
Government of Kerala
COMPENDIUM OF ENVIRONMENT STATISTICS
KERALA 2013
Department of Economics & Statistics, Kerala

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COMPENDIUM OF ENVIRONMENT STATISTICS

KERALA 2013

DEPARTMENT OF ECONOMICS AND STATISTICS,
KERALA - 695 033

PREFACE

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

Environment statistics aggregate, synthesize and structure environmental and other data according to statistical methods, standards and procedures. It is the role of environment statistics to process environmental data into meaningful statistics that describe the state and trends of the environment and the main processes affecting them. Not all environmental data are used in the production of environment statistics. The Framework for the Development of Environment Statistics (FDES) provides a framework that marks out environmental data that fall within its scope and then structures, synthesizes and aggregates them into meaningful statistics.

The scope of environment statistics covers biophysical aspects of the environment and those aspects of the human sub-system that directly influence and interact with the environment. Within this scope, environment statistics describe the state and changes of environmental conditions, the quality and availability of environmental resources, the impact of human activities and natural events on the environment, the impact of changing environmental conditions, as well as the social actions and economic measures taken by societies to avoid or mitigate these impacts and to restore and maintain the capacity of the environment to provide the services that are essential for life and human wellbeing.

Environment statistics support evidence based policy making by enabling the identification of environmental policy issues and the objective quantification of measures and impacts of policy initiatives. They strengthen assessments through quantitative metrics, making analyses more robust through the use of timely and comparable data. The type, the level of thematic, spatial and temporal aggregation and the format of environment statistics depend on the type of the user and the intended purpose of use. The main products of environment statistics are detailed tabulated environment statistics series, environmental accounts and environmental indicators

As an endeavor to know our environment, the Department of Economics and Statistics, Government of Kerala, has been bringing out the publication. This publication has been categorized into different chapters so as to make it easy for reference.

The Department would like to express gratitude to all parties concerned for their co-operation and assistance in providing the required data.

This publication is an outcome of earnest effort of I & ES Division under the guidance and supervision of Smt. Radhamani, Addl. Director. Comments and suggestions towards improving future reports would be greatly appreciated.

Thiruvananthapuram,
27/05/2016

V. RAMACHANDRAN
DIRECTOR GENERAL

CONTENTS

C O N T E N TS

Environment Statistics

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

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

CHAPTER-I

ENVIRONMENT & ENVIRONMENT DEGRADATION

CHAPTER - I

ENVIRONMENT AND ENVIRONMENT DEGRADATION

Introduction

The term environment has been derived from a French word “Environia” means to surround. It refers to both biotic (living) and abiotic (physical or non-living) environment. Environment can be defined as the physical surroundings, in which organism lives, it consists of atmosphere, hydrosphere, lithosphere and biosphere. It’s chief components are air, water, soil, organisms and solar energy. Environment and the organisms are two dynamic and complex component of nature. Environment regulates the life of the organisms including human beings that interacting systems of physical, biological and cultural elements which are interlinked both individually and collectively. Environment is the sum total of conditions in which an organism has to survive or maintain its life process. It influences the growth and development of living forms. It has provided us all the resources for leading a comfortable life.

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

Environment Degradation

Environmental degradation is the deterioration of the environment through depletion of resources such as air, water and soil; the destruction of ecosystems and the extinction of wildlife. It is defined as any change or disturbance to the environment

perceived to be deleterious or undesirable. As indicated by the I=PAT equation, environmental impact (I) or degradation is caused by the combination of an already very large and increasing human population (P), continually increasing economic growth or per capita affluence (A), and the application of resource depleting and polluting technology (T).

Environmental degradation is a process through which the natural environment is compromised in some way, reducing biological diversity and the general health of the environment. This process can be entirely natural in origin, or it can be accelerated or caused by human activities. The United Nations International Strategy for Disaster Reduction defines environmental degradation as "The reduction of the capacity of the environment to meet social and ecological objectives, and needs". Environmental degradation is of many types. When natural habitats are destroyed or natural resources are depleted, the environment is degraded. Efforts to counteract this problem include environmental protection and environmental resources management. Air, water, and soil are all resources which are vulnerable to depletion through overuse, as are natural resources like minerals and oil deposits. Habitat pressures which force animals into a small area can also contribute to resource depletion, as the animals consume a high volume of material in a small area.

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

Development Activities	Major Impacts on Environment
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.
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.
Agro industries	Air pollution due to burning of biogases as fuel in sugar mills, large amount of highly polluting organic wastes, surface water pollution
Introduction of new varieties of cereals	Reduction of genetic diversity of traditional monoculture resulting in instability, danger of multiplication of local strains of fungus, bacteria or virus on new variety
Use of pesticides	Organism develops resistance and new control methods are needed (e.g. in malaria, widespread use of dieldrin as a prophylactic agent against pests of oil palms made the problem worse), creation of complex and widespread environment problems. The pesticides used in agriculture sometimes go into food chain or in water bodies which may result in harmful health hazards.
Timber extraction	Degrades land, destroys surface soil, reduces production potential of future forests.
Urbanisation and industrialization	Concentration of population in urban centers makes huge demands on production in rural areas and put pressures on land, air and water pollution.
Water resource projects, e.g. Dam, extensive irrigation	Human settlement & resettlement, spread of waterborne diseases, reduction of fisheries, siltation, physical changes e.g. temperature, humidity.

Source: Compendium of Environment Statistics INDIA 2013

Table : 1.2 Local, Regional and Global effects of Pollution

Local Effects	Regional	Over Marine Water and Continents	Changes the climate due to ozone depletion and the greenhouse effect.
Heavy metals in air, soil, water and plants, eg. From industrial emissions and discharges, noise, smell, air pollutions	Eutrophication, Contaminants in the soil & water, Landscape changes due to mining or agriculture	Eutrophication, Acidification, Environment Contamination due to Radioactivity	Changes the climate due to ozone depletion and the greenhouse effect.

Source: Compendium of Environment Statistics INDIA 2013

Table : 1.3 Some Major Pollutants and their Sources

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

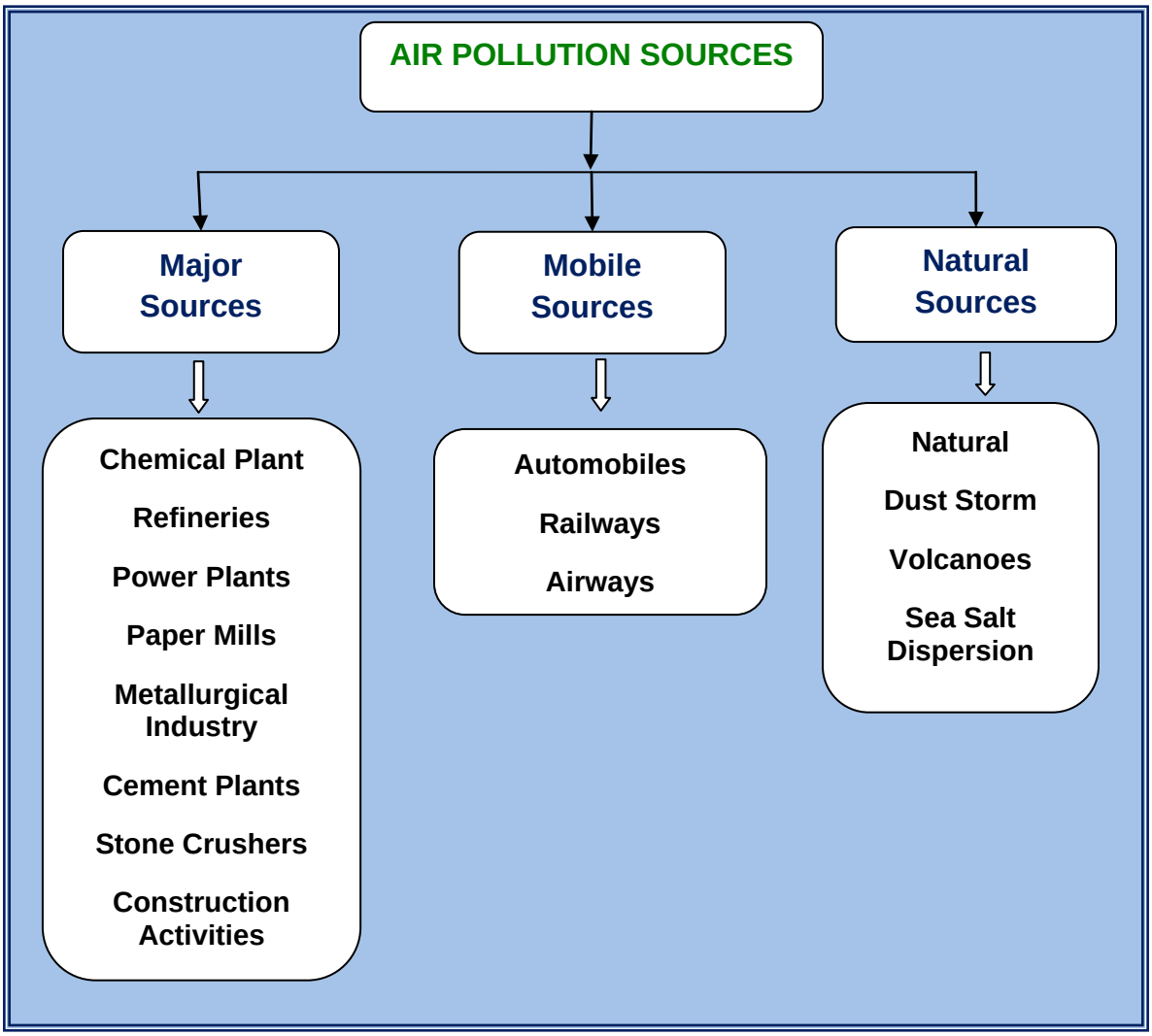
Source: State Pollution Control Board

Air pollution and Health Effects

Air pollution is recognized as a major threat to human health. We can survive without food for several weeks. We can also live without water for a few days. But, we cannot live without breathing air even for a few moments. The air we breathe directly gets into our blood stream. Hence, it is necessary for us to ensure that the air quality is not polluted beyond the threshold limits.

The human activities whether for cooking, space heating and transportation or for industrial production use fuels of various kinds. Burning of fuels leads to a plethora of combustion products, which contribute towards air pollution. Besides manmade pollutants, air pollution such as in arid and semi-arid areas which are having high levels of suspended particulate matter (SPM) can also be caused by natural conditions.

There are three principal sources of air pollution as below:-



Source: Kerala State Pollution Control Board

Table : 1.4 Water Born Disease and their Causative Factors

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

Source: Compendium of Environment Statistics INDIA 2013

Table : 1.5 Pollutants and their related Health hazards

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

Source: Compendium of Environment Statistics INDIA 2013

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CHAPTER-II

DEVELOPMENT OF ENVIRONMENT STATISTICS IN KERALA

CHAPTER - II

DEVELOPMENT OF ENVIRONMENT STATISTICS IN KERALA

Introduction

Kerala State is a total area of 38,863 km2, population of more than 30 million. The long coastline with an intricate system of backwaters along the coast, the tropical moist forests on the Western Ghats, the highly undulating terrain and the tropical monsoon climate make the State a unique geographical and environmental entity. The people have a high level of literacy and are generally conscious of health care practices, nutritional requirements and hygienic practices resulting in high life expectancy, low population growth and low infant mortality rate. The undesirable consequences of the development measures carried out without proper environmental considerations have left their indubitable impacts on the environment in Kerala.

Environment Statistics: Frame Work and Indicators

Main uses and user groups of environment statistics

Different users need environment statistics at different levels of aggregation and depths of information. They may need cross-cutting environment statistics data sets, for instance regarding climate change. In other cases they may only be interested in particular topics and themes pertaining to specific sectoral analysis and policy making. Policy and decision makers, and the general public would tend to use environmental indicators, whereas researchers, analysts, and experts may be more inclined to look at extensive and detailed environment statistics.

Environment statistics serve a variety of users, including but not restricted to:

i. Policy and decision makers at all levels;
ii. The general public, including media and civil society;
iii. Analysts and researchers;
iv. Academia; and
v. International agencies

The field of environment statistics has no single, overarching, internationally agreed classification of the environment for statistical purposes. Instead, there are a number of coexisting and emerging classifications and categorizations for specific subject areas in environment statistics. These include standardized statistical classifications as well as less formalized groupings or categories. Some of the classifications and categories that have been used in the environmental field have not been developed specifically for statistical purposes, and therefore have to be linked to statistical classifications.

UNSD developed and published in 1984 'A Framework for the Development of Environment Statistics (FDES).' The FDES sets out the scope of environment statistics by relating the components of the environment to information categories that are based on the recognition that environmental problems are the result of human activities and natural events reflecting a sequence of action, impact, and reaction. Relevant information, therefore, refers to social and economic activities and natural events, their effects on the environment, and the responses to these effects by the society. The scope of environment statistics include the media of the natural environment (air, water, land/soil), the biota found within these media, and human settlements. Within the broad range of subject areas, environment statistics describe the quality and availability of natural resources, human activities and natural events that affect the environment, the impacts of these activities and events, and social responses to these impacts.

The Healthy People 2020 Environmental Health objectives focus on 6 themes, each of which highlights an element of environmental health:

1. Outdoor air quality
2. Surface and ground water quality
3. Toxic substances and hazardous wastes
4. Homes and communities
5. Infrastructure and surveillance
6. Global environmental health

Kinds of Environmental Pollution

Different Types of pollution are categorized based on the part of the environment which they affect or result which the particular pollution causes. Each of these types has its own distinctive causes and consequences. Categorized study of pollution helps to understand the basics in more detail and produce protocols for the specific types. Accordingly, the main types of pollution are:

- ✓ Water Pollution
- ✓ Air Pollution
- ✓ Soil Pollution
- ✓ Thermal Pollution
- ✓ Radioactive Pollution
- ✓ Noise Pollution
- ✓ Light Pollution

Water Pollution

Water pollution can be defined in many ways. “Water Pollution” is a type of pollution that involves the contamination of various water bodies. Various aquatic creatures depend on these water bodies and its natural nutritious features to support its life. Usually, it means one or more substances have built up in water to such an extent that they cause problems for animals or people. Oceans, lakes, rivers, and other inland waters can naturally clean up a certain amount of pollution by dispersing it harmlessly.

Causes of Water Pollution

1. Industrial waste gets dumped into these water bodies. This causes a chemical imbalance in the water leading to death of the aquatic beings.
2. Insecticides, pesticides and ripening chemicals that are used on plants run into the ground water system or nearby streams.

3. Washing clothes near lakes and rivers cause detergents also causes a condition called “Eutrophication” which blocks sunlight from entering inside and reduces oxygen values in the water causing an inhabitable environment.
4. ‘Oil Spills’ are caused when giant oil tankers and oil rigs which are present in the oceans are damaged by either natural or human errors cause a long-time damage to the ocean as oil is lighter than water and floats on water forming a layer blocking sunlight.
5. Certain natural disasters like flash floods and hurricanes cause the intermixing of water with harmful substances on the land.

Air Pollution

The contamination of the air present in the atmosphere is known as “Air pollution”. Respiration is an important life process of all living things. We breathe in the air present in the atmosphere. Therefore if the air around us is contaminated with poisonous gases, it would have a fatal effect on us. The air naturally comprises of 78% of nitrogen, 21% of oxygen, 0.9% of oxide gases and 0.1% of inert gases. When this balance is disturbed, it causes disruptions of severe proportions.

Causes of Air Pollution

1. Partially combusted exhaust gases released from internal combustion engines add poisonous gases into the atmosphere.
2. Certain industries release some gases like sulphur dioxide and carbon monoxide which mix with the air and clouds and cause acid rains.
3. Burning of discarded plastic, wood and rubber also release carcinogenic gases into the atmosphere. Air pollution is very much fatal to living things as almost all living beings respire directly from the atmosphere without undergoing any treatment like water.

Soil Pollution

Stripping soil of its natural fertility by using artificial chemicals like pesticides, insecticides, ripening agents etc. is known as “Soil Pollution”. Plants depend on the nitrogenous compounds present in the soil for their nutrition. Use of insecticides, pesticides and other artificial chemicals absorbs the nitrogen from the soil making it unfit for the growth for plants. Plants are responsible for holding the soil together firmly so, when the plants can’t grow the soil splits, leading to soil erosion.

Main Causes of Soil Pollution

1) Industrial activity has been the biggest contributor to the problem in the last century, especially since the amount of mining and manufacturing has increased. Most industries are dependent on extracting minerals from the Earth. Whether it is iron ore or coal, their by products are contaminated and they are not disposed off in a manner that can be considered safe. As a result, the industrial waste lingers in the soil surface for a long time and makes it unsuitable for use.
2) Chemical utilization has gone up tremendously since technology provided us with modern pesticides and fertilizers. They are full of chemicals that are not produced in nature and cannot be broken down by it. As a result, they seep into the ground after they mix with water and slowly reduce the fertility of the soil. Other chemicals damage the composition of soil and make it easier to erode by water and air. Plants absorb these pesticides and when they decompose, they cause soil pollution.
3) Industrial waste is a cause to contamination, there is another way in which we are adding to the pollution. Every human produces a certain amount of personal waste products by way or urine and feces. While much of it moves into the sewer system, there is also a large amount that is dumped directly into landfills in the form of diapers. Even the sewer system ends at the landfill, where the biological waste

pollutes the soil and water. This is because our bodies are full of toxins and chemicals which are now seeping into the land and causing pollution of soil.

4) Oil leaks can happen during storage and transport of chemicals. This can be seen at most of the fuel stations. The chemical presents in the fuel deteriorates quality of soil and make them unsuitable for cultivation. These chemical can enter into the groundwater through soil and make the water undrinkable.

Thermal Pollution

Rise in the temperature in the ecosystem due the release of excessive heat energy into the environment by artificial methods or natural disasters is called "Thermal Pollution". Generally, manufacturing industries release a lot of heat energy which gets transferred to the air and water bodies. Even vehicles which have combustion engines release a lot of heat energy as they require high temperatures to function. Carbon dioxide has a property of blocking heat from exiting the atmosphere and so the heat coming in from the sun is trapped in the atmosphere.

Causes of Thermal Pollution

i. Production and Manufacturing plants are biggest source of thermal pollution. These plants draw water from nearby source to keep machines cool and then release back to the source with higher temperature. When heated water returns to the river or ocean, the water temperature rises sharply. When oxygen levels are altered in the water, this can also degrade the quality and longevity of life in wildlife that lives underwater.

ii. Soil erosion is another major factor that causes thermal pollution. Consistent soil erosion causes water bodies to rise, making them more exposed to sunlight. The

high temperature could prove fatal for aquatic biomes as it may give rise to anaerobic conditions.

iii. Trees and plants prevent sunlight from falling directly on lakes, ponds or rivers. When deforestation takes place, these water bodies are directly exposed to sunlight, thus absorbing more heat and raising its temperature. Deforestation is also a main cause of the higher concentrations of greenhouse gases.

iv. Urban runoff discharged to surface waters from paved surfaces like roads and parking lots can make water warmer. During summer seasons, the pavement gets quite hot, which creates warm runoff that gets into the sewer systems.

v. Natural causes like volcanoes and geothermal activity under the oceans and seas can trigger warm lava to raise the temperature of water bodies. Lightening can also introduce massive amount of heat into the oceans. This means that the overall temperature of the water source will raises significant impacts on the environment.

Radioactive Pollution

Radioactive pollution occurs when 'Radioactive' metals disintegrate releasing dangerous beta rays which can cause cancer and other mutative diseases. These types of pollution can occur by either the dumping of radioactive waste from nuclear power plants into water bodies, damage of nuclear reactors leading to radioactive contamination that would last for many years and many more. In the Second World War, when the U.S.A attacked Hiroshima and Nagasaki of Japan, the atomic bomb left a radioactive footprint leading to highly mutative diseases. So, most of the people who survived the atomic bombing died eventually from cancers and mutations.

Causes of Radioactive Pollution

1. Productions of nuclear weapons with radioactive materials have high health risks and release a small amount of pollution.
2. Decommissioning of nuclear weapons causes slightly more radioactive pollution than in the production, however, the waste (alpha particles) is still of low risk and not dangerous unless ingested.
3. Mining of radioactive ore (uranium, phosphate etc.) - mining these involves crushing and processing of the radioactive ores and this generates radioactive waste which emits alpha particles. This waste is of low risk unless ingested.
4. Some coal contains more radioactive material than usual and is often referred to as 'dirty' coal; when this is burnt the ash becomes more radioactive as the radioactive particles do not burn well. This level of radioactivity is less than in phosphate rocks, however, due to small amounts being released into the atmosphere and its ability to be inhaled, this ash is significantly more dangerous.
5. Medical waste - a number of radioactive isotopes are used in medicine, either for treatment or diagnostics. These can be left to decay over a short period after which they are able to be disposed of as normal waste.
6. Nuclear power plants - nuclear power plants under current standards produce little radioactive pollution due to safety precautions that must be adhered to. Accidents at these power plants can cause dangerously high radioactive pollution, such as in the case of Chernobyl, the most well-known and worst nuclear disaster in history and the more recent Fukushima, after the earthquake and tidal wave in Japan.

Noise Pollution

There are different qualities of sounds. The sounds which are not pleasant to hear are called ‘Noises’. So an excess of noise in the outdoors leads to “Noise Pollution”. This can be experienced by too many vehicles honking at the roads, heavy machinery being operated in the open (for ex, a jackhammer), trains, clubs, over populated crowds and many more. Noise pollution is known to cause mental stress and

depression. It can also cause damage to the ear drum which can cause deafness. Noise pollution has more of a psychological effect rather than a physical one.

Causes of Noise Pollution

1) Most of the industries use big machines which are capable of producing large amount of noise. Various equipments like compressors, generators, exhaustfans, grinding mills also participate in producing big noise.
2) In most of the developing countries, poor urban planning also plays a vital role. Congested houses, large families sharing small space, fight over parking, frequent fights over basic amenities leads to noise pollution which may disrupt the environment of society.
3) Noise is also produces social events like marriage, parties, pub, disc or place of worship, people normally flout rules set by the local administration and create nuisance in the area. People play songs on full volume and dance till midnight which makes the condition of people living nearby pretty worse.
4) Large number of vehicles on roads, aeroplanes flying over houses, underground trains produce heavy noise and people get it difficult to get accustomed to that. The high noise leads to lose the ability to hear properly in a normal person.
5) Under construction activities like mining, construction of bridges, dams, buildings, stations, roads, flyovers take place in almost every part of the world. These construction activities take place everyday as we need more buildings, bridges to accommodate more people and to reduce traffic congestion. The down point is that these construction equipments are too noisy.
6) Gadgets like TV, mobile, mixer grinder, pressure cooker, vacuum cleaners, washing machine and dryer, cooler, air conditioners are minor contributors to the amount of noise that is affects the quality of life of your neighborhood in a bad way.

Light Pollution

Bright lighting in functions, big cities, etc. causes “Light Pollution”. Excessive light on the retina causes extreme discomfort in the eyes, especially in dim conditions like during night time. Bright lights strain the eyes and also give headaches and migraines. If we observe, light pollution, thermal pollution and noise pollution all are types of pollution that are caused by the different forms of energy.

Causes of Light Pollution

Light pollution is unique as it is caused by man only. There is no comparable natural form of the pollution like carbon dioxide. The main causes of light pollution are:

1. The placement of signage and street lights is planned by engineers, if they do not take into account the effect placement has on the surrounding environment they can create glare, light trespass and light clutter.
2. Christmas lights are used for decoration but leaving them on all night is a form of pollution, is leaving a room with the lights still on or setting the timers on streetlamps and not adjusting the timer for the season. Not actively choosing to minimize energy waste is a huge source of light pollution.
3. That is really a zoning issue. Too many businesses, or too many residences, grouped in one area can cause light pollution.

Visual Pollution

All kinds of pollution can be measured and quantified. But certain forms of pollution affect our aesthetic senses and are very difficult to measure and define. This type of pollution is called aesthetic pollution.

