	Educational	Kalpetta post Puliyarmala	Bineesh	Employee / worker
Kalpetta	Municipal Office	Other Commercial Stores	Near muncipal Kalpetta	Deepu	Proprietor / Owner
Kalpetta	Emily Thadam	Household	Padmini quarterz Emily Kalpetta post	Dennis	Self
Kalpetta	Emily	Vegetable & Fruits Markets	Emily. Kalpetta	Dileep	Proprietor / Owner
Kalpetta	Emily Thadam	Household	Aparna House Kalpetta postEmily	Govindhan	Spouse
Kalpetta	Emily Thadam	Household	Yunus quarterz Kalpetta post Emily thadamHouse No 127	Hajira P	Spouse
Kalpetta	Municipal Office	Other Commercial Stores	Near muncipality	Hamsa	Proprietor / Owner
Kalpetta	Emily Thadam	Stationery	Buliding No 140 Emily Kalpetta post	Hamsa	Proprietor / Owner
Kalpetta	Emily Thadam	Household	Theyyil house Kalpetta post Emily thadam House No 63	Hamsathayyil	Spouse
Kalpetta	Emily Thadam	Household	Varappurath house Kalpetta post Emily thadam House No 128	Hasna E P	Self
Kalpetta	Emily Thadam	Household	Pookandiyil house Kalpetta post Emily thadam House No 65	Jameela kabeer	Spouse
Kalpetta	Emily	Household	Kuyilthodika 255 Fathima nagar Emili	Jamsheena	Parents
Kalpetta	Emily Thadam	Household	Karbolil House 147 Emily thadam Kalpetta post	Janardhanan	Self
Kalpetta	Emily Thadam	Household	Padmini quarterz Emily Kalpetta post	Jasmin	Spouse
Kalpetta	Municipal Office	Vegetable & Fruits Markets	Near muncipal office Kalpetta	Javadh	Proprietor / Owner
Kalpetta	Emily	Other Commercial Stores	Emily Kalpetta post	Jeevan	Proprietor / Owner
Kalpetta	Municipal Office	Other Commercial Stores	Near municipal office Kalpetta	Jince	Employee / worker
Kalpetta	Emily	Household	Apartment Emily Building No 735	Jisha	Spouse
Kalpetta	Emily	Other Commercial Stores	Emily Kalpetta	Junaid	Employee / worker
Kalpetta	Municipal Office	Other Commercial Stores	Near muncipality. Kalpetta	Junaid	Employee / worker
Kalpetta	Emily	Household	Chalaparambil house Emily, mythri nagar Kalpetta	Kamala	Self
Kalpetta	Maniangode	Household	Nedunilam colony Maniangode post Kalpetta	Kayama	Self

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Kalpetta	Nedungode	Household	Thiruthummal house Nedungode Kalpetta	Krishnakumar	Self
Kalpetta	Nedungode	Household	Lathika nivas Kalpetta post Nedungode Number 268	Kunjiraman	Self
Kalpetta	Maniangode	Household	Nedunilam colony Maniangode post Kalpetta	Kuttappan	Parents
Kalpetta	Maniangode	Household	Nedunilam colony Maniangode post Kalpetta	Leela	Parents
Kalpetta	Emily	Household	Cholakkal house Mythri nagar	Maimoona	Self
Kalpetta	Maniangode	Others	Puliyarmala Maniangode post Kalpetta	Malini	Employee / worker
Kalpetta	Maniangode	Educational	Puliyarmala Maniangode post Kalpetta	Malini	Employee / worker
Kalpetta	Nedungode	Household	Padakkottil house Nedungode	Mani p v	Self
Kalpetta	Maniangode	Household	Nandanam house Maniangode post Kalpetta	Manoj	Self
Kalpetta	Nedungode	Household	Pareekkal house Maniangode post Nedungode	Mathew P A	Self
Kalpetta	Emily Thadam	Stationery	Emily Thejus nagar Building No: 161 Kalpetta	Moidheen	Proprietor / Owner
Kalpetta	Emily	Stationery	Emily Kalpetta building no 286	Muhammed	Employee / worker
Kalpetta	Emily Thadam	Stationery	Emily Kalpetta post	Nabeesa	Proprietor / Owner
Kalpetta	Maniangode	Household	Nedunilam colony Maniangode Post Kalpetta	Njenan	Self
Kalpetta	Maniangode	Household	Nedunilam colony	Onan	Self
Kalpetta	Maniangode	Other Commercial Stores	Maniangode post Kalpetta	Prabhakaran	Proprietor / Owner
Kalpetta	Municipal Office	Vegetable & Fruits Markets	Gudalayi Muncipal office Kalpetta	Prabhakaran	Proprietor / Owner
Kalpetta	Municipal Office	Other Commercial Stores	Kalpetta Near muncipality office	Pramod	Proprietor / Owner
Kalpetta	Emily Thadam	Household	Thekkuveettil house Kalpetta post Emily 142	Prasanna	Son / Daughter
Kalpetta	Maniangode	Household	Vinayam house Maniangode post Kalpetta	Preetha k c	Spouse
Kalpetta	Nedungode	Household	KM thodiyil Fathima nagar Kalpetta post House Number 256	Rafagani	Spouse
Kalpetta	Nedungode	Household	Pulikkal house Nedungode Kalpetta	Rasheed	Self
Kalpetta	Maniangode	Household	Nedunilam colony Maniangode post Kalpettq	Ravi	Self
Kalpetta	Municipal Office	Other Commercial Stores	Near municipal office Kalpettq	Rishad	Employee / worker
Kalpetta	Emily Thadam	Household	Poonthottathil house Maniangode post Kalpetta	Santhosh	Self
Kalpetta	Emily Thadam	Household	Pookodan house Kalpetta pist Emily thadam House No 121	Sara P	Spouse
Kalpetta	Municipal Office	Stationery	Near muncipality Kalpetta	Sethuraman	Proprietor / Owner
Kalpetta	Emily	Household	Padinjarechaliyadi 29 Mythri nagar	Shaji	Self
Kalpetta	Emily	Household	Puthurvalappil house Fathima nagar Emily	Shaniba	Parents
Kalpetta	Maniangode	Household	Nedunilam colony Maniangode post. Kalpetta	Shantha	Self

ULB	Ward	Category of Property	Address	Name	Designation
Kalpetta	Maniangode	Household	Nedunilam colony Maniangode post Kalpetta	Shantha	Spouse
Kalpetta	Municipal Office	Vegetable & Fruits Markets	Gudalayi Kalpetta	Sharafu	Proprietor / Owner
Kalpetta	Maniangode	Household	Deepak Sadan house Maniangode post Kalpetta	Sharath	Self
Kalpetta	Emily Thadam	Household	Kavya nivas Kalpetta post Emily thadam	Sheela	Spouse
Kalpetta	Emily	Fancy Store	Emily Kalpetta post	Shivadas	Proprietor / Owner
Kalpetta	Municipal Office	Fancy Store	Near muncipal office Kalpetta	Shoufeeq	Proprietor / Owner
Kalpetta	Emily	Household	Moosharikandi house 254 Fathima nagar Emily	Shybi	Spouse
Kalpetta	Emily	Other Commercial Stores	Emily Kalpetta post	Siddique	Proprietor / Owner
Kalpetta	Municipal Office	Fancy Store	Kalpetta Near muncipality	Sindhu	Employee / worker
Kalpetta	Maniangode	Household	MANIANGODE POYIL	Soumya	Spouse
Kalpetta	Municipal Office	Other Commercial Stores	Kalpetta Near muncipality	Sreedharan	Proprietor / Owner
Kalpetta	Emily	Household	Sreebhavanam Fathima nagar Emily	Sreejith	Self
Kalpetta	Maniangode	Educational	Maniangode post Puliyarmala Kalpetta	Sreekumar	Proprietor / Owner
Kalpetta	Emily	Household	KM thodi Fathima nagar Emily Kalpetta	Subhaira	Self
Kalpetta	Emily	Other Commercial Stores	Emily Kalpetta	Sujeeb	Proprietor / Owner
Kalpetta	Emily	Household	Kadakkadan house 252 Emily Fathima Nagar	Sulaiman	Self
Kalpetta	Maniangode	Household	Nedunilam Colony Maniangode post Maniangode Kalpetta	Sumithra	Spouse
Kalpetta	Nedungode	Household	Pathil puthan veed Nedungode Kalpettq	Sumithran	Self
Kalpetta	Maniangode	Household	Nedunilam Maniangode Kalpetta	Suresh	Self
Kalpetta	Maniangode	Household	Nedunilam colony Maniangode post Kalpetta	Susheela	Spouse
Kalpetta	Puliyarmala	Educational	Kalpetta North post Puliyarmala	T T Joseph	Employee / worker
Kalpetta	Nedungode	Household	Sithara house Nedungode Kalpetta	Vinayan	Self
Kalpetta	Nedungode	Household	Nedungode house Maniagode post Kalpetta	Vineetha	Parents
Kalpetta	Emily Thadam	Household	Haritham House Kalpetta post Emily thadam	Vineetha k	Parents
Kalpetta	Maniangode	Household	Nedunilam colony Maniangode post Kalpettq	Shameer	Self
Kalpetta	Maniangode	Household	Nedunilam colony Maniangode post. Kalpetta	Revi	Self
Kalpetta	Maniangode	Household	Nedunilam colony Maniangode post Kalpetta	Joseph	Self
Kalpetta	Maniangode	Household	Nedunilam Colony Maniangode post Maniangode Kalpetta	Anupama	Spouse
Kalpetta	Maniangode	Household	Nedunilam colony Maniangode post Kalpetta	Sharmila	Spouse
Kasaragod	Nullippadi	Household	Kunila garden Kayarpalla road Surabi housing calany Nullipady kasaragod	Ahmed kunhi	Self

