Government of Kerala

COMPENDIUM OF ENVIRONMENT STATISTICS KERALA 2013-14

DEPARTMENT OF ECONOMICS & STATISTICS, KERALA

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DEPARTMENT OF ECONOMICS AND STATISTICS,
KERALA - 695 033.

PREFACE

Objective of Environment Statistics is to provide information about the environment, its most important changes over time and across locations, and the main factors that influence them. Ultimately, environment statistics aim at providing high quality statistical information to improve knowledge of the environment, to support evidence-based policy and decision making, and to provide information for the general public, as well as for specific user groups. Environment statistics are multidisciplinary and cross-cutting, involving numerous sources and stakeholders

Environment statistics aggregate, synthesize and structure environmental and other data according to statistical methods, standards and procedures. It is the role of environment statistics to process environmental data into meaningful statistics that describe the state and trends of the environment and the main processes affecting them. Not all environmental data are used in the production of environment statistics. The Framework for the Development of Environment Statistics (FDES) provides a framework that marks out environmental data that fall within its scope and then structures, synthesizes and aggregates them into meaningful statistics. Environment statistics support evidence based policy making by enabling the identification of environmental policy issues and the objective quantification of measures and impacts of policy initiatives. They strengthen assessments through quantitative metrics, making analyses more robust through the use of timely and comparable data. The main products of environment statistics are detailed tabulated environment statistics series, environmental accounts and environmental indicators

As an endeavor to know our environment, the Department of Economics and Statistics, Government of Kerala, has been bringing out the publication. This publication has been categorized into different chapters so as to make it easy for reference. The Department would like to express gratitude to all parties concerned for their co-operation and assistance in providing the required data.

This publication is an outcome of earnest effort of Publication Division under the guidance and supervision of Sri. P. V. Babu, Addl. Director (General) comments and suggestions towards improving future reports would be greatly appreciated.

Thiruvananthapuram,
27.05.2017

V. RAMACHANDRAN
DIRECTOR GENERAL

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Environment Statistics

Environment Statistics describe the qualitative and quantitative aspects of the state of the environment and it's Interaction with human activities and natural events by integrating data from a multitude of different subject areas and sources. Environment statistics is an emerging statistical field in official statistics in most countries and it is indispensable for evidence based policies and decision making to support sustainable development.

The Environmental Impact Assessment (EIA) experience in India indicates that the lack of timely availability of reliable and authentic environmental data has been a major bottle neck in achieving the full benefits of EIA. The environments being a multi-disciplinary subject, a multitude of agencies are involved in collection of environmental data. However, no single organization in India tracks available data from these agencies and makes it available in one place in a form required by environmental impact assessment practitioners. Further, environmental data is not available in enhanced forms that improve the quality of the EIA. This makes it harder and more time-consuming to generate environmental impact assessments and receive timely environmental clearances from regulators. With this background, the Environmental Information Centre (EIC) has been set up to serve as a professionally managed clearing house of environmental information that can be used by MoEF, project proponents, consultants, NGOs and other stakeholders involved in the process of environmental impact assessment in India. EIC caters to the need of creating and disseminating of organized environmental data for various developmental initiatives all over the country.

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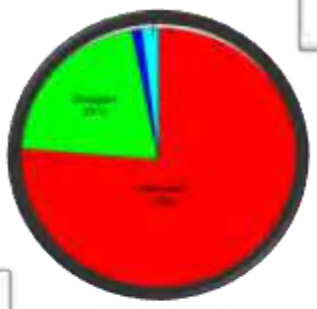

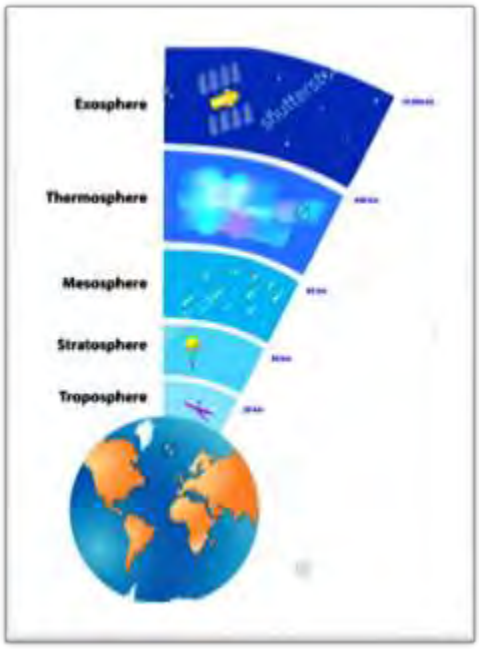

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CHAPTER - I

Environment and Environment Degradation

Introduction

Environment Statistics Kerala is aimed to provide statistical information about the environment, environmental changes over time in different locations of the State and its impact. It also support to produce quality statistical information to improve awareness of the environment, give data support to planners and decision makers in this field and to provide information for the general public. Statistical information collected and compiled in this publication is based on the statistical methods, standards and procedures developed by UNSD's Frame work for the Development of Environment Statistics (FDES). The role of Environment Statistics is to process environmental data into meaningful statistics that bring light on the status and trends of the environment and its impact. Environment regulates the life of the organisms including human beings that interacting systems of physical, biological and cultural elements which are interlinked both individually and collectively.

Environment can be defined as the physical surrounding of human being of whom there is a part on which he/she is depended for their activities like physiological functioning, production and consumption. The physical environment stretches from air, water and land to natural resources like energy carriers, soil and plants, animals and ecosystems. The deterioration of the environment through depletion of resources such as air, water and soil; the destruction of ecosystems and its impact. It is defined as any change or disturbance to the environment perceived to be undesirable.

Environment Degradation

Environmental degradation is the deterioration of the environment through depletion of resources such as air, water and soil; the destruction of ecosystems and the extinction of wildlife. It is a process through which the natural environment is compromised in some way, reducing biological diversity and the general health of the environment. This process can be entirely natural in origin, or it can be accelerated or caused by human intervocations. When natural habitats are destroyed or natural resources are depleted, the environment is degraded. Efforts to counteract this problem include environmental protection and environmental resources management. Air,

water, and soil are all resources which are vulnerable to depletion through overuse, Scarcity of natural resources slow down the sustainable production activity and consumption activities which directly effect the economic development.

Factors affecting Environment degradation:

1. Destruction of natural resources - Soil erosion, land salinization and the loss of nutrients are the major result of agriculture development and farming activities. Unscientific agricultural practices, over exploitation of water resources, increased rate of usage of fertilizers and pesticides and increased non agricultural use of land resulting land degradation and depleting resources.
2. Water pollution and scarcity – Over use of pesticides and fertilizers and unscientific waste disposals are the major source of contamination of water bodies.
3. Deforestation - Expansion of agriculture land, unplanned expansion of cities, industrialization, tourism, etc contribute a lot for the shrinkage of forest area.
4. Air pollution- Air Pollution creates problems of acidification, urban air quality deterioration and chronic health problems. Urban air quality deterioration is one of the major concerns of present day urban life.

Social factors:

1. Population - Population impacts in the environment is basically due to the excessive use of natural resources and unscientific disposal of large quantity of solid and liquid wastes which resulted in harmful environmental degradation and loss of biodiversity.
2. Poverty - Environment degradation linked with poverty mainly due to pressure extended to surrounding environment for daily livelihood. Continueous exploitation of natural resources to satisfy the livelihood of the community degraded the environment to an extend which no longer sustainable and lead to more poverty and environmental related problems such as deforestation, poor sanitation, air and water pollution, draught**,** famine, etc.
3. Urbanization - Deterioration of air and water quality, generation of waste, rural to urban migration, shortage of proper sanitation and housing facilities together contribute to urban poverty and environmental degradation. Direct loss in vegetation, biomass from areas with high probability of urban expansion contributes about 5% of total emission from tropical deforestation and land use change.

Table : 1.1 Some Impacts of Development Activities on Environment

Development Activities	Major Impacts on Environment
Forest clearing and land resettlements	Climate change and resultant outcome of extinction of rare species of flora and fauna, creation of condition for mosquito breeding leading to infectious diseases such as malaria, dengue etc.
Shifting cultivation in upland agriculture	Soil erosion in upland areas, soil fertility declines due to shorter cultivation cycle. The ore under natural forest may be declined fragmentation of habitant, disappeance of native species and invation of exotic weeds and other other plants are the ecological areas of flooding of low land areas.
Agro industries create environmental pollution through discharge of organic or hazardous waste to water bodies emission of gasses that affect air quality and produce toxic substances.	Air pollution due to burning of biogases as fuel in sugar mills, large amount of highly polluting organic wastes, surface water pollution
Introduction of new varieties of cereals	Reduction of genetic diversity of traditional monoculture resulting in instability, danger of multiplication of local strains of fungus, bacteria or virus on new variety
Use of pesticides	Organism develops resistance and new control methods are needed (e.g. in malaria, widespread use of dieldrin as a prophylactic agent against pests of oil palms made the problem worse), creation of complex and widespread environment problems. The pesticides used in agriculture sometimes go into food chain or in water bodies which may result in harmful health hazards.
Timber extraction	Degrades land, destroys surface soil, reduces production potential of future forests.
Urbanisation and industrialization	Concentration of population in urban centers makes huge demands on production in rural areas and put pressures on land, air and water pollution.
Water resource projects, e.g. Dam, extensive irrigation	Human settlement & resettlement, spread of waterborne diseases, reduction of fisheries, siltation, physical changes e.g. temperature, humidity.

Table : 1.2 Local, Regional and Global effects of Pollution

Local Effects	Regional	Over Marine Water and Continents	Changes the climate due to ozone depletion and the greenhouse effect.
• Heavy metals in air, soil, water and plants, eg. from industrial emissions • Discharges • Noise • Smell • Air pollutions • Urbanization	• Eutrophication • Contaminants in the soil & wate • Landscape changes due to mining or agriculture	• Eutrophication • Acidification • Environment Contamination due to Radioactivity	• Climate Change • Ozone Depletion

Table: 1.3 Some Major Pollutants and their Sources

Pollutant	Source
Carbon monoxide	Incomplete fuel combustion (e.g. two/four stroke engines)
Sulphur dioxide	Emissions by vehicles
Suspended particulate matter	Smoke from domestic, industrial and vehicular sources.
Oxides of nitrogen	Fuel combustion of motor vehicles, emission from power stations and industrial furnaces
Volatile hydrocarbons	Partial combustion of carbonaceous fuels (two stroke engines, industrial processes, disposal of solid wastes).
Oxidants and ozone	Emissions from motor vehicles, photochemical reactions of nitrogen oxides and reactive hydrocarbons
Lead	Emissions from motor vehicles, Battery industries

Table: 1.4 Air Pollution Sources

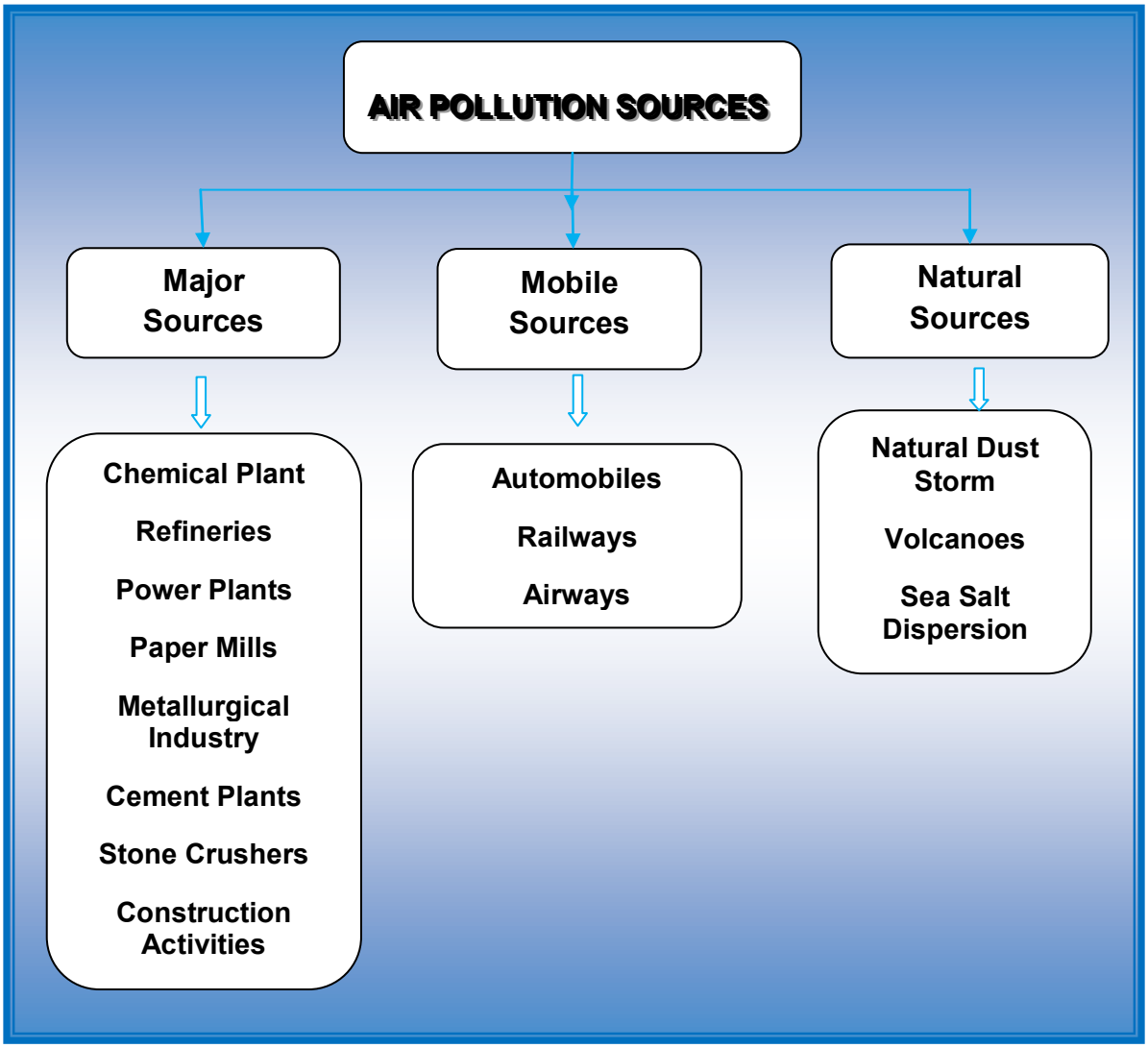


Table : 1.5 Water Born Diseases and their Causative Factors

Name of the Disease	Causative Organism
1. Water-borne diseases Bacterial	
Typhoid	Salmonella typhi
Gastroenteritis	Vibrio cholerae
Paratyphoid	Slmondlla parayphi
Cholera	Enterotoxigenic Escherichia coli
Bacterial dysentery	Variety of Escherichia coli
Viral	
Infectious hepatitis	Hepatitis-A-virus
Pliomycetis	Polio-virus
Diarrhea Diseases	Rota-virus, Norwalk agent,
Other symptoms of enteric Diseases	Other virus Echono-virus, Coxsackie – virus
Protozoan	
Amoebic dysentery	Entamoebahystolitica
2. Water-washed diseases	
Scabies	Various skin fungus species
Trachoma	Trachoma infecting eyes
Bacillary dysentery	E. coli
3. Water-based diseases	
Schistosomiasis	Schistosoma sp.
Guinea worm	Guinea worm
4. Infection through water related insect vectors	
Sleeping sickness	Trapanosoma through tsetse fly
Malaria	Plasmodium through Anaphelis
5. Infection primarily due to defective sanitation	
Hookworm	Hook worm, Ascaris

Table :1.6 Pollutants and their related Health hazards

Pollutants	Health Effects
Carbon Monoxide (from gasoline cars, 2-wheelers, 3-wheelers)	➢ Fatal in large doses ➢ Aggravates heart disorders ➢ Affects central nervous systems ➢ Impairs oxygen carrying capacity of blood
Nitrogen Oxides (from diesel vehicles)	➢ Irritation of respiratory tract
Ozone	➢ Eye, nose and throat irritation ➢ Risk asthmatics, children and those involved heavy exercise
Lead (from petrol vehicles)	➢ Extremely toxic ➢ Affects nervous system and blood ➢ Can impairmental development of children ➢ Cause hypertension
Hydrocarbons (Mainly from 2-wheelers and 3-wheelers)	➢ Drowsiness, eye irritation, coughing
Benzene	➢ Carcinogenic
Aldehydes	➢ Irritation of eyes, nose and throat, sneezing, coughing, nausea, breathing difficulties ➢ Carcinogenic in animals
Polycyclic Aromatic Hydro Carbons PAH (from diesel vehicles)	➢ Carcinogenic

CHAPTER - II

Development of Environment Statistics in Kerala

Introduction

Kerala State spread over a total area of 38,863 Km^2, population of more than 33 million lie in latitude between $8^0$18' and $12^0$48' and longitude between $74^0$52' and $77^0$22'. The long coastline of 580 Km with a intricate system of backwaters along the coast. The tropical moist forest is Western Ghat is highly undulating terrain and the tropical monsoon climate make the state a unique geographical and environmental entity. The people have a high level of literacy rate of 93.91 and are generally conscious of healthcare and hygienic practices resulting in high level of life expectancy, low population growth and low infant mortality rate. The undesirable act of development measures carried out without proper environmental considerations and concerns have left indubitable impacts on the environment.

Infrastructure and Environment Statistics Division

According to the recommendation of the 19th COCSSO, it is decided to constitute an Infrastructure and Environment Statistics Division in this Office. Hence I & ES Division came to effect on the lines of Environment Statistics guidelines brought out by Central Statistical Office, Ministry of Statistics and Programme Implementation, Govt. of India. So far three reports have been released from this division and Environment Statistics 2013-14 is the fourth publication from this division. The data presented in this report are collected from various Agencies and Departments working for the protection of environment or monitor the level of impart on environment.

The Environment Statistics is an annual publication of this division covering the one of bio-diversity of the State, Atmosphere, Rithosphere, Hydrosphere and Human Intervention and related stress on the environment.

Kerala State Pollution Control Board

Kerala State Pollution Control Board has been constituted on 12.9.1974 by the Govt. of Kerala for prevention and Control of Water Pollution. It was the first State Board constituted in the country under the Water Act in 1984. The Kerala State Pollution Control Board entrusted with the

implementation of the Air Act also. Administrative control over the Board is vested with the Environmental Department of the Government of Kerala and the Ministry of Environment and Forest, Government of India. The activities of the State Boards are co ordinated by Central Pollution Control Board.

1. The Water Act (Prevention & Control of Pollution)

- Plan a comprehensive program for the prevention, control or abatement of pollution of streams and wells in the State and to secure the execution thereof;
- Advise the State Government on any matter concerning the prevention, control or abatement of water pollution;
- Collect and disseminate information relating to water pollution and the prevention, control or abatement thereof;
- Encourage, conduct and participate in investigations and research relating to problems of water pollution and prevention, control or abatement of water pollution; to collaborate with the Central Board in organising the training of persons engaged or to be engaged in programs relating to prevention, control or abatement of water pollution and to organise mass education programs;
- Inspect sewage or trade effluents, works and plants for the treatment of sewage and trade effluents and to review plans, specifications or other data relating to plants set up for the treatment of water, works for the purification there of and the system for the disposal of sewage or trade effluents or in connection with the grant of any consent as required by this Act lay down, modify or annul effluent standards for the sewage and trade effluents and for the quality of receiving waters (not being water in an interstate stream) resulting from the discharge of effluents and to classify waters of the State.

2. The Water Cess Act (Prevention & Control of Pollution)

- Receive water consumption returns from persons liable to pay cess;
- Assess the cess payable by the concerned person carrying on any special industry or local authority;
- Allow rebate on the cess payable by any person carrying on any industry or local authority who install requisite plant for treatment of sewage or trade effluent;
- Collect cess from the assessees.

3. The Air Act (Prevention & Control of Pollution)

- Plan a comprehensive programme for prevention, control and abatement of air pollution and to secure the execution thereof;
- Advise the State Government on any matter concerning prevention, control or abatement of air pollution.;
- Collect and disseminate information relating to air pollution;
- Collaborate with the Central Board in organising the training of persons engaged or to be engaged in programmes relating to prevention, control or abatement of air pollution and to organise mass education programmes relating thereto;
- Inspect, at all reasonable times, any control equipment, industrial plant or manufacturing process and to give, by order, such directions to such persons as may be considered necessary to take steps for prevention, control or abatement of air pollution;
- Inspect air pollution control areas at such intervals as it may think necessary, assess the quality of air therein and take steps for the prevention, control or abatement of air pollution in such areas
- Lay down, in consultation with the Central Board and having regarding to the standards for the quality of air laid down by the Central Board, standards for emission of air pollutants into the atmosphere from industrial plants and automobiles or for the discharge of any air pollutant into atmosphere from any other source whatsoever not being a ship or an aircraft, provided that different standards for emission may be laid down under this clause for different industrial plants having regard to the quantity and composition of emission of air pollutant into the atmosphere from such industrial plants.

4. The Environment (Protection) Act

- Implement measures for the protection and improvement of environment and the prevention of hazards to human beings, other living creatures, plants and property;
- Remedial measures to prevent or mitigate environmental pollution in case of accidents;
- Inspections to check compliance and to collect or seize evidence thereof;
- Collect samples of air, water, soil or other substances;
- Service as Environmental Laboratory;
- Standardised methods for sampling and analysis of various types of environmental pollutants;
- Analyse samples sent by empowered officers;

- Carry out investigations to lay down standards, to monitor and to enforce standards;
- Carry out any other entrusted function;
- Take cognisance of offences.

Hazardous Wastes Rules

- Process applications for and to issue/refuse/renew authorisation for collection, reception, treatment, storage and disposal of hazardous wastes;
- Monitor compliance with the provisions and conditions of authorisation;
- Process and forward to the Ministry of Environment & Forests applications for imports;
- Review matters pertaining to identification and notification of disposal sites.

The Manufacture, Storage and Import of Hazardous Chemical Rules, particularly

- Enforce directions and procedures in respect of isolated storage of hazardous chemicals, regarding;
- Co-operate in preparation of on-site emergency plans;
- Enforce directions and procedures on import of hazardous chemicals on information regarding import;
- Issue direction to importer to take appropriate safety measures, including stoppage of import, if necessary;
- Informing concerned port authority on safety measures;
- Serve improvement notice on persons contravening the Rules.

Rules for the Manufacture, Use, Import, Export and Storage of Hazardous Micro-organisms, Genetically Engineered Organisms or Cells

- Inspect, investigate and take punitive action on behalf of the State Biotechnology Co-ordination Committee in case of violations;
- Supervise, on behalf of the Genetic Engineering Approval Committee, implementation of the terms and conditions of approvals granted by the Committee.

The Chemical Accidents Rules (Emergency Planning, Preparedness and Response)

- To serve in the State Crisis Group;
- To serve in the District Crisis Groups which are the apex bodies in the respective areas to deal with major chemical accidents and to provide expert guidance for handling chemical accidents.

The Biomedical Waste Rules (Management and Handling)

- Receive from institutions generating, collecting, receiving, storing, transporting, treating, disposing and/or handling biomedical wastes applications for authorisation, to process the same and issue/ refuse/ renew/ cancel/ suspend authorisation;
- Compile and furnish to the Central Pollution Control Board annual reports from occupiers / operators;
- Inspect and verify facilities and records;
- Receive and act upon reports of accidents.

The Plastics Manufacture, Sales and Usage Rules

- Receive and process applications for registration for manufacture of virgin/recycled or both plastic carry bags and containers and to issue/refuse/renew/cancel registration.

The Municipal Solid Wastes Rules (Management and Handling)

- Monitor compliance with standards on ground water, ambient air, leachate quality, compost quality and incineration;
- Receive and process application for authorisation for setting up waste processing and disposal facility and to issue / refuse / renew / cancel authorisation;
- Furnish annual reports to the Central Pollution Control Board.

The Noise Pollution Rules (Regulation and Control)

- Regulate and control noise of industrial origin;
- Monitor ambient sound levels;
- Advise the State Government on pollution control.

The Batteries Rules (Management and Handling)

- Receive and verify half yearly returns on sale of new batteries and collection of old batteries;
- Receive and verify half yearly returns on sale and collection of batteries by dealers;
- Receive and verify annual returns from recyclers of used batteries;
- Receive and verify half yearly returns form bulk consumers of batteries;
- Receive and verify half yearly returns by auctioneers of used batteries;
- Ensure compliance with the Rules;
- File annual compliance status report to the Central Pollution Control Board.

The EIA notification

- Receive request for environment public hearing;
- Notify the details of public hearing;
- Assist District Collector for public hearing and to furnish report thereof to the Ministry of Environmental and Forests.

Public Liability Insurance Act, 1991

- Make application to court to restrain owner under section 13(1) from handling hazardous substances, to implement the order of the Court under section 13(3)(b) and to recover cost thereof under section 13(4).
- Receive and act upon notice under section 18(b) of intention to make complaint to Court

Western Ghats Development Programme

- The Western Ghat region of Kerala (Sahyadri) stretches over 450 km (28.12%) out of the total length of 1600 km and is spread over 80 Block Panchayats and 537 Grama Panchayats. 31 Taluks in the State with a total geographical area of 28008 sq.km and around 50% of the State's population is in the Western Ghat region. Western Ghats plays an important role acting as barrier to southeast monsoons causing substantial rainfall over the hills (more than 3000 mm annually) and the "Sahyadri" gives birth to all the 44 rivers flowing through the State and sustains rich natural forests and minerals. This region is a treasure of plants and animals and is declared as one of the bio diversity hot spots in the world.

- The Western Ghats in Kerala have two major segments, southern segment south of Palakkad Gap and northern segment beyond the gap extending up to the Kodugu boundary. There are three sections of the eastern slopes of Western Ghats falling within Kerala viz. the Pambar- Chinnar basin, the Attappady Plateau drained by Bhavani, and the Wayanad section drained by Kabani. The Western Ghats that rise from low altitude of about 70 m MSL extend up to 2000m MSL on an average on the eastern boundary. Anamudy is the highest peak with an altitude of 2690m MSL.

- Western Ghats that supports a wide range of forest types ranging from tropical wet evergreen forests to grasslands, some 4000 species of flowering plants with high degree of endemism and rich fauna with endemism ranging from 11% to 78% among different groups. Consequently, Western Ghats constitutes not only one of the hotspots of biodiversity in the world, but also one among world's eight hottest hotspots.

- The life supporting and biodiversity rich ecosystems of Western Ghats are threatened today due to habitat pressures.

Western Ghats Development Programme, a centrally sponserd scheme funded by Government of India under the Hill and Railfall area development scheme to protect the rich biodiversity in this region through generation of the forest cover with People's Participation, Eco-Preservation, Natural Resource Management and Watershed Development programme.

Department of Environment

Department of Environment Statistics is responsible for the coordination of activities of different departments, authorities, and local bodies in the State relating to environment and implementation of the Environment Policy of the State. The department will focus on promotional aspects for the protection and conservation of the environment with the help of the concerned government departments, research institutes, regulatory bodies, local bodies and reputed non-governmental organizations, researchers and academicians.

National Centre for Earth Science Studies

National Centre for Earth Science Studies (NCESS) is the leading centres of excellence in the field of Earth System Science in the country, and is functional for the past 36 years. The CESS, as a scientific establishment carried out extensive research and development work in major components of Geosphere, Hydrosphere, and Atmosphere. The approach and accomplishments of CESS, in understanding and addressing the geological evolution of south India, complexities of the coastal processes and natural hazards, natural resources management have all along been consistent with the national R&D priorities in Earth Sciences and thrust areas of the Ministry of Earth Sciences (MoES). CESS has made important contributions towards understanding the complexities of coastal processes including the mud banks which is unique for the south-west coast of India.

Data generated under this programme found useful for various planning purposes at the State level and also to pursue systematic studies under various geo-environmental conditions. Data base has been generated under the broad resource categories of land, land use, water, forest, infrastructure, and population and allied activities. Water quality analysis also taken up for selected rivers and back waters for pollution monitoring and data base development. Land system and drainage pattern analyses are based on maps, images and direct field measurements. Earthquake monitoring and study of neo-tectonics are in hazard studies. Physical and social vulnerability analyses are taken up for hot spots in the Western Ghats and selected coastal stretch to develop management plans. Data on climatic parameters and greenhouse gases (GHG) will be acquired by installing field stations, one along coast and another at Munnar in Western Ghats region. Application of remote sensing will cover geological studies, corals and agricultural operations.

Kerala State Biodiversity Board

Kerala State Biodiversity Board has function as a centre for applied research for conservation of Kerala's biological diversity. The centre is being established for collection, collation, management, analysis, and dissemination of data on biological diversity. The research centre will provide scientific support to Kerala State Biodiversity Board in decision making on matters related to biodiversity, so as to enable the Board to advise the State Government on salient environmental and conservation issues. The centre will also enable the Board for

translating the knowledge generated for sustainable development and access to diverse species enables diversification of livelihood through, planting multiple crops and thus enabling food production throughout the year, or engaging in alternative income-generating activities. The availability of diverse resources also allows different genders, cultural or age groups to engage in and benefit from the resources.

Jawaharlal Nehru Tropical Botanic Garden and Research Institute (JNTBGRI)

Jawaharlal Nehru Tropical Botanic Garden and Research Institute (JNTBGRI) formerly known as Tropical Botanic Garden and Research Institute (TBGRI) was founded in 1979 with the objective of establishing a Conservatory Botanic Garden of tropical plant resources in general and of the country and the Kerala state in particular. It also undertakes research programmes for the sustainable utilization of these resources. The Government of Kerala established the Institute as an autonomous research and development organisation in 1979. In 1996, the Saraswathi Thangavelu Extension Centre of JNTBGRI housing the bioinformatics component became functional. During the year 2003, JNTBGRI was brought under the newly formed society, Kerala State Council for Science, Technology and Environment (KSCSTE), which is registered as a society under the Science and Technology Department, Government of Kerala. The institute is located in 300 acres of natural forestland, right in the lap of the Western Ghats of Palode, 40 km northeast to Thiruvananthapuram city, on the Thiruvananthapuram- Shenkottah state highway. The Extension Centre is situated at Puthenthoppe, 15 km north of Thiruvananthapuram city, near the sea coast.

Conservation and sustainable utilisation of the plant biodiversity advance knowledge, enjoyment and conservation of plants through excellence in biodiversity research management, horticulture displays and educational. JNTBGRI is reckoned as the biggest conservatory garden in Asia with over 50,000 accessions belonging to 4000 species. Highly coordinated multidisciplinary research is undertaken in the areas of Plant Taxonamy, Conservation Biology, Ethnobotany and Bioprospecting (Biotechnological, Pharmocological and Phytochemical).

National Institute of Oceanography

The National Institute of Oceanography Kochi Regional Centre is one of the 37 Constituent Laboratories of the Council of Scientific and Industrial Research Centres (CSIR) New Delhi. CSIR-NIO was established on 1966 following the international Indian Ocean Expedition in the 1960s. In addition of basic research of observing and understanding special oceanographic

characteristics of Indian Ocean, the institute also carries out Oceanographic data collection, environmental impact assessment, and modelling to predict environmental impact. The Institute also provide consultancy on a number of issues including marine environmental protection and coastal zone regulations. With the largest collection of ocean scientists in the country, and equipped with suitable ocean research infrastructure, CSIR-NIO serves as an advanced centre of education in ocean sciences. It has a School of Oceanography under the Academy of Scientific & Innovative Research (AcSIR). In addition, it is a recognized centre for doctoral research by a large number of universities.

Marine biodiversity - The Indian Ocean is a region of very high biological diversity has been analyzing and documenting diversity of all forms of life – microbes, plants and animals - from various marine ecosystems. National Institute of Oceanography has carried out investigations to unravel interactions between the environment and organisms and the key area of its research is the impact of natural and human-induced stresses such as deoxygenating, eutrophication and acidification on biogeochemistry and ecosystems in fresh water and marine environments. National Institute of Oceanography is actively engaged in monitoring the health of Indian coastal environs.

Kerala University of Fisheries and Ocean Studies (KUFOS)

Kerala University of fisheries and Ocean Studies (KUFOS) is an autonomous institution established on 20th November 2010. KUFOS is the first fisheries university in the country. The head quarters of KUFOS at Panangad 12 km away from Kochi City. It provides high quality instructional programmes in fisheries, Ocean Sciences and allied subjects.

Central Marine Fisheries Research Institute

Government of India established the Central Marine Fisheries Research Institute, Kochi on 3rd February 1947 under the Ministry of Agriculture and Farmers Welfare and later it joined the ICAR in 1967. During the course of over 65 years the Institute has emerged as a leading tropical marine fisheries research institute in the world. CMFRI devoted its research attention towards the estimation of marine fisheries landings and effort, taxonomy of marine organisms and the bio-economic characteristics of the exploited stocks of finfish and shellfish. This research effort contributed significantly to India's marine fisheries development from a predominantly artisanal, sustenance fishery till the early sixties to that of complex, multi-gear, multi-species fisheries.

Cochin University School of Environmental Studies

The School of Environmental Studies, a Centre for higher learning dedicated to environmental protection and sustainable development conceptualized in 1980 was established in 1983 to serve the cause of well-being of the society by imparting knowledge and by providing trained manpower and appropriate environmental technology. To achieve these objectives, the School offers a carefully designed regularly updated curriculum, competence-based consultancy and reaches out to the community with socially relevant extension programmes. Doctoral programme is offered in various facets of Environmental Science and Technology including Environmental Biology, Chemistry, Microbiology, Meteorology and Toxicology. The School has state-of-the-art laboratories in Environmental Chemistry, Environmental Biology, Environmental Toxicology, Environmental Virology, Environmental Biotechnology, Environmental Microbiology, and Remote Sensing Environmental Resource and Disaster Management. The School of Environmental Studies give equal importance to Research, Teaching and Extension in Environmental Science and Technology with the motto of Environmental protection for a sustainable development aiming at a better tomorrow.

Activities

Region based biodiversity conservation movement with the help of Life science Departments of local colleges. Activity includes biodiversity registry development, examination of local agricultural and industrial activities and any anthropogenic activity which would affect the existing biodiversity, develop alternative strategy to protect the ecosystem, creation and awareness among the local people on the need of protecting the biodiversity for holistic development. This also includes propagation of endangered species of plants and animals also.

Protection of Mangrove ecosystem of Kerala: Kerala was well known of its diverse mangrove plant species which formed the nursery ground of finfish and shell fishes and protected the coastal zone from erosion. This magnificent ecosystem is vanishing. A comprehensive programme to protect the system by bringing under mangrove aforestation more regions with the species lost from the region has been planned.

Protection of the rivers of Kerala: Kerala is blessed with 45 rivers. Tragically several of them are dieing. Immediate action has to be taken to revive them with people's participation. A comprehensive package is under development incorporating the NGOs who have been working in this realm for a long period.

National Centre for Aquatics Animal Health (formerly Centre for Fish Disease Diagnosis and Management) incepted in January 2000 under the faculty of Environmental Studies, pioneered the promotion of sustainable aquaculture using the latest developments in Marine Biotechnology in India. Motto of the centre is relentless effort for the Protection of Health of Aquatic Animals and their Environment and it continually endeavors to transfer the outputs of research directly to the end users, the aquarists. The research and development activities of the centre use cutting edge technology to bring in novel innovations for the development of sustainable aquaculture in India.

CHAPTER - III

Biodiversity of Kerala

Biodiversity reflects the number, variety and variability of living organisms and how these are change from one location to another and over time. Biodiversity includes diversity within species, between species, and between ecosystems. Biodiversity is essential for the ecosystems which provide regulating and supporting services for life in our planet. Air, water and food have been naturally regulated through a huge range of physical, chemical and biological interactions. The dispersal and dilution of pollutants, steady supply of clean water, protection of coast, prevention of flooding, regulation of climate through locking away of carbon, etc. The supporting services like the natural environment provides income from tourism, food, water and fuel. Wise and sustainable use of environment replace and replenish resources. Its role goes beyond ensuring the availability of raw materials to include security, resiliency, social relations, health and freedoms and choices.

Plant and animal biodiversity as a national and global resource is extremely valuable, inadequately documented and often waste. The preservation of biodiversity is both a matter of investment and insurance to sustain and improve agricultural, forestry and fisheries productions also act as a buffer against harmful environmental changes, provide raw materials for scientific and industrial innovations, and safe guard transferring biological richness to future generations.

In the atmosphere, gases such as water vapour, carbon dioxide, ozone, and methane act like the glass roof of a greenhouse by trapping heat and warming the planet. These gases are called greenhouse gases. The natural levels of these gases are being supplemented by emissions resulting from human activities, such as the burning of fossil fuels, farming activities and land-use changes. As a result, the Earth's surface and lower atmosphere are warming, and this rise in temperature is accompanied by many other changes.

There is ample evidence that climate change affects biodiversity. According to the Millennium Ecosystem Assessment, climate change is likely to become one of the most significant drivers of biodiversity loss by the end of the century. Climate change is already forcing biodiversity to adapt either through shifting habitat, changing life cycles, or the development of new physical traits.

Plant Diversity in Kerala

The Western Ghats region of the state is one of the 25 biodiversity hotspots in the whole world. The researchers in the field identified more than 4,500 species of flowering plants in the state and out of which about 1,500 taxa are endemic in nature. There is also equally rich fauna belt in the state. The diversity of lower plants and animal groups, and the marine flora and fauna in particular even though not fully known, is remarkably rich in the state. An earlier estimate had shown that there are about 10,035 plant species indigenous to the state. The available total floral wealth of the state is given below.

Table: 3.1 Flora Statistics Kerala and India 2013-14

Sl. No.	Category	Kerala	India	% to the Indian Flora
1.	Flowering Plants	4500	17500	25.71
2.	Gymnosperms	4	64	6.25
3.	Pteridophytes	236	1100	21.45
4.	Bryophytes	350	2850	12.28
5.	Lichens	520	2000	26.00
6.	Algae	325	6500	5.00
7.	Fungi	4800	14500	33.10

Source : Forest Statistics 2013

Endemic Species

There are about 1272 species of endemic angiosperms out of 3800 species in Kerala, which is 33.5%. The endemic flora in Kerala is mainly palaeotropic in composition, which is a part of the peninsular Indian endemic flora of Gondwanaland origin. There are about 189 endemic plant species reported from Agasthyamala. The recent surveys have resulted in the discovery of 35 new species of plants from this small stretch of forests. The endemic gene of Anamalai and High Ranges are *Haplothismia, Pseudoglochidion* and *Utleria*. The species which are critically

endangered or probably extinct are *Anaphalis barnesii, Begonia aliciae, Didymocarpus macrostachya, Habenaria flabelliformis, Impatiens anaimudica, I. johnii, I. macrocarpa, I. platyadena, I. verecunda, Ophiorrhiza barnesii, O. caudata, O. munnarensis and Sonerila nemakadensis*. The five endemic genera occurring in the Silent Valley - Wayanad region are: Chandrasekharania, Baeolepis, Kanjarum, *Meteoromyrtus,* and *Silentvalleya.*

Invasive alien species and biodiversity

Alien species are non-native or exotic organisms that occur outside their natural adapted ranges and dispersal potential. Many alien species support our farming and forestry systems, some of the alien species become invasive when they are introduced deliberately or unintentionally outside their natural habitats into new areas where they express the capability to establish, invade and out compete native species. Plants, mammals and insects comprise most common types of invasive alien species in terrestrial environments. The threat to biodiversity due to invasive alien species is considered second only to that of habitat destruction. Invasive species cause loss of biodiversity including species extinctions, and changes in hydrology and ecosystem function. Differences between native and exotic plant species in their requirements and modes of resource acquisition and consumption may cause a change in soil structure, its profile, decomposition, nutrient content of soil, moisture availability, etc.

Alien species cause major environmental and economic problems worldwide. Many native species are threatened by competition and predation from the invaders, resulting in the ecosystem modification and loss of biodiversity. Quantification of the ecosystem damage and loss to biodiversity due to alien species invasion is complex due to the interaction of many biotic and abiotic factors. Growth of human population and human activities related to trade and tourism, witnessing increased risks associated with alien species introductions.

Protected Areas of Kerala : The Protected areas of Kerala include a wide range of biomes, extending east from the coral reefs, estuaries, salt marshes, mangroves and beaches of the Arabian Sea through the tropical moist broadleaf forests of the Malabar Coast moist forests to the North Western Ghats moist deciduous forests and South Western Ghats moist deciduous forests to South Western Ghats montane rain forests on the western border of Tamilnadu in the Western Ghats.

Table : 3.2 Protected areas

Sl. No.	Protected Areas	Area (Km^2)	District
1	Periyar Tiger Reserve (PTR)	777	Idukki
2	Neyyar Wildlife Sanctuary	128	Thiruvananthapuram
3	Peechi-Vazhani Wildlife Sanctuary	125	Thrissur
4	Parambikulam Wildlife Sanctuary	285	Palakkad
5	Wayanad Wildlife Sanctuary	344.44	Wayanad
6	Idukki Wildlife Sanctuary	70	Idukki
7	Eravikulam National Park	97	Idukki
8	Peppara Wildlife Sanctuary	53	Thiruvananthapuram
9	Thattekkad Bird Sanctuary	25	Ernakulam
10	Shendurney Wildlife Sanctuary	171	Kollam
11	Chinnar Wildlife Sanctuary	90.44	Idukki
12	Chimmony Wildlife Sanctuary	85	Thrissur
13	SilentValley National Park	89.52	Palakkad
14	Aralam Wildlife Sanctuary	55	Kannur
15	Pampadum Shola National Park	1.318	Idukki
16	Mathikettan Shola National Park	12.817	Idukki
17	Anamudi Shola National Park	7.5	Idukki
18	Mangalavanam Bird Sanctuary	0.027	Ernakulam
19	Kurinjimala Sanctuary	32	Idukki
20	Choolannur Pea Fowl Sanctuary	3.42	Palakkad
21	Kadalundi-Vallikunnu Community Reserve	1.5	Kozhikkode & Malappuram
22	Malabar Wildlife Sanctuary	74.215	Kozhikkode

Western Ghats

The Western Ghats Region of Kerala covers 450 Kms. (28.12%) out of the total length of 1600 Kms. The Kerala region (Sahyadri) of Western Ghats comprises of 72% of the total geographical area of the State and around 50% of the State's population. Western Ghats play an important role in providing substantial rainfall in the State. The 'Sahyadri' is the birth place of 44 major rivers flowing through the State. The rich natural forests of this region are a treasure house of palnts, animals and minerals. The influence of Western Ghats has been remarkable in the preservation of ecology of the State.

Western Ghats province with five regions recognised for conservation management and they are Wayanad, Upper Nilgiri, Anamalai, Periyar and Agastyamalai. High rainfalls on the Ghats have blessed the state with tremendous biological values of great variety, Kerala has considerable ecological diversity. The peculiar topography of the state created spatial variation in climate and soil parameters. The high levels of local endemism can be attributed to biogeographic barriers provided by the large valleys. Today Kerala has 22 Protected Areas totaling 2,308 sq km or 5.9% of the total land area, which is inadequate to protect the great biological wealth of the forests.

Biological Values

The coastline largely degraded. Most biological values are found in the Western Ghat province. Kerala part of the Ghats has the Wettest, most tropical and most biologically diverse forests. Of the seven evergreen forest types recognised in the region, Kerala has four: Cullenia-Mesua; Persea - Dipterocarpus; Dipercarpus-Mesua; and montane shola. Major biogeographic barriers separate the Wayanad-Nilgiri areas from Anamalai-Periyar and that form the southern Agastyamalai hills. Extreme levels of localised endemism are borne out of the fact that the Kerala area of Agastyamalai has some 109 totally endemic plants, Nilgiri another 95 and Anamalai 39. The area's biological diversity is equally true of animal life. More than half of the country's amphibians are restricted to the Western Ghats. These are endemic reptiles like the Travancore tortoise, birds like the Grey Malabar Hornbill and mammals like the Malabar civet. The forests in Kerala have significant populations of tiger, leopard, elephant, gaur and many lesser ungulates. The Nilgiri Tahr is characteristic of higher mountain grasslands. There are two primates endemic to the area: the Nilgiri Langur and the Lion - tailed macaque. The Silent Valley National Park with its diverse flora and fauna is an excellent example of evergreen forest of immense biological values.

The Wayanad Evergreen Forests

Spread across Kerala and Karnataka, this region is the transition zone between the southern Cullenia dominated forest and the drier Dipterocarpus of the north. Floristically very rich, the tract has two small Sanctuaries: while Aralam Wild Life Sanctuary with an extent of 55 sq km is in Kerala, the Brahmagiri WLS is in Karnataka. Located on the western slopes of the Ghats, Aralam is rich in wildlife. Elephant, deer, bison are common. The plant life is typical of evergreen and semi-evergreen forests of the Ghats. The altitude varies from 50m to 1145m from MSL. Temperature varies at the foothills from 21°c to 40°c whereas on the higher reaches it is between 8°c and 25°c. The average rainfall is about 300 mm. June to August are the wettest months. Adjacent to the three contiguous protected areas of Nagarhole, Bandipore and Mudumalai is the Wayanad Wildlife Sanctuary of Kerala with an extent of 144 sq km. It is also an integral part of the Nilgiri Biosphere Reserve which was established for the conservation of the biological diversity of the region. There is a large elephant population, there are different kinds of deer, monkeys and birds. Tree species and plants common to South Indian moist deciduous forests and West coast semi-evergreen forests are seen.

The Upper Nilgiri of Kerala

The Nilgiri plateau and western slopes contain some of the finest forest Wildlife habitat in India. Two small partially adjacent Protected Areas are located here, one is the Silent Valley National Park of Kerala and the other is the Nilgiri Tahr WLS in Tamil Nadu. Only 89 sq km in extent, the Silent Valley National Park is the Core of the Nilgiri Biosphere Reserve and claims a long unbroken ecological history. The forests belong to the biogeographical class of the Malabar Rain Forests, and relic of the ancient India- Malayan continuum and harbour a thousand species of plants. The Valley has a fair representation of all peninsular mammals. There are also several species of birds, butterflies and moths.

The Anamalai Hills of Kerala

The Annamalai Hills are also known as Elephant Hills, the range of mountains that form the southern portion of the Western Ghats and the border of Kerala and Tamil Nadu. Anamudi (2700m) is the highest peak in the entire Western Ghats. The Palghat Gap has isolated the Anamalai Hills resulting in extensive speciation in several plant and animal groups. Elevation ranges between 150 m and 2500m. Forests extending from lowland Dipterocarp communities to wet temperate shola forests to moist and dry deciduous formations contain the most varied set of habitats and animal and plant species of any region in peninsular India.

Flora

Western Ghats occurring 7,402 species of flowering plants, 5,588 species are native or indigenous and 376 are exotics naturalised and 1,438 species are cultivated or planted as ornamentals. Among the indigenous species, 2,253 species are endemic to India and of them, 1,273 species are exclusively confined to the Western Ghats. Apart from 593 confirmed subspecies and varieties; 66 species, 5 subspecies and 14 varieties of doubtful occurrence are also reported and therefore amounting 8,080 taxa of flowering plants. An exotic product of Western Ghats is carried to outside India through the Silk Route and Arabian Sea from ancient time onwards.

