GOVERNMENT OF KERALA

COMPENDIUM OF ENVIRONMENT STATISTICS

KERALA-2012

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2012

GCPT. 37/4559/2013

PREFACE

Environment means" the surroundings". Land, water, air, plants, animals, solid wastes and other things that are surrounding us constitute our environment. Man and environment are closely related to each other. Two types of environment we may come across. One is the natural environment of the air, water, solid wastes, noise, radiation, soil, timber, wildlife and living space etc. The second one is the man-made environment that deals with work environment, housing, technology, aesthetics, transportation, utilities, settlement, urbanization and so on. These environmental components are considered as the resources and are mostly exploited and utilized by the mankind to fulfil their basic physical needs.

The environment around us consists of many different topics and issues. One little change in our environment is enough to determine the course of mankind. Studying the cycles of the world and discerning the cause and effects of our actions will allow us to help keep a healthy environment and let us live an enjoyable life. Here in lies the importance of environment statistics. Knowing our environment means knowing the facts and figures of our environment. As an endeavour to know our environment, the Department of Economics and Statistics, Government of Kerala, has been bringing out the publication. This publication has been categorised 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 the earnest effort of I&ES Division under the guidance and supervision of Sri. T.Gorkey Jose, Additional Director (P). Comments and suggestions towards improving future reports would be greatly appreciated.

THIRUVANANTHAPURAM
12 -08- 2013

V .RAMACHANDRAN
DIRECTOR

CONTENT

CHAPTER – I

ENVIRONMENT AND ENVIRONMENT DEGRADATION

Environment

Environment is a cross-sectoral and multi-disciplinary concept covering a large number of resource elements both natural and man-made. The natural elements include the environmental media of air, water and land/soil as well as the biota (flora and fauna) found in these media. The man-made environment is represented by human settlements which consist of physical elements, namely shelter and infrastructure and services to which these elements provide the material support.

Human development on this earth transforms indoor and outdoor environmental changes. Indoor environment is mainly related to the health risks due to the man made surroundings. Outdoor environment is due to the economic development process. The cost of development activities can be measured in terms of environmental degradation.Enviornment 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. Its incidence would be very high in future. The state of Kerala is considered as God's Own Country. But the present environment situation of the state has not yet been properly assessed. Assessments are required regularly to guide, rational and effective decision making for environment policy formulation. The sand mining, destruction of forests, over consumption of manufactured goods etc., adversely affects our environment.

Factors affecting Environment degradation:

- Destruction of natural resources
- Water pollution and scarcity
- Deforestation
- Air pollution

Social Factors:

- Population
- Poverty
- Urbanization

Table-1.1 SOME IMPACTS OF DEVELOPMENT ACTIVITIES ON ENVIRONMENT

SL.NO.	Development activities	Major impacts on Environment
1.	Forest Clearing and land resettlements.	Extinction of rare species of flora and fauna, Creation of condition for mosquito breeding leading to infectious diseases such as malaria, dengue etc.
2.	Shifting cultivation in upland agriculture.	Soil erosion in upland areas, Soil fertility declines due to shorter cultivation Cycle which is practiced due to population pressure, flooding of low land areas. The problems could be resolved by terraced cultivation.
3.	Agro Industries	Air pollution due to burning of bagasse as fuel in sugar mills, Large amount of highly polluting organic wastes, surface water pollution.
4	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.
5.	Use of pesticides.	Organism develop resistance and new control methods are needed (e.g. in malaria, wide spread use of dieldrin as a prophylactic agent against pests of oil palms made the problem worse), Creation of complex and wide spread environment problems. The pesticides used in agriculture sometimes go into food Chain or in water bodies and as such results in harmful health hazards.
6.	Timber extraction	Degrades land destroys surface soil, reduces production potential of future forests.
7.	Urbanization and industrialization.	Concentration of Population in urban centers makes huge demands on production in rural areas and put pressure on land, air and water pollution.
8.	Water resource projects e.g. Dam, extensive irrigation	Human settlement and resettlement spread of water born diseases, reduction of fisheries, siltation, physical changes. e.g. temperature, humidity.

Source: Compendium of Environment Statistics, 2009.

Table 1.2 LOCAL REGIONAL AND GLOBAL EFFECTS OF POLLUTION

Local Effects	Regional	Over Marine water and Continents	Global
• Heavy metals in air, soil and plants, e.g. From Industrial emissions and discharges. • Noise • Smell • Air Pollution	• Eutrophication • Contaminants in the soil • Landscape changes due to mining on agriculture.	• Eutrophication • Acidification • Environment • Contaminants • Radioactivity	• Change of the climate due to ozone depletion and the greenhouse effect.

Source: Compendium of Environment Statistics, 2009.

Table 1.3 WATER BORN DISEASES AND THEIR CAUSATIVE ORGANISM

Sl. No.	Name of Disease	Causative Organism
1	**WATER BORNE DISEASE BACTERIAL**	
	Typhoid	Salmanella typhi
	Gastroenteritis	Vibrio cholerae
	Parathphoid	Slmondlla Paraphi
	Cholera	Enterotoxicgenic 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	Entamoeba hystolitica
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 testse fly
	Malaria	Plasmodium through Anaphelis
5	**INFECTION PRIMARILY DUE TO DEFECTIVE SANITATION**	
	Hookworm	Hookworm,Ascaris

Source: Compendium of Environment Statistics, A.P, 2010

Table 1.4 SOME MAJOR POLLUTANTS AND THEIR SOURCES

Pollutant	Source
Carbon Monoxide	Incomplete fuel combustion (e.g. two stroke Engine)
Sulphur dioxide	Burning or sulphur containing fuel like in coal in power and oil by vehicles.
Suspended Particulate Matter	Smoke from domestic, industrial and vehicular sources.
Oxides of Nitrogen	Fuel combustion of motor vehicles, power stations and furnaces.
Volatile hydrocarbons	Partial combustion of carbonaceous fuels (two stroke Engine, industrial processes, disposal of solid wastes)
Oxidants and ozone	Emissions from motor vehicles, photo chemical reactions of nitrogen oxides and reactive by hydrocarbons.
Lead	Emissions from motor vehicles.

Source: Compendium of Environment Statistics, 2009.

Table -1.5 POLLUTANTS AND THEIR RELATED HEALTH HAZARDS

Pollutant	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 (No)(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 impair mental development of children: causes 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

Source: Compendium of Environment Statistics, 2009.

CHAPTER - II

DEVELOPMENT OF ENVIRONMENT STATISTICS IN KERALA

Department of Environment and Climate Change

Introduction

Department of Environment and Climate Change was formed with a mission to strengthen environmental governance, promote sustainable development, invest in environment management programs and create a civic movement on upkeep of environmental sustainability. Major schemes of the department are environmental education and awareness, environmental research and development, conservation of coastal ecosystem, eco-restoration of wetlands, river action plan, protection of catchments of reservoirs of water supply schemes, Environment Impact Assessment, air and water quality monitoring, studies on climate change and strengthening of the Department of Environment,. The department has spent a total of Rs. 10.98 Cr for environmentally significant activities during the financial year 2011-12 through various schemes. During 2012-13, the department has spent a total of Rs. 5.95 Cr for environmentally significant activities through various schemes.

Activities and Achievements

The major activities and achievements of Department of Environment and Climate Change during 2011-12 and 2012-13 are as follows

1. The department has instituted a research fellowship programme – Paristhithi Poshini – for encouraging the research in the field of environment and climate change. The department was able to initiate 9 environmentally significant research programmes through this scheme for the financial year 2012-13.
2. Bhoo Mithra Sena – program of establishing eco-clubs in colleges - were launched in 2009-10 to instill environmental awareness among students and to empower them to face environmental challenges and now 217 such clubs exist in the state. This scheme has helped the department to infuse affection towards nature among the pupil and to undertake various environmental protection activities all over Kerala through students. The department was able to implement various activities such as rejuvenation of water resources, waste management and clean development as part of this programme.
3. Paristhithikam – a state level environmental awareness campaign is launched as part of Environmental education and awareness scheme of Government of Kerala. The programme was aimed at various educational institutions, Government Organizations and NGOs. The department succeeded in bringing awareness among rural as well as urban people of Kerala regarding the necessity of practicing eco-friendly lifestyle and starting the cleanliness activities from individual houses itself through this scheme. We were able

to implement action plans suitable for local environmental issues through this programme.

4. The department has launched State level environmental awareness programme - Haritha Sparsam - with an aim of extending the environmental knowledge to rural areas and instituting Primary Environmental Awareness Care Establishing (PEACE) units through the involvement of other departments/agencies including NGOs. The theme of this programme was conducted from Kasargod to Thiruvananthapuram with an aim of making awareness among pupil as well as public regarding the necessity of Environmental protection. Various environment awareness programmes and activities were conducted in school level, District level and state level in association with National Service Scheme of Higher Secondary Department as part of this programme. Environment friendly model houses will be established as part of this programme.
5. 'Haritha Sala' training programme was implemented with an aim of capacitating two selected Bhoomithrasena Colleges in each district for investigating the environmental atrocities and water quality monitoring. By installing two 'Harithasalas' (qualified environmental laboratory) with basic requirements, the Department was able to ensure free water quality monitoring facility for public.
6. Environmental Research and Development program was started with an objective of promoting environmental research in the priority areas of low cost waste treatment, environment quality monitoring, solid waste management, energy efficiency, green technologies and other need based areas. At present the department is providing financial aid for 17 research project of various R&D Organizations and researchers. The research reports will be peer reviewed and considered for implementation based on feasibility.
7. Study of the effect of house boats on Vembanad lake ecosystem, projection of climate change over Kerala using ultra high resolution Global Climatic Model, study the abundance and feeding habits of the Chaoborus larvae in Sasthamkotta Lake, study of the Carbon foot print with special reference to secretariat, study of the impact of Sea Level Rise in Kerala Coast are some of the major research programmes of the Department.
8. Department of Environment and Climate Change has formulated and implemented various programmes with an objective of protection and eco-restoration of the deteriorated wetlands of Kerala. The sustainable fish farming implemented at Vellayani Kayal was a big success. This programme has helped to increase the fish catching from Vellayani Kayal into 20 tons, increase the income of the fishermen and attract more people into this sector.
9. With an objective of community empowerment for sustainable eco restoration of watershed, the department of Environment and Climate Change has formulated and implemented various plans for the conservation and eco-restoration of deteriorated ponds such as Chenkottukonam Kulam, Karumpukonam Mechira Kulam, Thrikkayur Kulam

and Irumpil Kulam. This programme has helped for ensuring mass public participation and involvement in the conservation of water resources. The Department has initiated a mega project with the participation of various Government Departments for the conservation of Vellayani Kayal through Thiruvananthapuram District Panchayath.

10. The Department has given financial aid to Kaladi and Kumali Panchayaths for installing sophisticated slaughter stations with an aim of eradicating unauthorized slaughter stations, maintaining healthy and hygienic environment and stopping river pollution from slaughter waste.
11. The functioning of State level Environment Impact Assessment Authority (SEIAA) and State level Environment Appraisal Committee (SEAC) were started during the financial year 2011-12. A total of 87 project proposals were come before SEIAA for consideration and environmental clearance was given for 32 proposals. The authority provides final decision on environmental clearance within 45 days which has given a great relief for the entrepreneurs of mining and construction sectors in Kerala.
12. The Department has initiated steps for establishing 5 automatic weather monitoring stations at Palakkad. This facility is meant for continuous monitoring of weather conditions and giving information to farmers directly regarding climate change. This will help to forecast the impacts of climate change and prepare the farmers for taking protective measures in the agriculture sector. The Department has also implemented student project fellowship programmes for encouraging the research in the field of climate change.
13. The department has formulated 'Sabarimala Zero Waste Management Scheme' for the scientific waste management of Sabarimala and Rs 500 lakh has been released for Travancore Devaswam Board during the financial year 2011-12 for the implementation of the scheme. It is expected that this scheme will help for the scientific solution of Sabarimala waste management issues.
14. By releasing 100 lakh rupees to Kerala Water Authority for installing Sewage Treatment Plant at Elamkulam the department may be able to resolve the sewage waste management issues of Ernakulam District to certain extend
15. Department of Environment and Climate Change has released financial aid for installing plastic shredding units at Kannur, Mattannur and Kottayam Municipalities and biogas plant at Kannur Municipality during the financial year 2012-13

Kerala State Pollution Control Board

The Kerala State Pollution Control Board was first constituted on 12.09.1974 by the Government of Kerala under the Kerala State Board for Prevention and Control of Water Pollution. It thus became the first State Board constituted in the country under the Water Act. It was renamed as the Kerala State Pollution Control Board in 1984 on being entrusted with

the implementation of the Air Act also. Administrative control over the Board is vested with the Environment Department of the Government of Kerala and the Ministry of Environment & Forests of the Government of India. The activities of the State Boards are coordinated by the Central Pollution Control Board.

ACTIVITIES OF THE BOARD

Water Pollution Control

Water pollution control is achieved through administering conditions imposed in the consent issued under the **Water (Prevention & control of Pollution) Act**, 1974. These conditions regulate the quality and quantity of effluent, the location of discharge, the periodicity of self monitoring and general environmental protection. Large and medium scale industries and a number of small scale units have put up effluent treatment plants. Though persuasion and, in extreme cases, coercion, the water pollution load from industries has been got reduced to about 40% of the 1974 levels. The consent conditions are enforced by regular inspection of the consented units and appropriate follow up actions. Earlier, industries which are more pollutionally significant were brought under the Board's purview. Now, hospitals, Major hotels, resorts, high rise apartments, houseboats etc. having water pollution potential have also been brought under the purview of the Water Act and have to obtain Consent to Establish for establishing the industry/establishment and Consent to Operate for discharging trade effluent/sewage.

Air Pollution Control

The Board issues consent to air polluting industries/establishments for establishing and for operating with conditions to regulate the quality and quantity of emission and stipulates the frequency of self monitoring of the emissions. Under the **Air (Prevention & Control of Pollution) Act,** 1984 consent of the Board is mandatory for making emissions to the atmosphere. The consent is extended only if there is compliance to consent conditions during the previous period. The air pollution load has been got reduced by about 50% from the 1984 levels.

Hazards Wastes Management.

Authorization under **Hazardous Wastes (Management & Handling and Transboundary movement) Rules** is required by generators/handlers/disposers of hazardous wastes for as collection, reception, treatment, transport, storage and/or disposal of hazardous wastes. The generators of waste oil/used oil, lead acid batteries; nonferrous metals can dispose their waste only by sale/transfer to reprocessors who have authorization from the

Board and registration from the Board (earlier the registration was done by the Central Pollution Control Board).

Bio-Medical Waste Management

Kerala has the highest number (about 27%) of health care institutions in India. All hospitals having inpatients, all clinics and laboratories serving more than 1000 persons per month and all operators providing facilities for biomedical waste transport, treatment and disposal have to obtain authorization from the Board. The Board has so far identified nearly 2537 bio-medical waste generators in the State. These institutions are required to obtain authorization from the Board and provide adequate facilities for collection, segregation, treatment and disposal of bio-medical wastes. Most of the major private hospitals have implemented necessary facilities as required in the Rules. Others are being pressurized to implement the requisite facilities. The IMA has set up a common bio-medical waste treatment facility at Kanjikode in Palakkad. Of the 2537 bio-medical waste generators identified by the Board, 1050 have joined the IMAGE.

Municipal Solid Wastes

The function of the Board under the **Municipal Solid Waste (Management & Handling) Rules** include issue of authorization, monitor compliance with the conditions of the authorization and taking appropriate follow up action. The urban local bodies and operators are required to obtain authorization of the Board for handling/processing/disposing solid wastes.

Plastic Rules

The Government of India has notified **Plastic Waste (Management & Handling) Rules**, 2011. Board is the prescribed authority for enforcement of provisions relating to manufacture and recycling of plastics carry bags and multilayered pouches and sachets. Every occupier manufacturing carry bags of virgin plastic or recycled plastic or both has to obtain registration from the Board.

Batteries Rules

Batteries (Management and Handling) Rules, 2001 are applicable to Manufacturers, Importers, Re-conditioners, Assemblers, Dealers, Recyclers, Auctioneers, Consumers and Bulk Consumers of batteries. Purpose of implementation of the Rules is to ensure collection and recycling of used batteries in an environmentally acceptable manner. The board is to help achieve this by collecting and compiling annual returns from the handlers.

e-Waste Rules

The e-waste (Management and handling) Rules 2011 will come into effect from 1st May 2012. The Board is preparing and inventory of e-waste in the State. As per the Rules grant and renewal of authorization, registration of recyclers of e-waste, monitoring compliance of authorization and registration conditions, implementation of programmes to encourage environmentally sound recycling and action against violations of Rules come under the purview of the Board.

Water Cess

The water (Prevention & Control of Pollution) Cess Act, 1977 provided for the levy and collection of Cess on water consumed/supplied by persons carrying on industries and by local authorities. The Board is empowered to assess and demand Cess based on consumption of water.

Environmental Public Hearing

The Ministry of Environment and Forests in the Government of India have made it mandatory for the State Pollution Control Board to conduct Environmental Public Hearing before issuing environmental clearance to selected types of development projects/industries and furnish report to the MoEF.

Classification of Water Bodies

Classification of surface waters on the basis of best designated use is an important tool for the effective management of the environment and for pollution control. This Board is implementing a continuous programe to classify the surface water of Kerala after assessing the water quality as per CPCB guidelines.

Rivers Classified

1) Karamana river
2) Kallada river
3) Achenkovil river
4) Pamba river
5) Manimala river
6) Meenachil river
7) Moovattupuzha river
8) Periyar river
9) Chalakkudy river
10) Bharathapuzha river
11) Chaliyar river
12) Valapattanam river

Classification of the above rivers has been taken up and more rivers are being taken up for classification.

Ambient Water Quality Monitoring

For maintaining and restoring the quality of the natural resources, the Board is carrying out 2 major schemes for ambient water quality monitoring. The schemes are

1) National Ambient Water Quality Monitoring Programme (NWMP)
   - Sponsored by CPCB
   - Covers 64 river stations, 11 backwater/lake stations, 20 ground water stations, 4 Reservoir stations and a pond
2) Ambient Water Quality Monitoring Scheme (AWAQUMS)
   - Board's own stations
   - Covers 119 stations in 21 rivers.

Ambient Air Quality Monitoring

The Board is monitoring the ambient air quality at 29 selected locations in the State. Of this 24 come under the National Ambient Air Quality Monitoring Programme (NSMP) of the CPCB and 5 under State Ambient Air Quality Monitoring Programme.

Awareness

The Board conducts awareness programmes to impart awareness to general public and concerned authorities on provisions in Environmental laws and their implementation. Small pamphlets on pollution abatement are released by the Board. Board also release an editorial by name Paristhithi Vartha which contains articles related to safe environment management

Pollution Control Incentives

The Board is also assessing the pollution control systems adopted by various industries, hospitals, municipal authorities etc. and providing incentives by way of cash awards based on their performance.

CHAPTER - III

BIO-DIVERSITY OF KERALA

Biodiversity is the variety of life on earth. It includes the variability of species in terrestrial, aerial and aquatic habitats, the diversity of ecosystems and the diversity of genes they harbor. It is an essential component of the nature and it ensures the survival of human species by providing food, fuel, shelter, medicines and other resources to mankind. Indirectly, biodiversity serves the humans by providing the basic life supporting systems such as clean air, water and fertile soil.

It is defined as the variability among living organisms and the ecological complexes of which they are part, including diversity within and between species and eco systems. Bio-diversity manifests at species genetic and ecosystem levels.

Biodiversity ensure food, fuel, shelter, medicines and other resources which are vital for our survival. Most of the crops pests are controlled by a variety of other organisms, including insects, birds and fungi; which are certainly superior natural pesticides than their chemical equivalents. The pesticides which are extensively used are really harmful to human beings and the environment. Kerala state is having rich biodiversity with different types of unique ecosystems viz. Forest ecosystem, **Wetland ecosystem, Mangrove ecosystem, Marine ecosystem** etc.

Biodiversity of Kerala

The bio-diversity conservation areas of the State of Kerala are tropical forests, Endemic centers, florist hotpots and genetic resources of economic plants. Kerala sprawled over an area of 38,863 sq. Km has a flora of 10, 035 species – 22%of the Indian Flora. The luxuriant flora of Kerala supports Tropical rain forests, Tropical moist deciduous forests, Tropical dry deciduous forests, Shola forests and Riparian forests. The other vegetation types are Mangroves and Myristica Swamps. Kerala's three Floristic 'hotspots' are:-

- Agastha malai
- Anaimalai High Ranges
- Silent Valley- Wayanad

Bio-diversity occurring in plants, animals and micro-organisms of economic value is now referred to as Agro bio-diversity.

Animal bio-diversity plays crucial role in maintaining the health of the eco-system. 75 species of mammals have been recorded from Kerala. Of these 14 species including the Lion-tailed macaque, Nilgiri langur, Nilgiri Tahr and Malabar Civet are andemic.

The tiger and leopard in large numbers are reported from the Periyar Tiger Reserve and adjacent forests. The gaur is the second largest animal in Kerala forests, mostly restricted to protected areas. The Periyar Tiger Reserve has high number of gaurs.

3.1 (a) Plant Diversity

Sl.No	Items	Number
1	Flowering plants	4000
2	Grass species	350
3	Bamboo species	15
4	Reeds species	9
5	Orchid species	214
6	Gymnosperms	4
7	Ferns and Fern allies	200
8	Liverworts	200
9	Algae	231
10	Fungi	1044
11	Lichens	800

Source: Natural Resources Data Bank, Kerala State Land Use Board

3.1 (b) Animal Diversity

Sl.No	Items	Number
1	Large and medium sized mammals	48
2	Birds species	475
3	Water Birds	101
4	Reptiles Genera	60
5	Lizard(endemic) species	30
6	Snake (endemic) species	57
7	Amphibian(endemic) species	87
8	Fresh water fish (endemic) species	84
9	Butterflies	313

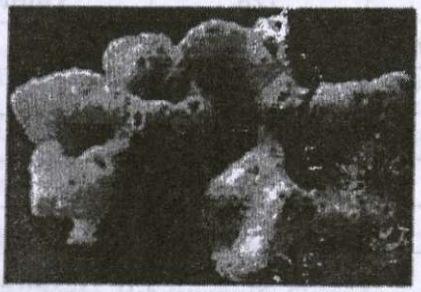
Source: Natural Resources Data Bank, Kerala State Land Use Board

Sl. No.	Vertebrates	Genus	Species
1	Mammals	45	75
2	Amphibians	-	113
3	Reptiles	-	171
4	Birds	-	475
5	Fishes	-	210
	Invertebrates		
6	Protozoa	63	-
7	Porifera	22	-
8	Coelenterates	90	-
9	Platihelminthes	117	-
10	Acanthocephalas	16	27
11	Aeschelminthus	121	265
12	Annelida	46	91
13	Chaetognaths	4	18
14	Mollusca	19	26
15	Echinodermates	7	8
16	Insects	193	6000
17	Non-insect Arthropoda	242	600

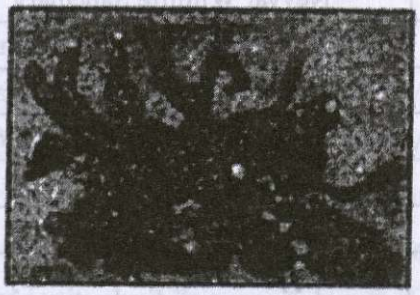
Marine and Coastal Biodiversity

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

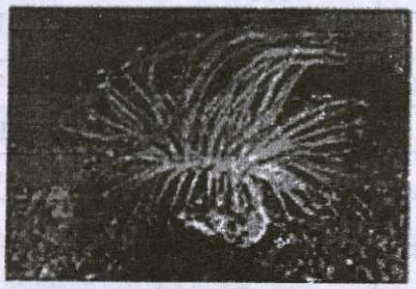
ecosystems of Kerala coasts include lagoons, mangrove swamps, sandy and rocky shores and open sea front. Apart from fishes Kerala coast has a rich array of Crustaceans, corals, echinoderms, mollusks, turtles etc.



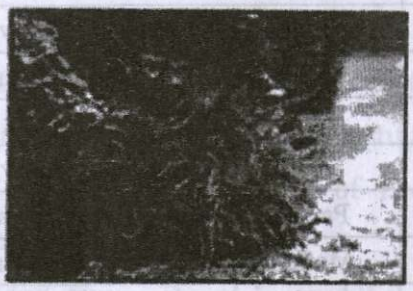
Callyspongia diffusa



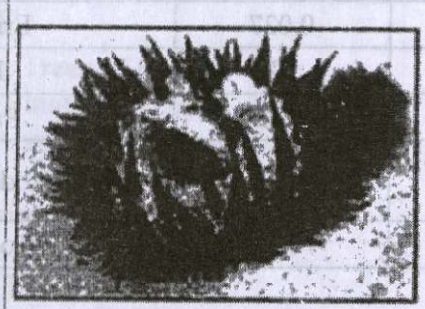
Pseudoceratina purpurea



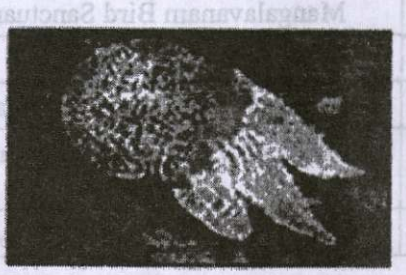
Cerianthus sp.



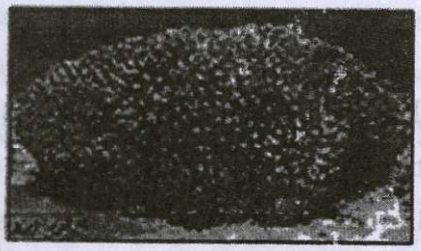
Rock Anemone



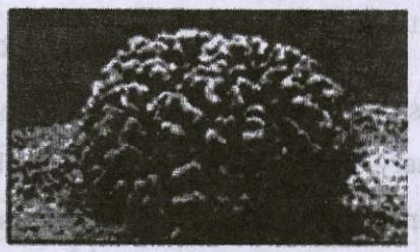
(Burrowing Anemone)



Acromitus flagellatus



Pocillopora damicornis



Pocillopora meandrina

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

3.2 List of wildlife sanctuaries, National parks and community Reserve

Sl.No	Protected Areas	Area (Km2)	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

Source: www.keralabiodiversity.org

Kerala State Biodiversity Board

As per the provisions of the Biological Diversity Act 2002, the KSBB was established in February, 2005 with the mandatory objectives to ensure the conservation of the biodiversity, sustainable utilization of the resources and equitable sharing of the benefits arising out of it.

Along with its mandatory duties, KSBB takes initiatives to mitigate the multidimensional conservation issues through various programmes at various levels. The Children's Ecological Congress, Media Awareness Programmes, BMC strengthening programmes are some of them conducted regularly. At the action level, Constitution of Biodiversity Club and establishment of Santhishal, agro biodiversity conservation programme through organic farming practices, river health assessment programme through fish

monitoring in 44 rivers of Kerala, Heronry conservation programme through providing incentives to the stakeholders are some of the outreach programmes of KSBB. KSBB instituted Green Awards under the title 'Haritha Puraskaram' to honour those who contribute towards the cause of conservation and creative awareness among the public on biodiversity and conservation.

KSBB hosted National Biodiversity Congress 2012, the first mega biodiversity event of India from 21-30 December 2012 under the auspices of MoEF and NBA with involvement of all State Biodiversity Boards. The focal theme of NBC 2012 is Biodiversity for food security with a special session on Western Ghats Challenges and Opportunities. National Biodiversity Expo, Students Biodiversity Congress, capacity building workshop involving NGOs, BMCs, Custodians of traditional Knowledge, Road shows, Quiz programmes, Photography competitions etc were also conducted.

Kerala State Biodiversity Board has the unique distinction of having constituted Biodiversity Management Committee (BMC) in all the Local Self Government Institutions, for conservation of biological resources at grass root level. Preparation of People's Biodiversity Registers have been completed in 496 Grama panchayats.

To facilitate field level identification of flora and fauna, Board has published the following handbooks

1. Common Trees of Kerala
2. Medical Plants of Kerala
3. Marine Animals of Kerala coast
4. Freshwater fishes of Kerala
5. Butterflies of Kerala
6. Mushrooms of Kerala
7. Invasive Plants of Kerala
8. Mangroves and Mangrove associates of Kerala

The Board also releases manuals/ brochures in local language and documentaries related to biodiversity conservation to promote awareness among the public and BMCs.

3.3 THE PLANT SPECIES DIVERSITY IN KERALA

Taxa	India	Kerala
Angiospherms	17500	4500
Gysnospherms	64	4
Pteridophytes	1100	236
Bryophytes (Moss)	2850	350
Lichens	2000	520
Algae	6500	325
Fungi	14500	4800
Total	44,514	10,035

Source: Biodiversity Board

Flora-Kerala

Status of Flora

The floral diversity of Kerala can be categorized into three (i)Wild and Indigenous, (ii) Indigenous and Cultivated (iii) Exotic, yet cultivated or wild.

Wild and indigenous floral elements are found in natural forests and other natural ecosystems. They offer a variety of products and services to mankind, including medicines and non wood forest produces. The natural forests are also rich in different types of traditionally used wood items.

Indigenous and cultivated plant varieties were once common in our agricultural fields and homesteads. These areas were also rich with a variety of indigenous rice, coconut, areca nut, pepper, ginger, turmeric, tapioca, plantains etc.In the last few decades many of these varieties have been neglected or ignored with the introduction of high-yielding hybrid varieties. In addition to this weeds and pests introduced into the state along with exotic crops replaced many indigenous varieties. Thus, the agribiodivesity in the state has become a mixture of both indigenous and exotic species.

Flora of Kerala comprises of a total of 11,840 taxa of plants (SoE,2007). Among them, angiosperms comprises the dominant group, composed of 4968 taxa, of which about 900 are those endemic to Western Ghats. Among the Western Ghats endemics, 252 taxa are those confined to Kerala State. The flora comprises of 866 species of algae, 4800 species of fungi, 520 species of lichens, 350 species of bryophytes, 332 species of pteridophytes, 4 species of gymnosperms and 4968 species of angiosperms or flowering plants. Habitat wise, algae species are mostly confined to aquatic or damp conditions whereas the other plant groups in the State ate mostly terrestrial in habit. Forest areas being well protected. Habit or life form-wise, there are herbs, shrubs, trees, lianas, epiphytes, lithophytes, saprophytes, etc. within the plant kingdom. Based on this the habitats are also different for different species.The following table gives the details of the representation of different plant groups in the flora of Kerala. Apart from this there are hundreds of cultivated species either on plantations or crop levels or as garden plants, ornamentals, etc. There are also 850 species and varieties of cultivars growing the State with their origin in mostly tropical parts of the globe. Due to various reasons, many of them are in various threat categories of IUCN Red List of flora and fauna (2004), prepared at global level.

3.4: Total Number of Plant Taxa Belonging to Different Groups Recorded from Kerala.

Sl. No.	Plant Groups	No. of Taxa
1	Algae	866
2	Fungi	4800
3	Lichens	520
4	Bryophytes	350
5	Pteridophytes	332
6	Gymnosperms	4
7	Angiosperms	4968
	Total	11,840

Source: SoE 2007

FAUNA

The Western Ghat's encompassing the forests of Kerala is one of the 34 Biodiversity hot spots in the World and Kerala has close to 90 % of its vertebrate fauna. Very high levels of species diversity and endemism provide importance to the faunal wealth of Kerala.

Faunal Wealth of Kerala		
Sl. No.	Group	No.of.Species
1	Mammals	145
2	Birds	486
3	Reptiles	164
4	Amphibians	85
5	Freshwater Fishes	196
6	Insects	4027
	TOTAL	5103

Endemic Fauna

Group	Nos
Amphibians	61
Reptiles	57
Birds	16

Mammals found in Kerala with their endemisity and protection

BIOSPHERE RESERVES

Biosphere Reserves

The concept of Biosphere Reserves was introduced and established under auspices of United Nations Educational Scientific and Cultural Organization (UNESCO) on Man and Biosphere Programme (MAB) during 1971. A Biosphere Reserve is voluntary, co-operative, conservation area created to protect the biological and cultural diversity of a region while promoting sustainable economic development. It provides an opportunity to scientists and managers to experiment and co-operate in generating data for understanding man's impact on nature. It is a place where local people, government officials and environmental groups work collaboratively on conservation and developmental issues. The Biosphere Reserve concept is crucial to achieving MAB's objective of striking a balance between conserving biodiversity, encouraging economic and social development and preserving cultural values.The important mangrove plants are Acanthus cillicifolius, Acrostichum aurem, Aegiceras corniculatum, Avicennia officinalis, A, rina, Azima tetracantha, Bruguiera gymnorrhiza, B. cylindrica, B sexangula, Excoecaria agallocha, E indica, Kandelia candel, Rhizophora apiculate, R mucronata, Sonneratia caseolaris, Calophyllum etc. Some of these species that disappeared from the Kerala coast are Azima tetracantha an Ceriops tagal, Heritiera littoralis and Flagellaria indica have discourteous distribution. Calamus rotang and Syzygium travancoricum are some of the rare and endangered species found in the mangroves.