ULB	Ward	Category of Property	Address	Name	Designation
Kasaragod	Nullippadi	Household	Bhanu Surabhi housing colany Kayarpallam nullipady Kasaragod	Baladithya shetty	Self
Kasaragod	Nullippadi	Household	Benaka Nullipadi Kasaragod	Manjula	Spouse
Kasaragod	Nullippadi	Household	Vignesh Surabhi colani Nullipady Kasaragod	K panduranga shetty	Self
Kasaragod	Nullippadi	Household	Suneesh Nullipadi Karyahalla	Kalavathi	Self
Kasaragod	Nullippadi	Household	Sannidhi house Kayyapalam road Surabhi colony Nulllipady kasaragod	Suresh	Self
Kasaragod	Nullippadi	Household	Poorna shree Surabhi housing colany Nullipady Kasaragod	Peri thangappan nayar	Self
Kasaragod	Nullippadi	Household	Sree nilayam Surabhi housing colany Nullipady Kasaragod	K naresh shetty	Self
Kasaragod	Nullippadi	Household	Krv nilayam Surabhi housing colany Nullipadi kasaragod	Indhu	Self
Kasaragod	Nullippadi	Household	Surabhi housing colany Nullipaddy kasaragod	Dominic	Self
Kasaragod	Nullippadi	Household	Ananbdham Surabhi housing colany Nullipady	Balachandra	Self
Kasaragod	Vidyanagar	Household	Roshan villa Nalkala road P.o vidyanagar Kasaragod	Mohammad ashraf	Self
Kasaragod	Vidyanagar	Household	Nerkala Vidyanagar	P.s muhammed sulaiman	Self
Kasaragod	Vidyanagar	Household	Vidyagar	Abdul nasar	Self
Kasaragod	Vidyanagar	Household	Krishnakripa house Nalkala Vidyanagar	Vishvanath	Self
Kasaragod	Vidyanagar	Household	Nalkala H colany P.o vidyasagar Kasaragod	Vjjaya	Spouse
Kasaragod	Vidyanagar	Other Commercial Stores	Helcy beauty parlour Vidya nagar p.o Kasaragod Kerala	Felcy	Proprietor / Owner
Kasaragod	Vidyanagar	Other Commercial Stores	Campus cafe Vidyasagar po Opp of govt college kasaragod Kasaragod dist	Shamseer	Employee / worker
Kasaragod	Vidyanagar	Other Commercial Stores	Shimla cool bar Vidyanagar po Kasaragod dist	Indulekha	Employee / worker
Kasaragod	Vidyanagar	Stationery	Opp. Govt College Vidyanagar KASARGOD	Dileep	Employee / worker
Kasaragod	Vidyanagar	Other Commercial Stores	Sabeer Fathima mansil Tn moola Muttathodi P.O Vidhyadhar KASARGOD	Shabeer	Proprietor / Owner
Kasaragod	Nullippadi North	Community Hall	Century park KASARGOD	Janakar	Employee / worker
Kasaragod	Nullippadi North	Restaurants / Hotels	Indian coffee house New bus stand KASARGOD	Santhosh	Employee / worker
Kasaragod	Nullippadi North	Restaurants / Hotels	Speedway inn Kasaragod	Abdul Samad	Employee / worker
Kasaragod	Vidyanagar	Household	Haris Chala road Vidyanagar p.o Kasaragod	Haris	Self

ULB	Ward	Category of Property	Address	Name	Designation
Kasaragod	Vidyanagar	Household	Te ye yem apartment Chala road Vidyanagar p.o Kasaragod	Zakeer hussain	Self
Kasaragod	Nullippadi North	Restaurants / Hotels	Viceroy inn nullipady	Mithun	Employee / worker
Kasaragod	Vidyanagar	Household	Topaz villas Chala road Vidyanagar p.o Kasaragod	Zaida banu	Self
Kasaragod	Vidyanagar	Household	Topaz villas Chala road Vidyanagar p.o Kasaragod	Sahira	Spouse
Kasaragod	Vidyanagar	Other Commercial Stores	Janaki auto parts Opp sbi Vidyanagar p.o Kasaragod	Vittala	Employee / worker
Kasaragod	Nullippadi North	Household	NRA 60 Nullipady north	Ashak Hussain	Self
Kasaragod	Nullippadi North	Household	NRA 62 Nullipady KASARGOD	Hemalatha	Spouse
Kasaragod	Nullippadi	Other Commercial Stores	Maruthi suzuki Nullipady p.o Kasaragod	Sharmila	Employee / worker
Kasaragod	Nullippadi	Other Commercial Stores	Goodwill furniture Nullipady p.o Kasaragod	Mansoor	Proprietor / Owner
Kasaragod	Nullippadi North	Provision	Pm miceroad Nullipady KASARGOD	Krishna Prasad	Proprietor / Owner
Kasaragod	Nullippadi	Provision	Badriya general store Nullipali p.o. Kasaragod	Abdulla	Proprietor / Owner
Kasaragod	Nullippadi North	household	NRA 84 Nullipady KASARGOD	Raghavan V	Self
Kasaragod	Nullippadi	Vegetable & Fruits Markets	Fathima store Nullipady p.o Kasaragod	Ahmed	Proprietor / Owner
Kasaragod	Nullippadi	Fancy Store	Look stiching centre Pms road Nullipady Kasaragod	Ravi	Proprietor / Owner
Kasaragod	Nullippadi	Religious	Muhiyudheen juma musjid Nullipady Kasaragod	Abdul kader	Employee / worker
Kasaragod	Nullippadi North	Household	NRA 82 Nullipady KASARGOD	Nanesh	Self
Kasaragod	Nullippadi North	Household	NRA 76 Nullipady KASARGOD	Sharadha	Self
Kasaragod	Nullippadi North	Religious	Sunni centre juma musjid New bus stand Kasaragod	Hakeem saqafi	Employee / worker
Kasaragod	Nullippadi North	Provision	M.M store Kottekanny road New bus stand KASARGOD	Seethram	Proprietor / Owner
Kasaragod	Nullippadi North	Provision	Kottekanny road Near New bus stand KASARGOD	Abraham	Proprietor / Owner
Kasaragod	Kadappuram South	Household	Divyadeepam Kadappuram south Kasaba beach Kasaragod	Ravi	Self
Kasaragod	Nullippadi North	Provision	Muzeena store Kottekanny road Near new Bus stand KASARGOD	Manzur	Proprietor / Owner
Kasaragod	Kadappuram South	Household	Sonia nilaa Kasaba beach Kasaragod	Shobha	Self

ULB	Ward	Category of Property	Address	Name	Designation
Kasaragod	Kadappuram South	Household	Sheeba navas Kadappuram south Kasaba kadappuram Kasaragod	Sarojini	Spouse
Kasaragod	Nullippadi North	Fancy Store	Shreesha beauty parlour Kotekani road KASARGOD	Ashwini	Proprietor / Owner
Kasaragod	Kadappuram South	Household	Sree shaila house Kasaba kadappuram Kasaragod	Shailaja	Self
Kasaragod	Kadappuram South	Household	Ranjana bhavanam Kadappuram south Kasaragod	Rama	Self
Kasaragod	Kadappuram South	Household	Sheela krishna nivas Kasaba beach Kasaragod	Sheela	Self
Kasaragod	Nullippadi North	Household	NRA 19 Nullipady KASARGOD	Adv. Sundharav	Self
Kasaragod	Kadappuram South	Household	Kandapuram south Kasaba kadappuram. Kasaragod	Chandra	Self
Kasaragod	Kadappuram South	Household	Kasaba kadappuram Kasargod	Saumini	Self
Kasaragod	Nullippadi North	Household	NRA 18 Nullipady KASARGOD	Madhsudhana shetty	Self
Kasaragod	Kadappuram South	Household	Kasaba beach Kasaragod kadappurM	Sarojini	Self
Kasaragod	Kadappuram South	Household	Kasaba beach Sai nagar road Kasaragod	Karthiyani	Self
Kasaragod	Nullippadi North	Household	NRA 21 Nullipady KASARGOD	R N Nayyar	Self
Kasaragod	Kadappuram South	Household	Kasaba Beach Kasaragod	Balan	Self
Kasaragod	Kadappuram South	Household	Kumaram kadav house Kasaba beach Kasaragod	Yashoda	Self
Kasaragod	Kadappuram South	Household	Kasaba beach Kasaragod	Ramanan	Self
Kasaragod	Kadappuram South	Household	Kasaba beach Kasaragod	Janitha	Self
Kasaragod	Nullippadi North	Household	NRA 24 Nullipady KASARGOD	Pratheek	Son / Daughter
Kasaragod	Kadappuram South	Household	Sreeja navas Kasaba kadappurM Kasaragod	Sindhu	Spouse
Kasaragod	Nullippadi North	Household	NRA 29 Nullipady KASARGOD	Raphael	Self
Kasaragod	Kadappuram South	Household	Pappi nivas Kasaba beach Kasaragod	Kanbothiayathal	Self