Table : 3.3 Species in major group of plants - India & Kerala

Sl. No.	Plant Groups	World	India	Kerala	% in India
1	Bryophytes	14,500	2504	465	18.57
2	Pteridophytes	12,000	1267	337	26.59
3	Gymnosperms	650	74	5	6.75
4	Angiosperms	250,000	17,926	4606	25.69

Fauna

The Western Ghats are home to thousands of animal species including at least 325 globally threatened species. Many are endemic species, especially in the amphibian and reptilian classes.

Table : 3.4 Globally Threatened Species

Sl. No.	Animal Groups	No. Genera/species
1.	Protozoa	63 genera
2.	Porifera	22 genera
3.	Cnidaria	90 genera
4.	Chaetognatha	18
5.	Platyhelminthes	117 genera
6.	Aschelminthes	265
7.	Acanthocephala	27
8.	Annelida	91
9.	Molludca (Fresh water)	26
10.	Insects	6000
11.	Non-insect Arthropda	600
12.	Echinodermata	8

Vertebrate Diversity of Kerala

Vertebrate Diversity of Kerala is represented by 1,847species in 330 families and 81 orders. Fishes are the most diverse group of vertebrates with 905 species followed by birds with 500 species, reptiles with 173 species, ambhibians with 151 species and mammals with 118 species.

Table : 3.5 Vertebrate diversity of Kerala

Sl. No.	Taxonomic Group	Orders	Families	Species
1	Fishes	41	172	905
2	Birds	22	88	500
3	Reptiles	3	24	173
4	Amphibians	2	11	151
5	Mammels	13	35	118
	All Vertebrates	**81**	**330**	**1847**

Fishes

As of 2004, 288 freshwater fish species are listed for the Western Ghats, including 35 also known from brackish or marine water. Several new species have been described from the region since then (e.g., *Dario urops*, *Horabagrus melanosoma* and *S. sharavathiensis*). There is higher fish richness in the southern part of the Western Ghats than in the northern, and the highest is in the Chalakudy River, which alone holds 98 species. Other rivers with high species numbers include the Periyar, Bharatapuzha, Pamba and Chaliyar, as well as upstream tributaries of the Kaveri, Pambar, Bhavani and Krishna rivers. The most species rich families are the Cyprinids (72 species), hillstream loaches (34 species; including stone loaches, now regarded a separate family), Bagrid catfishes (19 species) and Sisorid catfishes (12 species). The region is home to several brilliantly colored ornamental fishes like Denison's (or red line torpedo) barb, several species of *Dawkinsia* barbs, zebra loach, *Horabagrus* catfish, dwarf pufferfish and dwarf Malabar pufferfish. The rivers are also home to *Osteobrama bakeri*, and larger species such as the Malabar snakehead and Malabar mahseer. According to the IUCN, 97 freshwater fish species from the Western Ghats were considered threatened, including 12 critically endangered, 54 endangered and 31 vulnerable. An additional 26 species from the region are considered data deficient (their status is unclear at present). The primary threats are from habitat loss, but also from overexploitation and introduced species.

Birds

There are at least 508 bird species. There are at least 16 species of birds endemic to the Western Ghats including the endangered rufous-breasted laughingthrush, the vulnerable Nilgiri wood-pigeon, white-bellied shortwing and broad-tailed grassbird, the near threatened grey-breasted laughingthrush, black-and-rufous flycatcher, Nilgiri flycatcher, and Nilgiri pipit, and the least concern Malabar (blue-winged) parakeet, Malabar

grey hornbill, white-bellied treepie, grey-headed bulbul, rufous babbler, Waynaad laughingthrush, white-bellied blue-flycatcher and the crimson-backed sunbird.

Reptiles

The major population of snake family Uropeltidae of the reptile class is restricted to the region. The region has significant population of vulnerable Mugger crocodiles.

Amphibians

The amphibians of the Western Ghats are diverse and unique, with more than 80% of the 179 amphibian species being endemic to the rainforests of the mountains. The endangered purple frog was discovered in 2003. Four new species of frogs belonging to the genera *Rhacophorus*, *Polypedates*, *Philautus* and *Bufo* were described from the Western Ghats in 2005. The region is also home to many caecilian species.

Mammals

There are at least 118 mammal species. Of the 16 endemic mammals, 13 are threatened and amongst the 32 threatened species include the critically endangered Malabar large-spotted civet, the endangered lion-tailed macaque, Nilgiri tahr, Bengal tiger and Indian elephants, the vulnerable Indian leopard, Nilgiri langur and gaur.

These hill ranges serve as important wildlife corridors and forms an important part of Project Elephant and Project Tiger reserves. The largest population of tigers outside the Sundarbans is in the Western Ghats where there are seven populations with an estimated population size of 336 to 487 individuals occupying 21,435 km^2 (8,276 sq mi) forest in three major landscape units spread across Karnataka, Tamil Nadu and Kerala. The Western Ghats eco-region has the largest Indian elephant population in the wild with an estimated 11,000 individuals across eight distinct populations. The endemic Nilgiri tahr which was on the brink of extinction has recovered and has an estimated 3,122 individuals in the wild. The Critically Endangered endemic Malabar large-spotted civet is estimated to number fewer than 250 mature individuals, with no sub-population greater than 50 individuals. About 3500 lion-tailed macaques live scattered over several areas in the Western Ghats.

Marine and Coastal Biodiversity

Marine Biodiversity is the theme for International Day for Biological Diversity (IDB), 2012. The oceans cover 70% of the planet's surface area, and 95% of the biosphere. They produce a third of the oxygen that we breathe, offer a valuable source of proteins, and are among the largest natural resources of Carbon dioxide and moderates global climatic change. Some species, such as the great auk and the sea mink, are extinct; others, notably the great whales, have been hunted to fractions of their original populations. Species diversity is known to be as high as 1000 per square metre in the Indo-Pacific Ocean, and new oceanic species are continuously being discovered, particularly in the deep sea. Tropical marine ecosystems of Kerala coasts include lagoons, mangrove swamps, sandy and rocky shores and open sea front. Apart from fishes Kerala coast has a rich array of Crustaceans, corals, echinoderms, mollusks, turtles etc.

Major threats to marine and coastal ecosystems include:

- Land-based pollution
- Overfishing, destructive fishing, and illegal, unreported and unregulated fishing
- Invasions of exotic species
- Global climate change

Threats to the Biodiversity of Kerala

1. Encroachments : Kerala is one of the greater heights in the matter of biodiversity conservation and resource generation. Organised encroachment of forest land might have started as early as 1950s. Initially the policy of government was to allot forest land for schemes; like 'grow more food', 'arable land' etc. The direct impact of encroachment is habitat loss, besides the existence of constant threat on the forests by the fringe people. In addition to their involvement directly in the illegal activities they provide shelter for the unscrupulous offenders of the plains who are engaged in all kinds of illegal activities.

2. Cattle grazing : Grazing by cattle in forest, although not rampant as else where in the country, is identified as a threat to biodiversity in Kerala. The grazing not only removes the biomass and competes with wild herbivores, but also spread contagious diseases to wild animals. The trampling leads to soil erosion and changes the physical properties of soil. Intensive grazing will lead to domination of a single or a few species, changing the species composition of natural vegetation. Cattle grazing speeds up the invasion of weeds.

3. Collection of Fire wood : Firewood collection directly poses threat in the form of removal of biomass, which affects microhabitat of flora and fauna, and indirectly leads to extensive fire and other illegal activities. The proximity of settlements to the forests is the main factor, which determines the intensity of firewood collection. The firewood collection leads to degradation of habitats which subsequently alters the species composition and vegetation types. It is roughly estimated that 0.8 million cubic meters of firewood is illegally removed from the forest annually. Along with dead and wind fallen trees, standing trees and poles are also removed as firewood.

4. Man-Animal Conflict : A major problem associated with the conservation of wild animals especially the herbivores like elephants are that of crop depredation and man-slaughter. Animals such as elephants, gaur, sambar, wild boar and birds like peacock, cause extensive damage to the crops. This phenomenon has registered significant increase in recent years due to habitat fragmentation and degradation of natural forests and corridors. Almost all the Protected Areas and Non-Protected Areas of Kerala contain a large number of settlements either inside or on the periphery. This leads to degradation of surrounding habitats. The traditional tolerance among the people who live inside the forests or its adjacent areas are fast disappearing and people have become increasingly antagonistic. As a result, the people tend to kill the animals either by poisoning or by other means, like keeping crackers in fruits, etc.. This problem is very severe in northern Kerala where cultivation of paddy is extensive. At present Kerala Forest Department

provides compensation for the crop and property damage, human causalities and cattle loss caused by the scheduled animals like elephant, tiger, leopard, gaur, etc. Providing compensation is not a long term solution.

5. Poaching : The abundance of wild animals and high demand for their products in the clandestine, market pose threat to wild animals. Herbivores like gaur, sambar, chital etc are being poached for their meat. A lot of other not so spectacular species of animals ranging from reptiles to birds as well as plants and medicinal herbs are all part of the illegal wildlife trade. The major impact of poaching is species loss and change in their demography apart from extensive fire and other illicit activities.

6. Illegal and unsustainable/unscientific collection of Non-Timber Forest Produce (NTFP): Non-Timber Forest Produce (NTFP) collection is one of the major livelihoods of the local people. The NTFP consist of a variety of products, which are sources of food, fibre, manure, construction materials, cosmetics and cultural products. The users of NTFP range from local individuals to multinational companies. The forests of Kerala are very rich in NTFP including edible products, medicinal plants, toiletries, tans, dyes, gums, resins, rattan, bamboo, grasses and animal products. Although 500 species of NTFP are available in the forests of Kerala, about 120 items are listed as commercially important by the Kerala Forest Department. But as per record more than 200 species are being collected. Considering its widespread nature and higher prioritization, the threat needs to be tackled immediately to conserve biodiversity.

7. Mining : It is a threat to the stability of a landscape, which results in land sliding and lowering of water table. The removal of habitat will endanger the survival of riparian species since most of them occupied a very narrow habitat niche. At the same time regulated sand mining would help in keeping the health of the streams and reservoirs. Indiscriminate sand mining in some rivers systems in the state is posing severe threat to the stability of bridges and banks. Transportation of sand through the forests and other related activities pose severe threat to the ecosystem.

8. Mass Tourism and Pilgrimage : Mass Tourism and Pilgrimage are considered to be one of the major and increasing threats to biodiversity conservation. Approximately 13 million people visit forest areas annually either as pilgrims or visitors. Among all the Protected Areas in India, Periyar Tiger Reserve receives a maximum number of tourists. The major impact of tourism and pilgrimage is littering and over-utilization of resources such as soil erosion, fire, disturbance to wild animals for feeding, ranging etc are also reported due to a large number of pilgrims and unruly behaviour of visitors.

9. Forest Fires : Fire is one of the major threats facing the forests of Kerala. People who are engaged in grazing livestock often burn the area to get fresh shoots for their cattle, during lean season. Apart from this, those who are involved in illicit activities such as ganja cultivation, poaching, tree felling, NTFP collection and very often the ignorant tourists and pilgrims are also responsible for big forest fires. The effect of fire depends on the type of vegetation, frequency and intensity of fire and season of burning. Fire causes extensive damage in deciduous forests and grasslands due to heavy fuel load. Only some weeds manage to establish a strong foothold even after severe fire with the help of fire resistant adaptations. The direct impacts of fire are change in vegetation composition and physical properties of soil, soil erosion and loss of habitat.

10. Illicit Felling : Tree felling is one of the severe threats to biodiversity conservation in the state. The primary effect of tree felling on bio diversity is the removal of biomass and loss of habitat for many epiphytic and arboreal species. Tree felling leads to soil erosion and change of the soil properties. In some cases people involved in tree falling set fire to the forests. The opening up of canopy due to felling changes the microclimate and invite weeds to colonize and in turn changes the structure of vegetation. Apart from the direct impact of loss in terms of money to the state, the indirect impact of felling is the constant conflict between the administrative staff and the people involved in this illegal activity.

11. Invasive species: These are non indigenous or non-native plants and animals that adversely affect the habitats and bio regions they invade economically, environmentally and ecologically. The weed prevents sunlight and oxygen from reaching the water column and submerged plants. By crowding out native aquatic plants, it dramatically reduces biological diversity in aquatic ecosystems. Listed as one the 100 most dangerous invasive alien species of the world, this aquatic weed native to South America, was introduced to the country as an ornamental plant for cultivation in ponds because of its beautiful, large purple and violet flowers. Today, it invades more than 50 countries in five continents. Examples of animal invasion in our state include like Tilapia fish (Oreochromis mossambica), Sucker catfish (Plecostomus multiradiatus) and the African Giant Snail (Achatina fulica).

Threatended taxa of Kerala

	**Scientific name:** *Gonoproktopterusperiyarensis* Raj, 1941. The local people call it Kariyan due to the slate colour of the body. Periyar barb (English) Kariyan (Malayalam). This species is known from Kallar river, tributary of Pambiyar river to south of Pachakanam estate adjoining to Periyar lake.
	**Scientific name:** *Garrahughi Silas*, 1955. Commonly known as the Cardamonagarra due to its discover from the High ranges. It is adapted to the fast flowing regime of the stream with low water temperature. Heavy soil erosion, pollution and increased pesticide level in the habitat resulted in the decline of the population.
	**Scientific name:** *Tor khudree Sykes*. It is known as Deccan mahseer (English) Kuyil or Katti (Malayalam). Its ranges extends the entire Peninsular India. Habitat alteration, pollution, sand mining, over exploitation, fish poisoning, alien invasive fish species, dynamiting and electrocution are the major threats identified. According to IUCN, its status is endangered.
	**Scientific name:** *Vijayachelyssilvatica* (Henderson, 1912) Common Name: Cochin Forest Cane turtle (English); Chooralama, Kavalama (Malayalam). In Chalakudy, Kerala, South India. This is a poorly known species, endemic to the Western Ghats of Southern India. Pet trade, very low range of distribution, Habitat destruction are the major threat to the species. According to IUCN, its status is Endangered.
	**Scientific name:** *Cheloniamydas* (Linnaeus, 1758). Commonly called as Green turtle in English and Kadalama in Malayalam. Flesh and Egg is edible. The green turtle is a circumglobalspecies with foraging and nesting occurring throughout the tropics. Cheloniamydas is found throughout the Indian River Lagoon. As per IUCN, its status is endangered.
	**Scientific name:** *VaranusbengalensisDaudin*, 1802. Known as Bengal Monitor lizard in English and Udumbu in Malayalam. The flesh is said to have medicinal value. The greatest threat to this species is hunting as it is hunted commercially for its skin, and its meat is commonly eaten. The fat is also used in traditional medicine. However, IUCN included it in Least Concern category.

	**Scientific name:** *RhacophoruslateralisBoulenger*, 1883. This species is restricted to two small areas of the southern Western Ghats of India in Kerala (Wayanad Wildlife Sanctuary and its surroundings) and Karnataka (Coorg and its surroundings) at an elevation of approximately 800m asl. It might occur a little more widely than current records suggest. IUCN has listed in the endangered category.
	**Scientific name:** Bosgaurus C.H. Smith, 1827. Known as Guar or Indian Bison in English and Kattupothu in Malayalam. Poaching, loss and alteration of the habitat, competition with the domestic cattle, diseases, etc. IUCN has listed in the Vulnerable category.
	**Scientific name:** *Platacanthomyslasiurus Blyth* 1859. It is known as Malabar Spiny Dormouse, Malabar Spiny Tree Mouse, Spiny Tree Mouse. This species is endemic to Western Ghats of India ranging from Shivamogge, Karnataka in the north to Peppara Wildlife Sanctuary in Thiruvananthapuram district. Habitat loss, changes in land use are major threats to the species. It is very sensitive to change in quality of habitat and to human interference. In some areas of its occurrence it is threatened due to harvest for medicinal purpose.
	**Scientific name:** *Pachliopta hector* (Linnaeus, 1758). Its common name in English is Crimson Rose. It is stated to be endemic to Sri Lanka and southern India, but its range may extend along the east coast of Orissa, south Bihar, West Bengal and into Sikkim and parts of northeast India.
	**Scientific name:** *Hypolimnasmisippuz* (Linnaeus). Commonly known as DanaidEggfly. Loss and alteration of the habitiat, pollution, pesticide, fungicide and weedicide application, industrial pollution, etc. are the threats to the species. It is Included in the Wildlife Protection Act (1972) Schedule 1.
	**Scientific name:** *Lissemyspunctata* (Lacépède, 1788). It is commonly known as Indian Flap-shelled Turtle, Indian Flapshell Turtle. It is exploited for flesh, carapace and plastron. Over exploitation, Loss and alteration of the habitiat, pollution, pesticide, fungicide and weedicide application, industrial pollution are the threats. It is included in the Wildlife Protection Act (1972) Schedule 1 and the IUCN listed in the lower Risk category.

	***GlyptopetalumgrandiflorumBedd.*** Family : Celastraceae Habit : Small tree Habitat: Evergreen forests Distribution : So far known only from the windward evergreen forests in the Wayanad and Kannur region of Southern Western Ghats IUCN status : Endangered
	***HumboldtiaunijugaBedd.*** Family: Caesalpiniaceae Habit: Small tree Habitat: Evergreen forest Distribution: So far known only from the middle elevation evergreen forests in the Agasthyamalaiphytogeographical region of southern Western Ghats IUCN status: Endangered
	***Polyalthiashendurunii*** Basha&Sasidh. Family: Annonaceae Habit: Tall tree Habitat: Evergreen forests World distribution: So far known only from the evergreen forests of Agasthyamalaiphytogeographical region of southern Western Ghats IUCN status: Endangered
	Scientific name: ***Ceropegiadecaisneana Wight*** Common name: Palaancheera (Malayalam) Description: Herbaceous tuberous twiners in low altitude rocky grassland areas Economic value: Leaves edible, others not known Distribution: Western Ghats Endemism: Endemic to southern Western Ghats Threat to the species: Habitat disturbances
	Scientific name: ***Goniothalamuswynaadensis*** (Bedd.) Bedd. Description: Third storey undergrowth in evergreen forests Distribution: Southern Western Ghats Endemism: Endemic to windward region of Nilgiriphytogeographical region of Southern Western Ghats Threat to the species: Habitat disturbances

	Scientific name : ***Ixoralawsonii Gamble*** Description: Sub-shrub in shola forests Economic value : Not known Distribution: Southern Western Ghats Endemism: Endemic to windward region of Nilgiri phytogeographical region of Southern Western Ghats Threat to the species: Habitat disturbances
	Scientific name : ***MiliusanilagiricaBedd.*** Description: Shrubs in evergreen forests at higher altitutdes Economic value : Not known Distribution: Southern Western Ghats Endemism: Endemic to Windward region of Nilgiriphytogeographical region of Southern Western Ghats Threat to the species: Habitat disturbances
	Scientific name : ***TriasstocksiiBenth***. Description: Epiphyte in evergreen and semi-evergreen forests Distribution: Southern Western Ghats Endemism: Endemic to Southern Western Ghats Threat to the species: Habitat disturbances
	*Elephasmaximus* Linnaeus, 1758 Asian Eelphant (Endangered)
	Ophiophagushannah (Cantor, 1836) Hamadryad, King Cobra (Vulnerable)
	*Bucerosbicornis* Linnaeus, 1758 Great Hornbill (Near Threatened)

Table : 3.6 Endangered Forest Species in Kerala

Sl. No.	Species	Family	Habit
1.	Acampe congesta	Orchidaceae	Herbs
2.	Adenosma malabaricum	Scrophulariaceae	Herbs
3.	Anaphalis barnesii	Compositae	Herbs
4.	Arisaema attenuatum	Araceae	Herbs
5.	Arisaema auriculata	Araceae	Herbs
6.	Arisaema peltatum	Araceae	Herbs
7.	Hydnocarepus macrocarpa	Flacourtiaceae	Trees
8.	Atuna travancorica	Rosaceae	Trees
9.	Bombax scopulorum	Bombacaceae	Trees
10.	Buchanania barberi	Anacardiaceae	Trees
11.	Buchanania lanceolata	Anacardiaceae	Trees
12.	Bulbophyllum aureum	Orchidaceae	Herbs
13.	Calamus travancoricus	Arecaceae	Shrubs
14.	Ceropegia beddomei	Asclepiadaceae	Climbers
15.	Cirrhopetalum avreum	Orchidaceae	Herbs
16.	Clematis bourdillonni	Ranunculaceae	Climbers
17.	Colubrinma travancorica	Rhamnaceae	Shrubs
18.	Cyclea fissicalyx	Menispermaceae	Climbers
19.	Cynometra beddomei	Fabaceae	Trees
20.	Cynometra travancorica	Fabaceae	Trees
21.	Dalbergia beddomei	Fabaceae	Lianas
22.	Dialium travancoricum	Fabaceae	Trees
23.	Didymocarpus macrostachya	Gesneriaceae	Herbs
24.	Dysoxylum beddomei	Meliaceae	Trees
25.	Dysoxylum ficiforme	Meliaceae	Trees
26.	Eugenia argentea	Myrtaceae	Trees
27.	Eugenia discifera	Myrtaceae	Trees
28.	Garcinia imberti	Guttiferae	Trees
29.	Haplothismia exannulata	Burmanniaceae	Herbs
30.	Hedyotis beddomei	Rubiaceae	Herbs
31.	Hedyotis bourdillonii	Rubiaceae	Herbs
32.	Hedyotis wynaadensis	Rubiaceae	Herbs
33.	Hyalisma janthina	Triuridaceae	Herbs
34.	Hydrobryum johnsonii	Podostemaceae	Herbs
35.	Cinnamomum travancoricum	Lauraceae	Trees

36.	Impatiens aliciae	Balsaminaceae	Herbs
37.	Impatiens anaimudica	Balsaminaceae	Herbs
38.	Impatiens cochinica	Balsaminaceae	Herbs
39.	Impatiens coelotropis	Balsaminaceae	Herbs
40.	Impatiens concinna	Balsaminaceae	Herbs
41.	Impatiens johnii	Balsaminaceae	Herbs
42.	Impatiens leptura	Balsaminaceae	Herbs
43.	Impatiens macrocarpa	Balsaminaceae	Herbs
44.	Impatiens munnarensis	Balsaminaceae	Herbs
45.	Impatiens pandata	Balsaminaceae	Herbs
46.	Impatiens platyadena	Balsaminaceae	Herbs
47.	Impatiens pallidiflora	Balsaminaceae	Herbs
48.	Impatiens rivulicola	Balsaminaceae	Herbs
49.	Impatiens verecunda	Balsaminaceae	Herbs
50.	Inga cynometroides	Fabaceae	Tree
51.	Ipsea malabarica	Orchidaceae	Herbs
52.	Isachne fischeri	Gramineae	Herbs
53.	Isachne setosa	Gramineae	Herbs
54.	Ixora johnsonii	Rubiaceae	Herbs
55.	Jambosa bourdillonii	Myrtaceae	Trees
56.	Janakia arayalpathra	Periplocaceae	Herbs
57.	Limnopoa meeboldii	Gramineae	Herbs
58.	Litsea travancorica	Lauraceae	Trees
59.	Loesnerinella bourdilonii	Celastraceae	Climber
60.	Madhuca bourdillonii	Sapotaceae	Trees
61.	Meteoromyrtus wynaadensis	Myrtaceae	Trees
62.	Morinda reticulata	Rubiaceae	Climber
63.	Nilgirianthus asper	Acanthaceae	Shrubs
64.	Nilgirianthus barbatus	Acanthaceae	Shrubs
65.	Nilgirianthus beddomei	Acanthaceae	Shrubs
66.	Nilgirianthus ciliatus	Acanthaceae	Shrubs
67.	Nilgirianthus decurrens	Acanthaceae	Herbs
68.	Nilgirianthus foliosus	Acanthaceae	Herbs
69.	Nilgirianthus lupulinus	Acanthaceae	Herbs
70.	Nilgirianthus neilgherrensis	Acanthaceae	Herbs
71.	Nilgirianthus perrottetianus	Acanthaceae	Herbs
72.	Nilgirianthus punctatus	Acanthaceae	Herbs
73.	Nilgirianthus urceolaris	Acanthaceae	Herbs
74.	Ochlandra beddomei	Bambusaceae	Trees

75.	Ochreinauclea missionis	Rubiaceae	Trees
76.	Oianthus beddomei	Asclepiadaceae	Twiners
77.	Ophiorrhiza barnesii	Rubiaceae	Herbs
78.	Ophiorrhiza candata	Rubiaceae	Herbs
79.	Ophiorrhiza incarnata	Rubiaceae	Herbs
80.	Ophiorrhiza munnarensis	Rubiaceae	Herbs
81.	Orophea uniflora	Annonaceae	Shrub
82.	Otonephelium stipulaceum	Sapindaceae	Trees
83.	Palaquium bourdillonii	Sapotaceae	Trees
84.	Paphiopedilum druryi	Orchidaceae	Herbs
85.	Phaenanthus malabaricus	Annonaceae	Trees
86.	Phlebophyllum lawsonii	Acanthaceae	Shrubs
87.	Plectronia pergracilis	Rubiaceae	Shrubs
88.	Poeciloneuron indicum	Bonnetiaceae	Trees
89.	Poeciloneuron pauciflorum	Bonnetiaceae	Trees
90.	Pogostemon travancoricus	Labiatae	Herbs
91.	Polyalthia rufescens	Annonaceae	Trees
92.	Pterospermum reticulatum	Sterculiaceae	Trees
93.	Sageraea grandiflora	Annonaceae	Trees
94.	Schefflera bourdillonii	Araliaceae	Climbers
95.	Silentvalleya nairii	Gramineae	Herbs
96.	Smithia venkobarowii	Fabaceae	Shrubs
97.	Sonerila nemakadensis	Melastomataceae	Herbs
98.	Strobilanthes dupenii	Acanthaceae	Herbs
99.	Syzygium bourdillonii	Myrtaceae	Trees
100.	Syzygium palghatense	Myrtaceae	Trees
101.	Syzygium travancorcum	Myrtaceae	Trees
102.	Taeniophyllum scaberulum	Orchidaceae	Herbs
101.	Tephrosia wynaadensis	Fabaceae	Herbs
102.	Toxocarpus palghatensis	Asclepiadaceae	Herbs
103.	Vanilla wightiana	Orchidaceae	Herbs
105.	Vernonia anaimudica	Compositae	Herbs
106.	Vernonia heynei	Compositae	Herbs
107.	Vernonia multibracteata	Compositae	Herbs

Source: Kerala Forest Department

Table : 3.7 District Wise Forest Area 2013-14

Sl. No.	District	Geographic Area	Reserved Forest Area	Protected Forest	Total Forest Area (Km^2)
1.	Thiruvananthapuram	2192	460.1831	3.651	463.8341
2.	Kollam	2491	827.875	12.6922	840.5672
3.	Pathanamthitta	2642	1532.2257	1.568	1533.7937
4.	Kottayam	2203	100.8450	0	100.8450
5.	Idukki	5019	2679.072	34.6506	2713.7226
6.	Ernakulam	2407	823.8302	0	823.8302
7.	Thrissur	3032	1018.438	4.3137	1022.7517
8.	Palakkadu	4480	860.2	667.1564	1527.3564
9.	Malappuram	3550	325.3261	398.592	723.9181
10.	Kozhikode	2344	47.3658	243.0856	290.4514
11.	Wayanadu	2131	566.511	340.5337	907.0447
12.	Kannur	2966	143.7275	97.8442	241.5716
13.	Kasargod	1992	86.0221	33.7083	119.7304
TOTAL		**38863**	**9471.6215**	**1837.7956**	**11309.4171 ***

Source : Forest Statistics 2013

**** Difference due to an area of 0.0583Km^2 because of the forest lands available in Nenjangud, Mysore and Pollachi which are outside the territorial boundaries of Kerala.***

Table : 3.8 Division wise area of Forest 2013-14

Area in Km^2

Sl. No.	Division	Reserve Forest	Proposed Reserve	Vested Forest + EFL	Total	% of Total
Southern Circle, Kollam						
1.	Thiruvananthapuram	359.1240	5.8253	3.6510	368.6003	3.36
2.	Thenmala	123.4320	-	7.7350	131.1670	1.16
3.	Achencovil	284.3298	-	0.2082	284.5380	2.52
4.	Ranni	1050.3360	7.1600	1.5680	1059.0640	9.36
5.	Punalur	280.0510	-	0.1690	280.2200	2.48
6.	Ranni	320.6430	11.0210	-	331.6640	2.93
	Total	**2417.9158**	**24.0063**	**13.3312**	**2455.2533**	**21.71**
High Range Circle, Kottayam						
7.	Kothamangalam	316.8451	-	0.1576	317.0027	2.80
8.	Munnar	440.4900	175.2750	2.4500	618.2150	5.47
9.	Marayoor	13.9720	47.2600	0.0760	61.3080	0.54
10.	Mankulam	90.0600	-	-	90.0600	0.80
11.	Kottayam	627.2870	-	31.9670	659.2540	5.83
	Total	**1488.6541**	**222.5350**	**34.6506**	**1745.8397**	**15.44**
Central Circle, Thrissur						
12.	Vazhachal	413.9440	-	-	413.9440	3.66
13.	Chalakudy	279.7098	-	-	279.7098	2.47
14.	Malayattoor	617.2411	0.5248	-	617.7659	5.46
15.	Thrissur	293.7430	-	4.3137	298.0567	2.64
Total		**1604.6379**	**0.5248**	**4.3137**	**1609.4764**	**14.23**
Eastern Circle, Palakkad						
16.	Mannarkkad	150.7322	-	271.7213	422.4535	3.74
17.	Nilambur North	57.9196	0.0171	340.7032	398.6399	3.52
18.	Nilambur South	267.3894	-	57.8888	325.2782	2.88
19.	Palakkad	73.4100	-	162.0347	235.4947	2.08
20.	Nenmara	205.5170	-	150.2104	355.7274	3.15

Total		**754.9682**	**0.0171**	**982.6084**	**1737.5937**	**15.37**
North Circle, Kannur						
21.	Kozhikode	24.3998	22.9660	243.0856	290.4514	2.57
22.	Wayanad North	134.0240	15.0640	65.8527	214.9407	1.90
23.	Wayanad South	66.1381	6.8449	274.6810	347.6640	3.07
24.	Kannur	121.3702	0	65.2014	186.5716	1.65
25.	Kasaragode	86.0221	0	33.7083	119.7304	1.06
Total		**431.9542**	**44.9643**	**682.5290**	**1159.358**	**10.25**
Agastyavanam Biological Park						
26.	Thiruvananthapuram	212.0000	-	-	212.0000	1.87
27.	Shenthuruni	166.4200	-	4.5800	171.0000	1.51
Total		**378.4200**	**-**	**4.5800**	**383.0000**	**3.38**
Field Director (Project Tiger), Kottayam						
28.	Periyar East	618.0000	-	-	618.0000	5.46
29.	Periyar West	157.0000	-	-	157.0000	1.39
30.	Munnar	276.8450	-	-	276.8450	2.45
31.	Idukki	130.5240	-	-	180.5240	1.15
Total		**1182.3690**	**-**	**-**	**1182.3690**	**10.45**
Wildlife Circle, Palakkad						
32.	Parambikulam	274.1408	-	-	274.1408	2.42
33.	Wayanadu (WL)	344.4400	-	-	344.4400	3.05
34.	Silent Valley	154.3800	-	83.1400	287.5200	2.10
35.	Peechi	122.0644	3.4200	-	125.4844	1.11
36.	Aralam	22.3572	-	32.6428	55.0000	0.49
	Total	**917.3824**	**3.4200**	**115.7828**	**1036.5852**	**9.17**
	Grand Total	**9176.3016**	**295.3781**	**1837.7957**	**11309.4754**	

Source : Forest Statistics 2013

Classification of Forest Areas

Classification fo forest areas are mainly in 7 types - Tropical Wet Evergreen and Semi Evergreen, Tropical Moist Deciduous, Tropical Dry Deciduous, Montane Sub-tropical Temperate shoals, Plantations, Grass lands and others. The area of Tropical Wet Evergreen and Semi Evergreen is 3877.4413 Km^2, Tropical Moist Deciduous is 3615.9840 Km^2, Tropical Dry Deciduous is 391.3636 Km^2, Montane Sub-tropical Temperate shoals is 386.4210 Km^2, Plantations are 1527.1937 Km^2, Grass lands covers 501.0865 and others are 1009.9853 Km^2. and of total Forest Area is 11309.4754 Km^2.

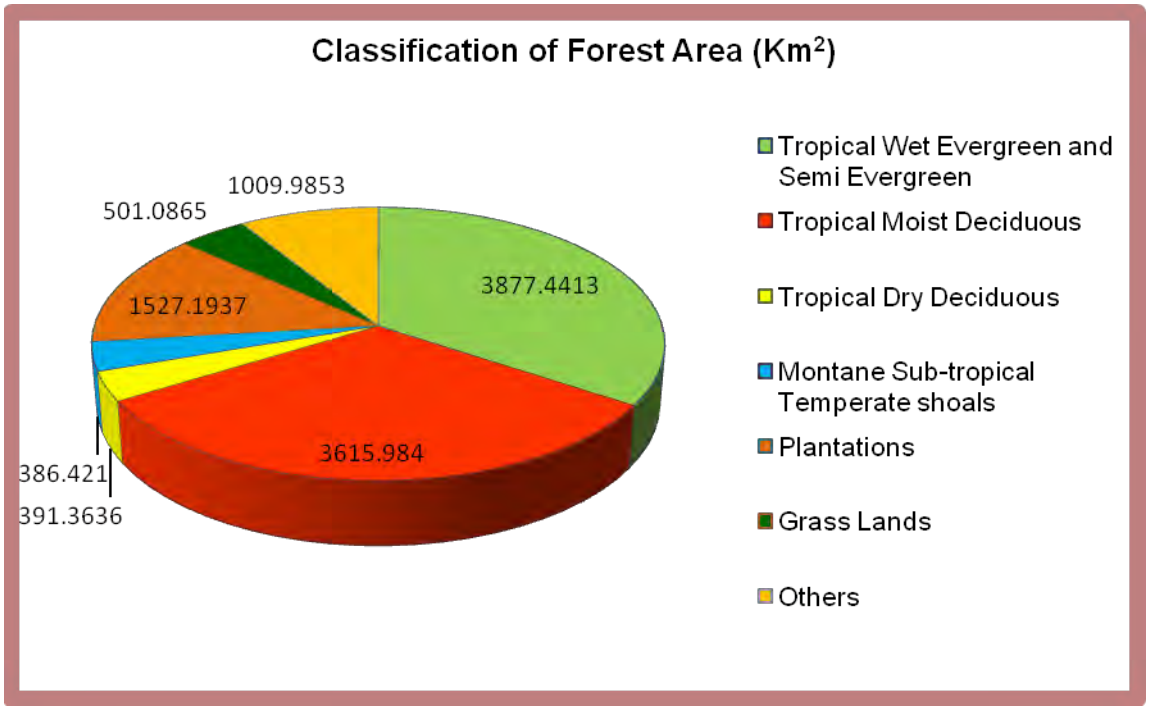


Table : 3.9 Classification of Forest Area 2013-14

Sl. No.	Type	Area (Km^2)	% of Total
1.	Tropical Wet Evergreen and Semi Evergreen	3877.4413	34.29
2.	Tropical Moist Deciduous	3615.9840	31.97
3.	Tropical Dry Deciduous	391.3636	3.46
4.	Montane Sub-tropical Temperate shoals	386.4210	3.42
5.	Plantations	1527.1937	13.50
6.	Grass Lands	501.0865	4.43
7.	Others	1009.9853	8.93
	Total	**11309.4754**	

Source : Forest Statistics 2013

Table : 3.10 Classification of Forest Area according to utilisation 2013-14

Sl. No.	Mode of Utilisation	Area (Km^2)	% of Total
1.	Dense Forest / Degraded Forest	8775.6517	77.60
2.	Plantations	1527.1937	13.50
3.	Area under Lease	595.97	5.27
4.	Forest Land diverted under FCA	410.66	3.63
	Total	**11309.4754**	

Source : Forest Statistics 2013

Table : 3.11 District wise Ecologically Fragile Land (EFL) Area

Sl. No.	District	Area (ha)
1.	Thiruvananthapuram	885.26
2.	Kollam	273.72
3.	Idukki	1411.8199
4.	Thrissur	76.5410
5.	Palakkad	4999.8710
6.	Malappuram	1285.0879
7.	Kozhikode	1544.99
8.	Wayanad	2961.5422
9.	Kannur	488.1291
10.	Kasaragode	662.9
	TOTAL	**14589.8611**

Source : Forest Statistics 2013

Forest Cover

The forest cover in the state based on interpretation of Forest Survey of India 2013 is 17922 Km^2 which is 46.12% of the state geographical area. In terms of forest canopy density classes, the state has 1529 km^2 area under very dense forest, 9401 km^2 area under moderately dense forest and 6992 km^2 area under open forest.

Table : 3.12 District wise Forest cover in Kerala

Sl. No.	District	Geographic Area	2013 Assessment				Percent to GA
			Very Dense	Moderate Dense	Open Forest	Total	
1.	Thiruvananthapuram	2192	60	719	537	1316	60.04
2.	Kollam	2491	100	675	620	1395	56.00
3.	Pathanamthitta	2642	158	1216	380	1754	66.39
4.	Alappuzha	1414	0	45	68	113	7.99
5.	Kottayam	2203	12	534	344	890	40.40
6.	Idukki	5019	350	2108	1394	3852	76.75
7.	Ernakulam	2407	12	287	399	698	29.00
8.	Thrissur	3032	181	447	440	1068	35.22
9.	Palakkadu	4480	319	685	624	1628	36.34
10.	Malappuram	3550	143	421	691	1255	35.35
11.	Kozhikode	2344	31	313	346	690	29.44
12.	Wayanadu	2131	142	1312	322	1776	83.34
13.	Kannur	2966	21	344	501	866	29.20
14.	Kasaragode	1992	0	295	326	621	31.17
TOTAL		**38863**	**1529**	**9401**	**6992**	**17922**	**46.12**

Source : Forest Statistics 2013

Table : 3.13 Forest cover in Kerala from 2010-13

Area in km^2

Sl. No.	District	Assessment				Change in			
		2010	2011	2012	2013	2010	2011	2012	2013
1.	Thiruvananthapuram	1350	1349	1349	1316	0	-1	0	-33
2.	Kollam	1337	1330	1330	1395	0	-7	0	65
3.	Pathanamthitta	1758	1755	1755	1754	0	-3	0	-1
4.	Alappuzha	38	38	38	113	0	0	0	75
5.	Kottayam	895	889	889	890	0	-6	0	1
6.	Idukki	3932	3930	3930	3852	0	-2	0	-78
7.	Ernakulam	696	695	695	698	0	-1	0	3
8.	Thrissur	933	931	931	1068	0	-2	0	137
9.	Palakkadu	1575	1575	1575	1628	0	0	0	53
10.	Malappuram	1211	1209	1209	1255	0	-2	0	46
11.	Kozhikode	591	591	591	690	0	0	0	99
12.	Wayanadu	1775	1775	1775	1776	0	0	0	1
13.	Kannur	641	641	641	866	0	0	0	225
14.	Kasaragode	592	592	592	621	0	0	0	29
TOTAL		**17324**	**17300**	**17300**	**17922**	**0**	**-24**	**0**	**622**

Source : Forest Statistics 2013

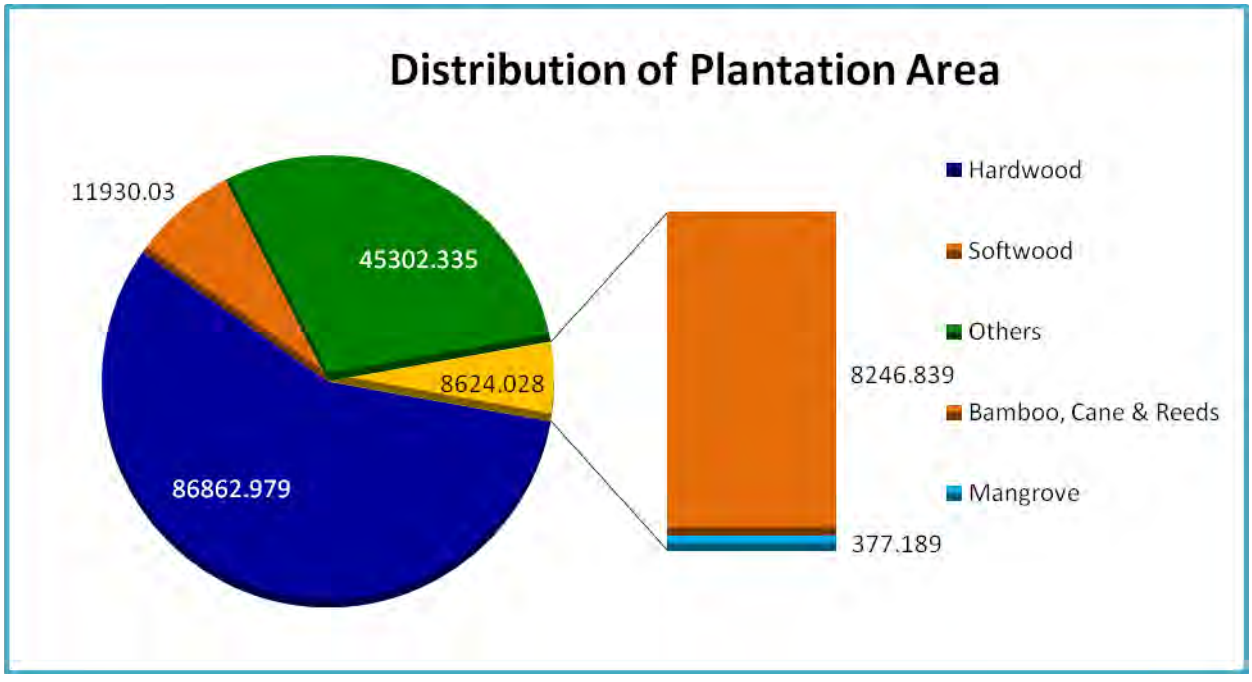
Plantations under Kerala Forest Development Corporation (KFDC)

The total Plantation area under Kerala Forest Development Corporation is 152719.372 ha, which comes to 13.5% of the total forest area. Distribution of plantation area under the management of KFDC is given below :

Table : 3.14 Distribution of Plantation Area

Sl. No.	Plantaion	Area (Ha)	Percentage
1.	Hardwood	86862.979	56.878
2.	Softwood	11930.03	7.812
3.	Others	45302.335	29.664
4.	Bamboo, Cane & Reeds	8246.839	5.399
5.	Mangrove	377.189	0.247
Total		**152719.372**	

Source : Forest Statistics 2013



The species wise plantation area under the management of Kerala Forest Development Corporation (KFDC) is given in below:-

Table 3.15 Species wise plantation area of KFDC

Sl. No.	Species	Area (ha)
1.	Eucalyptus	2421.108
2.	Accacia auriculifomis	2134.179
3.	Teak & Soft wood	1223.000
4.	Bamboo	907.576
5.	Cardamon	615.600
6.	Tea	100.000
7.	Coffee	688.400
8.	Cashew	312.263
9.	Pine, Alnus, Casurina, failed Eucalyptus etc	138.498
10.	Unproductive / Swamp / Rock / Building, etc	941.508
	Total	**9482.132**

Source : Forest Statistics 2013

Table : 3.16 Distribution of Plantation Area 2013-14

Sl. No.	Division	Hardwood	Softwood	Mangroves	Bamboo, Cane and Reeds	Others	Total
1.	Thiruvananthapuram	4345	376.976	0	205.7	1108.217	**6036.311**
2.	Thenmala	2505.82	465.81	0	0	574.71	**3546.34**
3.	Punalur	3649.990	657.900	0	176.35	1249.156	**5733.396**
4.	Achenkovil	2790.372	0	0	794.971	1774.342	**5359.685**
5.	Ranni	3755.455	0	0	506.552	2864.581	**7126.588**
6.	Konni	8376.354	32.48	0	882.900	408.18	**9699.914**
7.	Kottayam	2283.454	85.54	0	11.900	962.067	**3522.961**
8.	Munnar	790.524	4399.2	0	579.36	1272.210	**7041.294**
9.	Kothamangalam	4756.065	304.04	0	236.850	1137.387	**6434.342**
10.	Marayoor	100	821.34	0	90.8	152.5	**1164.64**
11.	Mankulam	42.25	101.000	0	135.25	214.63	**493.130**
12.	Malayatoor	5959.1	493.123	0	79.1	2672.995	**9204.319**
13.	Vazhachal	3933.87	479.51	0	330.940	2871.780	**9616.100**
14.	Chalakkudy	4454.050	107.8	0	38.6	1031.84	**5632.290**
15.	Thrissur	2771.500	458.15	0	696.86	6381.770	**10308.28**
16.	TS Perumbavoor	61.49	0	0	0	0	**61.49**
17.	Nenmara	1976.293	146.540	0	360.790	2461.982	**4945.605**
18.	Palakkad	1892.420	108.82	0	173.43	1390.140	**3565.080**
19.	Mannarkkad	569.11	143.92	0	35	640.030	**1088.060**
20.	Nilambur (South)	4603.767	0	0	436.32	0	**5040.087**
21.	Nilambur (North)	4225.070	41.509	0	709.754	422.278	**5398.611**
22.	Kozhikkode	308.83	1074.132	0	82.6	1112.270	**2582.832**
23.	Wayanad (South)	2366.550	681.550	0	96.880	1322.41	**4467.390**
24.	Wayanad (North)	859.350	315.690	0	0	2278.950	**3453.990**
25.	Kannur	691.592	0	255.979	102.100	3935.164	**4984.835**
26.	Kasaragod	1227.910	0	116.210	467.212	1675.297	**3486.629**
27.	Thiruvananthapuram Wildlife	101.08	140.54	0	1140.690	997.073	**2379.383**
28.	Parambikulam Wildlife	8747.466	0	0	0	0	**8747.466**
29.	Silent Valley Wildlife	482.3	57.89	0	0	94	**634.19**
30.	Wayanad Wildlife	7486.802	429.67	0	0	2987.899	**10904.37**
31.	Aaralam Wildlife	291.3	0	0	0	30	**321.3**
	Total	**86862.979**	**11930.030**	**377.189**	**8246.839**	**45302.335**	**152719.372**

Source : Forest Statistics 2013

Table: 3.17 Procurement of Minor Forest Produces

Sl. No.	Name	Quantity (kg)
1.	Ayurvedic Herbs	728633
2.	Spices	3762
3.	Fibre	93765
4.	Grass other than fodder	129100
5.	Incensive Plants	16757
6.	Honey	61687
7.	Bee's Wax	111
8.	Vegitable Oil Seeds	3373
9.	Medicinal Trees	599

Source : Forest Statistics 2013

Biosphere Reserves in Kerala

The Indian government has established 17 Biosphere Reserves of India, which protect larger areas of natural and often include one or more National Parks and/or preserves, along buffer zones that are open to some economic uses. Protection is granted not only to the flora and fauna of the protected region, but also to the human communities who inhabit these regions, and their ways of life.

Nilgiri Biosphere Reserve

The Nilgiri Biosphere Reserve is an International Biosphere Reserve in the Western Ghats, Nilgiri Hills range of South India. The Western Ghats, Nilgiri Sub-Cluster conjoining the Nilgiri Biosphere Reserve, is under the UNESCO World Heritage Site.