Visual pollution is one of them. The effects of visual pollution are increasing tremendously from day to day. Visual pollution is any unwanted sight that mentally or physically affects the community or creates any health hazard. Visual pollution generally refers to those elements of the landscape that the community finds unattractive, including badly maintained buildings, weeds, advertisements (hoardings), business signs, telephone and utility poles, garbage dumps and litter.

Home Theatre: A home pollution

Visual pollution is present not only outside your house but also inside. Watching television and working at computers may affect our eyes due to the radiation. There is a huge difference in watching a movie in a theater to the same movie in television. In a theater we are watching the reflected image from a screen, whereas in television we are directly seeing the bright TV screen. Certain colours also create visual pollution. It is pleasant to sit in a room painted white or pastel colours, but not in a room painted red.

Causes of visual pollution

Visual pollution disturbs the visual areas of people by creating negative changes in the natural environment. The main cause of visual pollutions are Billboards, open storage of trash, space debris, telephone towers, electric wires, buildings and automobiles are forms of visual pollution. An overcrowding of an area causes visual pollution. Visual pollution is defined as the whole of irregular formations, which are mostly found in natural and built environments.

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CHAPTER-III

BIODIVERSITY

CHAPTER - III

BIODIVERSITY OF KERALA

Introduction

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. The convention on biodiversity has defined it more precisely as the variability among living organisms from all sources including, INTER ALIA, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part, this includes diversity within species, between species and of ecosystems. Over the ages, human race used plants and animals as icons to establish cultural identity. The aesthetic value of biodiversity is better realized and it could not be valued ideally with the current economic valuation models. Of late, biodiversity is more reckoned for its unbelievable potential for supplying novel genes for a variety of applications in biotechnology and pharmacology.

Biodiversity of any given area being a function of precipitation, temperature, soils, altitude etc, its distribution across the globe is quite uneven. For instance, terrestrial biodiversity is as much as 25 times higher than marine biodiversity. Within the terrestrial habitats, tropics are found to support much richer biodiversity than alpine or polar regions. India is considered very rich in biodiversity. It is estimated that about 1/6th plant species of entire world belong to India. An area with a high concentration of endemic species is called a “hot spot”. Out of the twelve hot spots of the world, two (North East and Western Ghats areas) are in India.

The enormity and intensity of these efforts notwithstanding, there is hardly any room for complacency. Increase in population, urbanization, industrialization etc are often at the cost of destruction of habitats. The forces of development and that of

conservation apparently boarders arial relationships although this true only in the short term and both have commonalities in the long term. Rapid development at the cost of environmental degradation is doomed to be unsustainable. The country is endeavoring to balance the two.

Preventing a loss of biodiversity is important for mankind, given that humans depend on the natural richness of the planet for the food, energy, raw materials, clean air and clean water that make life possible and drive economies and societies. As such, are deduction or loss of biodiversity may not only undermine the natural environment but also economic and social goals. The challenges associated with preserving biodiversity have mad e this topic an international issue.

Biodiversity of Kerala

Kerala State is having rich biodiversity with different type of unique ecosystems viz, forest ecosystem, Wetland ecosystem, Mangrove ecosystem, marine ecosystem, etc. The biodiversity conservation areas are tropical forests, endemic centres, florist hotspots and genetic resources of economic plants. Biodiversity occurring in plants, animals and micro-organisms of economic value is now referred to as Agro biodiversity. Kerala sprawled an area of 38863 sq.km. has a flora of 10,035 species – 22% of the Indian Flora. The flora of Kerala supports Tropical Rain Forests, Tropical Moist Deciduous Forests, Tropical Dry Deciduous Forests, Shola Forests and Riparian Forests. The other vegetarian types are Mangroves and Myristica Swamps. Kerala's three floristic hotspots are :

- Agastha Malai
- Anamalai High Ranges
- Silent Valley – Wayanad

Western Ghats

The Western Ghats constitute the range of hills running almost parallel of Arabian Sea through Kerala, Tamil Nadu, Karnataka, Goa, and Maharashtra. Of the total length of about 1800 km., approximately 450 km falls in Kerala, with a break at Palaghat. The Western Ghats region of Kerala covering nearly 21856 sq km or 56% of the total geographical area of the State and 42.7% of the entire Western Ghats region is the watershed of all the 44 rivers that sustain the agro-economy of the state. Kerala sub region has population limit of 382 persons per km sq, against the national figure of 221. It was the treasure house of forest and mineral resources and controlled the soil water regimes. It possessed the most luxuriant tropical moist vegetation in the country comparable to any similar type of vegetation in the world. The phenomenal spurt in the population, demand for more and more forest land, for non forestry purposes coupled with indifferent attitude of those in authority led to the shrinkage of the forests to less than 20% of the land area. Fire, gazing, excessive and unscientific felling etc, also resulted in the degradation of forests.

Medicinal Plants constitute an important component of the plant resource spectrum of Kerala. Recent analysis shows that out of 4600 flowering plants estimated in Kerala, about 900 possess medicinal values. Of these, 540 species are reported to occur in forest ecosystems. Over 150 species of plants that are either indigenous or naturalized in Kerala are used in the Indian system of Medicine like Ayurveda and Sidha. The rural folk and tribal communities make use of about 2,000 species of lesser-known wild plants for various medicinal uses. About 60 to 65% of plants required for Ayurvedic medicine and almost 80% of plants used in Sidha medicine are found in the forests of Kerala. The major medicinal plants obtained from the forests of Kerala are Asparagus racemosus, Solanum anguivi, Desmodium gangeticum, Cissus quadrangularis, Psuedartheria viscida, Strobilanthes ciliatus, Dysoxylum malabaricum, Piper longum, Aristolochia indica, Ceasalpinia bonduc, Tribulus terrestris, Sarcostemma acidum, Baliospermum montanum, Aristolochia bracteolata etc.

There are about 1272 species of endemic angiosperms out of 3800 species occurring in Kerala, which is 33.5% of its flora. Out of 5725 endemics in India, endemics of Kerala constitute 22.6% of Indian endemics. The endemic flora in Kerala is mainly palateo tropic in composition, which is a part of the peninsular Indian endemic flora of Gondwana land origin. Though there are common elements, the characteristic endemic flora of Kerala and Sri Lanka was developed from a common stock, but isolated due to temporal or geographical barriers. The hill top flora of Nilgiris, Palani and Cardamom hills in peninsular India and Adam's Peak in Sri Lanka show similarities, which indicate that they are derived from a common stock. Three 'hot spots' of endemic centres in Kerala are: Agasthyamala, Anamalai- high ranges and Silent Valley- Wayanad. There are about 189 endemic plant species reported from Agasthyamala and they occur in small populations over narrow ranges. The recent surveys have resulted in the discovery of 35 new species of plants from this small stretch of forests.

The endemic genera of Anamalai and High Ranges are *Haplothismia, Pseudoglochidion* and *Utleria*. The species which are critically endangered or probably extinct are *Anaphalis barnesii, Begonia aliciae, Didymocarpus macrostachya, Habenaria flabelliformis, Impatiens anaimudica, I. johnii, I. macrocarpa, I. platyadena, I. verecunda, Ophiorrhiza barnesii, O. caudata, O. munnarensis and Sonerila nemakadensis*.

Flora

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

Table : 3.1 Flora Statistics: Kerala and India

Category	Kerala	India	% to the Indian Flora
Flowering Plants	4500	17500	25.71
Gymnosperms	4	64	6.25
Pteridophytes	236	1100	21.45
Bryophytes	350	2850	12.28
Lichens	520	2000	26.00
Algae	325	6500	5.00
Fungi	4800	14500	33.10

Source: Forest Statistics 2012-13

Fauna

Animals associated with sacred groves are of two categories, those which inhabit the groves and those which visit them. Snakes of different categories, frogs, lizards, millipedes, termites, ants, earth worms, and snails form a very important component of the sacred grove ecosystem. Termites, ants and earth worms play an important role in the make up of the soil. Many birds like crows, kites, owls, herons, mynas, parrots, humming birds, etc. nest in these sacred groves. Bats, humming birds and insects like mosquitoes, wasps, honey-bees, butterflies and beetles seem to be closely connected with pollination mechanism of various plants. Monkeys, most of the birds, rodents like rats, mice, bandicoots, squirrels, mongoose, hares which are also inhabitants of these sacred groves help the plants in dispersal of seeds and fruits.

As an ecosystem, sacred groves help in soil and water conservation besides preserving biological wealth. The ponds and streams usually adjoining the groves are perennial water sources. Many animals and birds resort to them for their water requirements during summer. These groves are good repositories of humus, which is formed by litter decomposition. The nutrients generated in the groves find their way into

the adjoining agro eco systems like paddy fields, tapioca and rubber plantations. The floral diversity of these groves is very high.

Table : 3.2 Fauna statistics: World, India and Kerala

	World	India	Kerala
Fishes	31000 (1)	2439 (1)	196 (2)
Amphibians	6184 (3)	277 (4)	117 (2)
Reptiles	8734 (5)	408 (3)	159 (2)
Birds	9782 (6)	1179 (7)	484 (8)
Mammals	5416 (9)	410 (3)	145 (2)

Source: Forest Statistics 2012-13

Forest

In Kerala, wet evergreen forests are mostly confined to the windward side of the WG, where the rainfall is above 2000mm. The distribution patterns of certain characteristic species, which reflect the climatic variations, the forests are further subdivided into eight main floristic types and three facies. All these types are classified according to low (0-800m), medium (800-1450m) and high (1400-1800m). The medium elevation forests in some places may appear at lower elevation (650 m) due to local variations in the moisture and exposure.

Table : 3.3 Forest Area

Total Forest Area	11309.5032 Sq.Km
Percentage of forest area to the total area of the state	29.101 %
Reserved Forests	9107.2006 Sq.Km
Proposed Reserve	364.5009 Sq.Km
Vested Forests & Ecologically Fragile Lands	1837.7957 Sq.Km
TOTAL	**11309.5032 Sq.Km**

Source: Forest Statistics 2012-13

Forest is a type of Habitat or Biome which has high density of Trees. The Forest is in fact a complex ecosystem with distinct inter relationships of non living organisms (the plants, animals, micro-organisms) and the non-living, inorganic or abiotic part (soil, climate, water, organic debris, rocks) of an environment. Forests can develop wherever there is an average temperature greater than about 10° C in the warmest month and an annual rainfall in excess of about 200 mm annually. Forests houses over two-thirds of known terrestrial Species of the World. There are various type of Forests of which the Tropical Rainforests are located at latitudes of 10° north and south of the Equator and the latitudes between 53°N and 67°N have Boreal Forests. Over 30% of the Earth's surface is covered with Forests in modern times where as once they covered 50% of total surface of the World. This has happened mainly because of Deforestation caused by Human need for wood, food, housing etc.

Table : 3.4 Classification of forest types of Kerala

Sl.No	Type Area	(Km_2)	% 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	391.363 6	3.46
Montane Sub-tropical			
4	Temperate shoals	386.4210	3.42
5	Plantations	1523.0999	13.47
6	Grass Lands	501.0865	4.43
7	Others	1014.0791	8.97
	Total	**11309.4754**	

Source: Forest Statistics 2012-13

Table : 3.5 Geographical area of forest types in Kerala

Sl. No.	Category	Number	Total Sq.km
1	Biosphere Reserve	2	3283.4
2	Community Reserve	1	1.5
3	National Parks	5	208.155
4	Wildlife Sancturies	16	2466.542
5	Reserved Forests	NA	9471.6215
6	Protected Forests	NA	1837.7957

Source: Forest Statistics 2012-13

The forest cover of the state based on interpretation of satellite data of December 2004 and February 2005 is 15595 sq.km, which is 40.13% of the geographic area. Very dense forest 1024 sq.km, moderately dense forest 8636 sq.km and open forest 5935 sq.km. As on Dec 2006 to March 2007, the forest cover in the state is 17324 sq.km, which is 44.58% of the total geographic area. The forest Area (km2) in Kerala during 2005 to 2013 is given below.

Table : 3.6 Forest Cover In Kerala

Year	Forest Cover (Sq.Km)
2005	15595
2007	17324
2009	17324
2011	17300
2013	13407

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Table : 3.7 Comparative Situation of Forest Cover In Kerala

Sl.No	District	Assessment (Km^2)				Change in (Km^2)			
		2010	2011	2012	2013	2010	2011	2012	2013
1	Thiruvananthapuram	1350	1349	1349	1316	0	-1	0	-33
2	Kollam	1337	1330	1330	1395	0	-7	0	65
3	Pathanamthitta	1758	1755	1755	1754	0	-3	0	-1
4	Alappuzha	38	38	38	113	0	0	0	75
5	Kottayam	895	889	889	890	0	-6	0	1
6	Idukki	3932	3930	3930	3852	0	-2	0	-78
7	Ernakulam	696	695	695	698	0	-1	0	3
8	Thrissur	933	931	931	1068	0	-2	0	137
9	Palakkadu	1575	1575	1575	1628	0	0	0	53
10	Malappuram	1211	1209	1209	1255	0	-2	0	46
11	Kozhikode	591	591	591	690	0	0	0	99
12	Wayanadu	1775	1775	1775	1776	0	0	0	1
13	Kannur	641	641	641	866	0	0	0	225
14	Kasargod	592	592	592	621	0	0	0	29
	TOTAL	**17324**	**17300**	**17310**	**17922**	**0**	**-24**	**0**	**622**

Source : Forest Statistics 2012-13

Table : 3.8 District Wise Forest Area in Km^2

Sl. No.	District	Geographic Area	Reserved Forest Area	Protected Forest	Unclassed Forest	Total Forest Area
1	Thiruvananthapuram	2192	460.1831	3.651	NA	463.8341
2	Kollam	2491	827.875	12.6922	NA	840.5672
3	Pathanamthitta	2642	1532.2257	1.568	NA	1533.7937
4	Alappuzha	1414	0	45	86	113
5	Kottayam	2203	100.845	0	NA	100.845
6	Idukki	5019	2679.072	34.6506	NA	2713.7226
7	Ernakulam	2407	823.8302	0	NA	823.8302
8	Thrissur	3032	1018.438	4.3137	NA	1022.7517
9	Palakkadu	4480	860.2	667.1564	NA	1527.3564
10	Malappuram	3550	325.3261	398.592	NA	723.9181
11	Kozhikode	2344	47.3658	243.0856	NA	290.4514
12	Wayanadu	2131	566.511	340.5337	NA	907.0447
13	Kannur	2966	143.7275	97.8442	NA	241.5716
14	Kasaragod	1992	86.0221	33.7083	NA	119.7304
TOTAL		**38863**	**9471.6215**	**1837.7957**	**0**	**11309.4172**

Source : Forest Statistics 2012-13

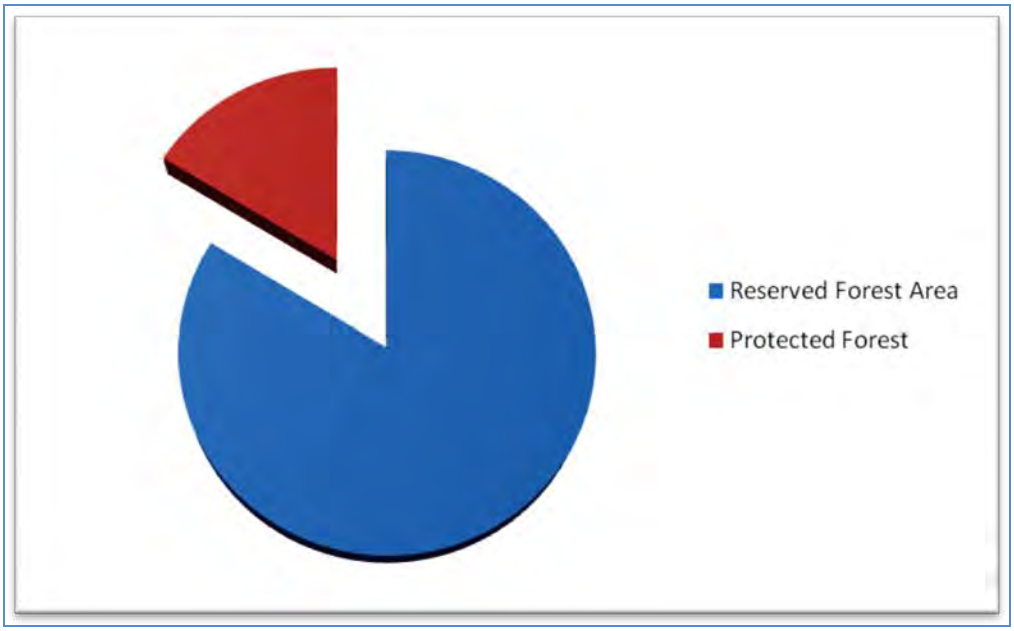


Table : 3.9 Diversion of Forest Land for non-forest use since the enforcement of forest (in Ha)

Sl.No.	Year	Forest Area Diverted	Cumulative Area Diverted
1	2010	0.00702	0.00702
2	2011	8.8704	8.87742
3	2012	20.0229	28.90032
4	2013	1.19884	30.09916

Table: 3.10 Current protected area status

Sl.No	Type	Number	Area in Km2
1	National Parks	5	356.155
2	Wildlife sanctuaries	17	2855.5822
3	Community Reserve	1	1.5
Total			**3213.24**

Source : Kerala Forest & Wildlife Department

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 and Ceriops tagal, Heritiera littoralis and Flagellaria indica have discourteous distribution.

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 have 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.

Table : 3.11 List of Biosphere Reserve

Sl. No.	Biosphere Reserve	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 ➢ Shendurney wildlife sanctuaries ➢ Achencoil ➢ Thenmala ➢ Konni ➢ Punalur ➢ Thiruvananthapuram territorial divisions and ➢ Agasthyavanam Biological Park Range.

Source : Kerala Forest & Wildlife Department

Table : 3.12 Community Reserve

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

Source : Kerala Forest & Wildlife Department

Table : 3.13 National Parks and Wildlife Sanctuaries at Kerala

Sl. No	Name of District	National Parks		Wild Life Sanctuaries		Total Area (km^2)
		Number	Area (km^2)	Number	Area (km^2)	
1	Idukki	4	118.635	4	1117.44	1236.075
2	Palakkad	1	89.52	2	288.42	377.94
3	Thiruvananthapuram	0	0	2	181	181
4	Kollam	0	0	1	171	171
5	Ernakulam	0	0	2	25.027	25.027
6	Thrissur	0	0	2	210	210
7	Kozhikode	0	0	1	74.215	74.215
8	Wayanadu	0	0	1	344.44	344.44
9	Kannur	0	0	1	55	55

Source : Kerala Forest & Wildlife Department

Table : 3.14 Wild Life Sancturies and National Parks in Kerala

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

Source : Kerala Forest & Wildlife Department

Table :3.15 Area of Tiger Reserves in Kerala

Sl. No.	Year of Creation	Name of Tiger Reserve	Area of core/critical tigher habitat	Area of the buffer/peripheral	Total area
1	1978-79	Periyar	881	44	925
2	2008-09	Parambikulam	390.89	252.77	643.66

Source: Compendium of Environment Statistics INDIA 2013

Table : 3.16 Elephant Census in Kerala

Sl. No	Item	2005	2007	2010	2012
1	No. of Elephants	5135	6068	6026	6177
2	Male Female Ratio	1:3.38	1:2.69	1:2.71	1:1.68

Source: Forest Statistics 2013

Table : 3.17 Location of Major Zoos in Kerala

Sl.No	Name of Zoo	District
1	State Museum & Zoo	Thrissur
2	Thiruvananthapuram Zoo	Thiruvananthapuram

Source: Compendium of Environment Statistics INDIA 2013

Plant Biodiversity

Plant biodiversity as a national and global resource is extremely valuable but is poorly under stood, inadequately document and often wasted. The preservation of biodiversity is both a matter of investment and insurance to sustain and improve agricultural, forestry and fisheries production, act as a buffer against harmful environmental changes, provide raw materials for scientific and industrial innovations and safeguard transferring biological richness to future generations.

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. The convention on biodiversity has defined it more precisely as the variability among living organisms from all sources including, INTER ALIA, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part, this includes diversity within species, between species and of eco systems. The aesthetic value of biodiversity is better realised and it could not be valued ideally with the current economic valuation models.

The Convention on Biological Diversity, of which India is a signatory, advocates that every country has the responsibility to conserve, restore and sustainable use the biological diversity within its jurisdiction. Further, the human species has the moral responsibility to ensure the survival of other living beings in the biosphere and conserve them for the benefit of future generations. In fact, conservation ethoses are interwoven in the cultural, spiritual and religious background of India, even though not fully practiced at present. Kerala state is having rich biodiversity with different types of unique ecosystems viz. Forest ecosystem, Wetland ecosystem, Mangrove ecosystem, Marine ecosystem etc.

Table: 3.18 Division wise area of Plantation (category-wise) as on 31.03.2013(Area in ha)

Sl. No	Division	Hard Wood	Soft Wood	Others	Bamboo, Cane and Reeds	Mangroves	Total
1	Thiruvananthapuram	3855.293	294.776	1098.205	205.7	0	5453.974
2	Thenmala	2505.82	465.81	574.71	0	0	3546.34
3	Punalur	3591.588	663.4	1269.806	176.35	0	5701.144
4	Achenkovil	2870.372	0	1694.342	794.971	0	5359.685
5	Ranni	3980.49	0	2806.381	588.672	0	7375.543
6	Konni	8374.084	32.48	408.18	912.9	0	9727.644
7	Kottayam	4123.455	213.8	2267.15	305.585	0	6909.99
8	Munnar	790.524	4399.2	1237.21	579.36	0	7006.294
9	Kothamangalam	4756.065	304.04	1140.987	220.85	0	6421.942
10	Marayoor	100	821.34	152.5	90.8	0	1164.64
11	Mankulam	42.25	117.6	314.63	135.25	0	609.73
12	Malayattoor	5959.1	493.123	190.065	79.1	0	6721.388
13	Vazhachal	3933.87	479.51	2738.64	306.24	0	7458.26
14	Chalakkudy	4401.88	107.8	1087.27	38.6	0	5635.55
15	Thrissur	2688.191	458.15	4375.713	696.86	0	8218.914
16	TS Perumbavoor	61.49	0	0	0	0	61.49
17	Nenmara	1397.456	146.54	1550.078	247.79	0	3341.864
18	Palakkad	1908.8	108.82	1354.9	173.43	0	3545.95
19	Mannarkkad	569.11	143.92	328.98	35	0	1077.01
20	Nilambur (South)	4603.767	0	436.32	0	0	5040.087
21	Nilambur (North)	4296.06	41.509	471.58	973.17	0	5782.319
22	Kozhikkode	308.83	1074.132	765.84	82.6	5	2236.402
23	Wayanad (South)	2599.43	624.64	1322.41	73.88	0	4620.36
24	Wayanad (North)	1014.79	496.05	2865.61	351.6	0	4728.05
25	Kannur	1179.256	0	1945.152	467.212	0	3591.62
26	Kasaragod	816.609	20	4194.363	587.003	361.289	5979.264
26	Wildlife Thiruvananthapuram	101.08	140.54	997.073	1140.688	0	2379.381
27	Wildlife Peechi	658.917	6.9	1177.007	165	0	2007.824
28	Wildlife Parambikulam	8747.466	0	0	0	0	8747.466
29	Wildlife Silent valley	482.3	57.89	94	0	0	634.19
30	Wildlife Wayanad	7486.802	429.67	2987.899	0	0	10904.371
31	Wildlife Aralam	291.3	0	30	0	0	321.3
	Total	**88496.445**	**12141.64**	**41877**	**9428.611**	**366.289**	**152309.986**

Source : Forest Statistics 2012-13

Table : 3.19 Out turn of Major Forest Produce

Sl. No.	Item	Unit	Quantity
1	Sawn and squared Timber	M3	25.095
2	Poles	Nos	78513
3	Firewood	MT	11439.777
4	Sandal Wood	Kg	58269.07
5	Bamboo	MT	19006.387
6	Reeds	MT	3366.244
7	Jungle Wood Poles	Nos	13324

Source : Forest Statistics 2012-13

Table : 3.20 Procurement of Minor Forest Produce

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

Source : Forest Statistics 2012-13

Status of Plant Species in Kerala

Kerala constitutes only 1.18% of the geographical area of India but it accommodates 28.41% of the flowering plants occurring in the country. Herbs constitute 50.1%, shrubs 15.8 % and trees 15.08% of the total flowering plant species of the state. About 5094 taxa under 1537 genera and 221 families of flowering plants are distributed in Kerala (Sasidharan, 2012). A total of 1709 taxa that are endemic to Peninsular India are found in Kerala; of which 237 species distributed in 47 families are exclusively endemic to Kerala (Nayar et al., 2008). flowering plants of Kerala include 858 exotics that have been introduced as agriculture, forestry as well as accidentally entered species (Sasidharan, 2012); of which around 200 species have become naturalised in the state. Gymnosperms are represented by just 5 species belonging to 3 genera. The state also harbours 337 species of pteridophytes (Easa, 2003), and 465 taxa of bryophytes (Manju et al., 2008). From Kerala 866 species of Algae , 4800 species of Fungi and 520 species of Lichens are reported. (Jayaraman et al, 2008).