ULB	Ward	Category of Property	Address	Name	Designation
Kasaragod	Kadappuram South	Household	Kasaba beach Kasaragod	Ajitha	Self
Kasaragod	Kadappuram South	Household	Geetha nilayum Kasaba kadappuram Kasaragod	Bhaskaran	Self
Kasaragod	Kadappuram South	Household	Kasaba beach Kasaragod	Regha	Spouse
Kasaragod	Kadappuram South	Household	Kasaba beach Kasaragod	Shaima	Self
Kasaragod	Nullippadi North	Provision	No name Kishore shore Kotekani road KASARGOD	Kishore	Proprietor / Owner
Kasaragod	Nullippadi North	Religious	St. Joseph`s Church Kotekani road KASARGOD	Fr. Vipin	Employee / worker
Kasaragod	Nullippadi North	Others	Jeevas conventional hall Kotekani road KASARGOD	Fr. Mani Melvettom	Proprietor / Owner
Kasaragod	Nullippadi North	Educational	Jaimatha E M Nursery school Kotekani road KASARGOD	Sr. Sharon	Employee / worker
Kasaragod	Nullippadi North	Religious	Jaimatha convent, Kotekani road KASARGOD	Sr. Philsy	Proprietor / Owner
Kasaragod	Nullippadi North	Clothing	Nullipady KASARGOD	Ravi	Proprietor / Owner
Kasaragod	Nullippadi North	Educational	Crysalis Training Hall Kotekani road KASARGOD	Fr Mani Melvettom	Proprietor / Owner
Kasaragod	Nullippadi North	Other Commercial Stores	Photo star studio KASARGOD	Sanju	Proprietor / Owner
Kasaragod	Nullippadi	Stationery	Nullipady KASARGOD	Ragavan	Employee / worker
Kasaragod	Nullippadi	Other Commercial Stores	Nullipady KASARGOD	Abhi ram	Employee / worker
Kasaragod	Nullippadi	Stationery	Nullipady KASARGOD	Ganesh	Employee / worker
Kasaragod	Nullippadi	Other Commercial Stores	Nullipady KASARGOD	Sameer	Proprietor / Owner
Kasaragod	Nullippadi	Fancy Store	Nullipady KASARGOD	Nagaraj	Proprietor / Owner
Kasaragod	Nullippadi North	Other Commercial Stores	New bus stand KASARGOD	Mohamed Ashraf	Proprietor / Owner
Kasaragod	Nullippadi North	Other Commercial Stores	New bus stand KASARGOD	Basheer	Employee / worker
Kasaragod	Nullippadi North	Clothing	New bus stand KASARGOD	Kandhi lal	Employee / worker
Kasaragod	Vidyanagar	Fancy Store	Vidhyanagar KASARGOD	Revathi	Employee / worker
Kasaragod	Vidyanagar	Other Commercial Stores	Vidhyanagar KASARGOD	Pramilla	Employee / worker
Kasaragod	Vidyanagar	Provision	Vidhyanagar KASARGOD	Krishna	Employee / worker
Kasaragod	Vidyanagar	Clothing	Vidhyanagar KASARGOD	Sarath	Employee / worker
Kasaragod	Vidyanagar	Clothing	Vidhyanagar KASARGOD	Jayadev	Employee / worker
Kasaragod	Nullippadi North	Other Commercial Stores	Nullipady KASARGOD	Krishnan	Employee / worker

ULB	Ward	Category of Property	Address	Name	Designation
Kasaragod	Nullippadi North	Stationery	Nullipady KASARGOD	Geethanjali	Employee / worker
Kasaragod	Nullippadi North	Household	Nullipady North KASARGOD	Harish	Self
Kasaragod	Nullippadi North	Household	Nullipady North KASARGOD	Manu	Son / Daughter
Kasaragod	Nullippadi North	Other Commercial Stores	Nullipady KASARGOD	Santhosh	Proprietor / Owner
Kasaragod	Nullippadi	Other Commercial Stores	Nullipady KASARGOD	Shafiq	Proprietor / Owner
Kasaragod	Nullippadi	Other Commercial Stores	Nullipady KASARGOD	Bhatt	Proprietor / Owner
Kothamangalam	Chelad	Vegetable & Fruits Markets	Nelikandathil Chelad	Nisha Biju	Proprietor / Owner
Kothamangalam	Chelad	Fancy Store	Public Library Building Chelad	Priya Vipin Das	Proprietor / Owner
Kothamangalam	Chelad	Provision	Edathala Traders Kakkathuruthel Complex Chelad Kothamangalam	Saju Joseph	Proprietor / Owner
Kothamangalam	Chelad	Other Commercial Stores	Services ciroperative Bank Chelad Kothamangalam	Jaimol James	Employee / worker
Kothamangalam	Chelad	Other Commercial Stores	Kunnath Complex Chelad Kothamangalam	Basil Binoy	Proprietor / Owner
Kothamangalam	Valadithandu	Vegetable & Fruits Markets	Shammos Fruitstall Malayinkeezhu Kothamangalam	Baby Paulose	Proprietor / Owner
Kothamangalam	Block Office	Other Commercial Stores	Lotus Bakery Malayinkeezhu	Ramendran P	Proprietor / Owner
Kothamangalam	Block Office	Fancy Store	Sanjos Gift Palace Malayinkeezhu Kothamangalam	Biju George	Proprietor / Owner
Kothamangalam	Valadithandu	Other Commercial Stores	Mundackal Plaza Malayinkeezhu Kothamangalam	Eldose Raju	Employee / worker
Kothamangalam	Block Office	Other Commercial Stores	Cheriyapalli Building Bypass Road Kothamangalam	Binoy P P	Proprietor / Owner
Kothamangalam	Block Office	Restaurants / Hotels	Malayinkeezhu Kothamangalam	Manoj M P	Employee / worker
Kothamangalam	Block Office	Other Commercial Stores	Near Oliapuram Saw Mill Malayinkeezhu Kothamangalam	Anil Kumar	Employee / worker
Kothamangalam	Block Office	Fancy Store	Olipuram Complex Malayinkeezhu Kothamangalam	Santhosh P L	Employee / worker
Kothamangalam	Block Office	Provision	Malayinkeezhu Ramalloor Kothamangalam	Vinu Joseph	Proprietor / Owner
Kothamangalam	Valadithandu	Vegetable & Fruits Markets	Malayinkeezhu Kothamangalam	Shaji Mathew	Proprietor / Owner
Kothamangalam	Valadithandu	Other Commercial Stores	Malayinkeezhu Bypass Road Kothamangalam	Dileep Kumar	Proprietor / Owner
Kothamangalam	Valadithandu	Other Commercial Stores	Malayinkeezhu Bypass Road Kothamangalam	Biju K	Employee / worker
Kothamangalam	College	Restaurants / Hotels	KN 12 Kala Nagar Kothamangalam	Abdul Basith	Employee / worker
Kothamangalam	College	Other Commercial Stores	M A College Road Kothamangalam	Mohammed V A	Proprietor / Owner
Kothamangalam	College	Other Commercial Stores	M A College Kothamangalam	Backer P P	Proprietor / Owner
Kothamangalam	College	Others	Two Brothers Building M A College	Nusrath Basheee	Employee / worker

ULB	Ward	Category of Property	Address	Name	Designation
			Kothamangakam		
Kothamangalam	College	Other Commercial Stores	Two Brothers Complex M A College Kothamangalam	Bavas V M	Employee / worker
Kothamangalam	Block Office	Restaurants / Hotels	Thangalam Bypass Road Kothamangalam	Sooraj Raju	Employee / worker
Kothamangalam	Block Office	Vegetable & Fruits Markets	St. Agustins GHSS	Tom James	Proprietor / Owner
Kothamangalam	College	Provision	St. Joseph Hospital Kothamangalam	Moideen P K	Proprietor / Owner
Kothamangalam	Block Office	Household	House no A2 T Square Kothamangalam P O Kothamangalam	Gilson C S	Son-in-law / Daughter-in-law
Kothamangalam	Block Office	Household	House B1 T Square Court Road	Godly P A	Self
Kothamangalam	Block Office	Household	Thekkekara House Kothamangalam	Jacob Varges	Self
Kothamangalam	Block Office	Household	Thekkekara Kothamangalam	Aiswarya	Son / Daughter
Kothamangalam	Block Office	Household	Thekkekara house Kothamangalam	Manoj Varges	Self
Kothamangalam	Block Office	Household	Martin Johnny Edakattukudy House Kothamangalam	E M Johnny	Parents
Kothamangalam	Block Office	Household	2/201 Elanjikal House Kothamangalam	Mathew Jose	Self
Kothamangalam	Chelad	Household	Niravathkandathil Chelad Kothamangalam	Sheeba Saji	Spouse
Kothamangalam	Chelad	Household	Nedungattu House Chelad	Biju James	Self
Kothamangalam	Chelad	Household	Kadalikandathil House Chelad Kothamangalam	Janaki	Others - Maid
Kothamangalam	Chelad	Household	Keezhamatte House Chelad Kothamangalam	K V Jose	Self
Kothamangalam	Chelad	Household	Mattamana House Chelad Kothamangalam	Smooni Alias	Spouse
Kothamangalam	Chelad	Household	Neranpuzha Chelad Kothamangalam	Paul Issac	Self
Kothamangalam	Chelad	Household	Vadakambakathe Chelad Kothamangalam	Shimi Jaisom	Spouse
Kothamangalam	Chelad	Household	Karukapilly Chelad Kothamangalam	K T Mathew	Parents
Kothamangalam	Valadithandu	Household	Kuttisrakudiyil House Malayankizhu Kothamangalam	K M Skariah	Self
Kothamangalam	Valadithandu	Household	Pookunnel House Malayankeezhu Kothamangalam	Shalomy Shaji	Spouse
Kothamangalam	Valadithandu	Household	Konullil House Malayankeezhu Kothamangalam	Rani Jose	Spouse
Kothamangalam	Valadithandu	Household	Pullarackal House Malayankeezhu Kothamangalam	Vincy Varges	Self
Kothamangalam	Valadithandu	Household	Thanikunnel House Malayankeezhu Kothamangalam	Sheena Sijo	Spouse
Kothamangalam	Valadithandu	Household	Kudiyattu House Malayankeezhu	Chinju Joy Kuriyatin	Son / Daughter

