REBUILDING SECURITY IN AN AGE OF IN SECURITY

VACATION TRAINING PROGRAMME
ON
BIO RESOURCES FOR SCHOOL CHILDREN

TRAINING MANUAL

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PREFACE

The great variety of life on Earth that has provided man with all his needs since time immemorial forms a support system which has been used by civilizations for their growth and development. Our dependence on nature is so great that man cannot continue to live without protecting the earth's environmental resources.

Understanding the organization of plants and animals has helped in utilizing the Earth's biological wealth for the benefit of humanity and has been integral to the process of 'development'. This includes better health care, better crops and the use of these life forms as raw material for industrial growth. However this has also produced the modern consumerist society which adversely affects the diversity of biological resources upon which it is based. The diversity of life is so great that if we use it sustainably we can go on developing new products from biodiversity for many generations. This can only happen if we manage biodiversity as a precious resource and prevent the extinction of species.

India is rich in biodiversity. Besides providing resources for people it is also the basis for biotechnological development. So far only 1.8 million living organisms have been described and named globally and many more still remain to be identified and described. There are several attempts being made to conserve them. Intellectual Property Rights have become important in a biodiversity rich country like India to protect microbes, plants and animals. The destruction of habitats, overuse of resources and environmental degradation have been responsible for the loss of a large number of life-forms.

The importance of understanding our bioresources thus cannot be disputed. Our individual actions will determine the impact on these bioresources. Biological systems cannot go on replenishing resources if they are misused or overused. Prevention of environmental degradation must become a part of our lives. Just as for any disease prevention is better than cure protecting our environment is economically more viable than cleaning up once it is damaged.

To encourage and create an interest among students about the rich biodiversity of or country its importance the Training Service Scheme ,Kerala Agricultural University and Center for Environment and Development, Trivandrum has organed a four week Vacation Training Program on Bioresources for school students from 24th April to 20th May 2006. The program has been catalysed and supported by the National Bioresource Development Board (NDBD) of the Department of Biotechnology, Government of India. This program was designed for meritous students who have appeared the standard X examinations this year and are awaiting their results.

This course had helped the students in exploring the possibilities of pursuing a career in the science of bioresources. Students now can decide to pursue very interesting and satisfying careers in this field. This course had attempted to enhance awareness about bioresources, threats faced by them and possible conservation measures. Along with this they had a chance to develop problem solving skills through innovative sessions such as 'Meet the Scientists', audio-visuals, discussions, role plays, field trips, camps, demonstrations, lab activities and field projects. The notes provided to the students by the scientists is compiled and edited to form this book.

Thiruvanathapuram
1.11.2006

Dr. K. Rajmohan
Course Director

FOREWORD

Biodiversity is the most significant of the resources available to man. Conservation of biodiversity is essential as a source of particular biological resources, to maintain different ecosystem services and the resilience of ecosystems, and to provide options for the future. Unfortunately, these benefits of biodiversity have not been well reflected in our decision-making and resource manage-ment. Hence, the current rate of loss of biodiversity is alarmingly high. It is essential to conscientise the young generation on the necessity of conserving our biodiversity and to inculcate in them an appreciation of the rich bioresources of our country. Children are more receptive to new ideas and have the potential to influence their families more effectively than any outside motivator.

With this initiative, the Training service Scheme of the College of Agriculture, Kerala Agricultural University (KAU), Vellayani, Thiruvananthapuram and the Centre for Environment and Development (CED), Thiruvananthapuram jointly conducted a vacation training programme on bioresources for school children from 24th April 2006 to 20th May,2006. The programme was sponsored by the National Bioresource Development Board, Department of Biotechnology, Ministry of Science and Technology, Government of India.

I am happy to note that this course helped the school students for inculcating a sense of appreciation of the biological resources of the state , their use and management and provided them hands on experience for identifying the available bio resources , especially plants, insects, birds, aquatic organisms etc. in selected places in the southern districts of Kerala and collect and document information on them. I understand that the students had taken a project to document locally available bio resources in their locality, their sustainable use and conservation. This unique training had enabled the students to interact with a variety of scientists and experts in the field including core and visiting faculty at the host organizations and other organizations. This training manual which contains the useful information on subjects related to bioresourses will not only a reference book but also a guide for student to experiment and learn.

Mannuthy
20.12.2006

Dr. M.K.Sheela
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INTRODUCTION TO BIODIVERSITY AND NATURAL RESOURCE USE

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BIODIVERSITY

Biodiversity / Biological diversity is the variety of all living organisms on Earth; living things in all forms and combinations. BIO means life (living organisms). DIVERSITY means different from one another. The word biodiversity has come to mean 'the web of life' or 'all living things interconnected'.

Biodiversity includes:

- species diversity
- genetic diversity
- ecosystem diversity

Species: A group of related and similar living organisms that can interbreed among their own species and produce fertile offspring.

Species diversity: The different types of living organisms within a region or ecosystem (plants, animals, and other life forms).

Genetic: Heredity passed from parent to offspring (physical and functional).

Genetic diversity: The differences between living organisms within a species.

Ecosystem: All the living organisms and all the non-living components of a given area interacting as a whole functional unit.

Ecosystem diversity: The variety of different habitats in a particular area (i.e., wetland, forest, grassland, mangrove, coral reef, desert etc.).

Therefore we can consider biodiversity as the totality of genes, species and ecosystems in a region. The question often asked is *how many organisms are there on earth*. The answer is "we do not know, not even to the nearest order of magnitude".

But there are various estimates:

1 to 2 million (Parker 1982)

30 to 50 million (Erwin 1988)

Counting species is an imprecise science. Some 1.75 million have been officially classified. Some organisms (bacteria and nematodes) are under-counted; some habitats (tree canopy, the deep ocean) are largely unexplored. Estimates of actual species range as high as 100 million.

The enormous range of **species diversity** is illustrated by the occurrence of more than one species of a genus of plant or animal. Examples are many:

The Chinese rose, Deccan hemp, Shoe-flower, Red sorrel, Rose of Sharon, Coast cotton tree and the Ladies-finger are different species of a single genus ***Hibiscus***.

The Potato, Egg-plant or Brinjal, Black nightshade, Jerrusalam cherry, Poison berry are different species of one genus ***Solanum***.

The Tiger, Lion, and Leopard are species of the same genus ***Panthera***.

The Leopard cat, Fishing cat, Jungle cat and the domestic cat are different species of the genus ***Felis***.

The crop and domesticated diversity illustrates **genetic diversity.** They are often referred to as 'strains' or 'varieties'. Look at the different examples:

Rice 50 to 60 thousand, Potato 16, Cotton 1975, Sorghum 5160, Yams 305, Coconut 78, Mango 103, Sheep 40, Goat 20, Cattle 26, Poultry 20, Humans 8 races.

The **ecosystem diversity** is exemplified by Forests, Grasslands, Rivers, Mountains, Wetlands, and Deserts.

The Value of Biodiversity:

Economists and Ecologists both agree that humanity considers biodiversity valuable. Value has two components: **Use component** and **Non-use component.**

Use component:

Food - Direct enjoyment. Scenic value, bird-watching, beauty of flowers etc .are indirect enjoyment.

Ecosystem services – nutrient cycling, energy flow.

Non-use component: existence values – enjoying wildlife without visiting forests.

But an economist cannot appreciate these aspects. For them monitory value for each and everything is important. And for fixing monitory value for biodiversity economists consider the following criteria:

1. Ethical,
2. Aesthetic,
3. Direct economic and
4. Indirect economic values.

The principles underlying these are the following:

Ethical: other living things also have a right to exist in this world. They deserve protection. Humans have only trusteeship rights on them.

Aesthetic beauty of flowers, birds, fishes, butterflies, forests etc.

Direct economic value relates to the goods and services of natural ecosystems. For example Food, medicines, dress, shelter, timber, pollution control, water purification, weather regulation, gene library, human civilization etc.

Indirect economic value as in rooted plants and water cycle, soil formation, Part of food web, recycling, photosynthesis etc. The fact is that there is no alternative for biodiversity. Assigning monitory value is impossible. We can assign value for a species. Eg Tiger or a Rhinoceros. We can transfer it to another habitat for conservation.

But its role in the ecosystem – Can we assign fiscal value to it? No.

Currently the conservation of biodiversity and the sustainable use of its components is a priority, given the environmental crisis of the planet in recent decades. Knowledge of biodiversity becomes urgent in view of the rapid process of the loss of ecosystems, species and genes, as well as a broad spectrum of environmental services and products derived from plants and animals pending discovery or study.

NATURAL RESOURCE

Natural resources are raw materials or energy resources available from nature. They are classified into **Renewable and Non-renewable.** Renewable resources are those capable of regeneration (for example, trees). Non-renewable resources are those which are replenished through extremely slow natural cycles (for example, Fossil fuels) or which for all practical purposes are not recycled at all (for example, Mineral deposits).

2.1. Distribution and consumption:

* Not distributed evenly & not exploited evenly.

*Access depends upon level of technology available.

* What determines a resource and its economic value?

  ~ Its supply and demand,

  ~ needs and wants of a society.

* Value of resource increases when availability decreases.

* The economic viability of the exploitation depends on several factors including

  ~ International prices

  ~ Quality of the accessible resource

  ~ State of technology

* As resources decrease and demands increase, competition for these resources. Increases. As a result, fewer people have access to these limited resources.

* Scarcity has been a basic cause for conflicts between people both as individuals and as nations.

* Scarcity of resources requires sharing of resources. How scarce resources are shared depends on social and cultural values, and economic and political systems

* Nations of the world consume disproportionate amounts of the Earth's resources. This is a factor of both population size and inequitable geographic and economic distribution? of resources.(The USA with 30 crores of people has a much higher per capita consumption of resources than India with 100 crores people).

* Overall per capita consumption is increasing. It has been estimated that the world is capable of supporting only 100 crores or just 1/5 of the current global population, at the standards currently enjoyed by the most developed nations.

* Choices between needs (essentials) and wants (non-essentials) may come into conflict more frequently as human population grows and competition levels rise within finite resource limits.

* Many developing countries export their resources to developed countries, often at low prices and poor terms of trade. The developed countries with 20% of the world's population consume 80% of the world's resources.

* Between its extraction and use, a natural resource may undergo many transformations. These steps often affect the environment in a negative way.

2.2. Natural Resource Use and Environmental degradation:

1. Fossil fuels:

Worldwide consumption has increased. Environmental degradation related to production, transportation and use are: Land degradation due to strip-mining; fresh water pollution from acid mine discharge, oil refinery operation and improper disposal of used oil; marine pollution from oil-spills; air pollution from fossil fuel consumption; regional impacts due to acid rains: global climatic change due to Green House Gases.

2. Metals & Minerals:

Extraction, refining, disposal of metals and industrial minerals cause problems. Mining degrades land. Air pollution due to dust, acidic gases from smelters, CO2 from Cement plants; water pollution from leacheates; impacts from mineral consumption like use of heavy metals, toxic in soils, ecosystems and food-chains.

3. Forest Products:

Extraction of firewood, charcoal, lumber, paper and cultivation of Rubber, Oil-palm, Coffee, and Tea brings about loss of critical habitats, loss of biodiversity, Flash floods, drought, and soil erosion.

4. Agricultural Products:

5. Grains, meat, Fiber, Fishery.

More than half of the grains consumed in the industrialized countries are fed to livestock. World's livestock population grows much faster than its human population – diverting resources that could be used to grow grains for human consumption.

BIODIVERSITY DOCUMENTATION (BD)

MAINTAING A PANCHAYATH BIODIVERSITY REGISTER (PBR)

Purpose:

The BD will

1. Act as a record of local knowledge
2. Act as preliminary bases for revitalization of local knowledge with linking BD and cultural use.
3. Alert conservationists about need for conservation.
4. Draw notice to the "use value" to the local community.
5. Be of use to BD legislation.
6. Use as an instrument to protect traditional knowledge of bioresources.

Preparation of PBR:

There are 4 components:

- Working Group formation & Training,
- Division of labour,
- Collection of data, and
- PBR writing.

The WG should consist of a leader-teacher and volunteers assisted by an academic team.

Each member of the WG should be told of his/her duties and responsibilities. Questionnaire for collection of data from a selected Ward should be done following the procedure given below:

1 Identify 4/5 groups of knowledgeable persons from the Ward and make a list writing down their name, age, occupation & address with photograph.

2. Arrange meeting with each group at a pre-decided place and time.
3. Talk to them and extract information based on a questionnaire. Two volunteers should write down answers in the prescribed diary. The interrogation shall not be too formal, like the census survey.
4. At the end of the day volunteers should sit with their leader and compare notes. Consolidate the information collected on that particular date.

5. Repeat data collection from other groups of knowledgeable persons.

6. Information has to be collected on the following items:

- Cereals & Millets
- Oil seeds
- Cash crops
- Tuber crops
- Vegetables
- Pulses
- Fruit trees
- Medicinal plants
- Grasses/ fodder plants
- Wild relatives of cultivars
- Ornamentals
- Chewing plants
- Essential oil yielding plants
- Incense plants
- Timber trees
- Birds/poultry
- Domestic animals
- Animals of medicinal importance
- Fishes
- Pests
- Weeds
- Wild animals
- Ethnic groups
- Traditional knowledge of
    - Vaidyas
    - Water diviners
    - Architecture/Vastu
    - Astrology
    - Blacksmiths/goldsmiths
    - Potters

- Weavers
- Basket makers
- Musical instrument makers
- Etc.

PBR writing:

1. Copy consolidated data in note books
2. Find out technical names of plants/animals
3. Transfer data into data sheets
4. Data sheets shall include columns for:

   Serial No:

   Name of crop in vernacular

   Name of variety

   Scientific name

   Common characters for identification

   Availability

   Is it cultivated? If so what extent?

   Commercial use

   Ward where available.

   Other particulars.

   For recording TK

   SNo:

   Activity / trade

   Name of individual

   Age

   Address

   Knowledge

   Claim / fact given

   Other particulars if any.

PBR should contain the following chapters:

1. Introduction
2. Background information on Panchayath/ ward
3. Revenue map of Panchayath and map of area covered
4. Summary of BD
5. Data sheets
6. Appendices
7. Bibliography
8. Acknowledgement.

Let me conclude this with a quotation from Late Smt.Indira Gandhi at the plenary session of UN Conference of Human Environment at Stockholm, June 14th 1972. She said "Modern man must re-establish an unbroken link with nature and with life. He must again learn to invoke the energy of growing things and to recognize, as did the ancients in India centuries ago, that one can take from the earth and the atmosphere only so much as one puts back into them. In their hymn to earth, the sages of the Atharva Veda chanted: **What of thee I dig out, let that quickly grow ever, let me not hit thy vitals, or thy heart.** So can man himself be vital and of good heart and conscious of his responsibility

BIODIVERSITY

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DEFINITION

Biodiversity refers to all forms of life, including all species and genetic variants within species and all ecosystems that contain and sustain those diverse forms of life. It is often described in terms of genes, species and ecosystems.