The major threats to the mangrove forests are land reclamation for urbanization, intensive aquaculture felling of mangrove trees for fuel and fodder, unsustainable land use, ambiguity in ownership etc.

Marine ecosystems where, through appropriate zoning patterns and management mechanisms, the conservation of ecosystems and their biodiversity is ensured.

There are two Biosphere Reserve in Kerala sharing its portions with adjoining States and are named as Nilgiri Biosphere Reserve and Agasthyamalai Biosphere Reserve

3.5 List of Biosphere Reserve

Sl. No.	Name of BR	Extent (Sq. Km)	Forests areas included as Kerala part
1	Nilgiri Biosphere Reserve	1455.40	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	Agasthyamalai Biosphere Reserve	1828	□ Neyyar □ Peppara and □ Shendurney wildlife sanctuaries □ Achencoil □ Thenmala □ Konni □ Punalur and □ Thiruvananthapuram territorial divisions and □ Agasthyavanam Biological Park Range.

COMMUNITY RESERVE

Serial No.	Name of Reserve	Area in Km^2	Year of Formation	District
1	Kadalundy Vallikunnu Community Reserve	1.5	2007	Kozhikkode & Malappuram

3.6 SANCTURIES, NATIONAL PARKS,IN KERALA

Sl. No.	Name	Area (Km2)	Year of Formation
	National Parks		
1	Eravikulam National Park	97.000	1978
2	Silent Valley National Park *	237.520	1984
3	Anamudi Shola National Park	7.500	2003
4	Mathikettan National Park	12.817	2003
5	Pambadum Shola National Park	1.318	2003
	Wildlife Sanctuaries		
1	Periya WLS (Tiger Reserve) **	925.000	1950
2	Neyyar WLS	128.000	1958
3	Peechi – Vazhani Wildlife Scantuary	125.000	1958
4	Parambikulam WLS (Tiger Reserve) ***	643.660	1973
5	Wayanad WLS	344.440	1973
6	Idukki WLS	70.000	1976
7	Peppara WLS	53.000	1983
8	Thattekkadu Bird Sanctuary	25.000	1983
9	Shenduruniey WLS	171.000	1984
10	Chinnar WLS	90.440	1984
11	Chimmony WLS	85.000	1984
12	Aralam WLS	55.000	1984
13	Mangalavanam Bird Sanctuary	0.0274	2004
14	Kurinjimala Sanctuary	32.000	2006
15	Choolannur Pea Fowl Sanctuary	3.420	2007
16	Malabar Sanctuary ****	74.215	2009
	KottiyoorWLS	30.3798	2011
	Total	**3211.7372**	

* Includes 148 Km2 of buffer zone added during 2007.

** Includes 148 Km2 of critical Tiger Core area from Goodrical Range.

*** Includes core or critical Tiger Habitat (390.89 Km2) and Buffer Zone (252.77 Km2)

**** These area are under the administrative control of Divisional Forest Officer, Kozhikode.

Source: Principal Chief Conservator of Fore , Kerala

3.7 Division-wise Area of Forest as on 31.03.2011 (km^2)

Sl. No.	Division	Reserve Forests	Proposed Reserve	Vested Forest +EFL	Total	% of total
Southern Circle, Kollam						
1	Trivandrum	359.1240	5.8253	3.6510	368.6003	3.26
2	Thenmala	123.4320	-	7.7350	131.1670	1.16
3	Achencoil	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	Konni	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	-	162.0847	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**
Northern 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	207.3923	-	98.9097	306.3020	2.71
Total		**431.9542**	**44.8749**	**682.5290**	**1159.3581**	**10.25**
Agasthyavanam Biological Park						
25	Trivandrum (WL)	212.0000	-	-	212.0000	1.87
26	Shenthuruni	166.4200	-	4.5800	171.0000	1.51
Total		**378.4200**	**-**	**4.5800**	**383.0000**	**3.38**
Field Director (Project Tiger), Kottayam						
27	Periyar East	618.0000	-	-	618.0000	5.46
28	Periyar West	157.0000	-	-	157.0000	1.39
29	Munnar	276.8450	-	-	276.8450	2.45
30	Idukki	130.5240	-	-	130.5240	1.15
Total		**1182.3690**	**-**	**-**	**1182.3690**	**10.45**

Wildlife Circle, Palakkad						
31	Parambikulam	274.1408	-	-	274.1408	2.42
32	Wayanadu (WL)	344.4400	-	-	344.4400	3.05
33	Silent Valley	154.3800	-	83.1400	237.5200	2.10
34	Peechi	122.0644	3.4200	-	125.4844	1.11
35	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: Principal Chief Conservator of Forest, Kerala

3.8 Forest cover as per latest assesment

Units: Km2

Reserve Forest	Proposed Reserve	Vested Forest + EFL	Total
9176.3016	295.3781	1837.7957	11309.4754
80.53%	3.22%	16.25%	100%

Source: Principal Chief Conservator of Forest, Kerala

3.9 Classification of Forest Area according to utilization as on 31.03.2011

Sl.No.	Mode of utilisation	Area (km^2)	% of total
1	Dense Forests / Degraded Forest	8982.9706	79.43
2	Plantation	1492.9166	13.20
3	Area under lease	423.2291	3.74
4	Forest land diverted under FCA	410.3591	3.63
Total		**11309.475411309.4754**	

Source: Principal Chief Conservator of Forest, Kerala

3.10 Range wise area of forests as on 31.03.2011

Sl. No.		Division/Range	Area (km^2)
1		**Thiruvananthapuram**	
	1	Kulathupuzha	219.6883
	2	Palode	107.5010
	3	Paruthippally	41.4110
		Total	**368.6003**
2		**Thenmala**	
	4	Ariyankavu	73.6660
	5	Thenmala	57.5010
		Total	**131.1670**
3		**Achancovil**	
	6	Achancovil	88.9550
	7	Kallar	78.9890
	8	Kanayar	116.5940
		Total	**284.5380**
4		**Ranni**	
	9	Ranni	136.2367
	10	Goodrikkal	653.9673
	11	Vadasserikkara	268.8600

Sl. No.		Division/Range	Area (km^2)
	Total		**1059.0640**
5	**Punalur**		
	12	Anchal	148.4120
	13	Pathanapuram	131.8080
	Total		**280.2200**
6	**Konni**		
	14	Konni	62.7280
	15	Naduvathumoozhi	138.9360
	16	Mannarappara	130.0000
	Total		**331.6640**
7	**Kothamangalam**		
	17	Thodupuzha	218.3896
	18	Kothamangalam	12.15310
	19	Kaliyar	49.0800
	20	Mullaringad	37.3800
	Total		**317.0027**
8	**Munnar**		
	21	Munnar	106.1900
	22	Devikulam	298.4130
	23	Adimali	110.8720
	24	Neriyamangalam	102.7400
	Total		**618.2150**
9	**Marayoor**		
	25	Marayoor	41.0410
	26	Kanthalloor	20.2670
	Total		**61.3080**
10	**Mankulam**		
	27	Mankulam	90.0600
	Total		**90.0600**
11	**Kottayam**		
	28	Erumeli	162.1830
	29	Ayyappancovil	88.0790
	30	Nagarampara	143.4000
	31	Kumili	265.5920
	Total		**659.2540**
12	**Vazhachal**		
	32	Charpa	59.9750
	33	Vazhachal	90.6430
	34	Sholayar	138.8800
	35	Kollathirumed	29.3480
	36	Athirappally	95.0980
	Total		**413.9440**
13	**Chalakudy**		
	37	Pariyaram	115.3118
	38	Palappilly	55.9971
	39	Vellikkulangara	108.4009
	Total		**279.7098**
14	**Malayattoor**		

Sl. No.		Division/Range	Area (km^2)
	40	Kalady	72.5149
	41	Kodanadu	56.7410
	42	Thundathil	131.4000
	43	Kuttampuzha	187.0400
	44	Edamalayar	170.0700
	Total		**617.7659**
15	**Thrissur**		
	45	Vadakkancherry	56.8530
	46	Pattikkad	167.5787
	47	Machad	73.6250
	Total		**298.0567**
16	**Mannarkkad**		
	48	Attappadi	169.4309
	49	Agali	129.0102
	50	Mannarkkad	124.0124
	Total		**422.4535**
17	**Nilambur North**		
	51	Nilambur	140.6156
	52	Edavanna	102.8365
	53	Vazhikadavu	155.1878
	Total		**398.6399**
18	**Nilambur South**		
	54	Kalikavu	59.6707
	55	Karulai	265.6076
	Total		**325.2782**
19	**Palakkad**		
	56	Olavakkode	80.1408
	57	Walayar	121.8025
	58	Ottappalam	33.5514
	Total		**235.4947**
20	**Nenmara**		
	59	Nelliyampathi	206.3626
	60	Kollengode	68.2413
	61	Alathur	81.1235
	Total		**355.7274**
21	**Kozhikkode**		
	62	Peruvannamoozhi	130.6934
	63	Kuttiyadi	44.8000
	64	Thamarassery	114.9580
	Total		**290.4514**
22	**Wayanad North**		
	65	Begoor	104.1612
	66	Periya	84.7323
	67	Manantavady	26.0472
	Total		**214.9407**
23	**Wyanad South**		
	68	Kalpetta	130.1101
	69	Meppady	133.0139

Sl. No.		Division/Range	Area (km^2)
	70	Chethalayam	84.5400
	Total		**347.6640**
24	**Kannur**		
	71	Kannavam	83.9893
	72	Kottiyoor	81.1969
	73	Thalipparamba	21.2659
	74	Kanjangad	59.3725
	75	Kasargod	60.4774
	Total		**306.3020**
	Wildlife Divisions		
25	**Thiruvananthapuram**		
	76	ABP, Kottoor	31.0000
	77	Neyyar Sanctuary	128.0000
	78	Peppara Sanctuary	53.0000
	Total		**212.0000**
26	**Shenduruney**		
	79	Shendurney Sancutuary	171.0000
	Total		**171.0000**
27	**Periyar East ,Thekkady**		
	80	Periyar	376.0000
	81	Thekkady	99.0000
	82	Vallakkadavu	143.0000
	Total		**618.0000**
28	**Periyar West, Peerumedu**		
	83	Pampa	90.0700
	84	Azhutha	66.9300
	Total		**157.0000**
29	**Idukki**		
	85	Idukki	105.3640
	86	Thattekkad	25.1600
	Total		**130.5240**
30	**Parambikulam**		
	87	Sunkom	81.7508
	88	Parambikulam	52.1800
	89	Orukkomban	71.8370
	90	Karimala	68.3730
	Total		**274.1408**
31	**Wayanad**		
	91	Tholpetty	77.6700
	92	Kurichiyatt	106.4500
	93	Muthanga	74.2900
	94	Bathery	86.0300
	Total		**344.4400**
32	**Silent Valley**		
	95	Silent Valley National Park	143.5200
	96	Bhavani	94.0000
	Total		**237.5200**
33	**Munnar**		

Sl. No.		Division/Range	Area (km^2)
	97	Eravikulam National Park	97.0000
	98	Chinnar Wild Life Sanctuary	90.4420
	99	Mathikettan Shola National Park	12.8100
	100	Anamudi Shola National Park	32.8400
	101	Pampadum Shola National Park	11.7530
	102	Kurinjimala Sanctuary	32.0000
	Total		**276.8450**
34	**Peechi**		
	103	Peechi	40.4174
	104	Chimmini	85.0670
	Total		**125.4844**
35	**Aralam**		
	105	Aralam	55.0000
	Total		**55.0000**
Grand Total			**11309.4754**

Source: Principal Chief Conservator of Forest, Kerala

3.11 District wise forest area (approx.) as on 31.03.2011

Sl. No.	District	Area (km^2)
1	Thiruvananthapuram	463.8341
2	Kollam	840.5672
3	Pathanamthitta	1533.7937
4	Kottayam	100.8450
5	Ernakulam	823.8302
6	Idukki	2713.7226
7	Thrissur	1022.7517
8	Palakkad	1527.3564
9	Malappuram	723.9181
10	Kozhikode	290.4514
11	Wayanad	907.0447
12	Kannur	241.4522
13	Kasaragode	119.8499
Total		**11309.4172**

Source: Principal Chief Conservator of Forest, Kerala

3.12 District wise Ecologically Fragile Land (EFL) Area

Sl. No.	District	Area (ha)
1	Thiruvanar.thapuram	881.7584
2	Kollam	273.7233
3	Idukki	1255.5515
4	Thrissur	70.7990
5	Palakkad	5177.5634
6	Malappuram	1265.1209
7	Kozhikode	1531.9014
8	Wayanad	2673.0326
9	Kannur	777.1344
10	Kasaragode	94.8827
Total		**14001.4676**

Source: Principal Chief Conservator of Forest, Kerala

3.13 Details of Encroachment

Circle	Encroachment to be evicted as on 01.01.2006	Evicted during 2006-2010	Regularised as per Forest Rights Act	Balance to be Evicted
Southern Circle, Kollam	18.9568	15.1600	0	3.7968
High Range Circle, Kottayam	1727.1602	95.1500	24.0000	1608.0102
Central Circle, Thrissur	276.0568	0	0	276.0568
Eastern Circle, Palakkad	3684.7010	10.5100	2101.780	1572.4110
Northern Circle, Kannur	1384.4413	62.8200	461.2200	860.4013
FDPT, Kottayam	5.0061	0	0	5.0061
Wildlife Circle (N), Palakkad	193.0155	0	0	193.0155
Total	**7289.3377**	**183.64**	**2587.00**	**4518.6977**

Source: FSI 2011

Forest Cover: The forest cover in the State based on the interpretation of Satellite Data of February 2009 is 17300 km^2 which is 44.52% of the State's geographical area. In terms of forest canopy density classes, the State has 1442 km^2 area under very dense forest, 9394 km^2

area under moderately dense forest and 6464 km^2 area under open forest. District wise forest cover in different canopy density classes are given in table below:

3.14 District wise Forest Cover in Kerala (km^2)

Sl. No	District	Geographic Area	2011 assessment				% to GA
			Very dense	Moderate dense	Open forest	Total	
1	Thiruvananthapuram	2192	55	824	470	1349	61.54
2	Kollam	2491	75	632	623	1330	53.39
3	Pathanamthitta	2642	144	1147	464	1755	66.43
4	Alappuzha	1414	0	12	26	38	2.69
5	Kottayam	2203	12	542	335	889	40.35
6	Idukki	5019	350	2159	1421	3930	78.30
7	Ernakulam	2407	12	298	385	695	28.87
8	Thrissur	3032	181	388	362	931	30.71
9	Palakkad	4480	276	693	606	1575	35.16
10	Malappuram	3550	144	406	659	1209	34.06
11	Kozhikode	2344	32	288	271	591	25.21
12	Wayanad	2131	140	1347	288	1775	83.29
13	Kannur	2966	21	351	269	641	21.61
14	Kasaragode	1992	0	307	285	592	29.72
State		**38863**	**1442**	**9394**	**6464**	**17300**	**44.52**

Note: The table reveals that there is a loss of forest cover to the extent of 24 km^2 as compared to previous assessment.

Source: FSI 2011

Plantation Area: The distribution of plantation area (category-wise) of species is given in table below:

3.15 Plantation Area of Species

Sl. No.	Plantation	Area (ha)	%
1	Hardwood	88449.813	59.25
2	Softwood	11851.917	7.94
3	Others	40162.252	26.90
4	Bamboo, Cane & Reed	8484.393	5.68
5	Mangrove	343.289	0.23
Total		**149291.664**	**100**

Source: FSI 2011

The species wise distribution of plantation area (ha) as on 31.03.11 is given in table 3.16

3.16 Species wise distribution of plantation area (ha)

Sl. No.	Species	Area (ha)	% to total Plantation	Sl. No.	Species	Area (ha)	% to total Plantation
1	Teak	76720.241	51.39	19	Anjali	583.421	0.39
2	Teakwood & Soft wood	15244.370	10.21	20	Kambakam	323.270	0.22
3	Accacia Mangium	4271.673	2.86	21	Elavu	781.930	0.52
4	Accacia Auriculiformis	6099.396	4.09	22	Rubber	86.470	0.06
5	Eucaliptus	7120.073	4.77	23	Balsa	41.200	0.03
6	Cane	3047.246	2.04	24	Wattle	2194.910	1.47
7	Bamboo	5209.357	3.49	25	Matti	510.620	0.34
8	Rosewood	39.545	0.03	26	Cashew	4799.953	3.22
9	Mahagani	103.740	0.07	27	Agave	47.000	0.03
10	Sandalwood	100.980	0.07	28	Alnus	74.350	0.05
11	Other Hardwood	207.547	0.14	29	Sesbania	21.070	0.01
12	Reeds	227.790	0.15	30	Casuarina	112.630	0.08
13	Cinnamon	3.740	0.00	31	Misc	16969.920	11.37
14	Pepper	142.540	0.10	32	Silver Oak	75.030	0.05
15	Medicinal Plants	2345.083	1.57	33	Mangroves	343.289	0.23
16	Gravelia Robesta	418.568	0.28	34	Fruit bearing	326.566	0.22
17	Pine	547.576	0.37				
18	Albezzia	150.570	0.10		**Total**	**149291.664**	

Source: FSI 2011

3.17 Classification of Forest Types as on 31.03.2011

Sl. No.	Type	Area(km2)	% of total
1	Tropical Wet Evergreen and Semi Evergreen	3877.4413	34.28
2	Tropical Moist Deciduous	3615.9840	31.97
3	Tropical Dry Deciduous	391.3636	3.46
4	Montane Sub-tropical Temperate sholas	386.4210	3.42
5	Plantations	1492.9166	13.20
6	Grass Lands	501.0865	4.43
7	Others	1044.2624	9.24
	Total	**11309.4752**	

Source: Principal Chief Conservator of Forest, Kerala

3.18 Production for Major Forest Produce (2000-01 to 2009-10)

Sl. No.	Item	Unit	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10
1	Timber (round logs)	Cum.	31000	39000	63000	71436.073	45012.20	42705.69	26774.36	48627.83	50300.79	51665.55
2	Timber (round poles)	No.	129000	245000	434000	1333825	438611	377953	296013	352896	294289	281154
3	Timber (Swan& Squard)	Cum.	3	9	11	112.220	45.09	603.03	17.29	23.35	299.07	76.69
4	Fire wood	MT	8000	11000	17000	29974	10636.04	13955.46	12748.40	12676.41	9217.50	19256.63
5	Caradamom	Kg.	4687	2911.5	3739.4	1181	11018.30	1807.50	2053	38.00	0	0
6	Honey	Kg.	47976	57068.95	36846.29	40050	59464.11	56982.97	197237.25	97015.45	79081	74398.20
7	Reeds	No.	49000000	3330000	33100000	44666415	34190835	22901309	21403530	15246981	19575186	14855403
8	Bamboo	No.	1390000	821000	4000	439019	1272444	1824596	1237030	1551168	1897907	695852
9	Jungle Wood Poles	No.	212	2397	17651	10464	14196	21131	21221	2044	21450	7411
10	Sandal wood	Kg.	400	24000	10000	88820.200	54622.30	78554.52	3159.35	17537.10	30808.63	51120

Source: Principal Chief Conservator of Forest, Kerala

3.19 Forest Fire Statistics

Year	Number of Incidents	Area destroyed by Fire(ha)	Financial Loss(Rs)
2007-08	**344**	**2381.544**	**55371.000**
2008-09	**871**	**5473.858**	**83580.000**
2009-10	**596**	**2333.824**	**59700.000**
2010-11	**460**	**2364.414**	**67895.000**

Source: Principal Chief Conservator of Forest, Kerala

3.20 Production of Fisheries in Kerala

Year	Marine	Inland	Total
2002-03	603286	75036	678322
2003-04	608525	76279	684804
2004-05	601863	76451	678314
2005-06	558913	77980	636893
2006-07	598057	79647	677704
2007-08	586286	91085	677371
2008-09	583150	102842	685992
2009-10	570013	116836	686849
2010-11	560938	121215	682153
2011-12	553177	140031	693208

Source: Department of Fisheries

3.21 Marine Fishery Resources of Kerala (2011-2012)

Sl. No.	District	Coastal Length (Km)	No of Fishing Villages-Marine	No of Fish Villages-Inland
1.	Thiruvananthapuram	78	42	4
2.	Kollam	37	27	26
3	Pathanamthitta	-	-	3
4.	Alappuzha	82	30	24
5.	Kottayam	-	-	8
6.	Idukki	-	-	1

7.	Eranakulam	46	21	15
8.	Thrissur	54	18	8
9.	Palakkad	-	-	2
10.	Malappuram	70	23	6
11.	Kozhikode	71	34	8
12.	Wayanad	-	-	1
13.	Kannur	82	11	5
14.	Kasaragod	70	16	2
	Total	590	222	113

Source: Department of Fisheries

3.22 -Fishermen population in Kerala

Sl. No.	Districts	2005-'06	2006-'07	2007-'08
1	Thiruvananthapuram	179011	181435	183181
2	Kollam	97670.	99276	100231
3	Alappuzha	11743 .4	118960	120104
4	Ernakulam	77763	78736	79493
5	Thrissur	78671	78736	79494
6	Malappuram	85553	86440	87270
7	Kozhikode	104103	105267	106281
8	Kannur	59434	59907	60484
9	Kasaragode	46449	47071	47523

Source: Department of Fisheries

3.23 Inland Fish Production and value in Kerala from 2000-2001 to 2011-2012

Year	Quantity(in M.T)	Value(Rs.in Lakhs)
2000-2001	85234	29995.20
2001-2002	78039	28867.00
2002-2003	75036	30014.00
2003-2004	76279	31890.16
2004-2005	76451	59851.46
2005-2006	77980	60415.54
2006-2007	79647	67658.18
2007-2008	91085	71813.13
2008-2009	102842	75778.87
2010-2011	121215	102124
2011-2012	140031	122390

Source: Department of Fisheries

3.24 Livestock and Poultry Population

(Numbers in thousands)

Sl. No.	Particulars	2003	2007
1.	**Cattle**		
	Adult Males	30	20
	Adult Females(i) in milk	714	611
	(ii) dry and not calved	301	232
	(iii) others	31	26
	Young stock	1047	851
	Total	**2123**	**1740**
2.	**Buffaloes**		
	Adult Males	12	5
	Adult Females(i) in milk	13	10
	(ii) dry and not calved	7	6
	(iii) others	2	1
	Young stock	32	36
	Total	66	58
3.	Sheep & Goats	1217	1730
4.	Pigs	76	59
5.	Total Poultry(excluding Broilers)	12215	13093
	Total Livestock	**13574**	**14940**

Source: Directorate of Animal Husbandry

3.25 District wise Livestock and Poultry Population

Sl. No.	District	Area in sq.km	Total Livestock population as per 2007 census	Density per sq.Km	Total poultry	Density per sq.km
1	Thiruvananthapuram	2192	341285	155.70	1272291	580.42
2	Kollam	2491	255773	102.68	766412	307.67
3	Pathanamthitta	2642	188143	71.21	694432	262.84
4	Alappuzha	1414	158657	112.20	1107523	783.26
5	Kottayam	2203	258011	117.12	1076450	488.63
6	Idukki	5019	39098	63.58	609986	121.54
7	Eranakulam	2407	332337	138.07	1172780	487.24
8	Thrissur	3032	320675	105.76	1267838	418.15
9	Palakkad	4480	325807	72.72	1425088	318.10
10	Malappuram	3550	369924	104.20	1522817	428.96
11	Kozhikode	2344	224423	95.74	811470	346.19
12	Wayanad	2131	146106	68.56	383723	180.07
13	Kannur	2966	212851	71.76	528932	178.33
14	Kasaragod	1992	134362	67.45	453806	227.81
	Total	**38863**	**3587452**	**92.31**	**13093548**	**336.92**

Source: Directorate of Animal Husbandry

3.26 Live Stock Population as per 2007 Census

Sl. No.	District	Cattle			Buffaloes	Sheep	Goats	Pigs		
		Crossbred	Indigenous	Total				Crossbred	Indigenous	Total
1	Thiruvananthapuram	146556	1829	148385	2755		188612	1218	1528	2746
2	Kollam	123303	1087	124390	4475		125905	973	1003	1976
3	Pathanamthitta	97500	825	98325	856		88054	782	908	1690
4	Alappuzha	77891	154	78045	3070		76957	585	585	1170
5	Kottayam	121958	635	122593	1921		124442	6249	9054	15303
6	Idukki	147159	10442	157601	2713	20	140723	15983	18040	34023
7	Eranakulam	150407	4577	154984	5111		166672	4416	5565	9981
8	Thrissur	130599	4070	134669	8102	6	170263	7107	7615	14722
9	Palakkad	196142	18953	215095	6871	131	101829	1493	1842	3335
10	Malappuram	97528	7801	105329	13532	257	248403	2197	2401	4598
11	Kozhikode	110016	23478	133494	1495		86925	2422	2509	4931
12	Kannur	115334	3810	119144	733		88941	3778	4031	7809
13	Wayanad	60965	4494	65459	2880	190	75375	1839	2196	4035
14	Kasaragod	45887	36717	82604	3631	361	46026	1421	1740	3161
	Total	**1621245**	**118872**	**1740117**	**58145**	**965**	**1729127**	**50463**	**59017**	**109480**

Source: Directorate of Animal Husbandry

3.27 Poultry Population

Sl. No.	District	Fowls		Ducks	Others	Total Poultry
		Desi	Improved			
1	Thiruvananthapuram	732701	461489	30056	48045	1272291
2	Kollam	284771	378397	71019	32225	766412
3	Pathanamthitta	385920	245494	46824	16194	694432
4	Alappuzha	431186	265109	383023	28205	1107523
5	Kottayam	822689	162916	66987	23858	1076450
6	Idukki	463617	104943	19012	22414	609986
7	Eranakulam	803424	237114	71070	61172	1172780
8	Thrissur	965649	180439	57370	64380	1267838
9	Palakkad	1219211	140065	38469	27343	1425088
10	Malappuram	1201925	221334	54908	44650	1522817
11	Kozhikode	645477	135336	10773	19884	811470
12	Wayanad	410761	102748	4689	10734	528932
13	Kannur	302902	66523	9005	5293	383723
14	Kasaragod	417375	30861	2126	3444	453806
	Total	**9087608**	**2732768**	**865331**	**407841**	**13093548**

Source: Directorate of Animal Husbandry

3.28 District-wise and Disease-wise number of out break, attacks and death in Kerala during 2010-11

Sl. No.	District	Canaine Distember			Purvo Virus			Ranikhet			Fowl pox	
		OB	AT	DT	OB	AT	DT	OB	AT	DT	OB	AT
1	Thiruvananthapuram	2	57	17	0	73	0	0	99	90	0	16
2	Kollam	0	0	0	0	0	0	4	229	128	5	259
3	Pathanamthitta	0	0	0	0	0	0	0	0	0	0	0
4	Alappuzha	0	0	0	0	0	0	0	0	0	0	0
5	Kottayam	0	0	0	0	0	0	12	30	482	0	0
6	Idukki	0	0	0	0	0	0	1	18	3	0	0
7	Eranakulam	1	6	3	0	0	0	0	0	0	0	0
8	Thrissur	12	15	3	15	33	7	23	1968	345	10	94
9	Palakkad	20	22	15	10	12	1	9	264	12	13	183
10	Malappuram	2	0	0	1	0	0	9	0	0	2	0
11	Kozhikode	0	0	0	0	0		0	0	0	0	0
12	Wayanad	0	0	0	0	0	0	3	0	0	0	0
13	Kannur	0	0	0	1	13	0	0	9	0	6	15
14	Kasaragod	1	12	3	0	0	0	0	0	0	0	0
	Total	38	112	41	27	131	8	61	2617	1060	36	567

Source: Directorate of Animal Husbandry

CHAPTER - IV

ATMOSPHERE

Atmosphere is composed of air containing Nitrogen, oxygen Argon and Carbon dioxide constituting 78%, 21%.0.93%and0.03%respectively.Helium.Methane,Krypton,Hydrogen,Xenon and ozone constituting the remaining 0.04%It becomes progressively thinner as its distance from the earth increases with varying temperature gradients.

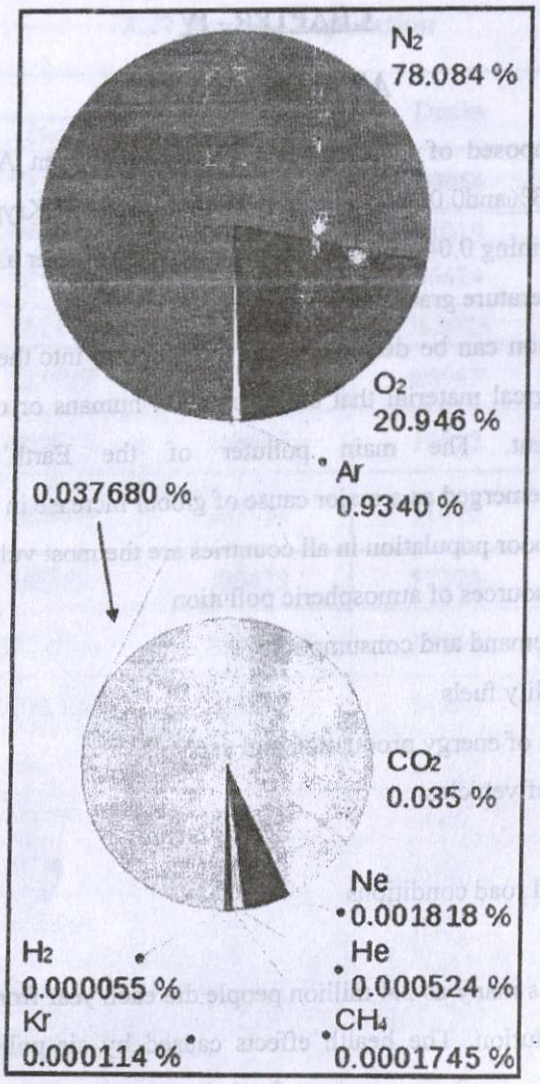
Atmospheric pollution can be defined as the introduction into the atmosphere of chemicals, particulate matter, or biological material that are harmful to humans or other living organisms and damaging the environment. The main polluter of the Earth's atmosphere is man. Environmental factors have emerged as a major cause of global increase in illness and deaths. Most of them are avoidable and the poor population in all countries are the most vulnerable victims.

The following are the main sources of atmospheric pollution

a) Increasing energy demand and consumption
b) The use of poor quality fuels
c) In-efficient methods of energy production and use
d) Increasing number of vehicles
e) Traffic congestion
f) Poor automobile and road conditions
g) Forest fire

It is estimated that as many as 2.4 million people die each year from diseases caused, or made worse, by atmospheric pollution. The health effects caused by air pollution include difficulty in breathing, wheezing, coughing and aggravation of existing respiratory and cardiac conditions. These effects can result in increased medication use, increased doctor or emergency room visits, more hospital admissions and premature death. Despite all of this knowledge, humans are slow to change their ways and habits. Atmospheric pollution will be a problem for generations to come. Hopefully, we as a species will eventually stop harming ourselves and our planet.

Vehicular pollution is a major culprit. Motor vehicles are the major sources of air pollution, besides industrial emissions from hazardous industries.Muncipal solid waste, Muncipal sewage waste; Hazardous industrial waste and Bio medical waste are the main causes for the pollution of water bodies.