Location: The reserve encompasses 5,520 km² in the states of Tamil Nadu (2537.6 km²), Karnataka (1527.4 km²) and Kerala (1455.4 km²). It forms an almost complete ring around the Nilgiri Plateau.

Ecology: Corresponding to their altitudinal and climatic gradients, the natural vegetation changes from tropical wet evergreen forest along the western slopes to montane stunted Shola forest amidst the grassy down on the upper plateau and on the east, progressively drier deciduous forests ending in thorny scrub. This setting is home for a variety of animals-the lion-tailed macaque in the evergreen forests, the Nilgiri tahr in the grassy downs, the black buck in the dry scrub and the tiger and the elephant throughout the region. To the north, the biosphere reserve begins in the Nagarhole National Park of Karnataka and the adjoining Wayanad sanctuary of Kerala. The moist deciduous forests and teak plantations of Nagarhole harbours abundant population of gaur, spotted deer, sambar and wild pig which support a sizeable number of carnivores such as tiger and leopard. Nagarhole is perhaps the best place in south India for sighting these large cats.

Protected Areas: Mudumalai wild life sanctuary and national park (321.1 km²), Wayanad wildlife sanctuary (344km²), Bandipur national park (874km²), Nagarhole national park (643 km²), Nugu wild life sanctuary, Mukurthi national park (78 km²) and Silent Valley national park (89.52km²) are protected areas within this reserve. The Biosphere Reserve also includes zones of the Nilgiris open to forestry and tourism including: Nilgiris District (North (448.3 km²) and Nilgiris District South (198.8 km²)), Erode District (Sathyamangalam forest (745.9km²) and Erode (49.3 km²)) and Coimbatore District (696.2 km²) in Tamil Nadu. The reserve extends from the tropical moist forests of the windward western slopes of the Ghats to the tropical dry forests on the leeward east slopes. Rainfall ranges from 500 mm to 7000 mm per year. The reserve encompasses three ecoregions, the South Western Ghats moist deciduous forests, South Western Ghats montane rain forests, and South Deccan Plateau dry deciduous forests. The habitat types include montane rain forest, semi-evergreen moist forest, thorn forest and scrub, montane grassland, and high-elevation Shola forests.

Fauna and Flora: Fauna includes over 100 species of mammals, 350 species of birds, 80 species of reptiles; about 39 species of fish, 31 amphibians, 60 species of reptiles 316 species of butterflies and innumerable invertebrates. Rare animals include the tiger and the Nilgiri Tahr. The reserve has very rich plant diversity. Of 3300 species, 1232 are endemic.

Conservation and Management of the Nilgiri Biosphere Reserve: Conservation and management of the Nilgiri Biosphere Reserve depends on the coordination between government agencies and the local people. For effective management, the Nilgiri Biosphere Reserve has been zonalised as (a) core zone (1240 sq.km), (b) buffer zone (4280 sq.km). The buffer zone is further divided into manipulation zones like forestry, tourism and recreation zones. These zones are located in all the three states of Tamilnadu, Karnataka and Kerala into which the Nilgiri Biosphere Reserve extends. Most of the plantations are seen only in the manipulation zone. Being one of the hotspots of biodiversity, the Nilgiri Biosphere Reserve has some national parks and wildlife sanctuaries within its boundaries. Conservation of wildlife is the main objective of these national parks and wildlife sanctuaries. Some of these areas have been designated by the government as Project Tiger and Project Elephant areas.

Agasthyamalai Biosphere Reserve

The Agasthyamalai Biosphere Reserve (ABR) was established in 2001 and includes 3,500 km^2 out of which 1828 km^2 is in Kerala and 1672 km^2 is in Tamil Nadu. The Western Ghats, Agasthyamalai Sub-Cluster, including all of Agasthyamalai Biosphere Reserve, is under consideration by the UNESCO World Heritage Committee for selection as a World Heritage Site. Agasthyamala is located in this biosphere area.

Location: This biosphere reserve straddles the border of Kollam and Thiruvananthapuram districts in Kerala andTirunelveli and Kanyakumari districts in Tamil Nadu, South India at the southern end of the Western Ghats. It is composed of Neyyar, Peppara and Shendurney wildlife Sanctuaries and their adjoining areas of Achencoil, Thenmala, Konni, Punalur, Thiruvananthapuram divisions and Agasthyavanam special division in Kerala. The reserve now covers parts of Tirunelveli and Kanyakumari Districts in Tamil Nadu and Thiruvananthapuram, Kollam and Pathanamthitta Districts in Kerala.

Ecology: The reserve includes the Indian Ecoregions of South Western Ghats moist deciduous forests, South Western Ghats montane rain forests and Shola. It is the habitat for 2,000 varieties of medicinal plants, of which at least 50 are rare and endangered species. Rare animals include the tiger, Asian Elephant, and Nilgiri Tahr. Agastyamalai is also home to the Kanikaran, one of the oldest surviving ancient tribes in the world.

The sanctuaries covered are Kalakad Mundanthurai Tiger Reserve. This region, extending to nearly 3,500 sq. Km., is considered the richest bio-geographic province in the Indian sub-continent. A sizable portion of the proposed biosphere reserve enjoys protected status at present. The biosphere concept recognises the need to involve the people subsisting on the resources of the region in the conservation efforts. The flow of funds under the programme targets the uplift of these people so that their dependence on the biological resources is brought to a sustainable level. The programme also lays stress on research and monitoring activities, documentation of the resources, environmental education and training and international interaction at a scientific level.

Protected Area: The protected area of the reserver includes Neyyar, Peppara and Shenduruny wildlife sanctuaries of Kerala and Kalakkad-Mundanthurai Tiger Reserve of Tamil Nadu.

Fauna and Flora: The proposed Agasthyamalai Biosphere Reserve is a pristine paleotropic region with a very high floral endemism and tremendously rich biodiversity, locked up in an area exhibiting an overall representation of the biota of the southern Western Ghats. The site represents the richest centre of endemic plants, abode of all vegetation types met within the peninsula, richest repository of medicinal plants, the southern-most haven of endangered animals including primates, amphibians, reptiles and fishes and a treasure house of wild relatives of domesticated crops.

Conservation and Management: A local committee and a state level Biosphere Management Committee co-ordinate the activities of various departments in the Agasthyamalai Biosphere Reserve area and ensure the scientific management of the ABR according to guidelines of the Indian Ministry of Environment and Forests. The Agasthyamalai reserve management is awaiting approval as participant in the UNESCO Man and the Biosphere (MAB) Programme.

Table : 3.18 Biosphere Reserves in Kerala

Sl. No	Name of reserve	Area Sq.Km	Forest areas included as Kerala part
1	Nilgiri	1455.4	Wayanad Wildlife Sanctuary Silent valley National Park Nilambur South (New Amarambalam, Karimpuzha) Mannarkkad (Attappady) Palakkad (Siruvani Reserved Forests) Nilambur North, (Chakkikuzhy, Kozhipara, Punchakolly, Ex.Karulai Range (Nilambur Kovilakom) Kozhikode (kuttyadi, Thamarassery, Vested Forests) Wayanad South (Kalpetta)
2	Agastyamalai	1828	Neyyar Peppara Shendurney wildlife sanctuaries Achencoil Thenmala Konni Punalur and Thiruvananthapuram territorial divisions and Agasthyavanam Biological Park Range.

Source : Forest Statistics 2013

Wildlife Conservation

During the year 2013-2014, Kerala has 3213.24 Km^2 of forests under protected areas (National Parks, Wildlife Sanctuaries and Community Reserve) and forms 28% of the total forest area. The list of Wildlife Sanctuaries, National Parks, and Community Reserve & Biosphere Reserve are given below.

Table : 3.19 List of Wildlife Sanctuaries, National Parks

Sl. No.	Name	District	Area (Km^2)	Year of Formation
	National Parks			
1	Eravikulam National Park.	Idukki	97.000	1978
2	Silent Valley National Park.	Palakkad	237.520	1984
3	Anamudi Shola National Park.	Idukki	7.500	2003
4	Mathikettan National Park.	Idukki	12.817	2003
5	Pambadum Shola National Park, Idukki	Idukki	1.318	2003
	Wildlife Sanctuaries			
1	Periyar WLS (Tiger Reserve), Idukki **	Idukki	925.000	1950
2	Neyyar WLS, Thiruvananthapuram	Thiruvananthapuram	128.000	1958
3	Peechi–Vazhani Wildlife Scantuary.	Thrissur	125.000	1958
4	Parambikulam WLS (Tiger Reserve)	Palakkad	643.660	1973
5	Wayanad WLS, Wayanad	Wayanad	344.440	1973
6	Idukki WLS, Idukki	Idukki	70.000	1976
7	Peppara WLS, Thiruvananthapuram	Thiruvananthapuram	53.000	1983
8	Thattekkadu Bird Sanctuary, Ernakulam	Ernakulam	25.000	1983
9	Shenduruniey WLS, Kollam	Kollam	171.000	1984
10	Chinnar WLS, Idukki	Idukki	90.440	1984
11	Chimmony WLS, Thrissur	Thrissur	85.000	1984
12	Aralam WLS, Kannur	Kannur	55.000	1984
13	Mangalavanam Bird Sanctuary.	Ernakulam	0.0274	2004
14	Kurinjimala Sanctuary, Idukki	Idukki	32.000	2006
15	Choolannur Pea Fowl Sanctuary	Palakkad	3.420	2007
16	Malabar Sanctuary.	Kozhikkode	74.215	2009
17	Kottiyoor WLS, Kannur	Kannur	30.3798	2011
	Total		**3211.7372**	

Source: Forest Statistics 2013

Mangroves

Conservation of mangrove vegetation is very important as it abode the rich biodiversity sustainability of seafood species and shoreline stability and survival of selected communities in the context of global warming and sea level rise. The ecological services and economic benefits provided by the wetland ecosystem including mangroves are services like flood control, erosion control, storm surge protection, shoreline protection, nutrient reclying, micro climate regulation, ozone layer stabilization and economic benefits like providing fish, farages, fuel wood, honey and waxes, etc. It provides unique habitat to birds, mammals and fish though a complex marine food chain and creation of breeding habitat.

Table : 3.20 District Wise Mangrove Area

Sl.No.	District	Area in Ha
1	Thiruvananthapuram	23
2	Kollam	58
3	Pathanamthitta	0
4	Alappuzha	90
5	Kottayam	80
6	Idukki	0
7	Ernakulam	260
8	Thrissur	21
9	Palakkadu	0
10	Malappuram	12
11	Kozhikode	293
12	Wayanadu	0
13	Kannur	755
14	Kasaragode	79
TOTAL		**1671**

Marine Eco System

Exorting pressure on the marine and coastal ecosystem due to land use changes, water disposal, coastal erosion, tourism industry and sand mining are reported from various studies in the State. The fisheries sector is facing pressure from access fishing fleet, habitat degradation, over fishing and juvenile fishing. Bottom trancing poses major threat to the marine ecosystem along the coast of Kerala. Kerala has high population density along with its 580 Km long coastline and coastal villages. The climate induced changes adversily affect livelihood option of fisherman community and a few millimetre rise in sea level directly affect the vulnerable coastal population.

Table : 3.21 Marine Fishing Villages in Kerala

Thiruvananthapuram		Kollam			
1.	South Kollengode	43.	Paravoor South	84.	Vadakkal South
2.	Paruthiyoor	44.	Paravoor North	85.	Vadakkal North
3.	Poovar	45.	Mayyanad	86.	Kanjiramchira
4.	Karumkulam	46.	Eravipuram North	87.	Thumboli South
5.	Kochuthura	47.	Eravipuram South	88.	Thumboli North
6.	Puthiyathura	48.	Pallithottam	89.	Chettikkad
7.	Pallam	49.	Port	90.	Kattoor
8.	Pulluvila	50.	Moodakkara	91.	Pollathai
9.	Adimalathura	51.	Vady	92.	Chethy
10.	Chowara	52.	Thankassery	93.	Chennaveli
11.	Vizhinjam North	53.	Kannimel	94.	Arthunkal
12.	Vizhinjam South	54.	Sakthikulangara	95.	Thaikkal
13.	Kovalam	55.	Neendakara	96.	Ottamassery
14.	Panathura	56.	Puthunthura	97.	Azheekkal
15.	Poonthura	57.	Karithura	98.	Pallithode South
16.	Beemapally	58.	Kovilthottam	99.	Pallithode North
17.	Cherithura	59.	Ponmana	**Ernakulam**	
18.	Valiathura	60.	Pandarathuruthu	100.	Chellanam
19.	Kochuthope	61.	Vellanathuruthu	101.	Maruvakkad
20.	Valiathope	62.	Cheriyazheekal	102.	Kandakkadavu
21.	Sanghumughom	63.	Alappad	103.	Kannamali
22.	Kannamthura	64.	Kuzhithura	104.	Cheriyakkadavu
23.	Vettukadu	65.	Prayakkadavu	105.	Manassery
24.	Kochuveli	66.	Srayikkadu	106.	Fort Cochin
25.	Pallithura	67.	Azheekkal	107.	Azheekkal
26.	Valiaveli	68.	Maruthoorkulangara	108.	Ochanthuruthu
27.	Vettuthura	69.	Kulasekharapuram	109.	Malippuram
28.	Puthenthope	**Alappuzha**		110.	Elamkunnapuzha
29.	Vettiyathura	70.	Valiazheekkal	111.	Njarakkal
30.	Mariyanad	71.	Tharayilkkadavu	112.	Nayarambalam
31.	Puthukurichi	72.	Kallikkadu	113.	Edavanakkadu
32.	Perumathura	73.	Arattupuzha	114.	Pazhangadu
33.	Thazhampally	74.	Pathiyankara	115.	Ayyampilli
34.	Poothura	75.	Thrikkunnapuzha	116.	Kuzhupilly
35.	Anjengo	76.	Pallana	117.	Pallippuram
36.	Mampelly	77.	Thottappally	118.	Cherai
37.	Kaikkara	78.	Punthala	119.	Munambam
38.	Arivalam	79.	Purakkad	120.	Saudi
39.	Vettoor	80.	Ambalapuzha		
40.	Chilakkur	81.	Neerkunnam		
41.	Odayam	82.	Punnapra South		
42.	Edava	83.	Punnapra North		

Thrissur		**Kozhikkode**		203.	Mattool
121.	Azheekode	162.	Chaliyam	204.	Puthiyangadi
122.	Eriyad	163.	Beypore	205.	Palacode
123.	Edavilangu	164.	Kappaikal	206.	Havvayi
124.	Vemballoor	165.	Thaikadappuram	**Kasaragod**	
125.	Kulimuttam	166.	Marad	207.	Thrikaripur
126.	Perinjanam	167.	Vellayil	208.	Valiaparamba
127.	Kaipamangalam	168.	Puthiyakadavu	209.	Padannakadappuram
128.	Chendrappini	169.	Thoppayil	210.	Thikadappuram
129.	Cheppallipuram	170.	Kampuram	211.	Kadangode
130.	Nattika	171.	Puthiyangadi	212.	Poonjakadappuram
131.	Thalikkulam	172.	Pallikandi	213.	Hosdurg
132.	Vadanappally	173.	Puthiyappa South	214.	Ajanoor
133.	Engandiyoor	174.	Puthiyappa North	215.	Pallikkara
134.	Blangadu	175.	Elathur	216.	Kottikulam
135.	Manathala	176.	Kannankadavu	217.	Kizhoor
136.	Kadappuram	177.	Edakkadavu	218.	Kasaba
137.	Edakkazhiyoor	178.	Ezhukudickal	219.	Kavungoli
138.	Manthalamkunnu	179.	Valiamangadu	220.	Koyippadi
Malappuram		180.	Cheriyamangadu	221.	Shiriya
139.	Palapetty	181.	Virunnukandy	222.	Bengara Manjeswar
140.	Veliyanoode	182.	Quilandy		
141.	Puduponnani	183.	Kollam-Mudadi		
142.	Thekkekadappuram	184.	Vanmugghaom		
143.	Mukkadi	185.	Thekody		
144.	Marakkadavu	186.	Melady		
145.	Meentheruvu	187.	Iringal		
146.	Pallivalappu	188.	Badakara South		
147.	Purathur	189.	Kuriyadi		
148.	Koottayi	190.	Badakara North		
149.	Paravanna	191.	Mathungal		
150.	Thevarkadappuram	192.	Madappally		
151.	Puthiyakadappuram	193.	Marakkara		
152.	Cheerankadappuram	194.	Chompola		
153.	Ossankadappuram	195.	Azhiyoor		
154.	Pandakadappuram	**Kannur**			
155.	Edakkadappuram	196.	Kurichiyil		
156.	Komankadappuram	197.	Chalil Gopalapetta		
157.	Elarankadappuram	198.	Pallissery		
158.	Parappanangadi	199.	Edakkadu		
159.	Arayankadappuram	200.	Thayyil		
160.	Ariyalloor Beach	201.	Kannur City		
161.	Kadalundi Beach	202.	Azhikkode Kadappuram		

Source ; Fisheries Department

Table : 3.22 Inland Fishing Villages in Kerala 2013-14

Thiruvananthapuram		40.	Muhamma	80.	Vadakkekar
1.	Attupuram	41.	Thirunellur	81.	Puthenvellikara
2.	Hariharapuram	42.	Panavally	**Thrissur**	
3.	Chirayinkeezhu	43.	Arukutty	82.	Anappuzha
4.	Vellayani	44.	Perumpalam	83.	Pullutte
Kollam		45.	Aroor	84.	Poyya
5.	Prayar	46.	Thuravoor North	85.	Puthenchira
6.	Sasthamkottah	47.	Thuravoor South	86.	Nedupuzha
7.	Puthukkadu	48.	Vayalar East	87.	Venkidangu
8.	Mangadu	49.	Mannar Sangham	88.	Karalam
9.	Koyivila	50.	Thalavady	89.	Velloor
10.	Kadavoor	51.	Noornadu	**Palakkad**	
11.	Aravila	52.	Eraviperoor	90.	Muthalamada
12.	Neendakara	53.	Marakkattu Ward	91.	Palakkadu
13.	Prakulam	54.	Ramamkary	**Malappuram**	
14.	Perumon	55.	Kavalam	92.	Kadavonadu (Ponnani)
15.	Mundackal	56.	Thevarvattom	93.	Gomughom
16.	Sinkarapally	57.	Thanneermukkom	94.	Purathoor
17.	Chavara South	**Kottayam**		95.	Kutturapuzha
18.	Chavara North	58.	Changanassery	96.	Palathungal
19.	Koduvila	59.	Kumarakom	97.	Kadalundipuzha
60.	Kumbalam	1.	Thiruvarpu	**Kozhikode**	
61.	Muttom	2.	Vaikom Town	98.	Karuvanthuruthy
62.	Chemmakkad	3.	Thalayazhom	99.	Cheruvannoor
63.	Kanjirakkode	4.	Chempu	100.	Eranjikal
64.	Manalikkadu	5.	Kaduthuruthi	101.	Vengalam
65.	Kuripuzha East	6.	Kottayam	102.	Vellur
66.	Mukkadu	**Idukki**		103.	Teragi
67.	Kottiyam	7.	Idukki	104.	Ullookadavu
68.	Padappakkara	**Ernakulam**		105.	Akalappuzha
69.	Ayiramthengu	8.	Kadamakudi	**Wayanad**	
70.	Arinelloor	68.	Ezhikkara	106.	Vythiri
Pathanamthitta		69.	Mulavukadu	**Kannur**	
71.	Parumala	70.	Cheranelloor	107.	Kurinjimangalam
72.	Thiruvalla	71.	Maradu	108.	Ezham
73.	Maramon	72.	Kumpalam	109.	Kattampally
Alappuzha		73.	Udayamperoor	110.	Mandalloor
74.	Kayamkulam	74.	Ernakulam West	111.	Eranholi
75.	Kochiyard Jetty	75.	Poonithura	**Kasaragode**	
76.	Chodatheruvu	76.	Nedumagramam	112.	Peelicode
77.	Payippadu	77.	Ernakulam East	113.	Thrikkaripur
78.	Karuvatta	78.	Kumbalangi		
79.	Chenkole	79.	Palluruthi		

Source: Fisheries Department

Table : 3.23 District wise Fish Production in Kerala 2013-14

Sl. No	District	Marine	Inland	Total
1	Thiruvananthapuram	41836	3705	45541
2	Kollam	105009	21877	126886
3	Pathanamthitta	…	2025	2025
4	Alappuzha	116159	24828	140987
5	Kottayam	...	8756	8756
6	Idukki	…	1344	1344
7	Ernakulam	51997	41449	93446
8	Thrissur	63905	25564	89469
9	Palakkadu	…	22036	22036
10	Malappuram	25155	3543	28698
11	Kozhikode	80050	4561	84611
12	Wayanadu	…	1005	1005
13	Kannur	22320	3139	25459
14	Kasaragode	15877	22505	38382
	Total	**522308**	**186337**	**708645**

Source: Fisheries Department

Table: 3.24 Inland Fishery Resources of Kerala 2013-14

Sl. No.	District	Rivers & Canals (in KM)	Reservoirs (in Ha)	Tanks & Ponds (in HA)	Brakish Water (in HA)
1	Thiruvananthapuram	278	2340	318.82	1424
2	Kollam	197	2590	273.70	8604
3	Pathanamthitta	199	2505	62.73	0
4	Alappuzha	145	0	382.98	15223
5	Kottayam	128	0	64.05	4327
6	Idukki	270	9861	7.55	0
7	Ernakulam	151	608	520.03	16213
8	Thrissur	178	3706	900.65	4272
9	Palakkadu	298	6863	1113.86	0
10	Malappuram	217	0	61.71	1796
11	Kozhikode	266	2122	34.38	4162
12	Wayanadu	63	2937	23.34	0
13	Kannur	423	648	242.77	5944
14	Kasaragode	407	0	1286.36	3248
	TOTAL	**3220**	**34180**	**5292.93**	**65213**

Source: Fisheries Department

Table : 3.25 Marine Fishery Resources of Kerala 2013-14

Sl.No	District	Continental shelf ('000 sq Kms)	Number of landing centres	Number of Fishing Villages
1	Thiruvananthapuram	5175	51	42
2	Kollam	2454	18	27
3	Pathanamthitta	0	0	0
4	Alappuzha	5440	16	30
5	Kottayam	0	0	0
6	Idukki	0	0	0
7	Ernakulam	3051	20	21
8	Thrissur	3582	21	18
9	Palakkadu	0	0	0
10	Malappuram	4644	11	23
11	Kozhikode	4710	19	34
12	Wayanadu	0	0	0
13	Kannur	5440	12	11
14	Kasaragode	4644	19	16
	TOTAL	**39139**	**187**	**222**

Source: Fisheries Department

CHAPTER - IV

Atmosphere

Atmospheric Pollution

Until a decade ago pollution was not a matter of concern for our State. Increasing use of fossil fuel in the transportation and industrial sectors is adversely affecting the air quality. Major cities like Thiruvananthapuram, Kochi and Kozhikode in the State have been experiencing degradation of air quality due to increasing population and vehicular traffic. Improper collection and disposal of garbage is aggrevating the problem. Scientific disposal facilities are inadequate even in major cities and garbage burned in open space is one among the major cause of air pollution. Vehicular movements and unrest use of loud speakers are responsible for the noise pollutions in the urban areas.

A recent study conducted by the State Pollution Control Board (SPCB) reveals that there is a sudden rise in air pollution, especially in the respirable suspended particulate matter(RSPM) and a subsequent fall in Oxygen content in many parts of the State. A trend analysis of major towns in the past decade by Pollution control Board shows that more than 10 tonnes exceeded the RSPM levels of 60 microgram per cubic meter (Mg/Md) which is the upper limit as per the National Ambient Air Quality Monitoring Program me (NAMP) standards.

The number of vehicles has increased 2000% from 119720 in 1975 to 2315372 in 2002. But the corresponding increase in road length for the same period has only 44%. The pollution from industries are mainly contributed from four major industrial areas of the state, three in Ernakulam and one in Kanjikkode at Palakkad. Most of the major/medium industries and the percentage share of total in the State are more in Ernakulam which naturally resulted in and adverse impact in the air quality. In the case of solid, hazardous and biomedical wastes the average waste generation per capita in Kerala is high in the State compared to the national average. The database of WHO regarding the air pollution monitoring from 1600 cities all over the world includes 124 cities from India of which eight are from Kerala.

Tabel : 4.1 Air Pollution Monitoring Cities in Kerala 2013-14

Rank	City	Particulate Matter upto 10 Micrometer (PM 10)	Particulate Matter upto 2.5 Micro metre (PM 2.5)
1	Pathanamthitta	23	10
2	Kollam	39	17
3	Alappuzha	46	20
4	Thiruvananthapuram	52	23
5	Kottayam	55	24
6	Kozhikkode	57	25
7	Kochi	64	28
8	Thrissur	73	32

Atmosphere

Atmosphere is considered to be the most essential entity that support and protect life on earth. The principal constituents of the lower atmosphere are:

- ✓ Nitrogen – 78.8% by volume
- ✓ Oxygen – 20.94%
- ✓ Argon – 0.93%
- ✓ Carbon dioxide – 0.033%

Besides there are minute proportions of other gases.

Green Plants during Photosynthesis absorb Co_2 from the atmosphere and use it to manufacture food and keep other biophysical processes. Ozone (O_3) consisting of 3 Oxygen atoms chemically linked in another variable constituent of the atmosphere. In the lowest layers the proportion of Ozone is very low.(less than 0.00005 by volume of atmosphere). Between 20 Km and 40 Km altitude greater concentrations of Ozone are found. At levels 32 Kms, it

increases forming what is known as Ozone belt, it plays a crucial role in blocking the harmful ultraviolet radiation from the sun. Water vapour is one of the most variable gaseous substances present in the atmosphere, constituting between 0.02% and 4% of the total volume in cold, dry, humid tropical climate respectively. 90% of moisture content in the atmosphere exist within 6 Km on the surface of the earth. Atmosphere also contains a colloid of fine solid particles or liquid droplets, in air or another gas which is known as aerosol. In addition, negligible quantities of other gases such as Argon, Neon, Helium, Hydrogen, Zeon, Krypton, Methane etc. were present in the Atmosphere.

Atmosphere can be classified into Troposphere, Stratosphere, Mesosphere, Thermosphere (Ionosphere) and Exosphere. Of the five layers constitute Atmosphere weather of course in the lowest layer known as Troposphere which lies close to the surface of the earth, it extend roughly to a height of 7 to 8 Km near the poles to some 16 Km all of the equator.

Stratosphere is a region of uniform temperature extending from an altitude of about 11 Km above the earth to a height of nearly 50 Km. It is free from water vapour clouds and dust. The upper part of the Stratosphere has plenty of Ozone which affords protection to human beings on the earth against fatal effects of ultraviolet radiations. Stratosphere also provides ideal conditions for flying aeroplanes. The upper limit of this layer is called Stratopause.

Mesosphere is a very cold region above the Stratosphere which extends from 50 or 80 Km above the earth surface. Mesopause is the boundary line between Ionosphere and Mesosphere. Thermosphere is the upper most layer of atmosphere extending from, the mesopause at an altitude of about 85 Km to the outer limits of atmosphere. Ionosphere is that part of the thermosphere which extends above the mesosphere from 65 Km to nearly 400 Km above the earth surface. It is an electrically charged layer characterised by the Ionisation of atoms. Due to the presence of electrical disharge in the Ionosphere, radio waves transmitted from the earth are reflected to the earth by this layer. Exosphere is the upper most region of the atmosphere. It extends beyond the Ionosphere above a height of about 400Km. The air is extremely rarefied and the temperature gradually increases through the layer. The pressure exerted by atmosphere as a result of its weight above a unit area of the earth's surface is called the atmospheric pressure which is expressed in millibars (mb) and is measured with a mercury barometer. Insolation is the radiant energy that reaches the surface of earth from the sun, insolation is the most important single source of atmospheric heat.

Green House Gas Emission in Kerala

Kerala has a fragile and closed ecosystem. In Kerala the emission rate of Co_2 and other green house gases (GHG) are comparatively low in the State. A study by Cochin University of Science and Technology reveals that sea level rise and climate changes which effects monsoon are very much linked to green house gas emission. Considering the high population of Kerala the total green house gas emissions will be 50.08 million tonnes. However the actual emissions for the state could be far below this range. Due to the population pressure, forest areas are under threat which leads to the higher concentration of Co_2 in atmosphere.

Ozone Depletion

Ozone depletion occurs when chlorofluoro carbon (CFCS) formerly found in aerosol spray cans and refrigerants are released into the atmosphere. These gases, through several chemical reactions, cause the ozone molecules to break down, reducing ozone's ultraviolet (UV) radiation absorbing capacity. CFCS are used in a variety of industrial, commercial and household applications. Depletion of ozone layer results in increased levels of ultraviolet radiation reaching the earth's surface. This leads to higher rates of skin cancer, cataract and damage to people's immune systems. Small increase in ultra violet radiation diminishes the productivity of important food crops and reduces levels of plankton in other ocean adversely affecting marine food supplies. There are many other substances that lead to ozone layer depletion such as hydro chlorofluoro carbons (HCFCs) and volatile organic compounds (VOCs). Such substances are found in vehicular emissions, by-products of industrial processes, aerosols and refrigerants. All these ozone depleting substances remain stable in the lower atmospheric region , but as they reach the stratosphere , they get exposed to the ultraviolet rays. This leads to their breakdown and releasing of free chlorine atoms which reacts with the ozone gas, thus leading to the depletion of the ozone layer. Hydrochlorofluoro Carbons (HCFC) are used mainly in the air conditioning, refrigeration , polyurethane foam manufacturing and cold chain sectors and must be replaced with better alternatives. The scenario is not different in Kerala which is considered to be a typical fast growing urbanised society. The refrigerant consumption shows a rapid growing trend in our state. The fact according to European Union report that HCFC gases are mostly used by split air conditioning units, car ACs and commercial refrigeration thus becomes a major threat which we will have to face in the near future.

Table : 4.2 Districtwise Wind Power Installed Capacity (Mw)

Sl.No	District	As on 31.12.2014
1	Thiruvananthapuram	
2	Kollam	
3	Pathanamthitta	
4	Alappuzha	
5	Kottayam	
6	Idukki	14.25MW
7	Ernakulam	
8	Thrissur	
9	Palakkadu	20.625MW
10	Malappuram	
11	Kozhikode	
12	Wayanadu	
13	Kannur	
14	Kasargod	

Source : ANERT

Humidity:

As the State stretches from north to south with the Arabian Sea in its west, relative humidity is in general high over the State. In the period January to March afternoon humidity reduce to 60-63%, varying from 35% in the interior to 71 % in the coastal area. The diurnal variation in relative humidity during this period is maximum and ranges from 4 to 16%, depending upon the proximity of the sea. The relative humidity in the monsoon period rises to about 85% for the state. The variation in this period is minimum.

Table : 4.3 Monthly mean Relative Humidity of Observatories in Kerala – 2013-14

Sl. No.	Stations	Relative Humidity %	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR
1	Alappuzha	At 0830 hrs IST	82	86	94	95	93	90	87	88	78	77	81	81
		At 1730 hrs IST	76	79	89	88	85	84	77	75	67	66	71	68
2	Kozhikode City	At 0830 hrs IST	74	80	96	97	95	89	86	88	81	79	79	77
		At 1730 hrs IST	67	72	88	92	85	81	78	78	66	63	62	65
3	Kannur	At 0830 hrs IST	75	70	95	97	92	91	87	78	65	68	76	72
		At 1730 hrs IST	67	72	91	94	86	85	82	74	63	66	64	63
4	Karipur Airport	At 0830 hrs IST	73	77	92	92	89	87	86	83	72	74	75	74
		At 1730 hrs IST	61	69	84	86	77	77	76	73	58	55	56	57
5	Kochi AP (Naval Base)	At 0830 hrs IST	76	83	92	93	89	87	85	81	76	72	76	78
		At 1730 hrs IST	71	73	87	84	81	80	75	73	62	57	63	65
6	Punalur	At 0830 hrs IST	91	92	97	96	91	88	88	85	63	73	80	79
		At 1730 hrs IST	65	68	89	84	76	76	78	75	71	53	55	57
7	Kottayam	At 0830 hrs IST	87	90	94	95	93	92	91	90	84	80	81	80
		At 1730 hrs IST	63	71	84	83	76	77	73	72	62	55	58	55
8	CIAL Nedumbassery	At 0830 hrs IST	82	86	94	93	90	90	89	84	81	75	81	78
		At 1730 hrs IST	65	71	84	84	76	77	73	71	58	51	58	56
9	Trivandrum City	At 0830 hrs IST	78	82	92	90	86	90	85	88	81	81	81	78
		At 1730 hrs IST	76	76	86	81	79	80	74	77	88	65	62	62
10	Trivandrum AP	At 0830 hrs IST	74	80	90	89	84	87	80	83	76	74	74	69
		At 1730 hrs IST	69	75	86	82	80	81	75	74	67	67	65	64
11	Vellanikara	At 0830 hrs IST	76	81	94	94	90	89	85	77	68	61	63	63
		At 1730 hrs IST	83	68	86	88	78	82	77	74	55	40	52	48
12	Palakkad	At 0830 hrs IST	76	78	94	95	92	91	89	80	75	69	75	68
		At 1730 hrs IST	48	56	87	89	79	81	75	62	58	50	48	34

Source : Meteriological Department

Temperature:

Day temperatures are more or less uniform over the plains throughout the year except during monsoon months when these temperatures drop down by about 3 to 5°C. Both day and night temperatures are lower over the plateau and at high level stations than over the plain. Day temperatures of coastal places are less than those of interior places. March is hottest month with a mean maximum temperature of about 33°C. Mean maximum temperature is minimum in the month of July when the State receives plenty of rainfall and the sky is heavily clouded. It is 28.5°C for the State as a whole in July, varying from about 28°C in the north to about 29°C in the South. Inland stations experience higher maximum temperatures than the coastal stations. From May onwards both the maximum and minimum temperatures start falling, the latter very rapidly while the former slowly.

Table :4.4 Monthly mean Maximum and Minimum Temperature of Observatories in Kerala, Year 2013-14

Sl. No.	Stations	Temperature (°C)	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR
1	Alappuzha	Maximum	33.2	32.4	28.6	28.5	29.1	29.9	30.5	31.4	31.5	32.4	32.7	33.5
		Minimum	28.8	26.2	23.4	23.3	23.8	24.3	24.5	24.4	23.4	23.3	24.0	25.2
2	Kozhikode City	Maximum	35.2	35.0	29.2	28.6	30.4	31.2	31.7	33.0	33.3	34.0	34.5	35.3
		Minimum	27.2	27.1	23.5	23.3	23.8	24.2	24.4	24.5	22.8	23.9	24.3	25.6
3	Kannur	Maximum	33.9	33.7	28.6	28.0	28.9	30.6	31.2	33.2	33.3	33.6	34.2	35.4
		Minimum	26.1	26.7	23.3	23.4	23.9	24.0	24.1	24.7	22.7	23.2	23.9	25.2
4	Karipur Airport	Maximum	34.1	33.4	28.5	28.0	29.1	29.7	30.4	32.0	32.2	33.0	33.5	34.8
		Minimum	26.0	25.6	22.6	22.4	22.8	23.0	23.1	23.4	21.6	21.9	23.2	25.1
5	Kochi AP (Naval Base)	Maximum	33.5	33.0	29.8	30.5	30.8	30.7	31.1	32.2	32.3	32.8	32.8	34.1
		Minimum	25.8	24.9	22.2	22.1	23.0	23.2	22.8	23.3	22.0	22.2	22.8	24.2
6	Punalur	Maximum	36.4	34.0	28.9	28.9	30.5	31.1	32.0	32.9	32.3	33.6	35.5	36.6
		Minimum	25.4	24.9	22.9	22.9	23.1	22.5	22.3	22.4	20.9	20.5	20.4	21.6
7	Kottayam	Maximum	35.2	33.3	28.9	28.9	29.8	30.7	31.9	33.3	33.2	34.0	34.2	35.9
		Minimum	25.1	25.1	22.7	22.7	21.7	22.4	21.6	23.3	22.2	22.4	23.0	23.9
8	CIAL Nedumbassery	Maximum	34.6	33.4	28.8	28.9	30.1	30.5	31.3	33.0	32.8	34.0	34.7	35.9
		Minimum	25.2	25.1	22.8	22.7	23.4	23.2	23.0	23.3	21.2	21.0	22.4	23.6
9	Trivandrum City	Maximum	34.6	32.9	29.3	29.7	30.6	30.9	32.4	31.8	32.9	32.6	33.5	34.4
		Minimum	28.2	25.4	23.3	23.3	23.9	23.8	23.6	23.9	22.9	22.7	23.2	24.1
10	Trivandrum AP	Maximum	33.4	32.4	28.9	29.4	29.8	29.4	31.2	30.9	31.6	31.1	31.7	32.8
		Minimum	26.4	25.7	23.7	23.5	24.1	24.1	24.2	24.2	23.6	23.0	23.4	24.1
11	Vellanikara	Maximum	34.8	33.9	28.6	28.4	29.7	30.1	30.7	32.6	31.9	32.9	34.6	36.6
		Minimum	25.1	25.2	22.7	22.7	22.9	22.2	22.7	23.8	22.3	23.0	22.9	24.2
12	Palakkad	Maximum	37.8	36.5	28.2	27.6	30.0	30.7	31.7	32.5	31.1	31.8	34.5	36.7
		Minimum	26.3	26.6	23.3	23.0	23.6	23.6	23.7	24.8	23.3	23.9	23.7	24.9

Source : Meteriological Department

Rainfall:

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 70% of its annual rainfall. Monsoon rainfall as percentage of annual rainfall decreases from north to south and varies from 83 % in northern district of Kasaragode to 50% southern district of Thiruvananthapuram. Northeast monsoon rainfall as percentage of annual rainfall increases from north to south and varies from 9% in north district of Kasaragode to 27% in south most district to Thiruvananthapuram. The rainfall amount in the State decreases towards the south with decrease of height of Western Ghats. The southern most district of Thiruvananthapuram, where Western Ghats are nearest to the sea coast and its average height is also least in the State receives minimum amount of rainfall. The thunderstorm rains in the pre-monsoon months of April and May and that of monsoon months are locally known as 'EDAVAPATHI'. Rainfall during northeast monsoon season is known as 'THULAVARSHAM'. The southwest monsoon sets-over the southern parts of the State by about 1st June and extends over the entire State by 5th June. June and July are the rainiest months, each accounting individually to about 23% of annual rainfall monthly distribution of Normal and Actual rainfall.

The diversity of the geographical features of the state has resulted in a corresponding diversity in climate. The High Ranges have a cool and bracing climate throughout the year, while the plains are hot and humid. The average level of annual rainfall is quite high when compared to other Indian states. The state basically enjoys 4 types of climate such as Winter, Summer, South West Monsoon and North East Monsoon.

Table: 4.5 Rainfall Distribution of Kerala for the year 2013-14

Sl. No.	Districts	2013						2014						2013-14		
		Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Actual	Normal	Departure %
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1.	Thiruvananthapuram	248.1	115.6	219.7	155.9	273.9	33.7	45.9	13.1	35.1	136.4	272.6	142.4	1692.4	1803.1	-6.1
2.	Kollam	449.0	205.4	373.4	290.9	213.8	39.5	0.6	15.7	51.4	151.7	290.8	283.5	2365.7	2491.6	-5.1
3.	Pathanamthitta	608.4	281.0	310.3	268.4	306.1	18.0	2.9	35.8	36.4	287.0	295.1	415.6	2865.0	2956.5	-3.1
4.	Alappuzha	636.5	245.4	292.2	186.4	171.5	15.2	0.2	23.3	32.7	641.5	250.6	362.8	2858.3	2838.4	0.7
5.	Kottayam	754.3	405.2	296.6	347.3	244.8	16.6	11.1	18.7	45.2	145.3	303.6	496.8	3085.5	2930.8	5.3
6.	Idukki	1025.0	688	507.2	230.0	199.2	13.7	7.8	14.2	27.1	86.8	235.0	493.0	3527.6	3303.2	6.8
7.	Ernakulam	826.7	374.5	314.3	318.7	211.0	45.1	0.0	11.1	22.4	375.7	287.9	550.1	3337.5	3028.9	10.2
8.	Thrissur	775.9	337.0	275.3	402.6	105.4	3.9	0.0	5.9	3.2	147.7	250.0	455.6	2762.5	3063.7	-9.8
9.	Palakkad	797.9	281.4	283.7	235.2	74.4	4.6	0.0	3.1	5.2	36.4	190.8	314.0	2226.7	2288.9	-2.7
10.	Malappuram	911.6	352.4	350.2	200.8	175.3	11.8	1.1	0.5	0.0	192.5	236.4	542.1	2974.7	2835.5	4.9
11.	Kozhikode	1113.8	391.6	235.0	269.0	96.6	13.8	0.0	0.0	0.8	90.7	254.4	508.2	2973.9	3514.0	-15.4
12.	Wayanad	997.6	413.6	253.4	186.3	27.7	16.7	0.0	4.2	10.1	142.0	202.0	539.4	2793.0	3251.4	-14.1
13.	Kannur	1193.9	421.1	322.0	318.8	50.0	12.2	2.3	8.4	0.0	23.2	253.4	634.2	3239.5	3318.6	-2.4
14.	Kasargod	1001.2	435.0	255.2	182.1	34.1	5.1	0.0	0.0	0.0	15.4	243.4	595.2	2766.7	3620.4	-23.6
	State (Average)	**833.2**	**374.2**	**321.9**	**259.1**	**155.0**	**16.6**	**4.7**	**10.3**	**17.9**	**156.1**	**250.7**	**454.4**	**2819.2**	**2946.1**	**-4.3**

Source : Agriculture Statistics 2013-14, DES

Table: 4.6 Rainfall details for the period of 2013-14 (in mms)

Sl. No.	Districts	2013									2014						2013-14		
		APRIL-MAY			JUNE-SEPT			OCT-DEC			JAN-FEB			MARCH			ANNUAL		
		A	N	D	A	N	D	A	N	D	A	N	D	A	N	D	A	N	D
1.	Thiruvananthapuram	152.6	333.3	-54	1109	871.4	27	463.5	522.6	-11	59	40.3	46	35.3	35.5	-1	1819.1	1803.1	1
2.	Kollam	249.8	406.7	-39	1777	1332	33	544.2	638.9	-15	16.3	50.8	-68	51.4	62.6	-18	2638.9	2491.1	20
3.	Pathanamthitta	201	479.7	-58	1928	1715	12	592.5	623.7	-5	38.7	64.7	-40	36.4	73.9	-51	2797	2957	-5
4.	Alappuzha	177.7	432.3	-59	2114	1746	21	373.1	571.7	-35	23.5	45.5	-48	32.7	45.1	-27	2720.8	2840.5	-4
5.	Kottayam	258.6	417.9	-38	2579	1898	36	608.7	535.4	14	29.9	37.5	-20	45.2	42.3	7	3520.9	2931	20
6.	Idukki	205.4	383.1	-46	3346	2279	47	442.8	564.5	-22	22	35.6	-38	27.1	43.6	-38	4043.1	3303.1	22
7.	Ernakulam	188.8	412.5	-54	2781	2065	35	574.9	489.1	17	11.1	30.9	-64	22.4	31.2	-28	3577.9	3028.7	18
8.	Thrissur	139.5	368.3	-62	2458	2198	12	511.9	469.5	9	6.3	11.5	-45	103.2	17	507	3218.4	3063.8	5
9.	Palakkad	90	257.1	-65	2090	1572	33	314.2	427.5	-27	3	9.1	-67	5.2	22.5	-77	2502.2	2288.2	9
10.	Malappuram	113.3	307.8	-63	2681	2061	30	387.9	448.2	-13	1.6	5.7	-72	0	12.7	-100	3183.3	2835.1	12
11.	Kozhikode	215.7	337.7	-36	3166	2603	22	379.4	422.1	-10	0	6.1	-100	0.8	15.1	-95	3762.3	3383.8	11
12.	Wayanad	152.9	257.7	-41	2690	2632	2	230.7	331.5	-30	4.2	12.3	-66	10.1	17.5	-42	3087.6	3250.9	-5
13.	Kannur	126.6	293.1	-57	3441	2669	29	381	344.8	11	10.7	4.2	155	0	7.6	-100	3958.8	3318.7	19
14.	Kasargod	162.7	264.1	-38	3086	3007	3	221.3	337.4	-34	0	2.9	-100	0	8.4	-100	3470.4	3619.9	-4
	State (Average)	**168.8**	**349.3**	**-52**	**2570**	**2040**	**26**	**430.7**	**480.7**	**-10**	**15.1**	**24.3**	**-38**	**25.6**	**30.5**	**-16**	**3210.3**	**2924.4**	**10**

Source : Institute of Disaster Management

LEGEND: A-ACTUAL N-NORMAL D-DEPARTURE%

JAN-FEB: Winter Season; MAR-MAY: Pre-Mansoon; JUN-SEP: South-west Monsoon; OCT-DEC: Northest Monsoon

.

Table : 4.7 District wise Annual Average Rainfall 2013-14 (in mm)

Sl. No.	Name of District	Normal Rainfall (mm)	Actual Rainfall (mm)	% Departure
1	Alappuzha	2840.5	2720.8	-4
2	Kannur	3318.7	3958.8	19
3	Ernakulam	3028.7	3577.9	18
4	Idukki	3303.1	4043.1	22
5	Kasargode	3619.9	3470.4	-4
6	Kollam	2491.1	2638.9	6
7	Kottayam	2931.0	3520.9	20
8	Kozhikkode	3383.8	3762.3	11
9	Malappuram	2835.1	3183.3	12
10	Palakkad	2288.2	2502.2	9
11	Pathanamthitta	2957.0	2797	.5
12	Thiruvananthapuram	1803.1	1819.7	1
13	Thrissur	3063.8	3218.4	5
14	Wayanad	3250.9	3087.6	-5
	STATE AVERAGE	**2924.3**	**3210.1**	**10**

Source : Agricultural Statistics, DES

Geographical Details

Geographically, Kerala roughly divides into three climatically distinct regions. These include the eastern high lands, the central midlands and the western low lands. Located at the extreme southern tip of the Indian sub continent, Kerala lies near the centre of the Indian tectonic plate (the Indian Plate); as such most of the state (notwithstanding isolated regions) is subject to comparatively little seismic or volcanic activity. Geologically pre-Cambrian & Pleistocene formations comprise the bulk of Kerala's terrain. Kerala is subjected to humid tropical wet climate which is mostly experienced by Earth's rainforests. The extreme eastern side experiences drier tropical wet climate, with an average annual rainfall of 2924 mm, whereas the low lands averages only 1250 mm of rainfall annually. The eastern high lands comprise the states wettest region receiving an excess of 5,000 mm rainfall annually. So the state of Kerala experience some 120 to 140 rainy days every year. The south west monsoon starts from June and continues till September. Kerala gets most of its rain from seasonal monsoons. The maximum temperature throughout the year is around 36.7° C. The milky cold and pleasant weather can be experienced at its best in December and January. The climate is humid and hot during April to June, which is the period through which summer extends itself.