Importance of biodiversity

Biodiversity helped us to develop new crops, new varieties, new farm animal resources, and new medicines. The productivity and sustainability of agriculture also depend on the productivity and sustainability of soils, and on a variety of services, such as pollination of crops and provision of biological control agents, that are furnished to agriculture from nearby natural or semi-natural ecosystems. Genetic diversity within animal and plant crops is essential to maximize yields.

Biodiversity can be preserved and used to the advantage of agriculture only if enough individuals of enough species are preserved, either as growing crops, in seed banks, or as wild crop relatives in native habitats.

Breeders produce new varieties with improved pest resistance and better weather tolerance by using genetic diversity. It is essential that crops be bred to catch up with continually changing and challenging disease and insect pest problems. Success depends on availability of biodiversity.

Biotechnology has increased the value of biodiversity. It has enlarged the pool of potential genes for crop breeding. Genes can be transferred from completely unrelated species into crops. Because of biotechnology, biodiversity can contribute more than ever to agriculture. Developed countries have made significant strides in biotechnology; however their gene resources are poor, compared to India, one of the twelve mega diversity countries in the world.

Threats to biodiversity

Destruction of the natural, native habitats of crops, livestock, and their relatives. Domestication and development of genetically uniform crop varieties and livestock breeds. Farmer or consumer preferences for certain varieties and breeds of crops and animals.

Biodiversity in Kerala is with diverse types of ecosystems rich in species and genetic diversity Elevation is below mean sea level to 2700 m above means sea level Demarcated into Low land, Mid land, High land Possess 580 km long sea coast. Excellent backwater system (lakes, rivers, lagoons, canals) in an area of 500 sq.km. Has wetland, estuarian and mangrove ecosystems in low land region. Mountainous and rocky terrain with tropical rain forest in High land region.Low and medium hills and hillocks with areas under cash crops. Rubber in Midland region 100 to 700 cm annual rainfall from two spells of monsoon. High average relative humidity of 70%.Presence of ancient rock types (2500 million years old). Forests account for 24 % of the total geographical area of Kerala. Forests belong to the tropical rain forests, famous for

biological exuberance. Kerala has 3500 species of flowering plants, of which 8 genera and 110 species are endemic to the region. It is also famous for several genera, and species of amphibia, reptiles, birds and mammals that are unique to the area.

Strategies in relation to biodiversity

Despite the high biodiversity in Kerala, no exhaustive studies have been taken up on the complete spectrum of biota. No serious attempts have been made to understand the taxonomy, ecology, distribution and productive potentials of our rich biological resources. Also, the extent of biodiversity in the lower group of plants and animals, especially the micro flora and micro fauna is not properly known.

A new strategy may be evolved with the participation of the people, universities, research and development agencies, public and private sector organisations, NGOs etc. for understanding, conserving and utilizing biodiversity of Kerala. A state level Biodiversity Coordination Committee may be established for the effective implementation of various programmes.

1. Documenting and characterizing biodiversity

Bioprospecting is the most efficient means to explore and evaluate the economic, genetic and chemical potential of biological resources through modern technological interventions. Morphological, cytological, enzymological, biochemical and molecular methods are useful in this respect.

Bioprospecting and economic evaluation of indigenous flora and fauna, including micro organisms of Kerala will be highly rewarding in terms of industrial and economic progress. It will help evolve new industrial, pharmaceutical and biochemical products. Setting up sufficient infrastructural facilities and strengthening technology base in biochemistry and biotechnology, including molecular systematics, are the immediate pre-requisites.

New socio economic realms of biodiversity evaluation and management should be evolved with people's participation and integrating science, industry, public and private sector organisations and NGOs.

2. Conserving biodiversity

In situ, ex situ and *in vitro* conservation methods may be adopted.

a. In situ conservation

It is the best and cost effective way of protecting the existing biodiversity. It is the on the site conservation wherein a wild species or stock of a biological community is protected and preserved in its natural habitat. It would prevent species from becoming endangered by human activities and reduces the need for human intervention to prevent premature extinction. Establishment of biosphere reserves, national parks, wild life sancturies sacred groves and other protected areas are resorted to.

Participatory forest management and ecodevelopment are useful for preserving biodiversity and increasing forest cover. It should place special emphasis on the poor farming communities, tribal villages, and women. Forestry Department and non-governmental organizations may be

asked to work with Village Forest Committees to develop microplans for rehabilitating forests in their area. Emphasis should be given on alternative fuels and cookers, forestry, eco-tourism, small-scale agriculture, livestock and agro-processing. Improved fire management system should be evolved.

b. Ex situ conservation

Ex situ conservation methods are complementary to *in situ* methods. Viable populations of many organisms can be maintained in cultivation or in captivity. Plants may also be maintained in seed banks and germplasm collections; similar techniques are under development for animals (storage of embryos, eggs, sperm). Botanic gardens, arborata, zoos, biological parks and tissue culture repositories are important in this respect.

The various Universities and Research and Development organizations of Kerala may be entrusted with a major share of *ex situ* conservation.

c. In vitro conservation

In vitro methods can effectively be used for conserving biodiversity. This method requires less space, labour, efforts and money. Global efforts are being made in this regard. Cryopreservation and slow growth techniques are widely adopted.

3 Utilizing biodiversity

About 80 per cent of the wild genetic resources remain untapped. In crop plants, a massive programme must be launched for exploiting the variablity among farmers varieties, and land races with respect to yield potential, tolerance to biotic and abiotic stress conditions, produce quality etc. Participatory survey, evaluation, selection and rapid multiplication as well as distribution of planting materials are vital. Research and Development organisations, NGOs, people's organisations etc. may be involved. Biodiversity can be utilized for the isolation of useful genes and promoters.

AQUATIC BIORESOURCES

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Aquatic bioresources include all the living plants, animals and micro organisms found in lentic and lotic habitats. ie, ponds, lakes, reservoir and rivers. The plants include small microscopic phytoplankton (algae etc) and large macrophytes such as emergent, floating and submergent rooted plants. The animals consist of invertebrates and vertebrates, of which aquatic arthropods and fishes are most abundant. Besides algae, microorganisms include protozoans, bacteria etc. The populations of all these organisms together constitute to the biotic community. They maintain their own spatial and trophic niches but live together maintaining equilibrium with the abiotic environment thereby establishing an ecosystem. The biota is very important links in the maintenance of the ecosystem. Each individual of the community has its own role and importance. The biotic resources are also quite useful to man in many ways. Therefore, protection and conservation of the resources are quite relevant. Studies on aquatic biota are needed for creating awareness on their importance.

Project works that can be undertaken on Aquatic Bioresources

1. Morphology of any organism/ organisms (plant or animal)
2. Nature of phytoplankton
3. Nature of Zooplankton
4. Benthic organisms (Benthos)
5. Macrophytes (Floating, rooted, submerged plants)
6. Aquatic insects
7. Fishes
8. Amphibians
9. Reptiles (Snakes, tortoise)
10. Birds
11. Periphyton
12. Neuston
13. Day and night fluctuations of plankton.
14. Seasonal variation of plankton.
15. Larval forms of animals (of insects, frogs etc)
16. Metamorphosis of frog (life cycle)
17. Morphological adaptations of organisms
18. Role or function of each organism

19. Trophic niche segregation of animals
20. Food chain and food web
    1) Grazing food chain
    2) Detritus food chain
21. Microbes (Bacteria)
22. Comparison of biota of pond / lake and river
23. Biotic community
24. Economic importance of plants and animals (Food, culture, medicinal etc)
25. Conservation of aquatic plants and animals
26. Environmental factors (air, water, sediment, soil) of organisms.

Practical

Demonstration on collection of plankton, micro and macro organisms and making observations on Vellayani lake –Collection of water using water sampler, plankton using plankton net, microscopic observation of the plankton, microbes, collection of aquatic insects, fishes, preservation of specimens using iodine and formalin, measurement of water temperature and transparency, pH, saltiness and primary productivity, collection of sediment and benthos.

COASTAL BIO-RESOURCE AND ECO SYSTEM

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INTRODUCTION

India has a coastline of 7516 Km of which the main land accounts for 5422 Km, Laccadive coast extends 132 Km and Andaman and Nicobar Island have coastline of 1,962 Km. The very wide range of coastal ecosystems such as Estuaries, lagoons, back waters, salt marshes, mangroves, sandy coasts, rocky coasts as well as coral reef etc. provide different characteristics of flora and fauna giving various types of bio resource potentials.

As far as the coastal mangrove resource is concerned while it protects the coastal area from sea erosion it also forms a rich nursery area for fish and shell fish young ones. A total area of 4,827 km2 is estimated as the mangrove resource of India and this is an additional support to forest wealth of India.

The marine Fishery resource of India is estimated around 2.3 to 3.5 million tones for the past many years and the fish landings of Kerala is around 0.5 million tones from the marine side.

About 700 species of marine algae have been reported from the East and West coast of India. The total standing crop of all sea weeds in Indian waters is more than one lakh tones (wet wt) including 6000 tonnes (wet wt) of Agar yielding and 16,000 tonnes (wet wt) of Algin yielding sea weeds. Some of the species are rich source of protein and iodine and many bio active compounds are extracted from the algae during the recent times. Algae are commercially important as Agarophytes, Alginophytes and Carrageenophytes and is industrially important in medical, pharmaceutical, confectionary, textile industries etc.

Whether it is in Indian coast or else where the bio-resource of any area is regulated by the interaction of various factors of the ecosystem like physiochemical, temperature, latitudinal, altitudinal etc. and their impacts on the climate and precipitation level of different regions. Let us examine what are the major impacts of ecosystem on the bio-resource generation.

Resource

Solar energy, wind energy, water energy, soil, minerals, ores, biological resources etc are some of the major resources of any nation. Out of this bio-resource has a characteristic feature of recycling and reproducing by the accumulation of solar energy through the process of photosynthesis.

What is Bio-resource?

The bio-resource is explained in terms as a Biological pyramid with the basic producers as the base of the pyramid with phytoplankton and algae in aquatic medium and plants in the terrestrial system. In both the system the herbivores and carnivores occupies the second and third position respectively towards the top of the pyramid. Finally this forms the nutrient cycle of the aquatic and terrestrial system as a biological process.

The relation between Bio-resource and Eco system

The bio-resource of any coastal or terrestrial system depends upon various factors as mentioned in the introduction. Because of this the productivity of any region varies according to the favourable or unfavourable circumstances of the region. This can be natural as well as man made because it is well known that productivity (Bio-resource) is very much affected through natural calamities like flood, cyclone, tsunami, tornado etc as well as by modernization and industrialization.

Indian Coastal System – Its Characteristics from the Ecological Perspectives

There are different aspects as follows which have direct impact on the coastal bioresources which have made India as a rich source of bio diversity and natural biological production.

a) Tropical climate

As the country occupies the tropical and sub tropical region there is not much latitudinal impact on the flora and fauna. However as seen elsewhere the altitudinal differences on the distribution of the flora and fauna is seen here also because of the zonation due to the temperature factors.

b) Monsoon

As the country is having two monsoons, the South West monsoon during June to September and the North East monsoon during November to February, there is a rich mixing of nutrients in the aquatic environment supporting high production of forest and mangrove forest as well as the cash crops and other crops of the country.

c) Continental Shelf

Continental shelf is the sea bottom area adjacent to the coastal water line to the depth of 100 fathoms which is the highly productive area in the sea as far as fish and shellfish population is concerned. The shelf in the East coast is very narrow and in the West coast it ranges from 20 km to 60 - 70 km towards the Konkan and Maharashtra coast and in the Gujarat coast, it is very wide because of the deposits by the Indus river. This also is an important factor for increasing the bio-resource of the West coast of India.

d) Rivers, Lakes, Deltas of rivers, Geological features and the Biological production cycle

A large number of rivers are discharging towards the sea along the East and West coast of India. Because of this and the coastal currents the NPK ratio is increased very high and maintained a balance for a rich biological production cycle. This also supports the standing stock of fish and shell fish and algae along the seas around India.

Bio-resources: Aquatic and Terrestrial

Because of a chain of lakes and river mouths opening towards the sea along the Indian coast we have the marine, brackish water and fresh water aquatic resource in the coastal belt of all states.

The resource of these areas include Cartilaginous and Bony fishes, Crustaceans like Prawns, Crabs and Lobsters, Bivalves like Mussels, Oysters and Clams, different types of Gastropods etc.

Among the bio-resource of aquatic plants the algae like diatoms, micro algae and major algae, play an important role and their contribution is given in the introductory part of this essay. Agarophytes like *Gelediella* spp, Alginophytes like *Sargassum* sp and Turbinaria spp, Carrageenophytes like *Hypnea* spp and protein rich *Ulva* spp, *Enteromorpha* spp and *Eucheuma* spp are some of the important forms.

The coastal belt has a rich variety of terrestrial bio-resource like Rice, Plantation crops, Medicinal and other crops , Mangrove forest etc. According to the regional condition the resource pattern is different along the East and West coast of India.

Bio-resource Conservation and Production

Conservation and resource generation are the most important factors as far as bio-resource conservation is concerned. As part of this estimation of natural resources, judicial exploitation for a sustainable resource maintenance and an Agency for conservation are some of the important factors for bio-resource conservation.

As part of resource development, Seed production, Hatcheries and Nurseries, Aquaculture including Sea farming, Brackish water farming and Fresh water farming as well as Sea ranching and Afforestation are the major programmes to be taken up.

INSECT BIODIVERSITY

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INTRODUCTION

Entomology is the branch of Zoology which deals with insects. (*entomon* - insect; *logos*- discourse- Greek). Insects are Arthropods with distinct head, thorax and abdomen, a single pair of antennae, three pairs of walking legs confined to the thorax and one or two pairs of wings.

Dominance of insects

Insects form the largest animal group with an estimated 9 lakhs described species. The total number of described species for all animal groups is about 15 lakhs. The Coleoptera (beetles) with over 3.5 lakhs species form the largest order and among them more than 60,000 species are included in the single family Curculionidae (weevils).

Insects are a remarkably successful group of organisms. They have been able to inhabit every nook and cranny of the globe except the depths of oceans.

The following are the plausible reasons for the successful development of insects into such huge numbers of species and individuals.

1) Exoskeleton: The chitinous exoskeleton provides rigidity as well as flexibility because the sclerites or plates are separated by soft membranes. It provides complete protection of vital organs and a large area for internal muscle attachment. The cuticle prevents loss of water by evaporation.

2) Functional wings: This has enabled insects to migrate and get dispersed, to discover their mates, seek food and escape from enemies.

3) Small size: Because of small size, individuals require less energy and time to complete development and sustain life. It is easier to find protection from predators and adverse environment. A greater number of ecological habitats are available for feeding and breeding. Smaller size greatly enhances the chances of random dispersal by wind. Smaller size has the disadvantage of making them vulnerable to predators and physical forces like rain.

4) High reproductive capacity

5) High adaptability: The same structure has modified to perform different functions in different groups. In some groups the same structure has become adapted to function under entirely different conditions, for example, the respiratory system in some insects are adapted for both aquatic and terrestrial life. Insects through continuous evolution have attained the ability to feed on a wide range of food materials.