4.1 Average Gaseous composition of Dry air in the Troposphere

Gas	Percent by volume (%)	Parts per million(ppm)
Nitrogen	78.080000	780840.00
Oxygen	20.946000	209460.00
Argon	0.934000	9340.00
Carbon dioxide	0.039000	390.00
Neon	0.001818	18.18
Helium	0.000524	5.24
Methane	0.000179	1.79
Krypton	0.000114	1.14
Hydrogen	0.000055	0.55
Xenon	0.000009	0.09
Ozone	Variable	~0.001- 0.3 (variable)

Source: Compendium of Environment Statistics 2011

source: en.wikipedia.org/wiki/**Atmosphere** of Earth

4.2 Pollutants and their Related Health Hazards

Sl. No.	Pollutants	Affects on Human Health
1	Carbon Monoxide	Affects the cardiovascular system
2	Nitrogen Oxide	Affects the respiratory system
3	Ozone	Causes increased sensitivity to infections, lung diseases, irritation in eyes, nose and throat
4	Sulphur Dioxide	Affects the functions of lungs
5	Suspended Particulate Matter(SPM)	Small particles are poisonous. They are carriers of carcinogenic transfer elements
6	Volatile Organic Substances(VOC)	Eg.Benzene are carcinogenic

4.3 STATE OF AMBIENT AIR QUALITY IN MAJOR CITIES OF KERALA UPTO 2012

1. Sulphur Dioxide (SO_2) in ug/m^3

THIRUVANANTHAPURAM											
SO_2 (Annual Average)											
Sl. No.	City	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1.	Veli (Industrial Area)	15.5	19.8	22	20	23.2	21.4	18.8	17.6	15.799	16.15
2.	S.M.V. School, Overbridge (Sensitive Area)	11.9	13.7	9	8	6.5	7.2	6.9	7.1	6.743	6.90
3.	Cosmo Hospital (Sensitive Area)								7.1	6.4488	6.50
4.	Pettah (Residential Area)								6.7	6.3341	6.65

1. Sulphur Dioxide (SO_2) in ug/m^3

KOLLAM											
SO_2 (Annual Average)											
Sl. No.	City	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1.	Chavara (Industrial Area)								2.7	3.47	3.64
2.	Kadapakkada (Residential Area)								3.1	2.08	3.28

1. Sulphur Dioxide (SO_2) in ug/m^3

PATHANAMTHITTA											
SO_2 (Annual Average)											
Sl. No.	City	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1.	Makkamkunnu (Residential Area)								5.0	2.00	2

1. Sulphur Dioxide (SO_2) in ug/m^3

ALAPPUZHA											
SO_2 (Annual Average)											
Sl. No.	City	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1.	Station at D.C.Mills (Industrial Area)								2.5	2.0	2
2.	Station at Alissery (Commercial Area)								2.5	*	*
3.	Thondamkulangara (Industrial Area)									2.00	2

* In 2010 and 2011, Station at Alissery has been changed to Thondamkulangara.

1. Sulphur Dioxide (SO_2) in ug/m^3

KOTTAYAM											
SO_2 (Annual Average)											
Sl. No.	City	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1.	Nagampadam (Residential/Commercial Area)	2	2	2	5	5.8	5.3	6.1	5.9	6.09	5.5
2.	Vadavathoor (Industrial Area)	2	2	2	4	4.8	6.2	5.5	5	4.94	4.42

1. Sulphur Dioxide (SO_2) in ug/m^3

IDUKKI											
SO_2 (Annual Average)											
Sl. No.	City	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1.	Thodupuzha (Commercial Area)								2.2	2.08	2.64
2.	Munnar (Sensitive Area)								2	*	*

* Station has been deleted.

1. Sulphur Dioxide (SO_2) in ug/m^3

ERNAKULAM											
SO_2 (Annual Average)											
Sl. No.	City	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1.	M.G. Road (Commercial Area)								3.8	17.6	4.27
2.	Near South Overbridge (Residential Area)								4.1	17.6	3.59
3.	Vytilla (Commercial Area)								4.3	17.6	3.9
4.	Irumpanam (Industrial Area)	2.9	4.8	6.2	5.4	4.8	2.2	4.2	3.5	17.6	3.16
5.	Kalamassery (Industrial Area)								4.5	17.6	3.8

6.	Eloor-Methanam (Residential Area)	30.4	29.7	56.7	42.9	29.7	14.5	3.9	2	17.6	2.24
7.	Eloor-TCC (Industrial Area)								2	17.6	2.55

1. Sulphur Dioxide (SO_2) in ug/m^3

THRISSUR

SO_2 (Annual Average)

Sl. No.	City	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1.	Poonkunnam (Residential Area)								2	2.00	2.2

1. Sulphur Dioxide (SO_2) in ug/m^3

PALAKKAD

SO_2 (Annual Average)

Sl. No.	City	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1.	Kanjikode (Industrial Area)		4.2	2	2	3.2	4.2	3	2.4	3.22	2.99

1. Sulphur Dioxide (SO_2) in ug/m^3

MALAPPURAM

SO_2 (Annual Average)

Sl. No.	City	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1.	Kakkanchery (Industrial Area)								2	2.00	2.0

1. Sulphur Dioxide (SO_2) in ug/m^3

KOZHIKODE

SO_2 (Annual Average)

Sl. No.	City	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1.	Palayam (Commercial Area)	2	2	2	2	2	2	2	2	3.59	2.6
2.	Nallalam (Industrial Area)	2	2	2	2	2	2	2	2	2.00	2

1. Sulphur Dioxide (SO_2) in ug/m^3

WAYANAD

SO_2 (Annual Average)

Sl. No.	City	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1.	Sulthan Bathery (Sensitive Area)								2.8	2.07	2.04

1. Sulphur Dioxide (SO_2) in ug/m^3

KANNUR											
SO_2 (Annual Average)											
Sl. No.	City	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1.	Kannur (Comercial Area)								2.8	2.04	2.2
2.	Mangattuparambu (Commercial Area)								2	2.09	2.4

1. Sulphur Dioxide (SO_2) in ug/m^3

KASARGODE											
SO_2 (Annual Average)											
Sl. No.	City	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1.	Kasargode (Commercial Area)								2	2.25	2.4
2.	Kanhangad (Commercial Area)								2	2.25	2.40

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2. Oxides of Nitrogen (NO_x) in ug/m^3

THIRUVANANTHAPURAM											
NO_X (Annual Average)											
Sl. No.	City	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1.	Veli (Industrial Area)	15.6	17.6	18	19	18.3	17.6	19.2	18.1	18.434	17.44
2.	S.M.V. School, Over bridge (Sensitive Area)	13.4	20	18	28	27.2	26.4	29.2	29.5	27.185	27.39
3.	Cosmo Hospital (Sensitive Area)								27.4	25.874	25.73
4.	Pettah (Residential Area)								26.7	25.369	24.64

2. Oxides of Nitrogen (NO_x) in ug/m^3

KOLLAM											
NO_X (Annual Average)											
Sl. No.	City	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1.	Chavara (Industrial Area)								9.2	9.96	17.27
2.	Kadapakkada (Residential Area)								13.1	18.76	22.14

2. Oxides of Nitrogen (NO_x) in ug/m^3

PATHANAMTHITTA											
NO_X (Annual Average)											
Sl. No.	City	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1.	Makkamkunnu (ResidentialArea)								18.1	13.44	13.13

2. Oxides of Nitrogen (NO_x) in ug/m^3

ALAPPUZHA											
NO_X (Annual Average)											
Sl. No.	City	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1.	Station at D.C.Mills (Industrial Area)								7.8	4.61	4.5
2.	Station at Alissery (Commercial Area)								7	*	*
3.	Thondamkulangara (Industrial Area)									4.60	4.5

* In 2010 and 2011, Station at Alissery has been changed to Thondamkulangara.

2. Oxides of Nitrogen (NO_x) in ug/m^3

KOTTAYAM											
NO_X (Annual Average)											
Sl. No.	City	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1.	Nagampadam (Residential/Commercial Area)	10.4	15.9	21	23	22.6	20.8	22.8	23.1	23.89	20.74
2.	Vadavathoor (Industrial Area)	6.4	4.5	4.5	14	14.7	15.9	14.5	15.4	14.41	12.31

2. Oxides of Nitrogen (NO_x) in ug/m^3

IDUKKI											
NO_X (Annual Average)											
Sl. No.	City	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1.	Thodupuzha (Commercial Area)								14.4	12.14	8.15
2.	Munnar (Sensitive Area)								12.2	*	*

* Station has been deleted.

2. Oxides of Nitrogen (NO_x) in ug/m^3

ERNAKULAM											
NO_X (Annual Average)											
Sl. No.	City	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1.	M.G. Road (Commercial Area)								15.7	18.1	19.3
2.	Near South Overbridge (Residential Area)								18.5	18.1	17.2

3.	Vytilla (Commercial Area)								14.3	18.1	15.31
4.	Irumpanam (Industrial Area)	5.9	9.8	12.5	9.5	5.9	7.1	10.1	10.6	18.1	12.04
5.	Kalamassery (Industrial Area)								12.5	18.1	15.2
6.	Eloor-Methanam (Residential Area)	9.8	28.2	14.6	15.9	10.4	9	5.2	6.5	18.1	5.04
7.	Eloor-TCC (Industrial Area)								6.4	18.1	5.18

2. Oxides of Nitrogen (NO_x) in ug/m^3

THRISSUR											
NO_X (Annual Average)											
Sl. No.	**City**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
1.	Poonkunnam (Residential Area)								13.2	6.75	13.12

2. Oxides of Nitrogen (NO_x) in ug/m^3

PALAKKAD											
NO_X (Annual Average)											
Sl. No.	**City**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
1.	Kanjikode (Industrial Area)	7.2	10.1	4.5	4.5	5.9	6.7	7.1	6.5	6.17	8.86

2. Oxides of Nitrogen (NO_x) in ug/m^3

MALAPPURAM											
NO_X (Annual Average)											
Sl. No.	**City**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
1.	Kakkanchery (Industrial Area)								4.8	4.53	5.9

2. Oxides of Nitrogen (NO_x) in ug/m^3

KOZHIKODE											
NO_X (Annual Average)											
Sl. No.	**City**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
1.	Palayam (Commercial Area)	8.4	4.5	4.5	4.5	8.4	5.9	9.7	17.1	8.49	8.3
2.	Nallalam (Industrial Area)	8	4.5	4.5	4.5	4.5	4.5	7.9	9.2	9.78	7.46

2. Oxides of Nitrogen (NO_x) in ug/m^3

WAYANAD											
NO_X (Annual Average)											
Sl. No.	**City**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
1.	Sulthan Bathery (Sensitive Area)								9.8	12.32	11.53

2. Oxides of Nitrogen (NO_x) in ug/m^3

KANNUR											
NO_X (Annual Average)											
Sl. No.	City	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1.	Kannur (Comercial Area)								9.8	5.72	6.55
2.	Mangattuparambu (Commercial Area)								5.4	7.32	5.24

2. Oxides of Nitrogen (NO_x) in ug/m^3

KASARGODE											
NO_X (Annual Average)											
Sl. No.	City	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1.	Kasargode (Commercial Area)								9.9	13.51	12.17
2.	Kanhangad (Commercial Area)								5.9	11.36	10.24

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3. Respirable Suspended Particular Matter (RSPM) in ug/m^3

THIRUVANANTHAPURAM											
RSPM (Annual Average)											
Sl. No.	City	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1.	Veli (Industrial Area)		140	126	112	106	98	86	78	63.70	67.27
2.	S.M.V. School, Overbridge (Sensitive Area)		126	125	93	92	88	60	62	56.20	56.68
3.	Cosmo Hospital (Sensitive Area)								56	50.330	51.05
4.	Pettah (Residential Area)								53	49.134	49.15

3. Respirable Suspended Particular Matter (RSPM) in ug/m^3

KOLLAM											
RSPM (Annual Average)											
Sl. No.	City	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1.	Chavara (Industrial Area)								50	30.97	57.25
2.	Kadapakkada (Residential Area)								57	57.88	51.06

3. Respirable Suspended Particular Matter (RSPM) in ug/m^3

PATHANAMTHITTA											
RSPM (Annual Average)											
Sl. No.	City	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1.	Makkamkunnu (Residential Area)								31	27.25	22.2

3. Respirable Suspended Particular Matter (RSPM) in ug/m^3

ALAPPUZHA										
RSPM (Annual Average)										
Sl. No.	City	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1.	Station at D.C.Mills (Industrial Area)								56	48.90	44.4
2.	Station at Alissery (Commercial Area)								57	*	*
3.	Thondamkulangara (Industrial Area)									39.64	39.5

* In 2010 and 2011, Station at Alissery has been changed to Thondamkulangara.

3. Respirable Suspended Particular Matter (RSPM) in ug/m^3

KOTTAYAM										
RSPM (Annual Average)										
Sl. No.	City	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1.	Nagampadam (Residential/ Commercial Area)		66	49	48	49	54	56	50	53.96	49.4
2.	Vadavathoor (Industrial Area)		48	46	31	38	42	35	36	40.94	43.6

3. Respirable Suspended Particular Matter (RSPM) in ug/m^3

IDUKKI										
RSPM (Annual Average)										
Sl. No.	City	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1.	Thodupuzha (Commercial Area)								20	22.34	16.99
2.	Munnar (Sensitive Area)								25	*	*

* Station has been deleted.

3. Respirable Suspended Particular Matter (RSPM) in ug/m^3

ERNAKULAM										
RSPM (Annual Average)										
Sl. No.	City	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1.	M.G. Road (Commercial Area)								37	78	39.9
2.	Near South Overbridge (Residential Area)								41	78	52.5
3.	Vytilla (Commercial Area)								41	78	46.5
4.	Irumpanam (Industrial Area)	67	42	62	61	58	42	38	37	78	37.4
5.	Kalamassery (Industrial Area)								40	78	58.6
6.	Eloor-Methanam (Residential Area)	145	61	64	70	77	47	46	51	78	16.73
7.	Eloor-TCC (Industrial Area)								49	78	18.3

3. Respirable Suspended Particular Matter (RSPM) in ug/m^3

THRISSUR											
RSPM (Annual Average)											
Sl. No.	City	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1.	Poonkunnam (Residential Area)								56	24.27	32.1

3. Respirable Suspended Particular Matter (RSPM) in ug/m^3

PALAKKAD											
RSPM (Annual Average)											
Sl. No.	City	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1.	Kanjikode (Industrial Area)	43	32	107	145	72	60	45	51	32.39	22.95

3. Respirable Suspended Particular Matter (RSPM) in ug/m^3

MALAPPURAM											
RSPM (Annual Average)											
Sl. No.	City	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1.	Kakkanchery (Industrial Area)								29	30.12	32.2

3. Respirable Suspended Particular Matter (RSPM) in ug/m^3

KOZHIKODE											
RSPM (Annual Average)											
Sl. No.	City	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1.	Palayam (Commercial Area)	22	28	55	67	52	48	40	32	44.56	35.59
2.	Nallalam (Industrial Area)	27	38	58	68	51	37	25	28	38.69	56.6

3. Respirable Suspended Particular Matter (RSPM) in ug/m^3

WAYANAD											
RSPM (Annual Average)											
Sl. No.	City	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1.	Sulthan Bathery (Sensitive Area)								52	45.74	28.5

3. Respirable Suspended Particular Matter (RSPM) in ug/m^3

KANNUR											
RSPM (Annual Average)											
Sl. No.	City	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1.	Kannur (Comercial Area)								52	38.76	42.46
2.	Mangattuparambu (Commercial Area)								41	35.47	43.4

3. Respirable Suspended Particular Matter (RSPM) in ug/m^3

KASARGODE											
RSPM (Annual Average)											
Sl. No.	City	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1.	Kasargode (Commercial Area)								57	52.62	55.7
2.	Kanhangad (Commercial Area)								42	50.59	49.9

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4. Total Suspended Particulate Matter (TSPM) in ug/m^3

THIRUVANANTHAPURAM											
TSPM (Annual Average)											
Sl. No.	City	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1.	Veli (Industrial Area)		158	134	122	116	114	97	88	84.33	As per revised National Ambient Air Quality Standards, standard for SPM has been removed.
2.	S.M.V. School, Overbridge (Sensitive Area)		138	134	102	103	96	80	72	64.54	
3.	Cosmo Hospital (Sensitive Area)								65	59.055	
4.	Pettah (Residential Area)								62	57.399	

4. Total Suspended Particulate Matter (TSPM) in ug/m^3

KOLLAM											
TSPM (Annual Average)											
Sl. No.	City	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1.	Chavara (Industrial Area)								80	51.01	As per revised National Ambient Air Quality Standards, standard for SPM has been removed.
2.	Kadapakkada (Residential Area)								95	108.39	

4. Total Suspended Particulate Matter (TSPM) in ug/m^3

PATHANAMTHITTA											
TSPM (Annual Average)											
Sl. No.	City	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1.	Makkamkunnu (Residential Area)								39	42.62	As per revised National Ambient Air Quality Standards, standard for SPM has been removed.

4. Total Suspended Particulate Matter (TSPM) in ug/m^3

ALAPPUZHA											
TSPM (Annual Average)											
Sl. No.	City	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1.	Station at D.C.Mills (Industrial Area)								110	76.21	As per revised National Ambient Air Quality Standards, standard for SPM has been removed.
2.	Station at Alissery (Commercial Area)								114	*	
3.	Thondamkulangara (Industrial Area)									71.03	

* In 2010 and 2011, Station at Alissery has been changed to Thondamkulangara.

4. Total Suspended Particulate Matter (TSPM) in ug/m^3

KOTTAYAM											
TSPM (Annual Average)											
Sl. No.	City	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1	Nagampadam (Residential / Commercial Area)		78	61	54	52	62	60	53	56.86	As per revised National Ambient Air Quality Standards, standard for SPM has been removed.
2	Vadavathoor (Industrial Area)		62	55	35	48	51	38	38	43.11	

4. Total Suspended Particulate Matter (TSPM) in ug/m^3

IDUKKI											
TSPM (Annual Average)											
Sl. No.	City	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1	Thodupuzha (Commercial Area)								32	34.76	As per revised National Ambient Air Quality Standards, standard for SPM has been removed.
2	Munnar (Sensitive Area)								37	*	

* Station has been deleted.

4. Total Suspended Particulate Matter (TSPM) in ug/m^3

ERNAKULAM											
TSPM (Annual Average)											
Sl. No.	City	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1	M.G. Road (Commercial Area)								63	88	As per revised National Ambient Air Quality Standards, standard for SPM has been removed.
2	Near South Overbridge (Residential Area)								78	88	
3	Vytilla (Commercial Area)								61	88	
4	Irumpanam (Industrial Area)	130	107	113	114	71	76	60	55	88	
5	Kalamassery (Industrial Area)								61	88	
6	Eloor-Methanam (Residential Area)	241	122	131	120	128	81	92	104	88	
7	Eloor-TCC (Industrial Area)								118	88	

4. Total Suspended Particulate Matter (TSPM) in ug/m^3

THRISSUR											
TSPM (Annual Average)											
Sl. No.	City	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1	Poonkunnam (Residential Area)								114	68.45	As per revised National Ambient Air Quality Standards, standard for SPM has been removed.

4. Total Suspended Particulate Matter (TSPM) in ug/m^3

PALAKKAD											
TSPM (Annual Average)											
Sl. No.	City	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1.	Kanjikode (Industrial Area)	172	207	191	173	140	131	145	125	61.46	As per revised National Ambient Air Quality Standards, standard for SPM has been removed.

4. Total Suspended Particulate Matter (TSPM) in ug/m^3

MALAPPURAM											
TSPM (Annual Average)											
Sl. No.	City	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1	Kakkanchery (Industrial Area)								72	43.38	As per revised National Ambient Air Quality Standards, standard for SPM has been removed.

4. Total Suspended Particulate Matter (TSPM) in ug/m^3

KOZHIKODE											
TSPM (Annual Average)											
Sl. No.	City	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1	Palayam (Commercial Area)	83	98	89	126	88	77	83	70	85.07	As per revised National Ambient Air Quality Standards, standard for SPM has been removed.
2	Nallalam (Industrial Area)	95	106	75	103	98	84	75	71	79.73	

4. Total Suspended Particulate Matter (TSPM) in ug/m^3

WAYANAD											
TSPM (Annual Average)											
Sl. No.	City	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1.	Sulthan Bathery (Sensitive Area)								67	69.66	As per revised National Ambient Air Quality Standards, standard for SPM has been removed.

4. Total Suspended Particulate Matter (TSPM) in ug/m^3

KANNUR											
TSPM (Annual Average)											
Sl. No.	City	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1.	Kannur (Comercial Area)								67	50.78	As per revised National Ambient Air Quality Standards, standard for SPM has been removed.
2.	Mangattuparambu (Commercial Area)								50	47.46	

4. Total Suspended Particulate Matter (TSPM) in $\mu g/m^3$

KASARGODE											
TSPM (Annual Average)											
Sl. No.	**City**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
	Kasargode (Commercial Area)								103	79.63	As per revised National Ambient Air Quality Standards, standard for SPM has been removed.
	Kanhangad (Commercial Area)								79	94.31	

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4.4 NATIONAL AMBIENT AIR QUALITY STANDARDS

Sl. No.	Industrial Areas	Industrial, Re idential, Rural & Other Area	Ecologically Sensitive Area
1.	Particulate Matter (Size less than 10μm) or PM_{10} $\mu g/m^3$	100	100
2.	Particulate Matter (Size less than 2.5μm) or $PM_{2.5}$ $\mu g/m^3$	60	60
3.	Sulphur Dioxide-120 $\mu g/m^3$	80	80
4.	Nitrogen Oxide-120 $\mu g/m^3$	80	80

Source: Kerala State Pollution Control Board

4.5 Category-wise Growth of Motor vehicles in Kerala from 2001 to 2011

Sl. No.	Type of vehicles	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11
1	**Goods Vehicles**											
	Four wheelers and above	142168	146719	152802	161043	173110	194232	211175	227454	246687	262824	294395
	Three wheelers including tempos	31688	37457	42561	50455	61081	70030	83316	94532	100919	108104	117266
2.	**Buses**											
	Stage carriages	25161	26899	29149	31889	33776	35206	37076	39763	41998	43727	46594
	Contract carriages/ Omni	40520	45067	50464	55358	61750	92368	101840	108230	110833	114351	119150
3.	**Cars and station wagons**											
	Cars	282996	305837	336240	378955	428309	498472	567294	654582	767753	901663	1060861
	Stationwagons	0	0	0	0	0	0	0	0	0	0	0
	Taxis	75628	82236	88236	93458	99656	119753	127873	134650	142054	151533	163407
	Jeep	69621	70212	70885	71656	72245	73158	73680	75360	73698	73700	73700
4.	**Three wheelers**											
	Auto rickshaws	**248350**	**265767**	**285149**	**303092**	**320788**	**342466**	**368706**	**391100**	**422905**	**466135**	**518741**
	Rickshaws	**58**	**63**	**63**	**63**	**63**	**61**	**61**	**61**	**61**	**61**	**61**
5.	**Two wheelers**											
	Motorised cycles	**1124**	**1124**	**0**	**1124**	**1124**	**1017**	**1017**	**1017**	**1017**	**1017**	**1017**
	Scooters/ Motor cycles	1151735	1289035	1448452	1595901	1818939	2098635	2418092	2677444	2928226	3216123	3610838
6.	Tractors	8177	8459	8702	9002	9459	9978	10657	11236	11656	11680	12224
7.	Tillers	4763	4979	4979	4980	5037	5184	5184	5184	5184	5217	5335
8.	Trailers	1576	1771	1818	1913	2001	2264	2307	2321	2321	2321	2324
9	Others	28680	29697	30334	32679	34750	15880	17072	21115	24745	39196	46106
	TOTAL	**2112245**	**2315322**	**2549807**	**2791568**	**3122088**	**3558704**	**4025305**	**4444049**	**4880057**	**5397652**	**6072019**

Source: Transport Commissionrate

4.6 Number of Motor vehicle having valid registration as on 2011

District	Goods Vehicle		Buses		Four Wheelers			Three Wheelers		Two Wheelers		Tractors/Trailors				Total
	Four Wheelers & above	Three wheelers including tempos	Stage Carriages	Contract Carriages/ Omni buses	Cars	Taxis	Jeeps	Auto rickshaws	Motorised cycle rickshaws	Motorised cycles	scooter /Motor cycles	Tractors/Trailors	Tillers	Trailers	Others	
Thiruvananthapuram	23843	11978	10747	16644	144434	16616	7172	48289	12	0	513099	375	113	143	5755	799220
Kollam	19610	7500	1310	7507	89810	8745	4879	38304	12	1004	275715	511	234	335	2484	457960
Pathanamthitta	11548	4605	1168	4477	59993	11093	3460	19913	9	4	140069	252	52	172	1249	258064
Alappuzha	18892	10590	1463	6339	62429	10676	544	21201	0	3	286373	1003	130	265	1338	421246
Kottayam	22365	6844	3034	11642	100537	15938	11130	41748	3	0	229505	680	124	60	2330	445940
Idukki	6100	2086	1196	2215	19494	5429	5367	16316	37	0	45383	238	139	16	1452	105468
Ernakulam	58849	15155	5566	20065	184205	22233	2124	56511	0	0	608960	1414	1301	155	8729	985267
Thrissur	27858	12938	4789	16828	93756	15852	4432	46412	0	0	409140	1032	467	612	2638	636754
Palakkad	21164	6836	2635	9336	44871	9487	3739	37931	0	0	252364	4646	969	121	3035	397134
Malappuram	28641	16044	4698	10494	79536	19832	9758	80083	0	6	247618	1238	724	97	3086	501855
Kozhikode	24011	10350	4043	5232	79936	10246	8003	41302	0	0	319618	339	154	79	3983	507296
Wayanad	4147	2118	584	1297	11134	3340	3874	9024	0	0	35109	151	258	102	2224	73362
Kannur	20661	8157	4291	6156	58820	10966	5936	38907	0	0	172323	1363	262	99	5049	332990
Kasargode	6706	2065	1070	906	31906	2974	3282	22800	0	0	75562	105	408	68	1611	149463
TOTAL	294395	117266	46594	119138	1060861	163427	73700	518741	73	1017	3610838	13347	5335	2324	44963	6072019

Source: Economic Review

4.7 Major Indicators showing Operational Efficiency of KSRTC

Sl.No	Items	Year		Increase/Decrease during last year
		2010-11	2011-12	
1	Fleet Strength (as on March 31 st)	5741	5803	62
2	Gross revenue earnings (in Crores)	1294.1	1555.72	261.62
3	Gross revenue expenditure (in Crores)	1673.42	1902.95	229.53
4	Gross operating loss (Crores)	(-)379.32	(-)347.23	-32.09
5	No. of schedules operated as on 31 st March	4611	4795	184
6	Average earning per vehicle on road per day (Rs)	7664	8423	759
7	Average earning per Km of Buses operated (paise)	2364	2613	249
8	Average earning per passenger (paise)	1036	1142	106
9	Average route length (Kms)	50.39	50.68	0.29
10	Average Kms.Run per bus per day	324.19	317.2	-6.99
11	Average number of buses held daily (Nos)	5573	5742	169
12	Passengers Carried (Lakhs)	12363	12579	216

Source: Economic Review

ENERGY

Power development plays a pivotal role in the overall development of the economy. Power Sector in Kerala plays a vital role in all developmental activities in Kerala. Obviously power crisis is the prime obstacle to start new initiatives in the industrial field. The need for power is increasing and the production of power should be increased accordingly. Monsoon is essential to sustain the hydropower base in the State. As we depend monsoon for the hydropower generation of power generation, the shortage in rainfall usually creates power crisis. The State of Kerala is rich in renewable sources of energy in the form of water resources. Kerala State Electricity Board is a public sector agency Established in 1957 under the authority of the Department of Power of kerala government. Kerala State Electricity Board (KSEB) has taken several initiatives to improve the

physical and financial performances. During the past several years KSEB has been responsible for the generation, transmission and supply of electricity in the State, with particular emphasis to provide electricity at affordable cost to the domestic as well as for agricultural purposes. The Board has set up adequate generation capacity and transmission network and Kerala is one of the few states in the country having availability of power to meet the demand.

Kerala is a power deficit state which imports 60 percent of power from other states. A major achievement is that Kerala has achieved full electrification in all villages

4.8 Growth of power system in Kerala

(from 2006 to 2011)

Sl. No.	Particulars	March 2006	2007-08	2008-09	2009-10	2010-11	2011-12
1.	Installed capacity -MW	2644.22	2662.24	2694.75	2746.19	2857.59	2872.79
2.	Maximum demand(system) - MW	2578	2745	2765	2998	3119	3348
3.	Generation per Annum-MU	7600.78	8703.55	6494.50	7240.38	7412.58	8350.74
4.	Import per Annum	6700.50	8074.62	9628.98	10199.96	10512.29	11270.71
5.	Export per Annum-MU	635.90	1346.76	463.33	53.90	130.24	201.1
6.	Energy sales per Annum-MU	10269.80	12049.85	12414.32	13971.09	14547.9	15980.53
7.	Percentage of energy loses to energy available for sales	24.59	21.63	20.45	19.41	17.99	17.45
8.	Per capita consumption-KWh	427	477	490	474	519	567
9.	220KV line-CT Kms		2654	2683	2701	2701	2713
10	110KV line-CT Kms		3905	3921	3970	4004	4005
11.	66 KV line-CT Kms		2987	2387	2387	2387	2387
12.	33KV line-CT Kms		878	1148	1348	1421	1497
14.	11KV line-CT Kms	34596	38227	41791.11	45541	49232	51392
13.	LT line- CT Kms		234252	252458	260670	266856	270718
14.	Step Up Transformer capacity -MVA		2561	2561	2564	2684	2689
15	No of EHT substations						
a.	400 KV	2	2	2*	2*	2*	2*
b.	220 KV	14	15	15	17	17	18
c	110KV	109	112	116	123	128	131
d	66 KV		89	85	82	80	80
e	33 KV		72	87	106	113	120
16	Step down Transformer capacity –MVA		13300.70	13519.70	15827.9	16222.1	16556.3
17a	Distribution Transformers Nos		42401	46955	52724	58427	62726
b	Capacity-MVA		5511	5937	6708	7320	7674
18	No of Villages electrified		1384	1384	1384	1467	1467

19	No of consumers-in Lakhs		90.34	93.63	97.43	101.28	104.57637
20	Connected load-MW		12378	15267.44	15866.55	16681.3	17518.42
21	No of Street light		1049047	1086688	1148220	1196503	1218610
22	No of Irrigation pumps		440958	431745	437878	446460	455078
23	Total revenue per Annum(Rs lakhs)		522714	609899	641138	692506	797804.89
24	Revenue from sale of power per annum(lakhs)		469695	509749	495060	540376	581781.92

*Pallipuram 400 KV substation owned by PGCIL

Source: Economic Review

4.9 Energy source in Kerala from 2007-2012

Sl. No.	Source of Energy	Installed Capacity(MW)				
		2007-08	2008-09	2009-10	2010-11	2011-12
1	Hydel:KSEB	1855.60	1888.10	1893.00	1997.80	2001.80
2	Thermal:KSEB	234.60	234.60	234.60	234.60	234.60
3	Wind:KSEB	2.03	2.03	2.03	2.03	2.03
4	NTPC	359.58	359.58	359.58	359.58	359.58
5	Thermal:IPP	177.44	178.93	188.93	188.93	198.93
6	Hydel;Captive	33	33	33	33	33
7	Hydel:IPP	0	0	7	10	10
8	Wind:IPP	0	21.90	28.05	31.65	32.85
	Total	**2662.25**	**2718.14**	**2746.19**	**2857.59**	**2872.79**

Source: Economic Review

NOISE

Sources and Effects of Noise Pollution

Noise pollution can be defined as the loud disturbing sound dumped into the ambient atmosphere without regard to the adverse effects it may have. Noise has many ill effects on human physiological functions. Noise seriously affects heartbeat, peripheral circulation and breathing pattern. Persistent noisy environment can cause annoyance, irritability, headache and sleeplessness and may seriously affect productive performance of humans. Noise pollution derives from several sources, including street traffic, aircraft, railroads, industry, construction, consumer products, and other sources. In order to better understand noise pollution, it is first important to understand where it comes from. Upon doing so, one can then more carefully consider its impacts on humans and more effectively investigate methods for reducing noise and preventing its negative consequences.

L_{eq} : The equivalent continuous Sound Pressure Level (SPL) for a particular duration.

L_{max}: The maximum Sound Pressure Level (SPL) value measured during the duration of monitoring.

L_{min}: The minimum Sound Pressure Level (SPL) value measured during the duration of monitoring.