Table : 3.21 The distribution of Plantaion Area of Species

Sl. No.	Plantation	Area(ha)	%
1	Hardwood	88496.445	58.103
2	Softwood	12141.640	7.972
3	Others	41877.001	27.495
4	Bamboo, Cane & Reeds	9428.611	6.190
5	Mangrove	366.289	0.240
	Total	**152309.986**	

Source : Forest Statistics 2012-13

Table : 3.22 Plant species at risk and threatened in endangered category

Sl. No.	Category	Approximate Number
1	**2**	**3**
1	Rare	287
2	Vulnerable	167
3	Endangered	1366
4	Possibly Extinct	40
5	Extinct	28

INDIA		
Status	**India**	**Kerala**
Extinct (EX)	380	19
Extinct/Endangered (EX/E)	371	41
Endangered (E)	6522	152
Vulnerable (V)	7951	102
Rare (R)	14505	251
Indeterminate (I)	4070	690
Total under threat	33418	1236
Total number of species	242013	16000
Percentage under threat	13.8	7.7

Source : Botanical Survey of India, Kolkata.

Table : 3.23 Marine Fishing Villages in Kerala 2012-13

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

Source: Fisheries Department

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

Source: Fisheries Department

Table : 3.24 Inland Villages in Kerala 2012-13

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

Source: Fisheries Department

Table : 3.25 District wise Fish Production in Kerala 2012-13

Sl. No	District	Marine	Inland	Total
1	Thiruvananthapuram	42241	2720	44961
2	Kollam	107816	16787	124603
3	Pathanamthitta	0	1640	1640
4	Alappuzha	120965	20290	141255
5	Kottayam	0	6865	6865
6	Idukki	0	979	979
7	Ernakulam	52026	35038	87064
8	Thrissur	62386	18621	81007
9	Palakkadu	0	16156	16156
10	Malappuram	26105	2778	28883
11	Kozhikode	80375	3905	84280
12	Wayanadu	0	813	813
13	Kannur	22444	2601	25045
14	Kasaragod	16280	19905	36185
	Total	**530638**	**149098**	**679736**

Source: Fisheries Department

Table: 3.26 Year wise Fish Production in Kerala upto 2012-13

Sl. No.	Year	Marine	Inland	Total
1	2007-08	100319	91085	191404
2	2008-09	100780	102842	203622
3	2009-10	107293	116836	224129
4	2010-11	124615	121215	245830
5	2011-12	155714	140031	295745
6	2012-13	166399	149098	315497

Source: Fisheries Department

Table: 3.27 Inland Fishery Resources of Kerala 2012-13

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

Source: Fisheries Department

Table : 3.28 Marine Fishery Resources of Kerala 2012-13

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

Source: Fisheries Department

Table : 3.29 Livestock population as per 2012 Census

Sl. No.	District	Cattle			Buffaloes	Sheep	Goats	Pigs		
		Cross bred	Indigenous	Total				Cross bred	Indigenous	Total
1	Alappuzha	75301	620	75921	5973	0	55158	468	122	590
2	Ernakulam	102107	4675	106782	12777	50	123538	4655	740	5395
3	Idukki	82933	7141	90074	5690	23	308503	10631	1065	11696
4	Kannur	52298	1483	99781	813	3	56445	4340	323	4663
5	Kasargod	52020	30678	82698	1280	10	33757	2615	326	2941
6	Kollam	100910	1369	102279	5792	9	11342	959	10	969
7	kottayam	80786	894	81680	6141	9	94297	6383	1108	7491
8	Kozhikkode	96073	8658	104731	4343	12	43962	2672	176	2848
9	Malappuram	77928	2619	80547	19855	9	137718	931	38	969
10	Palakkad	153567	12337	165904	9191	1157	113031	3749	389	4138
11	Pathanamthita	63783	551	64334	2846	18	51066	623	133	756
12	Thiruvanan-thapuram	97679	793	98472	3752	31	163980	2350	262	2612
13	Thrissur	99882	2865	102747	18650	94	128130	7000	137	7137
14	Wayanad	70315	2362	72677	5166	21	35150	3441	136	3527
	Total	**1251582**	**77045**	**1328627**	**102269**	**1446**	**1246077**	**5817**	**4965**	**55782**

Source: Animal Husbandry

Table : 3.30 Details of Backyard Poultry in Rural and Urban Combined for Fowls 2012-13

Sl. No.	District	Fowls					
		Cocks			Hens		
		Desi	Improved	Total	Desi	Improved	Total
1	Alappuzha	24268	42746	67014	105114	224934	330048
2	Ernakulam	59346	65505	124851	200072	252536	452608
3	Idukki	20454	35805	56259	60848	130924	191772
4	Kannur	16982	79379	96361	49130	272038	321168
5	Kasargod	47758	31297	79055	81606	100186	181792
6	Kollam	8556	78278	86834	33645	399396	433041
7	kottayam	22237	54658	76895	91576	277206	368782
8	Kozhikkode	61933	69614	131547	200904	220798	421702
9	Malappuram	167863	105064	272927	470260	271929	742189
10	Palakkad	121914	59636	181550	255865	140192	396057
11	Pathanamthitta	16207	37895	54102	74620	200971	275591
12	Thiruvananthapuram	84729	105399	190128	268979	350323	619302
13	Thrissur	97573	46584	144157	328515	165524	494039
14	Wayanad	12162	29496	41658	36783	105341	142124
	Total	**761982**	**841356**	**1603338**	**2257917**	**3112298**	**5370215**

Source: Animal Husbandry

Table : 3.31 Number of Equipments used in Livestock sector Rural and Urban combined 2012-13

Sl. No	District	Milking Machine	Mechanised Folder Cutter	Chopper & Baler	Dung Collection& Disposal Equipment
1	Alappuzha	154	14	251	12
2	Ernakulam	168	70	7	6
3	Idukki	72	41	0	2
4	Kannur	74	19	3	4
5	Kasargod	57	73	6	10
6	Kollam	177	28	2	37
7	kottayam	117	46	3	4306
8	Kozhikkode	92	18	0	8
9	Malappuram	74	22	3201	12
10	Palakkad	145	337	13	173
11	Pathanamthitta	79	10	0	3
12	Thiruvananthapuram	147	21	8201	41
13	Thrissur	230	97	10	43
14	Wayanad	91	32	3	5
	Total	**1677**	**828**	**11700**	**4662**

Source: Animal Husbandry

Table : 3.32 Details of Backyard Poultry in Rural and Urban Combined for Fowls under Chickens below 5 Months

Sl. No.	District	Fowls			Total Fowls
		Chickens below 5 Months			
		Desi	Improved	Total	
1	Alappuzha	21624	57924	79548	476610
2	Ernakulam	53740	219306	273046	850505
3	Idu kki	14434	33550	47984	296015
4	Kannur	9255	82442	91697	509226
5	Kasargod	38233	61247	9948	360327
6	Kollam	12157	129754	141911	661786
7	kottayam	18847	59945	78792	524469
8	Kozhikkode	59721	90637	150358	703607
9	Malappuram	191257	130800	322057	1337173
10	Palakkad	140289	81017	221306	798913
11	Pathanamthitta	14966	45665	60631	390324
12	Thiruvananthapuram	74850	128193	203043	1012473
13	Thrissur	127081	109820	236901	875097
14	Wayanad	9555	30887	40442	224224
	Total	**786009**	**1261187**	**2047196**	**9020749**

Source: Animal Husbandry

Table : 3.33 Details of Backyard Poultry in Rural and Urban Combined for Ducks 2012-13

Sl. No.	District	Ducks					
		Drakes			Ducks		
		Desi	Improved	Total	Desi	Improved	Total
1	Alappuzha	10791	8921	19712	59796	54882	114678
2	Ernakulam	9737	8254	17991	37199	31010	68209
3	Idu kki	2368	4603	6971	5863	10593	16456
4	Kannur	598	2645	3243	1552	5074	6626
5	Kasargod	1016	756	1772	1746	1493	3239
6	Kollam	3910	15775	19685	18525	65477	84002
7	kottayam	4333	22296	26629	22390	38405	60795
8	Kozhikkode	4349	4002	8351	8364	7987	16351
9	Malappuram	18342	8496	26838	35471	16323	51794
10	Palakkad	5442	2414	7856	10370	4764	15134
11	Pathanamthitta	9475	8696	18171	97161	19015	116176
12	Thiruvananthapuram	8106	11130	19236	17053	24777	41830
13	Thrissur	8503	4792	13295	25242	13348	38590
14	Wayanad	1341	2615	3956	3125	5506	8631
	Total	**88311**	**105395**	**193706**	**343857**	**298654**	**642511**

Source: Animal Husbandry

Table : 3.34 Detail of Dogs, Rabbits and Elephants in Rural and Urban Combined State Kerala 2012-13

Sl. No.	District	Dogs			Rabbits			Elephant		
		Male	Female	Total	Male	Female	Total	Male	Female	Total
1	Alappuzha	53833	17230	71063	4311	7643	11954	21	3	24
2	Ernakulam	75974	24431	100405	7467	15091	22558	29	7	36
3	Idu kki	45076	15971	61047	12277	27420	39697	10	4	14
4	Kannur	35127	12770	47897	2897	5629	8526	7	0	7
5	Kasargod	31941	8178	40119	1271	2238	3509	0	0	0
6	Kollam	72115	14940	87055	4542	8146	12688	60	10	70
7	kottayam	57076	20788	77864	7712	16394	24106	119	16	135
8	Kozhikkode	24211	8076	32287	3690	6875	10565	41	13	54
9	Malappuram	15734	4417	20151	7355	17074	24429	23	9	32
10	Palakkad	55798	13755	69553	2637	4095	6732	64	2	66
11	Pathanamthitta	51642	14106	65748	2832	5976	8808	29	6	35
12	Thiruvananthapuram	122010	21158	143168	8285	15044	23329	42	20	62
13	Thrissur	58351	22993	81344	6725	13119	19844	166	9	175
14	Wayanad	19011	6647	25658	4249	9556	13805	3	3	6
	Total	**717899**	**205460**	**923359**	**76250**	**154300**	**230550**	**614**	**102**	**716**

Source: Animal Husbandry

Table : 3.35 Number of Non Households Enterprises and Institutions Owning Animals/Poultry Birds in Rural and Urban Combined 2012-13

Sl.No.	District	Number of Non Households Enterprises and Institutions Having					
		Cattle	Buffaloes	Goats	Sheep	Pigs	Poultry Farm & Hatcheries
1	Alappuzha	123	8	19	0	65	12450
2	Ernakulam	248	51	32	1	53	425
3	Idu kki	114	9	12	0	33	196
4	Kannur	91	6	8	0	15	2079
5	Kasargod	18	5	8	0	9	105
6	Kollam	55	5	14	0	4	85
7	kottayam	179	23	11	0	37	150
8	Kozhikkode	43	6	3	0	3	28
9	Malappuram	13	0	1	0	1	61
10	Palakkad	57	21	10	0	10	234
11	Pathanamthitta	19	5	7	1	3	47
12	Thiruvananthapuram	109	8	19	1	43	256
13	Thrissur	311	47	43	3	49	808
14	Wayanad	108	13	22	1	20	56
	Total	**1488**	**207**	**209**	**7**	**345**	**16980**

Source: 2012 Livestock Census

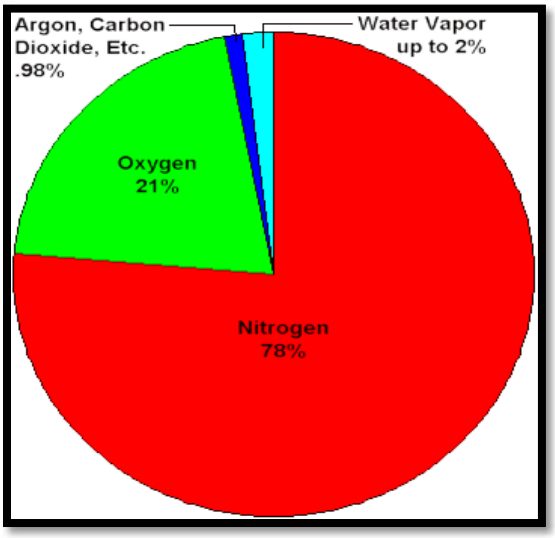
Table : 3.36 No.of Cattle, Buffaloes, Sheep, Goats and Pigs per Thousand households in Rural and Urban combined 2012-13

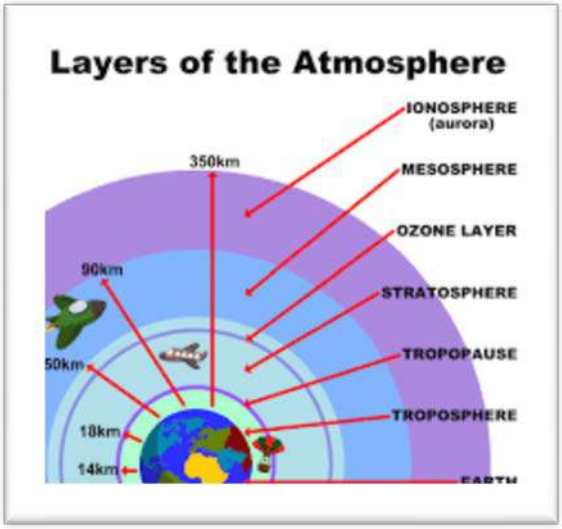
Sl. No.	District	No.of Households	Number of animals per 1000 Households				
			Cattle	Buffaloes	Sheep	Goats	Pigs
1	Alappuzha	592956	128	10	0	93	1
2	Ernakulam	930154	115	14	0	133	6
3	Idukki	334272	269	17	0	295	35
4	Kannur	6 36023	157	1	0	89	7
5	Kasargod	306674	270	4	0	110	10
6	Kollam	747227	137	8	0	149	1
7	kottayam	541538	151	11	0	174	14
8	Kozhikkode	743959	141	6	0	59	4
9	Malappuram	897730	90	22	0	153	1
10	Palakkad	706123	235	13	2	160	6
11	Pathanamthitta	361055	178	8	0	141	2
12	Thiruvananthapuram	965258	102	4	0	170	3
13	Thrissur	855483	120	22	0	150	8
14	Wayanad	220702	329	23	0	159	16
	Total	**8839154**	**150**	**12**	**0**	**141**	**6**

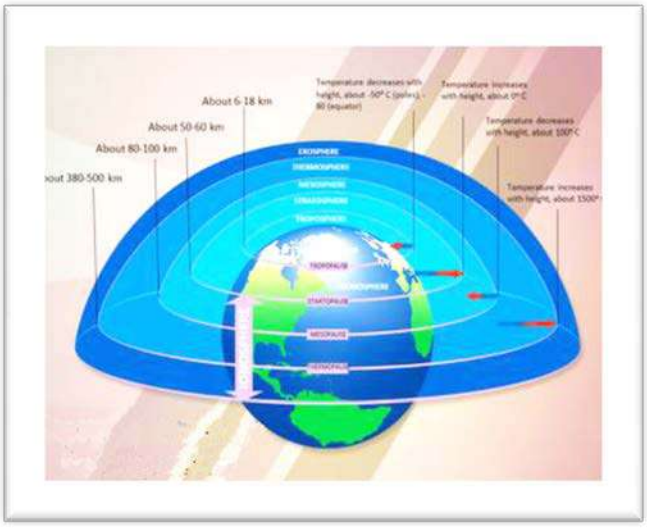
Source: 2012 Livestock Census

CHAPTER-IV

ATMOSPHERE







CHAPTER - IV

ATMOSPHERE

Atmosphere is a mixture of nitrogen (78%), oxygen (21%), and other gases (1%) that surrounds Earth. High above the planet, the atmosphere becomes thinner until it gradually reaches space. It is divided into five layers. Most of the weather and clouds are found in the first layer. The atmosphere is an important part makes Earth livable and it blocks some of the Sun's dangerous rays from reaching Earth. It protects heat, making Earth a comfortable temperature. And the oxygen within our atmosphere is essential for life.

Layers of the Earth's Atmosphere

The atmosphere is divided into five layers. It is thickest near the surface and thins out with height until it eventually merges with space.

1) The troposphere is the first layer above the surface and contains half of the Earth's atmosphere. Weather occurs in this layer.
2) Many jet aircrafts fly in the stratosphere because it is very stable. Also, the ozone layer absorbs harmful rays from the Sun.
3) Meteors or rock fragments burn up in the mesosphere.
4) The thermosphere is a layer with auroras. It is also where the space shuttle orbits.
5) The atmosphere merges into space in the extremely thin exosphere. This is the upper limit of our atmosphere.

Climate

The climate of Kerala, as per Koppen's classification, is tropical monsoon with seasonally excessive rainfall and hot summer except over Thiruvananthapuram district, where the climates as tropical savana with seasonally dry and hot summer weather. The entire state is classified as one meteorological sub division for climatologically purposes. The year may be divided into four seasons. The period March to the end of May is the hot season. This is followed by Southwest Monsoon season that continues

till the beginning of October. From October to December is the Northeast Monsoon season and the two months January & February winter season. The climate is pleasant from September to February. Summer months March to May is uncomfortable due to high temperature and humidity. The State is extremely humid due to the existence of Arabian Sea in the west of it.

Wind

The winds over the State are seasonal only in the region of Palghat Gap where winds are predominantly from the east in the period from November to March and from west in the rest of the year. In other parts of the State flow of wind is mainly governed by differential heating of land and water mass together with mountain winds. Winds have westerly component during the day and easterly components during the night through the year. In general winds are quite strong during afternoons when the thermal circulation is best developed and weak during night.

Table : 4.1 Districtwise Wind Power Installed Capacity (Mw)

Sl.No	District	As on 31.12.2013
1	Thiruvananthapuram	
2	Kollam	
3	Pathanamthitta	
4	Alappuzha	
5	Kottayam	
6	Idukki	14.25MW
7	Ernakulam	
8	Thrissur	
9	Palakkadu	20.625MW
10	Malappuram	
11	Kozhikode	
12	Wayanadu	
13	Kannur	
14	Kasargod	

Source : ANERT

Humidity

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

Temperature

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

Table : 4.2 Monthly mean Relative Humidity of Observatories in Kerala – 2012-13

Sl. No.	Stations	Relative Humidity %	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR
1	Alappuzha	At 0830 hrs IST	85	86	92	91	92	89	87	88	83	82	81	85
		At 1730 hrs IST	78	83	88	87	87	83	80	77	75	71	68	71
2	Kozhikode City	At 0830 hrs IST	80	82	93	92	92	88	85	85	79	83	81	80
		At 1730 hrs IST	70	72	83	80	83	77	74	72	66	66	66	68
3	Kannur	At 0830 hrs IST	75	76	93	92	94	89	82	76	68	70	76	76
		At 1730 hrs IST	66	68	86	86	88	83	78	74	68	67	66	67
4	Karipur Airport	At 0830 hrs IST	79	80	88	90	90	85	82	77	68	74	76	77
		At 1730 hrs IST	68	69	79	79	79	74	74	67	56	58	56	62
5	Kochi AP (Naval Base)	At 0830 hrs IST	81	84	89	89	90	83	82	81	73	73	76	77
		At 1730 hrs IST	70	73	81	79	81	76	73	71	63	61	65	68
6	Punalur	At 0830 hrs IST	93	94	94	95	96	95	95	92	87	87	88	89
		At 1730 hrs IST	77	73	81	76	81	78	79	75	55	47	45	52
7	Kottayam	At 0830 hrs IST	88	89	93	94	93	92	89	89	83	84	83	88
		At 1730 hrs IST	67	69	76	76	81	74	75	71	64	55	59	59
8	CIAL Nedumbassery	At 0830 hrs IST	82	85	91	91	91	88	87	85	78	78	78	82
		At 1730 hrs IST	73	69	75	76	80	75	73	70	56	52	55	62
9	Trivandrum City	At 0830 hrs IST	81	84	87	88	86	85	86	85	82	83	82	82
		At 1730 hrs IST	72	72	75	75	78	74	77	75	69	64	60	69
10	Trivandrum AP	At 0830 hrs IST	76	79	83	84	82	81	78	76	76	77	74	73
		At 1730 hrs IST	71	72	77	78	79	74	73	71	69	66	62	67
11	Vellanikara	At 0830 hrs IST	79	84	90	90	92	89	80	78	67	62	68	71
		At 1730 hrs IST	67	70	82	78	81	76	73	68	53	47	51	61
12	Palakkad	At 0830 hrs IST	xx	xx	87	93	93	89	80	79	71	70	73	79
		At 1730 hrs IST	xx	xx	79	81	84	74	64	58	50	40	48	52

Source : Meteriological Department

Table :4.3 Monthly mean Maximum and Minimum Temperature of Observatories in Kerala, Year 2012-13

Sl. No.	Stations	Temperature (°C)	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR
1	Alappuzha	Maximum	33.0	32.3	30.4	30.0	29.3	30.3	31.8	31.7	32.7	32.5	32.4	33.0
		Minimum	24.3	25.6	24.3	23.8	23.2	23.8	24.3	23.8	23.4	23.2	23.6	25.4
2	Kozhikode City	Maximum	34.7	34.1	30.8	30.9	30.1	31.5	33.4	32.8	33.4	33.6	34.0	34.6
		Minimum	26.0	26.9	24.2	24.4	24.2	24.4	24.9	23.9	23.6	23.8	24.6	26.1
3	Kannur	Maximum	34.9	35.1	30.3	29.9	29.0	30.2	32.0	32.0	33.3	33.4	33.5	34.3
		Minimum	24.6	26.2	23.8	24.2	23.9	23.8	24.5	23.5	23.5	23.1	24.3	25.7
4	Karipur Airport	Maximum	33.2	32.5	29.8	29.4	28.7	30.2	31.7	31.9	33.0	32.9	33.5	33.8
		Minimum	24.9	25.8	23.4	23.2	22.8	22.9	23.2	23.0	22.4	22.8	23.5	25.1
5	Kochi AP (Naval Base)	Maximum	33.5	32.8	31.6	30.8	30.1	31.1	32.2	32.3	32.9	32.6	32.8	33.3
		Minimum	24.5	25.8	23.6	23.4	23.2	23.4	23.6	23.5	22.9	22.7	23.6	24.7
6	Punalur	Maximum	34.7	33.5	32.2	31.1	30.9	31.5	33.1	33.4	34.2	35.5	36.3	36.8
		Minimum	21.5	22.8	21.6	21.5	20.7	22.0	22.9	23.0	22.1	21.9	21.8	22.9
7	Kottayam	Maximum	34.2	33.3	31.4	30.7	29.9	31.0	32.3	32.3	33.3	33.9	34.5	35.1
		Minimum	23.8	25.2	23.6	23.4	23.2	23.4	23.4	23.0	22.4	22.1	22.9	24.2
8	CIAL Nedumbassery	Maximum	33.8	32.5	30.7	30.4	29.7	30.8	32.3	32.3	33.6	34.2	34.4	34.5
		Minimum	24.0	25.0	23.4	23.4	23.0	23.2	23.4	22.7	21.6	21.4	22.6	23.9
9	Trivandrum City	Maximum	33.7	32.3	31.6	31.3	31.0	31.7	32.1	31.9	32.2	32.7	33.4	33.8
		Minimum	25.2	25.6	24.4	24.3	23.9	24.3	24.2	23.7	23.5	22.8	23.0	24.8
10	Trivandrum AP	Maximum	32.8	32.0	31.1	30.3	30.5	31.0	31.4	31.6	31.5	31.2	31.8	32.9
		Minimum	25.2	25.7	24.5	23.8	23.7	24.1	24.2	23.8	23.5	22.7	23.0	24.4
11	Vellanikara	Maximum	34.9	32.8	30.1	29.9	29.3	30.4	32.2	32.4	32.9	34.2	34.6	35.4
		Minimum	24.8	25.3	23.8	23.7	23.0	23.3	23.5	22.7	23.2	22.3	23.2	24.4
12	Palakkad	Maximum	xx	xx	30.3	29.1	28.8	30.3	31.9	31.8	32.0	33.2	34.5	36.8
		Minimum	xx	xx	23.9	23.4	22.7	23.6	24.4	23.4	24.0	23.5	23.8	25.5

Source : Meteriological Department

Rainfall

The total annual rainfall in the State varies from 360 cm. over the extreme northern parts to about 180 cm. in the southern parts. The southwest monsoon (June-October) is the principal rainy season when the State receives about 70% of its annual rainfall. Monsoon rainfall as percentage of annual rainfall decreases from north to south and varies from 83 % in north most district of Kasaragode to 50% south most district of Thiruvananthapuram. Northeast monsoon rainfall as percentage of annual rainfall increases from north to south and varies from 9% in north district of Kasaragode to 27% in south most district of Thiruvananthapuram. The rainfall amount in the State decreases towards the south with decrease of height of Western Ghats. The southern most district of Thiruvananthapuram, where Western Ghats are nearest to the sea coast and its average height is also least in the State receives minimum amount of rainfall. The thunderstorm rains in the pre-monsoon months of April and May and that of monsoon months are locally known as 'EDAVAPATHI'. Rainfall during northeast monsoon season is known as 'THULAVARSHAM' in local language. The southwest monsoon sets-over the southern parts of the State by about 1 st June and extends over the entire State by 5th June. June and July are the rainiest months, each accounting individually to about 23% of annual rainfall.Monthly distribution of Normal and Actual rainfall of Kerala state for last ten years.