6) Complete metamorphosis: This enables insects to divide the life history into different parts. This system has enabled the larva and adult to live in entirely different places and under

different conditions so that the larva has been able to take advantage of conditions most favorable for rapid growth and the adult to live in conditions best suited for reproduction and dispersal. This has helped the insects to avoid competition between larval and adult stages besides combining the advantages of two entirely different ways of life and at the same time avoiding the disadvantages of both.

Insects in relation to man

From the view point of man, insects can be broadly classified into (i) harmful (ii) beneficial and (iii) indifferent. The vast majority of insects belong to the third category. The following is a synopsis of insects in relation to man.

Insects as enemies of man

A) Pests of crop plants

- Damage done by feeding
- Sing plant parts for construction of nests. Eg. Red ant.
- Disseminating and protecting pestiferous species. Eg. Ants protect and transport aphids and mealy bugs.
- Act as vectors of plant pathogens. Eg. Aphids and leaf hoppers transmit viral diseases.

B) Annoy and injure man and domestic animals

- Annoy by presence, odour etc. eg. Cockroach, ants
- Apply stings, venoms etc. eg. Wasps, bees
- External and internal parasites eg. Louse, maggots
- Vectors of disease causing microbes,

C) Damage stored products eg. Rice weevil

Beneficial insects

A) Products from secretion of insects. Eg. Silk, bees wax, shellac.

B) Bodies useful as or contain substances such as:

- Dye eg. Cochineal insect.
- Cantharidin obtained from blister beetles
- Fish bait (eg. nymphs of stonefly)

C) Collect, elaborate and store plant products. Eg. Honey bee.

D) Products from plant galls formed by insects. Eg. Aleppo gall, which yields dye.

E) Insects as food for animals and man.

F) Perform pollination

G) Act as parasites and predators of harmful insects.

H) Weed killers

I) Improve soil fertility

J) Act as scavengers. Eg. Dung beetles

K) Insects and their products are used in medicine- eg. Bee-venom, cantharidin

L) As tools in scientific research – Drosophila melanogaster in genetics.

M) Aesthetic and entertainment value

Classification of insects

Super class INSECTA

Apterygota (wingless insects)

1. Collembola (6000) Springtails
2. Protura (500) Telsontails
3. Diplura (800) Twintails
4. Archaeognatha (350) Bristletails)
5. Thysanura (400) Bristle tails

Pterygota (winged insects)

6. Ephemeroptera (2000) Mayflies
7. Odonata (5000) Dragonflies and Damselflies
8. Plecoptera (2000) Stoneflies
9. Blattodea (4000) Cockroaches
10. Isoptera (2300) Termites
11. Mantodea (1800) Preying mantids
12. Grylloblattodea (16) Ice crawlers
13. Dermaptera (1800) Earwigs
14. Orthoptera (20,000) Crickets, grasshoppers etc.
15. Mantophasmatodea (20)
16. Phasmatodea (2500) Stick insects and leaf insects.
17. Embioptera (2000) Webspinners, Embiids
18. Zoraptera (30) Zorapterans
19. Psocoptera (3000) Booklice
20. Pthiraptera (3000) Lice
21. Hemiptera (50,000) True bugs
22. Thysanoptera (4500) Thrips/plant lice
23. Megaloptera (300) Alderflies, dobsonflies
24. Raphidioptera (200) Snakeflies, Camelneck flies

25. Neuroptera (5000) Lace wings/antlions
26. Coleoptera (3,00,000) Beetles
27. Strepsiptera (400) Twisted wing flies
28. Mecoptera (500) Scorpionflies
29. Siphonoptera (2380) Fleas
30. Diptera (1,50,000) Trueflies (mosquitoes, houseflies etc.)
31. Trichoptera (7000) Caddisflies
32. Lepidoptera (2,00,000) Moths and butterflies
33. Hymenoptera (1,00,000) Ants, bees, wasps, sawflies

Figures in parenthesis indicate the approximate number of known species in each order.

COLLECTION, PRESERVATION AND STUDY OF INSECTS

One of the basic methods in studying living organisms is by collecting them. All collected organisms have to be preserved properly for the purpose of study and evaluation. Badly preserved specimens may not be useful for purposes of scientific study. Insects, however, unlike many other organisms are collected for scientific purposes and also as a hobby. In either situation, it is necessary that these insects are preserved properly. On the other hand, insects might also be collected for consumption and for pest control, which may not require preservation!

COLLECTING INSECTS

Insects are widely distributed in nature and can be collected using different methods. The common methods employed for collection are outlined below.

a) Hand collection

Many large insects such as beetles can be hand collected. Insects that live in habitats such as leaf litter, dung, carrion, decaying food materials, flower inhabiting insects etc. need to be collected mainly by hand. Gall forming, parasitic insects or other kinds of tissue boring or internal feeders are best collected by sampling the affected plant part or the host species and then by keeping them for insect emergence.

b) Using nets

Nets used for insect collection can be of different types. Sweep nets are those that are generally used for collecting assorted group of aerial or plant inhabiting insects. However, specialized net may be necessary to collect certain groups of insects. Nets with wide mouth and medium long sacs made of light coloured semi transparent netted cloth are ideal for catching butterflies. Light and flexible net with short transparent sacs are ideal for collecting tiger beetles. Large opaque sacs with a window on one side, fitted to long sturdy handles are used for sampling small insects such as leaf hoppers from plants. Such nets are called as beating nets. Aquatic insects need stiff but highly porous net cloth to sweep through water to scan for insects.

c) Traps

Many kinds of traps are used for collecting insects. Most powerful traps that can attract a wide variety of insects are the light traps. Light traps are useful for sampling nocturnal insects and can use different sources of light. Mercury vapor lamps or black lights that emit UV radiation attract the greatest number and variety of insects.

Many traps make use of sun light for trapping flying insects. These include Malaise traps and window pane traps. Flight intersection traps are a variant form of window pane traps.

Yellow color attracts many insects. Pan traps painted with suitable shades of yellow can attract flying wasps, bees, beetles, flies etc.

Pit fall traps are used for trapping ground dwelling insects such as ground beetles, dung beetles, ants etc.

Modified malaise and pit fall traps can be used for collecting specific groups of insects. Largely, the modification includes addition of specific type of food lure.

d) Lures

Many kinds of lures or attractants can be used for insect collection. Food lures used include fish meal trap for flies, dung or rotten banana peels for dung beetles or certain kinds of flies, carcass for necrophagous insects, humans for blood sucking ectoparasites etc. Other kinds of lures include pheromones of moths and beetles, methyl eugenol or cuelure for fruit flies, eugenol for certain species of white grubs, etc. All kinds of lures are used in association with a suitable insect collecting device such as water or hanging traps.

Extraction methods

Small insects those live in soil, decaying organic matter, dung, leaf litter etc. can be collected by extracting them by using special techniques such as Berlese funnel, floatation techniques etc.

The choice of the method and the device to be employed for insect collection depends on the type of insect, purpose for which the collection is made and the knowledge of its behaviour.

Killing insects

Insects once collected need to be killed properly for proper preservation. Different methods are available for killing insects. Butterflies and moths can be killed by simply holding the insect at the region of thorax and then by pressing it hard until the insect ceases to breathe. Alternatively, insects can be killed by using certain chemicals such as potassium cyanide, ethyl acetate, benzene, ethyl alcohol, formalin, isopropyl alcohol etc. Fumigants such as bezene, ethyl acetate or potassium cyanide are used in air tight, mostly glass containers. Such containers, may use plaster of paris, pieces of rubber or saw dust as the absorbent material for fumigant. Therefore the fumigant is released slowly and the killing bottles, once prepared remain effective for a long time. Alternatively, 70-80 per cent ethyl or isopropyl alcohol, or 4 per cent formalin are also used for killing insects. Immature stages of insects and certain soft bodied insects are collected directly into the containers with any of these chemicals which serve as both killing

agents and preservative media. Many immature insects are best killed by dipping in hot water or in a mixture containing kerosene, acetic acid, alcohol and dioxane.

Preserving the killed insects

Insects once killed can be preserved either dry or in wet collections. Soft bodied insects ar generally preserved in liquid media. Ethyl or isopropyl alcohol, or formalin form the usual media used for preservation of many soft bodied insects. Alternatively, large soft bodied insects can be mounted dry following an elaborate procedure. Similarly, small insects can be mounted on slides after suitably clearing the specimens. Insects mounted on pins and dried can be preserved for generations without loss of characters. Most of the insects are pinned through the thorax. Beetles are pinned through the right elytra and wings are not stretched. Insects can also be mounted on cards, paper points or other kinds of stages to hold the insect and these in turn are mounted on a longer pin. Insect pins of different sizes ranging from size code 000, the smallest minuten, to number 7, the longest and the thickest pin. They are specially designed and made of non corrosive material.

Arranging the soft relaxed insect with its wings extended horizontally, and allowing it to harden in that attitude is called setting. The advantages of doing this are that a drawer of set insects looks much neater and more orderly than a collection in irregular attitudes; it is much easier to study the wings and the insect so stretched in one horizontal plane can be moved from box to box and the labels examined, with less risk of accidentally touching part of the specimen and breaking it off.

The drawbacks of setting are the time it takes; the extra space required to house the specimens; and a certain difficulty in seeing underneath the spread wings to examine the sides of thorax.

All moths and butterflies are set because in this group the pattern of the wings is of primary importance, and specimens are more convenient to study, as well as making a better display. Other insects with large and conspicuous wings – dragonflies and damselflies, mayflies, lace wings, some grasshoppers, cicadas – often look better if they are set. Flies and wasps are usually not set as the structures on the thorax and abdomen are more important than wings and can be seen if the wings and legs are drawn upwards and downwards respectively. Such insects, after pinning, need only to have the wings and legs gently separated, using a long thin pin, and taking care not to break off any hairs or bristles. Setting boards are used for setting moths and butterflies. Instead of setting boards, thermocole or cork with a groove cut in it for the body of the insect can also be used.

The specimen is thoroughly relaxed and pinned through the body on a long pin of appropriate thickness. It is adjusted to the desired height on the pin and is then carefully pinned into the groove of the setting board, pushing the pin right through so that the body of the insect is correctly settled into the groove. In butterflies and in other groups where the wings are of paramount importance, the legs are tucked into the side of the body, in the groove, and the specimen made to rest with the wings on the board so that they can be set flat. Forewings are set with the hind margin at right angles to the body and the anterior margin of the hind wing is arranged at right angles to the body so that both wings are clearly visible. A strip of setting-

paper is pined at the front end and the fore wing is drawn forward to the correct position by inserting a fine pin behind one of the strong veins, or through the vein itself.

Mounted and dried insects can be preserved in specially designed, air tight, metal or wooden boxes or trays, called insect cabinets. These in turn may be stored in a rack. Care is needed while preserving to protect dead and dried insects from the attack of insects, fungus and also from excess light. Excess and continuous exposure to light results in loss of color. Increased humidity might result in the growth of fungus and attack by insects which feed on specimens. To protect stored insects from these, chemicals such as creosote, para dichloro benzene, naphthalene etc. are used. For keeping insect specimens dry, silica gel is placed in insect boxes and periodically removed and dried.

Labeling

All specimens collected for scientific study need to be labeled. The information required to be supplied in these labels are given below. The labels have to be written legibly using India ink. The maximum size conventionally used for these labels is 1.5 x 1 cm.

Model labels to be attached to specimens collected for scientific study

Label No.1

Locality & date label

India: Kerala
Vellayani
4.v.2006
Kumar

Label No. 2

Host label

Collected on *Oryza sativa*

Label No. 3

Determination label

Leptocorisa acuta

(Linnaeus)Viraktamath det. 2006

Materials required for insect collection and curating

a) Insect collecting nets
b) Aspirator
c) Killing bottle
d) Specimen tube

e) Paper cover
f) Hand lens
g) Camel hair brush
h) Forceps
i) Pinning forceps
j) Insect pins
k) Mounting board
l) Paper points
m) 2% Gum Arabic or suitable adhesive
n) Insect labels
o) Pinning block
p) Insect cabinet box
q) Naphthalene/para dichloro benzene
r) 80 % ethyl alcohol or isopropyl alcohol or 4% formalin for preserving soft bodied insects

BIO-RESOURCES IN MAN MADE ECO-SYSTEM

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The English word 'Ecology' is taken from the Greek 'Oikos' meaning 'house' the immediate environment of man. The literal meaning of the word 'House' has now been extended to a broader sense involving environment. Hence we can define ecology as the study of the natural environment, particularly the interrelationship between organisms and their surroundings.

It is worth quoting the first paragraph of the classic text on ecology by Robert Ricklefs of University of Pennsylvania to have a clear understanding of the man made environment such as Homesteads in Kerala:

"The environment of each organism consists of different consists of different physical characteristics and different biological interactions. There are several organisms that live in a single location. A squirrel and an Oak tree may live on the same piece of land. They are nourished by the same sun light and same rains, but the world of Oak tree includes the subterranean region of its roots which is almost alien to squirrel. But the fate of squirrel is decisively affected by the prowling hunter who merely passes the Oak tree casually in pursuit of his prey. The environment of the organism, defined by its interaction with its surroundings, depends both on the organism and the habitat in which it lives. In the desert, the hot dry air that vaporizes the moisture from the bodies of organism may be the most significant component of the environment. In the humid forests, predators and parasites may be more important to an organism for its survival. Diverse aspects of the environment mold the life strategy of the organism in different ways."

The above paragraph gives us a basic idea on the relationship between organisms and their surroundings. Among these organisms, man alone is capable of studying these inter relationship with intense sense of achieving survival. The fitness parameter of survival is basically determined by the reproductive potential and the ability to survive in a given environment. It is under this down to earth perspective, we here attempt to study the man made ecosystems in Kerala.

In order to understand the nuances of man made ecological systems one should have a clear picture of the time scale of cosmic and cultural evolutions of earth and man which is summarized in a table form:

The origin of universe	-	900 crores years back
The origin of Earth	-	450 crores years back
The origin of Life	-	350 crores years back
The origin of Homo Spp.	-	50 Million years back
The origin of Primitive man	-	20 Million years back
The origin of Cultural man	-	11000 years back
The use of wild cereal seeds	-	11000 years back (Productivity of 50 kg/ ha)

The use of Farmers seeds	-	1000 AD (Productivity of 500 kg/ ha)
The use of Pure lines	-	1930's (Productivity of 1000 kg/ ha)
The use of HY Varieties	-	1964 (Productivity of 3000 kg/ ha)
The use of Latest Varieties	-	1999 (Productivity of 7000 kg/ ha)

The first human intervention on environment occurred when the nomadic men invented agriculture, some 11000 years ago and they settled down at various locations as social groups. This was followed by domestication of animals and later animal farming. Thus the two activities of man namely plant and animal agriculture was the basic cause for environmental degradation. The advent of industrial culture around the middle of 18th century changed the face of earth. The soil, water and atmosphere became polluted. Vast quantities of industrial wastes were dumped into the nature. Industrial culture of man has enhanced the consumerist attitude of man which aggravated the evils of pollution.