L_{peak}: The maximum value reached by the sound pressure at any instant during a measurement period

L_{AE}: Sound Exposure Level (SEL) with 'A' frequency weighing

L_{01}: The level that were exceeded during 1% of the measuring time in dB

L_{10}: The level that were exceeded during 10% of the measuring time in dB

L_{50}: The level that were exceeded during 50% of the measuring time in dB

L_{90}: The level that were exceeded during 90% of the measuring time in dB

L_{95}: The level that were exceeded during 95% of the measuring time in dB

The Noise has been recognized as ambient air pollutant. Standards in this regard are laid down under The Environment (Protection) Act, 1986 (and rules made there under) and under the Model Rules of the Factories Act, 1948 for occupational health and safety purposes. The Central Pollution Control Board constituted a National Committee of Experts on Noise Pollution Control. The Committee recommended noise standards for ambient air and for automobiles, domestic appliances and construction equipment, which were later notified under The Environment (Protection) Act, 1986 as given below:

4.10 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

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 vehicular horns, loudspeakers and bursting of crackers shall be banned in these zones.

METHODOLOGY OF STUDY

The monitoring stations selected include residential areas, silence areas, industrial and commercial areas and also adjacent to major roads (traffic) areas. The Global Positioning System (GPS) was used to get the exact position i.e. Latitude and Longitude of the monitoring locations. The main purpose of this exercise was to determine the noise levels and to compare it with ambient noise standards for the area. Further, it may help in identifying the significant sources of Noise and finding & implement of remedies to reduce the Noise levels.

There were a total of 84 locations covered in Trivandrum city. The detailed lists of monitoring locations are given below.

List of monitoring locations

Sl. No	Location	Position
1	Aryasala	8.48110°N;76.95510°E
2	Attakulangara	8.47960°N;76.95072°E
3	Attakulangara	8.47943°N;76.94734°E
4	Attukal	8.46931°N;76.95547°E
5	Ayurveda college	8.49166°N76.94724°E
6	Bakery Junction	8.50134°N;76.95374°E
7	Bheemapally	8.45701°N;76.93412°E
8	Chalai Market	8.48278°N;76.94927°E
9	Civil Station, Kudappanakunnu	8.55547°N;76.96238°E
10	Corporation office	8.50844°N;76.95298°E
11	Dooradarsan , Kudappanakkunnu	8.55767°N;76.96205°E
12	DPI Jn	8.49607°N;76.96159°E
13	East fort	8.48123°N;76.94745°E
14	Fine Arts College, Palayam	8.50566°N;76.95189°E
15	Gandhi Park	8.48308°N;76.94820°E
16	General hospital	8.29974°N;76.56613°E
17	Golf Links	8.52193°N;76.96545°E
18	Govt Hospital, Peroorkkada	8.53492°N;76.96739°E

19	Govt HSS Nemon	8.45348°N;77.00434°E
20	HLL Lifecare, PKD	8.52802°N;76.96864°E
21	International Airport	8.48887°N;76.92567°E
22	Jagathy	8.49411°N;76.96584°E
23	Kalady	8.47060°N;76.96452°E
25	Kanakakkunnu palace	8.5118°N;76.95848°E
26	Kesavadasapuram	8.52977°N;76.93844°E
27	Kowdiar	8.52222°N;76.96043°E
28	Kumarapuram	8.51329°N;76.92742°E
29	LMS Junction	8.50743°N;76.95215°E
30	Manacaud	8.47664°N;76.94798°E
31	Medical College	8.52330°N;76.92841°E
32	Mental Hospital,Oolampara	8.52665°N;76.96959°E
33	MG College, Paruthippara	8.53383°N;76.94205°E
34	Museum	8.50848°N;76.95544°E
35	Museum Jn	8.50843°N;76.95430°E
36	Nalanchira	8.54429°N;76.94264°E
37	Nemom Jn	8.45435°N;77.00305°E
38	Padmanabha Temple	8.48430°N; 76.94362°E
39	Palayam Market	8.3019°N;76.57053°E
40	Palyam Junction	8.50311°N;76.95071°E
41	Pangodu	8.50141°N;76.98867°E
42	Pappanamcode bus depot	8.47085°N;76.98235°E
43	Pattom	8.5016°N;76.98255°E
44	Pattoor	8.49767°N;76.93765°E
45	Pazhavangadi	8.48446°N;76.94741°E
46	Pazhavangadi Temple	8.48446°N;76.94741°E
47	Peroorkkada bus depot	8.53430°N;76.96777°E
48	Pettah	8.49673°N;76.93272°E
49	PMG	8.51025°N;76.94813°E
50	Poojappura	8.49051°N;76.97339°E
51	PRS Hospital	8.48090°N;76.95929°E
52	PTP Nagar	8.51305°N;76.98784°E
53	Public offices, Museum	8.50791°N;76.95469°E
54	Regional Cancer Centre	8.52077°N;76.92431°E
55	Sasthamangalam	8.51287°N;76.07121°E

57	SAT Hospital	8.52325°N;76.92612°E
58	SCT College of Engineering	8.47009°N;76.98123°E
59	Secretariat	8.29856°N;76.56915°E
60	Shangumukham	8.47888°N;76.91225°E
61	SMV School	8.48927°N;76.94743°E
62	SP Fort Hospital	8.48432°N;76.94190°E
63	State Central Library	8.50673°N; 76.95226°E
64	Statue	8.49542°N;76.94819°E
66	Thaliyal	8.47210°N;76.96632°E
67	Thampanoor bus depot	8.48777°N;76.95011°E
68	Thirumala	8.50249°N;76.99273°E
69	Thycaud Hospital	8.48736°N;76.95636°E
70	Thycaud Junction	8.48971°N;76.95776°E
71	Travancore Titanium	8.40244°N;76.90063°E
72	Uloor	8.52975°N;76.93011°E
73	University of Kerala	8.30189°N;76.56878°E
74	Vanchiyoor Court	8.49366°N;76.94069°E
75	Vazhuthacadu	8.49839°N;76.95694°E
76	Veli	8.51000°N;76.89024°E
77	Veli industrial Estate	8.50324°N;76.89663°E
78	Vellayambalam	8.51112°N;76.96187°E
79	Vellayani	8.45720°N;77.00021°E
80	Vettukadu	8.49378°N;76.90031°E
81	Vikas bhavan-Offices	8.30189°N;76.56853°E
82	Zoo	8.50841°N;76.5411°E

NOISE LEVELS AT VARIOUS LOCATIONS IN THE CITY:

Sl. No.	Monitoring Station	Date	L_{eq}	L_{AE}	L_{peak}	L_{max}	L_{min}	L_{01}	L_{10}	L_{50}	L_{90}	L_{95}
1	Aryasala	30/1/12	76.1	96.7	108.5	98.7	51.2	89.6	73.2	64.6	57.7	55.0
2		31/1/12	69.2	89.9	99.8	83.5	52.2	78.2	73.2	65.8	57.1	55.3
3	Attukal	30/1/12	61.4	82	92.3	75.7	43.9	70.9	65.5	55.8	47.7	46.4
4		31/1/12	59.9	8 .5	90.7	71.9	45.3	67.8	63.4	53.7	48.4	47.7
5	Ayurveda college-Inside	27/2/12	69.2	93.7	110.4	86.1	60.1	76.9	72.1	66.2	63.2	62.5
6	Ayurveda college-Outside	27/2/12	74.2	98.8	110.3	90.6	65.9	82.4	76.3	72.3	68.8	68.1
7	Ayurveda college Jn	4/1/12	79.1	103.4	116.5	104.5	55.7	87.9	80.6	73.7	65.4	63.3

8		3/1/12	74.8	98.2	104.8	93.1	57.6	84.1	77.6	70.0	64.8	63.1
9	Bakery Junction	21/2/12	78.4	102.9	109.9	93.8	66.9	87.4	80.8	75.4	70.6	69.7
10	Bheemapally	9/3/12	61.9	82.6	108 [illegible]	80.4	42.9	73.6	64.4	55.5	48.8	47.4
11		12/3/12	62.7	83.4	105.3	88.5	40.6	71.5	61.5	54.6	47.7	46.4
12	Chalai Market	5/1/12	69.5	98.8	102.8	88.7	54.4	78.6	73.0	66.1	61.1	59.5
13		6/1/12	74.9	104.3	118.3	97.8	59.3	85.1	78.3	69.3	64.1	63.1
14		8/3/12	76.1	100.7	115.5	94.1	57.6	85.4	78.4	70.1	63.1	61.8
15	Civil Station, Kudappanakunnu	27/3/12	68.6	93.2	109.3	82.1	49.0	76.6	72.5	64.9	56.9	54.8
16	Corporation office-Inside	2/3/12	70.6	95.1	114.2	92.2	58.4	77.5	73.4	68.0	63.6	62.6
17	Corporation office-Outside	2/3/12	73.2	97.7	114.6	89.9	64.4	80.6	76.0	70.8	67.6	66.8
18	Cosmopolitan Hospital-Inside	3/2/12	71.0	95.8	117.9	89.2	57.9	79.2	72.8	67.6	63.7	62.7
19	Cosmopolitan Hospital-Outside	3/2/12	66.0	92.7	109.6	82.5	56.4	75.5	69.3	62.6	59.7	59.1
20	Dooradarshan, Kudappanakkunnu	28/3/12	65.2	89.8	114.8	83.2	39.2	76.2	67.9	53.8	45.0	43.7
21	DPI Jn	28/1/12	54.7	85.3	104.3	82.8	48.8	75.7	66.7	59.9	54.4	52.8
22		28/2/12	53.6	94.2	113.5	99	54.2	81.6	72.9	66.6	61.2	58.9
23	East fort	2/11/11	70.2	102.5	110.9	100.7	56.9	79.0	72.0	66.1	62.2	61.3
24		3/11/11	70.8	103.2	104.2	92.4	59.5	80.5	72.7	67.5	63.8	63.0
25		25/11/11	73.4	105.7	106.2	94.5	58.6	85.9	73.5	67.9	64.0	62.9
26		25/1/12	80.4	107.9	113.4	103.1	58.1	90.0	82.1	75.8	69.4	66.3
27		4/1/12	80.1	107.2	118.2	105.2	58.7	89.7	82.0	75.6	66.3	64.0
28		5/1/12	81.1	110.5	115.0	101.0	58.6	91.7	84.4	75.3	67.4	66.0
29	East fort Busdepot	12/1/12	85.5	114.4	114.9	102.4	69.2	97.8	87.7	76.8	72.8	72.1
30		12/1/12	86.2	115.5	118.5	109.3	62.9	94.9	88.4	77.2	69.5	68.0
31	Fine Arts College, Palayam	13/3/12	76.0	100.5	107.0	94.4	63.6	85.3	78.4	72.5	68.9	68.1
32	Gandhi Park	9/3/12	70.4	95.0	108.8	91.4	59.7	77.8	73.2	66.9	63.4	62.5
33	General hospital Inside	8/2/12	70.2	97.7	101.9	87.7	59	77.5	72..6	68.2	64.6	63.8
34	General hospital outside	8/2/12	73.1	103.6	114.9	97.4	62.8	86.9	77.1	71	66	65.1
35	Golf Links	13/1/12	55.5	94.1	114.6	97.1	51.8	81.0	73.0	62.7	56.3	54.7
36		18/1/12	56.3	86.9	101.3	80.3	49.5	74.6	69.3	60.6	52.1	51.3
37	Govt Hospital, Peroorkkada-Inside	26/3/12	62.2	86.7	89.0	74.7	53.1	68.7	65.5	60.1	56.7	56.1
38	Govt Hospital, Peroorkkada-Outside	26/3/12	73.8	98.4	109.5	92.0	61.3	82.0	77.3	70.7	65.1	64.1
39	Govt Hospital, Thycaud-Inside	23/2/12	71.9	96.5	107.6	88.3	60.2	78.3	75.0	70.4	62.8	62.0
40	Govt Hospital, Thycaud- Outside	23/2/12	80.6	105.1	114.8	98.9	66.4	90.1	82.0	77.3	73.3	71.3

41	HLL Lifecare, PKD	24/2/12	72.0	96.6	108.4	95.1	45.8	81.0	72.4	64.3	55.5	52.2
42	International Airport	28/3/12	64.6	85.2	109.1	77.7	58.0	72.9	65.8	63.3	61.8	61.1
43		29/3/12	63.9	83.7	97.5	77.2	60.8	67.1	65.1	63.2	61.9	61.7
44	Jagathy	23/1/12	76.3	96.9	113.7	98.1	62.7	85	77	72	68.2	66.1
45		24/1/12	77.6	98.2	110.3	102.2	55.5	87.3	76.6	68.9	60.8	59.3
46	Kanakakkunnu palace	29/2/12	63.8	88.4	114.9	85.9	45.4	73.9	65.3	55.9	49.3	48.4
47	Kesavadasapuram	2/2/12	74.6	102.1	109.1	89.7	61.3	82.5	78.5	71.4	66.7	65.5
48	Kowdiar	6/1/2012	77.2	97.8	115.3	90.2	66.3	86.4	80.6	73.4	70.0	69.2
49	Kumarapuram	16/2/12	77.5	102.0	109.0	91.8	64.6	85.6	81.0	74.3	69.1	67.9
50	LMS Junction	7/3/12	78.1	102.7	109.8	98.5	60.8	85.2	79.8	74.0	70.6	68.2
51	Manacaud	27/2/12	74.7	95.4	110.4	87.9	54.3	84.4	78.4	70.3	61.6	58.7
52		29/2/12	74.4	95.0	106.6	87.7	58.3	81.0	77.2	70.9	64.4	61.6
53	Medical College-Inside	15/2/12	72.9	111.3	81.4	87.8	61.3	81.4	75.9	69.2	64.7	64.0
54	Medical College-Outside	15/2/12	76.9	101.5	118.3	99.3	66.1	84.8	78.9	72.6	68.8	68.2
55	Mental Hospital,Oolampara	23/3/12	74.6	99.2	113.0	96.5	47.5	84.1	77.0	67.7	58.6	56.1
56	Mg college	3/1/12	76.7	97.3	107.6	96	60	89	77.5	70.5	64.8	63.7
57		10/1/12	73.9	94.5	101.8	87.6	58.7	83	77.9	69.7	63.9	62.2
58	Museum Inside	21/1/12	63.7	92.2	113.2	86.5	55.7	76.9	71.4	62.5	59.1	58.5
59		22/2/12	64.8	88.6	100.2	78.2	56.7	71.0	67.5	63.1	59.6	59.0
60		5/3/12	65.3	100.8	106.2	91.6	59.3	84.5	80.1	72.2	64.8	63.4
61	Museum Jn	4/2/12	80.1	104.7	113.5	105.6	66.8	88.3	82.8	76.2	70.9	69.9
62	Nalanchira	2/1/2012	69.2	91.6	105.9	79.7	58.9	76.5	72.5	67.3	62.5	61.5
63		3/1/2012	73.3	95.7	106	85.6	56.8	81.9	76.9	70.1	64	62.8
64	Nemom Jn	22/3/12	81.9	106.5	114.5	103.1	61.0	92.1	80.8	74.4	69.5	66.9
65		22/3/12	79.5	104.0	114.3	101.2	60.9	87.9	82.6	74.7	68.1	65.2
66	Nemom School	21/3/12	79.6	104.2	114.0	96.1	56.6	89.8	81.9	75.0	66.0	62.6
67		21/3/12	81.6	106.2	117.8	101.0	61.0	91.9	82.1	75.5	68.6	66.3
68	Padmanabha Temple	1/2/12	65.0	85.6	99.4	79.7	49.5	72.8	68.6	58.1	51.9	51.0
69		6/3/12	64.2	86.9	105.1	80.8	48.2	75.1	70.2	62.5	53.5	51.9
70	Palayam Market	9/2/12	76	103.6	114.7	97.3	51.4	84.5	79.3	71.4	62.5	59.6
71	Pallimukku	14/2/12	82.3	106.9	114.8	104.8	64.3	90.6	84.3	77.4	70.9	69.4
72	Pangodu	19/1/12	75.8	96.4	105.9	94.4	50.9	84.7	78.1	69.7	59.0	55.8
73		20/1/12	73.0	93.6	116.6	88.9	54.0	82.8	76.8	68.8	58.1	56.5
74	Pappanamcode bus depot	16/3/12	75.7	100.3	109.3	91.4	59.8	83.6	78.5	73.2	67.5	65.1
75	Pattom	2/2/12	78.6	106.1	112.1	93.3	60.6	86.3	81.9	76.6	69.9	67.7
76	Pattoor	17/2/12	76.4	100.9	103.8	91.4	62.9	85.1	79.4	73.1	67.4	66.3
77	Pazhavangadi	3/2/12	75.6	96.2	105.6	94.0	63.8	84.2	77.5	72.9	69.1	68.4
78		2/3/12	73.5	94.1	105.2	87.5	62.9	78.4	76.2	71.5	67.3	66.1

79	Peroorkkada bus depot	24/3/12	71.4	96.0	112.7	92.5	54.3	79.0	74.1	66.9	61.0	59.9
80	Plamoodu	8/11/11	79.5	111.9	117.7	99.5	59.1	90.2	81.7	76.0	70.1	68.6
81		15/11/11	76.9	99.1	108.0	95.2	66.5	84.2	79.0	73.7	70.0	69.2
82		16/11/11	77.3	106.1	114.6	95.7	63.5	87.8	78.7	74.2	69.4	67.8
83		22/11/11	73.0	100.3	103.1	88.5	59.4	82.4	75.5	70.2	66.6	65.7
84		23/11/11	72.3	99.2	102.4	90.5	62.4	80.3	74.7	70.2	66.5	65.7
85		26/11/11	70.1	102.4	104.7	95.5	59.7	78.9	71.7	66.7	63.9	63.2
86		28/11/11	70.3	102.6	108.4	95.6	59.6	80.6	71.5	66.8	63.5	62.7
87		21/12/11	71.3	100.7	105.6	94.1	57.0	81.6	72.0	66.8	632	62.0
88		22/12/11	69.2	98.6	106.1	91.1	57.7	79.0	71.5	66.0	62.5	61.3
89		23/12/11	68.9	100.3	104.6	91.9	53.4	76.9	70.9	66.2	63.4	62.5
90		24/12/11	70.3	102.6	105.7	95.1	59.1	79.8	71.8	67.0	63.8	62.9
91		26/12/11	71.3	103.7	105.8	95.9	60.6	80.7	72.4	67.2	63.9	63.2
92		27/12/11	71.6	102.8	108.3	98.5	60.9	81.2	72.6	67.5	64.4	63.6
93		2/1/12	70.1	97.0	100.5	92.0	57.7	78.6	71.8	66.5	63.3	62.4
94		03/1/12	69.9	99.3	103.4	94.4	58.1	78.3	71.7	66.6	63.1	62.3
95		06/1/12	70.4	109.3	109.9	99.2	54.9	80.3	71.8	66.3	62.4	61.4
96		07/1/12	71.3	103.4	106.3	94.6	59.1	81.1	72.1	67.4	64.0	63.1
97		09/1/12	69.4	98.8	105.1	85.3	53.3	79.3	72.8	65.9	60.3	59.0
98		09/1/12	69.3	98.8	109.9	92.3	52.1	80.0	71.9	62.5	56.6	55.3
99		09/1/12	70.9	103.3	105.4	92.7	58.8	80.9	72.4	67.2	63.4	62.5
100		10/1/12	68.9	99.2	104.3	91.8	50.0	77.7	72.5	65.2	58.1	56.2
101		10/1/12	68.3	81.6	93.6	75.1	64.1	71.5	69.9	67.9	65.0	64.6
102		11/1/12	71.5	103.9	105.5	95.4	59.5	80.8	72.7	67.8	64.4	63.7
103		17/1/12	71.0	103.3	106.8	96.7	59.6	80.0	71.8	66.9	63.8	63.0
104		18/1/12	70.6	99.1	100.5	90.0	57.2	80.7	72.8	67.0	63.0	61.9
105		19/1/12	71.3	103.7	105.8	95.9	60.6	80.7	72.4	67.2	63.9	63.2
106		19/1/12	69.0	98.4	100.8	91.0	57.3	77.8	79.3	66.6	62.2	61.1
107		20/1/12	71.6	102.8	108.3	98.5	60.9	81.2	72.6	67.5	64.4	63.6
108		23/1/12	69.8	97.3	101.7	88.4	57.4	79.7	72.0	66.4	63.3	62.3
109		23/1/12	70.5	98.0	110.	67.1	62.3	78.0	72.7	67.6	64.8	64.2
110		24/1/12	69.8	97.3	99.5	86.8	61.4	78.0	71.8	66.3	64.8	64.0
111		28/1/12	76.6	100.0	103.7	92.5	57.9	79.2	72.1	67.0	63.2	62.1
112		28/1/12	70.1	99.4	102.5	92.4	56.4	80.4	71.9	66.6	63.0	61.8
113		30/1/12	70.2	99.6	102.0	93.0	57.7	81.2	72.0	66.5	62.5	61.6
114		31/1/12	72.2	98.7	103.2	94.6	59.5	81.1	73.1	67.8	64.3	63.3
115		29/2/12	72.5	97.1	114.5	91.0	66.0	80.2	75.3	69.5	68.1	67.6
116	PMG	5/3/12	75.2	102.8	114.0	93.7	61.4	84.6	78.2	72.1	67.9	66.7
117	Poojappura	23/1/12	75.6	96.3	110.9	97.1	55.5	81.1	77.1	71	63.7	61.3
118		24/1/12	70.4	91	102.6	84	52.8	79.2	74	66.9	58.3	55.7

119	PRS Hospital-Inside	14/3/12	69.4	94.0	114.9	93.2	62.0	75.6	69.9	66.9	64.6	64.0
120		15/3/12	72.7	97.5	103.4	87.9	61.6	81.8	74.8	70.1	66.4	65.5
121	PRS Hospital -Outside	14/3/12	82.7	107.2	114.7	102.4	67.0	93.6	83.5	76.7	71.8	70.5
122		15/3/12	78.8	108.2	103.4	94.2	64.3	87.8	81.6	75.7	70.7	69.5
123	PTP Nagar	13/1/12	54.7	85.3	102.0	83.6	52.8	75.2	67.0	60.1	56.0	55.4
124		18/1/12	55.5	89.2	101.0	92.7	47.2	77.7	68.0	59.1	52.6	50.6
125	PWD Office PMG	1/2/12	62.9	90.5	107.2	82.7	49.2	71.3	66.5	58.8	53.5	52.5
126	Public offices, Museum	1/3/12	69.7	94.3	116.1	88.7	58.3	77.9	72.4	66.9	62.3	61.1
127	Regional Cancer Centre -Inside	13/2/12	75.1	98.7	106.3	93.0	62.7	83.9	78.1	71.3	66.3	65.4
128	Regional Cancer Centre -Outside	13/2/12	76.1	100.6	110.0	90.7	57.5	84.0	79.5	72.9	66.3	63.9
129	Sasthamangalam	23/3/12	74.2	79.1	105.2	84.2	60.3	71.8	69.8	62.8	60.6	60.5
130	SAT Hospital -Inside	14/2/12	70.4	95.0	111.7	95.5	53.5	80.0	70.7	61.8	57.2	56.2
131	SAT Hospital-Outside	14/2/12	71.0	94.2	102.0	91.0	58.1	79.7	72.2	66.7	62.3	61.0
132	SCT College of Engineering	19/3/12	80.6	105.2	113.6	102.2	59.5	91.2	80.8	74.2	69.4	66.7
133		21/3/12	78.5	103.1	113.8	99.0	63.2	88.6	87.8	73.5	68.2	87.3
134	Secretariat	9/2/12	80.1	107.6	117.5	101.3	67.1	89.5	81.8	76.5	72.8	71.8
135	Shangumukham	13/3/12	65.0	86.4	114.5	83.1	37.2	76.8	67.9	55.1	42.7	40.9
136		14/3/12	56.0	76.6	101.5	71.9	41.1	65	58.8	48.3	44.4	43.8
137	SMV School	24/2/12	77.1	101.7	112.1	92.1	64.9	86.2	80.2	73.7	69.4	68.6
138	SP Fort Hospital	6/3/12	71.3	92.0	105.6	86.6	56.2	82.0	74.8	65.3	59.5	58.0
139		7/3/12	71.4	92.0	104.9	88.3	51.5	80.7	74.4	66.7	58.5	56.6
140	State Central Library	12/3/12	64.7	89.3	99.5	81.6	55.2	72.5	66.9	62.0	57.8	57.1
141	Statue	11/11/11	76.3	104.4	111.6	99.4	61.7	85.8	78.3	71.9	65.4	64.4
142		14/11/11	79.5	108.8	112.2	93.2	60.5	88.3	83.9	75.1	68.9	67.5
143		19/11/11	67.3	88.9	95.5	81.7	56.2	74.8	70.5	64.7	60.0	58.9
144		21/11/11	74.6	103.0	109.9	94.7	54.5	83.0	78.2	71.2	61.4	60.0
145		30/11/11	79.4	106.9	112.2	104.6	62.0	86.4	79.8	73.4	68.8	67.7
146		12/12/11	90.7	120.0	123.1	111.8	45.0	100.7	94.9	85.3	74.9	71.1
147		14/12/11	90.1	122.3	123.6	109.0	57.7	100.3	94.3	84.1	73.5	70.0
148		16/12/11	66.8	79.4	102.5	82.4	58.2	67.9	66.8	63.6	59.9	59.6
149		17/12/11	79.4	106.9	112.2	104.6	62.0	86.4	79.8	73.4	68.8	67.7
150		19/12/11	78.2	105.8	117	101.6	56.8	88.8	79.5	72.3	62.8	61.0
151		20/12/11	70.4	92.5	108	93.2	58.2	77.6	72.6	65.9	61.3	60.6
152		28/12/11	80.1	108.8	114.7	105.0	63.7	88.4	83.1	76.7	70.6	69.3
153		29/12/11	79.4	108.8	114.2	105.1	63.4	88.0	81.5	75.5	68.7	67.2
154		31/12/11	78.2	105.8	117	101.6	56.8	88.8	79.5	72.3	62.8	61.0
155		7/1/12	73.4	104.7	112.4	94.3	54.1	85.2	76.5	64.6	59.8	54.2
156		12/1/12	78.3	107.6	118.4	109.4	57.0	86.6	75.5	67.6	64.3	63.4

157		14/1/12	64.9	71.8	102.0	75.6	56.5	70.6	67.0	61.5	59.0	57.6
158		16/1/12	78.1	107.5	115.2	102.3	57.5	87.9	80.7	74.6	67.3	61.0
159		16/1/12	75.0	102.3	104.6	91.9	63.6	81.1	76.3	74.3	71.2	68.0
160		17/1/12	75.2	95.4	110.2	98.6	51.8	80.3	76.9	64.7	56.0	54.9
161		17/2/12	75.3	99.8	111.3	97.3	62.7	82.6	77.7	73.2	67.5	66.0
162		18/2/12	79.2	106.8	110.8	97.6	68.8	87.6	82.1	76.7	72.8	72.1
163	SUT Hospital-Inside	4/2/12	66.8	94.3	114.6	89.3	49.7	77.8	68.5	60.1	55.6	54.4
164	SUT Hospital-Outside	4/2/12	74.9	102.1	110.6	101.0	59.8	83.6	75.0	69.1	64.7	63.8
165	Thampanoor	5/11/11	78.0	104.0	110.1	101.5	62.1	86.1	80.0	73.7	68.5	66.4
166		9/11/11	74.0	96.9	106.4	89.8	65.2	81.2	76.2	72.5	68.5	67.5
167		10/11/11	73.7	103.1	113.1	94.9	61.8	82.1	76.4	71.3	66.9	65.7
168		17/11/11	78.3	107.6	112.4	106.3	60.5	87.5	78.4	72.6	67.1	65.5
169		18/11/11	74.9	98.2	109.6	91.9	57.3	62.6	76.2	69.8	64.2	85.7
170		24/11/11	73.0	95.1	99.5	85.6	58.2	82.5	75.7	70.6	66.2	63.7
171		29/11/11	75.6	99.8	105.9	94.4	64.3	83.7	77.5	72.6	68.4	67.5
172		1/12/11	70.4	95.1	102.9	88.3	58.8	79.4	73.5	66.6	63.4	62.8
173		2/12/11	70.6	99.9	107.6	90.8	59.8	80.7	72.6	67.4	63.5	62.7
174		3/12/11	72.0	91.7	108.2	86.7	57.5	79.1	75.2	67.7	62.2	61.2
175		6/12/11	72.6	99.0	115.6	94.4	50.8	82.8	74.6	64.6	56.5	55.1
176		16/12/12	75.3	100.5	108.4	94.2	60.1	84.0	78.2	71.4	65.4	64.2
177		2/1/12	77.9	107.2	112.6	102.9	61.1	87.3	80.2	74.3	67.2	65.4
178		7/1/12	70.4	95.1	102.9	88.3	58.8	79.4	73.5	66.6	63.4	62.8
179		9/1/12	70.6	99.9	107.6	90.8	59.8	80.7	72.6	67.4	63.5	62.7
180		11/1/12	75.3	104.7	109.6	96.7	62.7	84.5	77.6	73.2	69.4	68.4
181		11/1/12	72.0	91.7	108.2	86.7	57.5	79.1	75.2	67.7	62.2	61.2
182		25/1/12	80.1	107.7	110.2	103.4	61.2	92.0	80.2	72.7	66.7	65.3
183		9/2/12	75.6	99.8	105.9	94.4	64.3	83.7	77.5	72.6	68.4	67.5
184		10/2/12	77.1	98.3	114.8	89.7	67.8	83.9	79.8	75.4	72.1	71.3
185		16/2/12	72.6	99.0	115.6	94.4	50.8	82.8	74.6	64.6	56.5	55.1
186	Thampanoor bus depot	7/12/11	74.4	99.0	122.5	91.6	66.5	81.8	77.1	72.2	69.2	98.5
187		7/1/12	76.4	106.5	112.4	98.7	56.9	87.8	79.2	64.2	59.4	58.8
188	Thirumala	19/1/12	72.2	92.9	104.0	85.2	56.8	81.2	76.2	68.9	62.0	59.8
189		20/1/12	74.9	94.5	109.9	89.7	57.5	86.1	77.6	69.5	62.1	60.4
190	Uloor	10/2/12	76.2	99.0	118.1	93.0	63.4	84.6	78.8	71.9	67.3	66.5
191	University of Kerala	6/2/12	65.0	93.4	118.3	85.1	56.4	74.6	68.6	66.0	60.2	59.5
192	Vanchiyoor Court-Inside	18/2/12	64.2	91.7	105.3	88.6	52.6	76.5	70.0	62.6	57.3	56.2
193	Vanchiyoor Court-Outside	18/2/12	57.0	100.6	107.9	97.1	59.5	83.7	78.8	72.7	68.3	67.3
194	Vazhuthacadu	21/2/12	77.2	101.7	115.0	91.2	59.0	85.6	80.3	74.1	66.3	64.3
195	Veli	22/3/12	62.9	83.5	95.4	77.3	50.5	71.5	65.8	60.7	54.4	53.2

196		24/3/12	65.0	87.3	99.7	88.5	47.4	76.7	64.3	57.6	52.8	51.9
197	Vellayambalam	9/3/12	77.1	101.7	118.2	94.9	58.7	86.1	79.4	72.8	64.6	62.6
198	Vellayani	23/2/12	82.9	107.5	88.2	95.5	68.6	88.2	86.9	80.3	74.7	73.1
199		20/3/12	81.5	106.1	116.9	107.6	60.0	89.7	82.5	76.4	66.0	63.4
200	Vettukadu	16/3/12	64.3	85.0	113.7	88.4	49.9	74.6	65.7	56.9	52.8	51.9
201		19/3/12	64.9	86.0	120.9	85.0	44.8	76.6	67.8	59.0	52.8	51.4
202	Vikas Bhavan Bus Station	15/2/12	72.3	99.8	104.6	91.8	53.1	80.2	74.4	69.3	62.7	60.9
203	Vikas bhavan-Offices	17/1/12	58.4	66.8	81.6	64.2	54.8	58.4	58.2	56.5	55.8	55.5
204		18/1/12	65.7	92.8	107.4	85.4	51.8	75.1	68.6	62.7	58.0	56.5
205		25/1/12	73.1	100.6	114.4	103.7	50.0	78.9	72.6	64.0	56.4	55.1
206		7/2/12	70.3	97.9	102.1	92.1	54.8	79.3	73.6	65.3	58.0	57.2
207	Zoo	21/1/12	63.5	81.8	104.8	80.5	55.8	70.1	64.1	60.7	57.8	57.3
208		6/2/12	62.9	92.2	106.1	77.2	53.5	71.4	65.9	60.5	57.0	56.3
209		27/3/12	63.6	88.2	97.8	76.2	53.4	70.8	66.3	62.0	57.3	56.4