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

Table : 4.4 District wise Annual Average Rainfall 2012-13 (in mm)

Sl. No.	Name of District	Normal Rainfall (mm)	Actual Rainfall (mm)	% Departure
1	Alappuzha	2840.5	1883.1	-34
2	Kannur	3318.4	2732.4	-18
3	Ernakulam	3029.0	2663.1	-12
4	Idukki	3303.0	2611.3	-21
5	Kasargode	3619.7	3146.4	-13
6	Kollam	2491.1	1661.7	-33
7	Kottayam	2930.9	2344.0	-20
8	Kozhikkode	3384.1	3001.5	-11
9	Malappuram	2835.1	2018.9	-29
10	Palakkad	2288.1	1769.4	-23
11	Pathanamthitta	2956.7	1836.6	-38
12	Thiruvananthapuram	1803.0	1199.2	-33
13	Thrissur	3063.7	2418.0	-21
14	Wayanad	3250.7	1915.3	-41
	STATE AVERAGE	**2924.3**	**2234.1**	**-24**

Source : Agricultural Statistics, DES

Winter Season in Kerala

In Kerala the winter season starts when the northeast monsoons ends. That is from the month November till the middle of February. During this time, the temperature is less but it does not have much difference with the other seasons. The temperature remains cool constantly throughout the year in the highlands but the winter temperatures falls below 10°C. It is during this winter season that we receive some of the lowest amount of rainfall.

Average Temperature during Winter in Kerala:	Maximum: 28°C Minimum : 18°C
Average Rainfall during the season :	25 mm

Summer Season in Kerala

The temperature starts to increase with the end of February which indicates the beginning of summer in Kerala. The characteristics of summer in Kerala are relatively higher temperature, less rainfall and humid weather. The other Indian states have a temperature of about 40°C, whereas in Kerala it is comparatively cool and pleasant. It is mainly because of the presence of the Western ghats that prevents the northern wind from entering our state. The Arabian sea bordering us that gives a cool breeze which helps to make the temperature moderate. Another important feature of this season is the arrival of rain which is accompanied by thunder and lightening. The summer season extends from March till May or the beginning of June starts the beginning of monsoon.

Average Temperature during Summer in Kerala:	Maximum : 36°C Minimum : 32°C
Average Rainfall during the season :	135 mm

South West Monsoon in Kerala

The rainy season in Kerala is the Southwest monsoon. In malayalam this season is called as Edavappaathi which means in the middle of the malayalam month Edavam. It is called so because the rain starts by the middle of this month that is the end of May or early June. The following two months have torrential rain. As Kerala lies on the windward side of the Western Ghats and is the first state to get hit by the monsoon winds, this state receives heavy rainfall. It is the monsoon that provides almost 85% of the rains. The slopes of the Western Ghats receive the highest amount of rain. The rivers get flooded by the monsoons. This season continues till the end of September.

Average Temperature during this season :	Maximum : 30°C Minimum :19°C
Average Rainfall during the season :	2250-2500 mm

North East Monsoon in Kerala

The North east monsoon is also known as the Retreating Monsoon or the Reverse monsoons. This hits Kerala when the southwest monsoon winds take their return. These rains are called as Thulavarsham in malayalam because it rains during the malayalam month thulam. It comes in the month October and November and at times continues up to December. The main feature of this season is heavy rains during afternoon together with lightening and thunder. The days are usually warm and humid without much variation in temperature.

Average Temperature:	Maximum : 35°C Minimum : 29°C
Average Rainfall during the season :	450-500 mm

There has been a great change in the climatic condition of the Earth in the past few years. This has affected the weather conditions in Kerala also.

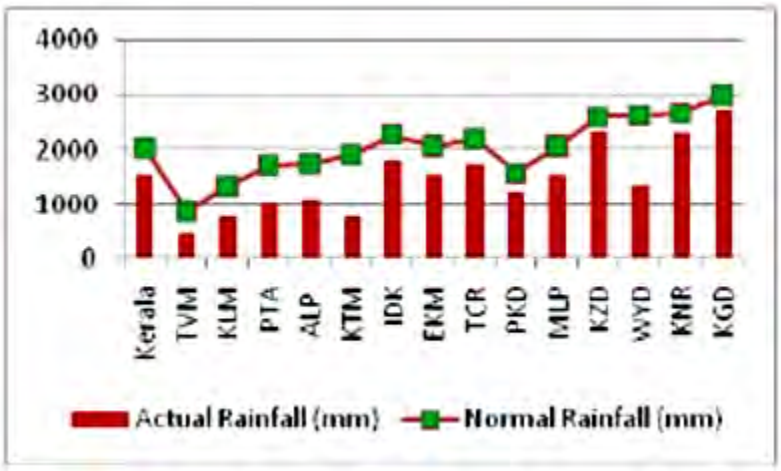
Average monthly rainfall in Kerala

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rainfall (mm)	14.6	16.6	36.1	110.9	252.6	653.2	687.2	404.7	252.3	270.7	158.6	45.9

Monsoon 2012

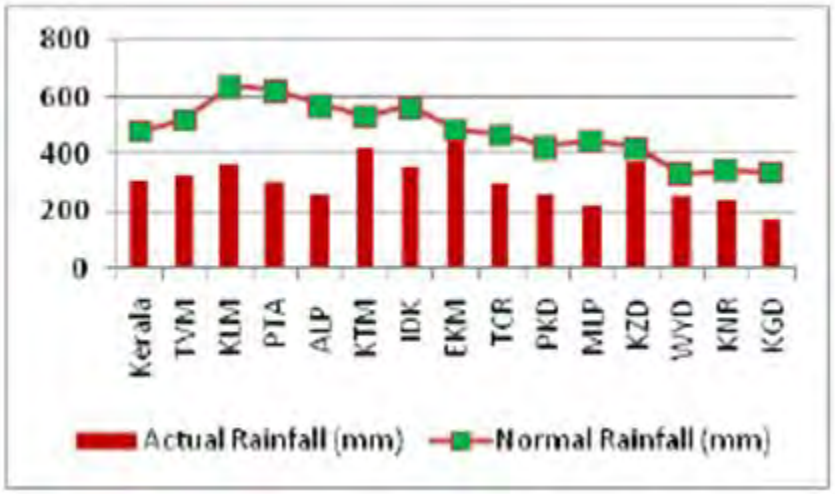
The Pre monsoon rainfall received in the state from 1st March 2012 to 31st May 2012 was normal with a departure of -19 percent from the normal. The actual rainfall received during the period was 308.5 mm. Ernakulam District recorded excess pre monsoon rainfall (23%) and Kannur District had scanty rainfall (-68% departure from normal). Normal rainfall was received in 7 districts of the state (Alappuzha, Idukki, Kollam, Kottayam, Pathanamthitta, Thrissur and Wayanad). Pre monsoon rains were deficient in 5 Districts including Kasargod, Kozhikkode, Malappuram, Palakkad and Thiruvanathapuram).

Southwest monsoon current advanced over the Andaman Sea on 23rd May with a delay of about 3 days and set in over Kerala on 5th June, 4 days later than its normal date of 1st June. The actual rainfall received in Kerala during the South West Monsoon season (1st June to 30th September 2012) was 1551.3 mm as against the normal rainfall of 2039.6 mm which was -24 percent deficient. During the previous SW monsoon (2011) Kerala had received an actual rainfall of 2215.8 mm. Eleven districts in the state received deficient rainfall during 2012, while Kasaragod, Kannur and Kozhikkode districts normal rainfall. Deficiency in SW monsoon was highest in Wayanad District (-49%) followed by Thiruvananthapuram (-43%) which is shown in the figure below.



South West Monsoon received in Kerala during 1st June – 30th September 2012

During the North East Monsoon season 2012 (1st October to 31st December 2012) the state received 310.8 mm of rainfall as against 480.7 mm of normal rainfall which was deficient with a percentage departure of -35 percent from the normal. Twelve districts in Kerala received deficient rainfall during this season except Ernakulam and Kozhikkode which recorded normal rainfall. Percentage departure from the normal was highest in Alappuzha District (-54%) followed by Malappuram and Pathanamthitta districts and both showed a deviation of -51 percent from the normal rainfall, which is shown in the figure below. District wise rainfall distribution in the state during 2012 is given in the Table *(District wise Actual Rainfall, Normal Rainfall and Percentage of Departure for the year 2012)*:



North East Monsoon received in Kerala during 1st October – 31st December 2012

Drought Situation 2012

During North East monsoon season the most affected districts during South West monsoon season ie. Thiruvananthapuram and Wayanad received comparatively more and distributed rainfall. But other districts still received less rainfall compared to normal. This adversely affected the second (Mundakan) crop of rice from which the farmers expected maximum yield. In addition to this Alappuzha district also suffered from salt water inundation. In North Kerala, Malappuram, Kasaragod and Palakkad were the most affected districts.

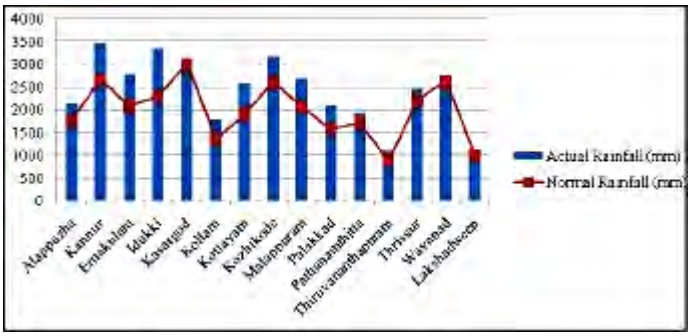
The deficiency of monsoons has affected the reservoir storage levels in major reservoirs in the state. The low levels of reservoir storage further narrows the chances of providing life saving irrigation to these crops and the end result will be extensive crop damage. The entire state has been declared as drought affected and a series of initiatives were proposed for implementation including restructuring loans with the support of commercial banks. Departments may prepare both short term and long term strategies for addressing drought situation. The restoration of tanks and ponds, basin wise management strategies for water management, micro irrigation and agronomic measures for improving water use efficiency needs to be implemented urgently.

Monsoon 2013

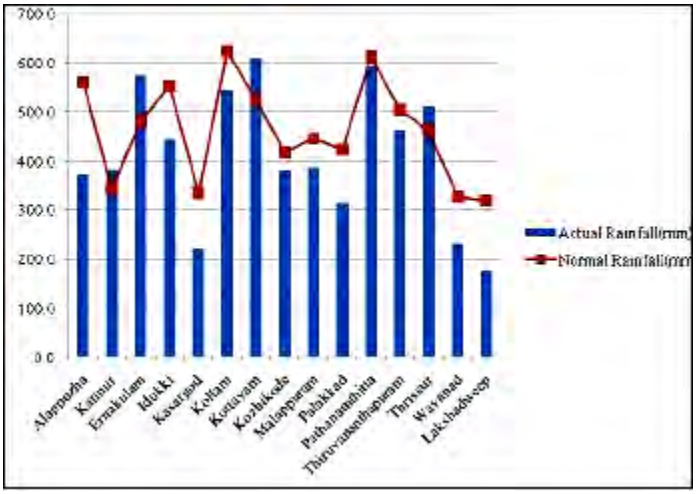
The pre monsoon rainfall received in the State from 1st March 2013 to 31st May 2013 was normal with a departure of -42 percent from the normal. The actual rainfall received during the period was 218.9 mm. All the Districts except Kottayam and Wayanad recorded deficient rainfall. The percentage departure from normal was highest in Palakkad (-56percent), Malappuram (-56 percent) and Thrissur (-56 percent) Districts.

South West monsoon current advanced over the Andaman Sea 3 days earlier than its normal date of 20th May and set in over Kerala on its normal date of 1st June. The South West monsoon covered the entire country by 16th June, about 1 month earlier than its normal date of 15th July. Out of the total 36 meteorological subdivisions, 14 subdivisions constituting 48 percent of the total area of the country received excess season rainfall, 16 subdivisions (38 percent of the total area of the country) received normal season rainfall and the remaining 6 subdivisions (14 percent of the total area of the country) received deficient season rainfall. Out of the total of 641 districts, 100 were affected by moderate meteorological drought (seasonal rainfall deficiency of 26 percent to 50 percent), while 39 were affected by severe meteorological drought (seasonal rainfall deficiency of 51 per cent to 99 per cent). The actual rainfall received in Kerala during the South West Monsoon season (1st June to 30th September 2013) was 2570.3 mm as against the normal rainfall of 2039.6 mm which was 26 percent excess. During the previous SW monsoon (2012) Kerala had received an actual rainfall of 1551.3 mm which was -24 percent deficient. During 2013 SW monsoon season, 10 districts in the State received excess rainfall and 4 districts viz. Wayanad, Thrissur, Pathanamthitta and Kasaragod had normal rainfall. Excess rainfall was maximum in Idukki District with 47 percent departure from normal.

The graphical representation of South West Monsoon Rainfall received from 1st June – 30th Sept 2013 is shown below:



During the North East Monsoon season 2013 the State received 430.7 mm (till 18th December 2013) of rainfall as against 473 mm of normal rainfall which was normal with a percentage departure of -9 percent. Five Districts in Kerala received deficient rainfall (Alappuzha: -33 percent, Kasaragod: -34 percent, Idukki: -20 percent, Palakkad: -26 percent, and Wayanad : -29 percent). The North East Monsoon Rainfall received from 1st October to 18th December 2013 is shown below and district wise rainfall distribution in the state during 2013 is *shown here*

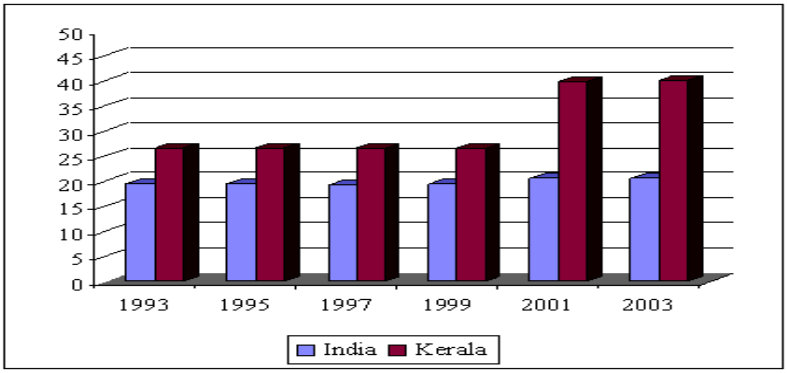


Source : Economic Review 2013

Kerala forest fall in two biogeographic provinces,viz Western Ghats and the Western Coast, and are rich in biodiversity and vital for environmental protection and considered to be a repository of rare and endangered flora and fauna.

Area under forest cover : Forest cover, as defined by Forest Survey of India, include all areas, more than one hectare in extent, with tree canopy density of more than 10 percent. Even though the land area of Kerala is only 1.2 percent of India , the forest cover is 2.30 percent of the national average. The National Forest Policy envisages achieving the goal of 33 percent of the land under forest and tree cover in the country. During 1993-1999, the area under forest cover in the State was around 26.59 percent and the national average was around 19.4 percent. This stable status of the ecosystem showed a sudden increase during 2001-03, reaching an average of 40 percent for the State, whereas the national average showed a slight increase reaching 20.50 percent. This shows that the drastic increase, as interpreted from remote sensing data, was not real and probably, other tree covered areas like rubber plantations, which is on the increase in the State during the period, might have contributed to the increased coverage. Moreover, the area recorded under forests during the period by the State Forest Department also supports this conclusion.

Table : Biennial Changes in Forest Cover (%) in India and Kerala during 1993- 2003



The geographical area recorded as forests by the state Forest Department shows that during 1993-2001, there is not much of a change or reduction in the extent of forests. However, during 2003, there is a slight increase as shown in Table 1.2 which is a positive trend, i.e. an area of 47 km^2 were added during the year and the coverage has almost attained 29 percent (Fig. 1.1). However, this also includes about 75,000 ha of plantations of different species, the dominant ones being teak and eucalypts, which impoverishes the biodiversity and reduces the quality of the ecosystem. The classification of forest area in Kerala in the context of land utilization (Fig.1.2) shows that 64 percent of the area is under dense forests and 19 percent of the area is under plantations, while 17 percent of the area is given to other agencies (KFD, 2004). The reports of the Kerala Forests and Wildlife Department further shows that the actual forest area in the State during 2003-04 was 9,400 km^2 which forms 24.19 percent of the total geographic area on the State. Still, with a population density of 819 persons per square kilometer (as per the State Census Report, 2001), the PER CAPITA availability of forest in Kerala is only 0.035 ha.

Biogas Plants

District-wise break-up is not available for achievement up to 2012. The cumulative achievement till 2012 is 102 nos. of large sized biogas plants.

Table : 4.5 Beneficiaries of Bio Gas Plant

Sl. No.	District	2012-13
1.	Thiruvananthapuram	85
2.	Kollam	86
3.	Pathanamthitta	162
4.	Alappuzha	793
5.	Kottayam	408
6.	Idukki	243
7.	Ernakulam	462
8.	Thrissur	436
9.	Malappuram	190
10.	Palakkad	242
11.	Kozhikode	508
12.	Wayanad	142
13.	Kannur	234
14.	Kasargod	26
	TOTAL	**4017**

Source : ANERT

Table : 4.6 District Wise Level Of So2, No2 And Rspm In Residential Areas Under National Ambient Air Quality Monitoring Programme (Namp) During 2013

Sl.No	Name of District	SO_2 µg/m^3 (annual)		NO_2 µg/m^3 (annual)		RSPM µg/m^3 (annual)	
		Max	Min	Max	Min	Max	Min
1	Thiruvananthapuram	2	2	5	4.5	56.1	36.3
2	Kollam	4.02	2.43	9.44	5.99	50.08	14.15
3	Pathanamthitta	2	2	18.5	4.5	25.6	21
4	Alappuzha	2	2	5	4.5	56.1	36.3
5	Kottayam	9	5.61	23.42	15.96	116.46	39.73
6	Ernakulam	3.7	2	14.35	4.5	142	27.56
7	Thrissur	2	2	14.83	7.5	60	35.5
8	Kozhikode	2	2	26.03	12.1	97.9	21
9	Kannur	7.58	2.26	8.3	4.5	132	21.33
10	Kasargod	2	2	18.07	4.84	67.02	11.9

Source : Kerala State Pollution Control Board

Table : 4.7 District Wise Level Of So2, No2 And Rspm In Industrial Areas Under National Ambient Air Quality Monitoring Programme (Namp) During 2013

Sl.No	Name of District	SO_2 µg/m^3 (annual)		NO_2 µg/m^3 (annual)		RSPM µg/m^3 (annual)	
		Max	Min	Max	Min	Max	Min
1	Thiruvananthapuram	18.36	15.43	20.94	18.44	61.22	51.11
2	Kollam	7.58	3.17	22.98	7.03	67.7	24.25
3	Alappuzha	2	2	5	4.5	56.1	36.3
4	Kottayam	9	5.61	23.42	15.93	116.46	24.63
5	Idukki	2	2	5	4.5	32.27	13.3
6	Ernakulam	3.4	2	11.84	3	205.71	5.6
7	Palakkadu	4.95	2	6.15	4.5	71.6	17.9
8	Malappuram	2	2	6.79	4.5	48	29.2
9	Kozhikode	2	2	19.03	9.35	90.13	27.76

Source : Kerala State Pollution Control Board

Table : 4.8 Air quality in important Cities in Kerala 2012-13

Annual Average mg/m3

Sl.No.	District	So 2	Air quality	NO2	Air quality	PM10	Air quality
1	Kochi	3	L	13	L	38	M
2	Kozhikkodu	2	L	8	L	46	M
3	Thrisur	2	L	14	L	33	M
4	Malappuram	2	L	5	L	30	L
5	Thiruvananthapuram	10	L	23	M	58	M
6	Kollam	4	L	20	L	53	M
SO2 Sulphur Dioxide, NO2 Nitrogen Dioxide PM10 Particulate Matter having an aerodynamic diameter							

Source : Kerala State Pollution Control Board

Table : 4.9 Ambient Air Quality Data 2013- Annual Average

Sl. No.	District	Monitoring Location	Sulphur Dioxide $\mu g/m^3$(50 $\mu g/m^3$, max)	Nitrogen Dioxide $\mu g/m^3$(40 $\mu g/m^3$, max)	Respirable Suspended Particulars Matter $\mu g/m^3$(60 $\mu g/m^3$, max)	Category
1	Thiruvananthapuram	Filatex, Veli	16.79	19.81	57.59	Industrial
		SMV School, Over Bridge	7.06	24.18	53.53	Sensitive
		Cosmopolitan Hospital, Murinjapalam	6.92	22.64	52.08	Sensitive
		Pettah Station	6.78	22.96	51.26	Residential
2	Kollam	Kadappakada Station	3.22	8.05	32.18	Residential & Others
		KMML, Chavara	5.34	14.63	39.71	Industrial
3	Pathanamthitta	Makkankunnu	2.00	13.38	23.33	Residential & Others
4	Alappuzha	DC Mills, Pathirappally	2.00	4.50	47.14	Industrial
		Thodankulangara	2.00	4.50	47.24	Industrial
5	Kottayam	Nagambadam	6.55	19.31	76.26	Residential & Others
		Vadavathur	6.93	18.44	65.75	Industrial
6	Idukki	Thodupuzha	2.00	4.50	14.79	Residential & Others
7	Ernakulam	Eloor Methanam	2.40	4.58	75.20	Residential
		Eloor TCC	2.34	4.57	70.34	Industrial
		South Overbridge	2.46	7.04	83.59	Residential & Others
		Vyttila	2.47	8.54	42.98	Residential Rural & Others
		Irumpanam	2.39	4.96	104.30	Industrial
		Kalamassery	2.46	7.14	66.32	Industrial
		M.G.Road	2.36	5.83	74.50	Residential & Others
8	Thrissur	Poonkunnam	2.00	10.80	46.74	Residential & Others