Population growth and Food production

The world population was around half a million some ten thousand years ago. Now it is around 650 crores. At the beginning of farming some 11000 years back, man used seeds of wild cereal plants for cultivation. The wild progenitor of rice plant is supposed to be *Oryza rufipogon*. The average production potential of this species is just 50 kg/ Ha. From mutant variants of this species the farmers selected the best through generations for thousands of years. The many thousand local rice varieties now available through out the rice growing areas of Asia and Africa are the result of this selection. The average production potential of these farmers varieties during the early 20th century was around 500 kg/ Ha. During this period Crop Research Stations were started in Europe and U.S.A to enhance yield of food crops through pure line selection. The British Government started a few such stations in India . The Pattambi Rice Research Station was one among those. The Breeders started pure line selection on local rice varieties. Ptb-1 selected from the Aryan variety was the first to release. This new variety yielded 20 to 25 percent higher than that of the local variety. Thus the average productivity was enhanced to 1000 kg / Ha. This situation continued till the late 1960's. The total food production in India at that time was round about 60 million tones / year. This was insufficient to feed the 60 crore population at that time. During the British rule in India there were 200 famines that took away the lives of millions of people. The last of such famines was the great Bengal famine of 1942 – 43 which alone resulted in the death of at least 10 millions of people! It was under these pathetic conditions that the intensive type of agriculture was initiated from 1950's onwards. But a break through came only during late 60's and 70's through the introduction of many High Yielding Varieties of rice and wheat which enhanced the yield to the tune of 3-4 tones/Ha. This was a quantum jump from the age old productivity of rice and wheat at 1 tonne/ Ha. The intensive use of chemical fertilizers coupled with the introduction of many semi dwarf HY varieties of Rice and Wheat with prophylactic measures of plant protection ushered in the Green Revolution Era in India. Thus our nation achieved self sufficiency in food production for the first time during the interval of two Centuries! But we had to pay a price for this achievement. The excessive use of chemicals in the fields and animal farms has resulted in soil degradation and water pollution. In the place of millions of local varieties of crops, animals and birds used in the plant and animal agriculture a few high yielding varieties and breeds were popularized. This

resulted in severe loss of bio-diversity. Such monoculture situation disrupted the host- pathogen relationship in the fields and barns which enhanced the susceptibility of crops and animals to many new variations of pathogens and pests. This in turn increased the use of pesticides and fungicides in plants and antibiotics in animals and birds. This situation is still continuing as a vicious cycle in our farm lands. It was under these circumstances that we have to have closer look at the dynamics of man made ecological situations in our State.

Agro-Ecological Zones of Kerala

Kerala State has been divided into five agro-ecological zones namely, Northern zone, Central zone, Southern zone, High altitude zone and Problem area zone.

Northern Zone

It is a long narrow strip consisting of Malappuram, Kozhikode, Kannur and Kasargodu districts. Alluvial, Saline, non saline and shallow to very deep laterite soils are the characteristics of this zone. Deep forest loam tracts adjacent to Western Ghats are also seen here. Rice and coconut are the main crops in this zone. Many large cashew plantations are also located in this zone. Annual crops like banana, tapioca, sweet potato and different vegetables are grown here. Perennial fruit crops like jack and mango and vegetables like drum stick are also popular in this zone.

Central Zone

This zone consists of pockets of specialized areas like Kole and Pokkali located in Ernakulam, Thrissur and Palakkad districts. Coastal alluvium soils that are poor in fertility are seen in this zone. The major crops grown are rice, pulses, vegetables, banana and tapioca besides coconut on raised bunds. The Palakkad rice bowl region is located here. The rain shadow areas of Palakkad where cotton, groundnut and millets are grown successfully. The black soil tract of Chittoor is in this zone. This is the only region in Kerala where the soil shows an alkaline reaction as against the acidic soils found elsewhere. The low rain area called Attappadi is located in this zone.

Southern Zone

Coastal wetlands, coastal dry lands, reclaimed lands from back waters, wet midlands and dry midlands of Kollam and Thiruvananthapuram districts forms the southern zone. Rice, coconut, tapioca, cashew, banana, pepper, rubber and vegetables are the major crops in this zone. Homestead farming is very popular in this zone.

High Ranges Zone

Wayanad, Idukki, some areas of Palakkad, Pathanamthitta, Kollam and Thiruvananthapuram districts form this zone. Uplands, wetlands and forest areas are the major components of this zone. Very large plantations of rubber, coffee, tea, cardamom and pepper are the land marks of this zone. Annuals crops like tapioca, banana, ginger, and yams are extensively grown in this zone. Cool seasons vegetables, sugarcane and millets are also grown in some pockets. Rice is the major crop in the wet lands of this zone.

Problem Zone

This zone forms part of Kollam, Pathanamthitta, Ernakulam, Malappuram and Thrissur districts.Onattukara region of central Travancore, Kayal lands of Kuttanad, special rice fields of Karappadam, Kari soils, Koottumundakan, Orumundakan, Pokkali and Kole lands are located in this zone.The soils of this zone is highly acidic and saline which require special cultivation practices for growing Rice. Coconut and vegetables are the other major crops grown in this zone.

HOMESTEAD FARMING

Homestead is the man made ecosystem typical to Kerala. This is an age old production system followed in Kerala from historic time. Mention of this type of farming is available even in Marcopolo's accounts. It is a low input sustainable farming system associated with the special type of dwelling in which families maintain a small area of land around the home for rearing few domestic animals and birds as well as a mixture of food crops. Even though the average area of such homesteads is as low as 30 to 40 cents, the total number of such units in Kerala comes to about 66 lakhs. Thus the total farming area of the homesteads in Kerala comes to more than 10 lakhs hectares!

The agro-eco system of homestead is comparable to tropical rain forest eco-system. In structure, species diversity, energy flows, nutrient cycling, water cycling and other ecological characteristics. Homesteads show a self sustainable quality at subsistence level of survival. An holistic ecological stability is inherent in homestead farming because of the luxuriant crop diversity present here. The conservation of soil, water, biodiversity, soil cover with thick bio-mulch, nitrogen fixing micro organisms and avoidance of heavy tillage operations ensure the sustainability of homestead. The maintenance of hedge trees helps the nutrient siphoning through green leaf manuring. The integrated plant nutrient and pest management will enhance the sustainability of homesteads.

The following list of plant and animal species gives an insight in to the intense biodiversity present in a Homestead :

Common tree crops found in homesteads

Coconut	(*Cocos nucifera)*
Arecanut	(*Areca catechu*)
Cashew	(*Anacardium occidentale*)
Drumstick	(*Moringa oleifera*)
Curry leaf	(*Murraya koenigii*)
Nutmeg	(*Myristica fragrance*)
Clove	(*Syzygium aromaticum*)
Cinnamon	(*Cinnamomum verum*)

Mango	(*Mangifera indica*)
Jack	(*Artocarpus heterophyllus*)
Papaya	(*Carica papaya*)
Guava	(*Psidium guajava*)
Custard apple	(Annona *squamosa*)
Tamarind	(*Tamarindus indica*)
Garcinia	(*Garcinia cambogia*)
Agathi	(*Sesbania grandiflora*)

Annuals and vines grown in Homesteads

Banana	*(Musa spp.)*
Tapioca	*(Manihot esculenta)*
Sweet potato	*(Ipomea batatas)*
Yams	*(Dioscorea spp.)*
Aroids	*(Colocasia, Xanthosoma, Amorphophallus, Alocasia etc.)*
Black pepper	(*Piper nigrum*)
Vanilla	*(Vanilla planifolia)*
Pineapple	*(Ananas comosus)*
Ginger	(*Zingiber officinale)*
Turmeric	*(Curcuma longa)*

Major vegetable crops grown in Homesteads

Okra	(Abelmoschus esculentus)
Amaranthus	(Amaranthus spp.)
Cow pea	(Vigna unguiculata)
Amara	(Lablab purpuriens)
Cluster beans	(Cyamopsis tetragonoloba)
Winged beans	(Psophocarpus tetragonolobus)
Bitter gourd	(Momordica charantia)
Cucumber	(Cucumis sativus)
Pumpkin	(Cucurbita moschata)

Snake gourd	(Trichosanthus cucumerina)
Ash gourd	(Benincasa hispida)
Ivy gourd	(Coccinia cordifolia)
Tomato	(Lycopersicon esculentum)
Chilli	(Capsicum spp.)
Brinjal	(Solanum melongena)

Essential Medicinal Plants to be grown in Homesteads

Tulsi	(Ocimum sanctum)
Adalodakam	(Adathoda zeylanica)
Koovalam	(Aegle marmelos)
Mullancheera	(Amaranthus spinosus)
Vepu or	
Neem tree	(Azadirachta indica)
Brahmi	(Bacopa monnieri)
Kudangal	(Centella asiatica)
Kasthuri manjal	(Curcuma aromatica)
Karuka pullu	(Cyanodon dactylon)
Kizhar nelli	(Phyallanthus niruri)
Asokam	(Saraka indica)
Nochi	(Vitex negundo)
Manithakkali	(Solanum nigrum)

MEDICINAL PLANTS OF KERALA

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"Oh! Divine plants
You are so fertile in nature
You are blessed with all kindness and happiness
Always be kind to us
Pour happiness over us
You have the power of the horse
You are the destroyer of fatal diseases
You are the guardian of mankind
Save and protect us from all kinds of illnesses" (The Rig Veda)

Medicinal plants constitute an important component of the plant resource spectrum of Kerala state. We also have a rich tradition in the use of medicinal herbs for health care system. Our ancestors and grand parents had very valuable knowledge on the medicinal uses of several plants seen around our households. Out of the estimated 3700 species of vascular flora in Kerala, about 900 are known with immense medicinal properties; of these about 540 species are reported to occur in forest ecosystems.

There is an increasing awakening among the people all over the world to adopt 'green life style' for healthy living. Billions of dollar worth herbal health care products are sold annually. The World Health Organization (WHO) projection for the year 2050 takes herbal products to 5 trillion US dollars. Now technologically advanced countries like Germany, France, Japan and China are in the forefront of the market with the scientifically validated herbal products. Kerala being in the tropical belt has rich biodiversity, and our flora is an excellent source of bioactive molecules.

HISTORY OF MEDICINAL PLANTS IN KERALA

Legend has it that '*Agasthyarkoodam*', the second highest peak of the southern Western Ghats, was named after sage Agastya. The seer had come down from his home in the Himalayas to Kerala, on the invitation of Sage Parasurama (who created the land of Kerala), to participate in a *Yagna*, specially conducted for the welfare of living beings. While accepting the invitation, Sage Agastya demanded that a *Nadapanthal* (shady bower, along the foot path) be erected, and a Nadapalaka (wooden planks along the foot path) be laid from the Himalayas to Kerala, for the holy visit. Honouring the request, the wise Sage Parasurama provided an olakkuda (an eco-friendly umbrella made of palm leaves) as *Nadapandal* and *Methiadi* (eco-friendly wooden footwear) was provided as Nadapalaka. Sage Agastya also requested that the local tribesmen should be deputed to assist him in the *Yagna*.

After conducting the Yagna, Sage Parasuraina permitted 64 Brahmin families to migrate and establish their colonies in the land of Kerala. For the welfare of these families, he constituted 18 *SABHAMATAS* (centre for higher education). For administrative convenience, he brought these centres under three main faculties namely *Sastra Sabhamata* (faculty of holistic science), *Sannyasa Sabhamata* (faculty of spiritual learning) and *Karmy Sabhamata* (faculty of Vedic studies). Apart from this, to deal with the health care of the people, Sage Parasurama trained a selected group of individuals and was named '*Ashtavaidyas*' (physicians). They were called *Ashtavaidyas* because they mastered all the 8 disciplines of Ayurveda namely *Kayachikitsa* (internal medicine), *Shalyatantra* (general surgery), *Shalakyatantra* (ophthalmology and otorhinolaryngyology), *Kaumarabhritya* (paediatric, obstetrics and gynaecology), *Agadatantra* (toxicology), *Rasayanatantra* (gerontology), *Vajeekaranatantra* (sexology) and *Bhutavidya* (psychiatry).

EARLY STUDIES AND CLASSICAL LITERATURE ON MEDICINAL PLANTS

In India, the study of plants began during the period of *Rig Veda*. The *Atharva Veda* contained authentic descriptive records of 289 plants. Later, during the *Samhita* period, observations and studies were conducted in a more analytical manner by organizing this knowledge system. The total number of medicinal plants in *Charaka Samhita*, *Susruta Samhita* and *Astanga Hridaya Samhita* has been roughly estimated as 1900, out of which 670 are common to all the three texts. Further addition of new medicinal plants in Ayurvedic literature during the period of lexicographs, (*nighantus*) started from 8th century onwards. There are more than 17 lexicographs exclusively describing medicinal plants. Lexicographic contributions of *Dhanwantari*, *Sodala*, *Madanpala*, *Naraharipandita* and *Bhavamisra* are a few among them. One hundred and fifty to 400 new additions of medicinal plants have been mentioned in these works. Over 150 species of plants that are either indigenous or naturalized in Kerala are employed in the classical systems of Indian medi-cine like Ayurveda and Sidha. A few of them (eg. *Adhatoda zeylanica, Anamirta cocculus, Andrographis patziculata, Azadirachta indica, Centella asiatica, Cissampelos pareira, Curcuma longa, Rauvolfia serpetitina* etc.) have been emerged as sources of modern drugs with proven clinical activities. Be-sides Ayurveda and Sidha, the rural folk and tribal communi-ties, who live in close proximity with the forest areas, make use of about 2000 species of lesser known wild plants for various medicare purposes.

Thus, medicinal plants constitute one of the important components effectively used by the physicians of Ayurveda not only for treating various disorders, but also for preventive, promotive and corrective purposes. For animal care, '*Mrigayurveda*' and for plant care '*Vrikshayurveda*', were also developed in the early years.

Table 1.
Number of medicinal plants used in different Indian systems of medicine

Name of the system of medicine	Number of plants mentioned
Ayurveda	900
Siddha	800
Unani	700
Amchi	300
Folk medicine / Tribal medicine	2000
Modern medicine	90

Kerala – An emporium of medicinal plants

Unlike any other tropical zones of similar geographic or physiographic dimensions, the medicinal flora of Kerala exhib-its enormous intraspecific variability and chemical polymorphisms. The occurrence of high genetic variability and an amaz-ing array of organic compounds are characteristic of the medici-nal plants of this region. The flora of Kerala thus represents a dynamic repository of potentially useful biodynamic com-pounds which may lead to new drug and pharmaceutical dis-coveries.