Sl. No.	Monitoring Station	Date	L_{eq}	L_{AE}	L_{peak}	L_{max}	L_{min}	L_{01}	L_{10}	L_{50}	L_{90}	L_{95}
1	Aeron Eng Works,Veli industrial Estate	20/3/12	70.1	90.7	94.8	79.8	67.7	75.4	71.1	69.5	68.9	68.7
2	Aeron Eng Works,Veli industrial Estate	21/3/12	69.3	89.9	92.5	74.6	67.6	71.8	70.0	69.2	68.6	68.4
3	BSNL Office, PMG-INTUC Meeting	1/2/12	93.0	117.6	118.6	107.0	64.9	102.3	98.0	80.8	72.2	70.8
4	Jeevanadi Gospal Church	19/2/12	73.0	97.6	97.0	84.2	44.5	80.6	77.0	70.3	61.9	57.6
5	M M industries, Cheruvarakonam	28/10/11	71.5	102.3	104.5	90.8	50.2	84.2	75.0	65.7	58.0	57.3
6	Meenakshi Plaza, Thycaud	22/2/12	89.1	113.1	114.6	94.3	72.0	93.3	92.7	87.9	84.5	83.5
7	Melamcode Devi Temple	1/2/12	74.5	91.5	97.7	85.4	59.3	79.7	77.1	73.1	69.0	67.3
8	Poabs Quarry-Blasting	27/9/11	72.0	99.8	104.6	91.8	53.1	80.2	74.4	69.3	62.7	60.9
9	Poabs Quarry-Quarrying	27/9/11	60.9	82	92.3	75.7	43.9	70.9	65.5	55.8	47.7	46.4
10	Secretariat-News reporters procession	21/1/12	84.7	112.2	116.1	102.6	72.5	92.7	87	82.1	77.1	75.9
11	Shahir Sawmill, Vellayini	20/3/12	84.2	108.8	115.0	95.3	70.8	88.7	87.3	82.7	77.8	76.2
12	Travancore Titanium	24/3/12	63.8	84.4	96.1	85.9	42.6	72.1	61.9	53.5	44.6	43.9
13	Travancore Titanium	27/3/12	61.2	81.8	94.7	76.0	33.3	68.8	65.3	57.3	45.2	39.7
14	Vijaya Mohini Mills,Thirumala -	15/12/11	82.6	102.5	107.2	86.5	73.5	85.9	84.9	82.9	77.9	76.2

	Inside										
15	Vijaya Mohini Mills,Thirumala - Inside	15/12/11	74.7	99.2	101.9	86.9	67.1	82.8	78.8	70.0	68.1	67.9
16	Vijaya Mohini Mills,Thirumala - Outside	15/12/11	69.3	93.8	106.4	86.8	52.1	82.1	69.2	58.6	53.2	53.0
17	Vijaya Mohini Mills,Thirumala - Outside	15/12/11	50.9	75.5	92.6	65.5	45.0	58.2	53.2	47.9	46.3	46.0
18	Vijaya Mohini Mills,Thirumala - Outside	15/12/11	66.7	91.3	103.4	92.4	57.9	75.9	68.4	59.8	58.9	58.8
19	Yahova Nissie Church	19/2/12	67.6	92.2	118.2	81.8	49.3	75.9	71.6	61.3	53.4	52.4

Attukal Pongala

(Between 7.00AM to 12.00 PM for 5 minutes)

Sl. No.	Date	Monitoring Station	L_{eq}	L_{AE}	L_{peak}	L_{max}	L_{min}	L_{01}	L_{10}	L_{50}	L_{90}	L_{95}
1	6/3/12	Palayam	101.1	118.8	119.4	110.9	85.2	107.1	104.4	99.6	92.2	90.3
2	6/3/12	Statue	97.9	118.6	119.1	108.8	68.0	105.9	101.6	95.6	87.0	75.4
3	6/3/12	VJT	99.2	119.9	118.7	109.6	86.8	107.7	103.0	97.4	92.3	91.2
4	6/3/12	AyurvedaCollege Jn	80.6	98.9	110.5	91.5	66.7	86.0	83.7	78.8	74.2	72.4
5	6/3/12	Pulimoodu Jn	79.4	100.1	109.9	94.0	71.2	82.9	81.2	78.8	75.5	74.4
6	6/3/12	Bakery Jn	78.0	102.6	118.0	93.6	69.1	83.5	80.2	77.2	73.6	72.5
7	6/3/12	East Fort	79.2	97.2	114.9	88.9	68.1	84.8	81.9	78.1	73.1	71.5
8	6/3/12	Thakaraparambu	86.0	106.8	115.8	101.4	68.6	96.0	87.7	76.3	72.6	71.5
9	6/3/12	Sreevaraham	84.1	108.3	118.4	100.5	65.7	93.1	88.0	77.3	71.1	69.0
10	6/3/12	Attakulangara	89.1	106.9	118.7	99.1	67.9	94.2	91.8	87.9	76.2	73.8
11	6/3/12	Attukal	90.9	115.5	117.8	101.1	65.8	96.4	94.3	89.3	77.6	72.7
12	6/3/12	Manacaud	82.6	106.7	114.0	97.5	58.6	91.1	86.7	76.7	67.2	65.3
13	6/3/12	Thaliyal	70.7	90.1	102.0	86.0	59.4	78.4	73.1	68.2	64.1	62.7
14	6/3/12	Pattoor	78.8	99.6	106.9	93.8	60.0	83.5	81.4	77.5	68.6	65.9
15	6/3/12	"Vanchiyoor	78.6	102.3	121.2	91.4	62.3	84.5	82.1	76.3	70.9	68.9
16	6/3/12	Kalady	94.4	112.0	117.1	102.5	76.3	99.7	97.2	93.4	88.7	87.3
17	6/3/12	Chalai	91.1	111.8	116.6	105.0	61.4	97.2	94.7	89.3	76.9	72.0
18	6/3/12	Karamana	87.8	112.4	115.7	101.3	60.8	95.5	91.5	84.6	78.6	74.9
19	6/3/12	Pappanamcode	79.2	96.9	115.7	86.5	64.7	84.7	82.8	76.2	71.1	69.8
20	6/3/12	Kaimanam	83.0	103.5	116.6	89.3	73.4	87.0	85.1	82.7	79.8	78.7
21	6/3/12	Bakery Jn	81.5	106.1	116.2	95.7	62.4	86.5	83.9	81.0	76.3	71.9
22	6/3/12	Thycaud	79.3	97.7	105. 6	90.7	69.9	84.9	81.7	77.8	73.1	72. 3

23	6/3/12	Model school Jn	77.8	98.4	115.5	91.9	64.6	83.1	80.7	76.8	72.3	70.6
24	6/3/12	Sreekandeswaram	78.6	102.9	110.0	97.3	61.6	88.3	80.3	76.0	70.7	68.4
25	7/3/12	Thampanoor Railway Station	76.6	100.6	117.3	92.9	65.4	83.3	79.8	74.1	70.0	68.8
26	7/3/12	Thampanoor bus depot	89.6	114.2	120.0	104.1	70.6	100.5	92.5	84.4	76.7	74.7
27	7/3/12	Overbridge	81.2	105.7	118.2	97.8	65.9	88.9	85.0	77.0	70.0	69.1
28	7/3/12	Pazhavangadi	81.0	105.6	115.0	102.7	61.0	89.0	84.1	76.8	70.2	68.8
29	7/3/12	East Fort	81.4	106.0	117.7	92.0	67.3	88.4	85.4	79.2	72.8	71.1
30	7/3/12	Attakulangara	85.2	109.7	118.7	108.9	65.5	89.9	86.9	79.4	71.0	69.1
31	7/3/12	Inside Fort	90.2	114.8	114.7	100.9	70.7	97.4	93.8	88.0	80.4	77.6

Zone categorization

Sl. No.	Location	Area
1	Aryasala	Industrial
2	Attakulangara Jn	Industrial
3	Attakulangara	Industrial
4	Attukal	Commercial
5	Ayurveda college	Industrial
6	Bakery Junction	Industrial
7	Bheemapally	Commercial
8	Chalai Market	Industrial
9	Civil Station, Kudappanakunnu	Industrial
10	Corporation office	Industrial
11	Cosmopolitan Hospital	Industrial
12	Dooradarsan , Kudappanakkunnu	Industrial
13	DPI Jn	Residential
14	East fort	Industrial
15	Fine Arts College, Palayam	Industrial
16	Gandhi Park	Industrial
17	General hospital	Industrial
18	Golf Links	Residential
19	Govt Hospital, Peroorkkada	Industrial
20	Govt HSS Nemon	Industrial
21	HLL Life care, PKT	Industrial
22	International Airport	Commercial
23	Jagathy	Industrial

24	Kalady	Industrial
25	Kanakakkunnu palace	Commercial
26	Kesavadasapuram	Industrial
27	Kowdiar	Industrial
28	Kumarapuram	Industrial
29	LMS Junction	Industrial
30	Manacaud	Industrial
31	Medical College	Industrial
32	Mental Hospital,Oolampara	Industrial
33	MG College, Paruthippara	Industrial
34	Museum	Commercial
35	Museum Jn	Industrial
36	Nalanchira	Industrial
37	Nemom Jn	Industrial
38	Padmanabha Temple	Commercial
39	Palayam Market	Industrial
40	Palyam Junction	Industrial
41	Pangodu	Industrial
42	Pappanamcode bus depot	Industrial
43	Pattom	Industrial
44	Pattoor	Industrial
45	Pazhavangadi	Industrial
46	Pazhavangadi Temple	Industrial
47	Peroorkkada bus depot	Industrial
48	Pettah	Industrial
49	Plamoodu	Industrial
50	PMG	Industrial
51	Poojappura	Industrial
52	PRS Hospital	Industrial
53	PTP Nagar	Residential
54	Public offices, Museum	Industrial
55	Regional Cancer Centre	Industrial
56	Sasthamangalam	Industrial
57	SAT Hospital	Industrial
58	SCT College of Engineering	Industrial
59	Secretariat	Industrial

60	Shangumukham	Commercial
61	SMV School	Industrial
62	SP Fort Hospital	Industrial
63	State Central Library	Industrial
654	Statue	Industrial
65	SUT Hospital, Pattom	Industrial
66	Thaliyal	Industrial
67	Thampanoor bus depot	Industrial
68	Thampanoor Railway Station	Industrial
69	Thirumala	Industrial
70	Thycaud Hospital	Industrial
71	Thycaud Junction	Industrial
72	Travancore Titanium	Commercial
73	Uloor	Industrial
74	University of Kerala	Commercial
75	Vanchiyoor Court	Commercial
76	Vazhuthacadu	Industrial
77	Veli	Commercial
78	Veli industrial Estate	Industrial
79	Vellayambalam	Industrial
80	Vellayani	Industrial
81	Vettukadu	Commercial
82	Vikas Bhavan Bus Station	Industrial
83	Vikas Bhavan-Offices	Industrial
84	Zoo	Commercial

Greenhouse Gases and Global Warming

Major issues of global environment change are global warming and stratosphere ozone depletion.

The atmospheric cover around the earth acts like a window glass pane. It allows most of the solar radiation to enter right up to the earth's surface, but does not allow a substantial amount of the long-wave radiation emitted by the earth to escape in space. The outgoing long-wave infrared radiation is absorbed by the greenhouse gases normally present in the atmosphere. The atmosphere radiates part of this energy back to the earth.Thus, the atmospheric greenhouse gases forming a blanket over the earth, control the escape of

heat from the earth's surface to outer space so as to keep it warm and hospitable. This phenomenon is referred to as greenhouse effect.

Major Greenhouse Gases

- Carbon dioxide (CO_2)
- Methane (CH_4)
- Nitrous Oxide (N_2O)
- Ozone (O_3)

Global Warming

The abnormal increase in the concentration of the green house gases is resulting in higher temperatures which are referred as Global Warming. Even a small change in the global temperature can have major consequences.

Global warming is likely to have a wide variety of effects on the following:

- Climate change
- Ocean and coast
- Glaciers, ice caps and permafrost
- Water, agriculture and food
- Animal and plant species

These effects are interconnected.

Approaches to deal with Global Warming

Some of the strategies that could reduce the warming by global stabilizing atmospheric concentrations of greenhouse gases include:

I. Reducing the greenhouse gas emissions by limiting the use of fossil fuels, and by developing alternative renewable sources of energy (eg.wind energy, solar energy etc)

II. Increasing the vegetation cover, particularly the forests for photosynthetic utilization of CO_2

III.Minimizing the use of nitrogen fertilizers in agriculture for reducing N_2O emissions

IV.Developing substitutes for chlorofluorocarbons.

Apart from the above mitigation strategies, adaptations to address localized impacts of climate change will be change.

CHAPTER - V

LITHOSPHERE

Soil

One of the most valuable gifts of nature to mankind is soil. In general, the soils of Kerala are acidic, kaolintic and gravelly with low CEC (Cation Exchange Capacity), low water holding capacity and high phosphate fixing capacity. Climate topography, vegetation and hydrological conditions are the dominant factors of soil formation. On the basis of morphological features and physico-chemical properties, different types of soil of Kerala have been classified into:

- Red loam
- Laterite
- Coastal alluvium
- Riverine alluvium
- Onattukara alluvium
- Brown Hydromorphic
- Saline Hydromorphic
- Kuttanad alluvium
- Black soils
- Forest loam

5.1 Area (in hectares) under important crops in Kerala

Sl. No.	Crops	2001-02	2002-03	2003-04	2004-05	2005-06	2006-'07	2007-'08	2008-'09	2009-10	2010-11
1	Paddy	322368	310521	287340	289974	275742	263529	228938	234265	234013	213187
2	Pepper	203956	201037	216440	237669	237889	216709	175679	153711	171489	172182
3	Tapioca	111189	110297	94297	88486	90539	87128	83990	87241	74925	72284
4	Arecanut	93193	92589	102504	107572	108590	102078	99787	97452	99188	99834
5	Cashew	89718	86623	86378	81547	78285	70463	58381	53007	48972	43848
6	Ginger(Dry)	10706	10365	8516	9991	12226	11082	8865	7421	5408	6088
7	Banana	50871	51805	55906	58866	61400	59143	59341	54739	51275	58671
8	plantain	55183	55412	53496	54612	55222	53096	51367	50126	47802	49129
9	Turmeric	3558	3388	2774	2881	3384	3917	3155	2782	2438	2391
10	Cardamom	41336	44237	4132	41378	41367	41362	39763	41588	41593	412420
11	Total food crops	1335409	1321696	1297542	1342974	1318644	1240582	1126495	1081873	1067468	1041540
12	Coconut	905718	905482	898498	899267	897833	872943	818812	787769	778618	770473
13	Tea	36899	36821	38327	35040	35043	35365	36131	36557	36845	36965
14	Rubber	475039	476047	478402	480661	494400	502240	512045	517475	525408	534230
15	Coffee	84795	84139	84684	84644	84644	84571	84115	84696	84796	84931

Source: Agricultural Statistics

5.2 Production (in tonnes) of important crops in Kerala

Sl. No.	Crops	2001-02	2002-03	2003-04	2004-05	2005-06	2006-'07	2007-'08	2008-'09	2009-10	2010-11
1	Rice	703502	688859	570045	667105	629987	641575	528488	590241	598339	522738
2	Sugarcane	26978	31283	29098	15430	9165	6582	15915	27548	28497	27184
3	Black Pepper	58240	67358	69015	74980	87605	64264	41952	33991	42459	45267
4	Ginger (cured)	40181	39886	32972	45305	56288	42496	31726	30809	28603	33197
5	Turmeric (cured)	7895	7598	5652	6244	8237	9980	7434	6364	6066	6198
6	Cardamom (proce d)	8380	6480	8875	8616	9765	8545	7031	8550	7800	7935
7	Banana	375903	379884	442220	475371	491823	463766	439803	435979	406242	483667
8	Other Plantain	393182	408649	399717	416115	445333	435636	391896	399633	338546	353772
9	Cashew nut (raw)	65867	63287	65655	60584	68262	61680	52402	42334	35818	34752
10	Tapioca	2455880	2504391	2540790	2400043	2568284	2518999	2556455	2712114	2525384	2408962
11	Mango	305545	347154	384190	525326	511131	445423	408143	392916	373168	3808859
12	Sesamum	284	260	285	260	210	294	171	309	206	228
13	Coconut (Million nuts)	5479	5338	5876	6001	6326	6054	5641	5802	5667	5287
14	Arecanut	84681	92039	105490	110340	119309	109968	114690	125654	116763	99909
15	Tea	66090	65800	57553	49508	56384	53659	51754	51726	57810	57291
16	Coffee	66690	64425	63850	49508	60175	59475	48650	57200	59250	65650
17	Rubber	580350	594917	655134	690778	739225	780405	753135	783485	745510	770580
18	Cocoa	4096	5109	4877	5061	5362	5783	9447	8778	6198	8673

Source: Agricultural Statistics

5.3 LAND UTILISATION PATTERN IN KERALA

(Area in Hectares)

Sl. No.	Classifications	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12
1	Total Geographical area	3885497	3885497	3886287	3886287	3886287	3886287	3886287	3886287	3886287
2	Forest	1081509	1081509	1081509	1081509	1081509	1081509	1081509	1081509	1081509
3	Land put to non agricultural use	395980	430084	370322	358684	371558	376155	361695	384174	399924
4	Barren &uncultivated land	28803	28891	26457	26125	25527	24931	17912	19573	17552
5	Permanent Pastures & Grazing land	316	292	274	301	216	229	96	153	83
6	Land under miscellaneous tree crops	10831	10193	9526	8959	6397	6002	4423	3690	3366
7	Cultivable waste	67285	70092	66133	90288	92764	96193	98014	91665	95437
8	Fallow other than current fallow	41261	40917	45171	47144	45214	45955	45374	51943	57670
9	Current fallow	68679	68634	70166	81651	82953	67759	76945	76028	77056
10	Net area sawn	2189940	2154885	2132483	2101431	2089029	2088955	2180679	2071507	2040132
11	Area sawn more than once	764514	841408	853244	816110	672065	605988	488026	575954	621625
12	Total cropped area	2954454	2996293	2985727	2917541	2761094	2694943	2668705	2647461	2661757

Source: Agricultural Statistics

5.4 Selected indicators of Agricultural Development in Kerala (2010-11&2011-12)

Sl. No.	Particulars	Unit	2009-10	2010-11	2011-12
1	**Fertilizer consumption**				
	• Nitrogen	MT	112752	117682	118729
	• Phosphorus	MT	58184	69000	52318
	• Potash	MT	93955	96857	82192
Total		**MT**	**264891**	**283539**	**253239**
2	**Plant Protection measures**				
	Fungicide(Liquid & Solid) in terms of technical grade	MT	438.46	389.99	341.23
	Insecticides(Liquid & Solid) in terms of technical grade	MT	122.5	50.58	31.55
	Weedicide(in terms of technical grade)	MT	65.97	44.39	16.8
	Rodenticide in terms of technical grade	MT	0	0.04	0.04
	Area under plant protection coverage	Lakh Ha.	15.02	4.3	3.66
	Rodent control operation	Lakh Ha	0.57	0.02	0.01
	Biological control of Nephantic Serinopa-parasites liberated	Lakh No	7.95	17.4	48.3
	Weed control	Lakh Ha	2.5	0.35	0.134
3	**High yielding varieties of paddy seeds distributed**	**MT**	**9860.6**	**7140**	**7700**
4	**Quality planting materials distributed**				
	Coconut seedlings	Lakh No	4.3	0.66	6.26
	Rooted pepper cuttings	Lakh No	27.72	26.13	26.13
	Cashew grafts	Lakh No	3.34	3.35	3.35
5	**Soil testing**				
	Soil samples analysed	No	215147	159333	115947

Source: Economic Review

Water-sheds

Kerala, with two third of its net sown area under plantation crops is a major producer of cash crops like Pepper, Rubber, Cashew, Cardamom, Ginger and Coconut in the country. These crops are mainly grown in the undulating midlands and steep highlands of western ghat region of the State. Area identified as high ranges i.e.1000 M above MSL, account for 5.15lakh ha. and are mainly spread over in Wayanad, Palakkad and Idukki districts forming 16 percent of the total area. High land areas i.e. 75 M above MSL are estimated to be about 18.71 lakh ha. The production of major crops like coconut, arecanut,pepper, cardamom, cashew, tea, coffee etc. showed wide variation during the last four decades for a variety of reasons such as drought, diseases etc.

Watershed has become an acceptable unit of planning for optimum use and conservation of soil and water resources.A watershed is hydrological units which produce water as an end product by interaction of rainfall and water shed factor.

Watershed development and management is an integration of technology within the natural boundary of a drainage area for optimum development of land, water and plant resources to meet the basic minimum needs of the people in a sustained manner.

5.5 Details of sanction for watershed products under RIDF-I

Sl.No.	District	No. of water sheds	Benefited Area (ha)	cost Revised	Balance cost	loans RIDF	GoK share
1	Thiruvananthapuram	4	1051	186.150	164.060	93.080	70.980
2	Idukki	10	295	267.819	189.507	128.425	61.077
3	Wayanad	7	600	92.224	61.724	45.976	15.758
4	Kannur	6	1030	167.664	140.938	83.633	57.305
5	Kasaragod	13	1926	299.730	262.565	149.865	122.700
	Total	40	5902	1013.199	818.789	500.979	317.810

WESTERN GHATS DEVELOPMENT PROGRAMME (WGDP)

SECTORAL PROGRAMMES – DETAILS OF SCHEMES

1. INTEGRATED DEVELOPMENT OF WATERSHEDS IN WESTERN GHATS REGION (WATERSHED PROJECTS)

Western Ghats Development Programme envisages improvement of ecological, economic, social and institutional development of Western Ghats region of the State through location specific interventions by Watershed Communities for the Integrated Development of Watersheds and also by promoting

programmes for Forestry, Research and Training in related fields. WGDP is integrated into the decentralized planning process institutionalized in the State. Allocation for Watershed Development sector is distributed to the District Collectors for funding projects/programmes initiated by Panchayat Raj institutions for the integrated development of priority watersheds and implemented in participatory mode by Panchayat Raj Institutions (PRIs) or reputed Non-Governmental Organizations (NGOs) as Programme Implementing Agencies (PIAs)

The Western Ghats act as the eastern boundary of the State of Kerala. This hilly region is about 560 Km long and is broken by long spurs, intensive ravines, dense forests and tangled jungles, full of flora and fauna in an excessively rolling terrain with an average elevation of more than 950 m above MSL. In high ranges, the elevation is between 1800 to 2600 m above MSL. The 'Anamudi' (2817 m) is the highest peak in Western Ghats in Kerala, which is the second highest peak in India.

Command area development and watershed area development are the two development approaches in the field of agricultural and rural development. Of these the watershed area development is pursued in rain fed areas, where the availability and distribution of rainfall is erratic and hence a more diversified mixed farming system is practiced.

Watershed based approach of development has been considered as ideal and logical for preserving the resource trinity of land, water and biomass. The Western Ghats Development Programme envisages a holistic sustainable watershed based development of the Western Ghats region using simple, easy and affordable technologies. Priority is given for eco-preservation and eco-restoration of the selected watershed. The programme aims at the overall upliftment of resident population and at changing their mindset towards eco-preservation. Based on various selection criteria, the most degraded or least developed watersheds are identified and prioritized for the integrated development activities.

The outlay will be utilized for the following purposes:-

a) Watershed Projects – (Natural Resource Management (NRM), Production System Management (PSM) including Food Security Mission (FSM), Livelihood Support System (LSS) and Entry Point Activities (EPA)

Natural Resource Management (NRM)

The Natural Resources Management is the main aim of this project which will regenerate the quality of soil, water and biomass of the target area. Hence it is proposed to implement the following programmes under Natural Resource Management.

Soil Conservation

i) Contour Bunding

Contour bunding with stone is the ancient method in agriculture which helps to prevent soil from severe soil erosion during the rainy season. The contour bunding activity both with stone and earth is

proposed to cover in the project area. This will prevent the soil erosion and lead to proper management by the farmers. It is expected to induce behavioral changes among beneficiaries towards proper land management. The bunding activities shall be performed by beneficiaries in their own lands. The beneficiaries can contribute their own labour towards their contribution and make arrangements for employing additional skilled workers to complete the activities.

ii) Retaining Wall

Construction of retaining wall is envisaged in the project by the total project period. The construction activity which shall be implemented by the group of beneficiaries selected by the committee. The PIA will facilitate the activities. It is also an employment-oriented component.

iii) Water Conservation

As part of introducing appropriate technologies in water harvesting, the project envisages installation of Rain Water Harvesting units in the project area. The project includes cost for construction of Ferro Cement tank, leading channels from house roof, inlet pipes, filter unit, tap etc. The beneficiary committee will make special attention to give Rain Water Harvesting units to more deserving families who are facing acute drinking water scarcity and non-accessibility to fetching drinking water. Construction of wells is also proposed in this project.

Production System Management (PSM)

Production System Management includes agriculture and allied sectors, crop husbandry, fisheries and forestry. Compared to other sectors, as a part of Food Security Mission, crop production sector is of much higher priority sector in the State. It is proposed to support all the activities related to agriculture and allied sectors. During the year it is envisaged to implement various action plan for the revival of food production sector. The outlay will be utilized for the following purpose:-

- ❖ Production and supply of quality planting material
- ❖ Enhancement of rice, milk, egg, pulses, vegetables etc.

Most of the individual schemes of the project are implemented through this. Fodder development project, low cost technology application, conventional energy practices, organic practices, dairy related programmes and the like may come in this sphere.

Livelihood Support System (LSS)

The main component of the sector is the various income generating activities in view of poverty eradication through proper schemes. Providing dairy units, ecological protective activities such as Azolla cultivation, production of Vermi compost etc. included. The outlay will be used for the support for the units covering dairy, poultry, goat rearing and fodder. The assistance will be provided based on the area plan for the development of livestock linked to the plan of the local Governments. The scheme will be

implemented in association with Dairy Development Department, Animal Husbandry Department, Agriculture Department etc.

Entry Point Activity (EPA)

There are many common issues to be addressed immediately in the project areas where the watershed people live. Problems such as there are no much facilities for them to gather together for cultural activities, common meetings and trainings. If there are such facilities it is useful the people to do creative discussions and promote cultural activities which are more connected with the life of the people. This may help them to promote the feeling of oneness and unity. It will help the authorities to organize common programmes and meetings. So the outlay is for proposal to construct Community Development Centre and other such facilities.

Subsidy

Special attention will make to give assistance to more deserving families. Normally only those Below Poverty Line are selected for these schemes.

The subsidy is allocated based to the individual subsidy norms of each scheme.

Bench Mark Survey

From the very beginning of the each project formulation bench mark survey have been conducted and collected the other details. In the case of integrated sustainable project the detailed household survey which will help to collect all details of socio-economic conditions of each family, their land use pattern, knowledge about scientific agriculture operations, rural technologies, soil and water conservation includes concept regarding children's education concepts and scope of leadership skills, health seeking behaviour, culture and heritage in the changing scenario on the base line survey. The project will have a detailed data using scientific software which can be used in future.

b) Footbridges (Infrastructure Development)

The amount is provided for the construction and maintenance of footbridges for filling gaps in the inaccessible areas of Western Ghats region giving preference to Tribal Settlement. District Collectors will implement this scheme in Districts.

c) Maintenance of Assets

Under the watershed programme various community assets are created such as water harvesting structures, community nurseries, community meeting halls etc. For maintaining the community assets after the completion of the project standing guidelines are adopted. Proposed outlay will be used for the purpose.

2) Forest Based Programmes

a) Project for WGDP activities and Eco-friendly activities in the Forest Area

Forest Based Programmes suited for Eco-restoration and Eco-preservation is emphasized under the forest component of Western Ghats Development Programme. The programmes for the forest sector are implemented by the Forest Department and Kerala Forest Development Corporation. Joint forest management with the co-operation of the Vana Samrakshana Samithis has yielded good results. Regeneration of the forest cover with People's Participation, Eco-Preservation, NRM activities etc. are the major activities proposed.

b) Project for the upliftment of Adivasis and Tribals within the forest

Schemes for improving the living condition of the Tribals/ Adivasis settlements within the forest area will be taken up. Participatory Forest Management programmes implemented with the participation of Tribal Communities in the fringe areas of forest.

Wet Lands

Wetlands play a vital role in maintaining the fragile environmental balance. Wetlands serve as sinks, sources and transformers of innumerable chemical, biological and genetic materials.They offer a unique habitat for a wide variety of flora and fauna as well. The wetlands are among the most important ecosystems of the earth.

Kerala is one of the green states of India and is well known for its wet lands. The major issues facing the wet lands of Kerala are mainly related to pollution, eutrophication, encroachment, reclamation, mining and biodiversity loss.Major wetland types observed in the state are Rivers, Lagoons and Reservoirs.Ashtamudi Wetland Sasthamkotta Lake, Vembanad-Kol Wetland are three Ramsar sites in Kerala, Other than these wetlands , Parambikulam Dam, Periyar Lake, Kaway Lagoon, Kumbalangi kayal, Malampuzha Reservior, Koltapuzha kayal, Vayalar lake, Kayamkulam Kayal, and Peechi Dam Reservoir are some of the important wetland sites. Extensive field work was carried out for these wetland areas. Wetland maps have been prepared for 5km buffer area of each wetland sites.

Wetlands of international/national importance in Kerala: Vembanad-kol, Ashtamudi and Sasthamkotta, are the three designated Ramsar sites of Kerala. In addition to this, two more wetlands - Kottuli in Kozhikode District and Kadalundi in Kozhikode and Malappuram Districts - have been identified by the Ministry of Environment and Forests, Government of India, under National Wetland Conservation Programme. The Ministry, in 2004, had approved a programme to prepare Management Action Plan for Kottuli Wetland.

Wetlands of Kerala: present scenario

In Kerala, despite its small land area of 38864 km2has about 590 km long coastline studded with world's best string of beaches. It is bestowed with a vast network of backwaters, lagoons, natural lakes, rivers and canals The State has two clearly distinct rainfall seasons i.e., south west monsoon and north east monsoon resulting in near water-logged conditions in almost 20% of the total geographic area of the State. Thus, as much as one fifth of its total landmass is wetlands.

5.6 Area under wetlands of Kerala

Inland wetlands	Area(ha)	%Area	No:of units
Natural	2180.00	1.70	11
Man made	32019.57	25.03	53
Total	**34199.57**	**26.73**	**64**
Coastal Wetlands			
Natural	85671.50	66.97	86
Man made	8059.00	06.30	07
Total	**93730.50**	**73.27**	**93**
Grand Total	**127930.07**	**100**	**157**

Source: www.kerenvis.nic.in

Land is a critical natural resource

Land is one of the most important critical resources which determine the success of development planning of any region.Promoting optimum land use is an essential purpose in achieving the planned goals of economic efficiency and ecological activity.

Wasteland defined

Wasteland is defined as "degraded land which can be brought under vegetative cover with reasonable effort and which is currently under utilized and land which is deteriorating for lack of appropriate water and soil management or on account of natural causes."Wastelands can result from inherent/imposed disabilities such as by location ,environment,chemical and physical properties of the soil or financial or management constraints.These land could fall under Government occupation,private occupation or forest lands.13 categories of wasteland have been standardized and State and Central Government departments are using the same.

Wasteland exist in Kerala, where the per capirta availablility of land is only 0.13 hectare and the average size of holding is 0.33 hectare.