ULB	Ward	Category of Property	Address	Name	Designation
			Kothamangalam		
Kothamangalam	Valadithandu	Household	Punnaikkal House Malayankeezhu Kothamangalam	Basil Eldose	Son / Daughter
Kothamangalam	Valadithandu	Household	Ellathukudy Malayankeezhu Kothamangalam	Valsa Ousep	Self
Kothamangalam	Valadithandu	Household	Edathalakudy Malayankeezhu Kothamangalam	Girija Joshy	Spouse
Kothamangalam	Valadithandu	Household	Thanikunnel House Malayankeezhu Kothamangalam	Nikhil Joseph	Son / Daughter
Kothamangalam	Valadithandu	Household	Niravathukandathil Malayinkeezhu Kothamangalam	Dolly Vages	Spouse
Kothamangalam	Valadithandu	Household	Thannikottil Malayinkeezhu Kothamangalam	Mathew John	Self
Kothamangalam	Valadithandu	Household	Thekkemaalil Kothamangalam	Seena Raju	Spouse
Kothamangalam	College	Household	Karikuttipurath House M A College Kothamangalam	K M Kuriakose	Self
Kothamangalam	College	Household	Kuzhikandathil House M A College Kothamangalam	Ally Paulose	Spouse
Kothamangalam	College	Household	Kuzhikandathil House M A College Kothamangalam	Benny K U	Self
Kothamangalam	College	Household	Aatupurath M A College Kothamangalam	Mercy Pathrose	Spouse
Kothamangalam	College	Household	Kadijumeel House M A College Kothamangalam	Jessy Eldose	Spouse
Kothamangalam	College	Household	Kokaliparambil House M A College Kothamangalam	Deepa Sathish	Spouse
Kothamangalam	College	Household	Athithottathil M A College Kothamangalam	Saramma KunjuKunj	Spouse
Kothamangalam	College	Household	Pallimalil House Kala Nagar KN 64 New MAC Road Kothamangalam	Bins Valsa Paul	Self
Kothamangalam	College	Household	Edappatte Kala Nagar Kothamangalam	Piya Shaji	Spouse
Kothamangalam	College	Household	Edappat House KN37 Kala Nagar Kothamangalam	Moti Lal	Parents
Kothamangalam	College	Household	Manimala House M A College Kithamangalam	Rosely	Others - Maid
Kothamangalam	College	Household	Kallathukuzhiyil M A College Kothamangalam	George Mathew	Self
Kothamangalam	College	Household	Palikkal House M A College Kothamangalam	Vilasini P S	Spouse
Kothamangalam	College	Household	Puthempurayil House M A College Kothamangalam	Shaju C Joseph	Self
Kothamangalam	College	Household	Parayil House Kala Auditorium	Shima Mathew	Spouse

ULB	Ward	Category of Property	Address	Name	Designation
			Kothamangalam		
Kothamangalam	College	Household	Parayil House Kala Nagar 6 Kothamangalam	Hilsha Kuryakose	Spouse
Kothamangalam	College	Household	Koomullil House Kala Nagar Kothamangalam	Annakutty Varges	Parents
Kothamangalam	College	Household	Chundatte House Kala Nagar Kothamangalam	Phelomina Papu	Other Relatives
Kothamangalam	Block Office	Household	Kannaparambil House Malayinkeezhu Kothamangalam	Thomas Eldho	Son / Daughter
Kothamangalam	Block Office	Household	Pumolil House Ramalloor Kothamangalam	Antony Stephen	Self
Kothamangalam	Valadithandu	Household	Pothanikkatte House Kothamangalam	Shanty Agusting	Self
Kothamangalam	Valadithandu	Household	Kallathu Kothamangalam	Joshy K V	Self
Kothamangalam	Valadithandu	Household	Kunnupurath House Ramalloor	Vishnupriya Rajan	Son-in-law / Daughter-in-law
Kothamangalam	Valadithandu	Household	Ammaparambil Kothamangalam	Anitha Vijayan	Spouse
Kothamangalam	Valadithandu	Household	Velumavudi Kothamangalam	July James	Spouse
Kothamangalam	Valadithandu	Household	Kachipillil Kothamangalam	Crisma Cheriyan	Spouse
Kothamangalam	Valadithandu	Household	Palakkathotti Kothamangalam	P P Pilie	Self
Kothamangalam	Valadithandu	Household	Thuruthiyil Kothamangalam	Shini Jose	Spouse
Kothamangalam	Valadithandu	Household	Putheeckal House Ramalloor Kothamangalam	Praveen Raju	Son / Daughter
Kothamangalam	Valadithandu	Household	Thalipparambil Kothamangalam	Thangamma Joseph	Spouse
Kothamangalam	Block Office	Household	Mundakkal Kothamangalam	M A Jose	Self
Kothamangalam	Valadithandu	Household	Thedasherry Kothamangalam	Lissy Eldhose	Spouse
Kothamangalam	Valadithandu	Household	Parippilkudiyil Kothamangalam	Akhil P A	Self
Kothamangalam	Valadithandu	Household	Konnakyal Kothamangalam	Kunjamma Sebastin	Spouse
Kothamangalam	Valadithandu	Household	Konnakyal Kithamangalam	Danya Angels Saviour	Spouse
Kothamangalam	College	Religious	Bethel Bapstistic Church M A College Kothamangalam	Satish K	Proprietor / Owner
Kothamangalam	College	Educational	M A School College Junction Kothamangalam	Eldho Thomas	Employee / worker
Kothamangalam	College	Educational	College Junction Kothamangalam	Mathews George	Employee / worker
Kothamangalam	College	Restaurants / Hotels	M A College Road Kothamangalam	Jessy Sebastin	Proprietor / Owner
Kothamangalam	Block Office	Restaurants / Hotels	MM Tower Malayinkeezhu Kothamangalam	Robin T	Employee / worker
Kothamangalam	Block Office	Others	Malayinkeezhu Kotgamangalam	Aswathy Renjith	Employee / worker
Kothamangalam	Valadithandu	Community Hall	Kallad Chelad Kothamangalam	Mini P K	Employee / worker
Kothamangalam	Valadithandu	Educational	Kallad Chelad Kothamangalam	Sindhu K Krishnan	Employee / worker
Kothamangalam	Block Office	Government Offices	Block Office Complex Block Office Kothamangalam	Reji Mathew	Employee / worker
Kothamangalam	Block Office	Government Offices	Office of Assistant Agriculture Director Block office Kothamangalam	Rani Paulose	Employee / worker

ULB	Ward	Category of Property	Address	Name	Designation
Kothamangalam	Block Office	Government Offices	Thaluk Referal Veterinary Hospital Block Office Kothangalam	Sreeja Kumar	Employee / worker
Perinthalmanna	Kovilakampadi	Household	Vadakethil, kovilakam padi, perinthalmanna	Sadumadavan	Spouse
Perinthalmanna	Chmebankunnu	Household	Chempankunnu parambu, chembankunnu, perinthalmanna	Deepa, baburaj	Self
Perinthalmanna	Kulirmala	Others - Hospital	Moulana hospital, kulirmala, perinthalmanna	Rafeeq	Employee / worker
Perinthalmanna	Valiyangadi	Others - Hospital	Kims al shifa hospital, valiyagadi, perinthalmanna	Genaral manger	Employee / worker
Perinthalmanna	Kulirmala	Restaurants / Hotels	Indian coffee house, kulirmala, perinthalmanna	Arjun	Employee / worker
Perinthalmanna	Kulirmala	Restaurants / Hotels	Kpm restaurant, kpm complexes	Ahammed	Proprietor / Owner
Perinthalmanna	Valiyangadi	Malls	Vavas mall, valiyagadi, perinthalmanna	Najmudheen	Employee / worker
Perinthalmanna	Valiyangadi	Others	Bismy hypermarket, valiyagadi, bypas perinthalmanna	Sfeer	Employee / worker
Perinthalmanna	Kulirmala	Restaurants / Hotels	Hotel eoyal plaza	Hussain	Proprietor / Owner
Perinthalmanna	Kulirmala	Malls	KTK complex	Mansoor	Security / house keeping staff
Perinthalmanna	Kulirmala	Other Commercial Stores (Market)	Chamayam textiles, kulirmala, perinthalmanna	Jafar	Employee / worker
Perinthalmanna	Lemon Valley	Others - Cinema Hall	Vismaya cinemas,	Sajeesh	Proprietor / Owner
Perinthalmanna	Kulirmala	Stationery (Market)	High way hypermarket, mannarkkad road, perinthalmanna	Santhi	Employee / worker
Perinthalmanna	Kulirmala	Office	Canara bank, near alukkas	Binoy	Employee / worker
Perinthalmanna	Kulirmala	Office	Icici bank, Hospital road	Radakrishnan	Security / house keeping staff
Perinthalmanna	Valiyangadi	Others	Navio family park, valiyagadi, perinthalmanna	Navio park	Proprietor / Owner
Perinthalmanna	Kulirmala	Office	Urban Coop Bank	Rahman	Security / house keeping staff
Perinthalmanna	Kulirmala	Stationery	CPM biriyani store, near market, perinthalmanna	Haris	Employee / worker
Perinthalmanna	Kulirmala	Household	Cheruvayil kothu, roos wood	Shahla	Self
Perinthalmanna	Kovilakampadi	Household	Tarayammal house, mamichi, perinthalmanna	Riyas tpm	Self
Perinthalmanna	Kulirmala	Household	Eduvammal hous, kulirmala, near mannarkad road, pin-679322	Said muhammed	Self
Perinthalmanna	Kulirmala	Household	Eduvammal house, kulirmala, mannarkad road,	Shabeer	Self
Perinthalmanna	Kulirmala	Others	Indus bank, near ksrtc	Rajan	Security / house keeping staff
Perinthalmanna	Kulirmala	Malls	Chilambukadan mall, Near ksrtc	Shamila	Proprietor / Owner
Perinthalmanna	Kulirmala	Household	Grace house, near mannarkad road, kulirmala	Dr salam	Self