9	Palakkadu	Kanjikkode	2.70	4.74	39.26	Industrial
10	Malappuram	Kakkancherry	2.00	4.87	37.46	Industrial
11	Kozhikode	Kozhikode City	2.00	19.41	51.33	Residential & Others
		Nallalam	2.00	13.48	45.75	Industrial
12	Wayanadu	Sulthan Batheri	2.00	4.50	42.24	Sensitive
13	Kannur	Kannur	3.75	5.05	35.63	Residential Rural & Others
		Mangattuparambu	3.47	5.25	77.73	Residential Rural & Others
14	Kasargod	Kasargod	2.00	8.53	50.98	Residential Rural & Others
		Kanhangadu	2.00	8.18	42.75	Residential Rural & Others

Source : Kerala State Pollution Control Board Directory 2013

Table : 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

Source : Kerala State Pollution Control Board

Note:

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

Table : 4.11 Effects of Noise Polltion in Human Health

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

Source : Kerala State Pollution Control Board

Table : 4.12 Major Indicators showing operational efficiency of KSRTC

Sl. No.	Items	Year		Increase/ Decrease
		2011-12	2012-13	
1	Fleet Strength (Nos)	5803	5812	(+)9
2	Gross Revenue Earnings (RS. In Crores)	1555.72	1704.8	(+)149.08
3	Gross Revenue Expenditure (RS. In Crores)	1902.95	2200.69	(+)297.74
4	Gross operating loss (RS. In Crores)	(-)347.23	(-)495.89	(-)148.66
5	No. schedules operated	4795	4067	(-)148.66
6	Average earnings per vehicle on road per day (Rs)	8423	9197	(+)774
7	Average earnings per km. of Buses operated (paise)	2613	2832	(+)219
8	Average Earnings per Passenger (paise)	1142	1294	(+)152
9	Average route length (Kms)	50.68	50.57	(-)0.11
10	Average kms. Run per bus per day	317.2	318.92	(+)1.72
11	Average number of buses held daily (Nos)	5742	5847	(+)105
12	Passengers carried (Lakhs)	12579	12156	(-)423

Source : Kerala State Transport Commisionerate

Table: 4.13 Working of Kerala State Road Transport Corporation

Fuel Efficiency(km/litre)	2010-11	4.3
	2011-12	4.2
	2012-13	4.3
Passenger kms performed (Lakh)	2010-11	6331
	2011-12	6558
Passenger carried (Lakhs)	2011-12	12579
	2012-13	12156

Source: Compendium of Environment Statistics India 2013

Table : 4.14 Category-wise Growth of Motor vehicles in Kerala from 2008-09 to 2012-13

Sl. No.	Type of vehicles	2008-09	2009-10	2010-11	2011-12	2012-13
1	**Goods Vehicles**					
	Four wheelers and above	246687	262824	294395	322450	354296
	Three wheelers including tempos	100919	108104	117266	128452	206901
2.	**Buses**					
	Stage carriages	41998	43727	46594	21457	34161
	Contract carriages/ Omni	110833	114351	119150	124290	137731
3.	**Cars and station wagons**					
	Cars	767753	901663	1060861	122691	1358728
	Station wagons	0	0	0	0	0
	Taxis	142054	151533	163407	175638	128250
	Jeep	73698	73700	73700	73700	74167
4.	**Three wheelers**					
	Auto rickshaws	422905	466135	518741	575763	602547
	Motorised Rickshaws	61	61	61	0	0
5.	**Two wheelers**					
	Motorised cycles	1017	1017	1017	0	0
	Scooters/ Motor cycles	2928226	3216123	3610838	4127227	5041495
6.	Tractors	11656	11680	12224	13740	14183
7.	Tillers	5184	5217	5335	5399	5399
8.	Trailers	2321	2321	2324	2407	2744
9	Others	24745	39196	46106	68325	88071
	TOTAL	**4853360**	**5370955**	**6045322**	**6865539**	**8048673**

Source: Transport Commissionarate

Table : 4.15 Newly Registered Motor Vehicles in Kerala 2012-13

Sl. No.	District	Transport					Non Transport						
		Multi exied/ Articulated vehicles/ Trucks & Lorries	Light Motor Vehicles (Goods)	Stage carriage/ contract carroiage/ Buses	Taxies	Other vehicles	Two Wheelers	Cars	Jeeps	Omni Buses	Tractors	Trailers	Other vehicles
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Thiruvananthapuram	2	2966	2149	12116	0	66149	14532	85	0	7	3	676
2	Kollam	110	3423	1076	7868	232	61795	13162	62	235	34	0	620
3	Pathanamthitta	22	4885	1216	4780	0	24518	7146	20	30	0	119	5539
4	Alappuzha	517	2055	750	4480	0	52253	9094	172	0	26	2	504
5	Kottayam	226	3114	1450	6948	184	32997	12126	80	182	43	0	1435
6	Idukki	285	1433	790	3749	54	11537	3103	26	28	12	0	1770
7	Ernakulam	107	6984	2502	10319	192	107200	23015	54	93	20	0	1191
8	Thrissur	156	3375	2121	7226	336	62550	12241	74	118	77	0	1494
9	Palakkadu	888	5814	2048	5099	0	48758	400	63	217	73	0	1288
10	Malappuram	0	61898	11554	7165	0	73825	78346	164	3	60	213	0
11	Kozhikode	62	5434	2903	7356	170	54756	17127	82	84	25	0	5218
12	Wayanadu	7	1098	402	1883	0	7988	2306	4	48	16	0	0
13	Kannur	84	17033	1697	6873	3954	38146	11914	189	245	34	0	247
14	Kasargod	59	3869	571	7881	111	12517	12548	122	208	16	0	5257
15	N.S	0	0	549	0	0	0	0	0	0	0	0	0
	TOTAL	**2525**	**123381**	**31778**	**93743**	**5233**	**654989**	**217060**	**1197**	**1491**	**443**	**337**	**25239**

Source : Kerala State Transport Commisionerate

Table : 4.16 Complying Status of Grossly Polluting Industries

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

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

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

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

Source : Kerala State Pollution Control Board

Table : 4.17 Electricity Generating Capacity of Kerala (MW)

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

Source : Kerala State Electricity Board

Table : 4.18 Electricity Generating Capacity of Kerala (MU)

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

Source : Kerala State Electricity Board

Table : 4.19 Planwise Growth of Electricity Sector in Kerala

Sl. No.	Period	Installed capacity (MW)		No. of Villages Electrified	Transmission Line				Distribution Lines		Annual per capita Consumption (KWh)
					220 KV	110KV	66KV	33KV	11KV	LT	
					As on 31.3.1992						
1	Eighth Plan (1992-97)	31.3.1992	31.3.1997	1219	1164.22Ckm	2329Ckm	2531Ckm	0	21551Ckm	108420	198
		1477	1508.5		**As on 31.3.1997**						
2	Ninth Plan (1997-2002)	31.3.1997	31.3.2002	1384	1175.99 km	2429.37km	2669.46Ckm	0	26444.14Ckm	132864km	224.18
		1508.5	2605.91		**As on 31.3.2002**						
3	Tenth Plan (2002-2007)	31.3.2002	31.3.2007	1364	2577.89Km	3610Km	2012.37Km	305.42 Km	30372Km	194678Km	271
		2605.91	2662.96		**As on 31.3.2007**						
4	Eleventh Plan (2007-2012)	31.3.2007	31.3.2012	1018	2640.85km	3993.71 Km	2150.78km	909.77 km	36576km	226128k	345
		2662.96	2875.7		**As on 31.3.2012**						
					2734.7Km	4151Km	2161.91Km	1534.8 km	51489Km	260554Km	478

Source : Kerala State Electricity Board

Ckm-Circuit Kilometre

Table : 4.20 Renewable Energy in Kerala State for the year 2013

Sl. No	Source Renewable	Power Generation (MKw/a)	Installed Capacity (MW)	Source
1	Hydel Power Generation	NA	158.4	Ministry of New and Renewable Energy Source
2	Solar Photovoltaic Power Generation	NA	0	Ministry of New and Renewable Energy Source
3	Other Biomass Power Generation	NA	0	Ministry of New and Renewable Energy Source
4	Windmill Power Generation	NA	35	Ministry of New and Renewable Energy Source
		0	193.7	

Source : Kerala State Electricity Board

Table : 4.21 Installed Generating Capacity 2012-13

Sl.No	Power	No.of stations	Station Capacity (MW)	Annual Generation capability (MU)
1	Hydel	30	2008.65	7073.94
2	Wind	1	2.025	4
3	Thermal	3	594.18	3660
4	Private Hydro	6	55.11	207.06
5	Private Thermal	4	198.9	1376.71
6	Private Wind	2	32.85	69.93

Source : Kerala State Electricity Board

Table : 4.22 Wind Power Installed Capacity (Mw) 2012-13

Sl.No	Name of Station	Station capacity (MW)
1	Kanjikode	2.025
2	Ramakkalmedu (Private)	14.25
3	Agali (Private)	18.6

Source: ANERT

Table : 4.23 Electricity Generating Capacity, Maximum Demand And Load Factor

Sl.No	Year	Installed Capacity	Energy input to system excl.aux.cons. & ext.losses (Gen+Purchases-Export) (MU)	Maximum demand (MW)	Load factor (%)
1	1987-88	1477	5063.31	1127.3	51.27
2	1988-89	1477	5738.04	1201	54.54
3	1989-90	1477	6105.16	1298	53.69
4	1990-91	1477	6794.1	1273.7	60.89
5	1991-92	1477	7153.62	1308.8	62.39
6	1992-93	1477	7219.79	1403	58.74
7	1993-94	1484	7809.17	1459.6	61.08
8	1994-95	1503.53	8794.39	1614.6	62.18
9	1995-96	1505.3	9274.07	1651.4	64.11
10	1996-97	1508.53	8771.25	1572	63.69
11	1997-98	1775.81	9394.67	1785.8	60.05
12	1998-99	2046.33	11164.61	1896.2	67.21
13	1999-00	2350.71	11880.98	2177	62.3
14	2000-01	2422.61	12464	2316	61.43
15	2001-02	2605.91	12518.31	2333	61.25
16	2002-03	2608.71	12391.13	2347	60.27
17	2003-04	2621.31	12280.87	2426	57.79
18	2004-05	2623.86	12504.84	2420	58.99
19	2005-06	2650.41	13331.03	2578	59.03
20	2006-07	2662.96	14427.96	2742	60.07
21	2007-08	2676.66	15065.15	2745	62.65
22	2008-09	2744.76	15293.41	2765	63.14
23	2009-10	2752.96	16982.29	2998	64.66
24	2010-11	2869.56	17340.28	3119	63.47
25	2011-12	2878.36	18938.81	3348	64.57
26	2012-13	2880.22	19877.16	3268	69.43

Source: Kerala State Electricity Board

Table : 4.24 The detail of Indian standards for maximum permissible limits for Industrial effluent discharges

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

Source: Compendium of Environment Statistics India 2013

Table : 4.25 Cumulative comparison of Power Supply position in Kerala 2012-13

Year	Requirement (MU)	Availability (MU)	Supply/ Deficit	Shortage
2005-06	13674	13578	-96	-0.7
2006-07	15023	14716	-307	-2
2007-08	15663	15284	-379	-2.4
2008-09	17645	15562	-2083	-11.8
2009-10	17619	17196	-423	-2.4
2010-11	18023	17767	-256	-1.4
2011-12	19890	19467	-423	-2.1

Source: Compendium of Environment Statistics India 2013

Table : 4.26 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 2013 India.

Table : 4.27 National Ambient Air Quality Standards 2012-13

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

Source: Kerala State Pollution Control Board

Table : 4.28 Registered Motor Vehicles In Million Plus City of Kerala

Name of City	Year	Transport							
		Multi-axled/Articulated Vehicles Trucks & Lorries	Light Motor Vehicles (Goods)	Buses	Taxies	Light Motor Vehicles (Passengers-Auto)	Total Transport		
Kochi	2010	3393	15954	5160	7592	14588	46687		
	2011	4375	20264	6105	9445	18444	58633		
	2012	5,290	24,635	7,005	10,346	21,522	68,798		
		Two Wheelers	Cars	Jeeps	Omni Buses	Tractors	Trailers	Others	Total Non-Transport
	2010	170326	90673	5832	5346	176	8	3218	275579
	2011	221157	113269	5832	5353	249	8	4021	349889
	2012	262,258	132,628	6,228	5,456	276	27	4,667	411,540

Source : Motor Vehicle Department

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

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

Particulate Pollutants

Particulate matter (PM) is a complex mixture of suspended solid and liquid particle in semi equilibrium. The particles constituents vary greatly in size, composition, concentration, depending on origin and age. The size distributions of airborne particles are important for health impact. The particles larger than 10µm in diameter are deposited almost exclusively in the nose and throat whereas those smaller than 1µm reach the lower regions of the lung. The intermediate size range gets deposited between these two extremes of the respiratory tract. Outdoor (ambient) PM size ranges from approximately 0.001-100 µm in aerodynamic diameter. PM is considered as the single best indicator of potential harm. There are two main size categories for PM measured in ambient air.

PM_{10}

They consist of PM with a diameter up to 10 µm. However for taxicity studies, the most important particles are those having a diameter of less than 10 µm (PM10) because they are respirable whereas the larger particles are not. PM10 deposit relatively quickly with a lifetime of less the 2 days, and exposure may lead to adverse response in the lungs triggering an array of cardio-pulmonary problems.

Environment Protection Rules Schl:38

i. Implementation of the following Pollution Control Measures:

a) Dust containment cum suppression system of the equipment.
b) Construction of wind breaking walls
c) Construction of metalled roads within the premises
d) Regular cleaning and wetting of the ground within the premises.
e) Growing of a green belt along the periphery.

ii) Quantitative standards for the SPM:

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

Table : 4.29 Summary of Health Effects of Basic Air Pollutant

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

Source : Kerala State Pollution Control Board

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CHAPTER-V

LAND AND SOIL

CHAPTER - V

LAND AND SOIL

Land

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

The state is gifted with ten soil types derived from the laterite base and has 12 distinct agro climatic zones. The undulating topography, vibrant climate and vivacious hydrology in the background of ever active tectonics resulted in 44 river basins, 1750 sub basins and 4452 mini watersheds providing multitudes of lively micro ecosystems. The environment of these micro watersheds are conducive to varying crop types, such as, coconut and rice in the sultry lowlands, rice, tapioca, banana, arecanut, coconut, pepper, cashew and rubber in hot humid midlands and tea, coffee and cardamom in the cool subtropic highlands. The micro ecosystems are such that the valleys with near waterlogged conditions for most part of the year are seen juxtaposed with dry hilltops decked with densely canopied trees.

Physiographic units, altitudes and areas			
Unit	**Altitude (m)**	**Area (Km^2)**	**Area(%)**
Lowland	0 - 7.5	3979.3	10.24
Midland	7.5 - 75	16231.2	41.76
Highland	> 75 m	18653.5	48.00

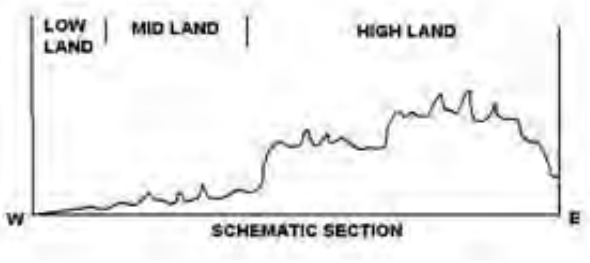
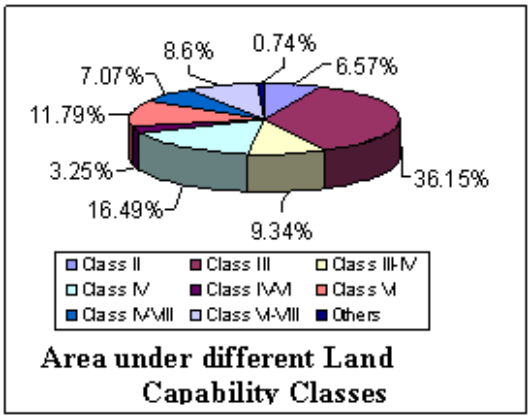


Figure 1

Land capability

Considering the characteristics of soil, drainage/wetness, erosion, runoff etc., Kerala has 18 land capability subclass associations of five broad land capability (LC) classes (KSLUB, 1995 and 2002). The broad LC classes are Class II (Good cultivable land), Class III (Moderately good cultivable land), Class IV (Fairly good cultivable lands), Class VI (Well suited for forestry or grazing), and Class VIII (Land suited only for wildlife and recreation). The approximate area under each class is given in Figure2. The soil of Kerala has limitations for sustained use under irrigation. Only about 37% of the area of Kerala is suitable for irrigation with certain limitations.

Figure2



Land area use

Kerala has a diverse land use and cropping pattern. The land reforms introduced in the State brought in radical and comprehensive institutional changes leading to drastic transformation in the land holding pattern. This has resulted in shift in the land use pattern. Agriculture is the dominant land use type of the State. It accounts for over 55% of the geographical area followed by forest land (including degraded forest) of 28% but area under non-agricultural use is only 11% (Farm Guide, 2006).

The land use pattern of Kerala reveals that out of a total geographical area of 38.86 lakh ha. net sown area is about 56 percent. Forest occupies around 28 percent. Agriculture and forest sectors together account over 84 percent of the land area. The net sown area has increased by 4.39 percent while the total cropped area has declined by 0.97 percent. Land under non-agricultural uses was 9 percent in 1999-00 and has increased to 9.68 percent in 2008-09 and it slightly declined to 9.31 percent in 2009-10. There was an increase in the area under current fallow (9186 ha) and a decrease in the area under fallow other than current fallow (581 ha) during 2009-10 over 2008-09. The cultivable waste area increased by 1821 ha. barren and uncultivated land declined by 7019 ha.

Out of a total geographical area of 38.86 lakh ha, one fourth was under forests, and one tenth of it was put to non agricultural use. Also, while the net sown area which accounts for 53 percent of the total area, did not record any significant changes, the area sown more than once which accounted for 14 percent of the total geographical area recorded a notable decline of 13 percent from 6.2 lakh ha to 5.4 lakh ha in 2012-13. As a result, the gross cropped area registered a decline of 3 percent. One notable feature is the decline in the area of barren and uncultivated land and an increase in permanent pastures and grazing land which although accounts for only 0.003 percent of the total geographical area registered a sharp increase of 39 percent in 2012-13. Numerical and graphical representation of land use pattern for the year 2012-13. The land use pattern in Kerala during 2012-13 is shown below.

Table : 5.1 Classification of Area on the Basis of Land Utilisation 2012-13 ***(Area in Ha.)***

Sl. No.	District	Total Geographical area	Forest	Land put to Non Agraicultral use	Barren & uncultivable land	Permananent pastures & other grazing land	Land under misc.tree crops	Cultivable waste	Fallow other than current fallow	Current fallow	Marshy land	Still water	Water loged Area	Social forestry	Net Area Sown	Area sown more than once	Total cropped Area
1	Thiruvananthapuram	218781	49861	29767	134	2	24	257	517	3357	8	4342	94	58	130360	23962	154322
2	Kollam	248788	81438	26734	212	0	96	2043	1980	4272	14	7581	619	88	123711	32053	155764
3	Pathanamthitta	265277	155214	16126	180	0	125	1754	2631	4577		2698	165	118	81659	18060	99719
4	Alappuzha	141011	0	22522	23	1	64	15680	1928	2898	33	12144	328	29	85361	18926	104287
5	Kottayam	220442	8141	26459	1317	0	143	5686	3305	5835		6360	159	98	162939	39113	202052
6	Idukki	436328	198413	12610	1807	91	189	2455	1216	2047		10480	1	1355	205664	62478	268142
7	Ernakulam	305826	70617	40819	469	2	137	10384	9429	11566	29	10318	289	105	151662	12105	163767
8	Thrissur	302919	103619	37445	406	12	244	8814	8133	8796	4	6328	320	147	128651	48529	177180
9	Palakkad	447584	136257	43690	2175	0	716	25215	14152	15380		15022		378	194599	96595	291194
10	Malappuram	355446	103417	45189	938	1	275	5951	5268	8138		6047	64	180	179978	50310	230288
11	Kozhikkode	234641	41386	28945	763	8	119	2580	1341	2015	5	3879	382	34	153184	50091	203275
12	Wayanad	212966	78787	10932	112	0	37	997	863	2363		3904	13	59	114899	55714	170613
13	Kannur	297112	48734	33684	1601	1	257	6215	2884	3202	96	6395	388	71	193584	29279	222863
14	Kasargod	199166	5625	27655	6217	0	373	8535	2188	2298		4291	18	108	141858	6410	148268
	Total	**3886287**	**1081509**	**402577**	**16354**	**118**	**2799**	**96596**	**55835**	**76744**	**189**	**99789**	**2840**	**2828**	**2048109**	**543625**	**2591734**

Source : Agricultural Statistics 2012-13, DES

Table : 5.2 Net Area Irrigated Source wise 2012-13

Sl. No	District	Small stream (Thode/ Canal)		Pond		Well		Borewell/ Tubewell	Lift& Minor Irrigation	From River & Lake				Total	Grand Total
		Govt	Private	Govt	Private	Govt	Private			Pump	Wheel	Other Methods	Other Sources		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	Thiruvanan thapuram	3775	0	217	7	0	2674	80	0	0	0	25	355	380	7133
2	Kollam	1129	6	15	66	44	2504	48	29	19	0	0	352	371	4212
3	Pathanamthitta	1812	4	0	199	0	1876	13	0	6	0	0	1	7	3911
4	Alappuzha	2420	0	0	449	5	839	6081	0	1335	0	28967	34	30336	40130
5	Kottayam	0	115	0	148	0	1539	8	0	33	0	11061	0	11094	12904
6	Idukki	2502	372	5	13847	4	4486	1536	0	20	0	13912	2909	16841	39593
7	Ernakulam	8253	164	306	1315	58	6432	421	4171	863	18	740	443	2064	23184
8	Thrissur	15832	115	258	3363	104	33804	1078	642	663		132	7032	7827	6323
9	Palakkad	37022	128	263	4824	31	14416	8060	530	9726	16	3345	6668	19755	85029
10	Malappuram	3600	263	136	4972	107	15965	1284	866	1006		2073	655	3734	30927
11	Kozhikkode	878	176	8	375	16	2444	84	18	111		118	1006	1235	5234
12	Wayanad	69	159		39	8	136	22	455	156		1183	11245	12584	13472
13	Kannur	2922	224	16	1258	25	10576	914	58	144		211	3243	3598	19591
14	Kasargode	504	731	51	11421	15	24230	6519	3	2965		625	461	4051	47525
	STATE	**80718**	**2457**	**1275**	**42283**	**417**	**121921**	**26148**	**6772**	**17047**	**34**	**62392**	**34404**	**113877**	**395868**

Source : Agricultural Statistics 2012-13, DES

Table : 5.3 Gross Area Under Irrigation(Crop wise) 2012-13

(Area in Ha.)