The study on medicinal plants of Kerala and their use in traditional medicare system has a hoary past. It was the bewil-deringly rich plant wealth and a matching cultural diversity of local people of Kerala, who used plants for various therapeutic aids, that prompted Van Rheede tot Draakenstein, the Dutch Councilor of the erstwhile Malabar province, to write *'Hortus Indicus Malabaricus'* (1687 - 1693) - the first comprehensive printed book on the natural plant resources of the Indian sub-continent written in a European language. *Hortus Indicus Malabaricus* is a twelve volume work which deals with descriptions and illustrations of 742 plants growing in and around the then province of Cochin in Kerala. Van Rheede published this monumental treatise with active collaboration of many including four renowned local physicians from Kerala namely: Itti Achuthan, Ranga Bhatt, Vinayaka Pandit and Appu Bhatt. *Hortus Itidicus Malabaricus* signifies not only as the first clas-sical work published on the medicinal plant botany of the world, but also forms the basis of many new genera and species de-scribed by Carl Linnaeus and subsequent workers. The 742 plants described and illus-trated by Van Rheede represented 690 taxa belonging to 143 families, and 660 of them have been recollected in or near their original localities in recent times.

TABLE 3.
RARE AND ENDANGERED MEDICINAL PLANTS OF KERALA

Plant species	Family
Aristolochia tagala Cham.	Aristolochiaceae
Asparagus racemosus Willd.	Liliaceae
Coscinium fenestratum (Gaertn.) Colebr.	Menispermaceae
Embelia tsjeriam - cottum (Roem. & Schult.)	Myrsinaceae
Embelia ribes Burm.f.	Myrsinaceae
Entada phaseoloides (L.) Merr	Papilionaceae
Garcinia gummigutta (L.) Robe.	Clusiaceae
Holostemma annulare (Roxb.) Schu. A. DC.	Asclepiadaceae
Hydnocarpus macrocarpa (Bedd.) Warb.	Flacourtiaceae
Kaempferia galanga L.	Zingiberaceae
Myristica malabarica Lam	Myristicaceae
Operculina turpethum (L.) Silva	Convolvulaceae
Piper barberi Gamble	Piperaceae
Piper longum L.	Piperaceae
Ravolfia serpentina (L.) Benth. ex Kurz Apocynaceae	
Saraca asoca (Roxb.) Willd.	Ceasalpiniacea
Stereospermum colaris (Buch - Ham ex Dill.) Mabberly	Bignoniaceae
Trichopus zeylanicus subsp. travancoricus Burkill ex. Narayanan	Trichopodaceae

List of medicinal and other important plants of Kerala with their Scientists file nme, vermacularance distribution in Kerala,m useful parts, acture priinciples and local uses are furmissed in Annexure I

PLANT COLLECTION, HERBARIUM, IDENTIFICATION AND NOMEMCLATURE

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1. PLANT COLLECTION

1.1 The purposes of collecting

Collections of plant specimens (herbaria) are the foundation for all studies of plant diversity and evolution. Specimens provide enormous economic and scientific returns to society and are irreplaceable resources that must be preserved for future generations.

Specimens provide the foundation of nomenclature, the basis for identification, the common reference for communication, and the vouchers for floras, as well as for evolutionary and genomic studies. Molecular and morphological characters that allow us to reconstruct the history of life can be obtained from herbarium specimens. All fields of biological science from the level of molecular biology to ecosystem science are dependent on collections, not just for application of names, but as the basis for referencing all aspects of biodiversity.

Beyond their scientific importance, herbarium collections offer many benefits to society by providing data or reference materials for critical endeavors such as agriculture, human health, biosecurity, forensics, control of invasive species, conservation biology, natural resources, and land management. Herbarium collections provide a wealth of information on our natural heritage and extend back hundreds of years; thus they provide the only reliable, verifiable record of the changes to our flora during the expansion of human population.

Because natural history collections play such an important role in societal endeavors, continued physical and financial support is absolutely critical. Collections are most valuable in their original institutional and geographical context. Because they are historical records linked to a time and place, lost collections cannot be replaced. Moreover, many populations documented in herbaria no longer exist and others are now protected. Furthermore, some specimens cannot be replaced due to the imposition of constraints on collecting.

1.2 What to look for in a specimen

Specimens for collection should be as complete as possible. Ideally flowers and fruit should be included, as well as vegetative parts. Clearly, in most cases, this is impossible since ripe fruit and flowers do not usually occur at the same time. Often, however, remains of growth from the previous year can be found at the base of the plant or on another specimen nearby. Only collect fruits or seeds if you are certain that they belong to the same plant or the same species.

Specimens should be typical and healthy, with at least some fully expanded leaves where possible. Avoid taking diminutive individuals because they fit into a press more easily or are

easier to reach. Take the plant from its typical habitat. If a species normally grows in woodland, do not collect specimens growing by the roadside or in a clearing. Sometimes leaf shape, flower colour and other characters are completely altered on plants growing in full sunlight.

1.3 What to collect

The whole of small vascular plants should be collected including the underground portion. Roots, trailing or underground stems and storage organs are often helpful (and sometimes essential) in identifying specimens. A strong knife or small trowel is helpful for digging out a plant. Excess soil can be shaken off, or washed off carefully if water is available.

Mosses and lichens should also be taken whole. Where they grow in mats a good handful should be removed. Ideally the specimen should be pure, not mixed with other species. Sometimes it is necessary to pick out individual plants one by one. In this case at least half a dozen to a dozen specimens should be taken. Mosses and lichens growing in cushions or clumps, or closely growing on the substrate should be cut away with some of the substrate. Thus the specimen consists of bark, rotting wood, soil, humus and so on as well as the plant. This ensures that the growth form of the plant is retained. Soil can be removed much more easily once the specimen has dried. Again "clean" specimens containing only one species should be aimed at. If fruiting bodies are available, these too should be collected, or identification may be impossible.

1.4 How to collect

Ideally, collections of vascular plants should be put immediately into a field press, because this produces the best looking specimens. Field presses are rather bulky to carry around and may prove impractical in some cases.

Collecting into plastic bags is another option favoured by many field botanists. A range of bag sizes should be available. Small plants can be placed singly, or two or three together if necessary, in a suitably sized bag. Plastic bags are not recommended for serious collecting because the risk of damaging the specimen is very great. Petals are likely to be knocked off, and stems will almost certainly be bent or broken.

Mosses, lichens and macro fungi should always be collected in paper bags or envelopes. These have the advantage of allowing the plant to be dried in the same bag. Notes can be written directly on the bag.

1.5 Notes to take

Every specimen should be accompanied by comprehensive notes retained in a collecting note book. These notes may not only aid in identification of the material, but will later be used to complete the information on the herbarium label. It is far better to take too many notes than too few, and is dangerous to trust information to memory, especially as there may often be several months or more between collection and processing. The notes should contain the following information:

(i) **Collection number**: A serial number specific to collector and specimen. The number may start at 1 and continue through the collector's life time. Other people augment the serial

number with notes of name, place, date. For example, JS/KAU/06/237 may be specimen #237 collected by Jitin Sabu in Kerala Agriculture University during 2006.

(ii) The name of the plant: This is important as it helps the collector remember the individual specimen even if the labels are accidentally lost or mixed. Even if the collector has no idea what the specimen is, it is sometimes useful to give a completely arbitrary name such as "Lacy Moss" or "Big Leaf". This has a double advantage in vegetation surveys in that this name can then be applied to other specimens of the same species if they are encountered before the material has been identified.

(iii) **Locality**: This should be as detailed as possible, including the name of roads lakes and so on in the vicinity, as well as Village or District. The latitude and longitude or the UTM Grid Reference and Map Number will be needed for the herbarium label, but can be added later if they are not known.

(iv) **Description**: This should include everything about the plant that is not obvious on the herbarium specimen. Essential items are the height, type of bark, whether the stem is upright, sprawling or drooping, obvious smells, whether the plant is clumped, single or growing in patches, and the presence of creeping or underground stems. Flower and fruit colour should also be noted as these often fade on dried specimens.

(v) **Habitat**: This should include the general habitat as well as more specific details of micro-habitat. Important points are type of soil or other substrate (sand, clay, granite, dead wood, other vegetation), associated species, moisture and aspect (fully exposed on a south facing bank; in a damp hollow under dense scrub, etc). The more careful and detailed such notes are the more useful they become.

(vi) **Date.**

(vii) **Names of collector(s).**

(viii) **Notes:** Space should be left to note the name of the person who makes the final determination (identification), the date on which it is made and the place were the specimen is sent or stored. The receiving herbarium will add their own accession number to the specimen.

Many herbaria and professional collectors have form-style collecting books with printed serial numbers. Carbon copies of field notes are made on perforated pages. These pages are torn out and placed with specimens when they are pressed. The original is retained in the notebook and kept for records. Number tags are also used for this purpose. Even without a printed notebook, collecting and note taking can be done very efficiently if a constant format is used.

1.6 Pressing and drying vascular plants

The most important thing to do with freshly collected material is to dry it out as fast as possible. This prevents fungal infections and preserves colour. Vascular plants must be pressed and dried as soon as possible after they are collected. Usually this means that plants should be pressed the day they are collected. It is an important aspect of plant collecting that enough time be left at the end of the day to process the specimens. If this includes identification, this stage

may be quite slow . When plants have to be left overnight they should be put in a cool place. Sometimes woody specimens can be placed in water for a day or so to force buds or restore wilting leaves.

1.7 The plant press

The plant press is designed so that plants can be dried quickly while being pressed flat. It consists of two cross-slatted wooded frames about the size of a folded newspaper (46-31 cm). Plant specimens are laid in folded newspaper between layers of blotter sheets or foam and corrugated cardboard. The newspaper provides a folder for the plant. The paper, blotter and foam draw the moisture away from the specimen. Blotters can be thick blotting paper or felt, or thin sheets of the polyurethane foam that is laid down under carpets. Foam is best for woody species or plants with large fruits, because the foam adjusts to the contours of the thickest parts of the specimen while at the same time ensuring that the leaves are well-pressed. The cardboard allows air circulation within the press to speeds up the drying process, and helps keep the specimens flat. Plants in their newspaper folders are piled in layers of alternating blotter and cardboard on one of the wooden frames (i.e., cardboard - blotter - folded newspaper [with plant inside] - blotter - cardboard - blotter - etc.). When laying out of the specimens is complete, the second frame is laid on top of the pile which is compressed and strapped as tightly as possible. The press is then placed to dry in warm (not hot), dry, circulating air. After 24 hours the paper and blotters should be changed to enhance the drying process. After this, the specimens may be left undisturbed for several months or weeks until they are completely dry and the press can be emptied. The straps have to be tightened periodically as the plant material shrinks.

Herbaria have special drying cabinets in which the presses are dried. In the field drying is not so easy, but it should have priority as specimens are easily ruined if they remain damp. A press left upright on a rock, or kept on a car roof rack, where air can circulate will dry much faster than one left lying in a tent, vehicle or room.

1.8 Laying out the specimens for pressing

Two important points should be borne in mind when plants are prepared for the press: (i) that the dried specimen should fit neatly onto a standard herbarium sheet of 420 x 297 mm; and (ii) that as many features as possible should be visible on the mounted specimen. Here are a number of tips which, if followed, will help produce attractive and worthwhile mounted material. With experience, all collectors develop their own techniques.

If a specimen is too tall to fit in the press or on the herbarium sheet, make a zig-zag bend in the stem. This shortens the effective length of the specimen without any of the material being lost. Plants with many long, narrow leaves such as grasses will bend and press more neatly if a piece of paper with a slit in it is placed over the elbow of the bend to hold all the leaves together.

Too many leaves on a herbarium sheet look untidy and can obscure detail. Where it can be done without destroying information, snip off some of the leaves, but ALWAYS leave part of the petiole so that it is evident that leaves have been removed.

Branches that are not naturally flat can be made easier to press if the angles or twigs are bent in the appropriate direction before the plant is laid on the newspaper. Care should be taken not to actually sever twigs or leaves.

The specimen should be laid out so that there is minimum of overlap between parts. Sometimes this involves spreading the plant unnaturally. Start near the folded edge of the newspaper and hold the parts in the desired position. Fold over enough newspaper to cover these parts and hold it down with the flat of the hand. Then move to the next portion of the plant, arrange it and fold down a few more centimeters of newspaper. Continue until all the newspaper is folded down and the flats of two hands can cover the whole sheet. You will find that you sometimes need all three hands as well as your chin for this process, but it will be worth it when you finally see the specimen mounted.

When stems are very thick they can be sliced lengthwise so that they are less bulky. Leaves of plants with thick stems do not always get sufficiently pressed and may tend to wrinkle. Using foam sheets helps prevent this because the foam molds itself around the specimen and ensures an even pressure throughout. The end of woody stems should be sliced diagonally so that the colour of the wood and pith are displayed.

Leaves or petals which have wilted, or are folded over, will not always lie flat for pressing. A piece of wet newspaper will "stick" them in place. By the time the newspaper is dry the leaf will have stabilized and cause no more trouble. On every mount, the back of at least one leaf should always be visible. Sometimes this involves twisting a petiole to obtain the desired effect.

If there are several flowers on a specimen, some should always be pressed open and flat so that the inside is displayed. This can usually be achieved by careful, deliberate pressure with the thumb before the newspaper is folded shut.

Loose seeds and fruit can be placed in a small paper packet and pressed with the specimen. Later this packet will be glued to the herbarium sheet. Some conifers loose most of their needles on dried specimens. Once the material is dried, the needles can be shaken off and placed in a packet.

Once plants are pressed, changing the paper after the first 24 hours not only enhances drying, but allows the collector to make cosmetic adjustments to the specimen while it is still supple. Folded leaves are the main problem. These can be prised open with a mounted needle and pressed flat the second time round. Sometimes petals stick to the newspaper as they dry and are impossible to remove without damage once they have become brittle. Changing the newspaper before the flower has dried completely helps to prevent this.

Pressing plants can be a long and laborious process. It will take considerably less time if you avoid reading all the advertisements and news items in the old newspapers. Sometimes, however, these can help considerably in elevating boredom!

1.9 Mounting specimens

Once material is pressed and thoroughly dried, it is mounted on herbarium sheets. The standard size for these sheets is 420 x 297 mm. They should be made from stiff, acid-free, paper or cardboard of good quality so that they will not turn yellow or crack with age.

Specimens should be laid on the sheet in an attractive, space-filling way. Space should be left in the lower right hand corner for the herbarium label. The sheet should be as full as possible without being crowded. When the arrangement is satisfactory, the specimen may be stuck to the sheet. Traditional methods require pasting the plant onto the sheet and reinforcing it with strips of tape or plastic stripping. The disadvantages are that pasting does not allow easy removal of parts for examination; tape is unsightly and may obscure important details; the ingredients for plastic stripping are highly carcinogenic, and in the presence of moth balls the plastic may become tacky.

1.10 Labeling

Most herbaria have printed labels about 8 x 10 cm which are filled in and glued to each herbarium sheet. The label should contain the following informations:

1. Collection No.
2. Date
3. Plant Name
4. Family
5. Locality
6. Lat Long:
7. Habitat
8. Collector Name
9. Determinant Name and date
10. Herbarium Ac. No.