ULB	Ward	Category of Property	Address	Name	Designation
Perinthalmanna	Kulirmala	Household	rose wood, kuliarmala	Mohammed	Son / Daughter
Perinthalmanna	Kovilakampadi	Household	Akaparamban, mamichi, perinthalmanna	Hijas	Self
Perinthalmanna	Kulirmala	Household	Near mannarkad road	Harish	Son / Daughter
Perinthalmanna	Kulirmala	Household	Pachath, rose wood apartment, perinthalmanna	Biju	Spouse
Perinthalmanna	Chmebankunnu	Household	Ulliattil palliyal, chembankunnu, perinthalmanna	Ramesh	Self
Perinthalmanna	Chmebankunnu	Household	Panniveettin padikkal, chrmbankunnu, perinthalmanna	Krishnan kutty	Self
Perinthalmanna	Kovilakampadi	Household	Mannaril house, mamichi apartment, perinthalmanna	Shabab	Self
Perinthalmanna	Kulirmala	Household	Near mannarkad road	Rizwan	Self
Perinthalmanna	Kulirmala	Household	rose wood, kuliarmala	Faisal	Son / Daughter
Perinthalmanna	Kulirmala	Household	Nechiyil, rose wood, kulirmala	Hasna	Self
Perinthalmanna	Kulirmala	Malls	Zarina mall near govt hospital	Arif	Security / house keeping staff
Perinthalmanna	Valiyangadi	Household	Karuvamparambhil, house number 6	Shruthi	Son-in-law / Daughter-in-law
Perinthalmanna	Kovilakampadi	Household	Kizhisseri, mamichi, perinthalmanna	Basheer	Self
Perinthalmanna	Kovilakampadi	Household	Melethil house	Hamza melethil	Self
Perinthalmanna	Valiyangadi	Household	Kizhisseri, house 10	Hakkem	Self
Perinthalmanna	Chmebankunnu	Household	Panniveettin padikkal	Bimesh	Son / Daughter
Perinthalmanna	Valiyangadi	Household	Elachola, house number 5	Arshad	Self
Perinthalmanna	Chmebankunnu	Household	Kalliyath, chembankunnu, perinthalmanna	Sugu	Self
Perinthalmanna	Chmebankunnu	Household	Ulliyattil palliyalil, chembankunnu	Harithasan	Spouse
Perinthalmanna	Kovilakampadi	Household	Sopna, mamichi apartment, perinthalmanna	Sopna	Others - Servant
Perinthalmanna	Kulirmala	Religious	ST` george orthodox sabha, kulirmala, perinthalmanna	Servant	Security / house keeping staff
Perinthalmanna	Kulirmala	Other Commercial Stores	Alukkas Jwellery	Visha	Employee / worker
Perinthalmanna	Valiyangadi	Household	Kizhisseri skss, house number 13	Arshad	Self
Perinthalmanna	Valiyangadi	Household	Kunnath, house number 4	Kareem	Son / Daughter
Perinthalmanna	Kulirmala	Household	rose wood, kuliarmala	Meenakshi	Son / Daughter
Perinthalmanna	Kovilakampadi	Household	Vadakkethil house, pathakara, kovilakampadi	Pathminiamma	Self
Perinthalmanna	Chmebankunnu	Household	Kallidumbil, chembankunnu, perinthalmanna	Arjunan	Self
Perinthalmanna	Kulirmala	Household	Mambra, rose wood apartment, kulirmala	Faisal	Self
Perinthalmanna	Valiyangadi	Household	Ameen manzil, house number 1	Ameen	Self
Perinthalmanna	Kulirmala	Other Commercial Stores	Alert industrial, kulirmala, mannarkkad road	Vijayan	Proprietor / Owner

ULB	Ward	Category of Property	Address	Name	Designation
Perinthalmanna	Chmebankunnu	Household	Adayattil, chembankunnu, perinthalmanna	Rasheed	Spouse
Perinthalmanna	Valiyangadi	Household	Kizhisseri, vazhayil, house number 12	Hamza	Son / Daughter
Perinthalmanna	Valiyangadi	Household	Kallingal	Dr Ahammed anwar, house number 7	Son / Daughter
Perinthalmanna	Valiyangadi	Household	Kunnath, house no 2	Muhammed ameen	Self
Perinthalmanna	Kovilakampadi	Household	Melethil house, kovilakam padi, perinthalmanna	Azees	Self
Perinthalmanna	Valiyangadi	Household	Kuruppath, house 11	Kareem	Son / Daughter
Perinthalmanna	Kovilakampadi	Household	Vattoly house, mamichi, perinthalmanna	Ameer vattoly	Self
Perinthalmanna	Chmebankunnu	Household	Adayatth, chembankunnu, perinthalmanna	Nafeesa	Self
Perinthalmanna	Kulirmala	Educational	Platinum classes, highschool road	Harshad	Employee / worker
Perinthalmanna	Kovilakampadi	Household	Chakkingal house, mamichi, perinthalmanna	Sulaiman c	Self
Perinthalmanna	Kovilakampadi	Household	Kunnath house, pathaikara, kovilakam padi	Hamza	Self
Perinthalmanna	Kulirmala	Household	cheman kothu, rooswood	Saman	Self
Perinthalmanna	Kulirmala	Others - IT Company	Near govt hospital	Hakkeem	Proprietor / Owner
Perinthalmanna	Valiyangadi	Household	Karinchanda, house number 9	Manuppa	Son / Daughter
Perinthalmanna	Kulirmala	Household	Chemban kothu, roos wood,	Mishab	Self
Perinthalmanna	Kovilakampadi	Household	Mamichi apartment, near fire station, perinthalmanna	Sulaiman	Self
Perinthalmanna	Valiyangadi	Household	Thorathody, house number 8	Sainaba	Spouse
Perinthalmanna	Kulirmala	Others	APMR terapia, near govt hospital, mannarkkad road, perinthalmanna. 679322	Jasmin	Employee / worker
Perinthalmanna	Valiyangadi	Household	Kunnathhouse number 3	Rasheeda	Self
Perinthalmanna	Chmebankunnu	Household	Ullattil palliyalil	Pradeep	Self
Perinthalmanna	Kulirmala	Other Commercial Stores	Zoya show mart, kulirmala, near mall aslam, perinthalmanna	Raswin	Proprietor / Owner
Perinthalmanna	Kulirmala	Vegetable & Fruits Markets	Vk vegetables, near market, kulirmala, perinthalmanna	Mujeeb	Employee / worker
Perinthalmanna	Kulirmala	Stationery	Nisar store, kulirmala, perinthalmanna	Nisar	Proprietor / Owner
Perinthalmanna	Kulirmala	Others	Optical center	Hameed	Proprietor / Owner
Perinthalmanna	Kulirmala	Other Commercial Stores	Near highway supermarket, mannarkad road, kulirmala	Jose	Proprietor / Owner
Perinthalmanna	Kulirmala	Others	Kottakal aryavaidhashala	Ramakrishnan	Employee / worker
Perinthalmanna	Kulirmala	Fancy Store	Ladies planet, kpm	Mujeeb	Employee / worker
Perinthalmanna	Kulirmala	Fancy Store	Bridal planet, kulirmala, perinthalmanna	Suhra	Employee / worker