Sl. No.	District	Paddy				Tubers	Vegetables	Coconut	Arecanut	Cloves	Nutmeg	Other spices & condiments	Banana	Betel Leaves	Sugar cane	Other Crops	Total
		Autumn	Winter	Summer	Total												
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	**Thiruvananthapuram**	594	1180	40	1814	19	997	2228	10		1	29	3358	17		1638	10111
2	Kollam	48	913	145	1106	1	1040	514	22		1		981	27		2359	6051
3	Pathanamthitta	23	399	1847	2269		821	867	29				1462	29		34	5511
4	Alappuzha	10322	4837	20318	35477	231	1333	6700	5		82	7	530	54	11	1945	46375
5	Kottayam	4348	2309	10902	17559		1374	58	3	104	1521	1	638	5		15	21278
6	Idukki	208	877	91	1176	2	4265	648	156	107	1377		1028	0	1439	41	10239
7	Ernakulam	605	2227	342	3174	60	1825	11833	1566	5	5974	3	3525	9		4035	32009
8	Thrissur	2	13010	7476	20488	45	1347	44142	4671	6	5829	1	2018	6		3804	82357
9	Palakkad	456	38890	2676	42022	40	3589	25910	3987	1	187	417	13129	3	246	5834	95365
10	Malappuram	61	3455	1458	4974	172	1348	19133	5684	2	252	8	5583	149		3336	40641
11	Kozhikkode		854	624	1478	9	695	2949	305	9	95	3	1643	9		296	7491
12	Wayanad		9194	1034	10228	28	1002	150	176		2	2	7922	0		50	19560
13	Kannur	568	2879	56	3503	7	875	13468	2033	2	27	1	2008	1		790	22715
14	Kasargod	43	1359	268	1670	5	508	35891	17393	29	120	24	511	16	1	2025	58193
STATE		**17278**	**82383**	**47277**	**146938**	**619**	**21019**	**164491**	**36040**	**265**	**15468**	**496**	**44336**	**325**	**1697**	**26202**	**457896**

Source : Agricultural Statistics2012-13, DES

Table : 5.4 Area & Production of Important Crops in Kerala 2012-13

Sl. No.	Crops	Area(Ha)			Production(Tonnes)		
		2001-02	2012-13	% Variation	2001-02	2012-13	% Variation
1	Paddy!!	322368	197277	-39	703504	508299	-28
2	Tapioca	111189	69586	-37	2455880	2458515	0.11
3	Coconut*	905718	798162	-12	5479	5799	6
4	Pepper	203956	84707	-58	58240	46298	*21
5	Cashew	89718	52086	-42	65867	37919	-42
6	Rubber	475039	539565	14	580350	80050	38
7	Groundnut	2437	784	-68	1812	976	-46
8	Sesamum	878	260	-70	284	98	-65
9	Cotton#	3760	343	-91	6069	572	-91
10	Pulses	8191	2948	-64	6281	1354	-78
11	Ginger(Dry)	10706	4505	-58	40181	22064	-45
12	Turmeric	3558	2628	-26	7895	6904	-13
13	Banana	50871	61011	20	345903	515607	49
14	Tobaco	71	13	-82	395	23	-94
15	Total Cereals	329875	197792	-40	708624	508614	-28
16	Arecanut*	93193	101775	9	84681	118233	40
17	Coffee	84795	85359	1	66690	68175	2
18	Tea	36899	30205	-18	66090	62963	-5

Source: Agricultural Statistics2012-13, DES

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

Table :5.5 Irrigated Area Source wise (Ha.) 2012-13

Sl. No.	Source	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13
1	Govt. Canals	98664	88318	95956	94813	85825	81737	80718
2	Private Canals	4300	4324	6318	2656	5584	1971	2457
3	Ponds	42064	41580	39752	40851	51064	47112	43558
4	Wells	114477	131002	133312	125892	137716	137193	122338
5	Other Source	125900	122321	123915	122050	134824	140901	146797
6	**Total**	**385405**	**387545**	**399253**	**386262**	**415013**	**408914**	**395868**
7	Total Irrigated Area	475231	455310	458238	454783	466038	490585	457896
8	Ratio of Actual Agricultural Method and Irrigated Area	18	18	19	19	20	20.04	19.32
9	Ratio of Total Agricultural land and Irrigated Area	16	16	17	17	18	18.43	17.67
10	Ratio of Total Irrigated Area and Irrigated Paddy Cultivation	45	40	37	37	32	31.24	32.09

Source: Economics & Statistics Department

Plantation Crops

The term plantation crop refers to those crops which are cultivated on an extensive scale in contiguous area, owned and managed by an individual or a company. The crops include tea, coffee, rubber, cocoa, coconut, arecanut, oil palm, Sesamum, palmyrah and cashew. These are high value commercial crops of greater economic importance and play a vital role in improving Indian economy, especially in view of their export potential, employment generation and poverty alleviation particularly in rural sector. The plantation crops covered in this checklist are arecanut, cashewnut, cocoa and coconut.

Table : 5.6 Area, Production, Productivity of Plantation Crops 2009-13

	2009-10		2010-11		2011-12		2013
	Kerala	India	Kerala	India	Kerala	India	Kerala
1	2	3	4	5	6	7	8
Area Ha.							
Tea	36840	579190	36965	580181	37028	NA	30205
Coffee	84796	399683	84931	404645	85359	409690	85359
Rubber	525408	635400	534230	661980	539565	NA	545000
Cardamom	41593	71170	41242	71170	41600	71110	41600
Production							
Tea	57810	991182	57291	966733	57903	NA	62963
Coffee	59250	289600	65650	302000	68175	314000	68175
Rubber	745510	831400	770580	861950	788940	NA	800050
Cardamom	7800	10075	7935	10380	10222	15000	10222
Productivity (kg/Ha)							
Tea	1569	1711	1550	1666	1564	NA	2085
Coffee	699	725	773	746	799	766	799
Rubber	1419	1308	1442	1302	1931	NA	1903
Cardamom	188	142	192	146	246	182	246

Source : Planters chronicle, Economic Review
Coffee Board
Tea Board
Rubber Board
Rubber cutting statistics

Table : 5.7 Chemical utilization in Kerala 2002-03 to 2012-13

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

Source: Agricultural Department CMIE

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

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

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

Source: Department of Agriculture

Mineral Based Industries in the State

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

Mining Lease in Kerala

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

Mineral Development and Mining Leases Division

This division is responsible for the implementation of Mines and Minerals (Regulation and Development) Act, 1957, The Mineral concession Rules,1960 and the Kerala Minor Mineral Concession Rules,1967. This function is being executed through 14 District Offices, and 3 Kerala Mineral Squads (Southern, Central and Northern Region) with their head quarters at Thiruvananthapuram, Thrissur and Kozhikode respectively.

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

- Recommending to State Government to grant/ renewal of mining leases and prospecting licences in respect of major minerals.
- Grant/renewal of quarrying permits, quarrying leases and dealer's licences in respect of major minerals.

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

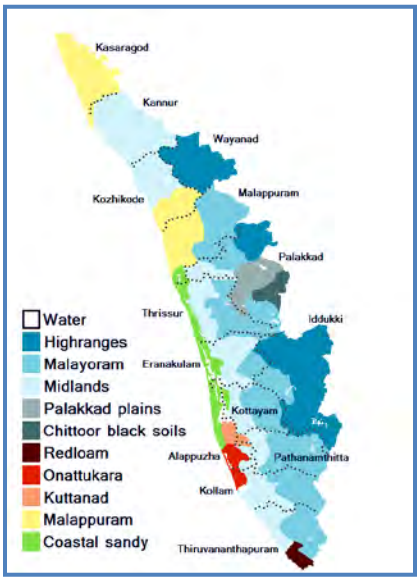
Table : 5.9 Mineral wise details of area covered by mining leases 2012-13

Sl.No.	Minerals	Place Ha.
1	China Clay	97.6736
2	Silica Sand	43.371
3	Bauxite	0.7237
4	Lime shell/Seashell	2450.59
5	Lime stone	245.69
6	Mineral sand	354.57
7	Quartz	2.8234
8	Graphite	1.2544
9	Iron Ore	86.06
10	Laterite	31.7801
	Total	**3314.5362**

Source : Economic Review

Minerals Resources

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



Mineral Based Industries in the State

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

Table : 5.10 Production and Royalty of Minerals in Kerala- 2012-13

Sl. No.	Minerals	Royalty (in Lakhs)	Production (Tone)
Important Minerals			
1	Chine Clay	108.53	434122
2	Illmanite	265.68	128349
3	Rutile	77.07	50
4	zircon	148.33	7919
5	Silminite	14.24	40
5	Silca Sand	125.97	88092
6	Limeshell/Seashell	27.39	43471
7	Limestone	353.32	560829
8	Boxite/Laterite	104.45	107684
9	Graphite	0.45	696
10	B. R. Illnite	5.84	50
11	Quartz	1.5	3488
Common Minerals			
1	Granite Building Stone	2436.42	15227651
2	Granite Dimension Stone	49.8	1245
3	Laterite	331.3	2070632
4	Lime/Seashell	2.4	4805
5	Brick Clay	151.53	1515293
6	Common Sand	318.7	3187036
7	River Sand	262.94	2629391

Source: Department of Mining & Geology

Individual Mineral Deposits Mineral Sand

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

Chavara barrier beach with a width of 225 m is divided into 8 blocks numbered I to VIII for separating ilmenite for the manufacture of TiO2. The blocks are apportioned between Kerala Minerals and Metals Ltd. (KMML),a State Government undertaking and Indian Rare Earths Ltd. (IRE), a Government of India enterprise under the Department of Atomic Energy.

Apart from the Chavara heavy mineral deposits a number of heavy mineral placers have been delineated in different parts of the State.

Table : 5.11 Heavy Mineral Deposits in Kerala 2012-13

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

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

Land Degradation

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

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

Table : 5.12 District wise Important Land Cover Categories of the State 2012-13

Sl. No.	Districts	Water Bodies	Barren rocky/ sheet rock area	Sands/ riverine	Underutilised/ degraded notified forest	Coastal Sand	Others	Total Area
1	Thiruvananthapuram	36.09	15.77	0.11	16.89	10.2	2111.77	2190.83
2	Kollam	118.16	0.59	0.22	0	0.11	2362.86	2481.94
3	Pathanamthitta	31.04	1.92	1.59	83.19	0	2535.79	2653.53
4	Alappuzha	175.5	0	0.01	0	0	1239.78	1415.29
5	Kottayam	80.56	0.92	0.41	27.86	0	2091.94	2201.69
6	Idukki	93.72	104.39	3.71	0	00	4162.74	4364.56
7	Ernakulam	173.53	17	1.41	0	0	2876.06	3068
8	Thrissur	87.4	6.68	0.15	0	0	2939.55	3033.78
9	Palakkad	121.79	93.98	0.78	1.34	0	4262.11	4480
10	Malappuram	55.5	27.23	18	59.29	31.04	3360.12	3551.18
11	Kozhikkode	60.16	22.93	0.56	44.43	0	2221.35	2349.43
12	Wayanad	11.88	3.43	0.34	4.61	0	2109.48	2129.74
13	Kannur	78.98	21.67	0.44	0	0	2864.91	2966
14	kasaragode	48.53	17.99	0.44	3.32	0	1920.66	1990.94
	Total	**1172.84**	**334.5**	**28.17**	**240.93**	**41.35**	**37059.12**	**38876.91**

Source: Agricultural Department

Table : 5.13 Consumption of Chemical Fertilizers in Kerala (in Kg)

Sl. No.	Year	Nitrogen	Phosphorous	Pottash	Total	N:(PK)%
1	1997-98	29.29	15.23	29.4	73.92	66
2	1998-99	29.5	14.58	18.14	62.22	90
3	1999-00	29.85	15.08	27.54	72.47	70
4	2000-01	28.43	12.66	20.82	58.32	85
5	2001-02	25.54	12.44	21.21	59.19	76
6	2002-03	29.18	13.53	26.19	68.9	73
7	2003-04	28.92	13.2	22.93	65.05	80
8	2004-05	29.87	14.14	24.2	68.21	78
9	2005-06	28	15	25	68	70
10	2006-07	31	16	43	89	53
11	2007-08	32	15	25	72	80
12	2008-09	38	19	32	89	74
13	2009-10	39	20	32	91	75
14	2010-11	40	24	33	97	70
15	2011-12	44	22	32	98	81
16	20012-13	52	16	26	94	124

Source : Economic Revirew 2013

Timber and Non-Timber forest products of Kerala

Forest Products collection is one of the major livelihoods of the local people. It consists of a variety of products, which are sources of food, fibre, manure, construction materials, cosmetics and cultural products. The users of NTFP range from local individuals to multinational companies. With the development of modern techniques, the number of products and uses based on NTFP has increased by many folds. Studies indicate NTFP collectors are amongst the lowest-income groups in India, often receiving a mere 5-20% of the value for their products (SPWD,1993). About 69% of the forest based employment is related to NTFP. The forests of Kerala are very rich in NTFP including edible products, medicinal plants, toiletries, tans, dyes, gums, resins, rattan, bamboo, grasses and animal products. Although 500 species of NTFP are available in the forests of Kerala, about 120 items are listed as commercially important by the Kerala Forest Department.

Table : 5.14 Out turn of Major Forest Produce 2012-13

Sl. No.	Item	Unit	Quantity
1	Sawn and squared Timber	M3	25.095
2	Poles	Nos	78513
3	Firewood	MT	11439.777
4	Sandal Wood	Kg	58269.07
5	Bamboo	MT	19006.387
6	Reeds	MT	3366.244
7	Jungle Wood Poles	Nos	13324

Source : Kerala Forest Department

Natural Disaster

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

Table : 5.15 Kerala's Major Natural Disasters 2012-13

Sl. No.	Item	Flood	Draught	Fire
1	Period of occurrence	2012-13	2012-13	2012-2013
2	Total number of districts in the State	14	14	14
3	Number and names of districts affected	12,Thiruvananthapuram, Kollam, Pathanamthitta, Alappuzha, Idukki, Kottayam, Ernakulam, Thrissur, Kannur, Malappuram, Kozhikkode, Wayanad,	14 Districts viz., Thiruvananthapuram, Kollam, Pathanamthitta, Alappuzha, Kottayam, Idukki, Ernakulam, Thrissur, Palakkad, Malappuram, Kozhikode, Kannur, Wayanad, Kasaragod	3, Palakkad, Idukki, Kannur
4	Number of villages affected	983	1584	20
5	Population affected (in lakh)	28.91	5.25	0.00131
6	Total land area affected (in lakh ha)	17639.5	36500	0.001022
7.1	Cropped area affected			0.00087
7.1.1	Total cropped area affected (in lakh ha.)	6249.68	36500	0.00087
7.1.2	Estimated loss to crops (Rs.in lakh)	19327.44	7500.00	78.00
7.1.3	Area where crop damage was more than 50%	5154.17	20000	0.00087
7.2	Percentage of cropped area held by SMF			100.00%
7.2.1	In State, as a whole		87.00%	0.02%
7.2.2	In the affected districts	Thiruvananthapuram -100, Kollam-75, Pathanamthitta-99.7, Alappuzha-95, Kottayam-95, Idukki-96, Ernakulam-59, Thrissur-97, Malappuram-76, Kozhikode-50, Kannur-80, Wayanad-80	Thiruvananthapuram -100, Kollam-75, Pathanamthitta-99.7, Alappuzha-95, Kottayam-95, Idukki-99, Ernakulam-59, Thrissur-97, Palakkad-100, Malappuram-76, Kozhikode-50, Kannur-100, Wayanad-100, Kasaragod-95	Palakkad-100, Idukki-99, Kannur-100
8	Houses damaged	22996	0	0

Contd….

Kerala's Major Natural Disasters 2012-13

Sl. No.	Item	Landslide	Hailstorm	Earthquake	Cyclone
1	Period of occurrence	2012-13	2012-13	2012-13	2012-13
2	Total number of districts in the State	14	14	14	14
3	Number and names of districts affected	4 Districts viz., Palakkad, Kozhikode, Ernakulam, Kannur	2 Districts viz., Palakkad & Idukki	1 Kozhikode	5 Alappuzha, Idukki, Thrissur, Kozhikode, Kannur
4	Number of villages affected	9	3	1	353
5	Population affected (in lakh)	0.04	0.04	0.002	14.2
6	Total land area affected (in lakh ha)	0.11	0.01	0.0003	0.17406
7.1	Cropped area affected	0.11	0.01	0	0.02702
7.1.1	Total cropped area affected (in lakh ha.)	0.11	0.01	0	0.02702
7.1.2	Estimated loss to crops (Rs.in lakh)	309.56	26.39	0	4603.37
7.1.3	Area where crop damage was more than 50%	0.11	0	0	90.16
7.2	Percentage of cropped area held by SMF	100.00%	99.00%	0	0
7.2.1	In State, as a whole	0	0	0	0
7.2.2	In the affected districts	Palakkad-100, Kozhikode-50, Ernakulam-59, Kannur-100	Palakkad-100 & Idukki-96		Alappuzha-95, Idukki-96, Thrissur-97, Kozhikode-50, Kannur-100

8	Houses damaged	294	0	48	1478
8.1	No. of houses damaged (Total)	294	0	48	1478
8.1.1	Fully damaged pucca houses	10	0	0	46
8.1.2	Fully damaged kutcha houses	0	0	0	13
8.1.3	Severely damaged pucca houses	140	0	24	98
8.1.4	Severely damaged kutcha houses	144	0	0	117
8.1.5	Partly damaged houses (pucca + kutcha)	0	0	24	1204
8.1.6	No. of huts damaged	0	0	0	0
8.2	Estimated value of damage to houses (Rs.in lakh)	28	0	9.2	73.64
9	No. of human lives lost	14	1	0	1
10	No. of persons who suffered grievous injuries	12	0	0	0
11	No. of persons who suffered minor injuries	23	0	0	0
12	Animal & Poultry Loss	0	0	0	25
12.1	No. of milch animal lost	0	0	0	11
12.1.1	Buffalo/Cow/Camel/Yak	0	0	0	5
12.1.2	Sheep/Goat	0	0	0	6
12.1.3	Others (indicate name)	0	0	0	0
12.2	No. of Draught animals lost	0	0	0	14

12.2.1	Camel/Horse/Bullock	0		0		0		0	
12.2.2	Calf/Donkey/Pony	0		0		0		14	
13	Damage to public properties	Length	Estimated Loss (Rs. in lakhs)	Length	Estimated Loss (Rs. in lakhs)	Length	Estimated Loss (Rs. in lakhs)	Length	Estimated Loss (Rs. in lakhs)
1.3.1	Roads (All)	4 Km.	97	0	0	0	0	0	0
13.1.1	State Roads	0	0	0	0	0	0	0	0
13.1.2	District Roads	0	0	0	0	0	0	0	0
13.1.3	Village Roads	4 Km.	97	0	0	0	0	0	0
13.2	Bridges & Culverts	0	0	0	0	0	0	0	0
13.2.1	Bridges	0	0	0	0	0	0	0	0
13.2.2	Culverts	0	0	0	0	0	0	0	0
13.3	Drinking Water Supply	No. of schemes:	Estimated Loss (Rs. in lakhs)	No. of schemes:	Estimated Loss (Rs. in lakhs)	No. of schemes:	Estimated Loss (Rs. in lakhs)	No. of schemes:	Estimated Loss (Rs. in lakhs)
13.4	Irrigation Sector	0	0	0	0	0	0	1	14
13.5	Power Sector	1	75	0	0	0	0	1	21.92
13.6	Education Sector	No. of buildings.	Estimated Loss (Rs. in lakhs)	No. of buildings.	Estimated Loss (Rs. in lakhs)	No. of buildings.	Estimated Loss (Rs. in lakhs)	No. of buildings.	Estimated Loss (Rs. in lakhs)

13.6.1	Primary Schools (Damaged/Destroyed)	0	0	0	0	0	0	0	0
13.6.2	Middle Schools (Damaged/Destroyed)	0	0	0	0	0	0	0	0
13.6.3	High/Higher Secondary Schools (Damaged/ Destroyed)	0	0	0	0	0	0	0	0
13.6.4	Other educational institutes (Damaged/Destroyed)	0	0	0	0	0	0	0	0
13.7	Health Sector	0	0	0	0	0	0	0	0
13.7.1	PHCs (Damaged/Destroyed)	0	0	0	0	0	0	0	0
13.7.2	CHCs(Damaged/Destroyed)	0	0	0	0	0	0	0	0
13.7.3	Other Buildings (Damaged/Destroyed)	0	0	0	0	0	0	0	0
14	Total Estimated damage to Houses, Crops and Public Properties.	0	509.56	0	26.39	0	9.2	0	4712.93

Source: Kerala State Disaster Management Authority

Table : 5.16 Frequently Occuring Natural Disasters in Kerala 2012-13

Sl. No	Type	Affected Districts	Affected Population in Lakhs
1	Cyclones	Alappuzha, Idukki, Thrissur, Kannur, Kozhikode	14.2
2	Floods	Thiruvananthapuram, Pathanamthitta, Kollam, Alappuzha, Kottayam, Idukki, Ernakulam, Thrissur, Malappuram, Kozhikode, Kannur, Wayanad	28.91
3	Drought	Thiruvananthapuram, Kollam, Pathanamthitta, Alappuzha,Kottayam, Idukki, Ernakulam, Thrissur, Palakkad, Malappuram, Kozhikode, Kannur, Wayanad, Kasaragod	5.25
4	Earthquake	Kozhikode	0.002
5	Landslide	Palakkad, Kozhikode, Ernakulam, Kannur	0.04
6	Hailstorm	Palakkad & Idukki	0.04
7	Fire	Palakkad, Idukki, Kannur	0.00131

Source: Kerala State Disaster Management Authority

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CHAPTER-VI

WATER

CHAPTER - VI

WATER

Introduction

Kerala has got 41 west-flowing and 3 east-flowing rivers were originating from the Western Ghats. The total annual yield of all these rivers together is 78.041 Million Cubic Meters (MCM) of which 70,323 MCM is in Kerala. The peculiarity of the rivers flowing across Kerala is short length of the river and the elevational difference between the high and the low land leading to quick flow of water collected from the river basin and quickly discharged into the Lakshsdweep sea, the state has not been able to utilise the river water sources to a major extent. The major portion of the runoff through the rivers takes place during the monsoon seasons. 67.29% of the surface water area of 3.61 lakh hectares is constituted by brackish water lakes, backwaters and estuaries. Kerala gets on an average of 307 cms rainfall, in which 70% is received during the South-West monsoon which sets in by June and extends upto September. The State also gets rains from the North-East monsoons during October to December. The State gets severe summer from January to May when the rainfall is minimum. The two monsoons have a direct bearing on the ground water potential of the state which also follows the same seasonal trends.

The ground water level receding drastically during the summer months and drying up of wells are common features of the ground water levels in many parts of Kerala. The ground water replenishment and hence the levels depends also on the geo-morphological, physical and chemical properties of the soil in general, the depth of water level in Kerala state varies from few cm bgl to 56 M bgl and most of the area fall under 0-20 M bgl. The depth of the water level in the weathered crystalline of midland areas in Kerala varies from 3- 16 M bgl. The midland area sustains medium capacity dugwelts Borewells tapping deeper fractured aquifer are feasible along potential features in the midland and hill ranges. Potential fractures are seen down to 240 M and

the most productive zone is between 60 M and 175 M. The discharge of borewells range between 3,600 Iph and 1,25,000 Iph. In laterites, which is the most widely distributed lithological area in the state having a thickness from a 3 M to 30 M, the depth of water level ranges from less than a meter to 25 M.bgl. lateries from potential aquifer along valleys and can sustain wells with yields in the range of 0.5 M3 to 6 M3 per day. Along the coastal plains the ground water occurs at depth ranging from less than a meter to 6 M.bgl. filter point wells are feasible wherever the saturated availability indicate that ground water depths are farthest for laterite regions and shallowest for coastal alluvium during all times of the year. The availability of the groundwater level between the post and ore monsoon levels varies widely. The water level fluctuations in the post monsoon and ore monsoon vary between coastal alluvium, river alluvium and valley hills.

Table : 6.1 Primary water quality criteria for bathing water (water used for organized outdoor bating)

Cubic meter

criteria	**Rationale**
Faecal Coliform : 500 (desirable) MPN /100ml: 2500 (maximum permissible) Faecal Streptococci: 100 (desirable) MPN/100ml :500 (maximum permissible)	To ensure low sewage contamination, faecal coliform and faecal streptococci are considered as they reflect the bacterial pathogenicity. The desirable and permissible limits are Suggested to allow for fluctuation in environment conditions such as seasonal Changes, changes in flow conditions, and so on.
pH: between 6.5 and 8.5	The range provides protection of the skin and delicate organs like eyes, nose, ears, and so on, which are directly exposed outdoor bathing.
Dissolved oxygen : 5 mg/l or more	The minimum dissolved oxygen concentration of 5 mg/l ensures reasonable freedom from oxygen consuming organic pollution immediately U/s which is necessary for preventing production of anaerobic gases (obnoxious gases) from sediments.
Biochemical oxygen Demand : 3 mg/l or less 3 days at 270 C	The biochemical oxygen demand of 3 mg/l or less of the waiter ensures reasonable freedom from oxygen demanding pollutants and prevent production of obnoxious gases.