Wasteland classification

The wasteland categories standardized by National Remote Sensing Centre, Hyderabad for Kerala for this project is as follows:

01 Land with scrub

02 Land with out scrub

03 Water logged- permanent

04 Water logged-seasonal

05 Under utilized/degraded notified forest land-scrub dominated

06 Degraded pastures/grazing land

07 Degraded land under plantation crop

08 0Sands (riverine/coastal/desertic)-flood plain

09 Coastal sand

10 Mining /industrial-Mining

11 Mining/Industrial-Industrial

12Barren Rocky/Stonywaste/sheet rock

13Steep slopping area

5.7 District - wise distribution of Wastelands – (Kerala 2010)

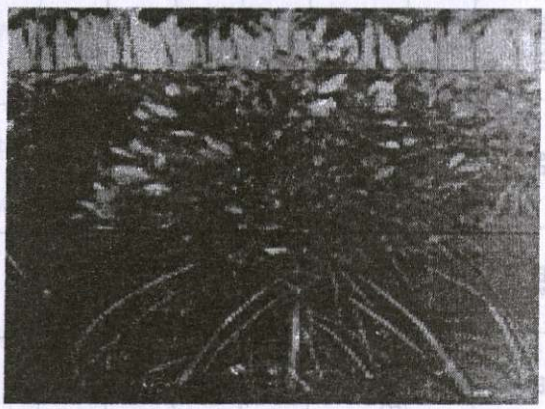
(in hect.)

Waste land Type/District	Alappuzha	Erńakulam	Idukki	Kannur	Kasaragod	Kollam	Kottayam	Kozhikode	Malappuram	Palakkad	Pathanamthitta	Thiruvananthapuram	Thrissur	Wayanad	Kerala
Gullied and/ or ravinous land	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Upland with or without Dense Scrub	2	3196	30771	16616	30102	3183	11063	4017	11850	16543	10850	1926	4418	6805	151340
Waterlogged and Marshy land	0	342	0	0	0	0	474	164	0	264	0	0	729	24	1997
Land affected by salinity/alkalinity	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Shifting Cultivation Area	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Under-utilised/ degraded forest	0	5203	2933	1707	42	1336	446	3321	5692	19069	45	14543	1469	1419	57225
Degraded pastures/ grazing land	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Degraded land under plantation crop	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mining Industrial Wastelands	0	0	0	0	0	0	0	21	0	0	0	6	2	0	20
Barren Rocky/Stony waste	0	1513	11253	1570	1585	47	68	1438	2166	8964	240	959	716	249	30768
Snow covered and / Glacial Area	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Source: Wasteland Atlas of India

MANGROVES

Mangroves are wetland ecosystems formed by the assemblage of specialized plants and animals adapted to semi saline swamps along coasts. Mangrove forests of Kerala are highly localized, but the species diversity of these mangroves and its associates are comparatively rich. It is confined to the upper reaches of estuaries, lagoons, backwaters and creeks. In Kerala mangroves are distributed in all the districts except Idukki, Pathanamthitta, Palakkad and Wayanad. Maximum extent is reported from Kannur district. The total extent of mangrove forests in the state is estimated to be less than 50km2 (Mohanan 1997). Mangroves play an important role in the economy of coastal people through various ways. Mangroves provide excellent habitat for migratory birds, serve as breeding ground for many species of fishes and prawns helps in controlling pollution, rutting of husks etc.



The important mangrove plants are Acanthus cillicifolius, Acrostichum aurem, Aegiceras corniculatum, Avicennia officinalis, A, rina, Azima tetracantha, Bruguiera gymnorrhiza, B. cylindrica, B sexangula, Excoecaria agallocha, E indica, Kandelia candel, Rhizophora apiculate, R mucronata, Sonneratia caseolaris, Calophyllum etc. Some of these species that disappeared from the Kerala coast are Azima tetracantha an Ceriops tagal, Heritiera littoralis and Flagellaria indica have discourteous distribution. Calamus rotang and Syzygium travancoricum are some of the rare and endangered species found in the mangroves. The major threats to the mangrove forests are land reclamation for urbanization, intensive aquaculture felling of mangrove trees for fuel and fodder, unsustainable land use, ambiguity in ownership etc.

GRASSLANDS

In Kerala grasslands are generally found above 1500 m. The grasslands, which are also called as 'shrub-savanna' are characterised by herbaceous and shrubby species mixed with grasses.

The grasslands below 1800 m that are adjacecnt to medium or high elevation evergreen forests, are often found with sparse trees, represented by Wendlandia thrysoidea, Glochidion spp. Terminalia chebula, Emblica officinalis, Careya arborea, Briedelia crenulata; in some places a dwarf palm. Phoenix is found in patches. At this elevation range, grasses are tall, and reach the height up to 1.5 m. They are commonly represented by Androprogon lividus, Arundinella purpurea, Agrostis peninsularis, Chrysopogon zeylanicus, Eulalia phaeothrix, Sehima nervosum, Heteropogon contortus, Eulalia sp, Themeda sp, Ischaemum indicum, and Tripogon bromoides. In cattle grazed and frequently burnt areas, unpalatable Cymbopogon flexuous and Pteridium, a fern are frequent.

The grasses in this zone are mixed with other herbs like Crotalaria, Desmodium, Hypericum, Knoxia, Leucas, Lobelia, Osbeckia etc. Phlebophyllum kunthianum, a monocarpic shrub species, often dominates the grass land landscape.

At above 1800 m, especially in the Anamalai region (Eravikulam and Munnar) grasslands are more specialised. During the colder months, the minimum temperature often goes below zero degree centigrade. In this zone grass layer is less than 1m and is represented by Andropogon foulkesii, Anthistiria ciliata, Arundinella spp., Arundinaria villosa, Bothriochloa pertusa, Chrysopogon orientalis, Cymbopogon spp.,Eragrostis nigra, Eulalia spp., Heteropogon contortus, Isachne spp., Themeda spp., Tripogon bromoides and Zenkeria elegans.

Among Shrubby elements Berberis tinctoria, Gaultheria frangrantissima, Hypericum mysorense, Lobelia excelsa, Oldenlandia stylosa, Osbeckia wightianum, Pteridium aquiilnum, Rubus fairholmianus, Phlebophyllum kunthianus are particularly frequent. Rhododendron arboreum var. nilagiricum in the form of small tree is also sporadically seen in grasslands.

The common herbaceous elements among grasses include Anaphalis spp., Campanula fulgens, Cassia spp., Crotalaria notonii, Cyanotis spp.,Indigofera pedicellata, Justicia simplex,Knoxia mollis, Leucas suffruticosa, Lilium neilgherrense, Oldenlandia articularis Polygala sibirica, Striga asiatica, Viola patrinii,and Wahlenbergia gracilis. In the swampy pockets Commelina spp., Centella asiatica, Drosera peltata, Fimbristylis uliginosa etc are common.

MINING

The land of Kerala is endowed with a number of occurrences/ deposits of good quality 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, Lime shell, 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/Lime shell, Silica Sand and Granite. The state owns mineral deposits like limestone, lime shell, silica sand, bauxite, graphite, iron ore, granite etc.These minerals are found in various districts providing base for forming various mineral based industries in the State. Kerala posses one of the world class deposits of minerals and sands and in the coastal tracts between Neendakara and Kayamkulam.Pazhayangadi, Kannur are some of the mineral based industries working in the State since several years. The resources of beautiful ornamental granites in the state are being exported to different countries. In fact, Heavy mineral sand and china clay contribute more than 90% of the total value of major production in the State. However, 75% of the mineral revenue comes from the minor minerals. For all the development activities, mineral is an essential commodity. The minerals deposited are found in various districts providing base for forming various mineral based industries in the State. Estimated available mineral reserves with occurrence and use are shown in Table 5.8 given below:

5.8 Available Resources for Mineral Industries

Minerals	Reserves (Million tones)	Occurrence	Uses
Gold	0.55	Wayanad, Marudp, Nilambur, Malappuram	Manufacture of ornaments
Iron	83.4	Kozhikode (Eleyettimala, Naduvallur Nanminda, Cheruppa, Alampara) Malappuram (Korattimala)	Iron is useful in building (Bridge, highway, rail road, etc.) , transportation (car, train, boats, plane, etc.) , tools (knife , machines , etc.)
China clay	172	Thiruvananthapuram,Kollam, Kannur,Kasaragod	Ceramics, pottery, paper, textiles, Rubber and paints
Ball clay	1.67	Thiruvananthapuram(Nadayara) Kollam(Kumbalam,Kanjirottusser, Mulavana) Kannur(Pattuvam,Karivalloor, Earipuram,Pazhayangadi)	Manufacture of Refractory products, Ceramic Granite Tiles, Glazed Tiles, Table Ware & High Tension Electric Insulators etc.
Fire clay	11.55	Kollam(Kundamon,Pallikkal), Alappuzha(Thamarakulam), Eranakulam(Amballoor, Kanjiramattom, Keezhumadu), Thrissur(Poomangalam) Kannur(Pattuvam)	Manufacture of firebrick and of various accessory utensils, such as crucibles, saggers, retorts, and glass pots, used in the metalworking industries
Silica	28.40	Coastal area of Alappuzha	Used in ceramics and to make glass with. It can also be used to strengthen iron and steel.
Bauxite	12.5	Thiruvananthapuram(mangalapuram, Chilambil,Sasthavattom), Kollam.(Poruvazhy,Aadichanalloor) Kannur,Kasaragod	Manufacture of Aluminum .It is used in cement, chemicals, face makeup, soda cans, dishwashers, siding for houses.
Lime shell	4.05	Alappuzha, Eranakulam (Vembanad lake), Kottayam, Thrissur (Vadanapally) Kannur (Payyannur, Thrikkkaripur)	Manufacture of a variety of products including white cements
Lime stone	24	Palakkad (Walayar)	Manufacture of cement, calcium carbide, Iron & steel Industry etc
Graphite	2.81	Thiruvananthapuram (Veli, Kuttichal), Eranakulam (vadakode), Kottayam (Chirakadavu)	Crucible Foundry, Refractory, Paints& Lubricant Industries
Lignite	9.65	Kannur(madai),Kasaragod Nileswaram, Palayi)	Used as fuel for steam electric power generation in some countries
Magnesite	0.037	Palak[illegible]d (Attapadi)	Refractory bricks for furnaces.

Source: Dept of mining & Geology

5.9 Production details of Major Minerals

(In Tonnes)

Minerals	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12
China clay	528363.65	611031.17	667479.30	737271.04	947619.80	1025112.35	812977.6667
Ilmenite	0.00	0.00	148766.02	192218.44	100589.88	111987.76	146401.7895
Rutile	0.00	0.00	6810.70	8686.11	6593.16	6513.50197	10490.44
Zircon	0.00	0.00	13383.84	10158.38	11844.11	13648.0993	16164.68125
Silimanite	0.00	0.00	10903.92	15570.07	9043.54	7366.9319	5988.319444
Silica sand	130343.75	137874.05	141764.60	133116.85	65366.76	72424.8909	45638.00806
Lime shell/ sea shell	59546.78	87047.87	74358.07	77549.04	60996.68	56906.0317	63781.14286
Lime stone	732572.29	423070.36	366154.33	406733.02	490392.17	527557	546304
Bauxite/Laterite	21387.92	72016.81	96604.00	80910.28	46941.86	47302.675	76859.35955
Quartz	2150	1200.00	1800	2565.60	1145.00	59	0
Graphite	0	250.00	50	200	820.00	249.6	327.04
Brown Ilmenite	0	0.00	0	0	0.00	0	2579.039

Source: Dept of mining & Geology

5.10 Production details of Minor Minerals

(In Tonnes)

Minerals	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12
GBS	3216115.81	4641131.00	6414453.81	9840832.31	9765296.19	10960208.8	13101468.63
GDS	2589.39	2915.96	1656.54	740.34	1109.65	1068.159	373.961
Laterite	603601.56	801618.31	1071537.69	1254878.94	1322706.00	1332570.81	1757764.313
Lime shell/Sea shell	14102.88	37403.56	7808.16	4421.13	4285.78	10451.1556	9486.54
Brick Clay	374154.6	304069.90	538711.40	1026139.50	1201741.10	837152.3	1588373.4
Ordinary Sand	6037840	4560252.30	5165247.20	3541904.30	2679072.50	2791575.9	3814097.1
River sand	2586047.5	4940442.20	5592126.50	5160936.30	5248901.60	3084704.4	3697269.8

Source: Dept of mining & Geology

5.11 Value details of Major Minerals

(in Rs)

Minerals	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12
China clay	184927277.5	229136690.22	266991721.74	294908417.39	426428910	461300557.5	183732953.42
Ilmanite	0	0	505804453.13	653542687.50	352064568.90	391957159.4	5124062615.00
Rutile	0	0	207726339.77	264926223.99	204388054.26	201918561.2	839235200
Zircon	0	0	528661659.21	401256020.39	473764503.93	545923972.5	1212351000
Silimanite	0	0	62697527.40	89527893.84	54261247.31	44201591.4	44912400
Silica sand	71689062.5	82724430	92146990.	86525952.50	45756734.55	50697423.64	54217955.88
Lime shell/sea shell	5656944.1	87047866.67	74358066.67	77549044.44	76245853.17	71132539.68	79726425
Lime stone	109885843.5	67691258.18	58584692.36	65077282.91	88270591.43	94960260	109260800
Bauxite/Laterite	3208188	10802520.83	14490600	12136541.67	82148259.38	82779681.25	153718720
Quartz	1182500	660000	1080000	1539360	801500	41300	0
Graphite	0	0	0	0	0	0	261632
Brown Ilmenite	0	0	0	0	0	0	64475975

Source: Dept of mining & Geology

5.12 Value details of Minor Minerals

(in Rs)

Minerals	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12
GBS	51457853	1392339300	1924336143.75	2952249693.75	3906118475	4384083500	7860881178
GDS	10357574	58319265	33130840	14806820	33289357.50	32044770	11218800
Laterite	9657625	112226563.75	150015276.25	175683051.25	634898880	639633990	896459798.10
Lime shell/Sea shell	705144	37403555.56	7808155.56	4421133.33	11743031.11	28636166.22	26562312
Brick Clay	3741546	25845941.50	45790469	87221857	300435275	209288075	476512020
Ordinary Sand	60378400	2736151380.00	3099148320	2125142580	6697681250	6978939750	10679421480
River sand	25860475	2964265320	3355275900	3096561780	13122254000	7711761000	11091809400

Source: Dept of mining & Geology

Natural Disasters

Apart from floods the mountain regions of the state experience several landslides during the monsoon season. The western flank of the Western Ghats covering the eastern part of Kerala is identified as one of the major land slide prone areas of the country. The Landslides in the state include rock falls, rock slips, debris flow and in a few cases rotational types of slides. But the most prevalent recurring and disastrous type of mass movement noted in Kerala are the debris flow (urulpottal) characterized by the swift and sudden down slope movement of highly water saturated overburden ranging in size from soil particles to boulders destroying and carrying with it every thing that is lying in its path. About 1500 km^2 area in the Western Ghats is prone to landslides. Every year with the onset of monsoon, land slips and land slides are reported. Population growth and high rain fall are identified as the major driving forces behind the land sliding.

It is known that a total of 65 fatal landslides occurred between 1961 and 2009 causing the death of 257 individuals (Kuriakose, 2010). Between the period, 1871-2000, the state experienced 12 moderate drought years. The 570 Km long coast line of Kerala is prone to erosion, monsoon storm surges, and sea level rise. Land subsidence due to tunnel erosion or soil piping which is a slow hazard, is recently noticed to be affecting the hilly areas in the state. This often goes unnoticed and is a hazard with potential of causing infrastructural damages and crop loss covering vast areas in the high land regions of the stare. (Kuriakose, 2009)

Kerala is prone to high incidence of lightning, especially during the months of April, May, October and November. It is estimated that about 70 people die every year due to lightening. About 14.8% of the state is prone to flooding (CESS, 2010). Kerala is a place of high incidence of lightening compared to most of the other parts in India. Weather and Western Ghats together cause formation of more lightning clouds. Relatively higher population density and vegetation density result in more causality. Accident caused by ground conduction from trees, which is a special feature of Kerala. In the month of April, May, October, and November, relatively much higher lightening incidence occurs.

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.

The coastal belt of Kerala was ravaged by Tsunami, killing at least 169 persons in 26 December 2005. The most ruined is the poor hamlet of Azheekkal near Karunagappally in Kollam District. Thousands displaced. Thousands injured. Thousands rendered homeless.

Kerala is also prone to several anthropogenic disasters such as road accidents, rail accidents, boat capsizing, industrial accidents, epidemics, pest infestation, crowd stampedes and infrastructure collapses. As many of the dams in the state have exceeded their design life, they are potentially disastrous to people living in the downstream.

CHAPTER – VI

HYDROSPHERE

A hydrosphere (from greek Hydro," water" and sphaira,"sphere") in physical geography describes the combined mass of water found on,under,and over the surface of a planet Water (H_2O) is the most abundant compound on Earth's surface, covering about 70 percent of the planet. Access to clean water is a key factor in reducing poverty, improving health and achieving sustainable development.

Water pollution adversely affects the health of the people. It is the root cause of many deadly diseases like cholera, dysentery, diarrhea, jaundice, tuberculosis etc. Many rural areas of the country are facing such problems. Many urban areas are also facing acute shortage of drinking water and pollution-free water. Polluted water also affects the quality and quantity of agricultural produce. It adversely affects the aquatic life.

Controlling Water Pollution

Water pollution is the contamination of water bodies (eg.lakes, rivers, oceans, ground water) .Controlling the problem of water pollution needs serious effects at different levels: individual, community, NGOs and government. There is a need for public co-operation making the people conscious about health, hygiene and causes and effects of water pollution. Certain bad practices like throwing the garbage, domestic wastes, dead bodies into rivers, community bathing, burning the corpses with fuel wood need change. Industries must install pollution control devices and effective steps should be taken for proper treatment of city sewage. Strict vigil should be maintained and guilty person should be punished.

Water Quality monitoring objectives

The Water Quality monitoring is being carried out to ensure that the water quality is being maintained or restored at desired level

6.1 Primary water quality criteria for bathing water

Criteria	Rationale
Faecel Coliform:500(desirable) MPN/100 mi:2500(maximum permissible) Faecal Streptococci:100(desirable) MPN/100 ml:500 (maximum permissible	To ensure low sewage contamination,faecal coli form and faecal streptococci are considered as they reflect the bacterial pathogenicity The desirable and permissible limits are suggested to allow for fluctuation in environmental 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 during 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 prevent production of anaerobic gases(obnoxious gases) from sediments
Biochemical oxygen:3 mg/l or less Demand 3 day,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 Pollution Control Board

6.2 AMBIENT WATER QUALITY STANDARDS

Sl. No.	Parameter	Use class				
		A	B	C	D	E
1	Dissolved Oxygen(DO) mg/l,min	6	5	4	4	-
2	BOD(3 days at 27°C mg/l,max	2	3	3		
3	Total Coliform Organisms MPN/100 ml,max	50		5000		
4	pH	6.5-8.5	6.5-8.5	6.5-8.5	6.5-8.5	6.0-8.5
5	Free ammonia (as N) mg/l,max				1.2	
6	Electrical conductivity Micromhos/cm,max					2250
7	Sodium Absorption Ratio,max					26
8	Boron,mg/l,max					2
9	Feacal Coliform MPN/100 ML		2500			

Note:-

A-Drinking water source without any conventional treatment but after disinfection

B-Outdoor bathing organized

C- Drinking water source with conventional treatment followed by disinfection

D-Propagation of wild life and fisheries

E-Irrigation, industrial cooling, controlled waste disposal

Source: Kerala Pollution Control Board

6.3 Minimum and maximum observed values of water quality parameters at PWD sites and rivers for 2011

Sl. No.	Name of River	Name of Site	Quality Parameters												
			pH			Dissolved Oxygen			B.O.D			Coliform bacteria			Class
			Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	
1.	Neyyar	Amaravila (Neyyatinkara Village)	7.6	6.6	7.23	7.9	6.8	7.28	1	0.2	0.68	1600	240	985	B
		Aruvippuram (Perumkadavila Village)	7.6	7	7.23	7.8	7	7.6	0.9	0.5	0.7	2400	350	1162	B
2.	Mamom	Mamom Bridge (Attingal Village)	7.7	6.7	7.2	8	7.4	7.7	1.2	0.2	0.7	2400	1300	1850	C
3.	Ayroor	Ayoor Bridge (Ayroor Village)	7.2	6.5	6.9	7.5	5.3	6.28	2	0.4	1.28	1600	500	1325	B
4.	Karamana	Mannattumukku (Thiruvallom Village)	7.8	6.5	7.07	6.8	0	0.78	18	6.2	11.91	22000	1600	11000	E
5.	Ithikkara	Ithikkara Bridge	7.1	6.8	6.95	6.8	5.6	6.05	1.5	0.4	0.80	1600	700	1150	C
		Ayroor Bridge	7.1	6.8	7	7.6	6.6	7.05	0.9	0.2	0.58	900	500	625	C
6.	Vamanapuram	Vamanapuram (Vamanapuram Village)	7.4	6.7	6.97	7.8	5.4	6.87	1.1	0.9	1.00	2400	1100	1533	B

7.	Pallickal	Nellimughal	7.1	6.5	6.83	6.9	6.2	6.425	0.6	0.4	0.525	700	500	575	B
8.	Achenkovil	Thumpamon	7.4	6.6	6.94	7.6	5.9	7.08	0.9	0.2	0.52	1100	240	640	B
		Chennithala	7.3	6.4	6.95	7.1	5.7	6.6	1.4	0.6	0.98	1600	280	820	B
9.	Kallada	Perumthottamkadavu	7.4	6.6	7.05	7.9	6.3	7.17	0.8	0.3	0.56	1100	220	686	A
10.	Pamba	Pamba Down (Mannar Panchayath)	7.4	6.2	6.63	7	6.3	6.725	1.3	0.7	0.875	1600	350	837	C
		Chenganoor (Chenganoor Muncipality)	7.3	6.1	6.58	7.5	5.9	6.95	0.8	0.4	0.58	900	410	577	C
		Thakazhy (Thakazhy Panchayath)	7.5	6.3	6.75	7.5	6.2	6.73	2	0.7	1.18	700	500	625	E
11.	Meenachil	Kidangoor (Kidangoor Panchayath)	6.9	6.3	6.63	7.8	6.2	6.80	0.6	0.4	0.50	3200	1100	2025	C
12.	Manimala	Thondara (Kuttoor Panchayath)	6.8	6.4	6.63	7.6	6.7	6.98	2.7	1	1.48	1200	800	1000	C
		Kallooppara (Kallooppara Panchayath)	7.4	6.4	7.05	7.8	6.5	7.28	2.6	0.3	1.28	1300	350	912	C

13.	Periyar	Eloor (Kadungallore Panchayath)	7.3	6.5	6.85	7	4.1	5.58	2.4	0.4	1.53	3500	500	1925	E
		Kalady (Kalady Panchayath)	7.3	6.8	6.98	8	6.7	7.43	1.6	0.2	0.88	3000	350	1195	B
		Aluva (Aluva Muncipality)	7	6.5	6.85	7.4	5.8	6.73	1.7	0.4	1.01	5000	600	2750	C
		Pathalam (Kadungallore Panchayath)	7	6.5	6.82	7.2	4.8	6.23	2.9	0.5	1.62	5000	350	2725	E
		Kalamassery (Kalamassery Muncipality)	7.1	6.5	6.79	7.2	2.4	5.18	3	0.6	1.75	5000	900	2650	C
		Purapallikadavu (Chengamanadu Panchayath)	7.2	6.7	6.93	7.6	5.4	6.77	2	0.3	1.05	5000	50	1258	C
		Muppathadam (Kadungallore Panchayath)	7.4	7.1	7.25	7.8	6.4	7.08	2.1	0.5	1.45	2800	500	1775	C
14.	Kadambrayar	Brahmapuram (Thrikkakkara Panchayath)	7.3	5	6.63	7.2	0.3	1.46	9.4	0.9	3.57	9000	240	2978	D
		Manakkakadavu (Thrikakkara Panchayath)	7.1	6.5	6.77	7.1	0.5	1.98	4.4	0.7	2.37	5000	500	1275	D
15.	Moovattupuzha	Vettikkattumukku (Mevallore Panchayath)	7.3	6.6	6.96	7.8	6.2	7.04	2	0.5	1.11	3500	500	1725	D

16.	Chalakudypuzha	Pullickakadavu (Kadakutty Panchayath)	7.3	6.6	6.89	7.3	5.6	6.48	3	0.4	1.31	2400	110	1126	C
17.	Chithrapuzha	Irumpanam (Trippunithura Muncipality)	7.1	6.6	6.80	3.1	0.6	1.98	3.6	2.2	2.88	16000	500	5425	E
18.	Karuvanoor	Karuvanoor Bridge (Porathissery Village)	6.9	6.2	6.48	7	6	6.4	2.4	0.6	1.33	2800	240	960	C
19.	Puzhakal	Puzhakkal Bridge (Adat Panchayath)	6.8	6	6.45	6.2	2.9	4.45	1.2	0.8	1.05	9000	300	2675	D
20.	Keecheri	Vadakkancherry (Eranellur Village)	6.7	6.4	6.55	6.4	4.5	5.45	2.3	0.6	1.45	1100	600	850	C
21.	Korayar	Kanjikkode (Kanjikkode Panchayath)	7.9	7.7	7.80	6.6	4.4	5.50	1.2	0.4	0.93	2800	500	1650	B
22.	Bharathapuzha	Kuttippuram (Kuttipuram Panchayath)	8	7.1	7.38	7.4	7	7.15	1.6	0.4	0.93	3500	1400	2225	A
		Pattambi (Pattambi Panchayath)	8	7.1	7.5	7.4	6.3	6.93	1.2	0.5	0.78	2400	1300	1725	A
23.	Kadalundi	Thirurangadi (Thirurangadi Village)	7.7	6.5	6.95	7	5	6	1.8	0.3	1.08	500	200	370	B
		Hajiyarpally (Panakad Village)	7.9	6.7	7.45	7.1	4.9	6.5	1.6	0.3	0.78	1400	220	585	B

24.	Tirur	Thalakkadathur (Cheriyamundam Village)	7.6	6.3	6.85	5	3.6	4.55	1.5	0.1	0.60	800	110	348	B
25.	Chaliyar	Koolimadu (Chathamangalam Panchayath)	7.6	6.8	7.05	7.9	6.8	7.11	0.8	0.2	0.64	2200	340	707	A
		Chungapally (Perumana Panchayath)	7.3	6.7	6.97	8	6.5	7.08	1	0.2	0.6	1300	220	626	D
26.	Kabani	Muthankara (Mananthavadi Panchayath)	7.2	6.8	7	7	6.3	6.7	0.8	0.5	0.7	700	340	435	A
27.	Bhavani	Elaichivazhi (Agali Panchayath)	8	6.8	7.28	7.5	6.8	7.13	0.6	0.2	0.43	400	160	315	A
28.	Kuttiyadipuzha	Estatemukku (Chakkittappara Panchayath)	7.6	6.5	6.98	7.5	6.9	7.1	0.5	0.4	0.43	400	110	217	A
29.	Mahe	Valayam (Valayam Panchayath)	7.9	6.7	7.18	8	7	7.25	0.8	0.3	0.58	800	120	165	A
30.	Kallai Puzha	Kallai Bridge (Kozhikode Corporation)	8	6.7	7.5	4.8	2.9	3.95	1.2	0.6	1.05	4000	350	1587	Below E (Esturine)
31.	Korapuzha	Kanayankode	7.3	6.5	7.03	6	5.2	5.63	1.6	0.8	1.2	3500	500	1650	E

32.	Kuppam	Taliparamba (Taliparamba Village)	7.5	6.4	7.15	8	4.6	6.58	2	0.6	1.1	5000	9	1412	E
		Rayoram (Alakkode Village)	7.8	6.4	7.23	8	4	6.83	1.6	0.6	0.98	240	22	148	B
33.	Thalassery	Pathipalam (Patyam)	7	6.5	6.75	7	5.3	6.50	1	0.2	0.58	2100	4	1026	B
34.	Ancharakkandy	Ancharakkandy (Ancharakandy Village)	7.2	5.9	6.7	8	6.9	7.37	1.2	0.3	0.68	2100	4	556	B
		Meruvamba (Vengad Village)	7.4	6.7	7.13	7.6	6.3	6.93	1.2	0.6	0.78	1600	21	520	B
35.	Ramapuram	Ramapuram Bridge (Cheruthazham Village)	7.7	6	7.00	5.5	3.3	4.03	1.2	0.2	0.90	400	11	233	E
36.	Kavai	Kuttiyolpalam (Peralam Village)	7.3	5.8	6.75	8	4.7	6.28	2	0.6	1.20	500	110	208	B
37.	Neeleswaram	Hosdurg (Neeleswaram Village)	8	6.3	7.15	6.3	5.8	6.08	1.6	0.2	1.03	3000	50	1140	E
		Nambiarckal (Hosdurg Village)	7.4	6.4	6.93	7.5	5.7	6.65	0.9	0.2	0.5	900	60	465	C
38.	Karingode	Kakkadavu (Cheemeni Village)	7.6	6.8	7.25	8	6.3	7.23	1.3	0.2	0.85	900	140	610	C

39.	Chandragiri Puzha	Padiayathadka	7.4	6.8	7.175	7.8	7.1	7.45	1.2	0.4	0.63	1700	80	900	C
40.	Pullur	Pullur Bridge (Ajanoor Village)	6.9	6.3	6.55	7.5	4.3	6.18	1.4	0.3	0.73	3000	170	1630	B
41.	Mogral	Mogral Bridge (Mogral Village)	7.7	6.1	7.05	6.1	4.8	5.55	1	0.3	0.58	2200	110	675	E
42.	Shriya	Angadimogaru (Angadimogaru Village)	8	7	7.40	8	4.8	7.03	1.8	0.3	1.00	1600	220	660	C
43.	Uppala	Uppala Bridge (Uppala Village)	7.3	6.8	7.00	7.5	2.8	6.08	1.2	0.2	0.65	5000	40	2060	D
44.	Manjeswaram	Bajrakkara Bridge (Vorcadi Village)	7.4	6.9	7.15	8.1	2.8	5.98	1.2	0.2	0.73	3500	220	1390	B
45.	Peruvamba	Chandapura (Kadanapally Village)	7.1	6.5	6.90	8	4.8	6.83	1.2	0.6	0.88	500	11	197	B

Source: Kerala pollution control Board

GROUND WATER

Richly endowed with natural resources, the tiny State of Kerala receives average annual rainfall of about 3000 mm.It also boasts of abundant fresh water resources including 44 rivers besides a large number of ponds and water bodies. The State also has a large number of large diameter open wells for extraction of ground water for various uses. Groundwater is water located beneath the earth's surface in soil pore spaces and in the fractures of rock formations. Ground water has traditionally been and still continues to be one of the preferred sources of fresh water for various uses in Kerala.

The need for ground water being felt by all sectors because of the shortage of surface water sources to mitigate the growing needs of the society.The total number of GWMWs as on 31.03.2010 is 941.Out of these, 662 are dug wells tapping phreatic aquifers and 279 are borewells/tubewells tapping deeper aquifers of confined/semi-confined nature.These GWMWs are spread over all the physiographic divisions of the State.