ULB	Ward	Category of Property	Address	Name	Designation
Perinthalmanna	Kulirmala	Other Commercial Stores	Power electrical, near moulana hospital, kulirmala perinthalmanna	Jamsheer	Employee / worker
Perinthalmanna	Kulirmala	Fancy Store	Fancy mahal, near market, kulirmala, perinthalmanna	Murshida	Proprietor / Owner
Perinthalmanna	Valiyangadi	Others	Presidency petroleum Valiyagadi, perinthalmanna	Kujnahammed	Employee / worker
Perinthalmanna	Kulirmala	Other Commercial Stores	Medicals	Hakkem	Employee / worker
Perinthalmanna	Valiyangadi	Others	Valiyagadi, Perinthalmanna, oty road	Latheef	Employee / worker
Perinthalmanna	Kulirmala	Fancy Store	Ever shine, market road, kulirmala, perinthalmanna	Jameela	Employee / worker
Perinthalmanna	Kulirmala	Other Commercial Stores	Metro bags, near gghss, kulirmala, perinthalmanna	Rahul	Employee / worker
Perinthalmanna	Kulirmala	Other Commercial Stores	Stadium sports, stadium kulirmala, perinthalmanna	Arjun	Employee / worker
Perinthalmanna	Kulirmala	Others	Bjimol CA	Biji	Proprietor / Owner
Perinthalmanna	Kulirmala	Other Commercial Stores	JK traders, near gghss, kulirmala, perinthalmanna	Arif	Proprietor / Owner
Perinthalmanna	Kulirmala	Government Offices	Bsnl office, kpm,	Mr. Rahul	Employee / worker
Perinthalmanna	Kulirmala	Fancy Store	Masoudha perfumes, kulirmala, near mall aslam, perinthalmanna	Jahfar	Proprietor / Owner
Perinthalmanna	Kulirmala	Religious	Masjithul huda	Hakkeem	Security / house keeping staff
Perinthalmanna	Kulirmala	Government Offices	Akshaya	Ramya	Employee / worker
Perinthalmanna	Kulirmala	Educational	IELTS english, near ksrtc	Hrithya	Employee / worker
Perinthalmanna	Kulirmala	Community Hall	Near govt hospital	Ramya	Employee / worker
Perinthalmanna	Kulirmala	Other Commercial Stores	Planet baags, kpm	Arjun	Employee / worker
Thalassery	Maariyamma	Fancy Store	Sithara Complex,NCC Road, Thalassery	Suchithra	Employee / worker
Thalassery	Maariyamma	Other Commercial Stores	Sithara complex, NCC Road, Thalassery	Nihas	Employee / worker
Thalassery	Maariyamma	Other Commercial Stores	Sithara Complex, NCC Road, Thalassery	Shukoor K	Proprietor / Owner
Thalassery	Maariyamma	Other Commercial Stores	Space Building, NCC Road, Thalassery	Madhusudan	Proprietor / Owner
Thalassery	Maariyamma	Other Commercial Stores	Logans Road, Thalassery	Prakash	Proprietor / Owner
Thalassery	Maariyamma	Fancy Store	OV Road, Thalassery	Muhammed Ali	Proprietor / Owner
Thalassery	Maariyamma	Other Commercial Stores	Near New old bus stand, Thalassery	Bhai	Proprietor / Owner
Thalassery	Maariyamma	Stationery	Near Trends, Main Road, Thalassery	Janatha	Proprietor / Owner
Thalassery	Maariyamma	Vegetable & Fruits Markets	Opp Trends, Near new bus stand, Thalassery	Saleem	Employee / worker
Thalassery	Maariyamma	Meat Market	Main Road, Thalassery	Rafeek	Employee / worker

ULB	Ward	Category of Property	Address	Name	Designation
Thalassery	Maariyamma	Other Commercial Stores	Pier Road, Thalassery	Abhijith	Employee / worker
Thalassery	Maariyamma	Other Commercial Stores	Pier Road, Thalassery	Mahmood	Employee / worker
Thalassery	Weavers	Stationery	Puthiyanirath, Azad beach road,Thalassery	Chandran	Employee / worker
Thalassery	Weavers	Provision	Azad Beach Road, Thalassery	Abhiraj	Employee / worker
Thalassery	Weavers	Provision	Main Road, Thalassery	Rahiman	Employee / worker
Thalassery	Weavers	Provision	Main Road, Thalassery	Radhakrishanan	Employee / worker
Thalassery	Weavers	Provision	Main Road,Thalassery	Joshua Paul	Proprietor / Owner
Thalassery	Weavers	Other Commercial Stores	Main Road, Thalassery	Sajeev	Employee / worker
Thalassery	Weavers	Other Commercial Stores	Main road, Thalassery	Musthafa	Proprietor / Owner
Thalassery	Weavers	Stationery	Main Road, Thalassery	Sooraj	Employee / worker
Thalassery	Maariyamma	Other Commercial Stores	NCC Road, Thalassery	Ajith kumar	Proprietor / Owner
Thalassery	Maariyamma	Other Commercial Stores	Logans Road, Thalassery	Ramesh	Security / house keeping staff
Thalassery	Maariyamma	Other Commercial Stores	Logans Road, Thalassery	Shahabas	Employee / worker
Thalassery	Palisseri	Meat Market	Chettam Kunnu Road, Thalassery	Abdul Salam	Proprietor / Owner
Thalassery	Palisseri	Other Commercial Stores	MG Road, Near Old Bus Stand, Thalassery	Majeed	Employee / worker
Thalassery	Maariyamma	Fish Market	Fish market, Near main Road, Thalassery	Linson	Employee / worker
Thalassery	Maariyamma	Other Commercial Stores	Good Shed Road, Thalassery	Monish	Employee / worker
Thalassery	Maariyamma	Other Commercial Stores	Goods Shed Road, Thalassery	Anish	Proprietor / Owner
Thalassery	Maariyamma	Provision	O V Road, Thalassery	Justin	Employee / worker
Thalassery	Maariyamma	Other Commercial Stores	NCC Road, Thalassery	Ansar	Employee / worker
Thalassery	Maariyamma	Provision	Old.Bus stand Road, Thalassery	Raheem	Proprietor / Owner
Thalassery	Maariyamma	Other Commercial Stores	Near Bus Stand, Thalassery	Radhakrishnan	Employee / worker
Thalassery	St. Peters	Household	M K House	Rabi N K	Self
Thalassery	St. Peters	Household	Zuroor, Gopalpeta temple gate	Ashraf	Self
Thalassery	St. Peters	Household	Mufeedha, Gopalpet Road	Muhammed	Self
Thalassery	St. Peters	Household	PP manzil,Gopalpetta	Shifin	Self
Thalassery	St. Peters	Household	Erphonia, Gopalpetta Road, Thalassery	Franky	Son / Daughter
Thalassery	Kaivattam	Household	Marathethil, Gopalpet Road, Thalassery	Adv. T V Ibrahim	Self
Thalassery	Kaivattam	Household	Carmel Villa, gopalpet road, Thalassery	Louis V I	Self
Thalassery	Kaivattam	Household	Bethesda, Near Customs Road, Thalassery	James J	Son / Daughter
Thalassery	Maariyamma	Household	M M Road, Thalassery	Asharaf	Son-in-law / Daughter-in-law
Thalassery	Palisseri	Household	Ishal, Chettakunnam Road, Thalassery	Ismail	Son / Daughter
Thalassery	Palisseri	Household	Rwink, Chettamkunnu Road, Thalassery	Swathi Krishna	Self
Thalassery	Palisseri	Household	Haven, chettukunam Road, Thalassery	Saleema	Spouse

ULB	Ward	Category of Property	Address	Name	Designation
Thalassery	Palisseri	Household	Zayan Manzil, near Enfield Turf, Thalassery	Namsheed	Son / Daughter
Thalassery	Palisseri	Household	Suhara Manzil, Kayith Road, Thalassery	Sabeela	Son / Daughter
Thalassery	Palisseri	Household	Sabarmati, Near Chettamkunnu LP school, Thalassery	Tidil	Self
Thalassery	Palisseri	Household	Varsha, Near Chettamkunnu School, Thalassery	Sreerag	Son / Daughter
Thalassery	Palisseri	Household	Maryam house, near Chettamkunnu LP School, Thalassery	Shiju P	Son / Daughter
Thalassery	Palisseri	Household	Padma Villa,Thalassery	T V Ramachandran Nair	Self
Thalassery	Palisseri	Household	Zafwa Manzil, Chettamkunnu Road, Thalassery	Nazeema	Son-in-law / Daughter-in-law
Thalassery	Palisseri	Household	Afna Villa, Chettamkunnu, Thalassery	Ramla	Spouse
Thalassery	Palisseri	Household	Hanniyah manzil, near Chettamkunnu Road, Thalassery	Althaf	Son / Daughter
Thalassery	Palisseri	Household	Nazakkat, Chettamkunnu Road, Thalassery	Not ready to disclose name	Spouse
Thalassery	Palisseri	Household	Padinjarepurath, Chettamkunnu, Thalassery	Sahir P	Son / Daughter
Thalassery	Palisseri	Household	Alhamd, chettamkunnu road, Thalassery	Shameer	Other Relatives
Thalassery	Palisseri	Household	Arayakandy, Chettakunnam , Thalassery	Arjun Arayakandy	Self
Thalassery	Palisseri	Household	Prabha, Chettamkunnam Road, Thalassery	Ravichandran	Self
Thalassery	Palisseri	Household	Sithara house, Thalassery	Swaroop	Son / Daughter
Thalassery	Kaivattam	Household	Fathimas, Garden Road, Thalassery	Ayoob Rahiman	Son-in-law / Daughter-in-law
Thalassery	Kaivattam	Household	Villa Joffre, Gardens Road, Thalassery	Jibin	Self
Thalassery	Kaivattam	Household	Fellah Apartmnets, Gardens Road, Thalassery	Victor	Self
Thalassery	Kaivattam	Household	Ajisha`s,Gardens Road, Thalassery	Amina	Other Relatives
Thalassery	St. Peters	Household	Ramzan Manzil, Gopalpeta Road, Thalassery	Muhammed Naser	Parents
Thalassery	St. Peters	Household	Darul Falah, Gardens Road, Thalassery	Thoufeek	Son / Daughter
Thalassery	St. Peters	Household	Baithul Rafeeq, gopalpet road, Thalassery	Rasiya	Spouse
Thalassery	St. Peters	Household	KP House, Gopalpeta Road, Thalassery	Antony	Self
Thalassery	Kaivattam	Household	Shamghunadam, Gardens road, Thalassery	Shaarada	Parents
Thalassery	Kaivattam	Household	Lakshmi Bhavan, Gardens Road, Thalassery	Karthik	Son / Daughter
Thalassery	Kaivattam	Household	Preenu Villa, Gardens Road, Thalassery	Sandra	Son / Daughter
Thalassery	Maariyamma	Household	Near MM Road,Thalassery	T V Moidu	Son / Daughter
Thalassery	Maariyamma	Household	Near M M Road	Sarosh Raveendran	Son / Daughter