Source: Kerala State Pollution Control Board

Table : 6.2 Water Quality Criteria (CPCB) 2012-13

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

Source: Kerala State Pollution Control Board

Table : 6.3 Storage levels in Reservoirs

Cubic Meter

Sl. No.	Item	2011	2012	2013
1	Storage of water on the beginning of the monsoon year	525	403.69	280.59
2	Storage of water at the end of the monsoon year	1274.26	744	1290.25
3	Increase in storage	749.26	340.31	1009.66
	Average for 10 Years			
5	Storage of water on the beginning of the monsoon year	431	430.8	395.63
6	Storage of water at the end of the monsoon year	1133	1116.76	1186.48
7	Increase in storage	702	686.56	790.85

Source: Economic Review

Table : 6.4 Name of Reservoirs

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

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

Source : Fisheries Department

Table : 6.5 Biological Water Quality Criteria (Bwqc) 2012-13

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

Source: Kerala Pollution Control Board

Table : 6.6 Navigable Waterways in Kerala 2012-13

Sl.No.	Name of the River	Length of the River	Navigable Length
1	Achenkoil	128	32
2	Anjarakandy	40	27.2
3	Ayroor	17	1
4	Bharatha Puzha	209	40
5	Chalakudy	130	16
6	Chaliyar	169	68.4
7	Chandragiri	105	12.8
8	Chittari	25	NA
9	Ithikkara	56	16
10	Kadalundi	130	43.2
11	Kallada	121	40
12	Kallayi	40	9.6
13	Kamom	27	1
14	Karamana	68	NA
15	Kariangode	64	24
16	Karuvannur	40	24
17	Kavvayi	31	9.6
18	Keecheri	51	NA
19	Korapuzha	40	24.8
20	Kuppam	82	24
21	Kuttiyadi	74	9.6
22	Mahe	54	24
23	Manimala	90	54.4
24	Manjeswar	15	3.2
25	Meenachil	78	41.6
26	Mogral	34	NA

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

Source: Fisheries Department

Table : 6.7 District Wise Brackish Water Area in Kerala 2012-13

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

Source: Fisheries Department

Table : 6.8 Fresh Water Lakes in Kerala

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

Source: Fisheries Department

Table : 6.9 Backwaters in Kerala

Sl.No.	Name of District	Sl. No.	Name of Backwaters	Area in (Ha)
1	Thiruvananthapuram	1	Poovar Kayal	30.93
		2	Poonthura Kayal	97.59
		3	Veli Kayal	22.48
		4	Kadinamkulam Kayal	346.88
		5	Anchuthengu Kayal	521.75
		6	Edava-Nadayara Kayal	157.65
		TOTAL		**1177.28**
2	Kollam	1	Paravoor Kayal	662.46
		2	Ashtamudi Kayal	6424.15
		3	Kayamkulam Kayal	140.58
		TOTAL		**7227.19**
3	Pathanamthitta	Nil		
4	Alappuzha	1	Kayamkulam	1511.75
		2	Poomeen Kayal	3.37
		3	Vadakkal Kayal	1.46
		4	Chethi Kayal	4.11
		5	Arthungal Kayal	5.96
		6	Pozhichal Kayal	20.41
		7	Vettakkalchal Kayal	27.1
		8	Vembanattu Kayal	10661.23
		TOTAL		**12235.39**
5	Kottayam	1	Vembanattu Kayal	2926.77
		TOTAL		2926.77
6	Idukki	Nil		
7	Enakulam	1	Vembanattu Kayal	2257.59
		2	Kochi Kayal	7503.80
		TOTAL		**9761.69**
8	Thrissur	1	Azhikode Kayal	82.02
		2	Kodungalloor Kayal	613.81
		3	Chettuva Kayal	713.87
		4	Pattikkara Kayal	-
		5	Manakkady Kayal	-
9	Palakkad	NIL		
10	Malappuram	1	Puthupponnani	150.83
		2	Ponnani Kayal	757.19
		3	Poorapuzha	62.98
		4	Kadalundi Kayal	323.56
		TOTAL		**1294.56**

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

Source : Fisheries Department

Rivers

There are 44 rivers in Kerala with the length of main stream exceeding 15 Km. Out of this 44 rivers, 41originate from the Western Ghats region on the east of the state and flow westward to join the Lakshadweep sea; The remaining three rivers (Kabani, Bhavani and Paambar) originate from the Western Ghats and floe towards the east and finally join the Bay of Bengal, after flowing through the neighbouring states.

Table : 6.10 List of 44 major rivers of Kerala

Sl. No.	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
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
39	Uppala			Arabian Sea	50
40	Valapattanam	Brahmagiri Forests		Arabian Sea	112
41	Vamanapuram			Anchuthengu Lake	80
Length of the rivers are approximate measures and are likely to vary with time and season.					
#	**East Flowing Rivers**			**Length (km)**	
42	Paampar	Paampar and Bhavani flows into Tamilnadu. Kabani enters Karnataka. All three of them empties into Kaveri		Flows only a few kilometres through Kerala	
43	Bhavani				
44	Kabani				

Source : Fisheries Department

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

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)	7.8	6.7	7.25	7.1	4.6	6.61	1	0.2	0.63	1200	500	940	B
		Aruvippuram (Perumkadavila Village)	7.5	6.8	7.15	7.7	5.7	6.91	0.8	0.2	0.52	1600	300	774	B
2.	Mamom	Mamom Bridge (Attingal Village)	7.9	6.4	7.15	7.7	0.6	5.77	1.3	0.3	0.79	1700	300	942	C
3.	Ayroor	Ayoor Bridge (Ayroor Village)	7.9	6.6	7.25	7.3	4.7	6.54	1	0.4	0.78	2400	900	1533	B
4.	Karamana	Aruvikkara	7.8	6.4	7.09	7.7	6.5	7.04	0.9	0.2	0.45	630	240	496	A
		Moonnattumukku (Thiruvallom village)	7.5	6.5	7.19	6.3	0	2.65	32	0.5	12.38	54000	350	18779	E
5.	Ithikkara	Ithikkara Bridge	7.8	6.7	7.17	7.1	5.2	6.2	2.8	1.2	1.98	800	200	483	E
		Ayroor Bridge	7.7	6.6	7.21	7.8	4.5	6.42	2.8	0.8	1.86	1400	210	618	C
6.	Vamanapuram	Vamanapuram Village	7.8	6.8	7.48	7.6	5	7.05	1	0.4	0.75	2400	300	1097	B
	Pallickal	Nellimughal	7.6	7.1	7.34	7	5	5.98	2.8	1	1.67	1300	170	597	B
7.	Achenkovil	Kallarakkadavu	7.4	6.5	7.06	7.1	4.9	6.31	2.5	0.8	1.27	900	310	593	B
		Chennithala	7.4	6.5	7.11	7.5	5.1	5.95	2.8	0.8	1.71	900	300	538	B
		Thumpamon	7.8	6.9	7.29	7.1	4.9	6.36	2.8	0.9	1.68	3500	110	788	B
		Pandalom	7.7	6.6	7.29	7.4	5.5	6.49	2.4	1.2	1.64	1300	300	545	B
	Kallada	Perumthottamkadav	7.4	6.8	7.13	7.7	4.2	6.73	2.8	1	1.61	1700	310	738	A

8.	Pamba	Pamba Down (Mannar Panchayath)	7.4	6.6	7.01	6.2	2.3	4.18	1.1	0.2	0.60	900	150	420	C
		Chenganoor Muncipality	7.5	6.8	7.17	7.2	5	6.12	1.8	0.2	0.72	430	210	311	C
		Thakazhy Panchayath	7.4	6.4	6.96	6.2	2.2	4.34	1.7	0.1	0.74	600	280	391	E
9.	Meenachil	Kidangoor Panchayath	7.8	6.6	7.19	7.9	5.2	6.97	1.2	0.3	0.55	6000	1700	3558	C
10.	Manimala	Thondara (Kuttoor Panchayath)	7.2	6	6.74	7.6	6.2	6.94	5.9	0.5	2.49	1700	220	701	C
		Kallooppara Panchayath	7.5	6	6.77	7.9	5.4	7.24	2.4	0.2	1.16	1700	460	941	C
11.	Periyar	Eloor (Kadungallore Panchayath)	7.6	6.4	7.04	7.8	2.4	5.52	4.4	0.8	2.22	4000	230	1894	Below E
		Kalady Panchayath	7.6	6.6	7.18	7.8	6.3	7.22	4	0.2	1.33	1600	220	828	C
		KWA Aluva Muncipality	7.4	6.1	6.99	7.3	5	6.51	2.9	0.3	1.43	3000	80	1221	C
		SOP Aluva Muncipality	7.6	6.6	7.03	7.1	5.7	6.25	2.8	0.3	1.55	3000	210	1876	C
		Pathalam (Kadungallore Panchayath)	7.9	6.3	6.99	7.3	3.9	5.86	3.5	0.8	2.22	3500	110	1284	Below E
		Kalamassery Muncipality	8	6.6	7.02	7.2	1.9	4.57	2.8	0.6	1.68	4300	240	1937	C
		Purapallikadavu (Chengamanadu Panchayath)	7.6	6.4	6.93	7.7	5.1	6.50	3.2	0.5	2.01	3500	130	1573	E
		Muppathadam (Kadungallore Panchayath)	7.9	6.9	7.24	7.5	5.6	6.37	2.5	0.6	1.41	2600	80	1357	C

12.	Moovattupuzha	Vettikkattumukku (Mevallore Panchayath)	7.8	6.7	7.24	7.4	6.3	6.8	0.8	0.3	0.58	4000	1200	2392	C
13.	Chalakudy puzha	Pullickakadavu (Kadakutty Panchayath)	7.5	6.5	6.93	6.9	3.8	5.6	2.4	0.3	1.23	1700	80	990	C
14.	Karuvanoor	Karuvanoor Bridge (Porathissery Village)	7.7	6.5	6.97	6.6	4.4	6.06	3.6	0.6	1.73	920	50	305	C
15.	Puzhakal	Puzhakkal Bridge (Adat Panchayath)	7.6	6.2	6.79	8.1	2.7	5.28	4.6	2	2.79	2100	60	523	D
16.	Keecheri	Vadakkancherry (Eranellur Village)	7.6	6.4	6.98	7.7	3.3	6.29	4	0.4	2.70	2000	80	543	C
17.	Bharathapuzha	Kuttippuram Panchayath	8.1	7.3	7.69	7.6	6.2	6.86	1.4	0.2	0.72	1600	80	443	C
		Pattambi Panchayath	8.5	7.4	7.87	7	6.2	6.65	1.4	0.2	0.9	900	7	426	C
18.	Kadalundi	Thirurangadi Village	7.05	6.5	6.93	8	5.9	6.72	2.2	1	1.62	1600	80	704	C
		Hajiyarpally (Panakad Village)	7.41	6.5	6.93	7.8	6	6.81	2.7	0.8	1.77	2400	60	708	C
19.	Tirur	Thalakkadathur (Cheriyamundam Village)	7.6	6.5	6.83	7.8	2.3	4.86	3	0.6	1.63	2200	100	614	Below E
20.	Chaliyar	Koolimadu (Chathamangalam Panchayath)	8	6.5	7.4	8	6.8	7.29	1.7	0.4	0.84	8000	300	4208	C
		Nilambur	7.9	7.1	7.38	8.5	5.7	7.14	0.8	0.5	0.62	6000	240	2831	C
		Chungapally (Perumana Panchayath)	8	6.4	7.32	7.6	6.1	6.94	1.6	0.4	0.84	8000	50	2440	Below E

21.	Kabani	Muthankara (Mananthavadi Panchayath)	8.3	7	7.51	7.8	5.9	6.94	0.9	0.2	0.51	120	31	92	A
22.	Bhavani	Elaichivazhi (Agali Panchayath)	8.5	7.1	7.85	7.8	4.3	6.88	2.4	0.2	0.63	1600	12	293	A
23.	Kuttiyadipuzha	Estatemukku (Chakkittappara Panchayath)	7.8	6.1	6.85	8	5.7	7.19	2	0.5	1.08	2000	170	683	A
24.	Mahe	Valayam (Valayam Panchayath)	8	6.9	7.24	8	6.4	7.27	1.8	0.6	0.88	60000	110	7721	C
25.	Kallai Puzha	Kallai Bridge (Kozhikode Corporation)	7.9	6.8	7.29	7.8	0	3.27	5	1.2	2.6	400000	400	112867	Below E
26.	Korapuzha	Kanayankode	7.7	6.8	7.24	7.4	5.2	6.08	2	0.4	0.86	13000	600	2975	Below E
27.	Kuppam	Taliparamba (Taliparamba Village)	7.1	6.4	6.73	8.6	3.1	5.89	3.4	0.3	1.45	800	200	377	E
		Rayoram (Alakkode Village)	7.2	6.4	6.82	8.5	7	7.83	3	0.2	1.37	800	110	319	C
28.	Thalassery	Pathipalam (Patyam)	7.4	6.1	6.55	8	3.7	5.95	2.7	0.6	1.45	600	280	398	C
29.	Ancharakkandy	Ancharakkandy Village	6.9	6.2	6.59	8.3	5.2	6.94	3	0.5	1.52	800	260	435	E
		Meruvamba (Vengad Village)	6.8	6.3	6.63	8	5.4	6.68	2.2	0.3	1.23	900	120	435	C
30.	Ramapuram	Ramapuram Bridge (Cheruthazham Village)	7	6	6.53	5	2.4	3.63	2.8	1.1	1.84	600	110	261	E
31.	Kavai	Kuttiyolpalam (Peralam Village)	6.6	6.1	6.38	7.6	4.4	6.03	3.1	0.7	2.11	600	140	300	C

32.	Valapattanam	Parassanikkadavu	7.1	6.4	6.83	8	5.5	6.63	1.9	0.2	1.14	900	110	347	E
33.	Neeleswaram	Hosdurg (Neeleswaram Village)	7.8	5.7	6.9	7.7	5.1	6.37	2.1	0.3	.97	600	70	277	E
		Nambiarckal (Hosdurg Village)	8	5.5	6.61	7.7	4.7	6.26	2.8	0.8	1.25	700	4	278	D
34.	Karingode	Kakkadavu (Cheemeni Village)	7.5	5.9	6.93	8.2	5	7.03	2.8	0.4	1.13	600	50	317	C
35.	Chandragiri Puzha	Padiayathadka	7.6	6	6.86	8.1	5.6	7.22	3.4	0.5	1.25	700	4	150	C
36.	Mogral	Mogral Bridge (Mogral Village)	7.6	6.1	7.00	8	1.6	5.90	2.9	0.2	1.48	1100	4	253	E
37.	Shriya	Angadimogaru Village	7.4	6.4	6.74	8	5	6.91	3.2	0.7	1.84	800	11	205	C
38.	Uppala	Uppala Bridge (Uppala Village)	7.6	6.2	6.99	8	2.7	6.33	3	0.2	1.43	1600	4	201	E
39.	Manjeswaram	Bajrakkara Bridge (Vorcadi Village)	7	6.2	6.73	8.3	6.7	7.48	3	0.7	1.64	540	11	109	C
40.	Peruvamba	Chandrapura (Kadanapally Village)	6.7	6.1	6.40	7.9	4.7	6.35	2.6	0.5	1.24	900	140	376	C

Source: State Pollution Control Board

Watersheds

A watershed is a georgraphical area that drains to a common point, which makes it an ideal unit of conservation of soil and water. Micro Watershed in the Grama Panchayat are chosen for easy administration. It is a logical unit for planning in the three tier system of Local Self Government and optimum development of the "resource trinity" namely land, water and biomass. It may extend over a Grama Panchayat or several Panchayts, contain both arable and non-arable lands, various categories of land-holdings and farmers whose action may impact on each other's interest. In those Watersheds extending beyond a Grama Panchayat, the Panchayat having major area in the Watershed will be the Programme Implementing Agency.

The Programme Implementing Agency should arrange collection and compilation of baseline data on land use pattern, cropping pattern, productivity od important crops, water level of wells and ponds, socio-economic data of watershed population etc. before starting any intervention in the project area.

Table : 6.12 Watersheds during 2012-13

Sl. No.	District	Name of Watershed	Area in Ha	Panchayat	Status
1	Thiruvananthapuram	Perayam	297	Vithura	Ongoing
		Aliyad	600	Manickal	Ongoing
		Iruloor	799	Vamanapuram	Ongoing
2	Kollam	Ambara	260	Pavithreswaram	Ongoing
		Thottuva	486	West Kallada	Ongoing
3	Pathanamthitta	Thenginal	250	Pallickal	Ongoing
		Melood	535	Pallickal	Ongoing
		Elamannoor I	710	Enadimangalam	Ongoing
		Elamannoor II	380	Enadimangalam	Ongoing
		Kodumudi	450	Chittar, Vadaserikkara	Ongoing
		Arthakandanmoozhy	350	Aruvappulam	Ongoing
		Paruthymoozhy	245	Aruvappulam	Ongoing
		Mannadi	173	Kadambanad	Ongoing
		Puthusseribhagam	255	Erathu	Ongoing
4	Kottayam	Parappallythode	600	Meenachal	Ongoing
		Uppukulam	496	Manimala	Ongoing

5	Idukki	Asarikkavala	428	Erattayar	Ongoing
		Ezhikumvayal-Kumbanmala	611	Nedumkandom	Ongoing
		Kuzhitholu-Kambanmettu	933	Karunapuram	Ongoing
6	Ernakulam	Mattathukandomthode	556	Keerampara	Ongoing
		Kakkad	367	Piravom	Ongoing
7	Thrissur	Thommana Padinjarepadam	590	Velukkara	Ongoing
		Karigachirapadam	516	Puthenchira	Ongoing
8	Palakkadu	Mulankavu	610	Kulukkallur	Ongoing
		Velladikkunnu	580	Thirumittakkode	Ongoing
9	Malappuram	Moorkanadthode	590	Moorkanad	Ongoing
		Athithode	550	Vazhikkadavu	Ongoing
		Neettilthode	800	Mankada	Ongoing
10	Kozhikode	Elambilathmoozhithode	607	Perambra	Ongoing
		Manthrathode	434	Karasseri	Ongoing
11	Wayanadu	Nedunilam	475	Kalpetta Municipality	Ongoing
		Karikkilode	350	Vengappally	Ongoing
		Kokkuzhy	706	Kottathara	Ongoing
		Chingadikkunnu	187	Kaniyanbetta	Ongoing
		Naduvanthar Sarvany	374	Thirunelly	Ongoing
		Vattathoor	144	Mullankolly	Ongoing
		Karachal	445	Amabalavayal	Ongoing
		Kallumukku	286	Noolpuzha	Ongoing
		Thalippuzha	250	Vythiri	Ongoing
		Sreepuram-Kakkampuzha	444	Vythiri	Ongoing
		Ayiramkolly	195	Ambalavayal	Ongoing
12	Kannur	Rayarome	460	Alkoode	Ongoing
		Padappengad	430	Chapprappadavu, Naduvil	Ongoing
		Adicheri Thazhathuvayal	300	Malapattom	Ongoing
13	Kasaragod	Pookkayam I	217	Panathady	Ongoing

Source : Western Ghats Development Programme

Coast Line of Kerala

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

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

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

Source : Fisheries Department

Table : 6.14 Summary of major components of Dynamic Ground Water Resources of Kerala-2011

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

Source: Ground Water Department, Kerala

Table : 6.15 Annual Ground Water Recharge 2010-11

Sl. No	District	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	452.90	29.92	100.40	130.32	103.72	319.27	28.78
2	Ernakulam	583.27	103.08	139.31	242.40	152.96	37.22	41.56
3	Idukki	196.55	28.74	54.96	83.70	59.85	107.96	42.58
4	Kannur	480.13	109.43	109.39	218.82	119.32	251.37	45.8
5	Kasargod	328.89	167.05	67.75	234.80	77.98	83.87	71.39
6	Kollam	422.21	40.15	119.33	159.48	130.16	251.90	37.77
7	kottayam	445.70	34.91	92.14	127.05	107.04	303.75	28.51
8	Kozhikkode	344.62	52.00	140.24	192.24	157.93	134.69	55.78
9	Malappuram	495.55	81.66	202.35	284.04	243.01	169.96	57.31
10	Palakkad	783.83	354.94	131.51	486.46	141.97	288.94	62.06
11	Pathanamthitta	253.02	34.63	60.04	94.67	63.04	155.34	37.42
12	Thiruvananthapuram	322.71	39.85	133.16	173.01	146.99	141.87	52.63
13	Thrissur	681.53	221.67	137.20	358.88	152.16	307.69	52.66
14	Wayanad	276.07	6.52	43.19	49.71	48.16	221.39	18.09

Source: Ground Water Department, Kerala

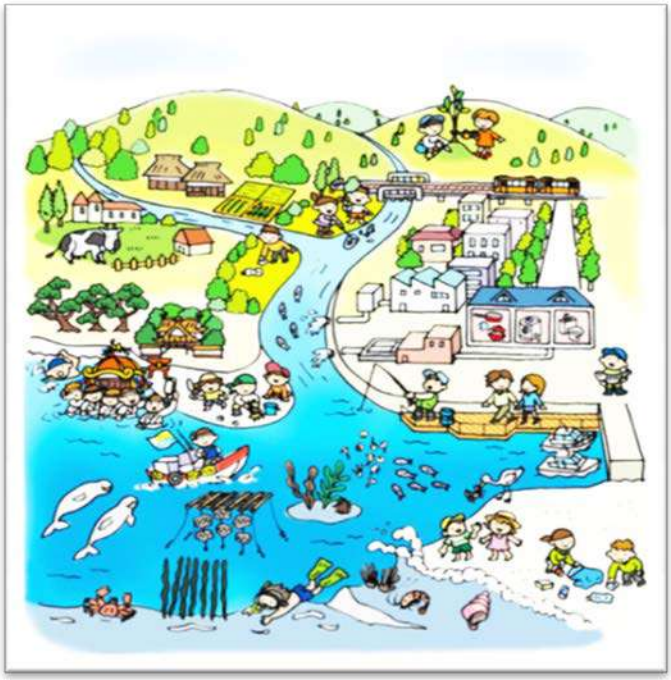
Table : 6.16 Ground Water Resources 2008-09

Sl. No.	Districts	Total Annual ground water Recharge	Natural discharge during non monsoon season	Net Annual Ground water availability	Annual ground water draft			Projected demand for domestic and industrial needs for 2025	ground water availability for future irrigation	Stage of ground water development in %
					Irrigation	Domestic & industrial uses	Total			
1	Thiruvananthapuram	33216.68	2742.69	30473.99	3984.99	13115.79	17100.78	14699.38	11789.61	56
2	Kollam	44923.48	3996.81	40926.67	4014.95	11696.2	15711.15	13101.55	23810.17	38
3	Pathanamthitta	31061.23	2649.97	28411.26	3462.73	5961.62	9424.34	6304.4	18644.13	33
4	Alappuzha	48375.37	3010.27	45365.1	2991.87	9942.97	12934.84	10371.6	32001.63	29
5	Kottayam	52284.74	4969.19	47315.55	3490.69	9106.64	12597.33	10704.21	33120.65	27
6	Idukki	21838.47	2183.85	19654.62	2873.72	5424.21	8297.93	5985.33	10795.57	42
7	Ernakulam	61572.07	5837.16	55734.91	10308.23	13667.45	23975.68	15254.34	30172.34	43
8	Thrissur	69947.41	5887.78	64059.63	22167.5	13505.79	35673.29	15216.4	26675.72	56
9	Palakkadu	87095.02	7570.24	79524.78	35494.33	12922.97	48417.3	14179	30042.42	61
10	Malappuram	53138.68	4707.63	48431.05	8166.42	19784.7	27951.12	24392.42	15872.22	58
11	Kozhikode	38377.55	3639.31	34738.24	5200.4	13771.26	18971.66	15792.55	13745.3	55
12	Wayanadu	30697.6	3069.76	27627.84	652	4116	4768	4815.95	22159.89	17
13	Kannur	53116.62	5205.53	47911.09	10943.46	10795.13	21738.59	11932.2	25035.44	45
14	Kasargod	36360.33	3636.03	32724.3	16704.87	6628.62	23333.49	7797.96	8221.48	71
TOTAL		**662005.3**	**59106.22**	**602899.03**	**130456.2**	**150439.53**	**280895.10**	**170547.3**	**302086.6**	**47**

Source: Ground Water Department, Kerala

CHAPTER-VII

HUMAN SETTLEMENT



CHAPTER - VII

HUMAN SETTLEMENTS

Population

Kerala is the leading state of India in terms of social development. The state is currently home to about 2.76% of India's total population. Present Population of Kerala is estimated to be 34 million. A large number of populations in Kerala belong to Malayali ethnicity. In terms of Population, Kerala is the twelfth largest state of India. Kerala is the only state in the country which has the lowest positive population growth rate in India. During 2001-2011, the state has added only 1.5 million people to its population. Thus, Kerala adds around 1.5 lakh human beings to its population each year which is considered to be descent in India. The state has shown major signs of improvement in social development of the people living there. The state also tops the chart in maintaining a highest literacy rate of 95% which is far above the national figure of 74.04% in India. There are 1084 women available for every 1000 males in the state, thus its sex ratio is considered to be the best of all Indian States. From 1951 to 1991, Population growth in Kerala was steady, from there on there has been a decrease in the population growth rate. Between 1991 to 2001, there was a growth of 9.4% in population of Kerala, this further was down to 4.9% in last finished Census of 2011. Kerala has witnessed a slow population growth rate in the last 20 years.