6.4 Annual Ground water Recharge

Assessment Year 2008-09

Sl. No.	Districts	Recharge from rainfall during monsoon season (MCM)	Recharge from other sources during monsoon season (MCM)	Recharge from rainfall during non-monsoon season (MCM)	Recharge from other sources during non-monsoon season (MCM)	Total Annual Ground Water Recharge (MCM)	Provision for Natural Discharges (MCM)	Net Annual Ground water Availability (MCM)
1	Alappuzha	301.37	0.70	73.00	108.69	483.75	30.10	453.65
2	Eranakulam	393.21	4.87	72.25	145.39	615.72	58.37	557.35
3	Idukki	162.33	1.10	31.19	23.76	218.38	21.84	196.55
4	Kannur	452.08	6.84	0.00	72.25	531.17	52.06	479.11
5	Kasaragode	309.94	8.15	0.00	45.52	363.60	36.36	327.24
6	Kollam	301.98	1.60	103.94	41.71	449.23	39.97	409.27
7	Kottayam	370.74	1.33	81.39	69.39	522.85	49.69	473.16
8	Kozhikode	367.01	2.29	0.00	14.47	383.78	36.39	347.38
9	Malappuram	392.47	3.69	54.42	80.80	531.39	47.08	484.31
10	Palakkad	465.38	17.42	80.13	308.02	870.95	75.70	795.25
11	Pathanamthitta	207.37	1.54	67.09	34.61	310.61	26.50	284.11
12	Thiruvananthapuram	225.40	2.75	74.21	29.81	332.17	27.43	304.74
13	Thrissur	517.80	10.70	0.00	170.97	699.47	58.88	640.60
14	Wayanad	304.30	0.21	0.00	2.46	306.98	30.70	276.28
Total		4771.38	63.19	637.62	1147.85	6620.05	591.07	6029
Total in BCM		4.771	0.063	0.638	1.148	6.620	0.591	6.029

Source: GW Dept

6.5 Dynamic Ground Water Resources of Kerala

Sl. No.	Districts	Net Annual Ground Water Availability	Existing Gross Ground Water Draft for irrigation	Existing Gross Ground Water Draft for domestic and industrial water supply	Existing Gross Ground Water Draft for all uses	Provision for domestic, and industrial requirement supply up to 2025	Net Ground Water Availability for future irrigation development	Stage of Ground Water Development (%)
1	*Alappuzha*	453.65	29.92	99.43	129.35	103.72	320.02	28.51
2	Eranakulam	557.35	103.08	136.67	239.76	152.54	301.72	43.02
3	Idukki	196.55	28.74	54.24	82.98	59.85	107.96	42.22
4	Kannur	479.11	109.43	107.95	217.39	119.32	250.35	45.37
5	Kasaragode	327.24	167.05	66.29	233.33	77.98	82.21	71.30
6	Kollam	409.27	40.15	116.96	157.11	131.02	238.10	38.39
7	Kottayam	473.16	34.91	91.07	125.97	107.04	331.21	26.62
8	Kozhikode	347.38	52.00	137.71	189.72	157.93	137.45	54.61
9	Malappuram	484.31	81.66	197.85	279.51	243.92	158.72	57.71
10	Palakkad	795.25	354.94	129.23	484.17	141.79	300.42	60.88
11	Pathanamthitta	284.11	34.63	59.62	94.24	63.04	186.44	33.17
12	Thiruvananthapuram	304.74	39.85	131.16	171.01	146.99	117.90	56.12
13	Thrissur	640.60	221.68	135.06	356.73	152.16	266.76	55.69
14	Wayanad	276.28	6.52	41.16	47.68	48.16	221.60	17.26
Total in MCM		6029	1304.56	1504.4	2808.95	1705.46	3020.86	47
Total in BCM		6.029	1.305	1.504	2.809	1.705	3.021	47

Source: GW Dept

Rainwater harvesting in Kerala

There are good opportunities for **Rainwater harvesting in Kerala** because Kerala is located in a geographical area with two rainy seasons. Kerala faces severe water scarcity between February and mid May every year. During summer, there are drinking water shortages. During this period drinking water and other water purposes become unavailable. This is expected in the coming years. In spite of 44 rivers and world's largest water well density, per capita surface water and groundwater availability of the State is lower than that of arid States of India. Moreover, Kerala has one of the lowest per capita rainwater availability in the Indian sub-continent and it is still decreasing over the time, even though it receives 3000 mm of rainfall, which is around 3 times the Indian national average. The high variations in spatial and temporal rainfall add to the complexity of problems associated with water management faced by the State.

6.6 Statement showing the district-wise rainfall **(in mm)**

Sl. No.	District	2006-07		2007-08		2008-09		2009-10		2010-11		2011-12	
		Actual	Normal	Actual	Normal	Actual	Normal	Actual	Normal	Actual	Normal	Actual	Normal
1	Thiruvananthapuram	2354.6	1923.2	1981.2	1923.2	1709.8	1923.2	1727.8	1923.2	2050.6	1866.4	1372.5	1803
2	Kollam	2798.6	2494.8	2576.5	2494.8	2051.5	2494.8	2339.1	2494.8	2881.7	2430.2	2001.3	2491.5
3	Pathanamthitta	2939.4	2839.5	2935.5	2839.6	2604.6	2839.5	2607.8	2839.5	3417.4	2873.8	2261.8	2956.8
4	Alappuzha	2960.5	2999.2	2977	2999.2	2617.2	2999.2	2625.9	2999.2	3036.8	2911.8	2209.6	2840.6
5	Kottayam	3531.7	3207.9	3203.3	3207.9	2386.1	3207.9	2941.6	3207.9	3804.6	3101.1	2641.3	2930.9
6	Idukki	3843.6	3769.2	4046.4	3769.2	2867.9	3769.2	3688.2	3769.2	3709.8	3600.4	3216.2	3342.8
7	Eranakualm	3632.4	3577.8	3953.5	3577.8	2838.8	3577.8	3544.5	3577.8	4154.8	3379.5	3038.4	3029.5
8	Thrissur	3257.9	3073.6	3698.2	3073.6	2371.5	3073.6	3187.2	3073.6	3177.1	3010.1	2949.8	3063.4
9	Palakkad	2500.2	2472.1	3075.9	2472.1	1666.6	2472.1	2735.4	2472.1	2649.5	2368.9	2217.6	2288.7
10	Malappuram	3054.8	2850.2	3484.5	2850.2	1771.0	2850.2	2831.2	2850.2	2919.2	2811.5	2472.7	2835.2
11	Kozhikode	3704.9	3671.4	4476.9	3671.4	2888.3	3671.4	4631.3	3671.4	3794.8	3575.5	3606.1	3384
12	Wayanad	2390.7	3408.9	3021.8	3408.9	1938.9	3408.9	4370	3408.9	2387.4	3382.4	2097.7	3251.3
13	Kannur	3331.8	3373.5	3939.7	3373.5	2657.7	3373.5	3706.9	3373.5	3657.7	3335.6	3086.1	3318.5
14	Kasaragode	3389.6	3613.4	3875.5	3613.4	2550	3613.4	3550.9	3613.4	3995.6	3588.5	3780.7	3620.3

Source: Agricultural Statistics, DES

River Water

Rivers are the lifeline of majority of population in cities, towns and villages and most of these are considered as sacred. Every river stretch has a distinct water use like bathing, drinking, municipal supply, navigation, irrigation and fishing etc.Simultaneously, it is also used as receptacle for discharge of industrial effluent, municipal sewage and dumping of solid wastes.

Details of Rivers in Kerala

There are 44 major rivers in Kerala of which 41 are west flowing and 3 east flowing. All these rivers originate from the Sahyadri hills. Periyar is the longest river in Kerala followed by Bharathapuzha and Pampa. Here is the complete list of all the 44 rivers of Kerala showing the direction of their flow, place of origin, major tributaries and distributaries and the length of each river.

6.7 List of all the 44 major rivers of Kerala

Sl. No.	West Flowing Rivers of Kerala	Place of Origin	Major Tributaries / Distributaries	Empties Into	Length (km)
1	Anjarakkandi			Arabian Sea	52
2	Achenkovil			Pampa	128
3	Baikal				10
4	Bharathapuzha (Nila)	Anamalai (Tamil Nadu)	Gayathripuzha, Kannadipuzha, Kalppathipuzha, Poothapuzha	Arabian Sea	209
5	Chalakkudy	Anamalai	Periyar	Periyar	144
6	Chaliyar	Elampaleri Hills	Iringipuzha, Cherupuzha, Kurumbanpuzha	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

Sl. No.	West Flowing Rivers of Kerala	Place of Origin	Major Tributaries / Distributaries	Empties Into	Length (km)
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	Azhuthayaar, Kakkattaar, Kallar, Manimala, Achenkovil	Vembanad lake	176
32	Periyar	Sivagiri	Splits into two	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

Sl. No.	West Flowing Rivers of Kerala	Place of Origin	Major Tributaries / Distributaries	Empties Into	Length (km)
39	Uppala			Arabian Sea	50
40	Valapattanam	Brahmagiri Forests		Arabian Sea	112
41	Vamanapuram			Anchuthengu Lake	80
Lengths of the rivers are approximate measures and are likely to vary with time and season.					

#	East Flowing Rivers		Length (km)
1	Paampar	Paampar and Bhavani flows into Tamilnadu. Kabani enters Karnataka. All three of them empties into Kaveri	Flows only a few kilometres through Kerala
2	Bhavani		
3	Kabani		

Source: http://www.prokerala.com/kerala/rivers.htm

6.8 LIST OF BACKWATERS OF KERALA

Sl. No.	Name of District	Nos.	Name of Backwater	Area(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 --Nadayar 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.	Alappuzha	1	Kayamkulam kayal	1511.75
		2	Poomen 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	27.10
		8	Vembanattu kayal	10661.23
			TOTAL	***12235.39***
4.	Kottayam	1.	Vembanattu kayal	2926.77
			TOTAL	***2926.77***
5.	Ernakulam	1.	Vembanattu kayal	2257.89
		2.	Kochi Kayal	7503.80
			TOTAL	***9761.69***
6.	Thrissur	1.	`Azhikode kayal	82.02
		2	Kodungalloor kayal	613.81
		3	Chettuva kayal	713.87
		4	Pattikkara kayal	-
		5	Manakkady kayal	-
			TOTAL	***1409.70***
7	Malappuram	1	Puthupponnani	150.83
		2	Ponnani Kayal	757.19
		3	Poorappuzha	62.98
		4	Kadalundi Kayal	323.56
			TOTAL	***1294.56***
8.	Kozhikode	1	Kadalundi Kayal	83.85
		2	Beypore Kayal	783.74
		3	Kallai Kayal	160.13
		4	Korappuzha	1038.08
		5	Payyoli puzha	26.70
		6	Kottapuzha	584.12
		7	Newmahe puzha	88.28
			TOTAL	***2764.90***
9	Kannur	1	Mahe	91.89
		2	Dharmadam Kayal	359.06

		3	Valappattanam	3077.64
		4	Palakkode	598.25
		5	Cheruvathur	30.58
			TOTAL	***4157.42***
10.	Kasaragode	1	Cheuvathur	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
		8	Mogral Puthur	89.74
		9	Kumbala	221.54
		10	Suvarnagiri	6.22
		11	Manjeswaram	158.41
		12	Thalappady	17.12
			TOTAL	3174.04
			GRAND TOTAL	46128.94

Source: Department of Fisheries

6.9 DISTRICT WISE DETAILS OF FRESH WATER RESOURCES

Sl. No.	District	Panchayath ponds		Holy ponds and streams		Village ponds and other water holds		Irrigation Tanks	
		No	Area(Ha)	No	Area(Ha)	No	Area(Ha)	No	Area(Ha)
1	Thiruvananthapuram	1706	297.25	67	20.03			34	1.54
2	Kollam	589	62.93	188	24.96	16	35.55	17	150.26
3	Pathanamthitta	390	43.28	66	3.97			6	15.48
4	Alappuzha	340	322.56	303	44.24			3	16.18
5	Kottayam	226	19.05	207	25.53	7	0.4	75	19.07
6	Idukki	65	2.81	25	0.71			47	4.03

7	Eranakulam	719	233.17	201	26.94	54	245.94	72	13.98
8	Thrissur	959	240.68	305	111.77	3	40.48	228	507.72
9	Palakkad	629	176.84	334	145.59	6	32.25	60	759.18
10	Malappuram	545	38.14	275	15.43	7	2.04	45	6.1
11	Kozhikode	96	13.53	264	17.64	11	2.1	24	1.11
12	Wayanad	28	5.16	5	2.08	22	10.66	61	5.44
13	Kannur	292	19.86	312	35.77	9	97.13	35	90.01
14	Kasaragod	264	11.43	137	4.71	50	25.94	145	1244.28
	Total	**6848**	**1486.69**	**2689**	**479.37**	**185**	**492.49**	**852**	**2834.38**

Source: Department of Fisheries

Irrigation projects in Kerala.

There are about twenty completed and seven ongoing major Irrigation projects in Kerala. Some of the completed Irrigation projects in kerala are Neyyar in Thiruvananthapuram district,, Kallada in Kollam district, Pampa in Pathanamthitta district,Periyar valley and Kanakkankadavu in Ernakulam district, Chalakkudy, Chimmoni Mupli, Vazhani, Cheerakuzhy and Peechiin Thrissur district, Malampuzha, Mangalam, Walayar, Gayathri, Pothundy, Kanjirapuzha, Thrithala and chitturpuzha in Palakkad district and finally Kuttiady in Kozhikode district ,Pazhassi in Kannur district. Ongoing project include Edamalayar and Moovattupuzha. At present all irrigation projects in Kerala are owned by government.

Irrigation Facilities

Irrigation facilities to the cultivable areas are provided by the existing major irrigation projects; lift irrigation schemes, minor irrigation works consisting of small storage works, diversion weirs wells, irrigation canals and salinity control works etc executed and maintained by the State.

Live storage capacities of irrigation Reservoirs

The live storage capacities of irrigation reservoirs during the beginning and end of the monsoon period for 2008 to 2011 are given in the following table:

6.10 Live storage capacities of irrigation Reservoirs

(Mm3)

Sl. No	Item	2008	2009	2010	2011
1	Storage at the beginning of the Monsoon	452	392	531	525
2	Storage at the end of the Monsoon	1156	1180	1213	1274
3	Increase due to Monsoon	704	788	682	749
4	Average for 10 years(2002-2011)				
	1.at the beginning of the monsoon				430.48
	2.at the end of the monsoon				1133.16
	3.increase in monsoon storage				702.68

6.10(a) Storage levels in reservoirs of completed projects in Kerala

Storage (Mm3)

Sl. No.	Name of Reservoir	01.10.2010	01.01.2011	01.01.2012
1	Malampuzha	200.139	177.238	149.176
2	Neyyar	102.220	99.570	103.106
3	Kallada	416.300	441.500	435.750
4	Kanhirapuzha	61.889	66.917	59.370
5	Kuttiyadi	102.221	69.416	73.360
6	Pothundy	34.526	34.992	25.712
7	Mangalam	24.341	18.327	10.221
8	Vazhazni	11.920	14.880	8.830
9	Peechi	53.770	70.150	53.590
10	Walayar	7.598	6.665	11.306
11	Meenkara	10.880	8.591	8.404
12	Chulliyar	11.846	10.360	9.323
13	Chimoni	141.090	131.560	117.680
14	Malankara	33.840	32.260	31.400
Total		**1212.580**	**1182.426**	**1097.228**

Source: Economic Review

6.11 Format for 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	Distance from Industry (Km)	Name	Distance From the discharge Point of the recipient Water body	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	40m	River Periyar	Discharge Directly in to river	Yes	550	pH SS Sulphate Cd. 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 in to river	Yes	4	Ph SS COD Amm.N_2 Phosphate Sulphide Zinc Fluoride Lead	9 40 100 20 2 0.8 2 0.8 0.4	OPRNS
3	FACT Ltd., Udyogamandal Division, Ernakulam	CU	Fertlizer	1966	River Periyar	300 m	River Periyar	Discharge Directly in to River	No	12000	pH SS Phosphate Hex.Chr O & G Free Amm Amm.Nitra 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., Petro chemical Division, Udyogamandal P.O., Eloor, Ernakulam	CU	Petro Chemical	1990	River Periyar	200m	River Periyar	Discharge Directly into River	Yes	5040	BOD pH SS COD O & G Free NH_3 Amm.NH_3 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, Ernakulum	PU	Chemical	1992	River Periyar	500m	River Periyar	Discharge Directly into River	Yes	250	pH SS O & G IIC Total Chr		8.5 25 2.5 0.25 0.5	OPRS
6	Hindustan Insecticides, Eloor, Ernakulam	CU	Pecticides	1958	Kuzhi-Kandom Thodu	1750 M	River Periyar	Through Kuzhi kandom Thodu	No	1024	pH SS TDS O & G SO_2 Chlorine		9 102.4 2150.4 10.24 1024 1024	OPRNS
7	Sudchemi (India),Pvt. LTd., Eloor, Ernakulam	PU	Chemical	1969	River Periyar	10 M	River Periyar	Discharge Directly into River	Yes	450	pH SS O & G Hex. Chr Zinc Free NH_3 Total Chr Amm. N_2		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 0.004 3 43 0.086 0.086	OPRS
9	TMS Leathers (Formerly Kainady Tanneries) IDA, Edayar, Ernakulam	PU	Tannery	2004	River Periyar	150m	River Periyar	Discharge Directly into River	Yes	1010	BOD pH SS Hex.Chr. Sulphide O & G		3.03 9 10.1 0.010 1 0.010 1 1.01	OPRNS
10	Sree Sakthi Paper Mills Ltd., IDA, Edayar, Ernakulam	CU	Pulp & Paper	1993	River Periyar	1 Km	River Periyar	Discharge Directly into River	No	10	pH SS BOD		9 1 0.3	OPRNS
11	Hindustan Organic chemicals Ltd., Ambalamugal, Ernakulam	CU	Petro Chemical	1988	Chithra-Puzha	>100m	Chithra Puzha River	Directly Discharge into Chithra-Puzha	Yes		BOD	41 2.8	9.6	OPRS
12	Kochi Refinery Ambalamugal Ernakulam	CU	Oil Refinery	1966	Chithra Puzha	>100m	Chithra Puzha River	Directly Discharge into Chithra-Puzha	Yes		BOD	24 21 03	20.43	OPRS

13	Gramox Paper and Boards, Puthuppady, Muvattupuzha, Ernakulam	PU	Pulp & Paper	1995		>100m	Kotha-mangalam River		Yes		BOD	12 3.5	23.92	OPRS
14	Nitta Gilatin India Pvt. Ltd., Kathikudam P.O., Koratti (via) Thrissur 680 308	PU	Ossein Maunufacturer	1979	Chala-Kudy River	0.5 km	Chala-Kudy River	0.5 Km	Yes	6290	BOD	15 72 5	151	OPRS
15	Sree Sakthi Paper Mills, Chalakudy, Thrissur	PU	Duplex Board	1995	Chala-Kudy River	0.005Km	Chala-Kudy River	0.005Km	No		BOD		292	OPRNS The company has requested to give permission to Dis Charge Effluent to the river and they have proposed augmentation of existing ETP to achieve quality compliance
16	Sitaram Textiles, Thrissur	Cu	Bleaching and dying process stopped hence no effluent generation											

17	Vaigai Threads (Former Madura Coats Ltd)	PU	Polyester/ Cotton Finished thread		Perumbi Thodu	0.25 Km	Chala-Kudy river	3.5Km	Yes	11.7	No process effluent as There is no dying and Bleaching and effluent From floor washing and Canteen treated in ETP and discharged satis-Factorily			OPRS
18	United Breweries Ltd. Kanjikode West P.O., Palakkad-678623	PU	Fermentatiion Industry	1970	Narakam Pilly- river	500m	Kalpathy River Tributary Of Bharath Puzha	5Km		400	BOD	345.6	10.4	
19	United Spirits Ltd., (Formaly McDowell & Co. Ltd) Cherthala, Alappuzha	PU	Distillery		Vemba-nad Lake	Banks of The lake	Vemba-Nadu Lake	Banks of the lake	No	270	BOD	313 2	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 Newsprint Ltd., Newsprint Nagar, Kottayam	CU	Pulp and Paper	1983	Muvattu Puzha River	2 Km	Muvattu Puzha River	2 Km	Yes	38384	BOD	1013 3	1152	OPRS
22	MRF Limited, Vadavathoor, Kottayam	PU	Rubber Industry	1959	Meenan-thara River	2Km	Meenan-thara River	2 Km	Yes	200	BOD	155	6	OPRS
23	Canara Paper Mills Pvt. Ltd., Chethipuzha, Changanacherry, Kottayam	PU	Craft Paper	1985	Chwthi Puzha Canal	50m	Vemba-Nad Kayal	8Km	Yes	5	1.8	0.64 5		OPRS
24	Kollam Dairy, Thevally, Kollam	CP	Milk Processing	1986	Ashta-mudi lake	0.01 Km					BOD	180	23.5	OPRS

6.12 Length of coastal line and coastal population (marine) of kerala

Sl. No.	District	Coastal length (Kms)	2008-09				2009-10			
			Male	Female	Children	Total	Male	Female	Children	Total
1	Thiruvananthapuram	78	69268	61200	54410	184878	69883	61743	54892	186518
2	Kollam	37	43205	36540	21416	101161	43588	36864	21605	102057
3	Alapuzha	82	47888	43713	29617	121218	48312	44100	29880	122292
4	Ernakulam	46	31802	29813	18615	80230	32084	30077	18780	80941
5	Thrissur	54	31083	31318	17830	80231	31359	31596	17987	80942
6	Malappuram	70	34455	28017	25607	88079	34761	28265	25834	88860
7	Kozhikode	71	42226	36833	28204	107263	42601	37160	28454	108215
8	Kannur	82	22732	20657	17656	61045	22933	20840	17813	61586
9	Kasaragode	70	18974	17915	11075	47964	19142	18073	11174	48389
	Total	**590**	**341633**	**306006**	**224430**	**872069**	**344663**	**308718**	**226419**	**879800**

Source: Department of Fisheries

6.13 POLLUTANTS AND THEIR IMPACTS ON THE MARINE ENVIRONMENT

Sl. No.	Sources	Impacts
1	Municipal and domestic waste	Reduce dissolved oxygen(DO);increase hydrogen sulphide levels; incidence of faecel coliform & faecel streptococci; high biological oxygen demand(BOD)
2	Industrial waste	Affect DO,temperature,turbidity,pH,ammonia values;increasesBOD,COD,suspended solids
3	Toxic metals	Cause change in chemical and biochemical processes, increase in turbidity, lethal and sub lethal effects on marine life
4	Oil pollution	Causes smothering, clogging and toxicity
5	Fertilizers	Affect nutrient levels and may cause eutrophication
6	Dredging & Reclamation	Affect habitats of marine organisms ;lethal and sub lethal effects; affects flushing capacity of the water body
7	Siltation	Increases in nutrient levels and can cause excessive algal bloom; may also cause damage to coral reefs and coastal nurseries
8	Discharge of coolant waters	Raises the temperature of the water can cause the growth of the blue-green algae
9	Toxic chemicals	Cause lethal and sub lethal effects on marine organisms
10	Offshore mining	Increases particulate loading which can lead to loss of light and reduced primary productivity; smothering and clogging of benthic communities
11	Radionuclide	Bioaccumulation in fish and other benthic communities

Source: Compendium of environment statistics, Kerala-2004

CHAPTER – VII

Human Settlements

Population:

The root cause of environmental degradation and depletion of natural resources can be attributed to rapid growth of population.

As per the provisional data published from the Directorate of Census, the population of Kerala at the 'zero hours' of Marchi,2011 was 3,33,87,677 persons. Out of this 1, 60, 21,290(48%) are males and 1, 73, 66,387(52%) are females. when the last census was taken in 2001,these figures were respectively3,18,41,374 total,1,54,68,614(48.6%) males and 1,63,72,760(51.4%) females. Children in the age group 0 to 6 account for almost 10 percent of the total population.

The growth rate of Kerala's population during the last ten years is 4.9 percent, one of the lowest rates among Indian states

7.1 Population and its Growth from 1901 to 2011

Census year	All India				Kerala			
	Population(Lakhs)			Decadal Growth Rate (%)	Population(Lakhs)			Decadal Growth Rate (%)
	Rural	Urban	Total		Rural	Urban	Total	
1901	2125.4	258.5	2383.9	-	59.4	4.5	63.9	-
1911	2261.5	259.4	2520.9	5.75	66.2	5.3	71.5	11.89
1921	2232.3	280.9	2513.2	-0.31	71.2	6.8	78	9.09
1931	2455.2	334.6	2789.8	8.62	85.9	9.2	95.1	21.92
1941	2745.1	441.5	3186.6	16.73	98.3	12	110.3	15.98
1951	2986.5	624.4	3610.9	13.32	117.2	18.3	135.5	22.85
1961	3602.9	789.4	4392.3	21.64	143.5	25.5	169	24.72
1971	4390.5	1091.1	5481.6	24.8	178.8	34.7	213.5	26.33
1981	5238.7	1594.6	6833.3	24.66	206.8	47.7	254.5	19.2
1991	6286.9	2176.1	8463	23.85	214.1	76.8	290.9	14.3
2001	7416.6	2853.6	10270.2	21.35	235.7	82.7	318.4	9.45
2011	8330.9	3771	12101.9	17.64	174.6	159.3	333.9	4.86

Source: Economic Review

Kerala Urban Population 2011

Out of total population of Kerala, 47.72% people live in urban regions. The total figure of population living in urban areas is 15,932,171 of which 7,617,584 are males and while remaining 8,314,587 are females. The urban population in the last 10 years has increased by 92.72 percent. Sex Ratio in urban regions of Kerala was 1091 females per 1000 males. For child (0-6) sex ratio the figure for urban region stood at 958 girls per 1000 boys. Total children (0-6 age) living in urban areas of Kerala were 1,574,735. Of total population in urban region, 9.88 % were children (0-6). Average Literacy rate in Kerala for Urban regions was 94.99 percent in which males were 96.83% literate while female literacy stood at 93.33%. Total literates in urban region of Kerala were 13,638,500.

Kerala Rural Population 2011

Of the total population of Kerala state, around 52.28 percent live in the villages of rural areas. In actual numbers, males and females were 8,403,706 and 9,051,800 respectively. Total population of rural areas of Kerala state was 17,455,506. The population growth rate recorded for this decade (2001-2011) was -25.96%.

In rural regions of Kerala state, female sex ratio per 1000 males was 1077 while same for the child (0-6 age) was 960 girls per 1000 boys. In Kerala, 1,747,512 children (0-6) live in rural areas. Child population forms 10.01 percent of total rural population. In rural areas of Kerala, literacy rate for males and female stood at 95.29 % and 90.74 %. Average literacy rate in Kerala for rural areas was 92.92 percent. Total literates in rural areas were 14,595,727.

7.2 Population Details

Description	Rural	Urban
Population (%)	**52.28 %**	**47.72 %**
Total Population	**17,455,506**	**15,932,171**
Male Population	8,403,706	7,617,584
Female Population	9,051,800	8,314,587
Population Growth	**-25.96 %**	**92.72 %**
Sex Ratio	**1077**	**1091**
Child Sex Ratio (0-6)	960	958
Child Population (0-6)	**1,747,512**	**1,574,735**
Child Percentage (0-6)	10.01 %	9.88 %

Literates	**14,595,727**	**13,638,500**
Average Literacy	**92.92 %**	**94.99 %**
Male Literacy	95.29 %	96.83 %
Female Literacy	90.74 %	93.33 %

Source: www.census2011.co.in

7.3 District-wise Details
2011 Census

District	Population	Headquarters
Thiruvananthapuram	3,307,284	Thiruvananthapuram
Kollam	2,629,703	Kollam
Pathanamthitta	1,195,537	Pathanamthitta
Alappuzha	2,121,943	Alappuzha
Kottayam	1,979,384	Kottayam
Idukki	1,107,453	Painavu
Ernakulam	3,279,860	Kochi
Thrissur	3,110,327	Thrissur
Palakkad	2,810,892	Palakkad
Malappuram	4,110,956	Malappuram
Kozhicode	3,089,543	Kozhicode
Wayanadu	816,558	Kalppetta
Kannur	2,525,637	Kannur
Kasaragod	1,302,600	Kasargod
Total	33,387,677	

Source: www.kerala.gov.in

7.4 Ranking of Districts by Population Size, 2001 and 2011

Rank in 2011	District	Population 2011	Per cent to total population of the State 2011	Population 2001	Per cent to total population of the State 2001	Rank in 2001
1	2	3	4	5	6	7
1	Malappuram	41,10,956	12.31	36,25,471	11.39	1
2	Thiruvananthapuram	33,07,284	9.91	32,34,356	10.16	2

3	Ernakulam	32,79,860	9.82	31,05,798	9.75	3
4	Thrissur	31,10,327	9.32	29,74,232	9.34	4
5	Kozhikode	30,89,543	9.25	28,79,131	9.04	5
6	Palakkad	28,10,892	8.42	26,17,482	8.22	6
7	Kollam	26,29,703	7.38	25,85,208	8.12	7
8	Kannur	25,25,637	7.56	24,08,956	7.57	8
9	Alappuzha	21,21,943	6.36	21,09,160	6.62	9
10	Kottayam	19,79,384	5.93	19,53,646	6.14	10
11	Kasaragod	13,02,600	3.90	12,04,078	3.78	11
12	Pathanamthitta	11,95,537	3.58	12,34,016	3.88	12
13	Idukki	11,07,453	3.32	11,29,221	3.55	13
14	Wayanad	8,16,558	2.45	7,80,619	2.45	14

Source: www.kerala.gov.in

7.5 Ranking of Districts by Sex-Ratio, 2001 and 2011

Rank in 2011	District	Sex- ratio (Number of Females per 1000 Males)		Rank in 2001
		2011	2001	
1	2	3	4	5
1	Kannur	1133	1090	3
2	Pathanamthitta	1129	1094	1
3	Kollam	1113	1069	5
4	Thrissur	1109	1092	2
5	Alappuzha	1100	1079	4
6	Kozhikode	1097	1057	8
7	Malappuram	1096	1066	6
8	Thiruvananthapuram	1088	1060	7
9	Kasaragod	1079	1047	9
10	Palakkad	1067	1066	6
11	Kottayam	1040	1025	10
12	Wayanad	1035	995	12
13	Ernakulam	1028	1019	11
14	Idukki	1006	993	13

Source: www.kerala.gov.in

7.6 Ranking of Districts by Literacy Rate and Sex: 2011

Rank	Persons		Males		Females	
	District	Literacy Rate	District	Literacy Rate	District	Literacy Rate
1	Pathanamthitta	96.93	Alappuzha	97.90	Pathanamthitta	96.26
2	Kottayam	96.40	Pathanamthitta	97.70	Kottayam	95.67
3	Alappuzha	96.26	Kozhikode	97.57	Alappuzha	94.80
4	Ernakulam	95.68	Kannur	97.54	Ernakulam	94.27
5	Kannur	95.41	Kottayam	97.17	Thrissur	93.85
6	Thrissur	95.32	Ernakulam	97.14	Kannur	93.57
7	Kozhikode	95.24	Thrissur	96.98	Kozhikode	93.16
8	Kollam	93.77	Kollam	95.83	Kollam	91.95
9	Malappuram	93.55	Malappuram	95.78	Malappuram	91.55
10	Thiruvananthapuram	92.66	Idukki	94.84	Thiruvananthapuram	90.89
11	Idukki	92.20	Thiruvananthapuram	94.60	Idukki	89.59
12	Kasaragod	89.85	Kasaragod	93.93	Kasaragod	86.13
13	Wayanad	89.32	Wayanad	92.84	Wayanad	85.94
14	Palakkad	88.49	Palakkad	92.27	Palakkad	84.99

Source: www.kerala.gov.in

7.7 Literacy Rate 1951-2011

Year	Persons	Males	Females
1	2	3	4
1951	47.18	58.35	36.43
1961	55.08	64.89	45.56
1971	69.75	77.13	62.53
1981	78.85	84.56	73.36
1991	89.81	93.62	86.17
2001	90.86	94.24	87.72
2011	93.91	96.02	91.98

Note: Literacy rates for 1951, 1961 and 1971 related to population aged five years and above. The rates for the years 1981 to 2011 related to the population aged seven years and above.