ULB	Ward	Category of Property	Address	Name	Designation
Thalassery	Kaivattam	Household	Manhatanvadi House, Thalassery	Roshini	Son-in-law / Daughter-in-law
Thalassery	Kaivattam	Household	Malika House, Chakkarakkarde ida, Thalassery	Noorjahani	Spouse
Thalassery	Kaivattam	Household	Ruksana house, near NH 66, Thalassery	Sereena house	Spouse
Thalassery	Kaivattam	Household	Near St Peter`s Church, Church compound, Chalil, Thalassery	Joel	Self
Thalassery	Kaivattam	Household	Anugrah, Chalil, Church Compound, Thalassery	George	Self
Thalassery	Kaivattam	Household	Silvester, Chalil, Church Compound, Thalassery	James	Other Relatives
Thalassery	Kaivattam	Household	Church compound,Chalil, Thalassery	Joseph	Self
Thalassery	Kaivattam	Household	Valiyaveetil, Chakkarakkarde ida, Thalassery	Vineetha	Spouse
Thalassery	St. Peters	Household	Gardens Road	Shammem	Self
Thalassery	St. Peters	Household	Gardens Road	Taufiq	Self
Thalassery	St. Peters	Household	Gopalpet Road	Brijesh	Self
Thalassery	St. Peters	Household	Gopalpet Road	Sudhakar	Self
Thalassery	Maariyamma	Restraunts/Hotels	Sithara Complex, NCC Road, Thalassery	Saji	Proprietor / Owner
Thalassery	Maariyamma	Government Offices	MM Road, Thalassery	Sukumari	Security / house keeping staff
Thalassery	Maariyamma	Others - Hospital/Clinic	Near trends, main road, Thalssery	Revathy	Security / house keeping staff
Thalassery	Maariyamma	Government Offices	Near to GH hospital, Thalassery	Jeevan	Employee / worker
Thalassery	Palisseri	Government Offices	Main Road Thalassery	Sujatha	Security / house keeping staff
Thalassery	Maariyamma	Government Offices	Near Muncipality Office, MG Road Thalassery	Meera	Employee / worker
Thalassery	Maariyamma	Government Offices	MG Road, Near Municipality, Thalassery	Shajahan	Employee / worker
Thalassery	Maariyamma	Educational	M G Road, Near Muncipality, Thalassery	Krishnapriya	Security / house keeping staff
Thalassery	Kaivattam	Religious	Chalil,Thalassery	Jomon	Security / house keeping staff
Thalassery	Kaivattam	Religious	Customs Road, Thalassery	Shihabudeen	Security / house keeping staff
Thalassery	Maariyamma	Others- Lab	Main Road, Thalassery	Shameem	Employee / worker
Thalassery	Maariyamma	Others -theatre	O V Road, Thalassery	Chandran	Proprietor / Owner
Thalassery	Maariyamma	Community Hall	Near Thalassery Rail Over Bridge	Satheesh	Security / house keeping staff
Thalassery	Maariyamma	Religious	Old T C Road, Thalassery	Saadath	Security / house keeping staff
Thalassery	Maariyamma	Educational	NCC Road, Near Bus stand, Thalassery	Jesna	Employee / worker
Thalassery	Maariyamma	Restraunts/Hotels	Logans Road, Thalassery	Rasheed	Employee / worker
Varkala	Ramanthali	Household	No-299, Canal Prompokku Ramanthali Varkala-695141	B.Usha	Spouse
Varkala	Ramanthali	Household	No-298, Charivila Veedu Ramanthali Varkala-	S.Vidhya	Son / Daughter

ULB	Ward	Category of Property	Address	Name	Designation
			695141		
Varkala	Ramanthali	Household	No-328	G.Bindhu	Spouse
Varkala	Ramanthali	Household	No-295, Canal Purampokku Ramanthali Varakala -695141	L.Salini	Spouse
Varkala	Ramanthali	Household	No--197, Pudhuvila Puthan Veedu Thachakonam Varkala-695141	K.Neethika	Spouse
Varkala	Ramanthali	Household	No-415, Nishana Mansion Ramanthali Varakala-695141	Hiru Nisha	Spouse
Varkala	Ramanthali	Household	No-P-24, Canalpuram Prompokku Ramanthali Varakala-695141	R.Jithu	Son / Daughter
Varkala	Ramanthali	Household	No-415, Canalpuram Prompokku Ramanthali Varakala-695141	M.Ameena	Spouse
Varkala	Ramanthali	Household	No--76, Canalpuram Prompokku Ramanthali Varakala-695141	M.Vasanthi	Self
Varkala	Ramanthali	Household	No-414, Canalpuram Prompokku Ramanthali Varakala-695141	P.Shamna	Spouse
Varkala	Ramanthali	Household	Canalpuram Prompokku Ramanthali Varakala-695141	R.Radha	Spouse
Varkala	Ramanthali	Household	No-402, Canalpuram Prompokku Ramanthali Varakala-695141	R.Ajitha	Son / Daughter
Varkala	Ramanthali	Household	No-400, Canalpuram Prompokku Ramanthali Varakala-695141	S.Kadhija	Spouse
Varkala	Ramanthali	Household	No--398, Canalpuram Prompokku Ramanthali Varakala-695141	C.Sudha	Spouse
Varkala	Ramanthali	Household	No--296, Pudhuval Veedu Ramanthali Varakala-695141	G.Geetha	Self
Varkala	Maithanam	Household	No--129, Deepa Prana Nivas Sivagiri Junction Varkala-695141	R.Saroja	Self
Varkala	Maithanam	Household	No-515, Sapallya near PWD Office Varakala-695141	P.Prasan	Son / Daughter
Varkala	Maithanam	Household	Flat No-4, Afia Complex Varakala -695141	M.Beena	Spouse
Varkala	Maithanam	Household	Flat No-3, Afia Complex Varakala-695141	S.Samshiya	Spouse
Varkala	Maithanam	Household	No-516, Prasand Nilayam Court Road Maithanam Varakala-695141	S.Sunitha	Spouse
Varkala	Thachankonam	Household	No-497, Thulasi Bavan Near Court	B.Thulasi Dass	Self

ULB	Ward	Category of Property	Address	Name	Designation
			Thachakonam Varkala-695141		
Varkala	Thachankonam	Others	Thulasi Bavan Near Court Thachakonam Varakala-695141	S.T.Lola Das	Proprietor / Owner
Varkala	Muncipal Office	Household	No--50, Archena Mundayil Near Railway Station Varakala --695141	C.K.Sathasivan	Self
Varkala	Muncipal Office	Household	No--50-A, Mundayil Near Railway Station Varakala-695141	V.Vimala	Spouse
Varkala	Muncipal Office	Household	No-632, Amurtha Sree Maithanam Varkala-695141	M.S.Sreekumar	Self
Varkala	Muncipal Office	Household	No-631, Hira Maithanam Varakala-695141	N.Fathima	Son / Daughter
Varkala	Muncipal Office	Others	Natharsha Hira Maithanam Varakala-695141	P.Jayakumar	Employee / worker
Varkala	Muncipal Office	Household	No-650,Sughosham Maithanam Varakala-695141	R.Rajalakshmi	Spouse
Varkala	Muncipal Office	Household	No-655, Aswathy Cottage Maithanam Varakala-695141	K.Thulasitharan	Self
Varkala	Muncipal Office	Household	No-628, K.S.Bhavan Maithanam Varakala-695141	S.Premjith	Self
Varkala	Muncipal Office	Household	No-695, Uthra Appartment Maithanam Varakala-695141	S.Vinitha	Spouse
Varkala	Muncipal Office	Household	No-668,N.N.Appartment Maithanam Varakala-695141	Any Aravind	Spouse
Varkala	Muncipal Office	Household	No-666, N.N Appartment Maithanam Varakala-695141	G.R. Girisree	Spouse
Varkala	Muncipal Office	Household	No-665, N.N.Appartment Maithanam Varakala-695141	K.Sabeena Gapur	Spouse
Varkala	Muncipal Office	Household	No-667,N.N.Appartment Maithanam Varakala-695141	A.Anilkumar	Self
Varkala	Maithanam	Household	No-51, Vaithiyasala Bungalow Maithanam Varakala-695141	V.Parvathi	Spouse
Varkala	Maithanam	Household	No-58, Mulluvila Veedu Maithanam Varakala-695141	K.Riseetha	Spouse
Varkala	Maithanam	Household	No-192, Rema Raman Maithanam Varakala-695141	S.Lakshmi	Spouse
Varkala	Maithanam	Household	No-60, Mulluvizha Veedu Maithanam Varakala-695141	A.Nisha	Spouse