Kerala State experiences three distinct seasons they being, the South west monsoon (June to September), the North East monsoon (October-December) and the Pre monsoon (January-May) The pre monsoon season is generally dry and receives only scanty rainfall. The South West monsoon is the major rainfall contributor to the state, providing an average 43% of the annual rainfall in Southern Districts and 83% of annual rainfall in the northern districts. The North East provides about 33% of the annual rainfall in Southern districts and 9% of annual rainfall in the northern districts. The reliability of the expected rainfall in the South West Monsoon is about 96% while that of North East Monsoon is only about 40%. The hydrological year in the state begins on 1st June and ends on 31st May which based on the long period average data of onset of South West Monsoon.

Rain fall Details

Annual average rainfall data for the period 1.4.13 to 31.3.2014 is given below.

Period	Actual (mm)	Normal (mm)	Departure %
1.4.2013 to 31.3.14	3210.3	2924.3	10%

Average rainfall data in different parts of the state during the year (ie. south west monsoon, North east monsoon, winter season, pre monsoon period mentioned separately) received from Director, Indian Meteorological Department, Thiruvananthapuram.

Table : 4.9 Cumulative Achievement of Bio Gas Plant in Kerala 2014

Sl. No.	District	2012-13	2013-14
1.	Thiruvananthapuram	85	13
2.	Kollam	86	56
3.	Pathanamthitta	162	58
4.	Alappuzha	793	676
5.	Kottayam	408	155
6.	Idukki	243	124
7.	Ernakulam	462	422
8.	Thrissur	436	402
9.	Malappuram	190	50
10.	Palakkad	242	79
11.	Kozhikode	508	150
12.	Wayanad	142	119
13.	Kannur	234	10
14.	Kasargod	26	11
	TOTAL	**4017**	**2325**

Source : ANERT

Table : 4.10 Air quality in important Cities in Kerala

Annual Average mg/m3

Sl.No.	District	So 2	Air quality	NO2	Air quality	PM10	Air quality
1	Kochi	3	L	13	L	38	M
2	Kozhikkodu	2	L	8	L	46	M
3	Thrisur	2	L	14	L	33	M
4	Malappuram	2	L	5	L	30	L
5	Thiruvananthapuram	10	L	23	M	58	M
6	Kollam	4	L	20	L	53	M

SO2 Sulphur Dioxide, NO2 Nitrogen Dioxide PM10 Particulate Matter having an aerodynamic diameter

L- Low; M- Medium

Source : Kerala State Pollution Control Board

Table : 4.11 Ambient Air Quality Data 2014 - Annual Average

Sl. No.	District	Monitoring Location	Sulphur Dioxide µg/m^3(50 µg/m^3 , max)	Nitrogen Dioxide µg/m^3(40 µg/m^3 , max)	Respirable Suspended Particulars Matter µg/m^3(60 µg/m^3 , max)	Category
1	Thiruvananthapuram	Filatex, Veli	14.58	19.54	52.4	Industrial
		SMV School, Over Bridge	7.68	24.65	51.64	Sensitive
		Cosmopolitan Hospital, Murinjapalam	6.87	23.25	50.35	Sensitive
		Pettah Station	6.86	22.27	51.26	Residential
2	Kollam	Kadappakada Station	3.76	9.49	33.82	Residential & Others
		KMML, Chavara	5.33	11.38	35.89	Industrial
3	Pathanamthitta	Makkankunnu	2.00	12.36	22.2	Residential & Others
4	Alappuzha	DC Mills, Pathirappally	2.00	4.50	40.61	Industrial
		Thodankulangara	2.00	4.5	44.16	Industrial
5	Kottayam	Nagambadam	8.63	21.70	64.86	Residential & Others
		Vadavathur	6.11	20.92	56.76	Industrial
6	Idukki	Thodupuzha	2.00	4.50	16.35	Residential & Others
7	Ernakulam	Eloor Methanam	2.00	10.46	52.43	Residential
		Eloor TCC	2.00	11.66	55.01	Industrial
		South Overbridge	2.60	7.44	71.02	Residential & Others
		Vyttila	3.00	8.74	65.82	Residential Rural & Others
		Irumpanam	2.73	5.03	106.64	Industrial

		Kalamassery	2.63	7.30	47.02	Industrial
		M.G.Road	2.86	7.51	74.39	Residential & Others
8	Thrissur	Poomkunnam	2.00	12.64	55.01	Residential & Others
9	Palakkadu	Kanjikkode	2.00	6.41	40.19	Industrial
10	Malappuram	Kakkancherry	2.00	11.50	43.54	Industrial
11	Kozhikode	Kozhikode City	2.00	22.28	51.37	Residential & Others
		Nallalam	2.00	16.22	40.41	Industrial
12	Wayanadu	Sulthan Batheri	2.00	4.50	36.00	Sensitive
13	Kannur	Kannur	2.82	4.53	87.46	Residential Rural & Others
		Mangattuparambu	2.80	4.52	55.14	Residential Rural & Others
14	Kasaragod	Kasargod	2.01	5.15	36.71	Residential Rural & Others
		Kanhangadu	2.00	5.39	37.7	Residential Rural & Others

Source : Kerala State Pollution Control Board Directory 2014

Table : 4.12 Ambient Air Quality Standards in Respect of Noise

Sl.No	Category Area	Limit in dB(A) Leq	
		Day time	Night time
(A)	Industrial area	75	70
(B)	Commercial area	65	55
(C)	Residential area	55	45
(D)	Silence zone	50	40

Source : Kerala State Pollution Control Board

Note:

1. Day time is reckoned from 6 A.M to 10 P.M.
2. Night time is reckoned from 10 P.M to 6 A.M.
3. Silence zone is referred as areas within 100 meters around premises such as hospitals, educational institutions and courts. The Silence zones are to be declared by the Competent Authority.
4. Use of Vehicle horns, loudspeakers and bursting of crackers shall be banned in these zones.

Table : 4.13 Effects of Noise Polltion in Human Health

A. Noise Hazards		B. Noise Nuisances	
Stage I	Stage II	Stage III	Stage IV
Threat to survival (a) Communication interference (b) Permanent hearing loss	Causing injury (a) Neural-humoral stress response (b) Temporary hearing loss (c) Permanent hearing loss	Curbing Efficient Performance (a) Mental Stress (b) Task Interference (c) Sleep interference	Diluting comfort and enjoyment (a) Invasion of privacy (b) Disruption of social Interaction (c) Hearing Loss

Source : Kerala State Pollution Control Board

Table : 4.13 Major Indicators showing operational efficiency of KSRTC

Sl. No.	Items	Year	
		2012-13	2013-14
1	Fleet Strength (Nos)	5812	5860
2	Gross Revenue Earnings (RS. In Crores)	1704.8	1863.56
3	Gross Revenue Expenditure (RS. In Crores)	2200.69	2433.66
4	Gross operating loss (RS. In Crores)	(-)495.89	(-)570.16
5	No. schedules operated	4067	4754
6	Average earnings per vehicle on road per day (Rs)	9197	9812
7	Average earnings per km. of Buses operated (paise)	2832	2989
8	Average Earnings per Passenger (paise)	1294	1426
9	Average route length (Kms)	50.57	52.01
10	Average kms. Run per bus per day	318.92	323.38
11	Average number of buses held daily (Nos)	5847	5830
12	Passengers carried (Lakhs)	12156	11634

Source : Kerala State Transport Commisionerate

Table : 4.15 Category-wise Growth of Motor vehicles in Kerala 2013-14

Sl. No.	Type of vehicles	2009-10	2010-11	2011-12	2012-13	2013-14
1	Goods Vehicles					
	Four wheelers and above	262824	294395	322450	354296	373218
	Three wheelers including tempos	108104	117266	128452	206901	140278
2.	**Buses**					
	Stage carriages	43727	46594	21457	34161	28356
	Contract carriages/ Omni	114351	119150	124290	137731	132144
3.	**Cars and station wagons**					
	Cars	901663	1060861	122691	1358728	1538246
	Station wagons	0	0	0	0	0
	Taxis	151533	163407	175638	128250	194358
	Jeep	73700	73700	73700	74167	73700
4.	**Three wheelers**					
	Auto rickshaws	466135	518741	575763	602547	663241
	Motorised Rickshaws	61	61	0	0	0
5.	**Two wheelers**					
	Motorised cycles	1017	1017	0	0	0
	Scooters/ Motor cycles	3216123	3610838	4127227	5041495	5288529
6.	Tractors	11680	12224	13740	14183	15030
7.	Tillers	5217	5335	5399	5399	5414
8.	Trailers	2321	2324	2407	2744	2411
9	Others	39196	46106	68325	88071	93011
	TOTAL	**5370955**	**6045322**	**6865539**	**8048673**	**8547966**

Source: Transport Commissionarate

Table : 4.16 Newly Registered Motor Vehicles in Kerala 2013-14

Sl. No.	Classification of Vehicles	TVM	KLM	PTA	ALP	KTM	IDK	EKM	TSR	PKD	MLP	KZD	WYD	KNR	KSD	NS	T0TAL
1.	Multiaxiled Articulated Vehicles	2	3	0	3	8	4	47	0	12	0	0	0	1	0	0	80
2.	Trucks& Lorries	228	156	16	154	165	126	235	146	745	0	36	6	63	56	0	2132
3.	Four Wheelers	1326	856	656	946	2158	966	3369	2565	1385	2572	3756	665	5914	2569	0	29703
4.	Three Wheelers	1418	746	1316	1126	728	256	1856	569	1123	3565	1256	125	5645	956	0	20685
5.	Stage Carriage	196	417	386	224	336	218	568	464	416	785	1614	236	1325	426	464	8075
6.	Contract Carriage	614	198	465	236	359	96	756	236	456	610	112	11	125	28	0	4392
7.	Private Service Vehicles	1426	36	126	6	16	14	39	10	0	223	14	1	10	5	0	1926
8.	Other Buses	0	42	0	46	31	18	21	55	65	754	36	12	36	19	0	1126
9.	Motor Cabs	1346	698	864	836	1356	426	1523	1222	565	556	369	74	426	226	0	10577
10.	Maxi Cabs/Taxi	146	26	7	0	14	12	0	44	0	0	0	0	0	0	0	249
11.	Other Taxi	0	0	16	46	0	8	123	8	60	116	15	56	55	460	0	549
12.	LMV 3 Seater	4794	1247	1920	1956	3956	1654	4226	3169	3000	4456	5312	1588	2236	3956	0	43770
13.	LMV 4 to 6 Seater	4225	2654	1126	2985	526	123	3746	0	0	0	0	0	2659	2265	0	20309
14.	Motor Cycle Hire	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2
15.	Other Transport	0	122	0	0	184	41	184	221	0	0	120	0	956	109	0	1937

	Vehicles																
16.	Scooters	2106	0	0	456	0	0	0	0	0	0	2113	33	166	0	0	1874
17.	Mopeds	2356	1113	300	1256	474	22	112	422	1123	0	2369	146	642	0	0	10335
18.	Motor Cycle including above & below 95cc	72156	54866	26518	40263	32523	10236	97653	49666	42565	63265	47365	7896	42561	13256	0	600789
19.	Cars	18565	9456	4316	8659	12126	3606	21036	13233	9564	13564	15456	2169	12256	8456	0	149462
20.	Jeeps	25	40	16	125	80	16	44	66	42	164	56	3	125	118	0	920
21.	Omni Buses	0	86	24	15	182	21	78	78	78	3	78	42	246	116	0	1047
22.	Tractors	6	6	2	16	43	10	18	47	26	60	13	15	26	16	0	304
23.	Trailors	2	11	24	2	12	12	0	0	0	213	0	0	0	0	0	276
24.	Others	534	421	612	502	1435	866	1023	794	669	0	1123	0	241	693	0	8913
	GRAND TOTAL	**111561**	**73200**	**38710**	**59858**	**56712**	**18751**	**136657**	**70105**	**62194**	**90397**	**81213**	**13078**	**75714**	**33318**	**464**	**922432**

Source : Kerala State Transport Commisionerate

Table : 4.17 Total Registered Motor vechicle in Kerala during 2013-14

	Transport															
SL. NO.	VEHICLE CLASS	Trivandrum	Kollam	Pathanamthitta	Alappuzha	Kottayam	Idukki	Eranakulam	Thrissur	Palakkad	Malappuram	Kozhikkode	Wayanad	Kannur	Kasargod	Total
1	Lmv - 3 Wheeled Vehicle For Transport- Passenger (A/R)	5427	3909	1765	1930	2086	1243	2961	2957	2160	4783	3064	1046	2530	1157	37018
2	Lmv - 3 Wheeled Vehicle For Transport- Goods	638	709	383	530	428	189	489	585	745	1164	925	245	651	137	7818
3	Lmv - Goods Carrier Truck	1516	1353	787	1546	1500	554	2755	1700	1155	2134	1418	361	1516	633	18928
4	Mgv - Goods Carrier Truck	97	105	34	49	72	34	224	112	85	65	70	16	160	32	1155
5	Hgv - Goods Truck	75	60	22	51	76	37	225	80	65	59	86	14	52	30	932
6	Multi Axled Vehicle	0	5	0	10	1	0	25	2	34	2	0	0	0	0	79
7	Articulated Vehicle	19	9	4	8	10	8	23	7	24	28	5	5	7	4	161
8	Private Service Vehicle	70	12	7	14	16	4	68	13	8	10	19	1	10	5	257
9	Contract Carriage (Eib)	256	113	87	107	96	54	282	146	120	173	137	25	134	73	1803
10	Stage Carriage	344	18	17	13	88	36	53	55	52	53	70	8	108	18	933
11	Contract Carriage	279	207	120	257	351	77	472	354	153	108	133	31	202	35	2779

12	Lmv Contract Carriage Imported Vehicle	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	All India Tourist Taxi	54	2	0	1	1	15	15	5	42	17	20	44	217	142	575
14	Excavator	1	0	0	0	0	0	1	0	0	0	0	0	0	0	2
15	Goods Carrier Tanker	9	6	2	4	3	3	30	9	6	1	4	1	6	0	84
16	Water Tanker	17	1	3	0	2	1	18	2	4	5	5	0	0	0	58
17	Oil Tanker	3	3	0	0	0	0	1	0	0	3	0	0	0	0	10
18	Gas Tanker	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	Hazardous Goods Tanker	4	2	1	0	2	0	14	28	4	8	3	0	3	0	69
20	Three WHEELER PASSENGER - 7 SEATER11	1039	945	905	1673	1344	548	2901	2061	1299	956	1263	319	1101	427	16781
21	Tractor Trailor	2	0	2	1	2	3	1	2	0	2	0	11	0	2	28
22	Trailor	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
23	Tipper	340	299	166	159	195	63	599	236	245	381	321	84	356	138	3582
24	Ambulance	56	40	26	20	41	16	59	31	23	37	49	17	21	5	441
25	Road Roller	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
26	Zonal Tourist Taxi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	All other Types of Vehicles	75	69	39	75	59	38	196	132	72	166	100	30	80	28	1159
	TOTAL	**10322**	**7867**	**4370**	**6449**	**6373**	**2923**	**11412**	**8517**	**6296**	**10155**	**7692**	**2258**	**7154**	**2866**	**94654**

	Non Transport															
Sl. No.	Vehicle Class	Thiruvananthapuram	Kollam	Pathanamthitta	Alappuzha	Kottayam	Idukki	Eranakulam	Thrissur	Palakkad	Malappuram	Kozhikkode	Wayanad	Kannur	Kasargod	Total
1	Motor Cycle – Below 95cc	1199	673	327	814	337	73	923	1828	4278	681	281	183	529	220	12346
2	Motor Cycle - Above 95cc	71465	55056	25612	45826	32257	12927	77794	59910	43978	64835	70349	8495	38217	17926	624647
3	Motor Car Below 1500 Cc	19822	13734	8789	10032	13349	3998	23731	15694	9573	16668	14613	2585	13344	7094	173026
4	MOTOR CAR 1500 CC And Above	2152	1281	926	781	1237	420	3268	1685	720	1020	1170	228	1005	475	16368
5	Psv For Personal Use Below 1500 Cc	253	221	88	113	181	43	164	152	125	230	137	50	197	192	2146
6	Tractor	15	25	22	24	24	6	54	69	86	67	12	10	41	16	471
7	Vehicle Mounted with Generator	0	0	1	0	0	0	7	0	0	1	0	0	0	0	9
8	Vehicle Mounted with Compressor	0	1	1	0	1	2	0	0	0	0	1	1	0	0	7

9	Vehicle Mounted with Rig	4	0	0	0	0	0	0	0	0	0	0	0	0	0	4
10	Vehicle Mounted with Crane	11	8	2	7	8	5	44	11	8	6	9	0	8	4	131
11	Invalid Carriage - Motor Cycle	306	19	6	52	31	1	32	11	7	18	20	15	16	19	553
12	Earth Moving Equipment	60	47	16	25	64	23	112	39	28	83	70	10	80	60	717
13	Road Roller	21	10	7	13	8	9	63	17	8	17	17	0	18	5	213
14	Bulldozer	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	Imported Psv Personal Use	317	230	126	97	188	46	342	309	204	267	293	37	198	104	4758
16	All Other Types of Vehicles	90	48	21	20	47	29	64	47	64	125	29	8	57	19	668
	TOTAL	**95715**	**71353**	**35944**	**57804**	**47732**	**17582**	**106598**	**79772**	**59079**	**84018**	**87001**	**11622**	**53710**	**26134**	**834064**

Source: Transport Commissionarate

Table : 4.18 Complying Status of Grossly Polluting Industries

Sl. No.	Name and Address of Industry	Sector	Category of Industry	Date of commencement of Industry	Effluents recipient water body or lakes		Concerned recipient River		Effluent		BOD (Kg/day) and other pollution load			ETP status
					Name	Dist. From industry (km)	Name	Distance from the discharge point of recipient waterbody	Quality Compliance (Yes/ No)	Quantity in KLD	Before treatment		After treatment	
1	2	3	4	5	6	7	8	9	10	11	12		13	14
1.	Binani Zinc Ltd., Edayar, Ernakulam	PU	Zinc	1967	River Periyar	40 m	River Periyar	Discharge directly into river	Yes	550	pH SS SulphateCd Zinc Fluoride		8.5 55 550 0.11 2.75 8.25	OPRS
2	Indian Rare Earth Ltd., Eloor, Ernakulam	PU	Mineral Processing	1952	River Periyar	0.1 km	River Periyar	Discharge directly into river	Yes	4	pH SS COD Amm.N2 Phosphate Sulphide Zinc Flouride Lead		9 40 100 20 2 0.8 2 0.8 0.4	OPRNS
3	FACT Ltd., Udyogamandal, Eloor, Ernakulam	CU	Fertilizer	1966	River Periyar	300 m	River Periyar	Discharge directly into river	No	12000	pH SS Phosphate Sulphide Hex.Chr O & G Free Amm Amm Nitra Nitrate TKN As. V Fluoride CN		8 1200 60 1.2 120 48 900 120 1800 2.4 2.4 18 2.4	OPRNS

4	FACT Ltd., Petrochemical Division, Udyogamandal P.O., Eloor, Ernakulam	CU	Petrochemical	1990	River Periyar	200 m	River Periyar	Discharge directly into river	Yes	5040	BOD pH SS COD O & G Free NH3 Amm.NH3 TKN Nitrate Phenolic Compounds		151.2 8.5 151.2 1260 50.4 25.2 252 504 100.8 5.04	OPRS
5	Cochin Minerals & Rutiles Ltd., Edayar, Ernakulam	PU	Chemical	1992	River Periyar	500 m	River Periyar	Discharge directly into river	Yes	250	pH SS O & G HC Total Chr.		8.5 25 2.5 0.25 25 0.5	OPRS
6	Hindustan Insecticides, Eloor, Ernakulam	CU	Pesticides	1958	Kuzhikandom thode	1750 m	River Periyar	Through Kuzhikandom thode	No	1024	pH SS TDS O & G SO2 Chlorine		9 102.4 2150.4 10.24 1024 1024	OPRNS RNS
7	Sudchemie (India) Pvt. Ltd., Edayar, Ernakulam	PU	Chemical	1969	River Periyar	10 m	River Periyar	Discharge directly into river	Yes	450	pH SS O & G Hex Chr Zinc Free NH3 Total Chr. Amm.N2		9 45 4.5 0.045 2.25 2.25 0.9 22.5	OPRS
8	Cochin Leathers Pvt. Ltd., IDA, Edayar, Muppathadom P.O., Ernakulam	PU	Tannery	1993	River Periyar	125 m	River Periyar	Discharge directly into river	Yes	43	BOD pH SS O & G Hex. Chr. Chloride Sulphide Total Chr.		1.29 8.5 4.3 0.43 0.0043 43 0.086 0.086	OPRS

9	TMS Leathers Pvt. Ltd., IDA, Edayar, Muppathadom P.O., Ernakulam	PU	Tannery	2004	River Periyar	150 m	River Periyar	Discharge directly into river	Yes	1010	BOD pH SS Hex. Chr. Sulphide O & G		3.03 9 10.1 0.0101 0.0101 1.01	OPRNS
10	SreesakthiPaper Mills Ltd., IDA, Edayar, Ekm.	PU	Pulp & Paper	1993	River Periyar	1 km	River Periyar	Discharge directly into river	No	10	BOD pH SS		0.3 9 1	OPRNS
11	Hindustan Organic Cemicals Ltd., Ambalamugal, Ernakulam	CU	Petrochemical	1988	Chithrapuzha	>100m	Chithrapuzha River	Discharge directly into Chithrapuzha	Yes		BOD	41 2.8	9.6	OPRS
12	Cochi Refinery, Ambalamugal, Ernakulam	CU	Oil Refinery	1966	Chithrapuzha	>100m	Chithrapuzha River	Discharge directly into Chitrapuzha	Yes		BOD	24 21 03	20.43	OPRS
13	Gramox Paper and Boards, Puthuppady, Muvattupuzha, Ernakulam	PU	Pulp & Paper	1995		>100m	Kothamangalam River		Yes		BOD	12 3.5	23.92	OPRS
14	Nitta Gelatin India Pvt. Ltd., Kathikudam P. O., Koratty (via) Thrissur-680308.	PU	Ossein Manufacture	1979	Chalakudy River	0.5 km	Chalakudy River	0.5km	Yes	6290	BOD	15 72 5	151	OPRS
15	Sree Sakthi Paper Mills, Chalakudy Thrissur	PU	Duplex Board	1995	Chalakudy River	0.005 km	Chalakudy River	0.005km	No		BOD		292	OPRNS company has requested to givepermission to dis- charge effluent to the river and they have proposed augmentation ofexisting ETP toachievequality compliance.

16	Sitaram Textiles, Thrissur.	CU	Bleaching and dyeing process stopped and hence no effluent generation											
17	Vaigai Threads (Former Madura coats Ltd)	PU	Polyster & Cotton finished thread		Perumbithoode	0.25km	Chalakudy River	3.5km	Yes	11.7	No process effluent as there is no dyeing and bleaching and effluent from floor washing and canteen treated in ETP and discharged satisfactorily.			OPRS
18	United Breweries Limited, Kanjikode West P. O., Palakkad – 678623.	PU	Fermentation Industry	1970	Narakampilly River	500m	Kalpathy River, tributary of Bharathapuzha	5km		400	BOD	345.6	10.4	
19	United Spirits Limited,Former McDowell& Co. Ltd) Cherthala, Alapuzha	PU	Distillery		Vembanadu Lake	Banks of the lake	Vembanadu lake	Banks of lake	No	270	BOD	3132	4.1	OPRNS
20	Tata Tea Ltd., Munnar, Idukki	CU	Food & Vegetables	1964	No effluent discharge to water bodies. Entire effluent discharged is recycled.									OPRS
21	Hindustan News print Ltd., Newsprint Nagar, Kottayam.	CU	Pulp & Paper	1983	Muvattupuzha River	2km	Muvattupuzha River	2km	Yes	38384	BOD	10133	1152	OPRS
22	MRFLtd., Vadavathoor, Kottayam.	PU	Rubber Industry	1959	Meenanthara River	2km	Meenanthara River	2km	Yes	200	BOD	155	6	OPRS
23	Canara Paper Mills Pvt. Ltd., Chethipuzha, Changanachery, Kottayam.	PU	Craft Paper	1985	Chethipuzha Canal	50m	Vembanat Kayal	8km	Yes	5	1.8	0.645		OPRS
24	Kollam Dairy, Thevally, Kollam.	CP	Milk Processing	1986	Ashtamudy lake	0.01km					BOD	180	23.5	OPRS

Source : Kerala State Pollution Control Board

Table 4.19 Generation Installed Capacity (Mw) 2013-14

Sl. No.	Source of Energy	Capacity(MW)	Firm Annual Generation Capability(MU)
1	Hydel-KSEB	2008.65	7073.94
2	Thermal-KSEB	234.6	1502
3	Wind-KSEB	2.025	4
4	Hydel-Pvt.	22.11	92.06
5	Hydel-Captive	33	115
6	Thermal –Pvt (including cogenerator)	198.9	1376.71
7	Wind-Pvt	32.85	69.93
8	NTPC	359.58	2158
	Total	**2891.72**	**12391.64**
9	Hydro-renewable		
	(1)KSEBL	103.9	372.94
	(2)Pvt.	22.11	89.2
10	RES_MNRE(wind+cogeneration)	54.875	211.64

Source : Kerala State Electricity Board

Table : 4.20 Transmission & Distribution Lines 2013-14

Sl.No.	Year	Transmission and Distribution Lines(KM)						LT
		220 KV	110 KV	66KV	33KV	22KV	11KV	
1	2012-13	2761	4178	2166	1599	160.59	52907	263620
2	2013-14	52765	4260	2202	1719	160.59	53579	264117

Source : Kerala State Electricity Board

Table : 4.21 Generation of Power at Different Stations in (MU) 2013-14

Sl. No.	Station	2012-13	2013-14
1.	Brahmapuram,Kochi	83.59	29.04
2.	BSES(Thermal-IPP)	131.3319	337.92
3.	Chembukadavu	9.52	12.42
4.	Idamalayar	249.92	386.07
5.	Idukky	1575.01	2738.72
6.	Kakkad	141.17	247.65
7.	Kallada	25.54	67.55
8.	Kanjikode(wind farm)	1.763	1.8
9.	Kayamkulam	1517.59	947.15
10.	KPCL(IPP)-Kasargode	2.6	0
11.	Kozhikkode(KDPP)	449.11	191.83
12.	Kuttiyadi	505.67	842.42
13.	Kuthunkal(Hydro Captive)-Idukki	22.95	42.48
14.	Lower periyar	356.82	601
15.	Lower Meenmutty	8.01	5.62
16.	Maniyar(PVT)	21.49	39.72
17.	Mattupetty-Idukki	2.49	5.75
18.	Malankara	26.69	30.38
19.	Neriyamangalam	232.32	365.76
20.	Pallivasal	176.89	215.53
21.	Panniyar	90.69	170.32
22.	Peppara	3.69	7.6
23.	Poringalkuthu	130.44	122.69
24.	Poringal LBE	99.86	114.03
25.	Sabarigiri	864.71	1635.44
26.	Sengulam	107.69	141.9
27.	Sholayar	210.2	233.63
28.	Urumi1&2-Kozhikode	10.79	13.67

Source : Kerala State Electricity Board

Table : 4.22 Electricity Generating Capacity of Kerala (MW)

Sl. No.	Sector	Generating capacity					
		2008-09	2009-10	2010-11	2011-12	2012-13	2013-14
1	Public (State)	2124.72	2130.97	2230.9	2244.03	2245.275	2245.275
2	Public (Central)	359.58	359.58	359.58	359.58	359.58	359.58
3	Private	254.736	255.48	272.08	272.09	275.05	286.9

Source : Kerala State Electricity Board

Table : 4.23 Electricity Generating Capacity of Kerala (MU)

Sl. No.	Sector	Generating capacity					
		2008-09	2009-10	2010-11	2011-12	2012-13	2013-14
1	Public (State)	6450.41	7201.85	7371.85	8303.45	5348.14	8177.94
2	Public (Central)	949.48	1153.89	1008.23	486.36	1517.6	947.15
3	Private	979.66	776.35	385.06	221.78	274.62	514.61

Source : Kerala State Electricity Board

Table : 4.24 Category wise sales of energy in Kerala (in MU) 2013-14

Sl. No.	Category	2012-13	2013-14
1.	Domestic	8313.36	8739.51
2.	Commercial	2224.06	2229.33
3.	Industrial LT	1101.96	1096.57
4.	Industrial HT&EHT	3905.15	4035.49
5.	Public lighting	313.2	319.06
6.	Agriculture	306.08	310.24
7.	Railways	173.67	200.69
8.	Licence	500.76	523.15
9.	Export	0.97	1414.6
10.	Total	16839.21	18868.64

Source : Kerala State Electricity Board

Table : 2.25 Electricity Generating Capacity, Maximum Demand And Load Factor

Sl.No	Year	Installed Capacity	Energy input to system excl.aux.cons. & ext.losses (Gen+Purchases-Export) (MU)	Maximum demand (MW)	Load factor (%)
1.	1990-91	1477	6794.1	1273.7	60.89
2.	1991-92	1477	7153.62	1308.8	62.39
3.	1992-93	1477	7219.79	1403	58.74
4.	1993-94	1484	7809.17	1459.6	61.08
5.	1994-95	1503.53	8794.39	1614.6	62.18
6.	1995-96	1505.3	9274.07	1651.4	64.11
7.	1996-97	1508.53	8771.25	1572	63.69
8.	1997-98	1775.81	9394.67	1785.8	60.05
9.	1998-99	2046.33	11164.61	1896.2	67.21
10.	1999-00	2350.71	11880.98	2177	62.3
11.	2000-01	2422.61	12464	2316	61.43
12.	2001-02	2605.91	12518.31	2333	61.25
13.	2002-03	2608.71	12391.13	2347	60.27
14.	2003-04	2621.31	12280.87	2426	57.79
15.	2004-05	2623.86	12504.84	2420	58.99
16.	2005-06	2650.41	13331.03	2578	59.03
17.	2006-07	2662.96	14427.96	2742	60.07
18.	2007-08	2676.66	15065.15	2745	62.65
19.	2008-09	2744.76	15293.41	2765	63.14
20.	2009-10	2752.96	16982.29	2998	64.66
21.	2010-11	2869.56	17340.28	3119	63.47
22.	2011-12	2878.36	18938.81	3348	64.57
23.	2012-13	2880.22	19877.16	3268	69.43
24.	2013-14	2891.72	20525.16	3588	65.3

Source: Kerala State Electricity Board

Table : 4.26 The detail of Indian standards for maximum permissible limits for Industrial effluent discharges

Sl. No.	Parameter	Into Inland Surface Waters Indian Standards 2490 (1974)	Into Public Sewers Indian Standards: 3306 (1974)	On land for Irrigation Indian Standards: 3307 (1974)	Marine Coastal Area
1	2	3	4	5	6
1	pH	5.5-9.0	5.5-9.0	5.5-9.0	5.5-9.1
2	Biological oxygen demand (for 5 days at 20oC)	30	350	100	100
3	Chemical oxygen demand	250	-	-	250
4	Suspended solids	100	600	200	
5	Total dissolved solids (inorganic)	2100	2100	2100	-
6	Temperature (°C)	40	45	-	45
7	Oil and grease	10	20	10	20
8	Phenolic Compounds	1	5	-	5
9	Cyanides	0.2	2	0.2	0.2
10	Sulphides	2	-	-	5
11	Fluorides	2	15	-	15
12	Total residual chlorine	1	-	-	1
13	Pesticides	-	-	-	-
14	Arsenic	0.2	0.2	0.2	0.2
15	Cadmium	2	1	-	2
16	Chromium (hexavalent)	0.1	2	-	1
17	copper	3	3	-	3
18	Lead	0.1	1	-	1
19	Mercury	0.01	0.01	-	0.01
20	Nickel	3	3	-	5
21	Selenium	0.05	0.05	-	0.05
22	Zinc	5	15	-	15
23	Chlorides	1000	1000	600	-
24	Boron	2	2	2	-
25	Sulphates	1000	1000	1000	-
26	Sodium (%)	-	60	60	-
27	Ammoniacal nitrogen	50	50	-	50
28	Radioactive materials				
29	Alpha emitters (milli curie/millilitre)	10^{-7}	10^{-7}	10^{-8}	10^{-7}
30	Beta emitters (μ curie/millilitre)	10^{-6}	10^{-6}	10^{-7}	10^{-6}

Source: Compendium of Environment Statistics India 2014

Table : 4.27 Average Gaseous composition of Dry air in the Troposphere

Sl. No.	Gas	Percent by volume (%)	Parts per million (ppm)
1.	Nitrogen	78.080000	780840.00
2.	Oxygen	20.946000	209460.00
3.	Argon	0.934000	9340.00
4.	Carbon dioxide	0.039000	390.00
5.	Neon	0.001818	18.18
6.	Helium	0.000524	5.24
7.	Methane	0.000179	1.79
8.	Krypton	0.000114	1.14
9.	Hydrogen	0.000055	0.55
10.	Xenon	0.000009	0.09
11.	Ozone	Variable	~0.001- 0.3 (variable)

Source: Compendium of Environment Statistics 2014 India.

Rapidly increasing industrialization, urbanization, population, growth and demand for transportation along with meteorological conditions influence air pollution in many Indian cities. In general combustion is the chief contributor to outdoor air pollution. In most cities, the major source of combustion is fuel use, which tends to increase along with the population size and economic activity.

The air breathe can become contaminated with pollutants viz. Sulphur dioxide (SO_2), oxides of Nitrogen (NO_x), Carbon monoxide (CO), Ozone (O_3) and particulate matter form various natural and manmade sources. In recent years, the focus of ambient air quality largely includes not only criteria air pollutants, but also other toxic air pollutants.

Particulate Pollutants

Particulate matter (PM) is a complex mixture of suspended solid and liquid particle in semi equilibrium. The particles constituents vary greatly in size, composition, concentration, depending on origin and age. The size distributions of airborne particles are important for health impact. The particles larger than 10µm in diameter are deposited almost exclusively in the nose and throat whereas those smaller than 1µm reach the lower regions of the lung. The

intermediate size range gets deposited between these two extremes of the respiratory tract. Outdoor (ambient) PM size ranges from approximately 0.001-100 µm in aerodynamic diameter. PM is considered as the single best indicator of potential harm. There are two main size categories for PM measured in ambient air.

Environment Protection Rules Schl:38

i. Implementation of the following Pollution Control Measures:

a) Dust containment cum suppression system of the equipment.

b) Construction of wind breaking walls

c) Construction of metalled roads within the premises

d) Regular cleaning and wetting of the ground within the premises.

e) Growing of a green belt along the periphery.

ii) Quantitative standards for the SPM:

The suspended particulate matter contribution value at a distance of 40 meters from a controlled isolated as well as from a unit located should be less than 600 mg NM3. The measurements are to be conducted at least twice a month for all the 12 months in a year.

Table : 4.28 Summary of Health Effects of Basic Air Pollutant

Pollutant	Health Effects
Carbon Monoxide	Poor reflexes
	Ringing in the ears
	Headache
	Dizziness
	Nausea
	Breathing difficulties
	Drowsiness
	Reduced work capacity
	Comatose State(can lead to death)
Lead (Pb)	Kidney damage
	Reproductive system damage
	Nervous system damage (including brain dysfunction and altered neuro physical behaviours)
Oxides of Nitrogen (NO2)	Increased risk of viral infections
	Lung irritation (including pulmonary fibrosis and emphysenal)
	Higher respiratory illness rates
	Airway resistance
	Chest tightness and discomfort
	Eye burning
	Head ache
Ozone (O3)	Respiratory system damage(lun damage from free radicals)
	Reduces mental activity
	Damage to cell lining(especially in nasal passage)
	Reduces effectiveness of the immune system
	Headache
	Eye irritation
	Chest discomfort
	Breathing difficulties
	Chronic lung diseases (including asthma and emphysema)
	Nausea
Sulphur dioxide (SO2)	Aggravates heart and lung diseases
	Increase the risk for respiratory illness (including chronic bronchitis, asthma, pulmonary emphysema)
	Cancer(may not show for decades after exposure
Respirable Particute matter (PM 10)	Respiratory illness (including chronic bronchitis increased asthma attacks, pulmonary emphysema)
	Aggravates he art disease

Source : Kerala State Pollution Control Board

CHAPTER - V

Land and Soil

Kerala is located on the southernmost tip of India and embraces the coast of Arabian Sea on the west and is bounded by the Western Ghats in the east. This South Indian state stretches from north to south along the coast line of 580 kms with an approximate breadth of 35 to 120 kms. Lying within east longitudes 74 degree 52' and 72 degree 22' and north latitudes 8 degree 18' and 12 degree 48' this idyllic land of pleasing beauty embraces1.18 % area of the country with a total area of Kerala is 38, 863 Sq Km.

Kerala is endowed with a combination of distinct altitudinal variations resulting from the rise of the land mass from 5 meters below sea level in the west to the soaring heights of 2695 meters in the east within the short span of 120 km. The small expanse of land with an area of 38,863 km^2 has a base length of 560 km along the coast and width ranging from 11 Km to 124 Km. Physiographically, the terrain has three natural regions namely, lowlands, midland and highlands. Geologically, Kerala is occupied by four major rock formations namely, crystalline rocks of Precambrian age, sedimentary rocks of Tertiary confined to Neogene period, laterites capping the crystalline and sedimentary rocks and recent and sub recent sediments forming the low-lying areas and river valleys. There are sporadic Paleozoic granites and pegmatite and Meso-Cenozoic dykes intruding these rocks. The oldest rocks so far dated in Kerala are the charnockites, which yielded an age of 2930 +/- 50 Ma (Soman, 1997& 2002). The varied rock formations under different geological domains harbour different mineral deposits and the transformed rock strata stockpile copious groundwater resource.

Traditionally Indian soils are divided into four major groups namely : red, black, alluvial, and laterite. The state is gifted with ten soil types derived from the laterite base and has 12 distinct agro climatic zones. The undulating topography, vibrant climate and vivacious hydrology in the background of ever active tectonics resulted in 44 river basins, 1750 sub basins and 4452 mini watersheds providing multitudes of lively micro ecosystems. The environment of these micro watersheds are conducive to varying crop types, such as, coconut and rice in the sultry

lowlands, rice, tapioca, banana, arecanut, coconut, pepper, cashew and rubber in hot humid midlands and tea, coffee and cardamom in the cool subtropic highlands.

- **The Western Ghats** - The mighty Western Ghats, a sequence of Rocky Mountains, edges the eastern boundary of Kerala and ascends roughly upto 1,500 m above sea level with the lofty peaks rising upto 2,500 m.
- **Hill and Valleys** - The narrow piece of land on the eastern border, close to the Western Ghats, encompasses precipitous hills, deep valleys and gorges which are covered with thick woods. Almost all the rivers of the state originate here.
- **Midland Plains**- These plains which lie along central Kerala, are located in the west of the hills and mountains.
- **Coastal Belt** – The narrow belt of coastal land along the Arabian Sea is characterized by paddy fields, rows of coconut trees and serene, and backwaters internally linked by rivers and inland waterways.
- **Backwaters and Rivers** -The Backwaters consists of lakes and inlets of oceans which straggle out in the land. The largest backwater is the Vembanad Lake which stretches out into the Arabian Sea at Cochin Port. There are 49 river/lakes flowing in the state of Kerala among them 46 flows to the west and the other 3 flow to the east. They evolve from Western Ghats and rush towards the west into the Arabian Sea.

Soil and Vegetation

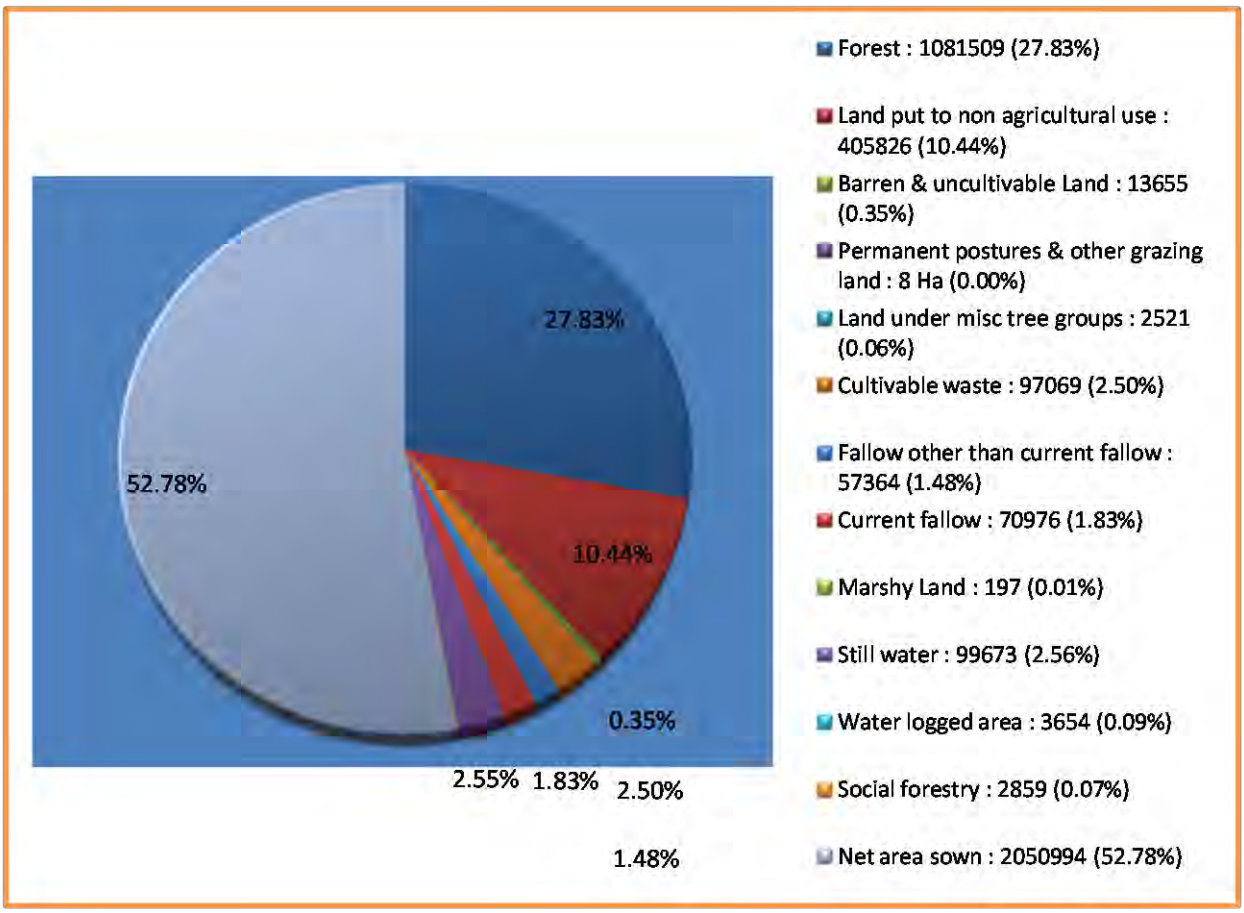
The state of Kerala with its wide array of topographical features such as coastlines along the Arabian Sea, hills of the Western Ghats, valleys, abundant waterbodies ,is the reserve of diverse types of soil such as red, ferruginous, sandy, black, peat and loamy soil. There are an assortment of flora and other plantation crops which grow in these soils. The natural vegetation of Kerala comprises 3,872 flowering plants including 900 plants of great medicinal value. The forested regions with an area of 9,400 km² comprises tropical wet evergreen partly-evergreen forests with thick undergrowth in the lower and mid altitudes, tropical damp and arid deciduous forests in the middle altitudes plus mountainous subtropical and temperate (shola) forests in the precipitous hills. Kerala basically thrives on agriculture. The main crops are paddy, coconut, pepper, cashew, tapioca and plantation crops like rubber, tea and coffee and other cash crops like spices, nutmeg, vanilla and cashew nut.

Land capability

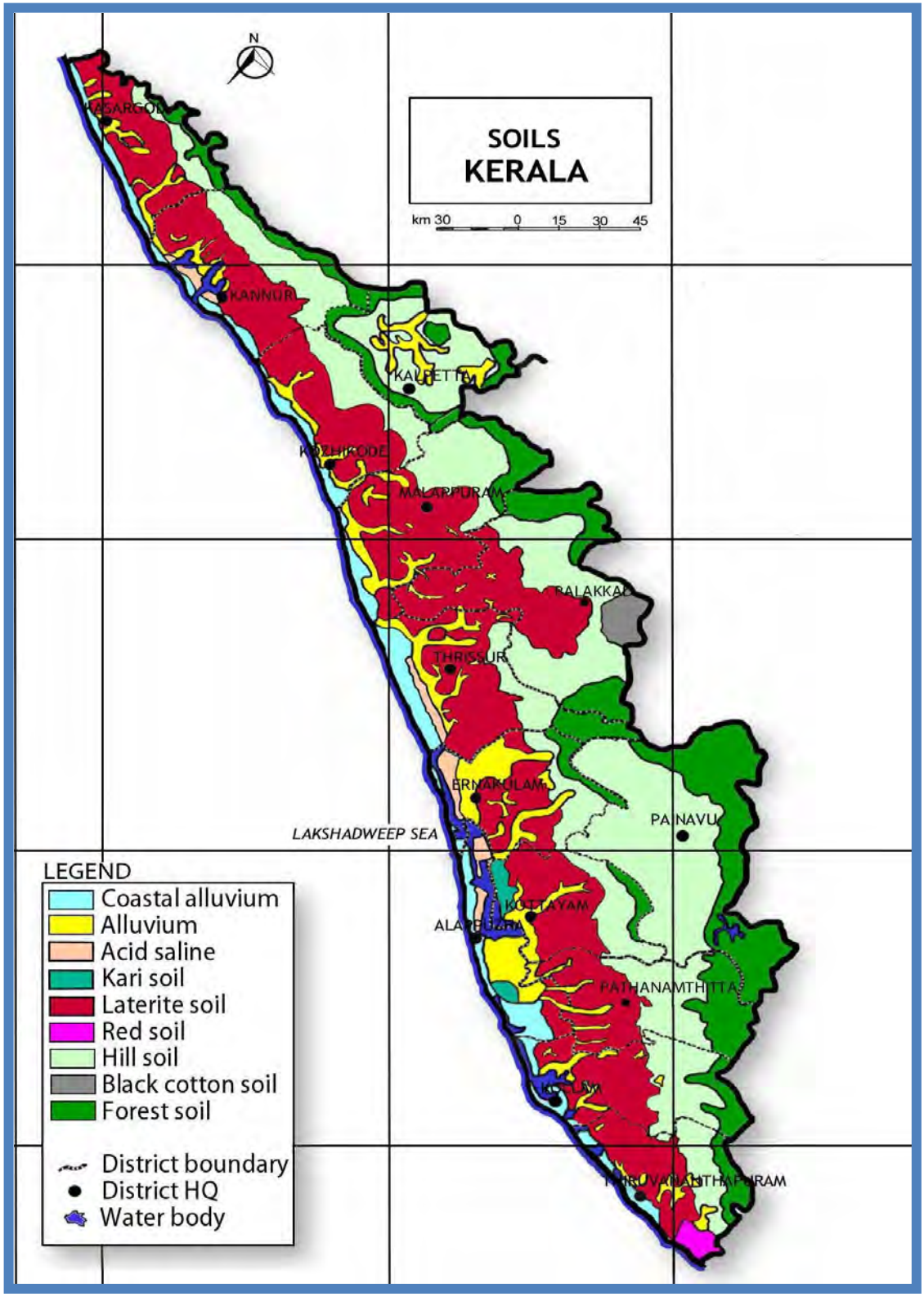
Land is degraded when it suffers a loss of intrinsic qualities, decline in its capabilities or loss in its productive capacity. Land degradation may be due to natural or human causes or it may be due to combination of both. Considering the characteristics of soil, drainage/wetness, erosion, runoff etc., Kerala has 18 land capability subclass associations of five broad land capability (LC) classes (KSLUB, 1995 and 2002). The broad LC classes are Class II (Good cultivable land), Class III (Moderately good cultivable land), Class IV (Fairly good cultivable lands), Class VI (Well suited for forestry or grazing), and Class VIII (Land suited only for wildlife and recreation). The approximate area under each class is given in Figure2. The soil of Kerala has limitations for sustained use under irrigation. Only about 37% of the area of Kerala is suitable for irrigation with certain limitations.