This provides room for all the essential information noted by the collector at the time of gathering, plus a catalogue number for the plant in the herbarium register (Acc.#). Most herbaria now keep specimen records in a database and have programs which create labels automatically. Before collecting and donating specimens to a herbarium, you should find out the field names, sizes and codes for the database they use so that you can provide information in a consistent format.

2. PLANT IDENTIFICATION

2.1 The specimen

Before identification of a plant can begin it is necessary to have the best possible specimen. Nearly all classifications and keys are based on the sexual parts of the plant (the flowers and the fruit). One of the main reasons for this is that floral parts tend to remain much more stable through time and under different environmental conditions than do the vegetative parts, and they reflect the true relationships of plants better. However, all parts, including underground organs may be needed for positive identification. A flower and a leaf would not be enough if the key called for stem and root characters. Notes about the plant should provide details of habit, growth form and so on. It is best to use fresh material for identification. When this is out of the question and preserved specimens have to be identified, the importance of good pressing and mounting techniques will be made very clear.

2.2 Equipment needed

The most obvious need is a good reference book or books. The best books have at least elementary keys. Line drawings or detailed paintings are more useful than most professional

taxonomists would care to admit. Colour photographs, although attractive, and showing the plant in its natural habitat, are often next to useless because they cannot show the range of detail which can be incorporated into a drawing. The following are some available floras for identification of Kerala plants:

Flora of British India (1872-1897) by Sir J. D. Hooker

Flora of the Presidency of Madras by J.S. Gamble (1915-36)

Flora of Thiruvananthapuram, Kerala' Mohanan M. and Henry A. N.; (1994)

Flora of Silent Valley by Dr. K.S. Manilal (1986)

Forest Trees of Travancore, Bourdillon T. F. (1909)

Trees of Kerala, Sashidharan N. (1987)

Flora of Agasthyamala, N. Mohanan and M. Sivadasan (2002)

Another essential piece of equipment is a hand lens, dissecting microscope, or some kind of magnifier. Even on large plants with big flowers, some of the features are very small and positive decisions can only be made if all the features are clearly visible. Other equipments are very fine forceps, two mounted needles and a sharp scalpel or razor blade.

One very useful piece of equipment which is, unfortunately, not always available, is an experienced botanist who knows the flora and can confirm identifications. Botanists usually have a stock of salient features by which they can recognize plants even without flowers or fruit. These characters are not always clearly stated in reference books. It follows that a note book and pencil will always prove useful.

2.3 Unidentifiable plants

Some plants do not seem to be identifiable even if they are carefully keyed out and all the essential parts are present. These plants should be sent to an expert for determination. If a likely candidate is not known locally, the specimen will have to be sent away. It may be sent directly to a local herbarium, but usually it pays to find out who is the best person to identify the particular plant or plants, and whether they would be willing to do your determinations. Sometimes this service has to be paid for, but usually it is done free if the specimen is donated to the person or establishment.

Other specimens are unidentifiable because they are incomplete. Usually the best method is to compare the unknown with specimens of known plants to see if the characters match. A local expert may recognize the specimen, but usually botanists and herbarium staff are unwilling to tackle incomplete specimens.

3. PLANT NOMEMCLATURE

3.1 The history of plant nomenclature

Humans have always needed to classify objects in the world around them. It's the only means we have of acquiring and passing on knowledge. Recognizing and describing plants has

always been especially important because of their use for foods and medicines. The commonest, showiest or most useful plants were given common names, but usually these names varied from country to country and often from district to district.

In the late 16th century, Casper Bauhin devised a system of using just two names for each plant, but it was not universally adopted until the Swedish naturalist, Carl Linnaeus (1707-1778) set about methodically classifying and naming the whole of the natural world.

3.2 The names of plants

In 1753, Linnaeus published his "***Species Plantarum***". The modern names of nearly all plants date from this work or obey the conventions laid down in it.

The scientific name for an organism consists of two words:

i) the genus or generic name,

ii) the specific epithet.

The generic name and specific epithet may be from any source, but they are always treated as Latin. The generic name is usually a noun. For example, the name *Oryza* is simply Latin for rice. The specific epithet is usually an adjective, but can be another noun or the name of a person. Thus in *Oryza sativa*, 'sativis' means cultivation.

3.3 The correct form of plant names

The scientific names of plants should always be underlined or written in italics (underlining is simply the typographic code for italics). The generic name is always written with a capital initial letter, and the specific epithet should always have a lower case initial letter. (Sometimes specific epithets honoring people are given a capital letter, but a small letter is always correct and therefore safer). The name is only correct and complete if it is followed by the name of the person or people who first described it or assigned the name to it. Often, for convenience, these names are abbreviated. For example, "L." always stands for Linnaeus. The correct name of rice plant is *Oryza sativa* L.

3.4 Classification

Plants are classified according to their assumed relatedness. A unit of classification, at whatever level, is called a taxon (plural taxa). There is a strict hierarchy of taxa of which the species is the lowest natural unit. The hierarchy is: species, genus, family, order, class and division.

3.5 The use of common names

Latin names often seem long and unpronounceable, and the system of naming (nomenclature) is complicated and involved. So why use them? Why not use common or vernacular names which are easy to remember and usually have a meaning in everyday language? Some of the reasons are listed below.

(i) Common names are not universal. They are usually only applicable to a single language. Thus the same plant may have numerous common names.

(ii) In most of the world only a small proportion of species have common names. Calling plants by common names usually means that the scientific name is translated or species are lumped under a generic name.

(iii) The convention of a generic name and a specific epithet is not used for common names. Sometimes closely related plants have completely different names.

(iv) It is quite common that two unrelated species have the same common name. For example, "pathiri" is used not only for *Myristica malabarica* which is in the family **Myristicaceae**, but also for several members of the genus *Steriospermum* , in the **Bignoniaceae.** More than 5 species of the genus *Sida* (S. acuta, S. retusa etc) are popularly known as "kurnthotti".

3.6 The meaning and origin of plant names

One of the reasons why people shy at scientific names is that they are unfamiliar, and sometimes rather long and they may seem difficult to pronounce. Understanding and therefore remembering names of plants becomes much easier, simpler, and more interesting, if the meaning or the origin the name is known. Many of the specific epithets are very common. They describe color, shape of leaves, habit, number of parts, size, habitat, place of origin and so on. Most of these are Latin, but unfortunately, to confuse the issue, some are Greek. For example, epithets describing four leaves could be either *quadrifolius* (Latin) or *tetraphyllus* (Greek), they both mean "four-leaves". Nevertheless, many of the Greek and Latin words which go to make up species epithets are the origins of many English words, and the meaning of names can often be interpreted by someone with no Classical background.

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CONSERVATION OF FISH BIODIVERSITY IN KERALA- CHALLENGES

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INTRODUCTION

Bounded by the forested hills of the Western Ghats in the east and Arabian sea in the west, and endowed with a warm temperature, high rainfall all congenial for intense biological activity, the climate and soil have endowed Kerala with a very rich flora and fauna. The state is longitudinally divided into three physiographic divisions; the highlands, midlands and low lands. Out of the total length of 1300 km of the Western Ghats, over 500 km fall in Kerala. Due to its location on the windward side of the Western Ghats, the state receives an average rainfall of 2800 mm. The Western Ghats form the catchment area of all the 41 rivers in the state.

The state of Kerala has a steep topography with landmasses 3-5m below mean sea level in the low lands to heights of over 2500 m in the eastern mountains, within a short span of 100-120 km. The two rainfall patterns and several soil types result in situations of high rainfall tropics to cool temperate. It is these configurations that enable such diverse plant and animal life. The undulating topography of the state create a variety of macro and micro environments in the river systems flowing through mountain ranges, valleys , slopes and plateau conducive for a variety of fish species.

All the rivers of Kerala originating from Western Ghats and roaring through the high ranges and sloping in to the backwater system are characterized by many rare and endemic fish species. Studies reveal that out of the total 600 and odd freshwater fish species identified in India, over 210 species are available in our river systems contributing to over 35 % of the total fish biodiversity in the country. The streams and rivers of Kerala are therefore known as biodiversity hotspots In terms of plant diversity also, Kerala stands out first. Over 10,035 species of plants, which represent around 22 percent of India's plant diversity is represented here. Out of these, several species occur exclusively in Kerala. As high as 30 percent of animal diversity is also concentrated in Kerala. Out of these, many are endemic to these places indicating ecological sensitivity of the region. It is this unique biodiversity that makes Kerala the 'Gods own country'

Water our strength

The inland fishery resources of Kerala consists of 2,42600 ha of brackish waters; 30000 ha of reservoirs; 3300 ha of freshwater ponds and tanks and 85000 ha of rivers and streams. Coupled with the marine water spread, of 36000 sq.km, coming under the Exclusive Economic Zone, the aquatic resource of the state constitute almost double the cultivated land area of the state.

The backwaters or estuarine systems of Kerala are formed of a chain of coastal wetlands including lakes, lagoons mudflats, tidal marshes and mangrove swamps. These backwater systems that lie parallel to the coastline exert a profound influence on the coastal fisheries, by functioning as the nursery and breeding grounds for coastal fish and shellfish species. The high fish productivity of the coastal seas of Kerala is undoubtedly linked to the chain of backwater systems that lie parallel to the coastline, and open to the coastal seas through *azhis* and *pozhis.*

The river systems also have a direct linkage on the coastal zone processes. The unique phenomenon of *mud bank* or *chakara* appearing along the coast of Kerala is a contribution of this estuarine system. Consequent to flooding of the backwater system, by the heavy monsoonal discharges from the rivers, the resultant hydrostatic regime promotes the discharge of loose mud from the river side towards the sea. The thixotropic properties of the mud cones by the kinetomatic viscosity of the medium result in the mud bank or *'chakara'* phenomenon. This result in the subsequent calming of the monsoon swells. The recurrence of such quiescent areas from year to year, results in a rich fishery on our coastal seas.

Human Interventions

However, most unfortunately, wetlands in Kerala are exposed to serious human onterferences. The classic example is the Vembanad wetlands. This system has been subject to shrinkage by reclamation, for agriculture, harbor development, urbanization and industrialization. A series of human interventions, to facilitate intensification of rice cultivation, has brought about appalling changes in the ecology of this wetland. The major intervention to intensify rice farming, ie. construction of the Thanneermukkom barrage, across the lake which prevented incursion of salinity has been most catastrophic to fish biodiversity.

Ecological backlashes

With the cutting of tidal circulation water conditions became stagnant in the lake. Adoption of high input rice cultivation practices and indiscriminate use of pesticides and chemical fertilizers lead to endangerment of many fish species. The most serious ecological outcome has been disruption of the physical and biological continuity of the lake with the sea.. The lake, which used to support a heterogeneous assemblage of truly estuarine and fresh water species has become impoverished..

Vanishing Biodiversity

The effects on the barrage on the very lucrative commercial prawn fisheries in the lake are well documented. The upper reaches of this estuarine system, known as; Kuttanad is the home ground of the world's largest freshwater prawn species *Macrobrachium rosenbergii* popularly known as *Kuttanadan konchu.* The upstream and downstream migration of these prawn species has been totally disrupted and this resulted in the decimation of its fishery in the lake. The annual catch of this species before construction of the barrage was 429 tons, which has dwindled to less than 27 tons during 2001. The alarming decline of this valuable resource is attributed to the physical obstruction inflicted by the barrage.

Extinction of mangroves

Another ecological consequence of these interventions has been the near extinction of mangroves that fringed the estuarine shores. It is well known that mangroves are natural fish

habitats and favored nursery areas of coastal and estuarine fisheries. The disappearance of the once luxuriant mangrove formations in Kumarakom region of the Vembenad waters has resulted in the poor breeding and recruitment of 'Karimeen', *Etroplus suratensis,* is cited to indicate the direct inter relationship of mangroves on the estuarine fisheries.

Decline of shell fisheries

The Vembenad Lake ranks first in natural lime shell production in the country, contributing over 90 percent of its total production. Lime shells collected from the Vembenad Lake forms the resource base of several industries. The lime shell fishery in the lake is sustained mainly by a clam species *Villorita cyprinoides* . The black clam, *Villorita cyprinoides*, that used to support a lucrative lime shell and clam fishery is fast diminishing in the lake due to salinity exclusion. The stock replenishment of this species is impaired by lack of desired salinity regime, as clam, *Villorita cyprinoidee* requires salinity, around 17-18 ppt for successful spawning.

Unethical fishing practices

The decline in biodiversity of inland fishes in this wetland is also attributed to unsustainable fishing practices such as poisoning, dynamiting, electric fishing etc. Operation of *madavalai* on the *pettti* and *para* pumping system in padasekharams of Kuttanad, prior to the annual *punja* rice season is yet another destructive fishing practice that cause indiscriminate destruction of diverse fish species. The massive trapping of spawner fish stocks with the onset of monsoons, unauthorised introduction of exotic fishes such as African cat fish, *Clarias garipineus*, and carnivorous fishes such as Red pirhana' etc are threats to fish biodiversity in these wetlands. The endemic carp fish of Kerala, *Labeo dussumieri,* the esteemed golden catfish of Kuttanad, *Horobagrus brachysoma*, the riverine coldwater fish, *Gonoproktopterus curmuca, Wallago attu,, Channa micropeltes, C. leucopunctatus Pristolepis malabaricus, Ompok bimaculatus* and *Clarias dussumieri.* are some of the critically endangered fish species in our river systems.

Other threats to biodiversity

Unscientific construction of check dams without provisions for fish ladder apparently affect migration and proliferation of fish species in our river systems. The large-scale removal of boulders and cobbles, from the riverine reaches, lead to rapid landslides and deprive the natural habitats for several hillstream fish species. With the enormous publicity given to the ornamental value of river fish species in international ornamental fish trade, the endemic fish species are being removed unscrupulously from our river systems for export. This is yet another threat to several native species in our rivers. Bio-piracy is another problem wherein many of our valuable ornamental fish species are traded internationally with out any compensation to our country. The situation calls for imposing responsible fishing practices.

Resolving conflicts

For the scientific management of fishery resources in our rivers, the focus should be on bio-manipulation. Fishery enhancement strategies such as ranching of fish seeds in natural rivers and habitat restoration will have to be promoted. In addition to

conventional fisheries, management measures such as regulation of mesh size, closed areas, or closed season etc, the situation calls for effective fishery management programs.

Open water fish sanctuaries

In the context that the endemic fishery resources are severely affected by man made interventions, poor natural recruitment and habitat alteration, one of the suggested strategies to conserve the endemics and rejuvenation of commercial fisheries is to protect biodiversity rich regions as 'protected waters' or 'protected sanctuaries'. Habitat restoration by engineering of simulated spawning grounds will also be of aid for rehabilitation of endangered species.

Developing ranching programs

Artificial stocking of natural water bodies is a valid mangement tool that can substantially enhance fish catches. In the context of the rapid decline of the endemic prawn Macrobrachium *rosenbergii,* the largest fresh water prawn in its home ground in Kuttanad, the Kerala Agricultural University has taken up a massive ranching program, whereby hatchery reared seeds of the species were produced in large numbers and released in the riverine locations upstreams Pamba, Manimala and Meenachil river systems. The increased prawn yields in subsequent years indicated the perceptible advantages of such rational stocking programs on fishery enhancement.