Source: www.kerala.gov.in

GCPT. 37/4559/2013

7.8 Population details of Kerala from 1991 to 2011

Population	1991 Census	2001 Census	2011 Census
Total Population(lakhs)	290.99	318.41	333.88
Male population(lakhs)	142.89	154.69	160.21
Female population(lakhs)	148.10	163.73	173.66
Density per sq.Km	749	819	859
Sex ratio(Females per 1000 males)	1036	1058	1084
Literacy (%)	89.81	90.86	93.91
Male literacy	93.62	94.24	96.02
Female literacy	86.17	87.72	91.98
Rural population(lakhs)	214.18	235.75	174.56
Urban Population(lakhs)	78.80	82.67	159.32
Increase of population(%)	13.88	9.43	4.86
Life expectancy(years)	68	73.70	74
Infant Mortality (per 1000)	22	16	12
Birth Rate(per1000)	19.8	18.3	14.7

7.9Literacy Rates by Sex for State and Districts: 2001 and 2011

State/ District Code	State/District	Literacy rate*					
		Persons		Males		Females	
		2001	2011	2001	2011	2001	2011
Kerala		**90.86**	**93.91**	**94.24**	**96.02**	**87.72**	**91.98**
01	Kasaragod	84.57	89.85	90.36	93.93	79.12	86.13
02	Kannur	92.59	95.41	96.13	97.54	89.40	93.57
03	Wayanad	85.25	89.32	89.77	92.84	80.72	85.94
04	Kozhikode	92.24	95.24	96.11	97.57	88.62	93.16
05	Malappuram	89.61	93.55	93.25	95.78	86.26	91.55
06	Palakkad	84.35	88.49	89.52	92.27	79.56	84.99
07	Thrissur	92.27	95.32	95.11	96.98	89.71	93.85
08	Ernakulam	93.20	95.68	95.81	97.14	90.66	94.27
09	Idukki	88.69	92.20	92.33	94.84	85.02	89.59
10	Kottayam	95.82	96.40	97.34	97.17	94.35	95.67
11	Alappuzha	93.43	96.26	96.27	97.90	90.82	94.80
12	Pathanamthitta	94.84	96.93	96.41	97.70	93.43	96.26
13	Kollam	91.18	93.77	94.43	95.83	88.18	91.95
14	Thiruvananthapuram	89.28	92.66	92.64	94.60	86.14	90.89

Source: www.kerala.gov.in

7.10 State-wise Percentage and Number of Persons below Poverty Line for the year 2009-10

Sl. No.	States and UTs	Percentage of Persons in Rural Areas	Number of Persons in Rural Areas in Lakhs	Percentage of Persons in Urban Areas	Number of Persons in Urban Areas in Lakhs	Percentage of Persons - Combined	Number of Persons-Combined in Lakhs
1	Andhra Pradesh	22.8	127.9	17.7	48.7	21.1	176.6
2	Arunachal Pradesh	26.2	2.7	24.9	0.8	25.9	3.5
3	Assam	39.9	105.3	26.1	11.2	37.9	116.4
4	Bihar	55.3	498.7	39.4	44.8	53.5	543.5
5	Chhattisgarh	56.1	108.3	23.8	13.6	48.7	121.9
6	Delhi	7.7	0.3	14.4	22.9	14.2	23.3
7	Goa	11.5	0.6	6.9	0.6	8.7	1.3
8	Gujarat	26.7	91.6	17.9	44.6	23.0	136.2
9	Haryana	18.6	30.4	23.0	19.6	20.1	50.0
10	Himachal Pradesh	9.1	5.6	12.6	0.9	9.5	6.4
11	Jammu & Kashmir	8.1	7.3	12.8	4.2	9.4	11.5
12	Jharkhand	41.6	102.2	31.1	24.0	39.1	126.2
13	Karnataka	26.1	97.4	19.6	44.9	23.6	142.3
14	Kerala	12.0	21.6	12.1	18.0	12.0	39.6
15	Madhya Pradesh	42.0	216.9	22.9	44.9	36.7	261.8
16	Maharashtra	29.5	179.8	18.3	90.9	24.5	270.8
17	Manipur	47.4	8.8	46.4	3.7	47.1	12.5
18	Meghalaya	15.3	3.5	24.1	1.4	17.1	4.9
19	Mizoram	31.1	1.6	11.5	0.6	21.1	2.3
20	Nagaland	19.3	2.8	25.0	1.4	20.9	4.1
21	Orissa	39.2	135.5	25.9	17.7	37.0	153.2
22	Puducherry	0.2	0.01	1.6	0.1	1.2	0.1
23	Punjab	14.6	25.1	18.1	18.4	15.9	43.5
24	Rajasthan	26.4	133.8	19.9	33.2	24.8	167.0
25	Sikkim	15.5	0.7	5.0	0.1	13.1	0.8
26	Tamil Nadu	21.2	78.3	12.8	43.5	17.1	121.8
27	Tripura	19.8	5.4	10.0	0.9	17.4	6.3
28	Uttar Pradesh	39.4	600.1	31.7	137.3	37.7	737.9
29	Uttarakhand	14.9	10.3	25.2	7.5	18.0	17.9
30	West Bengal	28.8	177.8	22.0	62.5	26.7	240.3
31	Andaman & Nicobar Island	0.4	0.01	0.3	0.004	0.4	0.01
32	Chandigarh	10.3	0.02	9.2	0.92	9.2	0.95
33	Dadra and Nagar	55.9	.02	17.7	0.25	39.1	1.27
34	Daman and Diu	34.2	0.22	33.0	0.54	33.3	0.75
35	Lakshwadeep	22.2	0.03	1.7	0.01	6.8	0.04
	All India	33.8	2782.1	20.9	764.7	29.8	3546.8

Source: www.data.gov.in

7.11 State-Wise Percentage of Population below Poverty Line by Social Groups, 2004-05

No. States	Rural				Urban				Rural & Urban
	SC	OBC	Others	All	SC	OBC	Others	All	Combined
1. Andhra Pradesh	15.4	9.5	4.1	11.2	39.9	28.9	20.6	28.0	15.8
2. Assam	27.7	18.8	25.4	22.3	8.6	8.6	4.2	3.3	19.7
3. Bihar	64.0	37.8	26.6	42.1	67.2	41.4	18.3	34.6	41.4
4. Chhattisgarh	32.7	33.9	29.2	40.8	52.0	52.7	21.4	41.2	40.9
5. Delhi	0.0	0.0	10.6	6.9	35.8	18.3	6.4	15.2	14.7
6. Gujarat	21.8	19.1	4.8	19.1	16.0	22.9	7.0	13.0	16.8
7. Haryana	26.8	13.9	4.2	13.6	33.4	22.5	5.9	15.1	14.0
8. Himachal Pradesh	19.6	9.1	6.4	10.7	5.6	10.1	2.0	3.4	10.0
9. Jammu & Kashmir	5.2	10.0	3.3	4.6	13.7	4.8	7.8	7.9	5.4
10. Jharkhand	57.9	40.2	37.1	46.3	47.2	19.1	9.2	20.2	40.3
11. Karnataka	31.8	20.9	13.6	20.8	50.6	39.1	20.3	32.6	25.0
12. Kerala	21.6	13.7	6.6	13.2	32.5	24.3	7.8	20.2	15.0
13. Madhya Pradesh	42.8	29.6	13.4	36.9	67.3	55.5	20.8	42.1	38.3
14. Maharashtra	44.8	23.9	18.9	29.6	43.2	35.6	26.8	32.2	30.7
15. Orissa	50.2	36.9	23.4	46.8	72.6	50.2	28.9	44.3	46.4
16. Punjab	14.6	10.6	2.2	9.1	16.1	8.4	2.9	7.1	8.4
17. Rajasthan	28.7	13.1	8.2	18.7	52.1	35.6	20.7	32.9	22.1
18. Tamil Nadu	31.2	19.8	19.1	22.8	40.2	20.9	6.5	22.2	22.5
19. Uttar Pradesh	44.8	32.9	19.7	33.4	44.9	36.6	19.2	30.6	32.8
20. Uttarakhand	54.2	44.8	33.5	40.8	65.7	46.5	25.5	36.5	39.6
21. West Bengal	29.5	18.3	27.5	28.6	28.5	10.4	13.0	14.8	24.7
All India	36.8	26.7	16.1	28.3	39.9	31.4	16.0	25.7	27.5

Source: socialjustice.nic.in › Sector Overview

7.12 Crimes against Children in Kerala during the Period 2008-2012

Sl. No.	Crime Heads	2008	2009	2010	2011	2012 (Provisional)
1	Total Murder	37	44	42	47	34
a	Infanticide	0	0	1	1	0
b	Other Murder	37	44	41	46	34
2	Rape	215	235	208	423	455
3	Kidnapping and Abduction	87	83	111	129	147
4	Foeticide	0	0	0	0	1
5	Abetment of Suicide	4	0	3	2	3
6	Exposure and Abandonment	6	7	9	4	4
7	Procuration of Minor Girls	13	14	6	9	10
8	Buying Girls for Prostitution	0	0	0	0	0
9	Selling Girls for Prostitution	0	0	0	0	0
10	Prohibition of Child marriage Act	4	0	6	3	6
11	Other Crimes against Children	183	206	211	835	664
Total Crimes		549	589	596	1452	1324

Source:www.keralapolice.org/newsite/scrb.html

7.13 Crime Statistics

Indian Penal Code (IPC) Cases

Sl. No.	Crime Heads	2008	2009	2010	2011	2012 (Provisional)
1	Murder	362	343	363	365	374
2	Attempt to commit murder	434	408	361	521	497
3	CH not amounting to murder	95	100	86	105	107
4	Rape	568	568	634	1132	1019
5	Kidnapping & abduction	253	256	261	299	281
	of women & girls	166	173	184	221	214
	of others	87	83	77	78	67
6	Dacoity	91	112	74	71	72
7	Robbery	816	830	636	741	725
8	Burglary	3882	3554	2682	3001	2710
9	Theft	5818	5564	4380	4704	4078
	Auto theft	1981	2029	1486	1454	1262
	Other theft	3837	3535	2894	3250	2816
10	Riots	8057	8086	8724	10754	10938
11	Criminal breach of trust	435	354	343	340	301
12	Cheating	3659	3394	3581	5155	4681
13	Counterfeiting	46	66	54	56	68
14	Arson	389	503	374	450	568
15	Hurt	19178	18274	18532	21747	21170
16	Dowry Deaths	31	20	22	15	32
17	Molestation	2745	2540	2936	3756	3735
18	Sexual harassment	258	395	537	573	498
19	Cruelty by husband or relatives	4138	4007	4797	5377	5216
20	Other IPC Crimes	59365	68995	98936	112665	101919
Total cognizable crimes (IPC)		110620	118369	148313	172137	158989

www.keralapolice.org/newsite/scrb.html

7.14 Number of Suicidal Victims by causes (2010)

Sl. No.	Causes	Number of Suicidal Deaths		
		Male	Female	Grand Total
1	Bankruptcy or sudden change in economic status	412	40	452
2	Suspected/Illicit relation	10	9	19
3	Cancellation/ non-settlement of marriage	17	18	35
4	Not having children (Barrenness/impotency	26	16	42
5	(i) Aids/STD	7	0	7
6	(ii) Cancer	119	40	159
7	(iii) Paralysis	62	25	87
8	(iv) Insanity/Mental Illness	881	389	1270
9	(v) Other prolonged illness	798	297	1095
10	Death of dear person	75	39	114
11	Dowry dispute	0	21	21
12	Divorce	10	6	16
13	Drug abuse/addiction	288	1	289
14	Failure in examination	30	26	56
15	Fall in social reputation	40	14	54
16	Family problems	2656	918	3574
17	Ideological causes/ Hero worshipping	0	0	0
18	Illegitimate pregnancy	0	4	4
19	Love affairs	59	81	140
20	Physical abuse (Rape, incest etc.)	0	4	4
21	Poverty	1	0	1
22	Professional/ Career Problem	47	10	57
23	Property dispute	55	8	63
24	Unemployment	18	2	20
25	Causes not known	492	171	663
26	Other causes (Please specify)	243	101	344
	Total	6346	2240	8586

CRIMES AGAINST WOMEN-2012

7.15 REPORTED CASES ON CRIMES AGAINST WOMEN FOR THE YEAR 2012

(Provisional)

Sl. No.	Districts	Rape	Moles-tation	Kidnapping	Eve-Teasing	Dowry Death	Cruelty By Husband/ Relatives	Other Offences	Total
1	Trivandrum City	41	226	16	19	0	159	45	506
2	Trivandrum Rural	97	541	10	38	8	398	48	1140
3	Pathanamthitta	46	171	18	41	4	336	59	675
4	Kollam City	49	269	14	20	1	325	15	693
5	Kollam Rural	32	137	17	8	2	162	28	386
6	Alappuzha	44	250	15	14	1	294	18	636
7	Idukki	55	265	17	55	1	255	91	739
8	Kottayam	53	189	10	10	1	219	16	498
9	Ernakulam City	28	108	5	16	0	127	100	384
10	Ernakulam Rural	59	162	9	25	0	216	157	628
11	Thrissur City	35	111	9	32		146	243	576
12	Thrissur Rural	46	218	9	36	2	361	149	821
13	Palakkad	68	144	9	11	4	400	30	666
14	Malappuram	97	221	3	21	2	668	252	1264
15	Kozhikode City	36	103	3	83		144	170	539
16	Kozhikode Rural	42	153	13	15		313	102	638
17	Wyanad	36	79	9	15	1	95	200	435
18	Kannur	66	183	18	12		391	317	987
19	Kasaragod	89	154	9	15	3	205	221	696
20	Railways		46	1	12			27	86
21	CBCID		5			2	2	0	9
TOTAL		1019	3735	214	498	32	5216	2288	13002

Source:www.keralapolice.org/newsite/scrb.html

Waste and Waste Management

Waste is an unavoidable by-product of most human activity. Economic development and rising living standards have led to increases in the quantity and complexity of generated waste. Solid waste is a mixture of organic and inorganic waste generated by domestic or commercial activities.

Waste management is the collection, transportation, processing, recycling or disposal, and monitoring of waste materials. However poor solid waste management is a threat to public health.Management of residential and institutional waste is considered to be the responsibility of local government authorities.

Sources of waste: Municipal Solid Waste is generated from households, offices, hotels, shops, schools and other institutions. The major components are food waste, paper, plastic, rags, metal and glass, although demolition and construction debris is often included in collected waste, as are small quantities of hazardous waste, such as electric light bulbs, batteries, automotive parts and discarded medicines and chemicals.

Types of wastes

There are degradable and non-degradable wastes. Degradable wastes are mainly organic substances. There are hazardous and non-hazardous wastes. As far Municipal waste is concerned, a major chunk of it emanates from households, hotels, schools, institutions, marriage parties, slaughter houses etc. Further, there are E- wastes as well.

Following tables present a picture of sources and types of solid wastes generated in Municipal localities in a developing country as well as in Kerala:

Source	Typical waste generators	Types of solid wastes
Residential	Single and multifamily dwellings	Food wastes, paper, cardboard, plastics, textiles, leather, yard wastes, wood, glass, metals, ashes, special wastes (e.g. bulky items, consumer electronics, white goods, batteries, oil, tires), and household hazardous wastes
Industrial	Light and heavy manufacturing, fabrication, construction sites, power and	Housekeeping wastes, packaging, food wastes, construction and demolition materials, hazardous

	chemical plants	wastes, ashes, special wastes
Commercial	Stores, hotels, restaurants, markets, office buildings, etc.	Paper, cardboard, plastics, wood, food wastes, glass, metals, special wastes, hazardous wastes
Institutional	Schools, hospitals, prisons, government centers	Paper, cardboard, plastics, wood, food wastes, glass, metals, special wastes, hazardous wastes
Construction and demolition	New construction sites, road repair, renovation sites, demolition of buildings	Wood, steel, concrete, dirt, etc
Municipal services	Street cleaning, landscaping, parks, beaches, other recreational areas, water and wastewater treatment plants	Street sweepings, landscape and tree trimmings, general wastes from parks, beaches, and other recreational area, sludge
Process	Heavy and light manufacturing, refineries, chemical plants, power plants, mineral extraction and processing	Industrial process wastes, scrap materials, off specification products, slag, tailings
Agriculture	Crops, orchards, vineyards, dairies, feedlots, farms	Spoiled food wastes, agricultural wastes, hazardous wastes (e.g. pesticides)

TOTAL SANITATION CAMPAIGN

Total Sanitation Campaign is a comprehensive programme to ensure sanitation facilities in rural areas with broader goal to eradicate the practice of open defecation.TSC envisages synergized interaction between Government, people and active NGOs. It follows a principle of "low to no subsidy" where a nominal subsidy in the form of incentive is given to rural poor households for construction of toilets. TSC had given strong emphasis on Information, Education and Communication (IEC), Capacity Building and Hygiene Education for effective behaviour change with involvement of PRIs, CBOs and NGOs etc. The key intervention areas are Individual household latrines (IHHL), School Sanitation and Hygiene Education (SSHE),

Community Sanitary Complex, Anganwadi toilets supported by Rural Sanitary Marts (RSMs) and Production Centers (PCs). The main goal of the GOI is to eradicate the practice of open defecation by 2010. To give fillip to this endeavour, GOI has launched Nirmal Gram Puraskar to recognize the efforts in terms of cash awards for fully covered PRIs and those individuals and institutions who have contributed significantly in ensuring full sanitation coverage in their area of operation.NGP is also a way of awareness as well as a competition between Panchayats for firstly create open defecation free area and seek the Nirmal Gram Puraskar.

Objectives

The main objectives of the TSC are as under

- Bring about an improvement in the general quality of life in the rural areas
- Accelerate sanitation coverage in rural areas
- Generate felt demand for sanitation facilities through awareness creation and health education
- Cover schools/ Anganwadis in rural areas with sanitation facilities and promote hygiene education and sanitary habits among students
- Encourage cost effective and appropriate technologies in sanitation
- Eliminate open defecation to minimize risk of contamination of drinking water sources and food
- Convert dry latrines to pour flush latrine, and eliminate manual scavenging practice, wherever in existence in rural areas

Waste Management in Kerala

Introduction

Implementation of an appropriate strategy for waste management especially in urban areas in India is a burning problem faced by the Local Bodies and Governments since long and Kerala State is no exemption from this. The geophysical peculiarities and the demographical and sociological conditions of the people of Kerala, aggravate the problem of waste generation, collection and its transportation. One among the major type of waste is the hospital waste, which is also known as Bio-medical waste, generated from Hospitals, Nursing Homes, Clinics, Dispensaries, Veterinary Institutions, Animal Houses, Pathological Laboratories, Blood Banks etc. These wastes include infectious, hazardous, radioactive and other general wastes. Biomedical waste as on today is defined as "any solid or liquid waste generated in the diagnosis, treatment or

immunization of human beings or animals, in research pertaining thereto or in the production or testing of biological materials"

The seven components or package of practices involved in sanitation are,

(i) safe disposal of human excreta; (ii)solid waste management; (iii) liquid waste management; (iv) safe handling of drinking water; (v) home sanitation and food hygiene; (vi) personal hygiene; and (vii) community environmental sanitation. Over the years, Kerala has taken various initiatives to improve latrine coverage and waste management through intensive Information, Education and Communication (IEC) campaigns.

Keralites are traditionally well known for maintaining personal hygiene by almost all sections of people. Environmental awareness is very high in the state due to high literacy. They are therefore demanding better environmental quality. Solid and liquid waste management are the essential components of societal hygiene. But the peculiar characteristics of the state such as high water table in coastal areas, where most of the urban local bodies are situated and long period of monsoon season spread over six months in an year, makes the solid and liquid waste management a challenging job. Another peculiarity of the state is its very high density of dug wells, it comes about 400 dug wells per square Kilometer, makes the job of waste management at household level a difficult task. Small land holdings having well for drawing drinking water and household latrines with on-site excreta disposal system is a common scene in rural settings. In these circumstances finding a suitable site for household processing of solid waste using popular technologies like pit composting, ring composting, or biogas plant is very difficult.

Segregation of wastes at source of generation itself is the key element promoted for managing wastes at household level, institutions and other major waste generators. Encouragement has been given to segregate solid waste to at least two fractions namely, biodegradable and non degradable. Biodegradable wastes include all organic fraction of solid waste, which is intended to be processed at source. If biodegradable, especially the easily biodegradable waste is separated, then the non-degradable and hazardous waste could be handle safely. Non-degradable wastes include plastics, metal, glass etc. Homely hazardous wastes consist of CFL lamps, tube lights, discarded battery, discarded medicines, mosquito coils, remnant of pesticides, etc. The main advantage noticed from cultivating the habit of segregation and storage of waste at source is that the problematic easily degradable waste can be removed daily for processing at household level or at community level, and the non-degradable and hazardous wastes can be stored for comparatively a longer period, without mixing with biodegradable wastes. The first experiment in this regard in Kerala state was tried during 2003 at Kozhikode Municipal Corporation with the financial assistance of the Ministry of Environment and Forests, Government of India. Two bin

systems, green bin for biodegradable and white bin for non-degradable were issued to the residents. House to house collection was introduced by involving Kudumbasree (Women Self Help Groups) volunteers, which showed encouraging results.

Technologies such as pit composting ring composting, vermin composting and biogas plants are being promoted for processing of biodegradable wastes at household level and institutional level. Aerobic windrow composting, vermin composting and biogas plants are being promoted for processing of biodegradable waste at community level. In order to help the local bodies, the State Government in the Local Self Government Department has issued a comprehensive guideline on standards, specifications, operation and maintenance of protocol for the above mentioned processing technologies.

Solid Wasted management is an important component of sanitation. The solid waste management is a mandatory responsibility of Local Self Government institutions, as per provisions of the Kerala Municipality Act 1994, Kerala Panchayat Raj act 1994 and the Municipal Solid Waste (Management & Handling) Rules, 2000 notified under the Environment (Protection) Act. In order to make the waste management system more effective, implementation of the Municipal Solid Waste Rules has been done, which necessitates integrated Solid Waste management System (ISWMS) comprising of segregated storage of waste at source, primary and secondary collection system, street sweeping, regulated transportation, processing and disposal of rejects through engineered landfills. Thus, in brief, as per the provisions of the above legislations the LSGIs have been assigned with the mandatory responsibility to provide basic infrastructure for collection, conveyance, treatment and disposal of Municipal Solid waste. They are also responsible for operation and maintenance of such facilities. The District Collectors are responsible for overall co- ordination of solid waste management activities undertaken by the LSGIs as per the MSW Rules. Therefore the State Government is responsible for coordinating assisting the LSGIs for implementing the MSW Rules.

The sectoral status study on Municipal Solid Waste Management done in Kerala has indicated that the total solid waste generation in the State is about 8300 tonnes per day. Studies have also indicated that 70-80% of the total waste generated is biodegradable in nature and these putrescible waste needs to be managed within 24 hours. Of the total, 13% of the waste is generated by the five City Corporations, 23% by the 53 Municipalities and the rest by the 999 Grama Panchayats (2006 data)

7.16 Municipal Solid Waste Generation in Kerala

Local Governments	Population (Census 2001)	Per capita waste generation in gm	Waste generation per day in tone (2006)
5 City Corporations	2456618	400	1091
53 Municipalities	5810307	300	1935
999 Grama Panchayats	23574449	200	5312
Total			8338

In the state, 27 Municipalities and all the five Municipal Corporations have already completed the construction of Solid Waste Processing Plants and made the plant operational. They have been following the treatment technology based on biological processing of Municipal Solid waste, using mainly the Windrow Composting and biogas plants, as specified in the MSW Rules. The Suchitwa Mission has been focusing and filling the gap in the field of Solid Waste Management in urban areas and focusing in activities mainly at Grama Panchayats and small Municipality level. The Kerala sustainable Urban Development Project (KSUDP) has been involved in providing technical and financial support to Municipal Corporations, and some of the major Municipalities under the JNNURM/UIDSSMT schemes. Even though, the technical and financial support have been extended to Municipal Corporations and major Municipalities, through the KSUDP project, there are gaps and issues in those LSGIs in the field of solid waste management. Present status of implementation of Solid Waste Management System in ULbs has been assessed and a summary of the same is given below.

7.17 Status of Implementation of Integrated Solid Waste Management Projects in Urban Local Bodies

Components	No. of UIBs			
	Nil	Minimal	Moderate	Adequate
Primary Collection	25	25	13	2
Source Segregation	53	9	3	
Transportation	25	4	31	5
Processing	16	34	13	2

The five City Corporations and 53 Municipalities were supported with partial financial assistance from the Suchitwa Mission for establishing full-fledged integrated Municipal Solid Waste Management Facility, with financial support from the state Plan. Funds have also been made available for solid waste management from LSG fund, and financial resource of Jawaharlal Nehru National Urban Renewal Mission Urban Renewal Mission, Urban Infrastructure Development

scheme for small and medium Towns and Kerala Sustainable Urban Development Project. However, there are certain technical issues like odour nuisance, open dumps, menace from flies, birds and dog, need to collect and treat leach ate, need for proper mechanization of processing plants, need to protect the site with boundary wall and barbed fencing, need to have a proper sanitary landfill system, need to have a resource recovery centre, need to have a proper waste management system for slaughterhouses, etc, that required to be addressed for mitigating the environmental impacts linked to ISWM facilities, in general, and waste processing plants, in particular.

The suchitwa Mission has also been providing technical support and part financial assistants to the Grama Panchayats for establishing solid waste management activities. A three level approach is being taken in this regard. At household level, Institution level and community level, biological treatment technologies are being followed for the purpose of source treatment of bio degradable waste. The suchitwa Mission has been giving technical approval and part financial support to Rural LSGIs for establishing solid waste management facilities under the centrally sponsored programme of Total Sanitation Campaign (TSC) and from Plan Schemes of the suchitwa Mission.

At present, the Municipal Corporations and Major Municipalities have been following the treatment technology based on biological processing of Municipal Solid Waste, using mainly the Windrow Composting and biogas plants, as specified in the MSW Rules. Those LSGIs have been facing the difficulties such as lack of adequate land for disposal of rejects from the compost plants, inadequacies of processing facilities and odour nuisance, excessive leach ate generation, water pollution and other environmental issues from operation of the compost plants. The major issues faced by these plants are being highlighted by media and there are public protests in some urban local bodies. There is a wide spread public concern over the management of Municipal Solid Waste especially in Corporation and major Municipalities. Hence, the Government is in the process of searching for alternate or better technologies for solving the above mentioned issues in those urban LSGIs. The selected technological options are to tried under the Kerala condition, in consideration of its special waste characteristics, climatic conditions, land constraints, environmental sensitiveness, etc.

There are a lot of environmental and operational issues due to mixing of waste plastic carry bags with municipal solid wastes. Therefore, the LSGIs are facing lot of problems in their waste treatment activities due to higher percentage of plastic waste. More over unscientific disposal of waste plastic carry bags led to various environmental issues in the State. The Plastic Waste (Management and handling) Rules, 2011 notified under Environment (Protection) Act, 1986 insist

that the local bodies have to take action for collection of waste plastic carry bags and to take action for using the collected carry bags for mixing it with bitumen for road tarring and or co-incineration in the kilns of cement plants. The LSGIs are as part of their waste management projects, are planning to establish Plastic shredding Units at Grama Panchayat and Municipality level, for shredding the collected waste plastic carry bags. There is therefore an urgent need for utilization of these shredded plastic carry bags for road tarring or co- incineration in the Cement Kilns, as stipulated in the said Rules. In the case of sanitary latrines, Kerala has a good record. We have extensive coverage of sanitary latrines in the state. The coverage increased exponentially in the 90's backed up by a well organized programme and commitment of funds. Table 3 gives the progressive achievement in provision of household sanitary latrines in the state.

7.18 Household sanitary latrines: Access to sanitation facilities

Time line	1991	1995	2001	2005
Rural household with toilets (%)	44	73.4	81.3	94.9
Urban Household with toilets (%)	73	90.0	92.0	98.3

Emerging challenges of waste management in Kerala are many. Following are a few important challenges:

- Per capita generation of wastes in Local Self Governments in Kerala is higher than those in other states due to the peculiar consumption pattern in the State.
- Primary collection is limited to urban local self Governments. Storage of waste at source is limited to a few cities and towns.
- Plastic wastes and e-wastes are on the increase.
- After attaining high coverage of sanitary latrines, the remaining target mostly consists of landless people or those having very low extent of land, where construction of toilets poses a major challenge.
- High water table areas particularly in the coastal and in low lying areas like Kuttanad pose a technological challenge.
- Septage treatment has not been addressed so for.

7.19 Districtwise and scheme wise expenditure details scheme: solid waste management

SL. NO.	NAME OF DISTRICT	YEAR			
		2008-09	2009-10	2010-11	2011-12
1	Thiruvananthapuram	2,490,000	0	2,577,500	82,610,050
2	Kollam	1,117,000	0	225,000	38,920,433
3	Pathanmathitta	0	115,000	488,000	1,035,000
4	Alappuzha	0	0	225,000	24,891,892
5	Kottayam	1,000,000	3,526,000	1,596,000	22,103,666
6	Idukki	0	600,000	0	11,457,500
7	Ernakulam	3,226,000	0	1,966,000	26,293,828
8	Thrissur	570,000	500,000	1,489,000	27,815,000
9	Palakkad	4,628,000	2,734,000	0	18,311,483
10	Malappuram	860,000	0	1,600,000	55,172,750
11	Kozhikode	1,127,000	0	738,000	6,590,306
12	Wayanad	0	0	0	1,586,033
13	Kannur	600,000	1,445,000	1,950,000	77,503,595
14	Kasaragod	4,126,000	220,000	263,000	22,517,817
TOTAL		**19,744,000**	**9,140,000**	**13,117,500**	**416,809,353**

Source: suchitwa Mission

7.20 Districtwise and scheme wise expenditure details

Scheme: integrated low cost sanitation (ilcs)

SL.NO	NAME OF DISTRICT	YEAR
		2010-11
1	Ernakulam	3,702,000
2	Palakkad	6,565,000
3	Malappuram	5,428,000
4	Kozhikode	2,593,000
5	Kasaragod	1,867,000
TOTAL		**20,155,000**

Source: suchitwa Mission

7.21 DISTRICTWISE AND SCHEME WISE EXPENDITURE DETAILS SCHEME: GIRL FRIENDLY TOILET AND BABY FRIENDLY TOILET

SL.NO	NAME OF DISTRICT	2008-09	2009-10	2010-11
1	Thiruvananthapuram	0	33,500	27,500
2	Kollam	110,000	0	0
3	Pathanmathitta	0	0	33,500
4	Alappuzha	110,000	0	0
5	Ernakulam	110,000	140,000	27,500
6	Thrissur	0	0	67,000
7	Palakkad	0	67,000	0
8	Malappuram	110,000	0	0
9	Kozhikode	110,000	67,000	0
10	Wayanad	0	0	0
11	Kannur	0	100,500	0
TOTAL		**550,000**	**408,000**	**155,500**

Source: suchitwa Mission

Bio-medical Waste

Hospitals in general, generate waste at an average rate of 1 Kg/bed/day. A small percentage of this waste is toxic and harmful not only to the staff and patients but also to the general public at large. The improper management of Bio-medical waste causes serious environmental problems in terms of air, water and land pollution. A study conducted by the World Health Organization in1996, reveals that more than 50,000 people die every day from infectious diseases in the whole world. The situation has not improved yet. One of the reasons for the increase in infectious diseases is the improper waste management. Blood, body fluids and body secretions which are constituents of Bio-medical waste, harbor most of the viruses, bacteria and parasites that cause infection. Improper practices such as dumping of Bio- medical waste in municipal dustbins open spaces, water bodies etc. leads to the spread of diseases. Bio-medical waste can also cause health hazards to animals, birds and plan

7.22 Total Sanitation Campaign (TSC)-Physical Achievement from April 2002 to March 2012

District-wise Physical Progress During 04/2002-03/2012

Sl. No	District	IHHL (BPL)	IHHL (APL)	IHHL TOTAL	Sanitary Complex	School Toilets	Anganwadi Toilets	RSM	PC	SLWM	Total School covered
1	Thiruvanathapuram	134348	12496	146844	57	383	587	10	0	78	378
2	Kollam	95130	7290	102420	400	422	351	6	6	2	362
3	Pathanamthitta	53799	1200	54999	25	172	121	0	0	4	86
4	Alappuzha	114359	4500	118859	107	166	246	10	10	21	166
5	Kottayam	28118	1840	29958	30	165	133	0	0	19	83
6	Idukki	86535	13823	100358	61	139	248	0	0	9	82
7	Ernakulam	55916	16219	72135	62	365	394	7	2	37	365
8	Thrissur	51017	7051	58068	46	316	839	5	2	10	158
9	Palakkad	107018	24424	131442	49	289	520	6	0	2	165
10	Malappuram	61905	7850	69755	30	466	180	14	1	7	466
11	Kozhikode	42285	2140	44425	18	253	250	2	0	15	205
12	Wayanad	50655	2481	53136	41	84	94	3	0	2	43
13	Kannur	37628	18269	55897	40	174	374	3	3	33	174
14	Kasaragode	59153	23300	82453	32	281	382	1	0	1	186
	Total	**977866**	**142883**	**1120749**	**998**	**3675**	**4719**	**67**	**24**	**240**	**2919**

Source: Commissionarate of Rural Development

7.23 Year wise achievements of Physical Components

Sl. No	Component	2001-2002	2002-2003	2003-2004	2004-2005	2005-2006	2006-2007	2007-2008	2008-2009	2009-2010	2010-2011	2011-2012	2012-2013
1	IHHL BPL	0	100867	108225	138982	130298	100087	246152	74297	56723	20047	2188	1560
2	IHHL APL	0	0	6800	27450	23688	21571	44033	7568	11579	194	0	0
3	TOTAL IHHL(BPL+ APL)	0	100867	115025	166432	153986	121658	290185	81865	68302	20241	2188	1560
4	Sanitary Complex	0	71	331	110	31	24	63	89	153	58	68	24
5	school Toilets	0	112	757	435	320	221	672	605	448	29	76	30
6	Anganwadi Toilets	0	0	15	476	291	163	1416	713	1390	195	60	174

Source: suchitwa mission

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Government Central Press, Thiruvananthapuram, 20