Land Use Pattern

Recently the land put under non – agricultural use has increased due to in developmental activities like housing, transport system, irrigation etc.The total geographical area of the State is 3886287 Ha. And the area classified according to thirteen different type of uses of land during 2013-14 which is presented in the chart given below. The net are under cultivation during the year 2013-14 was 20,50,994 Ha., which occupies 52.78% of the total area in the State. The gross cropped area is 26,16,670 Ha.



Source: Agricultural Statistics 2013-14, DES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LEGEND
Coastal alluvium
Alluvium
Acid saline
Kari soil
Laterite soil
Red soil
Hill soil
Black cotton soil
Forest soil
District boundary
District HQ
Water body

Net Area Sawn

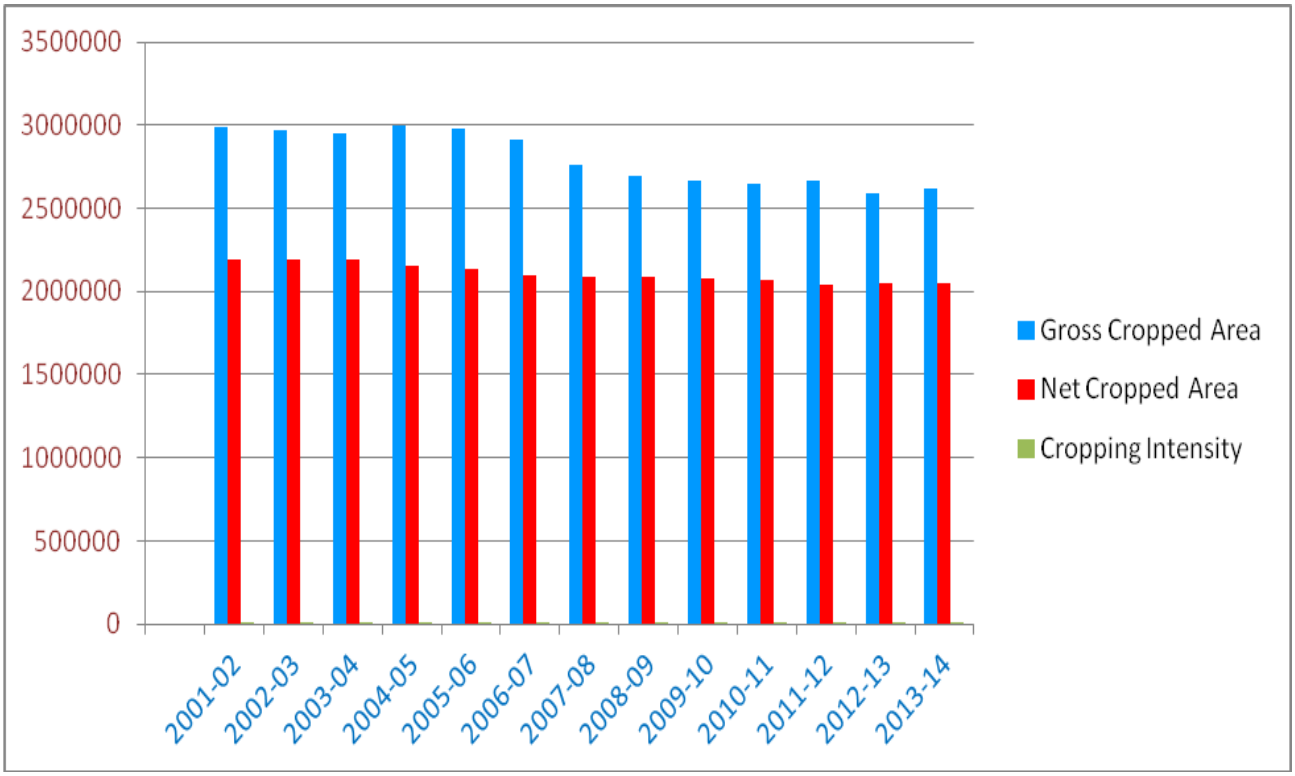
Out of 38.86,287 Ha of total geographical area, 20,50,994 Ha of land constituting 52.78% is cultivated atleast once during the year 2013-14. There is slight increase of 0.14% in net area sown compared to the previous year.

Table : 5.1 State Level estimate of Gross Cropped Area, Net Cropped Area and Cropping Intensity (2001-02 to 2013-14)

Sl. No.	Year	Gross Cropped Area Ha	Net Cropped Area Ha	Cropping Intensity
1.	2001-02	2992252	2190690	136.59
2.	2002-03	2970384	2188537	135.72
3.	2003-04	2954454	2189940	134.91
4.	2004-05	2994666	2154885	138.97
5.	2005-06	2982454	2132483	139.86
6.	2006-07	2913873	2101431	138.66
7.	2007-08	2761094	2089029	132.17
8.	2008-09	2694943	2088955	129.01
9.	2009-10	2668678	2078715	128.38
10.	2010-11	2647461	2071507	127.80
11.	2011-12	2661757	2040132	130.47
12.	2012-13	2591734	2048109	126.54
13.	2013-14	2616670	2050994	127.58

Source: Agricultural Statistics 2013-14, DES

Stale level estimate of Gross Cropped Area and Net Cropped Area



Source : Agricultural Statistics 2013-14, DES

Table : 5.2 Classification of Area on the Basis of Land Utilisation 2013-14

(Area in Ha.)

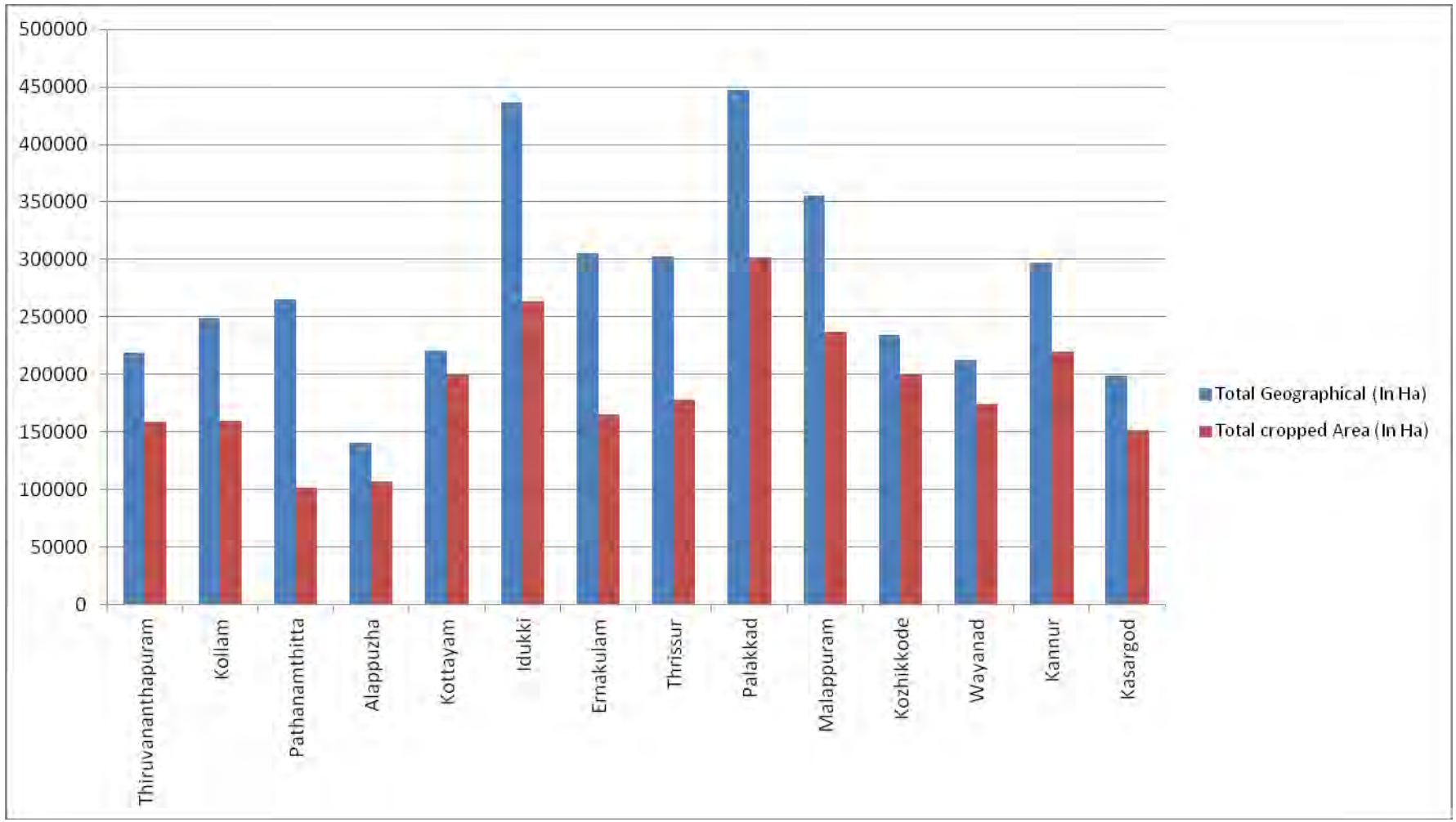
Classification	Thiruvananthapuram	Kollam	Pathanamthitta	Alappuzha	Kottayam	Idukki	Eranakulam	Thrissur	Palakkad	Malappuram	Kozhikkodu	Wayanad	Kannur	Kasargodu	State
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1 Geographical Area	218781	248788	265277	141011	220442	436328	305826	302919	447584	355446	234641	212966	297112	199166	***3886287***
1 Forests	49861	81438	155214	0	8141	198413	70617	103619	136257	103417	41386	78787	48734	5625	***1081509***
2 Not Available for Cultivation(a+b +c+d+e+f))	35130	35929	19631	35137	36359	26369	52296	44671	62745	54752	34936	15342	41160	32306	***526763***
(a) Non Agricultural Uses	30396	27247	16488	22567	27611	12700	40875	37613	45231	47363	29798	11295	32457	24185	***405826***
(b) Barren and Uncultiable land	236	189	162	29	1231	1833	578	259	1795	1098	784	71	1690	3700	***13655***
c) Marshy Land	6	24	0	33	0	0	29	4	0	0	5	0	96	0	***197***
d) Still Water	4342	6924	2698	12143	6360	10480	10410	6328	15340	6047	3933	3904	6472	4292	***99673***
e)Water logged Area	90	1439	165	332	159	1	299	320	0	64	382	13	372	18	***3654***
f)Social Forestry	60	106	118	33	998	1355	105	147	379	180	34	59	73	111	***3758***

3 Other Uncultivated Land Excluding fallow land (a+b+c)	394	1975	1966	15136	6390	2569	11192	8473	24492	6355	2688	998	8066	8904	***99598***
a) Permanent pasturres and Other Grazing Land	0	0	0	0	0	0	0	3	0	3	0	0	2	0	***8***
b) Land Under Miscellaneous Tree Cropes and groves not included in net Area sown	20	62	93	72	145	248	121	191	698	222	103	35	167	344	***2521***
c)Cultiable Waste land	374	1913	1873	15064	6245	2321	11071	8279	23794	6130	2585	963	7897	8560	***97069***
4)Fallow Land (a+b)	3646	5380	7102	6033	9234	2867	19935	17771	26898	12533	3732	2695	6229	4267	***128322***
a) Fallow Land Other than Current Fallows	660	1708	2974	2670	3108	1220	10350	8256	14152	4823	1581	589	3117	2138	***57346***
b) Current Fallows	2986	3672	4128	3363	6126	1647	9585	9515	12746	7710	2151	2106	3112	2129	***70976***
5)Net Area Sown(6-7)	129750	124066	81364	84705	161217	206110	151786	128385	197192	178389	151899	115144	192923	148064	***2050994***
6)Gross Cropped Area(5+7)	159217	159584	101326	106619	199535	263171	165157	177618	301712	237098	200116	174190	219456	151871	***2616670***
7)Area Sown more than Once	29467	35518	19962	21914	38318	57061	13371	49233	104520	58709	48217	59046	26533	3807	***565676***
III Irrigated Area	7658	3911	4987	38063	12395	37441	24752	63580	90012	30621	4931	13256	15980	49580	***397167***

Source : Agricultural Statistics 2013-14, DES

Classification of Area on the Basis of Land Utilisation 2013-14

(Area in Ha.)



Source : Agricultural Statistics 2013-14, DES

Table : 5.3 Net Area Irrigated Source wise 2013-14

Unit - Hectare

Sl. No	District	Small stream (Thode/ Canal)		Pond		Well		Borewell/ Tubewell	Lift& Minor Irrigation	From River & Lake				Other Sources	Grand Total
		Govt	Private	Govt	Private	Govt	Private			Pump	Wheel	Other Methods	Total		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	Thiruvanantha-puram	2911	170	554	18	0	2736	84	888	0	0	0	0	297	7658
2	Kollam	1166	1	40	85	15	1854	11	0	0	0	1	1	738	3911
3	Pathanamthitta	2795	11	16	44	0	2118	2	0	0	0	1	1	0	4987
4	Alappuzha	1855	0	0	282	1	887	6420	0	2972	0	23388	26360	2258	38063
5	Kottayam	6	105	0	182	0	1561	15	0	35	0	10491	10526	0	12395
6	Idukki	1231	10	4	14936	4	5376	2784	3	36	0	10258	10294	2799	37441
7	Ernakulam	8647	11	434	1748	0	7131	532	4276	1051	0	568	1619	354	24752
8	Thrissur	15313	0	165	3272	60	35060	1090	816	1177	0	20	1197	6607	63580
9	Palakkad	41374	95	764	4596	118	12757	10316	674	10534	0	1277	11811	7516	90012
10	Malappuram	2426	552	243	4275	151	16733	942	1279	1164	0	2453	3617	403	30621
11	Kozhikkode	1004	15	1	453	3	2372	47	2	160	0	97	257	777	4931
12	Wayanad	48	0	0	24	0	182	0	75	137	0	19	156	12771	13256
13	Kannur	364	109	25	1331	16	9894	383	12	160	0	581	741	3105	15980
14	Kasargode	867	369	180	11611	0	25821	7377	0	2907	0	115	3022	333	49580
	STATE	**80007**	**1448**	**2426**	**42857**	**368**	**124482**	**30003**	**8025**	**20333**	**0**	**49269**	**69602**	**37958**	**397167**

Source : Agricultural Statistics 2013-14, DES

Table : 5.4 Gross Area Under Irrigation (Crop wise) 2013-14

(Area in Ha.)

Sl. No.	District	Paddy				Vegetables	Coconut	Arecanut	Cloves	Nutmeg	Banana	Betel Leaves	Sugar cane	Other Crops	Total
		Autumn	Winter	Summer	Total										
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	Thiruvananthapuram	873	993	133	1999	1080	2145	3	0	0	2343	14	0	1810	9394
2	Kollam	48	937	5	990	987	438	14	0	0	1407	30	0	23	3889
3	Pathanamthitta	2	488	1964	2454	821	1025	31	2	514	1652	22	16	138	6675
4	Alappuzha	5613	10847	19626	36086	1303	6823	4	0	77	423	47	45	1331	46139
5	Kottayam	1087	6817	7823	15727	1346	121	6	104	1478	718	7	7	202	19716
6	Idukki	62	560	39	661	4702	602	90	76	1607	1148	0	1660	79	10625
7	Ernakulam	580	2707	433	3720	1948	11648	1342	9	6046	4609	7	0	2862	32191
8	Thrissur	7	12552	7884	20443	1434	44122	4555	10	6523	2331	2	0	4690	84110
9	Palakkad	2708	42373	4642	49723	3748	26118	3658	1	167	15637	5	471	8378	107906
10	Malappuram	8	4162	1798	5968	1194	19443	5344	3	269	5419	173	0	1587	39400
11	Kozhikkode	0	2	563	565	510	2761	269	0	194	1547	7	0	193	6046
12	Wayanad	0	9915	1522	11437	637	54	60	0	1	6633	0	0	2	18824
13	Kannur	0	2285	20	2305	851	12403	1666	3	43	1967	1	0	509	19748
14	Kasargod	2	1542	407	1951	505	38677	17440	34	126	478	17	1	4428	63657
STATE		**10990**	**96180**	**46859**	**154029**	**21066**	**166380**	**34482**	**242**	**17045**	**46312**	**332**	**2200**	**26232**	**468320**

Source : Agricultural Statistics2013-14, DES

Table : 5.5 Area & Production of Important Crops in Kerala 2013-14

Sl. No.	Crops	Area(Ha)			Production(Tonnes)		
		2001-02	2013-14	% Variation	2001-02	2013-14	% Variation
1	Paddy!!	322368	199611	-38	703504	564325	-20
2	Tapioca	111189	67589	-39	2455880	2479070	1
3	Coconut*	905718	808647	-11	5479	5921	8
4	Pepper	203956	84065	-59	58240	29408	-50
5	Cashew	89718	49105	-45	65867	33375	-49
6	Rubber	475039	548225	15	580350	648220	12
7	Groundnut	2437	710	-71	1812	868	-52
8	Sesamum	878	265	-70	284	88	-69
9	Cotton#	3760	177	-95	6069	284	-95
10	Pulses	8191	2989	-64	6281	3019	-52
11	Ginger(Dry)	10706	4538	-58	40181	21521	-46
12	Turmeric	3558	2430	-32	7895	6253	-21
13	Banana	50871	62261	22	345903	531299	54
14	Tobaco	71	9	-87	395	17	-96
15	Total Cereals	329875	199937	-39	708624	564635	-20
16	Arecanut*	93193	100008	7	84681	100018	18
17	Coffee	84795	85359	1	66690	66645	0
18	Tea	36899	30205	-18	66090	62938	-5

Source: Agricultural Statistics2013-14, DES

!! Paddy
* Production in million nuts
# Production in bales of 170 kg

Table : 5.6 Area, Production, Productivity of Plantation Crops upto 2014

Area Ha.	2010-11		2011-12		2012-13	2014
	Kerala	India	Kerala	India	Kerala	Kerala
1	2	3	4	5	6	7
Tea	36965	580181	37028	NA	30205	30205
Coffee	84931	404645	85359	409690	85359	85359
Rubber	534230	661980	539565	NA	545000	548225
Cardamom	41242	71170	41600	71110	41600	39730
Production						
Tea	57291	966733	57903	NA	62963	62937
Coffee	65650	302000	68175	314000	68175	66645
Rubber	770580	861950	788940	NA	800050	648220
Cardamom	7935	10380	10222	15000	10222	14000
Productivity (kg/Ha)						
Tea	1550	1666	15643	NA	2085	#2084
Coffee	773	746	799	766	799	*781
Rubber	1442	1302	***1931	NA	***1903	NA
Cardamom	192	146	246	182	246	352

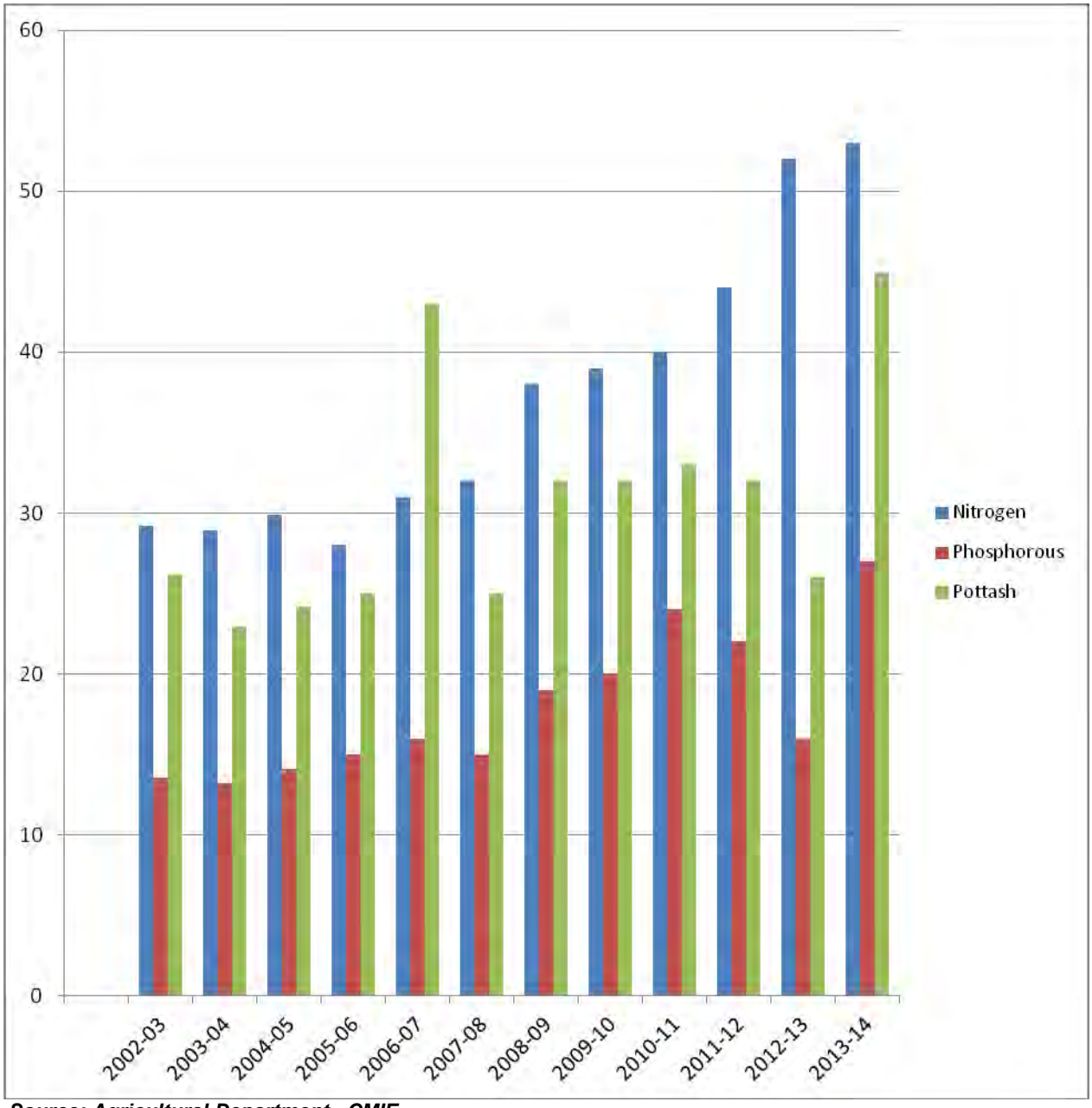
Source : Economic Review
*Coffee Board
#Tea Board
***Rubber Board

Table : 5.7 Chemical Fertilizers utilization in Kerala 2002-03 to 2013-14

Year	Nitrogen	Phosphorous	Pottash	Total		N:(P+K)%
				Kerala	India	
1	2	3	4	5	6	7
2002-03	29.18	13.53	26.19	68.90	86.00	73
2003-04	28.92	13.20	22.93	65.05	89.80	80
2004-05	29.87	14.14	24.2	68.21	98.34	78
2005-06	28.00	15.00	25.00	68.00	104.50	70
2006-07	31.00	16.00	43.00	89.00	113.26	53
2007-08	32.00	15.00	25.00	72.00	117.07	80
2008-09	38.00	19.00	32.00	89.00	NA	74
2009-10	39.00	20.00	32.00	91.00	NA	75
2010-11	40.00	24.00	33.00	97.00	NA	70
2011-12	44.00	22.00	32.00	98.00	NA	81
2012-13	52.00	16.00	26.00	94.00	NA	124
2013-14	53.00	27.00	45.00	125.00	NA	73

Source: Agricultural Department, CMIE

Chemical Fertilizers utilization in Kerala 2002-03 to 2013-14



Source: Agricultural Department, CMIE

Table : 5.8 Soil Types in Kerala (District-Wise)

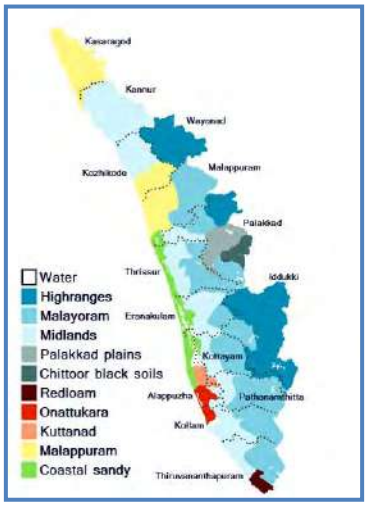
District	Type of Soil	Details of location
Thiruvananthapuram	• Fairly rich brown loam of laterite • Sandy loam • Rich dark brown loam of granite origin	Middle part of the district Western coastal region Eastern hilly parts of the district
Kollam	• Sandy loam • Laterite soil	Karunagappally and part of Kollam taluks Kottarakkara , Kunnathur and parts of Kollam and Pathanapuram taluks
Pathanamthitta	• Clay soil • Laterite soil	Western and Eastern hilly regions Parts of Ranni and Kozhencheri taluks
Alappuzha	• Sandy loam • Sandy soil • Clay loam with much acidity • Laterite soil	Karthikappally and parts of Mavelikkara taluks Cherthala & Ambalappuzha taluks Kuttanad Chengannur and parts of Mavelikkara taluks
Kottayam	• Laterite soil • Alluvial soil	Parts of Changanacherry and Kottayam taluks and Kanjirappally and Meenachil taluks. Vaikom taluk and part of Changanacherry and Kottayam taluks
Idukki	• Laterite soil • Alluvial soil	Peermade and Thodupuzha taluks Devicolam and Udumbanchola taluks
Ernakulam	• Laterite soil • Sandy loam • Alluvial soil	Muvattupuzha, Kothamangalam and part of Aluva and Kunnathunad taluks Parur, Kochi and Kanayannur taluks Parts of Aluva and Kunnathunad taluks

Thrissur	• Sandy loam • Laterite soil • Clayey soil • Alluvial soil	Part of Mukundapuram, Thrissur and Chavakkad taluks Eastern part of Thrissur and Western part of Thalappally taluks Back-water area of Chavakkad and Mukundapuram taluks Portions of Chavakkad taluk
Palakkad	• Laterite soil • Black soil	Major part of the district North-Eastern part of Chittur taluk
Malappuram	• Laterite soil • Sandy soil	Interior region of the district Along the costal belt of the district
Kozhikode	• Laterite soil • Sandy soil	Major part of the district except coastal strip Coastal strip
Wayanad	• Laterite soil • Loamy soil	Major part of the district Valleys in the middle portion of the district
Kannur	• Laterite soil • Sandy soil	Major part of the district except coastal strip Coastal strip
Kasaragod	• Laterite soil • Sandy soil	Major part of the district except coastal strip Coastal strip

Source: Department of Agriculture

Mineral Based Industries in the State

Kerala State is endowed with a number of occurrences/deposits of minerals such as Heavy Mineral Sands (Ilmenite, Rutile, Zircon, Monazite, Sillimanite) ,Gold, Iron ore, Bauxite, Graphite, China Clay, Fire Clay, Tile and Brick Clay, Silica Sand, Lignite, Limestone, Limeshell, Dimension Stone (Granite), Gemstones, Magnesite, Steatite etc. However, mining activities on large scale are confined mainly to a few minerals - Heavy Mineral Sands, China Clay and to a lesser extent Limestone/Limeshell, Silica Sand and Granite. In fact, Heavy mineral sand and China Clay contribute more than 90% of the total value of mineral production in the State.



The State owns mineral deposits like china clay (kaolin), limestone, limeshell, silica sand, bauxite, graphite, iron ore, granite etc. The major mineral based industries like Indian Rare Earths Ltd., Kerala Minerals and Metals Ltd., Chavara; Malabar Cements, Walayar; Travancore Cements Ltd., Kottayam; Kundara Ceramics, Kollam; English Indian Clays Ltd. (EICL), Thiruvananthapuram; Excel Glass Industry, Alappuzha; Kerala Clays and Ceramic Products Ltd., Palayangadi, Kannur are some of the mineral based industries working in the State since several years. The resources of ornamental granites in the state are being exported to different countries.

Mining Lease in Kerala

There are 83 major mineral mines that are mined in the State. Also there are3024 licensed minor mineral quarries in the state. Government gets revenue from minerals mainly by way of royalty. Revenue collected during the year 2012-13 is Rs.49.7 crore which is 12% higher than the previous year collection of Rs.44.3 crore. Total area covered by mining leases is 3314.52 ha.

Mineral Development and Mining Leases Division

This division is responsible for the implementation of Mines and Minerals (Regulation and Development) Act, 1957, The Mineral concession Rules,1960 and the Kerala Minor Mineral Concession Rules,1967. This function is being executed through 14 District Offices, and 3

Kerala Mineral Squads (Southern, Central and Northern Region) with their head quarters at Thiruvananthapuram, Thrissur and Kozhikode respectively.

The main activities of Mineral Development and Mining Lease Division are as follows:

- Recommending to State Government to grant/ renewal of mining leases and prospecting licences in respect of major minerals.
- Grant/renewal of quarrying permits, quarrying leases and dealer's licences in respect of major minerals.
- Inspection of mines and quarries and enforcement of relevant rules and regulations by virtue of the powers vested with it under the Mines and Minerals (Development & Regulation) Act, 1957, the Minerals Concession Rules, 1960 and the Kerala Minor Mineral Concession Rules, 1967.
- Collection of revenue on both major as well as minor minerals.
- Curbing of illegal mining and clandestine movement of minerals.
- Attending to court cases in connection with mining and movement of minerals.
- Collection of data on production/sales/consumption of major and minor minerals and furnishing the required information to government of India and other Central/ State institutions.

Table : 5.9 Mineral wise details of area covered by mining leases 2013-14

Sl.No.	Minerals	Place Ha.
1	China Clay	03.1078
2	Silica Sand	24.5063
3	Bauxite	-
4	Lime shell/Seashell	-
5	Lime stone	-
6	Mineral sand	184.8
7	Quartz	-
8	Laterite	07.5704
	Total	**219.9845**

Source :-Mining &Geology

Table : 5.10 Production and Royalty of Minerals in Kerala- 2013-14

Sl. No.	Major Minerals	Production in Tonnes		Royalty(Rs.)	
		2012-13	2013-14	2012-13	2013-14
1.	China Clay	434121.88	904663	10853047	15379264
2.	Lime Stone	560828.95	455781	35332224	28714206
3.	Iliminite	128348.9	84247	26568222	25611098
4.	Silica Sand	88081.64	76890	12597104	12917482
5.	Limeshell	43470.97	37333	2738671	2351981
6.	Latrate	107683.96	190591	10445344	21917944
7.	Zircon	7919.35	3861	14832938	8340801
8.	Sillimianite	5161	8905	1424332	1896705
9.	Rutile	5236	2830	7707021	6632488
10.	Graphite	696	628	45240	36400
11.	Quatz	3488.37	1570	150000	67500
12.	Bauxite Ilmonite	483	49	584000	65574
	Minor Minerals				
		2012-13	2013-14	2012-13	2013-14
1	Granite(Building stone)	15227650.75	13973155	243642412	223570485
2	River sand	2629390.8	1893766	26293908	18937663
3	Ordinary sand	3187035.7	1914116	31870357	19141156
4	Laterite	2070631.5	2578368	33130104	412538889
5	Brick Clay	1515292.5	1243116	15152925	12431163
6	Lime shell	4804.66	7450	240233	469375
7	Granite(dimension stone (cubic mtrs)	1245.11	1219	4980445	4877084
8	Ordinary earth	880443	4827325	17608862	965464995

Source : Department of Mining &Geology

Individual Mineral Deposits Mineral Sand

The Heavy Mineral Sand deposits in Kerala contain an assemblage of Ilmenite, Rutile, Leucoxene, Monazite, Zircon and Sillimanite. The State possesses one of the world class deposits of mineral sands in the coastal tracts between Neendakara and Kayamkulam. This, commonly known as the Chavara deposit, after the main locality, covers a total length of 22 km and a width of about 8 km in the northern side and 6 km in the southern side. The Chavara barrier beach portion contains concentration of heavy minerals above 60%. The Chavara deposit is estimated to contain 127 million tonnes of heavy minerals with ilmenite content of 80 million tonnes from the total reserve of raw sand of the order of 1400 million tonnes. In the northern portion beyond Kayamkulam Pozhi extending up to Thottappally in Alappuzha district, the total reserve of heavy minerals estimated to the order of 17 million tonnes with ilmenite content of 9 million tonnes from the raw sand of 242 million tonnes.

Chavara barrier beach with a width of 225 m is divided into 8 blocks numbered I to VIII for separating ilmenite for the manufacture of TiO2. The blocks are apportioned between Kerala Minerals and Metals Ltd. (KMML),a State Government undertaking and Indian Rare Earths Ltd. (IRE), a Government of India enterprise under the Department of Atomic Energy. Apart from the Chavara heavy mineral deposits a number of heavy mineral placers have been delineated in different parts of the State.

Table : 5.11 Heavy Mineral Deposits in Kerala 2013-14

Sl. No.	Locality	Total Heavy Minerals	Ilmenite	Rutile	Zircon	Monazite	Sillimanite
1	Chavara Major Deposit	127.09	79.45	5.38	4.82	0.82	28.72
2	Northern contiguity of Chavara deposit*	16.93	9.03	0.64	0.40	0.17	5.66
3	Southern Kerala^	1.83	1.15	0.11	0.12	0.05	0.27
4	Northern Kerala$	3.35	0.53	0.01	0.05	0.003	0.80

** Kayamkulam-Arattupuzha-Thrikkunnapuzha-Thottapally*
^ Kannimalssery-Neendakara-Maleppuram-Odetti, Anjengo-Vettoor, Veli-Kazhakuttom, Vizhinjam-Kovalam-Pachallur
$ Valapattanam-Azhikode, Ponnani-Chavakkadu

Heavy Mineral Deposits in Kerala

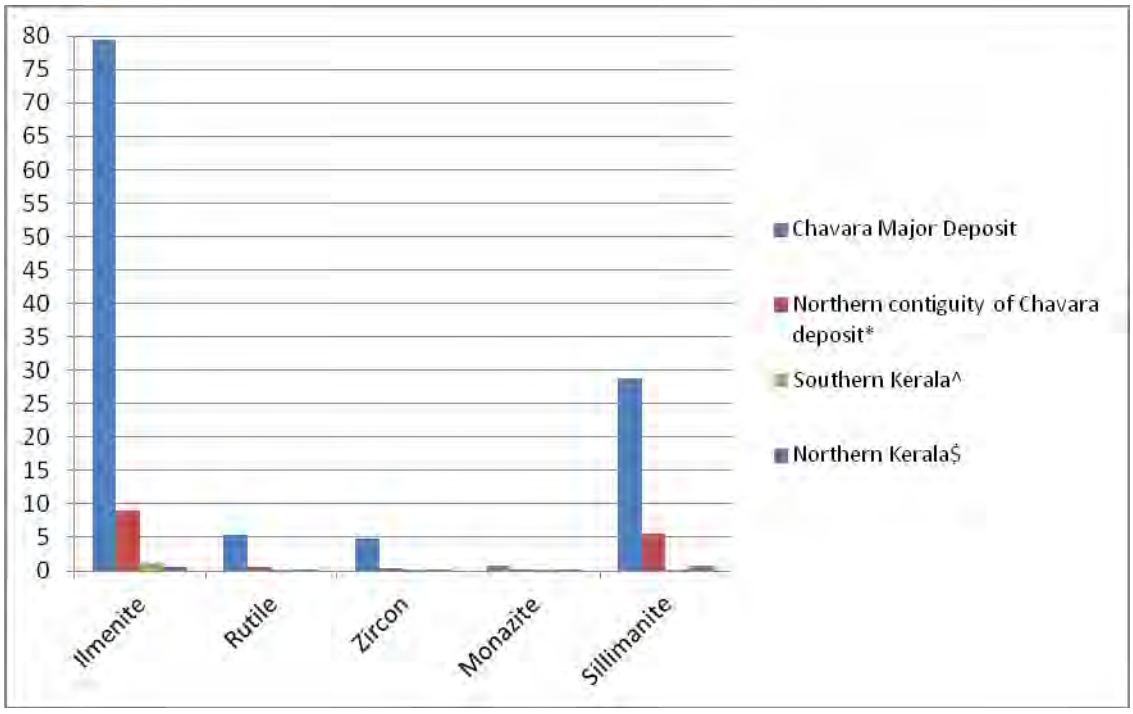


Table : 5.12 Heavy Mineral Deposits in Kerala 2013-14

Sl. No.	Locality	Oxidised (million tonne)	% of Fe	Unoxidised (million tonne)	% of Fe	Total (million tonne)
1.	Eleyettimala	14.7	39.4	4.5	31.5	19.2
2.	Naduvallur	6.1	39.8	3.7	33.7	9.8
3.	Nanminda	4.3	41.2	-	-	4.3
4.	Cheruppa	3.2	35.5	7.5	31.7	10.7
5.	Alampara	9.0	35.6	26.2	35.2	35.2
6.	Korattimala	1.9	37.7	2.5	33.6	4.4

Bauxite

Bauxite occurs in close association with laterite all along the west coast of the State. Traces of bauxite are seen in almost all laterite cappings. But bauxite deposits of economic significance in south Kerala are a few and are located at Sooranad, Vadakkumuri, Chittavattom, and Adichanallur in Kollam district and Mangalapuram, Chilambil, Sasthavattom and Attipra areas of Thiruvananthapuram district. Geological Survey of India (GSI) and Mineral Exploration Corporation Ltd. (MECL) have conducted extensive studies of bauxite occurrence of Kasargod and Kannur districts in North Kerala during the period between 1968-'74 including geological mapping, pitting, drilling and sampling. Based on various investigations, the total bauxite reserves in the State are estimated at 12.5 million tonnes. The largest bauxite deposits are in Nileswaram with a reserve of 5.32 million tonnes.

China Clay

China Clay (Kaolin) consisting dominantly of kaolinite is one of the most sophisticated industrial minerals with a host of applications, viz., in ceramics, refractories, paper coating, filler for rubber, insecticides, cement, paint, textiles, fertilizers and others including abrasives, asbestos products, fibreglass, chemicals, cosmetics, pharmaceuticals, electrical ware, foundry and glass.

The Department of Mining and Geology through their past investigation campaigns in parts of Kerala, identified two major china clay zones viz., the southern china clay zone between Kundara and Thiruvananthapuram (Thiruvananthapuram and

Kollam districts) and the northern china clay zone between Kannapuram Madayi - Cheruthazham in Kannur district to Nileswarm - Manjeshwaram in Kasargod district. Kerala china clay is one of the finest quality clay and is world class. In fact, Kaolin marketed by English Indian Clays Ltd. (EICL), Thiruvananthapuram claims to have similar or even better properties compared to imported clays.

Production

The paper coating grade china clay is produced by English Indian Clays Ltd., Thiruvananthapuram and Kerala Ceramics Ltd., Kundara. Ceramic grade high quality china clay is produced by Kerala Clays and Ceramic Products Ltd. (KCCP) from their mines at Kannapuram and Pazhayangadi, Kannur District and Pudukai, Kasargod District. Among the 25 working china clay mines in Kerala, 17 are in Thiruvananthapuram, 4 in Kollam, and 2 each in Kannur and in Kasargod districts, and these jointly produced 4,47,000 tonnes in 2000-'01 fiscal. Kerala has a prominent place in the refined clay map of the country, contributing about 58% of the national annual out put. Being the largest producer of high grade processed china clay, the enormous export potential and relatively good infrastructure like ports, road and rail links, Kerala is yet to make a mark in the export of china clay.

Potential for China Clay Industries

The very large reserves of china clay, identified and proved by the Department, calls for new mining ventures and clay based industries. The Data Repository of the Department and Kerala Clay Data Book of Regional Research Laboratory, Thiruvananthapuram have adequate data and information on china clay in Kerala. Jointly these database provide most useful baseline data, like color, plasticity, tensile strength and particle size, to diverse users and industries.

Ball Clay

Ball clay (inferred reserve of 5.67 million tonnes) is found to occur in certain areas in Kollam, Alappuzha, Ernakulam, Thrissur and Kannur districts. Though it does not conform to specification of ball clays, yet it is considered to be a good substitute. At present, there is no commercial production.

Fire Clay

The fire clay occurrences are in association with Tertiary sediments in the coastal land and the inferred reserve stands at 11.50 million tonnes. However, this resource is waiting to be exploited.

Tile and Brick Clay

The tile and brick clays are usually of low grade and red burning. The main requisites are that they should mould easily and burn hard at low temperature. There are about 400 tile factories and about 5000 brick kilns spread over the entire state to manufacture tile and bricks. The vast resources of alluvial clays in the paddy land and valley fill areas are used by this industry in the State. Clays available for the manufacture of tiles are mostly found in the districts of Thrissur, Kozhikode, Ernakulam, Kollam, Thiruvananthapuram, Kannur and Palakkad Districts. There are two main types of tile and brick clays in the State, lacustrine and floodplain. The former are confined to Kannur district. Clays are generally fine plastic to dull white to variegated colours and occur in the depressions in the laterite near Pattuvam, Alakode, Thaliparamambu etc. The flood plain deposits, which occur in the neighbourhood of rivers are found in a number of districts. Tile manufacturing units are concentrated in certain areas in the State mainly Feroke area of Kozhikode district, Amballur, Ollur of Thrissur district, Aluva of Ernakulam district, Chathannur of Kollam district and Amaravila of Thiruvananthapuram district.

Graphite

Graphite occurs in nature in the form of vein, dissemination (flaky) and amorphous variety. The first two types of occurrences are found in Kerala. The vein - type graphite mined earlier around Veli, Vellanad and Changa is confined only to the Thiruvananthapuram district. The flake type of graphite is extensive in occurrence in Thiruvananthapuram, Kollam, Kottayam, Idukki and Ernakulam districts which have been studied by Geological Survey of India and are quite akin to the celebrated flaky graphite mined in the Malagasy Republic. The graphite occurs as thin flakes distributed more or less evenly in the rock constituting on an average about 5% - 10% of the bulk of the rock, although rich pockets are not uncommon. The studies in various laboratories in the country and abroad in respect of the bulk samples collected from the flaky graphite deposits of Vadakode, Nagapuzha (Muvattupuzha taluk, Ernakulam district) and Chirakkadavu (Kanjirappally taluk, Kottayam district) point to good beneficiation characteristics, a high recovery of fixed carbon (about 85%) and preservation of suitable flake size facilitating

their use in key value added industrial application like crucible manufacture etc. The reserve position in respect of the flaky graphite deposits of Ernakulam and Kottayam districts are given below:

Table : 5.13 Graphite Deposits in Kerala 2013-14

Sl. No.	Graphite	Nagapuzha	Vadakode	Chirakkadavu	Total
1.	Ore reserve (tonnes)	1059352	5050938	700000	6810920
2.	Grade (%c carbon)	7.3	5.0	3.0	
3.	Recoverable graphite (tonnes)	43000	24000	16000	83800
4.	Concentrate grade (% carbon)	89	91	88	-
5.	Recovery	79	80	80	-

Silica Sand

The coastal tract between Alappuzha and Aroor in Alappuzha District contain extensive deposits of silica sand. The best deposits are confined to the narrow strip of land sandwiched on either side by Vembanad lake and stretching from Cherthala to Arookutti over a distance of about 35 km. Besides, there are also smaller deposits in other districts of Kerala. The sand deposit comprises of flat to gently dipping sandy stretches, generally about 5m above Mean Sea Level.

Vertical sequence	
0-0.75 m below ground level	White sand mixed with soil
0.75-2.50 m below ground level	White sand
2.50-10.00 m below ground level	Brown sand

Reserves of Deposit Based on the recent appraisal carried out by the Department of Mining and Geology over the open area likely to be available for mining, the inferred reserve of silica sand in the villages are estimated as below:

Village	Approximate area in hectares	Reserve in million tones
Pallipuram	300	18.40
Thycauttuserry	120	6.50
Panavally	50	3.50
Total	**470**	**28.40**

Quality of Sand

Investigation carried out at Regional Research Laboratory (RRL), Thiruvananthapuram have revealed that the silica sand of Pallippuram is superior compared to the sands of certain other countries (Mdina and Baraboo of USA and Germany) as raw material for silica refractory. Chemical analysis indicates that the sands are of high quality suitable for glass manufacturing. The brown sands occurring below the white sand in Varanad area have also shown that they are superior in quality to the white sand in the same area and are suitable for manufacture of glass. Varanad sand could be used for making high grade colourless glass such as crystal glass, table ware etc. The scope for beneficiation of the sand established its usefulness in optical and ophthalmic glass industry. The reserves estimated tentatively are of the order of 250 million tonnes.

Lignite

Lignite, the only fuel mineral discovered recently in the State assumes special significance. Since no coal deposits have been identified and the landed cost of coal remains high, the possibility of substitution of coal and fire wood by lignite in the user industries would be worth pursuing. As per the recommendations of the task force on lignite constituted for Kerala, the erstwhile Kerala Mineral Exploration & Development Project had carried out detailed investigation for lignite in Madai area, Kannur district.

Limestone

Crystalline Limestone

Kerala State is deficient in crystalline limestone and only a few bands of crystalline limestone in Palakkad and Idukki districts have been located in addition to the limestone deposit proved at Pandarathu, Walayar, Palakkad district. The Pandarathu limestone deposit (24 million tonnes) is now the captive mine producing limestone for M/s. Malabar Cements Ltd., the Portland cement plant in Kerala. A number of small bands have also been identified in other localities in Nattuvanki, Athurasram, Vannamadai, Thavalam in Palakkad district and in a few localities in Idukki district.

Kankar Limestone

Limestone of Kankar variety has been reported from Chittoor- Kozhinjampara area in Palakkad district. The economic significance of low-grade limestone has not been indicated by the studies conducted so far. The 16 km2 area between Thavalam and near Anaiketty shows that kankar caps the amphibolite over 0.3 km2.

Fossiliferous Limestone

Fossiliferous Limestone is known to occur in various parts of Kollam district such as Kallurkadavu, Mughathala, Kannanallur, Kottiyam, Mayyanad, Nedumgandam and Edava in Thiruvananthapuram district. The occurrence of shell limestone is in the form of discontinuous lenses intercalated with black carbonaceous clay in the Tertiary formations.