Biodiversity Inventory

The greatest threat to biodiversity is the lack of awareness of our biodiversity strength. Conservation of endangered species can be facilitated by habitat protection and recruitment promotion. This calls for efforts to inventories the biodiversity of our river systems so as to form a database on endemic species. Precise information on breeding, spawning and migratory behavior will be of immense use in formulating action plans for conservation.

Agri-Aqua Integrated Farming

Integrated management of resources is the most essential approach to ensure sustainability in fish production. In order to enhance fish production, there is a dire need for integration of inland fisheries, aquaculture and agriculture. The Integrated fish farming model tested and developed by the Kerala Agricultural University, such as *Oru nellum Oru Meenum* is one such model that can make rice farming more organic, productive and profitable.

Integrated Management

The biodiversity conservation of the river system also calls for an integrated approach for management of our river basins. Construction of fish ladders should be made mandatory while constructing check dams in river systems. So that fish movement is not restricted. Measures are also needed to augment the low water flow in rivers, wherever dams are constructed. This can be facilitated by modifying the operational policies of the hydroelectric projects so that more tail race waters are released during summer months. It is also necessary to reduce the pollution load in our river system by promoting recycling of wastewaters and popularization of waste water fed.

VALUE OF BIORESOURCES

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What is value?

Value is a human concept

Even lesser organisms value certain things

Eg. Survival, food, reproduction.

The value system of humans is quite complex and culturally determined

Even within a community values differ with gender, age, assets, education and other personal situation.

Value is a philosophical concept, economic, sociological, political, theological implications

We value,

Peace, life, health, good food, comforts, assets, recreation, knowledge, beauty, luxuries, power

Value is determined by **love**

Value is determined by one's **beliefs**

Value is determined by ones **education and experiences**

Value is determined by one's **outlook on life**

All religions teach the **goodness, kindness and fullness** of God

All religions teach that man and woman must strive to become God like in goodness, kindness and fullness

To achieve such status we must pursue some ethical principles of truthfulness fairness, tolerance, understating, helpfulness etc, and avoid negative or socially harmful traits sush as selfishness, pride, arrogance, greed dishonest actions etc.

Value is usually considered as an economic concept

The unit of valuation is normally money

But bioresources value is much more than a mere economic concept.

What is the value of a human life? What is the value of a person dear to you? Can you put a price tag on your mother, brother or sister? Would you be willing to exchange them for an amount of cash?

Value is different from price

Price is actually the exchange value of a commodity

Price is a monetary value

It is denoted in Rupees, Euros or Dollars.

Different value concepts

Use values – a personal tooth brush

Exchange value – the farm gate price of 100 rubber sheets

Option value – a climax natural forest that is retained in its original state.

The option value is lost when it is converted to an agricultural land, a power project site or an open cast mine.

Bequeath value – A resource or an asset that can be transferred to the next generation, or heir.

What determines value?

Value is determined by:

Need – food, water, towel

Individual and social preferences, tastes – gold, chocolate, benz cars

Rarity – a painting by Raja Ravi Varma, Rembrant,

Quality – basumathy rice, Parker pen

Durability – a kanchipuram saree, a Rolex watch

The return promised – a share in TCS or Wipro or ONGC

Expectation of appreciation – a piece of commercial land at Statue Jn., or a plot of residential land at Kowadiar.

Aesthetics – A hotel located at a scenic spot (kovalam, Kumarakom)

Level of affluence or poverty of the individual (economic status)

GENETIC RESOURCES AND GERMPLASM POOL

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Plant genetic diversity is the key component of any agricultural production system, without which natural evolutionary adjustment of the system to changing environmental and biotic conditions would be impossible. The significance of variation with in a species is critical in agriculture and continued productivity of existing crops hinges in large part on harnessing the genetic variation found within each species. There is an abundance of local expertise in plant genetic resources that has been in use over a considerable period of time and is also constantly evolving. In agriculture, for instance, this knowledge is shown in the development and adaptation of plants and crops to different ecological conditions

The genes required for crop improvement are present in different lines, varieties, strains or populations of the crop species and their relatives. Some useful genes, often very important ones, are contributed by the wild relatives of plants. The various lines, strains, populations of the crop species and its related wild species constitute the germplasm of the crop. Thus *the germplasm of a crop may be defined as the sum total of hereditary material ie. all the alleles of various genes, present in a crop species and its wild relatives.* The germplasm of a crop consists of the following five types of materials.

1) Land races 2) Obsolete varieties 3) Varieties in cultivation 4) Breeding lines and 5) Wild forms and wild relatives

Gene Pool :

Gene pool consists of all the genes and their alleles present in all such individuals whom hybridize or can hybridize with each other. The gene pool is classified into three groups viz., Primary Gene Pool (GP_1), Secondary Gene Pool (GP_2) and Tertiary Gene Pool (GP_3)

Primary Gene Pool (GP_1)

It includes all such strains and species, which hybridize readily with each other and give rise to fertile hybrids. It consists of all the different strains or varieties of a crop species and, in some case, even some related species as well. The members of primary gene pool are the most commonly used in breeding programmes.

Secondary Gene Pool (GP_2)

Members of secondary gene pool hybridize with those of the primary gene pool with some difficulty and the hybrids are only partially fertile Gene transfers from GP_2 to GP_1 are possible but usually difficult. Members of this group are also used in breeding programmes, but not to the same extent as that of Primary gene Pool.

Tertiary Gene Pool (GP_3)

The species belonging to this group cross with the members of primary gene pool with considerable to great difficulty, and hybrids, if produced, are invariably sterile. Gene transfers from this group to the primary gene pool are very difficult and require special techniques. Gene transfers from GP_3 to GP_2 are relatively easier. GP_3 is used only occasionally in breeding programmes, and that too by a group of researchers having the competence and the patience for tackling the associated problems.

Germplasm Collections:

A germplasm collection of a crop species consists of a large number of lines, varieties and related wild species of a crop. Such collections are also called gene banks. When a germplasm collection is sufficiently large to include entries or accessions from all over the world, it is called world collection.

Germplasm Conservation:

The various activities in germplam conservation can be grouped into the following categories 1) Collection of germplasm 2) Conservation 3) Evaluation 4) Cataloguing data storage and retrieval 5) Multiplication and distribution and 6) Utilization

Collection of germplasm:

The process of obtaining the various germplasm accessions for a germplasm collection is known as collection of germplasm. This can be done in two chief ways: 1) Exploration 2) Procurement from other agencies individuals etc.

Exploration:

Explorations are trips for collection of various forms of crop plants and their related species. Therefore, cultivated forms like land races, open-pollinated varieties etc., wild forms and wild relatives are all collected. Explorations are the primary source of all the germplasm present in various germplasm collections.

Objectives of Exploration:

Explorations are planned to fulfill mainly the following two objectives.

1) Collection of germplasm needed by breeders. The germplasm accessions collected for this purpose possess the specific traits that are required by breeders either in the immediate future or in the foreseeable future.
2) Collection of the variability remaining in the crop plants and their relatives for its conservation. For this purpose, germplasm samples are collected without any reference to the presence of specific traits; the consideration for collection is that as many diverse types are collected as possible.

Areas of Collection

The areas to be covered by explorations are usually the centers of origin of the concerned crops. In addition, collections should also be made from the peripheral regions of species distribution, and even in areas where it was introduced in comparatively recent times. This is because in these areas the crops are exposed to environmental stresses, and special mutations may have been selected for.

Sampling Sites.

The locations of sampling sites within the collection area should be carefully planned in advance. This should be based on a consideration of the changes in ecological, agricultural and social conditions in the area; soil patterns and changes in agricultural practices should also be considered. If there is considerable variation for these factors, the sampling sites should be closer, otherwise they should be relatively farther apart. Generally, sites for cultivated materials would be scattered over the entire area, while those for wild materials would occur in clusters. A preliminary survey of the area may be done before the actual collection.

Sampling Procedure:

The objective of sampling is to capture, the maximum amount of genetic diversity with the minimum number and size of samples. The collection of plant materials from sampling sites may be (1) random or (2) selective. In random sampling, samples are collected without considering their distinctiveness, while in selective sampling distinct forms are collected. Random sampling is the most suited for conservation efforts and is expected to collect the whole range of variability present in a species. Selective sampling, on the other hand, may pick out morphological variants only and may miss entirely such genes as those for adaptation, resistance to biotic and abiotic stresses etc. Hence a combination of both sampling approaches has been advocated.

The collector should aim at the collection of as many diverse types as possible with the least (ideally little or no) duplication. This is very difficult to achieve as the genotypes of the various types cannot be assessed at the time of collection.

Sample Size:

It has been suggested that 50-100 plants should be collected from each sample site. In addition, at least 50 seeds should be collected from each plants. Thus each sample should consist of 2,500 to 5,000 seeds.

Field Records:

Adequate field records must be maintained during collection. For this purpose, minimum data sheets have been proposed, which can be used with some modifications, if necessary.

Merits of Exploration:

The chief merits of plant exploration are listed below:

1. It is the source of virtually all genetic diversity stored in gene banks.
2. It is the only means of collecting and conserving the threatened genetic diversity.
3. It often provides access to materials of special interest, e.g. new genes (alleles), new species etc.

Limitations of Plant Explorations:

The chief limitations of plant explorations are given below:

1. It is tedious, time-taking and expensive.
2. It poses various hardships to the collectors, e.g. in boarding, transportation etc. especially in remote areas.
3. There may even be a threat to life, especially from wild animals.

Procurement from other Agencies:

Germplasm can be obtained from other agencies concerned with germplasm conservation, from research institutions, individuals or companies. Generally, the involves an import of the germplasm, it is therefore considered in a greater detail later under plant introduction.

Germplasm Conservation:

The germplasm has to be maintained in such a state that there is minimum risk for its loss and that either it can be planted directly in the field or it can be prepared for planting with relative ease; this is called germplasm conservation. Germplasm can be conserved either (1) *in situ* or (2) *ex situ*.

***In situ* Germplasm Conservation**

Conservation of germplasm in its natural habitat or in the area where it grows naturally is known as *in situ* germplasm conservation. This is achieved by protecting this area from human interference; such an area is often called natural park, biosphere reserve or gene sanctuary. A gene sanctuary is best located within the center of origin of crop species concerned, preferably covering the microcentre within the centre of origin. NBPGR, New Delhi, is making attempts to establish gene sanctuaries in Meghalaya for *Citrus* and in the North-Eastern region for *Musa*, *Citrus*, *Oryza*, Saccharum and *Mangifera*.

Gene sanctuaries offer the following two advantages.

1. A gene sanctuary not only conserves the existing genetic diversity present in the population, it also allows evolution to continue. As a result, new alleles and new gene combinations would appear with time.
2. The risks associated with *ex situ* conservation are not operative.

Gene sanctuaries suffer from certain limitations as listed below:

1. They are easiest to demarcate, difficult to establish and very difficult to maintain. This is particularly so in a country like India, which has an ever increasing population pressure.
2. These cannot conserve the variability found in crop plants, for which *ex situ* conservation is the only answer.

Ex situ Germplasm Conservation

Conservation of germplasm away from its natural habitat is called ex situ conservation. It can be achieved in the following 5 ways; (1) seed banks (2) plant or field banks (3) shoot tip banks (4) cell and organ banks and (5) DNA banks.

Seed Banks. In seed banks germplasm is stored as seeds of various accessions. Virtually all gene banks are essentially seed banks. Seed conservation is quite easy, relatively safe and ordinarily needs minimum space. Under suitable conditions, seeds of many species can be stored for upto 50-100 years. Containers of glass tin, plastic or a combination of these may be used for seed storage. Seeds are classified, mainly on the basis of their storability, into two major groups: (1) orthodox and (2) recalcitrant. Orthodox Seeds are those which can be dried to moisture content of 5% or lower without lowering their viability. Most crop seeds belong to this category. Such seeds can be easily stored for long periods. The viability of recalcitrant seeds, on the other hand drops drastically if their moisture content is reduced below 12-30%. Seeds of many forest and fruit trees, and of several tropical crops like Citrus, cocoa, coffee, rubber, oil palm, mango, jack fruit etc... Belong to this group. Such seeds present considerable difficulties in storage. Therefore, germplasms of such plants are conserved by alternative approaches.

The conditions for seed storage depend mainly on the duration of storage. Generally, seed bank collections are classified into three groups: (1) base collections (2) active collections and (3) working collections. This grouping increases the efficiency of use and the level of management of the collections.

Base Collections: These consist of all the accessions present in the germplasm of a crop, which are stored at about –20° C with 5% moisture content; they are disturbed only for regeneration. Germination tests are done every 5-10 years. When the germination of an accession falls below, usually, 95% of its germination at the start of storage, the accession is generated.

Active collections: The accessions in an active collection are stored at temperatures close to 0°C or at 0°C, and the seed moisture is between 5 and 8%. The storage is for medium duration, i.e., 10-15 years. These collections are used for evaluation, multiplication and distribution of the accessions. Active collections are usually maintained by multiplying the seeds of their own accessions. But from time to time, base collection material should be used for regeneration of these collections. This is essential to prevent any appreciable shift in these genetic made up of the collections.

Working Collections: The accessions being actively used in crop improvement programmes constitute working collection. Their seeds are stored for 3-5 years at 5-10°C and they usually contain about 10% moisture.

Plant Banks: Essentially, a field or plant bank is an orchard or a field in which accessions of fruit trees or vegetatively propagated crops are grown and maintained. Field banks suffer from the following serious limitations, they (1) require large areas (2) are expensive to establish and maintain, and are prone to damage from (3) disease and insect attacks (4) man-made or (5) natural disasters and (6) human errors in handling. Few good plant banks exist in India.

Shoot Tip Banks: In such gene banks, germplasm is conserved as slow growth cultures of shoot-tips and node segments. Their regeneration consists of sub culturing the cultures, which may be done every 6 months to 3 years. This approach offers the following chief merits for the conservation of germplasms of vegetatively propagated crops and tree species.

1. Genotypes of the accessions can be conserved indefinitely free from diseases and pests.
2. They can be used for such crops, which either do not produce seeds or produce recalcitrant seeds.
3. Subculture becomes necessary only after relatively long periods (every 6-36 months).
4. Regeneration, ie. sub culturing, requires a comparatively very short time.

Cell and Organ Banks: A germplasm collection based on cryopreserved (at –196°C in liquid nitrogen) embryogenic cell cultures, shoot-tips and or somatic/zygotic embryos may be called cell and organ bank. The techniques for cryopreservation of plant cells and tissues are being rapidly refined, and soon such banks may be established.

DNA Banks: In these banks, DNA segments from the genomes of germplasm accessions are maintained as cosmid clones, phage lysates or pure DNA (the last one being for relatively short periods). These DNA segments can be evaluated and the desired ones may be used to produce transgenic plants. This approach is applicable to the conservation of genetic materials of already extinct species since DNA extracted from well preserved herbarium specimens can often be cloned. However, it is very expensive and highly sophisticated.