ULB	Ward	Category of Property	Address	Name	Designation
Varkala	Maithanam	Household	No--55, Mulluvizha Veedu Maithanam Varakala-695141	B.Haseena	Spouse
Varkala	Punnamoodu	Household	No-502, Pulari Therakulam Kurakkanni Varakala-695141	T.Neela	Spouse
Varkala	Punnamoodu	Household	No-544,Manikanda Bavan Therakulam Kurakkanni Varakala-695141	E.Uthchimali	Spouse
Varkala	Punnamoodu	Household	No-545, Charivilam Veedu Therakulam Kurakkanni Varakala-695141	J.Jaya	Son / Daughter
Varkala	Punnamoodu	Household	No-546, Kudaram Therakulam Kurakkanni Varakala-695141	S.Manju	Spouse
Varkala	Punnamoodu	Household	No-547,Chitrai Therakulam Kurakkanni Varakala-595141	G.Geetha	Spouse
Varkala	Punnamoodu	Household	No-540, R.K.K Sathanam Therakulam Kurakkanni Varakala-695141	PK.Vijayalakshmi	Spouse
Varkala	Punnamoodu	Household	No-538/1, Gokulam Therakulam Ponnumoodu Varakala-695141	G.Priya	Spouse
Varkala	Punnamoodu	Household	No-537, Mahaeram Therakulam Kurakkanni Varakala-695141	S.Sunuja	Spouse
Varkala	Punnamoodu	Household	No-537, Charivilam Veedu Therakulam Kurakkanni Varakala-595141	S.Sathi	Spouse
Varkala	Punnamoodu	Household	No-533, Cherivila Veedu Therakulam Kurakkanni Varakala-695141	B.S.Sujithra	Spouse
Varkala	Punnamoodu	Household	No-529, Saleem Cottage Kurakkanni Varakala-695141	S.Amalsha	Spouse
Varkala	Punnamoodu	Household	No-528, Lakshmi Bavan Therakulam Kurakkanni Varakala-695141	R.Saraswathiamma	Spouse
Varkala	Punnamoodu	Household	No-525, Parayeil Veedu Therakulam Kurakkanni Varakala-695141	P.Sreekumar	Self
Varkala	Muncipal Office	Government Offices	No.KSEBL Maithanam Varakala	R.Sreekumar	Employee / worker
Varkala	Maithanam	Other Commercial Stores	I S Agencies Shams Complex Maithanam Varakala-695141	S.Suresh	Employee / worker
Varkala	Maithanam	Others	Sham Complex Ground floor Opposite Railway Station Varakala-695141	A.Ajina	Employee / worker
Varkala	Maithanam	Fancy Store	Pooram Textiles Station Road Varakala-695141	H.Ajis	Proprietor / Owner

ULB	Ward	Category of Property	Address	Name	Designation
Varkala	Maithanam	Other Commercial Stores	Alami Electronics Maithanam Varakala-695141	V.Sunilkumar	Proprietor / Owner
Varkala	Maithanam	Other Commercial Stores	Bhramas Hotel Maithanam Varakala-695141	S.Mohan	Proprietor / Owner
Varkala	Maithanam	Others	G H D Varakala-695141	S G. Rejitha	Employee / worker
Varkala	Maithanam	Government Offices	Agriculture office Varakala-695141	G.Baiju	Employee / worker
Varkala	Maithanam	Malls	Dhanya Super Market Shankar Complex Maithanam Varakala-696141	A.Sherif	Employee / worker
Varkala	Maithanam	Other Commercial Stores	S.N.Electric and Radio Maithanam Varakala-695141	M.Rajan	Proprietor / Owner
Varkala	Maithanam	Stationery	Crayon Books Nediyavizha Maithanam Varakala-695141	P.Sheepa	Proprietor / Owner
Varkala	Maithanam	Fancy Store	Fandacy Fancy Maithanam Varakala-695141	K.U.Samu	Proprietor / Owner
Varkala	Maithanam	Other Commercial Stores	S.K Metals Maithanam Varakala-695141	K.Jayakumar	Proprietor / Owner
Varkala	Maithanam	Other Commercial Stores	HP Dealers Varkala-695141	Abdul Alim	Proprietor / Owner
Varkala	Maithanam	Other Commercial Stores	Braken Fly Maithanam Varakala-695141	S.Saritha	Employee / worker
Varkala	Maithanam	Other Commercial Stores	Vasu Complex Maithanam Varakala-695141	S.Nishanth	Proprietor / Owner
Varkala	Maithanam	Vegetable & Fruits Markets	Bismillah Vegetables Maithanam Varakala-695141	S.Hairnisha	Proprietor / Owner
Varkala	Maithanam	Provision	Kavitha Store Maithanam Varakala-695141	E.Jayaraj	Proprietor / Owner
Varkala	Maithanam	Vegetable & Fruits Markets	Sri Janarthanam Vegetables Maithanam Varakala-695141	G.Babu Chandiran Nair	Proprietor / Owner
Varkala	Maithanam	Malls	Rex Super Market Maithanam Varakala-695141	A.Prakash	Proprietor / Owner
Varkala	Maithanam	Fancy Store	Rex Textiles Maithanam Varakala-695141	G.Jayaraj	Proprietor / Owner
Varkala	Maithanam	Fancy Store	Bombay Fancy Maithanam Varakala-695141	M.Muneer	Proprietor / Owner
Varkala	Maithanam	Other Commercial Stores	Subrapatham Hotel Maithanam Varakala-695141	R.Prabhu	Employee / worker
Varkala	Maithanam	Community Hall	Varasha Meag Maithanam Varakala-695141	V.S.Raju	Employee / worker
Varkala	Maithanam	Other Commercial Stores	I S International Maithanam Varakala-695141	P.S Nair	Employee / worker
Varkala	Kottumoola	Educational	G L. P .G S Varakala-695141	M. Baiju	Employee / worker
Varkala	Mundayil	Educational	GMHSS Varakala -695141	M.Mini	Employee / worker
Varkala	Papanasam	Restaurants / Hotels	Marain Palace Papanasam Varakala	V.R Babu	Employee / worker
Varkala	Papanasam	Restaurants / Hotels	Near Helipad North Cliff Varakala -695141	N.Thoufeeq	Proprietor / Owner
Varkala	Papanasam	Restaurants / Hotels	Helipad North Cliff Varakala -695141	K.G.Umesh Menan	Proprietor / Owner
Varkala	Papanasam	Restaurants / Hotels	Arabiyan Soul Papanasam Varakala -695141	Chenbakh Naveen	Proprietor / Owner
Varkala	Papanasam	Restaurants / Hotels	Dhanal Resort Helipad Cliff Papanasam	P.Subash	Employee / worker

ULB	Ward	Category of Property	Address	Name	Designation
			Varakala-695141		
Varkala	Papanasam	Vegetable & Fruits Markets	Senbagam Super Market Helipad Varakala-695141	A.R.Rafik	Proprietor / Owner
Varkala	Hospital	Others	Government Taluk Head Quarter Hospital Varkala-695141	R.Akil Raj	Employee / worker
Varkala	Kottumoola	Restaurants / Hotels	Chimney Family Restraunt Varkala-695141	Akil Babu	Employee / worker
Varkala	Kottumoola	Meat Market	Bismillah Poultry Form Near Government Hospital Varkala-695141	N.Navas	Employee / worker
Varkala	Hospital	Fish Market	Near Hospital Varakala-695141	J.Sibu	Proprietor / Owner
Varkala	Hospital	Meat Market	N.N.Poultry Farm Maithanam Varakala-695141	C.Monish	Proprietor / Owner
Varkala	Sivagiri	Others	Sivagiri Junction Varakala-695141	B.Sudharsanan	Employee / worker
Varkala	Maithanam	Community Hall	City Center Maithanam Varakala-695141	I.Saifudeen	Employee / worker
Varkala	Kottumoola	Community Hall	Eudy Auditorium Maithanam Varakala-695141	S.Sunil Dat	Employee / worker
Varkala	Kottumoola	Other Commercial Stores	Serin Flour Maithanam Varakala-695141	B.mumdaj	Proprietor / Owner
Varkala	Muncipal Office	Other Commercial Stores	Furniture Making Maithanam Varakala-695141	K.Vijayakumar	Employee / worker
Varkala	Maithanam	Educational	BSS IT College Maithanam Varakala-695141	S.V.Vimitha	Employee / worker
Varkala	Sivagiri	Religious	Sivagiri Madam Varakala-695141	Swamy Sandraananda	Employee / worker
Varkala	Muncipal Office	Restaurants / Hotels	Anandan Tourist Home Opposite Railway Station Varakala-695141	S.Nishanth	Employee / worker
Varkala	Muncipal Office	Restaurants / Hotels	Jaya Tourist Home Maithanam Varakala-695141	B.Bhadran	Employee / worker
Varkala	Muncipal Office	Other Commercial Stores	Vinu Cycle Maithanam Varakala-695141	A.Viswanathan Nair	Proprietor / Owner
Varkala	Maithanam	Fancy Store	Swayamvara Textiles Maithanam Varakala-695141	S.G.Sathisnath	Employee / worker