Lime Shell

The State is deficient in high-grade limestone. Consequently the requirement of lime for chemical industry is depended on the limeshell resources occurring in the backwaters/estuaries, river mouths and lagoons along the coastal tract. By far the largest reserves of lime shell are known to occur in Vembanad lake and adjoining portions comprising parts of Alappuzha, Ernakulam and Kottayam Districts. The Department of Mining and Geology by its detailed investigation in certain parts of Vembanad lake and adjoining areas have established a reserve of 3.29 million tonnes as shown below:

Locality	Reserve in million tones
Vembanad Lake	2.50
Kualsekharamanagalam	0.18
Pallipuram	0.10
Vechoorpadam	0.26
Thannirmukkom	0.25

The lime shell resources next in importance to Vembanad lake are those in Kannur and Kasargod districts in North Kerala. The department had also investigated on the occurrence of limeshell in Thrissur, Malappuram and Kannur districts and the reserves indicated are as follows:

Sl. No.	District	Place	Reserve in million tones
1.	Thrissur	Naduvullikara, Vadanapalli, Chettuva, and Kappad	0.33
2.	Kannur	Payyannur, Cheruvathur, and Thrikkarippur	0.29
3.	Malappuram	Kanhiramukku	0.14

Magnesite

A total possible reserve of 0.037 million tonnes has been estimated in Mulli-Salayur areas, Attappadi in Palakkad District by the Department of Mining and Geology. In Salayur area, magnesite veins varying in thickness from 10 to 30 m were observed in pits. The average recovery of magnesite was assessed as 100 kg/m3 of magnesite - bearing rocks and samples on analysis were found to contain 43.05 to 46.73% MgO, 1.51 to 6.59% of Si02 and 0.29 to 0.59% of CaO.

Steatite / Talc

It is consumed in many manufacturing industries of paper, insecticide, textile, fertilizers, ceramics, rubber products, cement, asbestos etc. Several steatite occurences have been identified in Thalassery Taluk of Kannur district. The total reserves estimated are of the order of 7.94 million tonnes.

Granite (Dimension Stone)

An important aspect of recent trend in architecture and construction is the increasing use of buildings and monuments. In this regard a number of rock types broadly grouped as"Granite" that exist in various parts of Kerala are utilised for this purpose. The major granite belt of Kerala can be classified by its geologic setting into three categories:

- Charnockite-Khondalite belt of Thiruvananthapuram, Kollam, Pathanamthitta and Kottayam districts (colour ranges from pale green with mottled red, bluish green with cordierite, deep dark green, greyish white).
- True intrusive or anatectic granites and associated migmatites of Proterozoic age from Idukki, Palakkad, Kannur, Kasargod and Wayanad districts (colour: Pink, light pink, Gray, yellowish white and bluish pink with wavy .patterns).

- Dolerite-Gabbro dykes, Proterozoic intrusive hypabasal dyke swarms from Kottayam, Palakkad, Malappuram and Kozhikode districts (colour: dark greenish blue, black and dark gray with black spots).

In Kerala, the importance of exploration of granites has been recognised rather late although investigations have been initiated right from 1976. There has been a spurt in quarrying leases for granite dimension stone in the early nineties that resulted in creatiol"1 of international market for green and white coloured granites of Kerala. Though Kerala has large resources of dimension stone granite in most of the districts amenable for being cut and polished, there are only 19 quarries producing 3589 cbm annually (2001-'02) which is low compared to the production of other southern States of Tamilnadu, Karnataka and Andhra Pradesh.

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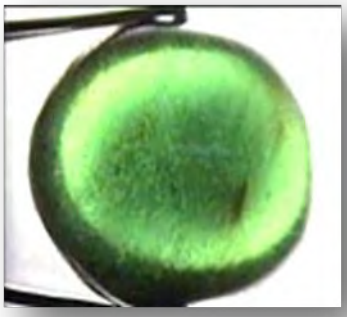
- the pegmatites traversing the crystalline rocks
- in association with gravels in the river channels of the present day
- in the older gravels which are often consolidated and lateritised



These settings have fairly extensive geographical distribution in Thiruvananthapuram district, the localities of importance are Andoorkonam, Aruvikkara, Balaramapuram, Bonaccord Estate, Braemore Estate, Changa, Chullimanur, Madathara, Manickkal, Pirappancode, Venjaramoodu, Venganoor, Vembayam, Thonnakkal, Uzhamalakkal, Manvila, Mudakkal, Nedumangad, Vellanad, Nettani, Ooroottambalam, Pothencode and in Kollam, the main gem bearing localities are Adukkalamula, Podiattuvila, Kulathupuzha, and Talachira. Besides these localities several stretches of rivers like Kallar-Vamanapuram Ar, Karamana Ar, Neyyar in Thiruvanathapuram District and Kulathupuzha,

Kallada rivers in Kollam district are also subjected to sporadic mining activities, though there is no legalized gem mining in the State.

Land Degradation

Land is degraded when it suffers a loss of intrinsic qualities, decline in its capabilities or loss in its productive capacity. Land degradation may be due to natural or human causes or it may be due to combination of both. The State wise information of wetland and degraded land of the Districts is in table 5.3.1. and 5.3.2.

Land degradation is a global problem, largely related to agricultural use. The major causes include:

- Land clearance, such as deforestation .
- Agricultural depletion of soil nutrients through poor farming practices .
- Livestock including overgrazing .
- Inappropriate Irrigation .
- Urban sprawl and commercial development .
- Land pollution including industrial waste
- Vehicle off-roading .
- Quarrying of stone, sand, ore and minerals

Alkali or alkaline, soils are clay soils with high pH (> 9), a poor soil structure and a low infiltration capacity. Often they have a hard calcareous layer at 0.5 to 1 meter depth. Alkali soils owe their unfavourable physico-chemical properties mainly to the dominating presence of sodium carbonate which causes the soil to swell. Alkaline soils are difficult to take into agricultural production. Alkaline soils are difficult to take into agricultural production.

Soil is the non-renewable natural resource which supports life on earth. It is estimated that one-sixth of the world's soils have already been degraded by water and wind erosion. This has two important consequences: the reduced ability of society to produce sufficient food due to loss of quality and depth of soils; and resulted in off-site pollution associated with erosion. These include siltation of dams, pollution of water-courses by agricultural chemicals and damage to property by soil-laden runoff. On-site issues of declining soil quality tend to be spatially dispersed occurring on many different soil types whereas off-site pollution issues tend to be locally concentrated.

Soil erosion by rain and river that takes place in hilly areas causes landslides and floods, while cutting trees for firewood, agricultural implements and timber, grazing by a large number of livestock, over and above, the carrying capacity of grass lands, traditional agricultural practices, construction of roads, indiscriminate (limestone) quarrying and other activities, have all led to the opening of hill-faces to heavy soil erosion. Wind erosion causes expansion of deserts, dust, storms, whirlwinds and destruction of crops, while moving sand covers the land and makes it sterile. Excessive soil erosion with consequent high rate of sedimentation in the reservoirs and decreased fertility has become serious environmental problems with disastrous economic consequences.

Soil erosion results in huge loss of nutrients in suspension or solution, which are removed away from one place to another, thus causing depletion or enrichment of nutrients. Besides the loss of nutrients from the topsoil, there is also degradation through the creation of gullies and ravines, which makes the land unsuitable for agricultural production. Subsidence of the land in some areas and landslides in the hilly tracts are problems affecting highways, habitations and irrigation dams.

Land degradation implies "temporary or permanent recession from a higher to a lower status of productivity through deterioration of physical, chemical and biological aspects". Land degradation has numerous environmental, economic, social and ecological consequences. Every ecosystem on the surface of the earth is affected by some or other form of land degradation. The past five decades have witnessed a significant rise in food production, but in many places the better yields have been associated with agricultural practices that have degraded the land and water systems. Farming systems “face the risk of progressive breakdown of their productive capacity under a combination of excessive demographic pressure and unsustainable agriculture use and practices.

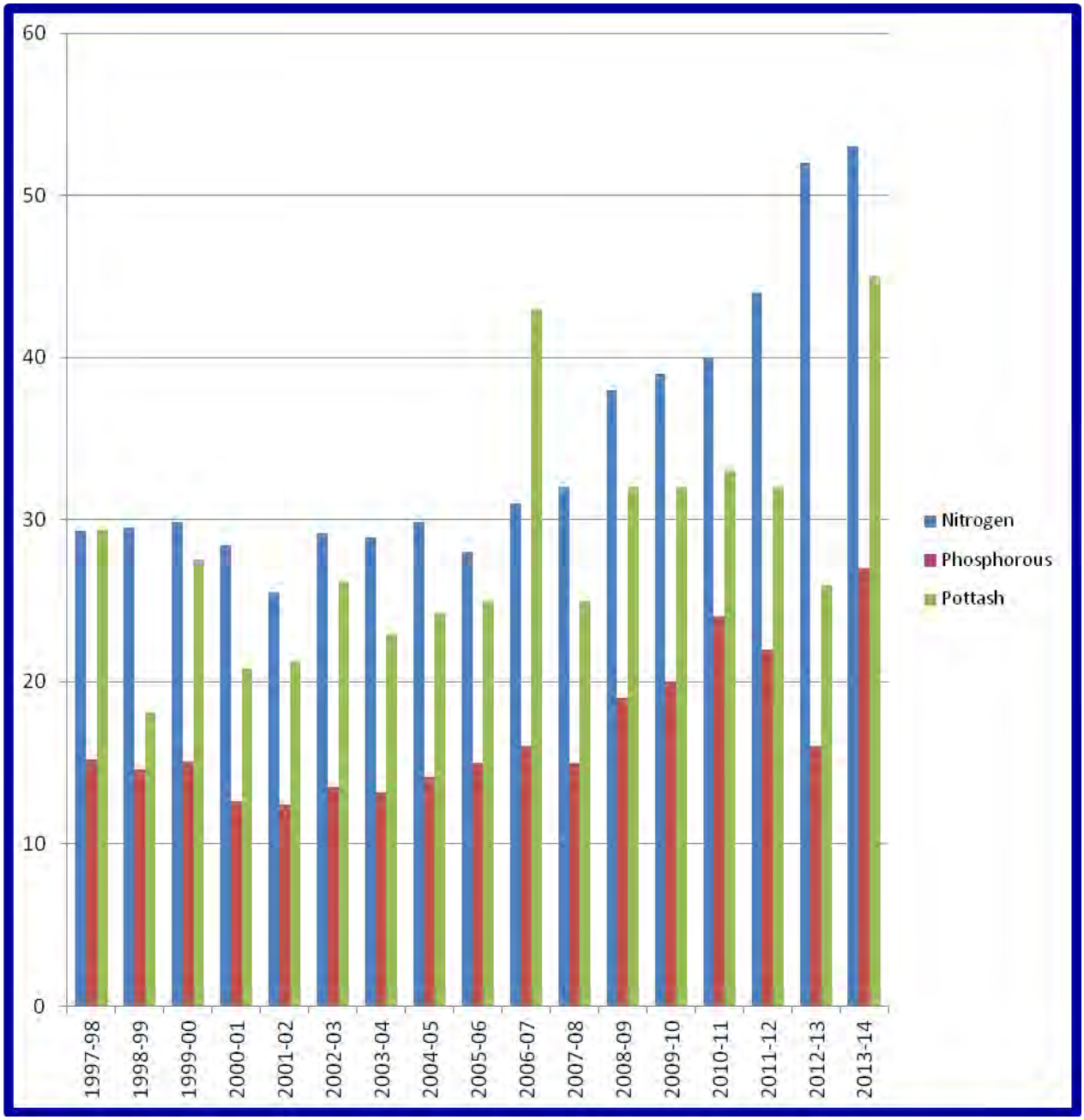
The total spatial extent of land degradation in Kerala is 5.2 lakh hectares constituting 13.4 percent of geographical area. A major consideration in present estimate is with respect seasonal water logging. In valley fills, under high rainfall conditions, the choice of cropping is restricted to paddy and other economically beneficial crop cannot be cultivated. Hence it was considered as a land degradation problem.

Table : 5.14 Consumption of Chemical Fertilizers in Kerala (in Kg)

Sl. No.	Year	Nitrogen	Phosphorous	Pottash	Total	N:(PK)%
1	1997-98	29.29	15.23	29.4	73.92	66
2	1998-99	29.5	14.58	18.14	62.22	90
3	1999-00	29.85	15.08	27.54	72.47	70
4	2000-01	28.43	12.66	20.82	58.32	85
5	2001-02	25.54	12.44	21.21	59.19	76
6	2002-03	29.18	13.53	26.19	68.9	73
7	2003-04	28.92	13.2	22.93	65.05	80
8	2004-05	29.87	14.14	24.2	68.21	78
9	2005-06	28	15	25	68	70
10	2006-07	31	16	43	89	53
11	2007-08	32	15	25	72	80
12	2008-09	38	19	32	89	74
13	2009-10	39	20	32	91	75
14	2010-11	40	24	33	97	70
15	2011-12	44	22	32	98	81
16	2012-13	52	16	26	94	124
17	2013-14	53	27.00	45.00	125	73

Source : Economic Revirew

Consumption of Chemical Fertilizers in Kerala (in Kg)



Source : Economic Revirew

Table : 5.15 Out turn of Major Forest Produce 2013-14

Sl. No.	Item	Unit	Quantity
1	Sawn and squared Timber	M^3	6.893
2	Teak Poles	Nos	117222
3	Firewood	MT	22066.016
4	Sandal Wood	Kg	62587.640
5	Bamboo	MT	5938.996
6	Reeds	MT	9917.023
7	Jungle Wood Poles	Nos	5545

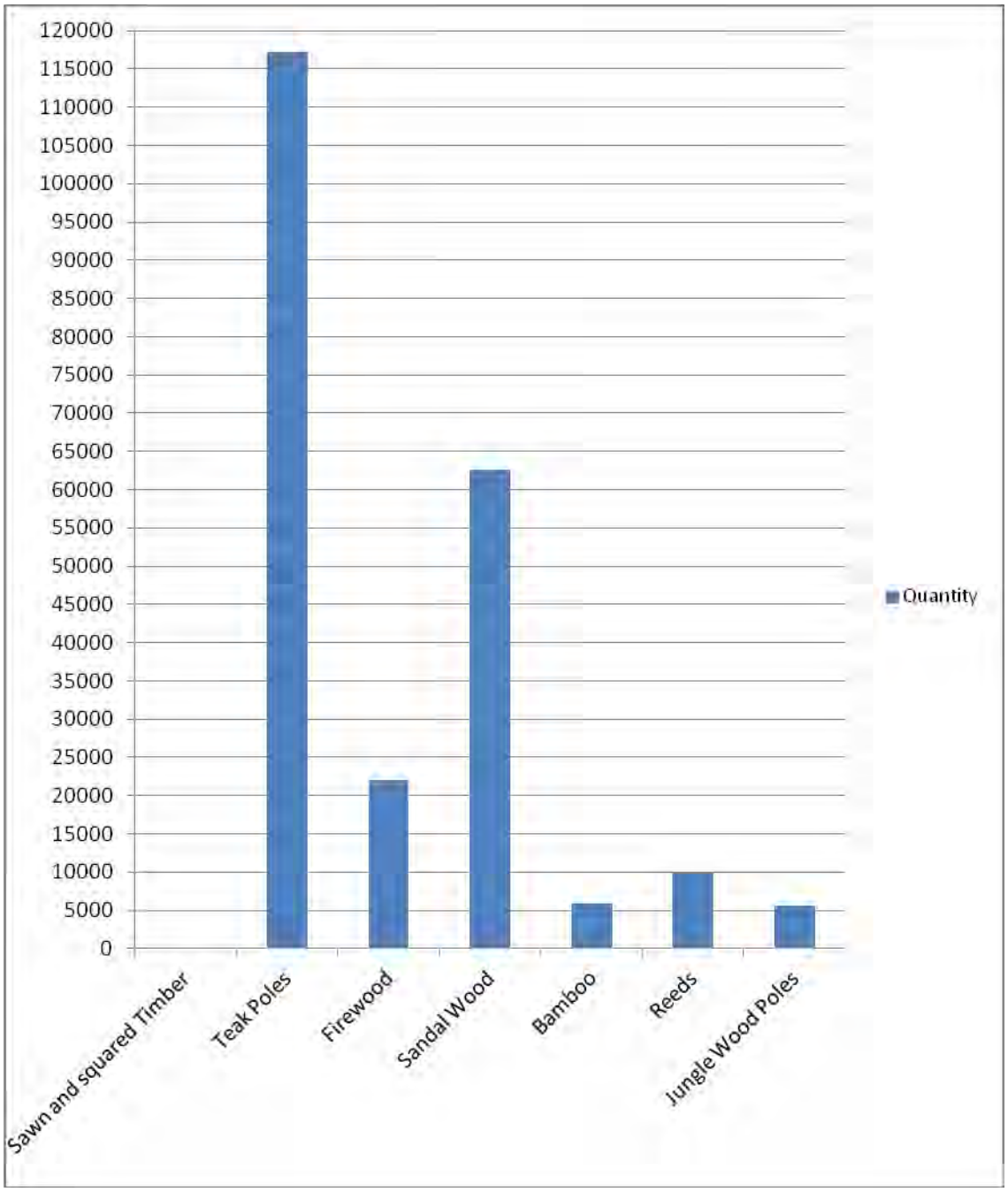
Source : Forest Statistics, Kerala Forest Department

Table : 5.16 Total consumtion of all kinds of wood during 2013-14 (in m3)

Sl. No.	District	Hardwood				Softwood			
		Forest	Local	Import	Total	Forest	Local	Import	Total
1	Thiruvananthapuram	6526	147919	16405	170850	1016	26919	107	28042
2	Kollam	12682	126997	4195	143874	1247	38359	-	39606
3	Pathanamthitta	1867	57246	15490	74603	140	17716	5	17861
4	Alappuzha	8090	247244	7531	262865	251	107062	25	107338
5	Kottayam	728	113642	3534	117904	815	43466	169	44450
6	Idukki	1909	26766	201	28876	461	9499	10	9970
7	Eranakulam	18041	138564	33724	190329	4424	66385	1	70810
8	Thrissur	12120	160981	28087	201188	359	106535	165	107059
9	Palakkad	3407	104603	6325	114335	463	56892	366	57721
10	Malappuram	8155	1565521	14504	188180	260	83677	13	83950
11	Kozhikode	17506	104983	17650	140139	3183	74914	158	78255
12	Wayanad	271	27134	480	27885	-	22935	-	22935
13	Kannur	2576	70538	14166	87280	271	54190	130	54591
14	Kasaragode	1156	28295	10254	39705	2082	27237	386	29705
	Total	**95034**	**1520433**	**172546**	**1788013**	**14972**	**735786**	**1535**	**752293**

Source : Report on saw mills in Kerala

Out turn of Major Forest Produce 2013-14



Source : Forest Statistics, Kerala Forest Department

Outturn of Timber

Category wise outturn of Timber classified according to utility is given below:-

Table : 5.17 Outturn of Timber based on utility 2013-14

Sl. No.	Category	Unit	Quantity
1.	Industial wood	M^3	29135.433
2.	Plywood	"	471.311
3.	Matchwood	"	361.466
4.	Bobbin wood	"	424.85
5.	Pencil wood	"	10.517
6.	Packing case wood	"	198.29
7.	Pulpwood		
a)	Eucalyptus	MT	16560.728
b)	Accasia	"	114362.201
c)	Bamboo	"	5938.996
d)	Reeds	"	9917.023
8.	Miscellaneous		
a)	Timber	M^3	1453.05
b)	Firewood	MT	22.66.016
c)	Teak poles	Nos	117222
d)	Jungle wood poles	Nos	5545
e)	Teak Billets	MT	1832.756

Source : Forest Statistics, Kerala Forest Department

Natural Disaster

A natural disaster is the consequence of the combination of a natural hazard (a physical event e.g. volcanic eruption, earthquake, landslide) and human activities. Human vulnerability, caused by the lack of appropriate emergency management, leads to financial, structural, and human losses. The resulting loss depends on the capacity of the population to support or resist the disaster, their resilience. This understanding is concentrated in the formulation: "disasters occur when hazards meet vulnerability". A natural hazard will hence never result in a natural disaster in areas without vulnerability, e.g. strong earthquakes in uninhabited areas. The term natural has consequently been disputed because the events simply are not hazards or disasters without human involvement. The degree of potential loss can also depend on the nature of the hazard itself, ranging from wildfires, which threaten individual buildings, to impact events, which have the potential to end civilization.

Specific vulnerabilities of the State

History of vulnerability of the state to the disasters of different types . The state of Kerala is vulnerable to a multitude of hazards and is categorized as a multiple-hazard prone state. The state experiences various kinds of disasters of recurrent nature that results in loss of life, livelihood and property, and disruption of economic activity, besides causing immense hardship to the affected population. Kerala has a long coast line of 590kms out of which, 322 Km is prone to severe sea erosion. The density of population is 819 persons per sq.km which is the second highest density in the country. About 96.9% of the total area in the state lies in the 140.4km/h wind zone which is classified as Moderate Damage Risk Zone by the BMPTC Atlas while the remaining area lies in 118.8km/h wind zone

The mean maximum storm surge height in the state is 3.5m and minimum is 2.3m. If the storm surge is during high tide, the maximum surge height in the state will be 4.2m and minimum storm height will reach up to 3m, as observed by the Meteorological Department, Thiruvanthapuram. The coastal belt of Kerala is one of the most densely populated regions in the country, which adds to its vulnerability. The Western flank of the Western Ghats covering the eastern part of Kerala is identified as one of the major landslide prone areas of the country.

Floods: In Kerala, riverine flooding is a recurring event consequent to heavy or continuous rainfall exceeding the absorptive capacity of soil and flow capacity of streams and rivers. This causes a water course to overflow its banks onto flood plains; which by definition is a relatively flat land adjacent to a natural water course, composed primarily of unconsolidated depositional material derived from sediments transported by the related stream and subjected to periodic flooding. Reclamation and settlement in floodplain areas is a major cause of flood damage in Kerala. Defining the entire flood potential in a given area is a delicate task.

Landslides: In Kerala, landslides commonly occur in localised areas of the Western Ghats region where the slope is steep and the soil is over saturated as a result of prolonged rainfall. These events vary from events affecting a parcel of land to those larger ones with much causality. Only the larger ones with losses of lives have been highlighted and studied in detail. The smaller events also indicate landslide potential of an area. Case studies by CESS show that most of the events are of debris flow type triggered by excess rainfall and are influenced by terrain factors like slope, overburden thickness, landuse, relative relief, disposition of streams, landform at micro level etc. The area of the state is about 38863 sq.km of which 40% lies in the highland region forming the western slopes of Western Ghats. A considerable part of all districts of Kerala except the coastal district of Alleppey falls within this region. The western declivity of the Western Ghats is steep and usually terraced resembling ghat or landing stairs from which it derives the name. This region is characterized by rugged hills with steep slopes on which rests the soil and earth materials. The slope in the Western Ghats region is generally steep to very steep with plateau edges highly indented having > 25 slope. The term landslide includes a broad range of different types of motion whereby earth material is dislodged by falling, sliding and flowing under the influence of gravity. In fact mass movements such as landslides are natural phenomenon that causes landscape changes, threat to life and destruction of property. The most common type of landslides in Kerala is debris flows.

Earthquakes: Kerala has experienced occasional mild tremors since historical times. None of them are reported to have caused casualties or major damages to built-up structures as in the case of Lathur earthquake. A seismic hazard map with 10% probability of exceedance in 50 years assigns low-level hazard to regions falling in Kerala. However pockets of higher ground acceleration have been identified in central Kerala. In this region higher levels of earthquake hazard are expected calling for the introduction of better building practices.

Tsunami: The superimposition of tsunami waves with high tide was a factor that compounded the inundation resulted in higher intensity of damage. The worst affected part of the coast in terms of inundation, run-up and erosion was the 10 km segment of Azhikkal coast. Satellite imagery of this tract a day after the tsunami clearly shows highly turbid sediment-laden water. Many concrete houses, fishing boats canoes and automobiles of this area were uprooted and thrown to distances of 100 to 200 m. Even blocks of rocks (1m size) of the seawall were thrown ashore to 150m by the rushing tsunami waves.

Coastal hazards: In Kerala, out of 14 districts, 9 districts are bordering the sea coast vulnerable to various disasters such as floods, cyclones, coastal erosion, landslides etc. These nine districts are namely, Kasargode, Kannur, Kozhikode, Malappuram, Thrissur, Ernakulam, Alappuzha, Kollam and Thiruvananthapuram. The state has 223 coastal villages which has the probability of being affected by cyclone. Natural causes of coastal erosion are due to the action of waves, winds, tides, near shore currents, storm surges and sealevel rise. Human activities such as the construction of harbours, jetties and groynes, river training works, mining and dredging can also lead to erosion of certain regions. Some of the coastal stretches in Kerala have shown long-term erosion with net loss of land. It is reported that about 480 km length of the coast is under the threat of erosion. The rocky coasts with pocket beaches have minimum level of erosion. In areas with laterite cliffs, under cutting of the softer clay layers lead to slumping with a net landward migration of the shoreline. In the sandy areas some of the segments show long term erosion while others with either accretion or stable condition.

Lightning: Lightning is a weather phenomenon. It is essentially an electrical discharge. This is not a phenomenon peculiar to Kerala. It is part of a global electrical system known as the Global Electric Circuit‘ involving the earth, ionosphere, and the atmosphere in between. On an average about 70 people in the state die due to lightning. There are numerous overlaps of dots in the plot. It can be seen that there is a relative void in incidents in an area west of the Palakkad. More specifically the region west of Palakkad namely the region near Thrisur has less incidence. This is because the mountain range has a gap in Palakkad and so the absence of mountain results in less Cb formation and lightning incidence. The two figures indicate that the mid land of Kerala has more lightning.

Table : 5.18 Kerala's Major Natural Disasters 2013-14

Sl. No.	Item	Flood	Drought	Fire
1	Period of occurrence	2013-14	2013-14	2013-14
2	Total number of districts in the State	14	14	14
3	Number and names of districts affected	14,Thiruvananthapuram, Kollam, Pathanamthitta, Alappuzha, Idukki, Ernakulam, Kottayam, Ernakulam, Thrissur, Palakkad, Kannur,Malappuram, Kozhikkode, Wayanad, Kasaragod	14 Districts viz., Thiruvananthapuram, Kollam, Pathanamthitta, Alappuzha, Kottayam, Idukki, Thrissur, Palakkad, Malappuram, Kozhikode, Kannur, Wayanad.	3, Palakkad, Pathanamthitta, Alapuzha
4	Number of villages affected	1399	617	3
5	Population affected (in lakh)	70.20	25	0
6	Total land area affected (in lakh ha)	18.31	6.39	0.24
7.1	Cropped area affected			
7.1.1	Total cropped area affected (in lakh ha.)	13.76	3.32	0.24
7.1.2	Estimated loss to crops (Rs.in lakh)	8601.74	6936.58	56.86
7.1.3	Area where crop damage was more than 50%	12.19	3.24	100%
7.2	Percentage of cropped area held by SMF	92%	96%	88%
7.2.1	In State, as a whole	55.04%	13.28%	0.01%
7.2.2	In the affected districts	Thiruvananthapuram -100, Kollam-75, Pathanamthitta-100, Alappuzha-95, Kottayam, Idukki-89, Ernakulam-60, Thrissur, Palakkad-100, Malappuram-100, Kozhikode-98, Kannur-96, Wayanad-80, Kasaragod 99.	Thiruvananthapuram -100, Kollam-85, Pathanamthitta-100, Alappuzha-95, Kottayam, Idukki,Thrissur, Palakkad-19.82, Malappuram, Kozhikode-98, Kannur-96, Wayanad.	Palakkad-70, Pathanamthitta-100, Alapuzha-95
8	Houses damaged	36046	0	0

Kerala's Major Natural Disasters 2013-14

Table : 5.19 Frequently Occuring Natural Disasters in Kerala 2013-14

Sl. No	Type	Affected Districts	Affected Population in Lakhs
1.	Floods	Thiruvananthapuram, Kollam, Pathanamthitta, Alappuzha, Kottayam, Idukki, Ernakulam, Thrissur, Palakkad, Malappuram, Kozhikode, Kannur, Wayanad, Kasaragod.	70.20
2.	Drought	Thiruvananthapuram, Kollam, Pathanamthitta, Alappuzha,Kottayam, Idukki, Thrissur, Palakkad, Kannur, Malappuram, Kozhikode, Wayanad	25
3.	Landslide	Palakkad	0.00
4.	Fire	Palakkad, Idukki, Kannur	0.00

Source: Kerala State Disaster Management Authority

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CHAPTER - VI

Water

Water quality management in India is accomplished under the provision of water (Prevention to control of pollution) Act1974. Main objective of the act is to prevent the pollution of water by Industrial, agricultural and household waste water that can contaminate our water source.

Water is used for drinking & other domestic purposes in most communities are obtained from Natural Sources such as rivers, streams, lakes, ponds & springs of artificial sources such as wells and bore wells. Most times these water supplies are likely to be polluted with waste. Micro organisms in these natural sources are numerous in both number and diversity. Water plays a very important role in human health. To determining the health of individuals and the whole communities , the quality of water supplied is more important.

Bacteriological monitoring is based on knowledge of the sanitary condition of water supply which is based on the detection of Colifom bacteria in the specific indicator of human faecal condamination, Escherichacol(E.coli) The term indicator organisms refers to micro organ isms whose presence in water shows that the water is polluted with faecal method from human or other warm blooded animals. Coliform bacteria are a group of becteria found in the intestinal trait of human and other animals. There are rod-shaped micro organism.

Coliform will not likely cause illness. However the presence of coliform in drinking indicates the presence of disease-cause of organisms Eschericha-coli, Enterobacteria,, aeigens, Salmonella and Klebasialla re some examples of this group. Coliform bacteria do not occur naturally in ground water. However it can live within biofilm formed by naturally occurring ground water micro organisms. The main cause of contamination are :

1) Missing/defective well cap seals around wires/pipes
2) Coracles of holes in the well casing
3) Many older wells were not sealed with grout when constructed.
4) Well flooding
5) Close proximity of a well to septic tanks, drain fields sewers, drains and surface water
6) Cross connection with waste water plumping.

Total Coliform, faecal coliform, and EColi are the indicators of drinking water quality. Total Colifrm bacteria are found in the environment (Soil or vegetables) are usually harmless. Fecal Coliform bacteria are subgroup of the Total Coli form group. They are found in intestine and faces of warm-blooded animal. E-Coli is sub group of the faecal coli form group. They are also found in the intestines of people and warm blooded animals. Most E-coli are harmless but some strains may cause serious illness.

Table : 6.1 Primary water quality criteria for bathing water

Cubic meter

criteria	Rationale
Faecal Coliform : 500 (desirable) MPN /100ml: 2500 (maximum permissible) Faecal Streptococci: 100 (desirable) MPN/100ml : 500 (maximum permissible)	To ensure low sewage contamination, faecal coliform and faecal streptococci are considered as they reflect the bacterial pathogenicity. The desirable and permissible limits are Suggested to allow for fluctuation in environment conditions such as seasonal Changes, changes in flow conditions, and so on.
pH: between 6.5 and 8.5	The range provides protection of the skin and delicate organs like eyes, nose, ears, and so on, which are directly exposed outdoor bathing.
Dissolved oxygen : 5 mg/l or more	The minimum dissolved oxygen concentration of 5 mg/l ensures reasonable freedom from oxygen consuming organic pollution immediately U/s which is necessary for preventing production of anaerobic gases (obnoxious gases) from sediments.
Biochemical oxygen Demand : 3 mg/l or less 3 days at 27 C	The biochemical oxygen demand of 3 mg/l or less of the waiter ensures reasonable freedom from oxygen demanding pollutants and prevent production of obnoxious gases.

Source: Kerala State Pollution Control Board

Table : 6.2 Water Quality Criteria (CPCB) 2013-14

Designated-Best-Use	Use Class	Criteria
Drinking water source without conventional treatment but after disinfection	A	Total Coliforms MPN/100ml shall be 50 or less. pH : 6.5. and 8.5 DO : 6mg/l or more BOD : 2 mg/l or less.
Outdoor bathing (Organised)	B	Total Coliforms MPN/100ml shall be 500 or less pH : 6.5 and 8.5 DO : 5 mg/l or more BOD : 3mg/l or less.
Drinking water source after conventional treatment and disinfection.	C	Total Coliforms MPN/100 ml shall be 5000 or less pH : 6.5 to 8.5 DO : 4mg/l or more BOD : 3mg/l or less.
Propagation or Wild Life and Fisheries	D	pH: 6.5 to 8.5 DO : 4mg/l or more, Free Ammonia (as N) 1.2 mg/l or less.
Irrigation, Industrial Cooling, Controlled Waste disposal	E	pH: 6.0 to 8.5 Electrical conductivity at 250C micro mhos/cm Max 2250 Sodium Absorption Ratio Max: 26 Boron Max 2mg/l
	Below E	Not Meeting A, B, C, D & E Criteria

Source: Kerala State Pollution Control Board

Table : 6.3 Storage levels in Reservoirs

Cubic Meter

Sl. No.	Item	2012	2013	2014
1	Storage of water on the beginning of the monsoon year	403.69	280.59	415.16
2	Storage of water at the end of the monsoon year	744	1290.25	1316.46
3	Increase in storage	340.31	1009.66	901.3
Average for 10 Years				
4	Storage of water on the beginning of the monsoon year	430.8	395.63	360.5
5	Storage of water at the end of the monsoon year	1116.76	1186.48	1087.27
6	Increase in storage	686.56	790.85	726.77

Source: Economic Review, DES

Table : 6.4 Name of Reservoirs

Sl. No.	Name of Reservoir	District	Area(Ha)
1	Neyyar	Thiruvananthapuam	1500
2	Peppara	Thiruvananthapuam	582
3	Aruvikkara	Thiruvananthapuam	258
4	Thenmala Dam (Kallada)	Kollam	2590
5	Pamba	Pathanamthitta	570
6	Kakki	Pathanamthitta	1800
7	Maniyar	Pathanamthitta	110
8	Gani & Kallar Dam	Pathanamthitta	25
9	Ponmudi	Idukki	260
10	Idukki Arch Dam	Idukki	6160
11	Anayirankal Dam	Idukki	433
12	Gundala	Idukki	230
13	Mattupetty Dam	Idukki	324
14	Sengulam Dam	Idukki	33
15	Neriyamangalam	Idukki	413
16	Periyar Lake	Idukki	2890
17	Edamalayar Dam	Idukki	350
18	Kallarkutty Dam	Idukki	58
19	Munnar Headworkers Dam	Idukki	250
20	Kallar Division Dam	Idukki	220
21	Lower Periyar Dam	Idukki	150
22	Erattayar Dam	Idukki	200
23	Malankara Dam	Idukki	120
24	Mullaperiyar Dam	Idukki	400
25	Kulamavu Dam	Idukki	6160

26	Cheruthoni Dam	Idukki	
27	Bhoothathankettu	Ernakulam	608
28	Peechi	Thrissur	1200
29	Vazhani	Thrissur	255
30	Sholayar	Thrissur	870
31	Peringalkuthu	Thrissur	280
32	Chimmini- Dam	Thrissur	1000
33	Poomala	Thrissur	75
34	Pathazhakunnu Dam	Thrissur	14
35	Asuram Kundu Dam	Thrissur	12
36	Malampuzha	Palakkad	2313
37	Mangalam	Palakkad	393
38	Meenkara	Palakkad	259
39	Chulliyar	Palakkad	159
40	Pothundi	Palakkad	363
41	Walayar	Palakkad	289
42	Parambikulam	Palakkad	2092
43	Thunakkadavu	Palakkad	283
44	Lakkidi	Palakkad	25
45	Kanjirappuzha	Palakkad	512
46	Cheramangalam	Palakkad	200
47	Tharampilli	Palakkad	244
48	Kuttiyadi	Kozhikkode	1052
49	Kakkayam	Kozhikkode	1070
50	Peruvannamuzhi	Kozhikkode	1050
51	Banasurasagar	Wayanad	1277
52	Korapuzha	Wayanad	1660
53	Pazhassi	Kannur	648
	Total		**44289**

Source : Fisheries Department

Table : 6.5 Biological Water Quality Criteria (Bwqc) 2013-14

Sl. No.	Taxonomic groups	Range of Saprobic Score (BMWP)	Range of Diversity Score	Water quality charecteristics	Water quality class	Indicator colour
1	Ephemeroptera, Plecoptera, Trichoptera, Hemiptera, Diptera	7 and more	0.2-1	Clean	A	Blue
2	Ephemeroptera, Plecoptera, Trichoptera, Hemiptera, Planaria, Odonata, Diptera	6-7	0.5-1	Slight pollution	B	Light Blue
3	Ephemeroptera, Plecoptera, Trichoptera, Hemiptera, Odonata, Crustacea, Mollusca, Polychaeta, Coleoptera, Diptera, Hirundinea, Oligochaeta	3-6	0.3-0.9	Moderate Pollution	C	Green
4	Hemiptera, Mollusca, Coleoptera, Diptera, Oligochaeta	2-5	0.4 &less	Heavy Pollution	D	Orange
5	Diptera, Oligochaeta, No Animal	0-2	0-0.2	Severe Pollution	E	Red

Source: Kerala Pollution Control Board

Table : 6.6 Navigable Waterways in Kerala 2013-14

Sl.No.	Name of the River	Length of the River	Navigable Length
1	Achenkoil	128	32
2	Anjarakandy	40	27.2
3	Ayroor	17	1
4	Bharatha Puzha	209	40
5	Chalakudy	130	16
6	Chaliyar	169	68.4
7	Chandragiri	105	12.8
8	Chittari	25	NA
9	Ithikkara	56	16
10	Kadalundi	130	43.2
11	Kallada	121	40
12	Kallayi	40	9.6
13	Kamom	27	1
14	Karamana	68	NA
15	Kariangode	64	24
16	Karuvannur	40	24
17	Kavvayi	31	9.6
18	Keecheri	51	NA
19	Korapuzha	40	24.8
20	Kuppam	82	24
21	Kuttiyadi	74	9.6
22	Mahe	54	24
23	Manimala	90	54.4
24	Manjeswar	15	3.2

25	Meenachil	78	41.6
26	Mogral	34	NA
27	Muvattupuzha	121	25.6
28	Neyyar	56	NA
29	Nileswar	46	NA
30	Pallikal	42	3
31	Pamba	176	73.6
32	Periyar	244	72
33	Peruvamba	51	16
34	Puzhakkal	29	NA
35	Ramapuram	19	5.4
36	Shiriya	67	4.8
37	Thalasseri	28	21.6
38	Tirur	48	9.6
39	Uppala	50	3.2
40	Valapattanam	110	44.8
41	Vamanapuram	88	11.2
TOTAL		**3093**	**837.2**

Source: Fisheries Department

Table : 6.7 District Wise Brackish Water Area in Kerala 2013-14

Sl. No	Name of District	Area in (Ha)
1	Thiruvananthapuram	1424
2	Kollam	8604
3	Pathanamthitta	Nil
4	Alappuzha	15223
5	Kottayam	4327
6	Idukki	Nil
7	Ernakulam	16213
8	Thrissur	4272
9	Palakkadu	Nil
10	Malappuram	1796
11	Kozhikode	4162
12	Wayanadu	Nil
13	Kannur	5944
14	Kasaragod	3248
TOTAL		**65213**

Source: Fisheries Department

Table : 6.8 Fresh Water Lakes in Kerala 2013-14

Sl.No	Name of Lake	District	Area in (Ha)
1	Vallayani Lake	Thiruvananthapuram	250
2	Sasthamkotta Lake	Kollam	440
3	Eravikulam Lake	Idukki	3
4	Devikulam Lake	Idukki	10
5	Elephant pond	Idukki	6
6	Periyar Lake	Idukki	605
7	Mankodi Lake	Thrissur	205
8	Muriyadu Lake	Thrissur	94
9	Pookote Lake	Wayanadu	7
	TOTAL		**1620**

Source: Fisheries Department

Table : 6.9 Backwaters in Kerala 2013-14

Sl.No.	Name of District	Sl. No.	Name of Backwaters	Area in (Ha)
1	Thiruvananthapuram	1	Poovar Kayal	30.93
		2	Poonthura Kayal	97.59
		3	Veli Kayal	22.48
		4	Kadinamkulam Kayal	346.88
		5	Anchuthengu Kayal	521.75
		6	Edava-Nadayara Kayal	157.65
		TOTAL		**1177.28**
2	Kollam	1	Paravoor Kayal	662.46
		2	Ashtamudi Kayal	6424.15
		3	Kayamkulam Kayal	140.58
		TOTAL		**7227.19**
3	Pathanamthitta	**Nil**		
4	Alappuzha	1	Kayamkulam	1511.75
		2	Poomeen Kayal	3.37
		3	Vadakkal Kayal	1.46
		4	Chethi Kayal	4.11
		5	Arthungal Kayal	5.96
		6	Pozhichal Kayal	20.41
		7	Vettakkalchal Kayal	27.1
		8	Vembanattu Kayal	10661.23
		TOTAL		12235.39
5	Kottayam	1	Vembanattu Kayal	2926.77
		TOTAL		**2926.77**
6	Idukki	**Nil**		
7	Ernakulam	1	Vembanattu Kayal	2257.59
		2	Kochi Kayal	7503.80
		TOTAL		9761.69
8	Thrissur	1	Azhikode Kayal	82.02
		2	Kodungalloor Kayal	613.81
		3	Chettuva Kayal	713.87
		4	Pattikkara Kayal	-
		5	Manakkady Kayal	-

9	Palakkad	**NIL**		
10	Malappuram	1	Puthupponnani	150.83
		2	Ponnani Kayal	757.19
		3	Poorapuzha	62.98
		4	Kadalundi Kayal	323.56
		TOTAL		**1294.56**
11	Kozhikode	1	Kadalundi Kayal	83.85
		2	Beypore Kayal	783.74
		3	Kallai Kayal	160.13
		4	Korapuzha	1038.08
		5	Payyolipuzha	26.70
		6	Kottapuzha	584.12
		7	Newmahepuzha	88.28
		TOTAL		**2764.90**
12	Wayanad	**NIL**		
13	Kannur	1	Mahe	91.89
		2	Dharmadam Kayal	359.06
		3	Valapattanam	3077.64
		4	Palakkode	598.25
		5	Cheruvathur	30.58
		TOTAL		**4157.42**
14	Kasaragode	1	Cheruvathur	1123.12
		2	Nileswaram	824.69
		3	Chittari Kayal	89.33
		4	Bekal Kayal	43.37
		5	Kappil Pozhi	2.22
		6	Neembil Kayal	22.47
		7	Chandragiri	575.81`
		TOTAL		**2681.01**

Source : Fisheries Department

Rain Water

India is home to an extraordinary variety of climatic regions, ranging from tropical in the south to temperate and alpine in the Himalayan north, where elevated regions receive sustained winter snowfall. The nation's climate is strongly influenced by the Himalayas and the Thar Desert. The Himalayas, along with the Hindu Kush mountains in Pakistan, prevent cold Central Asian katabatic winds from blowing in, keeping the bulk of the Indian subcontinent warmer than most locations at similar latitudes. Simultaneously, the Thar Desert plays a role in attracting moisture-laden southwest summer monsoon winds, that, between June and September, provide the majority of India's rainfall. The rainfall in the country is mostly confined to four monsoon months between June to September during which almost 80% of the total rainfall takes place.

Rainwater harvesting can enable households, factories, schools and offices to overcome their problems of irregular and inadequate water supply or water supply of poor quality. The process involves storing rainwater that falls within one’s premises and re-using it after basic treatment. By using equipment that is easily available, rainwater is diverted towards existing underground tanks or terrace fitted tanks and then supplied to the taps. The purification methods can be used by households, factories and offices to treat rainwater. Treated rainwater is safe not just for cleaning and washing but also for cooking and personal consumption. The amount of rainfall notwithstanding, people living and working in various types of geographical terrains can harvest rainwater. In the long run, rainwater harvesting can replenish India’s rapidly depleting ground water levels, and lead to water security and sustainability.

Rivers

Out of the 44 rivers flowing through the State, 41originate from the Western Ghats region on the east of the state and flow westward to join the Lakshadweep sea; The remaining three rivers (Kabani, Bhavani and Paambar) originate from the Western Ghats and flows towards the east and finally join the Bay of Bengal, after flowing through the neighbouring States.