Kerala's religious population presents a cultural backdrop of various religions living together with peace and harmony. Hinduism is the most dominant religion with 56% Kerala Hindus in the state. Islam is the second largest group with a population of 24.7%. There are many languages that are widely spoken in Kerala. Malayalam is the official language of the state. Almost 96% of the total population in Kerala speaks Malayalam, followed by Tamil which is spoken by Tamil people in the state. According to Census of India 2011, about 2.8 million Keralites reside outside and permanently settled abroad. More than 70% of these are settled in UAE, Saudi Arabia, Oman and Qatar. Muslims forms 45% of this majority followed by Hindus (37.5%) and Christians (17.5%) respectively.

Table :7.1 Profile of Kerala State 2012-13

Sl. No	District	Total Land Area (Sq.km)	Number of Villages	Population (Lakhs)	Literacy Rate (%)	Cropped Area (in 000 Ha.)	% of SMF*	Inter-State Rivers	Normal Annual Rainfall (mm)
1	2	3	4	5	6	7	8	9	10
1	Thiruvananthapuram	2192	121	33.01	93.02	155065	100	0	1803.1
2	Kollam	2492	104	26.35	94.09	161466	75	3	2491.1
3	Pathanamthitta	2637	68	11.97	96.55	99719	75	0	2957
4	Alappuzha	1414	91	21.28	95.72	219100	95	0	2840.5
5	Kottayam	4358	64	19.74	97.21	15522	70	0	2931
6	Idukki	2208	95	11.09	91.99	51652	80	0	3303.1
7	Ernakulam	3068	124	32.82	95.89	7731	72	0	3028.7
8	Thrissur	3032	254	31.21	95.08	1700.57	74	2	3063.8
9	Palakkadu	4480	156	28.1	89.31	31471	100	0	2288.1
10	Malappuram	3550	135	41.13	93.57	18784	100	1	2835.1
11	Kozhikode	2344	117	30.86	95.08	300	50	0	3383.8
12	Wayanadu	2132	49	8.17	89.03	207930	80	4	3250.9
13	Kannur	2966	129	25.23	95.10	226570	96	0	318.7
14	Kasargod	1991.66	127	13.07	90.09	140757	99	8	3619.9
	Kerala	**38,865**	**1,634**	**334**	**93.70**	**1,337,768**	**83.29**	**18**	**2,924.30**

Source: Agricultural Department

Table : 7.2 Current Population of Kerala

Sl. No.	Name	Persons	Males	Females	Sex Ratio
1.	Kasaragod	13,02,600	6,26,617	6,75,983	1079
2.	Kannur	25,25,637	11,84,012	13,41,625	1133
3.	Wayanad	8,16,558	4,01,314	4,15,244	1035
4.	Kozhikode	30,89,543	14,73,028	16,16,515	1097
5.	Malappuram	41,10,956	19,61,014	21,49,942	1096
6.	Palakkad	28,10,892	13,60,067	14,50,825	1067
7.	Thrissur	31,10,327	14,74,665	16,35,662	1109
8.	Ernakulam	32,79,860	16,17,602	16,62,258	1028
9.	Idukki	11,07,453	5,51,944	5,55,509	1006
10.	Kottayam	19,79,384	9,70,140	10,09,244	1040
11.	Alappuzha	21,21,943	10,10,252	11,11,691	1100
12.	Pathanamthitta	11,95,537	5,61,620	6,33,917	1129
13.	Kollam	26,29,703	12,44,815	13,84,888	1113
14.	Thiruvananthapuram	33,07,284	15,84,200	17,23,084	1088
	Kerala	**3,33,87,677**	**1,60,21,290**	**1,73,66,387**	**1084**

Source: Census 2011

Table : 7.3 Urban-Rural, No.of Households, Total Population, Male , Female 2013

District Name	Rural / Urban	No.of house holds	Total Population	Male	Female
Thiruvananthapuram	Total	837877	3301427	1581678	1719749
	Rural	390967	1529831	724864	804967
	Urban	446914	1771596	856814	914782
Kollam	**Total**	**669375**	**2635375**	**1246968**	**1388407**
	Rural	376679	1448217	680687	767530
	Urban	292696	1187158	566281	620877
Pathanamthitta	**Total**	**322684**	**1197412**	**561716**	**635696**
	Rural	287615	1065799	499820	565979
	Urban	35069	131613	61896	69717
Alappuzha	**Total**	**535958**	**535958**	**1013142**	**1114647**
	Rural	248616	248616	464713	514930
	Urban	287342	287342	548429	599717
Kottayam	**Total**	**487296**	**1974551**	**968289**	**1006262**
	Rural	346899	1409158	692673	716485
	Urban	140397	565393	275616	289777
Idukki	**Total**	**279812**	**1108974**	**552808**	**556166**
	Rural	267208	156929	527245	529684
	Urban	12604	52045	25563	26482
Ernakulam	**Total**	**814011**	**3282388**	**1619557**	**1662831**
	Rural	259915	1048025	51851	529515
	Urban	554096	2234363	1101047	1133316
Thrissur	**Total**	**759210**	**3121200**	**1480763**	**1640437**
	Rural	250877	1024794	488303	536491
	Urban	508333	2096406	992460	1103946
Palakkad	**Total**	**637220**	**2809934**	**1359478**	**1450456**
	Rural	4825285	2133124	1031466	1101658
	Urban	154935	676810	328012	348798
Malappuram	**Total**	**793999**	**4112920**	**1960328**	**2152592**
	Rural	448037	2295709	1095308	1200401
	Urban	345962	1817211	865020	952191
Kozhikode	**Total**	**697710**	**3086293**	**1470942**	**1615351**
	Rural	235703	1013721	484784	528937
	Urban	462007	2072572	986158	1086414
Wayanad	**Total**	**190894**	**817420**	**401684**	**415736**
	Rural	183375	785840	386283	399557
	Urban	7519	31580	15401	16179
Kannur	**Total**	**554298**	**2523003**	**1181446**	**1341557**
	Rural	202229	882017	425682	456335
	Urban	352069	1640986	755764	885222
Kasaragod	**Total**	**273410**	**1307375**	**628613**	**678762**
	Rural	169240	798328	387716	410612
	Urban	104170	509047	240897	268150

Source: Economic Review 2013

Table :7.4 Distict Wise SC/ST Population (2011 Census)

District	Total Population			Scheduled Caste			Scheduled Tribes		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
Kasaragode	628613	678762	1307375	26385	26898	53283	23950	24907	48857
Kannur	1181446	1314557	2353003	40260	43090	83350	20141	21230	41371
Wayanad	401684	415736	817420	16406	16172	32578	74476	76967	151443
Kozhikode	1470942	1615351	3086293	97279	101912	199191	7429	7799	15228
Malappuram	1960328	2152592	4112920	151557	156709	308266	11272	11718	22990
Palakkad	1359478	1450456	2809934	197451	26382	503833	24314	24658	48972
Thrissur	1480763	1640437	3121200	156480	167870	324350	4342	5068	9430
Ernakulam	1619557	1632831	3282388	131573	136838	268411	8349	8210	16569
Idukki	552808	556166	1108974	72399	73087	145486	27995	27820	5815
Kottayam	968289	1006262	1974551	75503	78406	153909	10974	10998	21972
Alappuzha	1013142	1114647	2127789	97183	104028	201211	3175	3399	6574
Pathanamthitta	561716	635696	1197412	78942	85523	164465	3947	4161	8108
Kollam	1246968	1388407	2635375	157801	170462	328263	5185	5566	10761
Thiruvananthapuram	1581678	1719749	3301427	178589	194388	372977	12624	14135	26759
Kerala	**16027412**	**17378649**	**33406061**	**1477808**	**1561765**	**3039573**	**238203**	**246636**	**484839**

Source: Economic Review 2013

Table :7.5 District wise Fisherman Population in Kerala – Census 2011

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

Source: Fisheries Department.

Table : 7.6 District Wise Percentage of Household by Number Of Dwelling Rooms

District Name	Rural/ Urban	Number of Dwelling Rooms						
		No exclusive room	One room	Two rooms	Three rooms	Four rooms	Five rooms	Six rooms and above
Thiruvananthapuram	Total	1.3	8.5	24.8	32.3	20	7.8	5.3
	Rural	1.5	8.9	25.8	32.8	20	7	4.1
	Urban	1.2	8	23.9	31.9	20.1	8.5	6.4
Kollam	Total	1.1	7.7	26	32.5	20.6	7.3	4.7
	Rural	1.3	7.8	27.1	32.5	20.3	6.9	4.2
	Urban	1	7.7	24.6	32.5	21.1	7.8	5.3
Pathanamthitta	Total	1.1	6.5	29.7	29.3	19.6	8.2	5.7
	Rural	1.1	6.3	30.1	29.4	19.5	8	5.5
	Urban	1.2	7.5	25.9	27.7	20.2	10	7.5
Alappuzha	Total	0.9	7.7	29.2	30.4	19.5	7.3	5
	Rural	1.1	8.2	30.2	30.7	18.9	6.7	4.2
	Urban	0.8	7.3	28.4	30.1	20	7.8	5.6
Kottayam	Total	0.8	5.9	27.2	31.3	20	8.5	6.4
	Rural	0.9	6.1	27.7	31.5	19.6	8.2	6
	Urban	0.7	5.4	25.7	30.8	21	9.2	7.3
Idukki	Total	1.2	13.4	26.7	30.3	18.1	6.3	4
	Rural	1.2	13.9	27	30.3	17.8	6.1	3.7
	Urban	0.7	3.6	19.2	30.4	24.4	10.9	10.8
Ernakulam	Total	0.8	5.3	19.9	35.1	23.7	8.8	6.4
	Rural	0.8	5.7	21.1	34.5	23.8	8.3	5.7
	Urban	0.7	5.2	19.3	35.3	23.7	9	6.8
Thrissur	Total	1.1	6.7	22.4	34.2	22.2	8.1	5.4
	Rural	1.2	7.1	24.5	35.2	21.3	6.7	3.9
	Urban	1	6.5	21.4	33.7	22.6	8.8	6.1
Palakkad	Total	1.5	10.3	32	30.4	16.1	5.7	4.1
	Rural	1.6	10.5	32.3	30.5	15.9	5.4	3.7
	Urban	1.1	9.7	30.8	30	16.7	6.6	5.2

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

Source : House Listing & Housing Census 2011

Table : 7.7 District wise Infant Death Rates from 2010-13

Sl. No.	Districts	Rural/Urban	2010	2011	2012	2013
1	Thiruvananthapuram	Rural	0.24	1.76	2.80	1.83
		Urban	19.29	15.01	16.73	14.52
		Total	**14.63**	**12.13**	**13.76**	**12.08**
2	Kollam	Rural	0.54	1.87	1.91	1.39
		Urban	4.23	3.43	3.10	2.77
		Total	**2.05**	**2.62**	**2.50**	**2.10**
3	Pathanamthitta	Rural	5.82	5.62	4.54	4.50
		Urban	4.44	5.67	5.23	5.25
		Total	**5.19**	**5.64**	**4.87**	**4.87**
4	Alappuzha	Rural	15.54	9.78	10.21	9.07
		Urban	0.88	1.04	0.94	0.41
		Total	**5.72**	**4.39**	**4.72**	**4.11**
5	Kottayam	Rural	11.10	11.83	13.37	11.81
		Urban	3.14	3.44	2.00	1.17
		Total	**8.43**	**9.24**	**9.88**	**8.29**
6	Idukki	Rural	2.46	3.50	5.54	4.41
		Urban	1.71	1.43	2.16	1.22
		Total	**2.23**	**2.83**	**4.40**	**3.28**
7	Ernakulam	Rural	7.97	8.73	11.77	11.85
		Urban	9.12	8.12	8.44	7.24
		Total	**8.93**	**8.22**	**8.97**	**8.06**
8	Thrissur	Rural	10.06	10.99	12.40	14.38
		Urban	5.50	7.35	6.51	5.88
		Total	**6.98**	**8.48**	**8.33**	**8.54**
9	Palakkad	Rural	1.99	3.17	3.92	3.33
		Urban	3.63	4.08	2.78	3.30
		Total	**2.93**	**3.69**	**3.30**	**3.31**
10	Malappuram	Rural	3.08	3.87	4.36	4.42
		Urban	5.51	5.20	4.78	3.40
		Total	**4.17**	**43.60**	**4.59**	**3.83**
11	Kozhikkode	Rural	1.42	1.59	1.67	1.57
		Urban	25.19	23.87	27.49	24.79
		Total	**18.40**	**17.67**	**20.33**	**18.22**
12	Wayanad	Rural	3.67	6.12	5.26	4.38
		Urban	2.99	2.09	3.41	1.84
		Total	**3.50**	**4.97**	**4.74**	**3.72**
13	Kannur	Rural	16.60	20.12	20.23	20.09
		Urban	3.36	3.08	3.50	2.66
		Total	**5.61**	**6.03**	**6.42**	**5.48**
14	Kasaragod	Rural	1.86	4.11	2.86	2.95
		Urban	3.96	3.88	3.30	3.12
		Total	**3.10**	**3.97**	**3.16**	**3.06**
	Kerala	Rural	4.89	5.97	6.58	6.32
		Urban	9.10	8.45	8.86	7.73
		Total	**7.42**	**7.53**	**8.02**	**7.22**

Source : Department of Economics & Statistics

Water Supply

According to 1991 census, the State of Kerala has an urban population of 76.80 lakhs and rural population of 214.18 lakhs. The extent of water supply coverage in the State is presently 54% for the rural population and 78% for the urban population. The remaining population has to depend on open draw wells, ponds, natural stream etc. It has been estimated that 45% of the rural population depends on privately owned wells.

The Kerala Water Authority (KWA) is responsible for the design, construction, execution, operation and maintenance of most of the water supply schemes in the state and for the collection and disposal of the waste water. KWA is implementing water supply and sewerage schemes in both urban and rural areas and sewerage schemes in urban areas only. The source of water supply in the state of Kerala was primarily from surface water and groundwater. Surface water sources are primarily reservoirs / dams, rivers and canals and groundwater through wells. The Central Public Health Environmental Engineering Organisation (CPHEEO), Government of India, has prescribed the following norms for estimating the water demands for planning & design purposes based on the type of town/city. The water supply norms are 40 lpcd (litres per capita per day) in case of public stand posts, 70 lpcd in case of towns without underground drainage and 135 lpcd in case of towns with underground sewerage system and 150 lpcd in case of metropolitan cities having population more than one million. The state of Kerala has 58.89 percent of households in urban areas dependent upon wells for drinking purpose.

Table: 7.8 Location of Drinking Water Source

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

Source: Housing census 2011

Table : 7.9 Drinking Water Availability in Kerala – Source wise

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

Source: Housing census 2011

Table :7.10 District wise Water Supply Schemes Implemented by KRWSA31.3.2012

Sl.No.	District	No.of Schemes in Operation	No. of Water Supply connections			Population Covered
			Domestic	Non Domestic	Street Tap	
1	2	3	4	5	6	7
1	Thiruvananthapuram	84	3203	1	-	18821
2	Kollam	61	20285		-	107511
3	Pathanamthitta	60	2398	2	-	12709
4	Alappuzha	-	-	-	-	-
5	Kottayam	114	4120	8	-	21983
6	Idukki	94	2697	1	-	14950
7	Ernakulam	49	2173	-	-	13501
8	Thrissur	524	25398	9	7	139744
9	Palakkad	676	34840	31	680	209078
10	Malappuram	875	49176	87	-	319614
11	Kozhikkode	708	27155	25	-	157981
12	Wayanad	142	7397	11	60	39954
13	Kannur	174	5059	-	-	29080
14	Kasaragod	149	4320	-	-	24557
	Total	**3710**	**188221**	**175**	**747**	**1109483**

Source: Economic Review 2013

Table : 7.11 District wise Water Supply Schemes implemented by KWA30.9.2013

Sl. No.	District	Rural population covered	% to Total Rural Population	Urban Population Covered	% to Total Urban Population	Total Population Covered	% of Total Population
1	Thiruvananthapuram	1910867	89.18	958617	87.81	2869484	88.72
2	Kollam	1619265	76.41	453781	97.38	2073046	80.19
3	Pathanamthitta	888473	80.03	107700	87.00	996173	80.73
4	Alappuzha	1202805	80.85	528255	85.00	1731060	82.07
5	Kottayam	1197584	72.41	292663	97.62	1490247	76.28
6	Idukki	687801	64.18	55262	95.95	743063	65.80
7	Ernakulam	1600350	98.26	1425000	96.47	3025350	97.41
8	Thrissur	1952601	91.47	828354	98.68	2780955	93.50
9	Palakkad	1583342	70.03	340964	95.62	1924306	73.52
10	Malappuram	2107224	64.45	353850	99.35	2461084	67.88
11	Kozhikkode	760044	42.75	830762	75.44	1590806	55.25
12	Wayanad	694217	92.44	14835	50.10	709052	90.83
13	Kannur	1167377	97.60	708332	58.40	1875709	77.86
14	Kasaragod	869925	89.65	143298	61.32	1013223	84.15
	Total	**13241875**	**77.38**	**7041683**	**85.18**	**25283558**	**79.40**

Source: Economic Review 2013

Rural Water Supply

The RGNDWM during 1993 undertook a survey of the status of water supply in the rural areas of the country. According to this, there are 990 Panchayats and 9776 habitations (Wards in Kerala) in the State. Against 2289 Non-Covered(NC) habitations and 7422 Partially- Covered(PC) habitations, as on today there are still 994 NC habitations and 6889 PC habitations in the State which are yet to be taken up for implementing water supply facilities.

Urban Water Supply

There are 53 Municipalities, 1 Township and 5 Corporations in addition to nearly 100 classified Census Towns in Kerala of the Municipalities, nearly 20 have a supply level of less than 70 lpcd and as such require immediate augmentation.

Table:7.12 Categories of Water Connection

Sl.No	Category	Purpose
1	Domestic	To supply water for domestic purposes
2	Non-domestic	Other than domestic purposes (includes Special Casual Connection except industries)
3	Industrial	To supply water for manufacturing process which includes service stations, factories, Railways, Roadways, any other establishments where water is used as a raw material.
4	Casual	For construction, fairs, or any other temporary use etc. for a maximum period of one year

Strategy for Full Coverage

The Kerala Water Authority, Ground Water Department and Local Bodies have to go hand in hand with their schemes for achieving full coverage. The activities in this direction shall combine the traditional practices and modern technology as briefed below:

1	Early completion of ongoing water supply schemes of KWA
2	Improvement and rehabilitation of existing water supply schemes
3	Completion of mini water supply schemes by Local Bodies
4	Water conservation measures
5	Development and rejuvenation of traditional sources
6	Construction of new bore/tube wells
7	Repairing of non-functional bore/tube wells

Emissions, Residuals and Solid Waste Management

There has been significant importance given to implement the Municipal Solid Waste (Management & Handling) Rule, 2000 which envisages segregated storage of waste at source, collection from source, protected transportation to the treatment facility, establishment environmentally safe treatment system and its operation and maintenance and safe disposal of inert rejects. A sectoral status study on MSW management in Kerala, undertaken with the support of WSP- South Asia in 2007, indicated that the total MSW generation in the state is about 8300 tpd. These studies indicated that 70-80% of the total waste generated is biodegradable in nature and these putrescible waste needs to be managed within 24 hours. 13% of the waste is generated by the five City Corporations, 23% by the 53 Municipalities and the rest by the 999 Gram Panchayats.

The five City Corporations and 49 Municipalities and 44 Grama Panchayats are being supported for establishing full-fledged integrated MSW management facility with financial support from the plan allocation to the State and the Local Governments, funds under the Jawaharlal Nehru National Urban Renewal Mission (JNNURM), Urban Infrastructure Development Scheme for Small and Medium Towns (UIDSSMT) and Kerala Sustainable Urban Development Project (KSUDP) and own fund mobilized by the Local Governments.

Local Governments	**Population 2001**	**Per capita waste generation (g/day)**	**Waste generation per day (tonne)**	
			2001	**2006**
5 City Corporations	2456618	400	983	1091
53 Municipalities	5810307	300	1743	1935
999 Grama Panchayats	23574449	200	4715	5312
Total			**7441**	**8338**

Waste Water Treatment and Disposal

Wastewater disposal and treatment was a major problem in cities in Kerala. The waste water from toilets is been disposed through septic tanks and soak pits and grey form of wastewater from kitchen and bathrooms is directly discharged into the sludge drains without any treatment. As per Census 2011 45.45 percent of the urban households have “no drainage”. There are 14.32 percent of the households connected to centralized sewerage system.

School Sanitation

There are total of 15,310 schools in the state of Kerala out of which 2,346 are in urban areas. Provision of sanitation in schools is one of the primary needs for the holistic development of a child during school education years. The sanitation facilities should be age-set and gender appropriate 14 District Information Systems for Education

(DISE) [2011-12] Elementary Education in Urban and Rural India 22 Kerala State Sanitation Strategy (under NUSP 2008) through development of such relevant norms.

Table : 7.13 Hazardous waste generation Management of Waste

State and Central Government Schemes		2011-12			2012-13		
Sl. No.	**Scheme**	**Total Benefited**	**No.of new cases**	**Amount Spent (lakh)**	**Total Benefited**	**No. of new cases**	**Amount Spent (lakh)**
1	Cancer Suraksha Scheme (Govt. of Kerala)	1307	531	356.92	2463	510	427.85
2	Chis Plus (Govt. of Kerala)	1763	1763	252.22	8004	3171	1052.82
3	Karunya Benevolant Fund (Govt. of Kerala)	8	8	2.83	2166	89	457.16
4	Society for Medical Assistance to the poor (Govt. of Kerala)	325	61	30.67	0	0	0
5	Thalolam (Govt. of Kerala)	20	8	2.33	35	6	2.79
6	Comprehensive Health Care Scheme for Scheduled Caste/ Scheduled Tribes (STDD) (Govt. of Kerala)	69	24	11.01	220	33	21.30
7	Snehasanthwanam for Endosulphan victims (Govt. of Kerala)	16	16	5.62	18	0	12.15
8	Prime Minister's Relief Fund	140	68	44.09	508	40	101.76
9	Health Minister's Rashtriya Arogya Nidhi (RAN)	440	307	71.72	1220	378	239.51
	TOTAL	**4088**	**2786**	**777.41**	**14634**	**4227**	**2315.33**

Source : Suchitwa Mission

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Website: www.ecostat.kerala.gov.in, E-mail: ecostatdir@gmail.com

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