Table : 6.10 List of 44 major Rivers of Kerala 2013-14

Sl. No.	Flowing Rivers of Kerala	Place of Origin	Empties Into	Length (Km)
1.	Anjarakkandi		Arabian Sea	52
2.	Achenkovil		Pampa	128
3.	Baikal		-	10
4.	Bharathapuzha (Nila)	Anamalai (Tamil Nadu)	Arabian Sea	209
5.	Chalakkudy	Anamalai	Periyar	144
6.	Chaliyar	Elampaleri Hills	Arabian Sea	168
7.	Chandragiri		Arabian Sea	104
8.	Chittar		Arabian Sea	25
9.	Itthikkara	Madathara	Paravoor Lake	56
10.	Kaariyankode		Kavvai Lake	64
11.	Kadalundi		Arabian Sea	130
12.	Kallada	Kulathoorpuzha hills	Ashtamudi lake	120
13.	Kallai		Arabian Sea	22
14.	Kalnadu		-	8
15.	Karamana		Arabian Sea	67
16.	Karuvannoor	Poomalai	Enamaakkal Lake	48
17.	Kavvai		Kavvai Lake	22
18.	Keecheri		Enamaakkal Lake	43
19.	Korappuzha	Arikkan Hills	Arabian Sea	40
20.	Kumbala			10
21.	Kuppam		Valapattanam River	80
22.	Kuttyadi		Arabian Sea	73
23.	Maahi	Wayanad Hills	Arabian Sea	54
24.	Manjeshwaram	Baleppooney hills	Uppala Lake	16
25.	Manimala	Thattamalai	Pampa	91

26.	Maugral		Arabian Sea	33
27.	Meenachil		Vembanadu lake	67
28.	Muvattupuzha		-	120
29.	Neeleshwaram		Kaariyankode River	46
30.	Neiyyar	Agasthi Hills	Arabian Sea	56
31.	Pampa	Peermedu	Vembanad lake	176
32.	Periyar	Sivagiri	Kodangalloor lake	244
33.	Perumpa		-	40
34.	Purapparamba		-	8
35.	Ramapurampuzha	Eringal Hills	Arabian Sea	19
36.	Shiriya		Arabian Sea	65
37.	Thalasseri		Arabian Sea	28
38.	Tiroor		Bharatapuzha	48
39.	Uppala		Arabian Sea	50
40.	Valapattanam	Brahmagiri Forests	Arabian Sea	112
41.	Vamanapuram		Anchuthengu Lake	80
Length of the rivers are approximate measures and are likely to vary with time and season.				
#	**East Flowing Rivers**			**Length (km)**
42	Paampar	Paampar and Bhavani flows into Tamilnadu. Kabani enters Karnataka. All three of them empties into Kaveri		Flows only a few kilometres through Kerala
43	Bhavani			
44	Kabani			

Source : Fisheries Department

Table : 6.11 Minimum and Maximum Observed values of water quality parameters at PWD sites and River Stations : 2014

Sl. No.	Name of River	Name of Site	Quality Parameters												Class
			pH			Dissolved Oxygen			B.O.D			Coliform bacteria			
			Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	
1.	Neyyar	Amaravila (Neyyatinkara Village)	8.0	6.3	7.05	7.8	5.8	7.71	1.5	0.2	0.62	790	430	624.16	C
		Aruvippuram (Perumkadavila Village)	7.5	6.5	6.98	7.9	6.6	7.19	1.6	0.1	0.59	700	310	435	C
2.	Mamom	Mamom Bridge (Attingal Village)	7.9	6.5	7.09	7.3	5.2	677	1.9	0.4	0.84	1600	920	1268.33	C
3.	Ayroor	Ayoor Bridge (Ayroor Village)	7.8	6.2	6.94	7.4	4.6	6.3	3.9	0.2	1.62	2400	1300	2008.33	C
4.	Karamana	Aruvikkara	7.4	6.5	7	7.8	6.8	7.35	0.5	0.1	0.14	920	310	410.83	C
		Moonnattumukku (Thiruvallom village)	8.5	7.3	7.73	4.1	0	1.9	40	3.4	26.86	54000	16000	37250	E
5.	Ithikkara	Ithikkara Bridge	8.0	6.8	7.42	6.9	5.1	6.05	2.8	1.2	1.95	920	210	521.66	E
		Ayroor Bridge	7.9	7	7.51	7.7	3.9	6.73	2.4	1	1.63	1100	110	474.16	C
6.	Vamanapuram	Vamanapuram Village	8.0	6.8	7.48	8	5.5	6.87	0.9	0.4	0.59	2200	1100	1625	C
	Pallickal	Nellimughal	7.9	6.7	7.6	6.7	5	6.01	1.6	0.8	1.26	920	140	525	C
7.	Achenkovil	Kallarakkadavu	7.9	6.4	7.47	7.7	4.9	6.67	1.6	0.8	1.32	790	180	459.09	C
		Chennithala	7.9	7	7.42	7.1	4.8	5.79	2	1.2	1.4	1100	430	690	C
		Thumpamon	7.8	7.2	7.5	7.6	4.8	6.69	2	1	1.36	630	180	420.83	C
		Pandalom	7.9	6.7	7.53	7.4	5.9	6.72	2	1.2	1.35	790	240	442.5	C
	Kallada	Perumthottamkadav	8.1	7.3	7.61	7.8	5.9	7.19	2	1	1.31	630	220	405.45	C
8.	Pamba	Pamba Down (Mannar	7.2	6.4	6.88	4.7	2.8	3.71	0.9	0.2	0.48	350	240	293.63	C

		Panchayath)													
		Chenganoor Muncipality	7.3	6.5	6.81	6.6	3.7	5.07	1	0.2	0.62	430	230	302.72	C
		Thakazhy Panchayath	6.9	6.4	6.75	6.2	3	4.8	2	0.2	0.69	460	240	340.9	C
9.	Meenachil	Kidangoor Panchayath	7.1	6.1	6.59	7.9	5.5	6.81	0.7	0.2	0.48	7000	1400	2963.63	C
10.	Manimala	Thondara (Kuttoor Panchayath)	7.3	6.4	6.94	7.3	5.8	6.52	4.1	0.2	1.34	0.08	1600	220	C
		Kallooppara Panchayath	7.2	6.1	6.8	7.8	5.9	6.79	7.4	0.4	1.73	1100	220	683063	C
11.	Periyar	Eloor (Kadungallore Panchayath)	7.5	6.4	6.84	6	3.8	4.83	4	0.4	1.81	1600	110	610.9	E
		Kalady Panchayath	7.9	6.3	7.02	7.8	6.6	7.05	1.7	0.2	1	1100	49	526.27	C
		KWA Aluva Muncipality	8.0	6.2	6.95	7.2	5.7	6.58	2	0.5	1.32	1100	110	498.18	C
		SOP Aluva Muncipality	7.7	6.6	6.92	6.9	5.3	6.31	2	0.4	1.21	2200	63	789.36	C
		Pathalam (Kadungallore Panchayath)	7.8	6.2	6.8	7	0.4	5.6	4.6	0.7	1.97	2100	63	777.54	E
		Kalamassery Muncipality	8.1	6.1	6.94	7.5	4.4	5.87	8.4	1.6	3.2	3500	350	1226.36	C
		Purapallikadavu (Chengamanadu Panchayath)	8.0	6.3	7.1	7.4	6.1	6.64	2.2	0.4	1.25	3100	21	832.81	E
		Muppathadam (Kadungallore Panchayath)	7.7	6.2	6.85	8	5.2	6.25	2.6	0	1.26	2300	210	987.27	C
12.	Moovattupuzha	Vettikkattumukku (Mevallore Panchayath)	6.9	6.2	6.72	7.8	6.2	6.91	0.9	0.3	0.56	6300	1100	3363.63	C

13.	Chalakudy puzha	Pullickakadavu (Kadakutty Panchayath)	7.5	6.1	6.87	8	5.5	6.8	2.2	0.2	1.13	1100	49	551.72	C
14.	Karuvanoor	Karuvanoor Bridge (Porathissery Village)	7.7	6.8	7.22	7.3	4.4	6.25	3.6	0.5	1.37	1100	210	509.09	C
15.	Puzhakal	Puzhakkal Bridge (Adat Panchayath)	8.0	6.7	7.26	6.3	2.8	4.34	2.7	0.2	1.59	1700	210	742	C
16.	Keecheri	Vadakkancherry (Eranellur Village)	8.3	6.6	7.38	7.6	0.6	5.5	3.5	0.5	1.62	1100	280	697	C
17.	Bharathapuzha	Kuttippuram Panchayath	8.1	6.9	7.34	7.6	5.8	6.87	1.6	0.1	0.69	1100	79	497	C
		Pattambi Panchayath	8.3	7	7.68	7.7	4.6	6.59	3.8	0.2	1.63	1300	240	571	C
18.	Kadalundi	Thirurangadi Village	7.8	5.7	6.83	7.6	5.8	6.83	2.8	0.5	1.64	630	22	318	C
		Hajiyarpally (Panakad Village)	7.8	6	6.88	7.8	5.6	6.9	2.8	0.5	1.54	540	43	235	C
19.	Tirur	Thalakkadathur (Cheriyamundam Village)	7.6	6.3	6.90	7.1	2.7	4.65	4.8	0.7	2.1	460	21	234	C
20.	Chaliyar	Koolimadu (Chathamangalam Panchayath)	8.0	6.8	7.52	8	5.9	6.96	2.1	0.3	0.79	9400	300	3691	C
		Nilambur	7.9	6.8	7.38	8	5.7	7.13	1	0.1	0.65	4300	70	1372	C
		Chungapally (Perumana Panchayath)	8.0	6.7	7.42	7.4	4.2	6.64	1	0.3	0.77	6300	430	1760	E
21.	Kabani	Muthankara (Mananthavadi Panchayath)	8.2	7	7.70	7.9	5.7	6.64	0.8	0.2	0.44	180	33	95	A
22.	Bhavani	Elaichivazhi (Agali Panchayath)	8.4	6.9	7.6	7.8	6.5	7.33	1.8	0.2	0.72	790	110	298.18	C

23.	Kuttiyadipuzha	Estatemukku (Chakkittappara Panchayath)	7.6	6.8	7.16	8.2	6	7.08	0.8	0.2	0.63	1600	140	635	C
24.	Mahe	Valayam (Valayam Panchayath)	8.0	6.7	7.34	7.9	5	6.5	0.9	0.2	0.64	35000	700	7645	C
25.	Kallai Puzha	Kallai Bridge (Kozhikode Corporation)	8.4	6.8	13.13	6.9	0.6	3.91	2	0.3	1.14	210000	5400	63973	E
26.	Korapuzha	Kanayankode	8.3	7	7.45	8	4.9	6.109	1.5	0.06	0.65	5400	430	2611	E
27.	Kuppam	Taliparamba (Taliparamba Village)	7.1	6.4	6.78	8.3	4.4	6.07	2.3	0.2	1.53	430	94	172	E
		Rayoram (Alakkode Village)	7.3	6.5	6.88	8.3	4.9	7.36	2.1	0.3	1.15	310	100	158	C
28.	Thalassery	Pathipalam (Patyam)	7.1	6.2	6.56	7.8	2.9	5.76	2.5	0.2	0.87	430	94	157.09	C
29.	Ancharakkandy	Ancharakkandy Village	7.0	6.4	6.7	7.8	4	6.47	2.6	0.2	1.29	790	94	321	C
		Meruvamba (Vengad Village)	7.3	6.5	6.93	7.7	5.3	6.68	2	0.4	0.88	310	49	178	C
30.	Ramapuram	Ramapuram Bridge (Cheruthazham Village)	7.3	6	6.67	7.5	2.1	4.46	4	0.3	1.56	350	70	180	E
31.	Kavai	Kuttiyolpalam (Peralam Village)	7.3	6.3	6.65	7.9	3.2	5.58	2.6	0.4	1.14	310	79	147	C
32.	Valapattanam	Parassanikkadavu	7.5	6.5	7	7.9	4.1	6.65	2	0.3	0.85	210	0	100	E
33.	Neeleswaram	Hosdurg (Neeleswaram Village)	7.9	6.2	7.2	7.3	4.7	6.25	3.6	0.3	1.51	2200	43	565	E
		Nambiarckal (Hosdurg Village)	7.5	6.2	6.81	8	5.5	7	4.2	0.3	1.8	170	0	65	E

34.	Karingode	Kakkadavu (Cheemeni Village)	7.9	6.2	7.08	8	6.8	7.63	3.4	0.5	1.23	1600	170	731	C
35.	Chandragiri Puzha	Padiayathadka	7.8	602	7016	8.1	6.7	7.5	3.6	0.3	1.17	1300	110	596	C
36.	Mogral	Mogral Bridge (Mogral Village)	7.9	6.2	7.11	7.2	3.9	5.6	4.1	0.6	2.09	920	21	486	E
37.	Shriya	Angadimogaru Village	7.4	6.6	6.92	8.4	7.06	7.706	2.6	1	1.81	1200	280	598	C
38.	Uppala	Uppala Bridge (Uppala Village)	7.8	6.7	7.13	8	4.9	6.89	3.1	0.1	1.16	2100	43	650	E
39.	Manjeswaram	Bajrakkara Bridge (Vorcadi Village)	7.2	6.5	6.93	8	6.9	7.47	4.4	1	1.78	1400	140	686	C
40.	Peruvamba	Chandrapura (Kadanapally Village)	7.3	6	6.52	7.7	4	6.49	1.7	0.3	0.85	540	49	183	C

Source: State Pollution Control Board

Watersheds

A watershed is a georgraphical area that drains to a common point, which makes it an ideal unit of conservation of soil and water. Micro Watershed in the Grama Panchayat are chosen for easy administration. It is a logical unit for planning in the three tier system of Local Self Government and optimum development of the "resource trinity" namely land, water and biomass. It may extend over a Grama Panchayat or several Panchayts, contain both arable and non-arable lands, various categories of land-holdings and farmers whose action may impact on each other's interest. In those Watersheds extending beyond a Grama Panchayat, the Panchayat having major area in the Watershed will be the Programme Implementing Agency. The Programme Implementing Agency should arrange collection and compilation of baseline data on land use pattern, cropping pattern, productivity of important crops, water level of wells and ponds, socio-economic data of watershed population etc. before starting any intervention in the project area. The water shed development programme taken up in the State through the Western Ghats Development Programme (WGDP) with the financial support of Government of India is given in table 6.12. The basic intentions of the programme is to preserve the natural resources with the judicious use of resources and conservation methods. Other agencies like soil conservation Department and Rural Development Department also implementing various schemes and programmes for watershed based development programmes.

Table : 6.12 Watersheds during 2013-14

Sl. No.	District	Name of Watershed	Area in Ha	Panchayat
1	Thiruvananthapuram	Perayam	297	Vithura
		Aliyad	600	Manickal
		Iruloor	799	Vamanapuram
2	Kollam	Ambara	260	Pavithreswaram
		Thottuva	486	West Kallada
		Valiyapadam	540	West Kallad
3	Pathanamthitta	Thenginal	250	Pallickal
		Melood	535	Pallickal
		Elamannoor I	710	Enadimangalam
		Elamannoor II	380	Enadimangalam
		Kodumudi	450	Chittar,Vadaserikkara
		Arthakandanmoozhy	350	Aruvappulam
		Paruthymoozhy	245	Aruvappulam
		Mannadi	173	Kadambanad
		Puthusseribhagam	255	Erathu
4	Kottayam	Parappallythode	600	Meenachal
		Uppukulam	496	Manimala
		Maniakkupara	525	Marangattupally
5	Idukki	Asarikkavala	428	Erattayar
		Ezhikumvayal-Kumbanmala	611	Nedumkandom
		Kuzhitholu-Kambanmettu	933	Karunapuram
6	Ernakulam	Mattathukandomthode	556	Keerampara
		Kakkad	367	Piravom
7	Thrissur	Thommana Padinjarepadam	590	Velukkara
		Karigachirapadam	516	Puthenchira
8	Palakkadu	Mulankavu	610	Kulukkallur
		Velladikkunnu	580	Thirumittakkode
		Chathikuzhy	900	Mankara
		Ambankadavu	675	Kanjirampuzha

		Annamthodi	760	Thachanattukara
9	Malappuram	Moorkanadthode	590	Moorkanad
		Athithode	550	Vazhikkadavu
		Neettilthode	800	Mankada
10	Kozhikode	Elambilathmoozhithode	607	Perambra
		Manthrathode	434	Karasseri
11	Wayanadu	Nedunilam	475	Kalpetta Municipality
		Karikkilode	350	Vengappally
		Kokkuzhy	706	Kottathara
		Chingadikkunnu	187	Kaniyanbetta
		Naduvanthar Sarvany	374	Thirunelly
		Vattathoor	144	Mullankolly
		Karachal	445	Amabalavayal
		Kallumukku	286	Noolpuzha
		Thalippuzha	250	Vythiri
		Sreepuram-Kakkampuzha	444	Vythiri
		Ayiramkolly	195	Ambalavayal
12	Kannur	Rayarome	460	Alkoode
		Padappengad	430	Chapprappadavu, Naduvil
		Adicheri Thazhathuvayal	300	Malapattom
		Nidumpramchaal	610	Kanichar, Kolayad
		Kolladi	340	Alakkode
		Parakkadi	470	Chengalai
		Kundula Chappa	680	Kanichar. Kolayad
		Taalipaara	420	Udayagiri
		Kaipankuzhy	470	Naduvil
		Parippai	610	Sreekandapuram, Chengalai
		Umayanchal	440	Cherupuzha
		Muvanchal	412	Naduvil
		Chambocheri	430	Malappattam
		Pudusseripoyil	390	Koliyad
13	Kasaragod	Pookkayam I	217	Panathady

Source : Western Ghats Development Programme

Coast Line of Kerala

Kerala is a coastal state bordered on the west by Arabian Sea. The coastline of the state runs to a length of about 590 Km. The continental shelf area is 39139 Sq.Km. The Exclusive Economic Zone (EEZ) extends up to 200 nautical miles far beyond the continental shelf, which covers an area of 218536 Sq.Km. provide opportunities in traditional fishing in inshore waters from ages. Thus fisheries form one of the most important sectors of Kerala's economy.

Table : 6.13 District-wise Distribution of Coast Line of Kerala

Sl. No.	District	Coast line length (in km)	Percentage of Total
1	Thiruvananthapuram	78	13.22
2	Kollam	37	6.27
3	Alappuzha	82	13.90
4	Ernakulam	46	7.80
5	Thrissur	54	9.15
6	Malappuram	70	11.87
7	Kozhikode	71	12.03
8	Kannur	82	13.90
9	Kasaragod	70	11.86
	TOTAL	**590**	**100.00**

Source : Fisheries Department

Water Supply

Kerala water authority is an autonomous authority established for the development and regulation of water supply and waste water collection and disposal. Kerala Water Authority is the largest entity in the field of water supply and implemented thousands of small, medium and large urban and rural piped water supply schemes. The interaction between water and human health are indeed complex. Access to safe drinking water is a recognised Universal human need. Kerala Water Authority came into existence on Ist April 1984. Government of Kerala thousand of water supply schemes were implemented under the Panchayat System as well. The State also gets rain from the North-East monsoon during October to December and the South west monsoon during May to June. In early period the rural household for domestic water supply depends are traditional ground water system and rarely use piped water supply system and early used pipe water system.

With the high density of population, Industrialisation and rapid urbanisation on the one hard and the impact of climate change the availability of different user groups on the other climate condition of the earth has been changing over the few year. This will affect the weather condition of Kerala.

Ground Water

Ground water is one among the nations most important natural resources. Groundwater has been the main stay for meeting the domestic needs of more than 80 % of rural and 50% of urban population. The ground water level receding drastically during the summer months and drying up of wells are common features of the ground water levels in many parts of Kerala. The availability of the ground water level between the post and one monsoon levels varies widely. Kerala water authority is a autonomous authority established for the development and regulation of water supply and waste water collection and disposal. The National Water policy of the Govt. of India states that the non conventional method for utilisation of water such a through artificial recharge of ground water and traditional water conservation practices like rain water harvesting need to be practised to increase the utilisable water resources. In the past we used to depend more on surface water sources like rivers ponds and streams. But with depletion of water bodies due to extremes summer and other factors the peoples shifted our focus to ground water.

Jalanidhi Project

Jalanidhi is a project of Kerala Rural Water Supply Authority (KRWSA) which is aided by World Bank. The World Bank aided Jalanidhi scheme for rural water supply. It aims to assist Govt of Kerala in improving the quality of rural water supply and delivery of environmental sanitation services to achieve sustainability of investment. The KRWSA was launched as a nodal agency to facilitate the implementation of rural water supply systems. Jalanidhi – I Project completed during the year 2000-08 with the cost of Rs.381.50 crores had completed 3705 water supply schemes covering 112 Grama panchayaths. Consequent to the successful implementation of Jalanidhi-I, Govt of Kerala has decided to implement Jalanidhi -2 with world bank support Jalanidhi projects covers 112 Grama Panchayaths from all districts of Kerala.

Jalanidhi I & II water supply connection provided in domestic and non domestic purposes, 195928 and 175 connection respectively.

Dug wells are unlined boreholes and used for maximum height of free water over intake length. Piezometers are line bore holes used for measuring pressure of free water at intake depth. On the analysis of date related to ground water, the total number of dug wells is 428 but piezometers are 426. Kasargode has highest dug well at rate of 9%, but piezometers has highest in Thiruvananthapuram at rate of 10%.

KWA implement many schemes related to drinking water in the state. Schemes are divided into 2 streams namely urban water supply and rural water supply. Rural water supply schemes included multi Panchayath and single Panchayath. In rural water supply schemes ,single panchayath has 1067 connections . It is comparatively higher than multi Panchayath schemes and urban water supply schemes.

Table : 6.14 Summary of major components of Dynamic Ground Water Resources of Kerala

Sl. No.	District	Command/ non-command/ Total (Sq.Km)	Recharge from rainfall during monsoon season (Ha.m)	Recharge from other sources during monsoon season (Ha.m)	Recharge from rainfall during non monsoon season (Ha.m)	Recharge from other sources during non monsoon season (Ha.m)	Total Annual Ground Water Recharge (Ha.m)	Provision for natural discharge (Ha.m)	Net Annual Ground Water Availability (Ha.m)
1	Alappuzha	1414.03	30407.07	69.76	7300.06	10869.00	48645.90	3355.78	45290.11
2	Ernakulam	2368.50	42495.98	483.32	7949.93	13578.24	64499.47	6172.78	58326.69
3	Idukki	1031.86	16232.72	110.49	3118.92	2376.33	21838.47	2183.85	19654.62
4	Kannur	2346.28	45296.16	679.46	0.00	7255.89	53231.51	5218.87	48012.65
5	Kasargod	1630.67	31038.83	814.96	0.00	4689.82	36543.61	3654.36	32889.25
6	Kollam	2490.97	31964.73	166.33	10452.04	4172.48	46755.58	4534.58	42221.00
7	kottayam	2040.29	34779.52	133.05	7330.56	6938.94	49182.06	4611.98	44570.08
8	Kozhikkode	1674.83	36227.34	229.34	0.00	1447.19	37903.86	3441.58	34462.28
9	Malappuram	2453.62	40080.52	360.01	5590.17	8499.97	54530.67	4975.66	49555.00
10	Palakkad	3179.90	45501.18	1741.87	7769.01	30802.12	85814.18	7431.58	78382.60
11	Pathanamthitta	1319.77	18208.10	122.91	6125.56	3461.28	27917.85	2616.23	25301.62
12	Thiruvananthapuram	2207.87	24891.61	284.81	7438.60	2980.83	35595.85	2724.39	32871.46
13	Thrissur	2866.07	57151.20	1071.64	0.00	17282.13	75504.97	7352.16	68152.81
14	Wayanad	1055.89	30407.16	21.30	0.00	246.26	30674.72	3067.47	27607.25
	Total	**28087.54**	**484682.14**	**6289.26**	**63066.84**	**114600.47**	**668638.71**	**63341.27**	**607297.44**
	TOTAL in BCM		**4.85**	**0.06**	**0.63**	**1.15**	**6.69**	**0.61**	**6.07**

Source: Dynamic Ground Water Resources of Kerala (2011)

Table : 6.15 Annual Ground Water Recharge

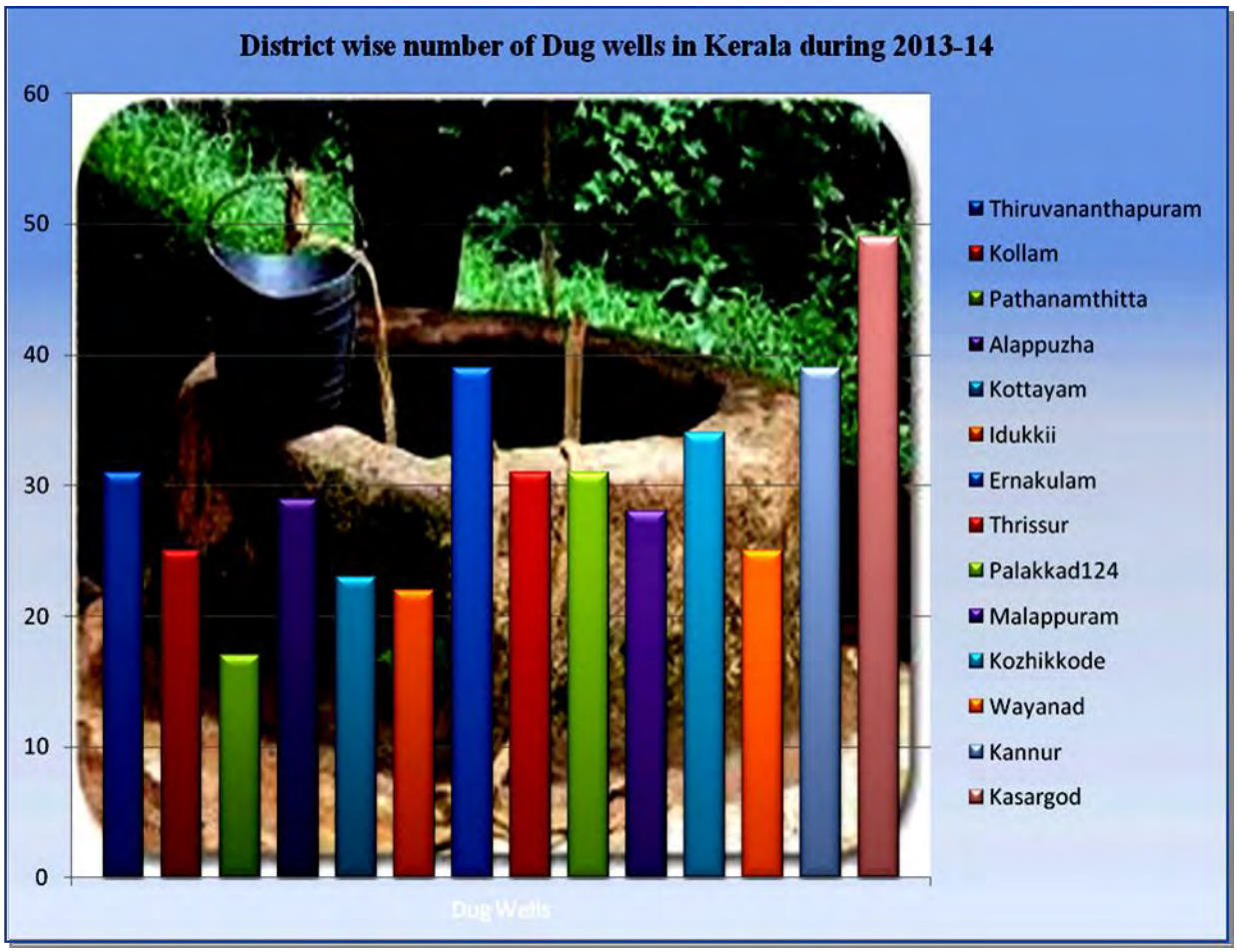
Sl. No	District	Net Annual Ground Water Availability (Ha.m)	Existing Gross Ground Water Draft for irrigation (Ha.m)	Existing Gross Ground Water Draft for domestic and industrial water supply	Existing Gross Ground water Draft for all uses (Ha.m)	Provision for Domestic and industrial requirement supply up to 2025 (Ha.m)	Net Ground Water availability for future irrigation development (Ha.m)	Stage of Ground Water Development (%)
1	Alappuzha	45290.11	2991.87	10040.47	13032.34	10372.60	31926.64	29
2	Ernakulam	58326.69	10308.49	13931.32	24239.82	15295.83	32722.37	42
3	Idukki	19654.62	2873.72	5495.94	8369.67	5985.33	10795.57	43
4	Kannur	48012.65	10943.33	10939.17	21882.50	11932.23	25137.09	46
5	Kasargod	32889.25	16704.82	6774.71	23479.53	7797.51	8386.91	71
6	Kollam	42221.00	4014.97	11932.86	15947.83	13015.56	25190.47	38
7	kottayam	44570.08	3490.69	9214.29	12704.99	10704.21	30375.18	29
8	Kozhikkode	34462.28	5200.40	14023.92	19224.32	15792.55	13469.33	56
9	Malappuram	49555.00	8166.41	20234.67	28401.08	24392.10	16996.50	57
10	Palakkad	78382.60	35494.33	13151.26	48645.59	14197.15	28894.24	62
11	Pathanamthitta	25301.62	3462.72	6004.47	9467.20	6304.40	15534.50	37
12	Thiruvananthapuram	32871.46	3984.99	13315.72	17300.71	14699.19	14187.28	53
13	Thrissur	68152.81	22167.50	13720.24	35887.73	15216.48	30768.84	53
14	Wayanad	27607.25	652.00	4318.70	4970	4815.96	22139.29	18
	KERALA STATE	**607297.44**	**130456.25**	**153097.75**	**283554.00**	**170520.00**	**306524.22**	**47**
	(BCM)	**6.07**	**1.31**	**1.53**	**2.84**	**1.71**	**3.07**	**47**

Source: Dynamic Ground Water Resources of Kerala (2011)

Table : 6.16 Ground Water Monitoring Wells in Kerala

Sl. No.	Districts	No. of GWMW		
		Dug Wells	Piezometers	Total
1	Thiruvananthapuram	31	41	72
2	Kollam	25	30	55
3	Pathanamthitta	17	30	47
4	Alappuzha	29	40	69
5	Kottayam	23	29	52
6	Idukki	22	25	47
7	Ernakulam	39	25	64
8	Thrissur	31	37	68
9	Palakkadu	31	37	68
10	Malappuram	28	30	58
11	Kozhikode	34	34	68
12	Wayanadu	25	19	44
13	Kannur	39	28	67
14	Kasargode	49	21	70
TOTAL		**423**	**426**	**849**

Source: Dynamic Ground Water Resources of Kerala (2011)


District wise number of Dug wells in Kerala during 2013-14
60
50
40
30
20
10
0
Dug Wells
Thiruvananthapuram
Kollam
Pathanamthitta
Alappuzha
Kottayam
Idukkii
Ernakulam
Thrissur
Palakkad124
Malappuram
Kozhikkode
Wayanad
Kannur
Kasargod

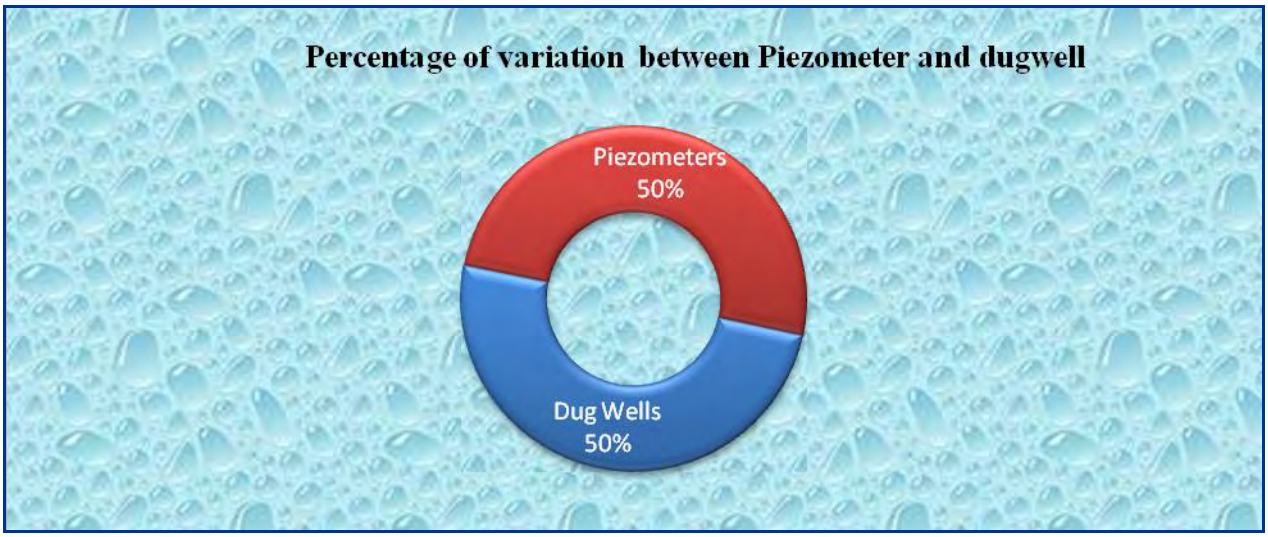

Percentage of variation between Piezometer and dugwell
Piezometers
50%
Dug Wells
50%

Table : 6.17 Physical achievements under Ground Water Development Schemes 2013-14

Sl. No.	Items	Unit	2009-10	2010-11	2011-12	2012-13	2013-14
1	2	3	4	5	6	7	8
1	Detailed Hydroligical Survey (Site Selection)		5969	5244	7174	8500	10134
2	Siting and providing technical assistance for open wells		862	496	916	966	904
3	Siting and construction of different types of drilled wells		1561	1162	1206	1240	2130
4	Creation of additional irrigation facilities						
5	Training of personnel		12 officers attend different training 3 officers attend DSS Planning		23 Officers attend various trainig	54 officers attended STP Training and 3 officers attended CGWB, 5 officers attended workshop on ground water prospect map.	17 officers attended training on procurement procedures at IMG.Trivandrum. 3 officers attend train ing on pump test at CGWB. Raipur, 30 Officers attened National Conference on safe drinking water at Ernakulam. Three officers attended workshop on aquifer mapping at Hydrabad. Six officers attended Workshop at CGWB Trivandrum
6	Water Sample analysis		3822	2900	3478	2952	4400

Source: Ground Water Department

Table : 6.18 District wise Population covered by Water Supply Scheme 2013-14

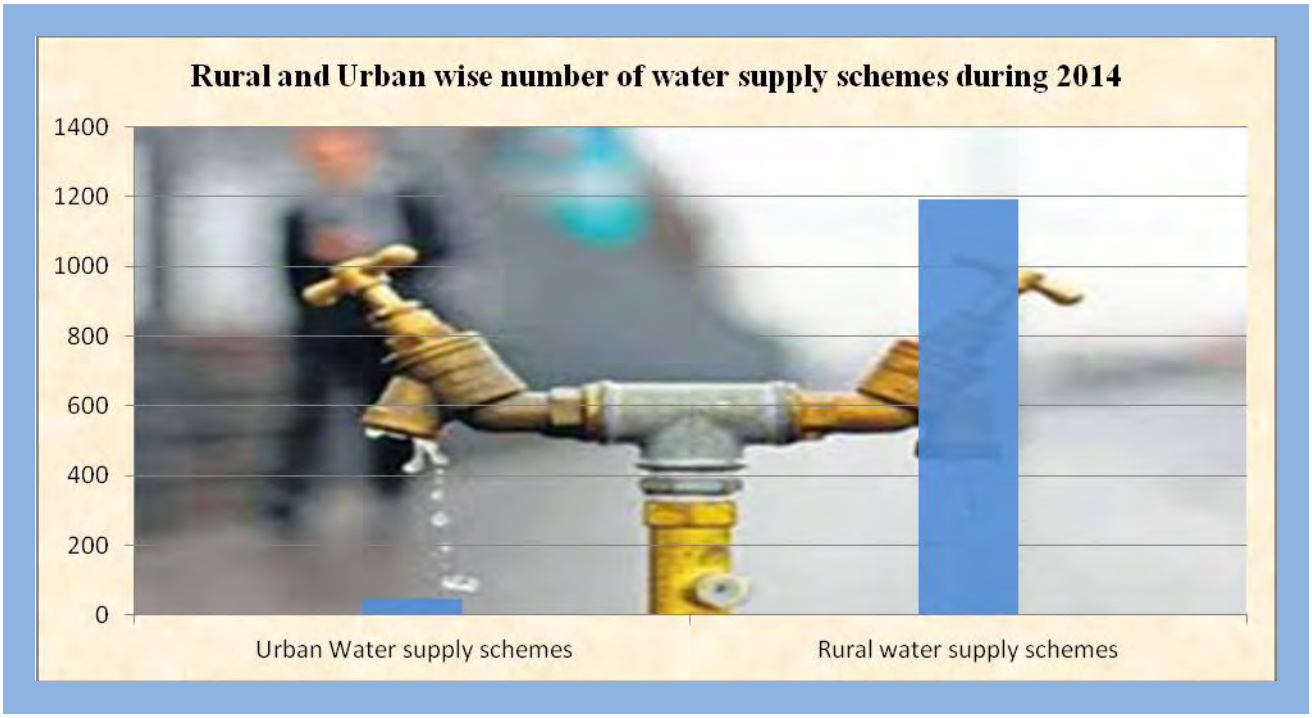
Sl. No.	District	Rural population covered	% to Total Rural population	Urban population covered	% to total Urban population	Total population covered	% to Total population
1	Thiruvananthapuram	873399	57.16	894797	50.29	1768196	53.46
2	Kollam	1094521	75.83	459269	38.71	1553790	59.09
3	Pathanamthitta	418636	39.34	74427	56.62	493063	41.24
4	Alappuzha	882521	90.52	201325	17.55	1083846	51.08
5	Kottayam	601652	42.56	167615	29.63	769267	38.86
6	Idukki	241518	22.88	28161	54.13	269679	24.35
7	Ernakulam	1915185	182.87	760707	34.07	2675892	81.59
8	Thrissur	994509	97.45	445235	21.31	1439744	46.29
9	Palakkad	765479	35.88	245035	36.18	1010514	35.95
10	Malappuram	863377	37.63	165727	9.12	1029104	25.03
11	Kozhikode	500477	49.32	516655	24.9	1017132	32.92
12	Wayanad	430576	54.85	11659	36.92	442235	54.16
13	Kannur	587210	66.52	158179	9.63	745389	29.51
14	Kasargode	197782	24.80	34975	6.92	232757	17.87
	Total	10366842	59.39	4163766	26.13	14530608	43.52

Source: Kerala Water Authority

Table : 6.19 District and Category wise Number of Water Supply scheme KWA in operation 2013-14

Sl.No.	Name of District	No.of Urban Water supply schemes	Rural water supply schemes		Total
			Multi panchayat	Single panchayat	
1	Thiruvananthapuram	6	10	94	110
2	Kollam	3	5	66	74
3	Pathanamthitta	2	8	63	73
4	Alappuzha	4	1	61	66
5	Kottayam	5	21	84	110
6	Idukki	1	11	89	101
7	Ernakulam	8	17	82	107
8	Thrissur	4	7	104	115
9	Palakkad	4	8	84	96
10	Malappuram	5	10	42	57
11	Kozhikode	2	12	87	101
12	Wayanad	0	5	25	30
13	Kannur	3	5	109	117
14	Kasargode	1	5	77	83
	Total	**48**	**125**	**1067**	**1240**

Source: Kerala Water of Authority


Rural and Urban wise number of water supply schemes during 2014
1400
1200
1000
800
600
400
200
0
Urban Water supply schemes
Rural water supply schemes

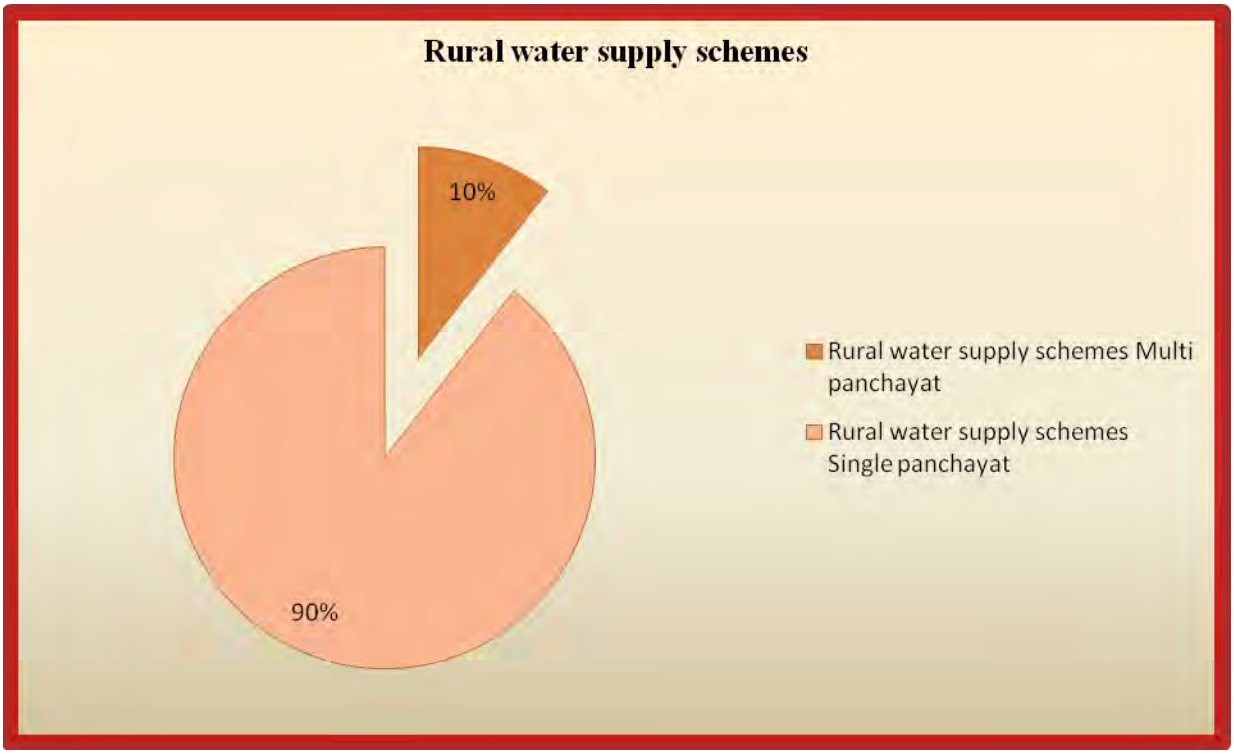

Rural water supply schemes
10%
90%
Rural water supply schemes Multi panchayat
Rural water supply schemes Single panchayat

Table : 6.20 District wise details of water supply connections and street Taps 2013-14

Sl. No.	District	Water Supply connection				Street taps		
		Domestic	Non-Domestic	Industrial	Total	Panchayat	Corporation / Muncipality	Total
1	Thiruvananthapuram	250683	35819	102	286604	12449	5615	18064
2	Kollam	131523	6257	198	137978	14716	4770	19486
3	Pathanamthitta	61820	2820	36	64676	10567	1550	12117
4	Alappuzha	132809	4396	184	137389	22967	4422	27389
5	Kottayam	75654	5419	75	81148	7599	2096	9695
6	Idukki	22054	1997	5	24056	3276	532	3808
7	Ernakulam	352167	25606	220	377993	29791	9286	39077
8	Thrissur	135554	4967	46	140567	22055	5370	27425
9	Palakkad	106067	6707	82	112856	13744	3214	16958
10	Malappuram	62769	3698	9	66476	7255	2331	9586
11	Kozhikode	59963	4105	28	64096	4516	3525	8041
12	Wayanad	13340	1325	3	14668	4216	222	4438
13	Kannur	42932	5342	77	48351	5582	1632	7214
14	Kasargode	17141	994	10	18145	3170	599	3769
	Total	**1464476**	**109452**	**1075**	**1575003**	**161903**	**45164**	**207067**

Source: Kerala Water of Authority

Table : 6.21 District wise & category wise number of ongoing water supply schemes during 2013-14

Name of District	Number of ongoing Water Supply schemes (including Major and Minor water supply schemes)																Total
	Rural water supply schemes										Urban water supply schemes						
	NRDWP	Technology Mission	TRP schemes funded by Govt	State Plan	SAARK (2010-11)	New Water Supply Schemes (2013-14)	NABARD	Externally Assisted (JICA)	Deposit works of KWA (For schemes of local bodies/other agencies)	Saark (2009-10) New capital schemes	Completion of ongoing UWSS-special package	Externally Assisted (JICA)	JNNURM	SAARK (2009-10) Replacement of old pipes.	UIDSSMT	Bank	
Thiruvananthapuram	17	-	Completed	4	-	-	4	-	73	1	2	1	1	Now taken under new head-Replacement of old and obsolete pipe	-	-	103
Kollam	11	-		0	-	-	1	1	60	-	-	-	-		-	-	73
Pathanamthitta	20	-		1	-	-	1	-	131	-	-	-	-		-	-	153
Alappuzha	8	1		1	-	-		-	25	-	-	-	-		1	-	36
Kottayam	25	-		6	-	-	1	-	50	1	-	-	-		2	-	85
Idukki	21	-		-	-	-	1	-	18	-	-	-	-		-	-	40
Ernakulam	14	-		-	-	-	1	-	385	-	1	-	1		-	-	402
Thrissur	6	-		-	1	-	3	-	326	-	5	-	-		2	-	343
Palakkad	14	1		-	-	-	2	-	39	-	1	-	-		2	-	59
Malappuram	24	-		-	3	-	2	-	134	-	-	-	-		2	-	165
Kozhikode	16	1		1	-	-	1	-	56	-	-	1	-		1	-	77
Wayanad	3	-		-	-	-	3	-	29	-	-	-	-		1	-	36
Kannur	9	-		-	1	-		1	96	-	3	-	-		2	-	112
Kasargode	7	-		-		-	6	-	51	-	-	-	-		-	-	64
Total	**195**	**3**		**13**	**5**	**0**	**26**	**2**	**1473**	**2**	**12**	**2**	**2**		**13**	**0**	**1748**

Source: Water Authority of Kerala

Table : 6.22 District wise Distribution of KWA Transferred to Local Bodies 2013-14

Sl. No.	District	No. of Schemes (Rural)		Total	Population Coverage
		From the list of 1050 schemes	From other than the list of 1050 schemes		
1	Thiruvananthapuram	2	0	2	33667
2	Kollam	2	0	2	3950
3	Pathanamthitta	0	0	0	0
4	Alappuzha	0	0	0	0
5	Kottayam	4	5	9	8710
6	Idukkii	9	0	9	32400
7	Ernakulam	20	24	44	61630
8	Thrissur	1	0	1	1500
9	Palakkad	69	56	125	434300
10	Malappuram	45	58	103	264643
11	Kozhikkode	54	66	120	163315
12	Wayanad	11	3	14	42645
13	Kannur	7	2	9	5100
14	Kasargod	14	25	39	28700
	Total	**238**	**239**	**477**	**1080560**

Source: Water Authority of Kerala

Table : 6.23 Jalanidhi I & II On Going water supply schemes 2013-14

Sl. No.	District	Rural water supply schemes		
		Spread between more than one panchayath	One panchayath	Total
1.	Thiruvananthapuram	-	85	85
2.	Kollam	1	60	61
3.	Pathanamthitta	-	62	62
4.	Alappuzha	-	0	0
5.	Kottayam	-	142	142
6.	Idukki	-	106	106
7.	Ernakulam	-	49	49
8.	Thrissur	-	527	527
9.	Palakkad	-	683	683
10.	Malappuram	-	880	880
11.	Kozhikode	-	738	738
12.	Wayanad	-	144	144
13.	Kannur	-	182	182
14.	Kasargode	-	201	201
	Total	**1**	**3859**	**3860**

Source: Kerala Rural Water Supply and Sanitation Agency

Table : 6.24 Jalanidhi I&II District wise Population covered by of water supply schemes 2013-14

Sl. No.	District	Rural Population covered	Total rural population as per 2011 Census	% of Total rural population
1	Thiruvanathapuram	17746	1528030	1.16
2	Kollam	11581	1443363	7.76
3	Pathanamthitta	13746	1064076	1.29
4	Alappuzha	0	974916	0.00
5	Kottayam	30885	1413773	2.18
6	Idukki	17071	1055423	1.62
7	Ernakulam	11964	1047296	1.14
8	Thrissur	153894	1020537	15.08
9	Palakkad	200280	2133699	9.39
10	Malappuram	272471	2294473	11.88
11	Kozhikode	155598	1014765	15.33
12	Wayanad	41002	784981	5.22
13	Kannur	28783	882745	3..26
14	Kasargode	35767	797424	4.49
	Total	**1090788**	**17455501**	**6.25**

Source: Kerala Rural Water Supply and Sanitation Agency

Table : 6.25 Jalanidhi I & II Water Supply Connections and Public Taps 2013-14

Sl. No.	No. of water supply connections					
	District	Domestic	Non Domestic	Industrial	Public Taps	Total
1.	Thiruvananthapuram	3227	1	0		3228
2.	Kollam	20285	0	0		20285
3.	Pathanamthitta	2518	0	0		2518
4.	Alappuzha	0	0	0	0	0
5.	Kottayam	5941	2	0		5943
6.	Idukki	3190	0	0		3190
7.	Ernakulam	2173	8	0		2181
8.	Thrissur	25655	9	0	7	25671
9.	Malappuram	49522	87	0		49609
10.	Kozhikode	28510	25	0		28535
11.	Palakkad	35205	31	0	680	35916
12.	Wayanad	7460	1	0	60	7521
13.	Kannur	5262	11	0		5273
14.	Kasargode	6980	0	0		6980
	Total	**195928**	**175**	**0**	**747**	**196850**

Source: Kerala Rural Water Supply and Sanitation Agency

Table : 6.26 Location of Drinking Water Source

Sl. No.	District	Within Premises			Near Premises			Away premises		
		Rural	Urban	Total	Rural	Urban	Total	Rural	Urban	Total
1	Thiruvananthapurm	82.1	86.1	84.2	1.7	8.6	10.1	6.2	5.3	5.7
2	Kollam	85	86.6	85.7	9.5	10	9.7	5.4	3.4	4.6
3	Pathanamthitta	78.9	86.1	79.7	12.2	8.5	11.8	8.9	5.4	8.5
4	Alappuzha	70	75.1	72.7	17.9	14.3	16	12.1	10.6	11.3
5	Kottayam	69.8	80.8	72.9	16.1	12.2	15	14.1	7	12.1
6	Idukki	39.5	83.7	41.4	32.4	10.3	31.4	28.2	6	27.2
7	Ernakulam	78.1	81.3	80.03	14.8	14.9	14.9	7.1	3.7	4.8
8	Thrissur	80.3	85.5	83.8	13.8	10.5	11.6	5.9	4	4.6
9	Palakkad	69.3	79.2	71.7	21.1	15.8	19.8	9.6	5	8.5
10	Malappuram	78.5	84.7	81.2	13.8	10.3	12.3	7.7	5.1	6.5
11	Kozhikode	74	82	79.3	14.1	11.8	12.6	11.9	6.2	8.1
12	Wayanad	59.7	74.1	60.2	23.8	18.8	23.7	16.5	7.2	16.1
13	Kannur	73.1	85.7	81.1	15	9.8	11.7	11.9	4.5	7.2
14	Kasaragode	65.9	84.7	73	18.2	9.9	15.1	15.9	5.4	11.9
	Kerala	**72.9**	**83.3**	**77.7**	**16.3**	**11.5**	**14.1**	**10.8**	**5.2**	**8.2**
	India	**35**	**71.2**	**46.6**	**42.9**	**20.7**	**35.8**	**21.1**	**8.1**	**17.6**

Source: Housing census 2011

Table : 6.27 Drinking Water Availability in Kerala – Source wise

Sl.No.	District	Within premises	Near premises	Away
1	Thiruvananthapuram	84	10	6
2	Kollam	86	10	5
3	Pathanamthitta	80	12	9
4	Alappuzha	73	16	11
5	Kottayam	73	15	12
6	Idukki	41	31	27
7	Ernakulam	80	15	5
8	Thrissur	84	12	5
9	Palakkadu	72	20	9
10	Malappuram	81	12	7
11	Kozhikode	79	13	8
12	Wayanadu	60	24	16
13	Kannur	81	12	7
14	Kasargod	73	15	12
	Kerala	**78**	**14**	**8**
	India	**47**	**36**	**18**

Source: Housing census 2011

CHAPTER - VII

Human Settlement

Density of population in the State is 819 during 2001 census and 860 in 2011 census. It shows that the density of population has increased at last decades. Similarly, the population of Kerala has increased from 31841374 in 2001 census to 33406061 in 2011 census increased by 4.68%. The analysis of population growth rate indicates that Kerala is likely to achieve zero population growth in 25 to 30 years. The low population growth rate with high level of urbanisation will increase the scarcity of labour in agriculture and in otherside depletion of natural resources due to industrialization and infrastructure development activities. Migration of rural to urban area further added pressure to the urban centres for meeting adequate food, water and sewerage needs. Most of the migration to Urban area is due to search of employment opportunities and better facilities available in urban area.

The rural population in Kerala as per 2011 census is 17471135 in which the male population is 84080547 and the female population is 9063081. Out of 15934926 urban population, male population is 7619358 and female population is 8315568 which constituted 52.29% population rural area and 47.70% population in urban area respectively.

Population Census

As per population census 2011 the total population of Kerala is 33406061 of which male and female are 16027412 and 17378649 respectively. The most populated district in Kerala is Malappuram in which 4112920 followed by Thiruvananthapuram is 3301427. As per the projected figure of population in 2014 Kerala is 33941670 of which male population is 16284385 and female population is 17657285. Age is one of the most important characteristics of population composition. The age groups 0-14 and above 65+ are economically inactive population. 10.77% of the State population is dependent and 68.13% of population is considered as working age population and they are economically active.

Table : 7.1 Profile of Kerala State 2013-14

Sl. No	District	Total Land Area (Sq.km)	Number of Villages	Population (Lakhs)	Literacy Rate (%)	Cropped Area (in 000 Ha.)	% of SMF*	Inter-State Rivers	Normal Annual Rainfall (mm)
1	2	3	4	5	6	7	8	9	10
1	Thiruvananthapuram	2192	121	33.01	93.02	155065	100	0	1803.1
2	Kollam	2492	104	26.35	94.09	161466	75	3	2491.1
3	Pathanamthitta	2637	68	11.97	96.55	99719	75	0	2957
4	Alappuzha	1414	91	21.28	95.72	219100	95	0	2840.5
5	Kottayam	4358	64	19.74	97.21	15522	70	0	2931
6	Idukki	2208	95	11.09	91.99	51652	80	0	3303.1
7	Ernakulam	3068	124	32.82	95.89	7731	72	0	3028.7
8	Thrissur	3032	254	31.21	95.08	1700.57	74	2	3063.8
9	Palakkadu	4480	156	28.1	89.31	31471	100	0	2288.1
10	Malappuram	3550	135	41.13	93.57	18784	100	1	2835.1
11	Kozhikode	2344	117	30.86	95.08	300	50	0	3383.8
12	Wayanadu	2132	49	8.17	89.03	207930	80	4	3250.9
13	Kannur	2966	126	25.26	95.10	226570	96	0	318.7
14	Kasargod	1991.66	127	13.07	90.09	140757	99	8	3619.9
	Kerala	**38865**	**1634**	**334**	**93.70**	**1337768**	**83.29**	**18**	**2924.30**

Source: Agricultural Department

Table : 7.2 District wise Population

Sl. No.	Districts	Census 2011			
		Male	Female	Population	Ratio
1.	Thiruvananthapuram	1581678	1719749	3301427	1088
2.	Kollam	1246968	1388407	2635375	1113
3.	Pathanamthitta	561716	635696	1197412	1129
4.	Alappuzha	1013142	1114647	2127789	1100
5.	Kottayam	968289	1006262	1974551	1040
6.	Idukki	552808	556166	1108974	1006
7.	Ernakulam	1619557	1662831	3282388	1028
8.	Thrissur	1480763	1640437	3121200	1109
9.	Palakkad	1359478	1450456	2809934	1067
10.	Malappuram	1960328	2152592	4112920	1096
11.	Kozhikode	1470942	1615351	3086293	1097
12.	Wayanad	401684	415736	817420	1035
13.	Kannur	1181446	1341557	2523003	1133
14.	Kasaragode	628613	678762	1307375	1079
	Kerala	**16027412**	**17378649**	**33406061**	**1084**

Source: Census 2011

Table : 7.3 Gender wise Population

Sl. No.	District	Rural /Urban	Total Population	Male	Female
1.	Thiruvananthapuram	Total	3301427	1581678	1719749
		Rural	1529831	724864	804967
		Urban	1771596	856814	914782
2.	Kollam	Total	2635375	1246968	1388407
		Rural	1448217	680687	767530
		Urban	1187158	566281	620877
3.	Pathanamthitta	Total	1197412	561716	635696
		Rural	1065799	499820	565979
		Urban	131613	61896	69717
4.	Alappuzha	Total	535958	1013142	1114647
		Rural	248616	464713	514930
		Urban	287342	548429	599717
5.	Kottayam	Total	1974551	968289	1006262
		Rural	1409158	692673	716485
		Urban	565393	275616	289777
6.	Idukki	Total	1108974	552808	556166
		Rural	156929	527245	529684
		Urban	52045	25563	26482
7.	Ernakulam	Total	3282388	1619557	1662831
		Rural	1048025	51851	529515
		Urban	2234363	1101047	1133316
8.	Thrissur	Total	3121200	1480763	1640437
		Rural	1024794	488303	536491
		Urban	2096406	992460	1103946
9.	Palakkad	Total	2809934	1359478	1450456
		Rural	2133124	1031466	1101658
		Urban	676810	328012	348798
10.	Malappuram	Total	4112920	1960328	2152592
		Rural	2295709	1095308	1200401
		Urban	1817211	865020	952191
11.	Kozhikode	Total	3086293	1470942	1615351
		Rural	1013721	484784	528937
		Urban	2072572	986158	1086414
12.	Wayanad	Total	817420	401684	415736
		Rural	785840	386283	399557
		Urban	31580	15401	16179
13.	Kannur	Total	2523003	1181446	1341557
		Rural	882017	425682	456335
		Urban	1640986	755764	885222
14.	Kasaragod	Total	1307375	628613	678762
		Rural	798328	387716	410612
		Urban	509047	240897	268150
	KERALA	**Total**	**33406061**	**16027412**	**17378649**
		Rural	**17471135**	**8408054**	**9063081**
		Urban	**15934926**	**761935**	**8315568**

Source: Census 2011

Table : 7.4 Density of Population(per Sq.Km) by residence : 2001-2011			
Sl. No.	State /Districts	Density of Population (Per Sq .Km) - 2001	Density of Population (Per Sq .Km) - 2011
1	Thiruvananthapuram	1476	1508
2	Kollam	1038	1061
3	Pathanamthitta	468	452
4	Alappuzha	1492	1504
5	Kottayam	885	895
6	Idukki	259	255
7	Ernakulam	1012	1072
8	Thrissur	981	1031
9	Palakkad	584	627
10	Malappuram	1021	1157
11	Kozhikode	1228	1316
12	Wayanad	366	384
13	Kannur	812	852
14	Kasaragod	604	657
	Total	**819**	**860**

Table : 7.5 District wise Sex-Ratio from 1901-2011

Sl. No.	State/Districts	Sex-ratio (Number of Females per 1000 Males)											
		1901	1911	1921	1931	1941	1951	1961	1971	1981	1991	2001	2011
1	Thiruvananthapuram	996	990	981	1003	1017	1010	1005	1008	1030	1036	1060	1087
2	Kollam	987	988	989	1006	1013	997	996	1000	1022	1035	1069	1113
3	Pathanamthitta	986	987	949	975	986	996	1011	1019	1056	1062	1094	1132
4	Alappuzha	986	987	986	997	1003	1022	1026	1025	1043	1051	1079	1100
5	Kottayam	965	969	947	966	966	987	988	991	1001	1003	1025	1039
6	Idukki	839	842	850	834	875	909	914	937	963	975	993	1006
7	Ernakulam	985	990	969	994	994	1008	999	988	997	1000	1019	1027
8	Thrissur	1004	1009	1051	1075	1082	1105	1093	1081	1100	1085	1092	1108
9	Palakkad	1042	1057	1069	1079	1079	1085	1077	1056	1056	1061	1066	1067
10	Malappuram	1017	1020	1037	1059	1062	1055	1057	1041	1052	1053	1066	1098
11	Kozhikode	1009	1022	1038	1032	1044	1019	1007	1004	1020	1027	1057	1098
12	Wayanad	805	815	786	804	835	838	903	922	949	966	995	1035
13	Kannur	1060	1079	1121	1106	1110	1074	1048	1033	1040	1049	1090	1136
14	Kasaragod	1060	1053	1050	1040	1039	1046	1026	998	1020	1026	1047	1080
	Total	**1004**	**1008**	**1011**	**1022**	**1027**	**1028**	**1022**	**1016**	**1032**	**1036**	**1058**	**1084**

Source: Census of India

Table : 7.6 Population Rural and Urban break-up – 2011 Census

Sl. No.	State /District	Total Population	Rural			Urban		
			Male	Female	Total	Male	Female	Total
1	Thiruvananthapuram	3301427	724864	804967	1529831	856814	914782	1771596
2	Kollam	2635375	680687	767530	1448217	566281	620877	1187158
3	Pathanamthitta	1197412	499820	565979	1065799	61896	69717	131613
4	Alappuzha	2127789	464713	514930	979643	548429	599717	1148146
5	Kottayam	1974551	692673	716485	1409158	275616	289777	565393
6	Idukki	1108974	527245	529684	1056929	25563	26482	52045
7	Ernakulam	3282388	518510	529515	1048025	1101047	1133316	2234363
8	Thrissur	3121200	488303	536491	1024794	992460	1103946	2096406
9	Palakkad	2809934	1031466	1101658	2133124	328012	348798	676810
10	Malappuram	4112920	1095308	1200401	2295709	865020	952191	1817211
11	Kozhikode	3086293	484784	528937	1013721	986158	1086417	2072575
12	Wayanad	817420	386283	399557	785840	15401	16179	31580
13	Kannur	2523003	425682	456335	882017	755764	885222	1640986
14	Kasaragode	1307375	387716	410612	798328	240897	268150	509047
	Total	**33406061**	**8408054**	**9063081**	**17471135**	**7619358**	**8315568**	**15934926**

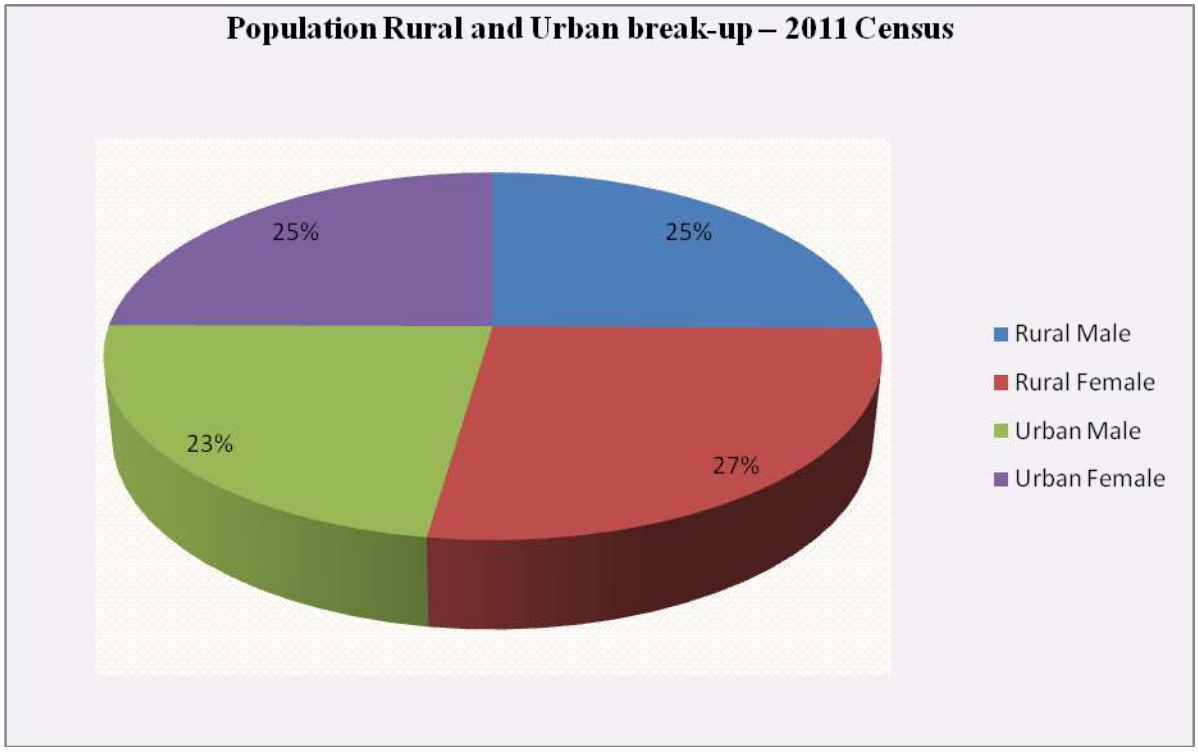

Population Rural and Urban break-up – 2011 Census
25%
25%
23%
27%
Rural Male
Rural Female
Urban Male
Urban Female

Table : 7.7 District wise Population in 5 yr age group - 2011 Census (General Category)										
Sl. No.	State/Districts	All ages			0-4			5-9		
		Total	Male	Female	Total	Male	Female	Total	Male	Female
1	Thiruvananthapuram	3301427	1581678	1719749	216891	110287	106604	227143	115487	111656
2	Kollam	2635375	1246968	1388407	178550	90349	88201	192036	97758	94278
3	Pathanamthitta	1197412	561716	635696	67294	34022	33272	76061	38863	37198
4	Alappuzha	2127789	1013142	1114647	134233	68661	65572	146499	75050	71449
5	Kottayam	1974551	968289	1006262	120699	61477	59222	137235	69895	67340
6	Idukki	1108974	552808	556166	73798	37443	36355	81682	41740	39942
7	Ernakulam	3282388	1619557	1662831	214713	109407	105306	226293	115494	110799
8	Thrissur	3121200	1480763	1640437	213202	109165	104037	213202	109165	104037
9	Palakkad	2809934	1359478	1450456	214550	108923	105627	219514	111856	107658
10	Malappuram	4112920	1960328	2152592	410106	208636	201470	407354	207693	199661
11	Kozhikode	3086293	1470942	1615351	236427	119951	116476	247158	125979	121179
12	Wayanad	817420	401684	415736	65082	33062	32020	69746	35656	34090
13	Kannur	2523003	1181446	1341557	196829	99755	97074	196829	99755	97074
14	Kasaragode	1307375	628613	678762	110718	56396	54322	110107	56329	53778
	Total	**33406061**	**16027412**	**17378649**	**2453092**	**1247534**	**1205558**	**2555112**	**1303190**	**1251922**

Table : 7.8 District wise population in 5 yr age group - 2011 Census(General Category)										
Sl. No.	State/Districts	10-14			15-19			20-24		
		Total	Male	Female	Total	Male	Female	Total	Male	Female
1	Thiruvananthapuram	263246	134006	129240	255313	128688	126625	266969	128374	138595
2	Kollam	212437	108388	104049	194497	98395	96102	199854	95208	104646
3	Pathanamthitta	89315	45295	44020	84509	43388	41121	82770	41860	40910
4	Alappuzha	165547	84279	81268	147508	75552	71956	146758	72479	74279
5	Kottayam	155915	79113	76802	138696	72099	66597	129329	68170	61159
6	Idukki	91858	46763	45095	79704	40943	38761	81667	41758	39909
7	Ernakulam	252209	128742	123467	229573	118577	110996	235855	121109	114746
8	Thrissur	250700	127773	122927	239833	121875	117958	239355	116293	123062
9	Palakkad	244128	123988	120140	228471	115748	112723	246144	119819	126325
10	Malappuram	424031	216411	207620	393009	198452	194557	406877	194357	212520
11	Kozhikode	266107	136111	129996	245547	125167	120380	246515	116838	129677
12	Wayanad	77418	39481	37937	63919	32424	31495	66417	31936	34481
13	Kannur	207988	106226	101762	195500	99226	96274	199663	94983	104680
14	Kasaragode	121871	62341	59530	114473	57765	56708	117636	55642	61994
	Total	**2822770**	**1438917**	**1383853**	**2610552**	**1328299**	**1282253**	**2665809**	**1298826**	**1366983**

Table : 7.9 District wise population in 5 yr age group - 2011 Census (General Category)										
Sl. No.	State/Districts	25-29			30-34			35-39		
		Total	Male	Female	Total	Male	Female	Total	Male	Female
1	Thiruvananthapuram	258879	120193	138686	245395	114711	130684	257169	117565	139604
2	Kollam	199985	89590	110395	195866	88041	107825	210925	93671	117254
3	Pathanamthitta	79258	36071	43187	78280	34401	43879	87475	37466	50009
4	Alappuzha	150967	69517	81450	153465	70438	83027	168866	75029	93837
5	Kottayam	129779	63724	66055	132945	63546	69399	152837	71558	81279
6	Idukki	85747	43333	42414	83361	41198	42163	94420	45273	49147
7	Ernakulam	238325	116775	121550	239287	116713	122574	262692	124545	138147
8	Thrissur	226434	103198	123236	217204	97933	119271	242166	106832	135334
9	Palakkad	242415	116092	126323	211243	100653	110590	217268	99958	117310
10	Malappuram	364628	164498	200130	300552	132859	167693	281541	121166	160375
11	Kozhikode	245890	109469	136421	234874	104571	130303	242221	106829	135392
12	Wayanad	70224	33366	36858	65644	31334	34310	67856	32250	35606
13	Kannur	197603	86704	110899	195261	85303	109958	194385	84138	110247
14	Kasaragode	113958	51448	62510	102124	46516	55608	99852	45539	54313
	Total	**2604092**	**1203978**	**1400114**	**2455501**	**1128217**	**1327284**	**2579673**	**1161819**	**1417854**

Table : 7.10 District wise population in 5 yr age group - 2011 Census (General Category)										
Sl. No.	State/Districts	40-44			45-49			50-54		
		Total	Male	Female	Total	Male	Female	Total	Male	Female
1	Thiruvananthapuram	241071	110566	130505	245603	114946	130657	202305	96880	105425
2	Kollam	194318	87448	106870	194136	89847	104289	159033	75188	83845
3	Pathanamthitta	88083	38251	49832	92323	41026	51297	79426	36511	42915
4	Alappuzha	163706	74902	88804	162485	75544	86941	134926	63861	71065
5	Kottayam	156328	75162	81166	154192	74632	79560	132330	65223	67107
6	Idukki	88118	43562	44556	86264	42405	43859	72116	36153	35963
7	Ernakulam	266293	130357	135936	256448	126876	129572	215067	107761	107306
8	Thrissur	239311	110044	129267	233160	109457	123703	194664	92929	101735
9	Palakkad	188881	89633	99248	185219	89055	96164	145372	71048	74324
10	Malappuram	241469	106628	134841	217799	98035	119764	172496	82690	89806
11	Kozhikode	222484	102379	120105	210002	98203	111799	170780	82899	87881
12	Wayanad	57693	28496	29197	55397	27117	28280	42987	21742	21245
13	Kannur	179536	80011	99525	172802	78840	93962	142427	66823	75604
14	Kasaragode	85207	39985	45222	82700	39615	43085	64216	31483	32733
	Total	**2412498**	**1117424**	**1295074**	**2348530**	**1105598**	**1242932**	**1928145**	**931191**	**996954**

Table : 7.11 District wise population in 5 yr age group - 2011 Census (General Category)										
Sl. No.	State/Districts	55-59			60-64			65-69		
		Total	Male	Female	Total	Male	Female	Total	Male	Female
1	Thiruvananthapuram	188288	92084	96204	147631	70801	76830	108793	51008	57785
2	Kollam	151920	74390	77530	117038	56968	60070	85527	39780	45747
3	Pathanamthitta	78078	37255	40823	64733	31189	33544	48508	22448	26060
4	Alappuzha	128419	62876	65543	107060	51767	55293	73923	34042	39881
5	Kottayam	120629	60260	60369	97534	47795	49739	70803	33301	37502
6	Idukki	60796	31521	29275	42600	21778	20822	30790	14248	16542
7	Ernakulam	192149	97746	94403	149443	73548	75895	103428	48357	55071
8	Thrissur	168923	82900	86023	142384	67432	74952	99052	44405	54647
9	Palakkad	130083	63772	66311	113415	53287	60128	81894	37059	44835
10	Malappuram	148036	73341	74695	124191	60432	63759	87856	39659	48197
11	Kozhikode	154449	77249	77200	127863	63245	64618	86813	39360	47453
12	Wayanad	36277	18451	17826	28307	14181	14126	19045	8801	10244
13	Kannur	129416	62516	66900	108136	51107	57029	73238	32424	40814
14	Kasaragode	54945	27166	27779	44336	21606	22730	32464	14340	18124
	Total	**1742408**	**861527**	**880881**	**1414671**	**685136**	**729535**	**1002134**	**459232**	**542902**

Table : 7.12 District wise population in 5 yr age group - 2011 Census (General Category)													
Sl. No.	State/ Districts	70-74			75-79			80+			Age not specified		
		Total	M	F	Total	M	F	Total	M	F	Total	M	F
	Kerala	**733372**	**326562**	**406810**	**501367**	**208317**	**293050**	**541849**	**204348**	**337501**	**34486**	**17297**	**17189**
1	Kasaragode	22162	9802	12360	14054	5958	8096	14798	5745	9053	1754	937	817
2	Kannur	55799	24181	31618	38295	15248	23047	40770	14743	26027	5761	2935	2826
3	Wayanad	12686	5737	6949	8542	3524	5018	9482	3741	5741	698	385	313
4	Kozhikode	60549	27251	33298	41629	17021	24608	44026	16860	27166	2959	1560	1399
5	Malappuram	57916	25771	32145	36779	15070	21709	35037	13043	21994	3243	1587	1656
6	Palakkad	59901	26530	33371	39364	16215	23149	38937	14287	24650	3135	1555	1580
7	Thrissur	77623	32997	44626	53997	21454	32543	55539	19501	36038	2963	1468	1495
8	Ernakulam	79552	35457	44095	55915	23493	32422	62456	23351	39105	2690	1249	1441
9	Idukki	22129	10163	11966	15168	6518	8650	17872	7510	10362	884	499	385
10	Kottayam	54951	25011	29940	40020	17062	22958	48781	19500	29281	1548	761	787
11	Alappuzha	56333	24960	31373	39785	16557	23228	45145	16581	28564	2164	1047	1117
12	Pathanamthitta	37326	17014	20312	28439	12294	16145	34377	13761	20616	1157	601	556
13	Kollam	61775	27341	34434	40849	17021	23828	44823	16696	28127	1806	889	917
14	Thiruvananthapuram	74670	34347	40323	48531	20882	27649	49806	19029	30777	3724	1824	1900

'F'- Femal, 'M' - Male

Table : 7.13 Age Wise, Sex Wise Population 2011 & Mid Year 2014						
Age group	2011 Census Population			Mid year population 2014		
	Male	Female	Total	Male	Female	Total
0-4	1247534	1205558	2453092	1267536	1224888	2492424
5to9	1303190	1251922	2555112	1324085	1271993	2596078
10to14	1438917	1383853	2822770	1461988	1406040	2868028
15to19	1328299	1282253	2610552	1349595	1302813	2652408
20to24	1298826	1366983	2665809	1319650	1388901	2708551
25to29	1203978	1400114	2604092	1223282	1422562	2645844
30to34	1128217	1327284	2455501	1146307	1348564	2494871
35to39	1161819	1417854	2579673	1180447	1440587	2621034
40to44	1117424	1295074	2412498	1135340	1315838	2451178
45to49	1105598	1242932	2348530	1123325	1262859	2386184
50to054	931191	996954	1928145	946121	1012939	1959060
55to59	861527	880881	1742408	875340	895004	1770344
60to64	685136	729535	1414671	696121	741232	1437353
65to69	459232	542902	1002134	466595	551606	1018201
70to74	326562	406810	733372	331797	413333	745130
75to79	208317	293050	501367	211657	297748	509405
above80	204348	337501	541849	207624	342913	550537
age not stated	17297	17189	34486	17575	17465	35040
TOTAL	16027412	17378649	33406061	16284385	17657285	33941670

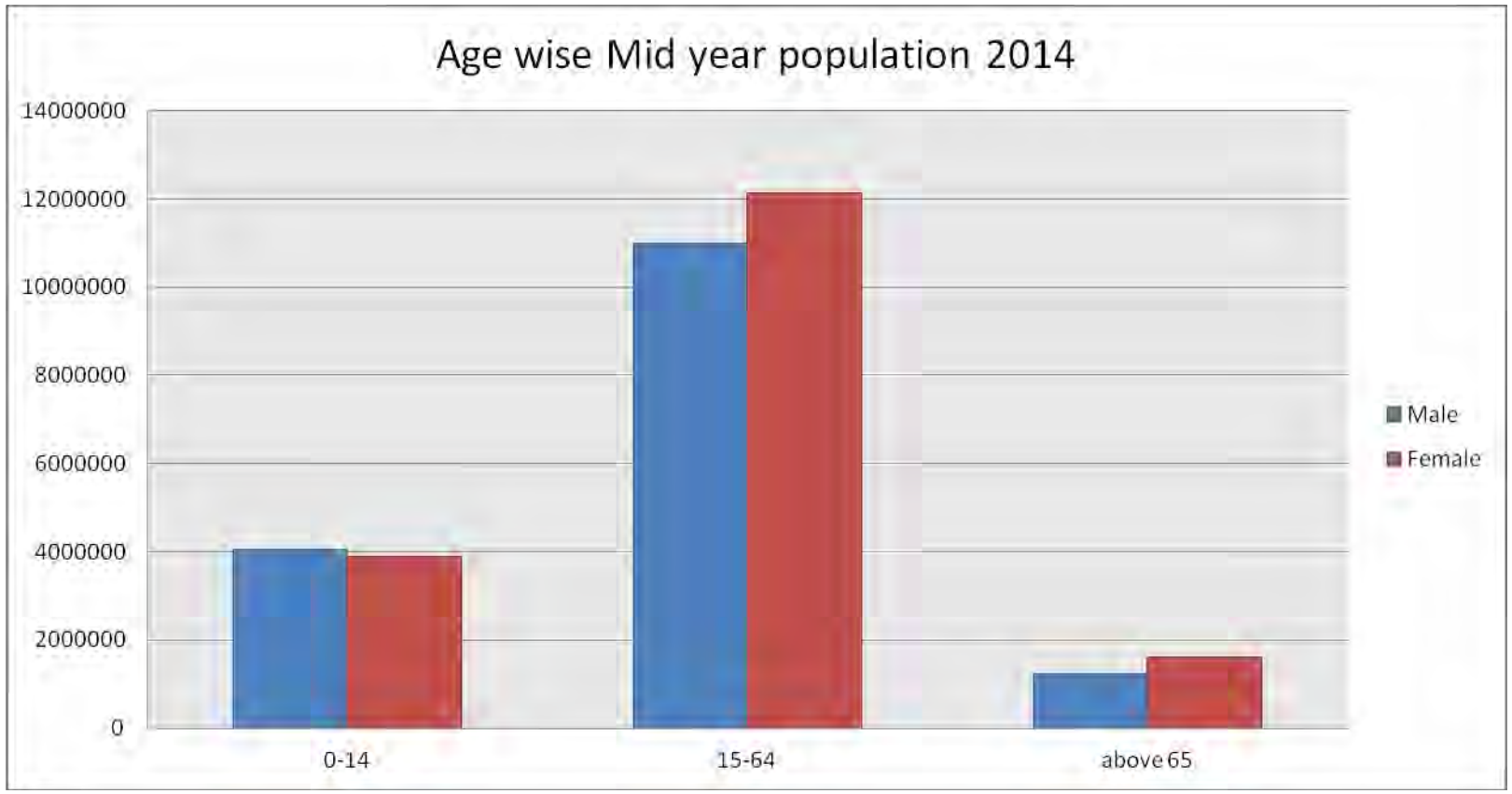

Age wise Mid year population 2014
14000000
12000000
10000000
8000000
6000000
4000000
2000000
0
0-14
15-64
above 65
Male
Female

Table : 7.14 District wise Fisherman Population in Kerala – Census 2011

Sl. No.	District	Marine				Inland				Total
		Male	Female	Children	Total	Male	Female	Children	Total	
1	Thiruvananthapuram	61261	54120	48120	163501	439	509	434	1382	164883
2	Kollam	38210	32316	18940	89466	13215	12440	7979	33634	123100
3	Pathanamthitta	0	0	0	0	912	792	369	2073	2073
4	Alappuzha	42352	38659	26193	107204	24491	23472	12627	60590	167794
5	Kottayam	0	0	0	0	9611	9124	5685	24420	24420
6	Idukki	0	0	0	0	261	264	166	691	691
7	Ernakulam	28126	26366	16463	70955	23258	22746	16428	62432	133387
8	Thrissur	27489	27697	15768	70954	7769	7104	4479	19352	90306
9	Palakkadu	0	0	0	0	847	832	855	2534	2534
10	Malappuram	30472	24778	22647	77897	1771	1542	834	4147	82044
11	Kozhikode	37345	32575	24944	94864	4090	4309	3350	11749	106613
12	Wayanadu	0	0	0	0	74	80	76	230	230
13	Kannur	20104	18269	15615	53988	2369	2505	1346	6220	60208
14	Kasargode	16781	15844	9795	42420	386	366	170	922	43342
Total		**302140**	**270624**	**198485**	**771249**	**89493**	**86085**	**54798**	**230376**	**1001625**

Table : 7.15 District Wise Percentage of Household by Number Of Dwelling Rooms

District	Rural/ Urban	Number of Dwelling Rooms						
		No exclusive room	One room	Two rooms	Three rooms	Four rooms	Five rooms	Six rooms and above
Thiruvananthapuram	Total	1.3	8.5	24.8	32.3	20	7.8	5.3
	Rural	1.5	8.9	25.8	32.8	20	7	4.1
	Urban	1.2	8	23.9	31.9	20.1	8.5	6.4
Kollam	Total	1.1	7.7	26	32.5	20.6	7.3	4.7
	Rural	1.3	7.8	27.1	32.5	20.3	6.9	4.2
	Urban	1	7.7	24.6	32.5	21.1	7.8	5.3
Pathanamthitta	Total	1.1	6.5	29.7	29.3	19.6	8.2	5.7
	Rural	1.1	6.3	30.1	29.4	19.5	8	5.5
	Urban	1.2	7.5	25.9	27.7	20.2	10	7.5
Alappuzha	Total	0.9	7.7	29.2	30.4	19.5	7.3	5
	Rural	1.1	8.2	30.2	30.7	18.9	6.7	4.2
	Urban	0.8	7.3	28.4	30.1	20	7.8	5.6
Kottayam	Total	0.8	5.9	27.2	31.3	20	8.5	6.4
	Rural	0.9	6.1	27.7	31.5	19.6	8.2	6
	Urban	0.7	5.4	25.7	30.8	21	9.2	7.3
Idukki	Total	1.2	13.4	26.7	30.3	18.1	6.3	4
	Rural	1.2	13.9	27	30.3	17.8	6.1	3.7
	Urban	0.7	3.6	19.2	30.4	24.4	10.9	10.8
Ernakulam	Total	0.8	5.3	19.9	35.1	23.7	8.8	6.4
	Rural	0.8	5.7	21.1	34.5	23.8	8.3	5.7
	Urban	0.7	5.2	19.3	35.3	23.7	9	6.8
Thrissur	Total	1.1	6.7	22.4	34.2	22.2	8.1	5.4
	Rural	1.2	7.1	24.5	35.2	21.3	6.7	3.9
	Urban	1	6.5	21.4	33.7	22.6	8.8	6.1
Palakkad	Total	1.5	10.3	32	30.4	16.1	5.7	4.1

	Rural	1.6	10.5	32.3	30.5	15.9	5.4	3.7
	Urban	1.1	9.7	30.8	30	16.7	6.6	5.2
Malappuram	Total	0.9	5.4	24.9	32.2	21.7	8.3	6.6
	Rural	0.1	5.8	25.8	33	21.2	7.7	5.5
	Urban	0.8	4.8	23.8	31.2	22.4	9.1	7.9
Kozhikode	Total	1.1	6.9	28.5	34.2	18.3	6.4	4.8
	Rural	1.3	8.1	28.4	34.9	18.3	5.6	3.6
	Urban	1	6.2	28.6	33.8	18.2	6.8	5.4
Wayanad	Total	1.3	10.3	22.3	29.7	22.6	9.1	4.7
	Rural	1.3	10.3	22	29.7	22.8	9.2	4.7
	Urban	1	10	30.3	31.1	16.9	6.7	4
Kannur	Total	0.9	4.4	16.3	32	24.6	10.8	11.1
	Rural	1.1	5.9	17.7	32.9	24.8	9.9	7.6
	Urban	0.7	3.5	15.4	31.5	24.5	11.4	13.1
Kasaragod	Total	1.7	9.3	23.4	29.3	20	8.8	7.5
	Rural	2.1	10.6	24.7	29.4	19.2	7.9	6
	Urban	1.1	7.1	21.2	29.2	21.2	10.3	10
TOTAL	Total	1.1	7.3	25.1	32.2	20.6	7.9	5.8
	Rural	1.2	8.1	26.7	32	20	7.2	4.8
	Urban	0.9	6.3	23.3	32.4	21.4	8.6	7

Source : House Listing & Housing Census 2011

Table : 7.16 District wise Infant Death Rates from 2010-14

Sl. No.	Districts	Rural/Urban	2010	2011	2012	2013	2014
1	Thiruvananthapuram	Rural	0.24	1.76	2.80	1.83	0.97
		Urban	19.29	15.01	16.73	14.52	13.36
		Total	14.63	12.13	13.76	12.08	11.10
2	Kollam	Rural	0.54	1.87	1.91	1.39	2.81
		Urban	4.23	3.43	3.10	2.77	1.79
		Total	2.05	2.62	2.50	2.10	2.26
3	Pathanamthitta	Rural	5.82	5.62	4.54	4.50	5.34
		Urban	4.44	5.67	5.23	5.25	5.47
		Total	5.19	5.64	4.87	4.87	5.40
4	Alappuzha	Rural	15.54	9.78	10.21	9.07	7.10
		Urban	0.88	1.04	0.94	0.41	0.09
		Total	5.72	4.39	4.72	4.11	3.39
5	Kottayam	Rural	11.10	11.83	13.37	11.81	13.81
		Urban	3.14	3.44	2.00	1.17	1.48
		Total	8.43	9.24	9.88	8.29	9.81
6	Idukki	Rural	2.46	3.50	5.54	4.41	4.84
		Urban	1.71	1.43	2.16	1.22	1.22
		Total	2.23	2.83	4.40	3.28	3.53
7	Ernakulam	Rural	7.97	8.73	11.77	11.85	7.88
		Urban	9.12	8.12	8.44	7.24	5.76
		Total	8.93	8.22	8.97	8.06	6.15
8	Thrissur	Rural	10.06	10.99	12.40	14.38	10.86
		Urban	5.50	7.35	6.51	5.88	5.20
		Total	6.98	8.48	8.33	8.54	7.10
9	Palakkad	Rural	1.99	3.17	3.92	3.33	3.07
		Urban	3.63	4.08	2.78	3.30	2.67
		Total	2.93	3.69	3.30	3.31	2.87

10	Malappuram	Rural	3.08	3.87	4.36	4.42	3.83
		Urban	5.51	5.20	4.78	3.40	3.46
		Total	4.17	43.60	4.59	3.83	3.62
11	Kozhikkode	Rural	1.42	1.59	1.67	1.57	1.16
		Urban	25.19	23.87	27.49	24.79	20.46
		Total	18.40	17.67	20.33	18.22	15.22
12	Wayanad	Rural	3.67	6.12	5.26	4.38	4.00
		Urban	2.99	2.09	3.41	1.84	1.93
		Total	3.50	4.97	4.74	3.72	3.39
13	Kannur	Rural	16.60	20.12	20.23	20.09	16.91
		Urban	3.36	3.08	3.50	2.66	2.32
		Total	5.61	6.03	6.42	5.48	4.77
14	Kasaragode	Rural	1.86	4.11	2.86	2.95	3.11
		Urban	3.96	3.88	3.30	3.12	1.74
		Total	3.10	3.97	3.16	3.06	2.21
	Kerala	**Rural**	**4.89**	**5.97**	**6.58**	**6.32**	**5.82**
		Urban	**9.10**	**8.45**	**8.86**	**7.73**	**6.81**
		Total	**7.42**	**7.53**	**8.02**	**7.22**	**6.45**

Source : Department of Economics & Statistics

Table : 7.17 Live Births, Deaths, Infant Deaths and their Rates - 2014

Sl. No.	Districts	Rural/ Urban	Births		Deaths		Infant Deaths	
			Number	Rate	Number	Rate	Number	Rate
1	Thiruvananthapuram	Rural	9268	4.32	12244	5.71	9	0.97
		Urban	41706	35.3	18231	15.43	557	13.36
		Total	50974	15.33	30475	9.16	566	11.1
2	Kollam	Rural	14608	6.74	14213	6.56	41	2.81
		Urban	16806	35.13	4548	9.51	30	1.79
		Total	31414	11.88	18761	7.09	71	2.26
3	Pathanamthitta	Rural	8234	7.71	8656	8.11	44	5.34
		Urban	8233	69.63	2615	22.11	45	5.47
		Total	16467	13.89	11271	9.5	89	5.4
4	Alappuzha	Rural	9715	5.4	13128	7.3	69	7.1
		Urban	10924	32.45	3107	9.23	1	0.09
		Total	20639	9.66	16235	7.6	70	3.39
5	Kottayam	Rural	18314	10.46	16231	9.27	253	13.81
		Urban	8804	38.64	2594	11.39	13	1.48
		Total	27118	13.71	18825	9.52	266	9.81
6	Idukki	Rural	8682	8.3	5645	5.4	42	4.84
		Urban	4919	90.87	877	16.2	6	1.22
		Total	13601	12.36	6522	5.93	48	3.53
7	Ernakulam	Rural	8245	3.71	13346	6.01	65	7.88
		Urban	36962	32.86	15309	13.61	213	5.76
		Total	45207	13.51	28655	8.56	278	6.15
8	Thrissur	Rural	17315	6.89	18823	7.49	188	10.86
		Urban	34225	51.6	8961	13.51	178	5.2
		Total	51540	16.23	27784	8.75	366	7.1
9	Palakkad	Rural	19847	7.61	13882	5.32	61	3.07

		Urban	21316	81.08	3569	13.58	57	2.67
		Total	41163	14.33	17451	6.08	118	2.87
10	Malappuram	Rural	36992	10.41	14217	3.73	152	3.83
		Urban	52591	112.38	4849	10.36	182	3.46
		Total	92283	21.56	19066	4.45	334	3.62
11	Kozhikkode	Rural	16388	6.83	10764	4.49	19	1.16
		Urban	43880	57.83	13717	18.08	898	20.46
		Total	60268	19.09	24481	7.75	917	15.22
12	Wayanad	Rural	10011	12.54	3877	4.86	40	4
		Urban	4135	128.15	352	10.91	8	1.93
		Total	14146	17.03	4229	5.09	48	3.39
13	Kannur	Rural	7866	3.59	12679	5.79	133	16.91
		Urban	39142	104.37	4737	12.63	91	2.32
		Total	47008	18.33	17416	6.79	224	4.77
14	Kasaragod	Rural	7711	6.57	5383	4.59	24	3.11
		Urban	14919	87.18	1688	9.86	26	1.74
		Total	22630	16.83	7071	5.26	50	2.21
	Kerala	Rural	195896	7.07	163088	5.89	1140	5.82
		Urban	338562	54.14	85154	13.62	2305	6.81
		Total	534458	15.75	248242	7.31	3445	6.45

Source : Vital Statistics 2014, DES

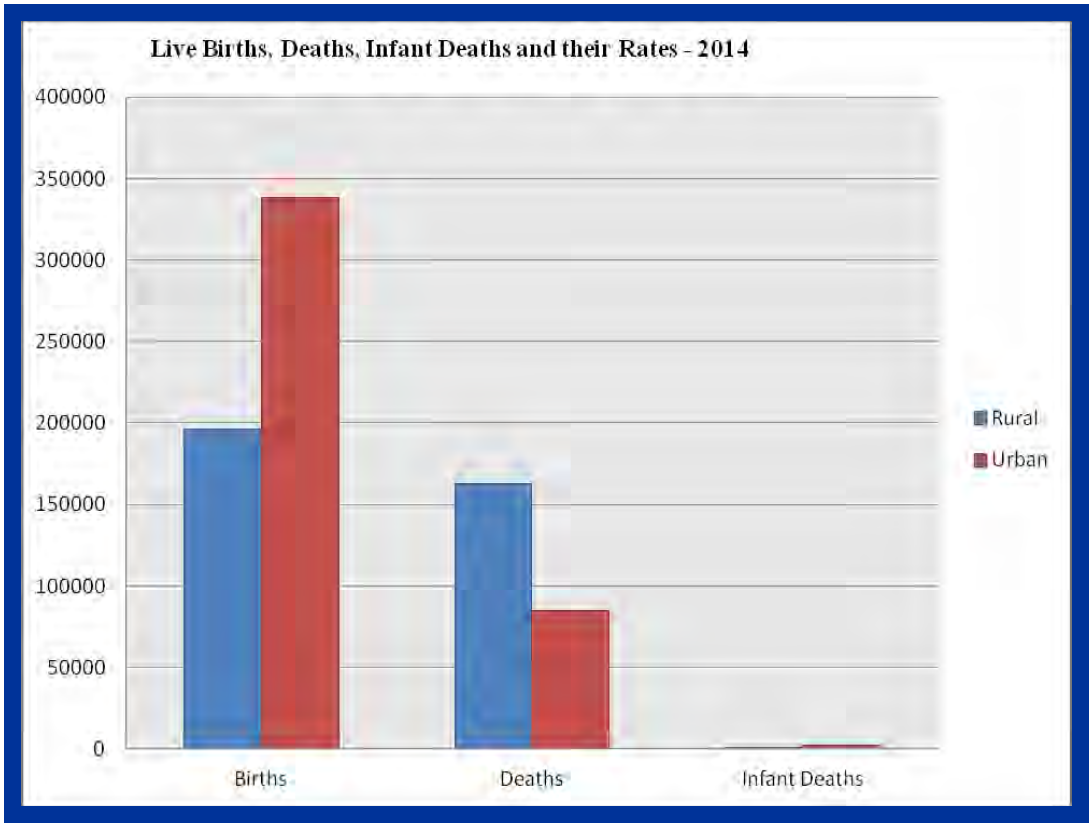

Live Births, Deaths, Infant Deaths and their Rates - 2014
400000
350000
300000
250000
200000
150000
100000
50000
0
Births
Deaths
Infant Deaths
Rural
Urban

Table : 7.18 District wise Infant Mortality Rate by Sex – 2014

Sl. No.	District	Male	Female	Total
1.	Thiruvananthapuram	12.67	9.41	11.1
2.	Kollam	2.62	1.89	2.26
3.	Pathanamthitta	5.84	4.95	5.4
4.	Alappuzha	3.23	3.56	3.39
5.	Kottayam	8.92	10.74	9.81
6.	Idukki	3.33	3.73	3.53
7.	Ernakulam	6.92	5.36	6.15
8.	Thrissur	7.47	6.71	7.1
9.	Palakkad	2.87	2.86	2.87
10.	Malappuram	3.75	3.48	3.62
11.	Kozhikkode	17.07	13.27	15.22
12.	Wayanad	3.69	3.08	3.39
13.	Kannur	4.97	4.56	4.77
14.	Kasaragode	2.31	2.11	2.21
Total		**6.94**	**5.93**	**6.45**

Source : Vital Statistics 2014, DES

Table : 7.19 Vital Rates at a Glance Kerala – 2014

Year	Crude Birth Rate	Crude Death Rate	Infant mortality rate	Still Birth Rate	Maternal Mortality Rate
1994	17.52	5.38	10.41	5.14	0.06
1995	18.09	5.28	10.15	5.72	0.07
1996	18.76	5.51	9.53	5.14	0.11
1997	19.19	5.25	9.07	5.18	0.13
1998	18.43	5.79	9.00	4.65	0.12
1999	18.32	5.73	8.27	5.25	0.00
2000	18.01	5.42	7.10	6.43	0.02
2001	18.13	5.70	5.43	4.65	0.01
2002	18.05	5.73	5.54	4.90	0.13
2003	17.16	5.97	4.40	4.02	0.24
2004	17.15	6.06	4.25	4.68	0.23
2005	17.34	6.33	7.35	6.27	0.64
2006	16.63	6.55	8.1	5.56	0.67
2007	16.18	7.08	8.48	6.05	0.19
2008	15.74	6.52	7.58	3.71	0.21
2009	15.82	6.74	6.84	5.36	0.21
2010	15.75	6.88	7.42	5.30	0.30
2011	16.75	7.32	7.53	4.92	0.18
2012	16.37	7.14	8.02	4.50	0.20
2013	15.88	7.7	7.22	5.15	0.36
2014	15.75	7.31	6.45	4.73	0.28

Source : Vital Statistics 2014, DES

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