Germplasm Evaluation:

Evaluation consists of assessment of the germplam accessions for their various features or traits of some known or potential use in breeding programmes. Generally, germplasm accessions are evaluated for morphological, physiological, biochemical, plant pathological (ie. disease resistance), entomological (ie. insect resistance) and other features. The characters assessed must be related to the need of the breeders since they are the ones who are going to utilize the germplasm. Obviously, evaluation involves experts from different disciplines. It is the most critical step determining the utilization of a collection. A poorly assessed germplasm collection is unlikely to be of any use to the breeders.

Germplasm Cataloguing, Data Storage and Retrieval

Each germplasm accession is given an accession number. This number is prefixed, in India, with IC (indigenous collection), EC (exotic collection) or IW (indigenous wild). Information on the species and variety names, place of origin, adaptation and on its various features or descriptors is also recorded. The usefulness of an accession, in fact, the entire germplasm collection, becomes known to the plant breeders only when the information about

the features of the accessions becomes available to them. Therefore, catalogues of the germplasm collections for various crops are published by the gene banks.

Germplasm multiplication and distribution:

The germplasm accessions requested by breeders/researchers are multiplied and supplied to them, usually without cost. Ordinarily, active collections are used for this purpose. This is a very important activity of gene banks since it is the very purpose for which they are established. Generally, only a limited quantity of seed is provided to each worker. It is expected that each breeder/research worker will report back to the gene bank his assessment of the important characters of the accessions used by him.

Germplasm Utilization:

The germplasm can be used in a breeding programme in the following 3 ways (1) direct release as a variety (2) it may be subjected to selection for developing a variety and (2) it may be used as parents in hybridization programmes.

MICROBIAL BIORESOURSES

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Biodiversity is the sum of all the different species of annuals, plants and microbial organisms living on earth and the variety of habitats on which they live. Biodiversity provides the basic biotic resources that sustain the human race.

Soil is a unique habitat that harbours a variety of micro flora and fauna and gives mechanical and nutritional support to higher plants on which human civilization is based. Soil consists of mineral particles, organic residues from plant and animal sources and micro organisms. Micro organisms constitute one of the major components of the biosphere that sustain the nutrient cycling on this planet. Soil organisms constitute 1 % of the total soil volume. A tremendous diversity exists in the population. A diverse population of micro organisms is active in soil. It includes both beneficial and deleterious organisms. Beneficial organisms out numbers the deleterious ones.

Major soil organisms include soil bacteria, fungi,actinomycetes , protozoa and algae.

SOIL BACTERIA

They are the smallest unicellular prokaryotes with size ranging from 0.5-1 × 1-2 micro metre. It is the most abundant group and usually more numerous than others. Their number varies between 108 and 1010 cell per gram soil. They have a biomass of 160 g/ m2.They exhibit wide range of morphology, and physiologically they range from aerobes to obligate anaerobes, heterotrophs to autotrophs, saprophytes to mutualistic and parasitic symbionts. They are found in high number in cultivated soils than virgin land. Maximum number of bacteria is noted in rhizosphere due to aeration and nutrient availability. Bacteria do not occur freely in soil but are closely attached to soil particles or embedded in organic matter.

They play a major role in organic matter decomposition, biogas production and nitrogen fixation. Flourescent pseudomonas plays an important role in crop disease management and plant growth promotion due to production of antibiotics and plant growth regulator like IAA respectively. The commonly occurring soil bacteria are *Pseudomonas, Bacillus, Nitrosomonas, Nitrobacter, Rhizobium, Thiobacillus* etc.

FUNGI

In most of the aerated or cultivated soils, fungi share a major part of the total microbial biomass because of their large diameter and extensive network of mycelium. The population of soil fungi ranges from 2× 104 to 1× 106 propagules per gram dry soil. Fungi derive nutrients for their growth from organic matter and living plants. On the basis of substrate specialization fungi are classified into root inhabiting and soil inhabiting ones. Fungal mycelium is interwoven among the soil particles and it binds thus improving the texture of clay soils. The major part of the fungal flora occurs in the upper soil horizons where there is more organic matter. Some of the naturally occurring soil fungi are *Trichoderma, Aspergillus, Pencillium, Fusarium* and *Mucor.*

MYCORRHIZAE

They are symbiotic association between certain fungi and roots of higher plants. They include ectomycorrhizae, endomycorrhizae and ect-endomycorrhizae. They play an important role in nutrient uptake and translocation and stress tolerance. Examples are *Glomus* and *Gigaspora*.

ACTINOMYCETES

They share both the characters of fungi and bacteria and are commonly called ray fungi due to their close affinity with fungi. They are G+ve and release antibiotics substances. Earthy odour of newly wetted soil is due to the volatile growth product of actinomycetes. The population of actinomycetes in soil remains greater in grass lands than in cultivated lands. The number of actinomycetes ranges from 105 to 108 per gram soil. Their luxuriant growth is favoured by neutral or alkaline pH. Their number generally increases with the increase in temperature and decrease with soil depth. The important members are *Streptomyces* and *Nocardia*.

The major factors affecting microbial community in the soil are soil moisture, organic and inorganic chemicals, organic matter, and type of crop & season of cultivation.

These micro organisms play an important role in organic matter decomposition, nitrogen fixation, phosphorus solubilisation and mobilization, plant growth promotion, disease management & stress tolerance. Micro organisms which convert atmosphere nitrogen and fix them in soil and which help in phosphorus nutrition hold great promise. Microbial agents are harmless to human beings and animals, effective throughout crop growth period, improves yield, performs in a sustainable way and contributes to sustainable crop production.

Isolation and characterization of soil micro-organisms

Micro organisms are essential components of every eco system. Micro organisms present in soils have the following roles i.e., synthesis of new organic matter from CO2 and other inorganic compounds during primary production and decomposition of this accumulated organic matter. Several studies have shown that soil micro organisms are able to transform, degrade and grow at the expense of an enormous range of natural and synthetic organic compounds and thereby constitute the most important vehicles for the recycling of reduced carbon. Soil microbes are mainly of three types ie, bacteria, fungi and actinomycetes. These organisms can be isolated easily from soils separately by adopting different culture media and different methods.

Collection of Soil flora

a) Enumerations of soil flora

The microbial population in a particular soil sample is very large. In order to do quantitative enumeration of micro organisms decimal dilution method is followed. The soil sample are diluted separately i.e., 1 gm of soil is dissolved in 100 ml of sterile distilled water. Then 9 ml distilled water is taken in several test tubes and sterilized. Then from the 100 ml, 1 ml of the distilled water is taken and added to the first test tube to make it 10 ml and from this 10 ml, 1ml is taken and the dilution is continued. Then from each diluted test tubes, 0.1 ml each of the sample is taken and plated by pour plate technique.

Soil flora to be enumerated includes bacteria, fungi and actinomycetes. For bacteria the media used here is soil extract agar media without glucose. Instead of glucose as carbon source, the organism will utilise the hydrocarbons present in the soil extract. In the case of fungi the medium used is the Rose Bengal agar media with streptomycin and for actinomycetes Kenknight's medium is used.

After inoculation, the plates were incubated at 37o C for 24 hours in the case of bacteria and 48 hours for fungus and actinomycetes. After incubation, the plates were taken for colony countings. Since the main objective of this project work is isolation of hydrocarbon degrading organisms it will take time to grow in the media provided. So we have to increase the incubation period in order to obtain sufficient colonies.

b) Isolation of soil flora

After counting the colonies, the individual colonies obtained should be transferred to separate plates. Here for the isolation of bacteria the media used is nutrient agar. The colonies obtained were streaked on to this media. For fungus potato dextrose agar media supplemented with streptomycin is used. In the case of actinomycetes Kenknights medium is used. The isolate obtained were then characterised by their morphology and growth patterns.

c) Identification of the organism (isolates)

The isolated colonies should be identified separately. For that usually the method employed is staining.

For bacteria usually Gram staining is done. A smear was prepared on a clear slide. Then it was heat fixed. Then the smear was flooded with 2 or 3 drops of Crystal Violet and then after two minutes it was washed and Gram's iodine was added. Then after few minutes destaining solution was used and then safranin was used as the counter stain, the organisms which retains the the Gram's stain were grouped as Gram positive and those organisms which do not retain the Gram's stain will get stained with the counter stain, safranin. So they will be grouped as Gram negative.

In the case of fungus the staining solution used was Lactophenol cotton blue. A wet mount was prepared and then covered with a cover slip and then observed under a light microscope. Using the guide of Buchanan etal.,(1959) fungal types were identified.

Remote Sensing and Geographic Information Systems (GIS) applications in Bioresources Management

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INTRODUCTION

Remote sensing and ***Geographical Information System*** are powerful tools which have revolutionized our understanding of and approach to the earth's resources and environment and their management. Knowledge in these modern technologies has become inevitable these days, especially to those scientists, technologists, managers and planners who handle large amount of spatial data. Though both these technologies have developed independently, in today's world both are considered as complementary to each other. GIS is a fast working, computer-based system for data management and analysis, in which spatial data in the form of maps constitute the essential component, while remote sensing comes handy as a faster map generating technique in meeting the demands of GIS. Remote sensing is the technique of acquiring information about the earth surface from a vantage position in space or air. Thematic maps, the main outputs of remote sensing, form the primary inputs in GIS.

Remote Sensing

The term ***remote sensing*** in a broader sense implies sensing an object from a distance without being in physical contact with it. But in more specific terms, ***remote sensing*** is defined as the science and art of acquiring information about an object or area through the analysis of data obtained by a device from a distance, either on the ground, in the sky or in space. The use of the term is generally restricted to the measurement of reflected or emitted electromagnetic (EM) energy in some parts of the EM Spectrum.

Why Remote Sensing?

Remote sensing data have several advantages over the conventional ground methods.

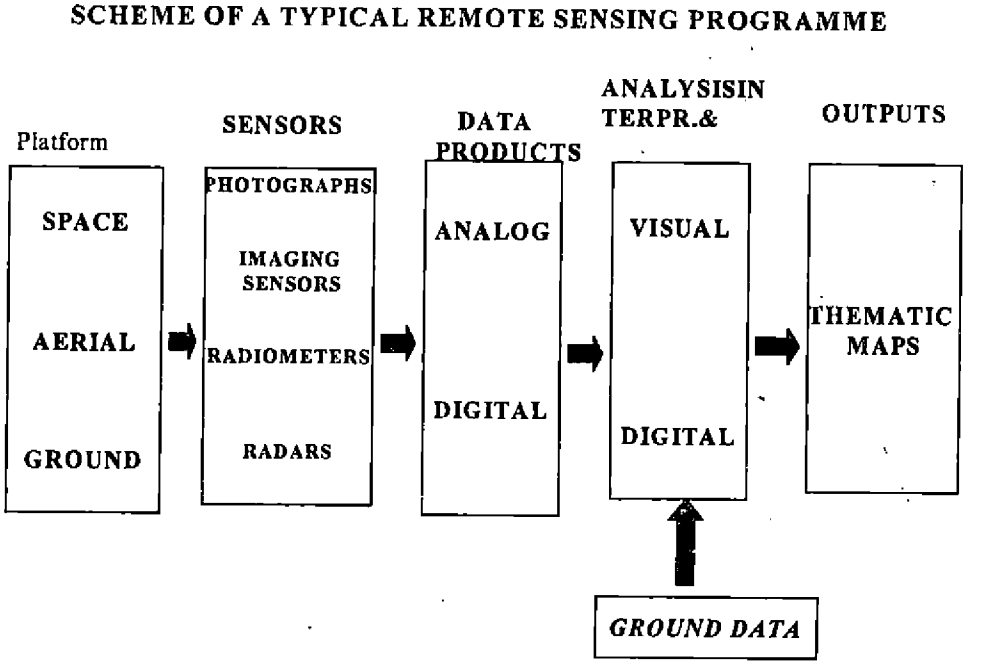
- They provide synoptic view of a large area.
- Enable coverage of inaccessible terrains.
- Data can be obtained in different spectral bands.
- Provide accurate and true picture of the terrain.
- Multi- date data enables monitoring of changes.
- Permanent records, so amenable to reinterpretation.
- Digital data: compatible to computer processing.
- Cost and time is considerably reduced.

Components of Remote Sensing

The main components of RS are the following.

Energy source	Electromagnetic Radiation (EMR) passive active
Data Acquisition (Technology)	Platform Sensors Detectors
Data Utilization	- Data Processing - Interpretation & analysis - Map preparation - Application

The typical scheme of a remote sensing programme is shown:



Platforms: *Remote sensing platforms* are the vehicles or carriers for remote sensors. The platforms may be the vehicles moving on the ground such as trucks, vans etc with the sensors mounted on them, or airborne carriers such as balloons, helicopters and air crafts or space borne vehicles such as satellites and space shuttles. The most typical remote sensing platforms are the aircrafts and satellites.

Satellites are of two types: Geo-stationery and Polar satellites. *Geostationary satellites* make fixed point observation of the earth from an altitude of 36,000 km and are mainly used for meteorological observations, communication, TV and radio transmissions etc. INSAT series of satellites are geostationary satellites.

Polar satellites are the remote sensing satellites. They move around the earth in near circular orbits, very close to the poles, at an altitude of 700 to 1000 km. When the satellite moves in its orbit around the earth and the earth itself revolving on its axis within the orbit, the satellite in its each orbital path passes over different strips on the ground. In this way the entire earth is covered by the satellite with in a pre-decided period.

Remote sensing satellites are characterized by their altitude, orbital coverage and type of sensors. There are several remote sensing satellites in operation at present. These include the LANDSAT series of USA, SPOT series of European Space Agency, IRS series of India and JERS series of Japan.

Sensors: A *sensor* or 'remote *sensor*' is a devise to detect the EMR reflected or emitted from an object on the earth. A variety of sensors are in use in remote sensing. Some are passive sensors, others are active sensors. Some are imaging sensors, the sensors that produce a visual image of the ground, while others are non-imaging sensors which only measure the EMR without producing an image. The most commonly used imaging sensors are photographic camera, Video camera, CCD scanners, Opto-mechanical scanners, microwave radiometer, synthetic aperture radar, thermal scanners etc., while the non-imaging sensors include microwave radiometer, microwave altimeters etc. The most common sensors are of *Opto-mechanical* (or *cross-track scanners*) and push broom (or *along-track*) scanners. LANDSAT MSS and TM sensors used the Opto-mechanical type of scanners in which an oscillating mirror in the satellite covered scan lines across the satellite track. The EMR reflected or emitted by unit area of the ground is sensed by a series of detectors which are sensitive to different wave lengths of the EMR.

A *push broom scanner*, on the other hand, uses a detector consisting of a linear array of CCD elements, each element receiving the EMR reflected by a ground resolution cell along a line across the satellite ground track. The ground is covered along- track like a push broom. There will be separate detector arrays for each spectral band. IRS and SPOT systems used push broom scanners with CCD array detectors. The strength of signal received by the detectors depends on the average reflectance of the corresponding ground resolution cell. This signal is recorded in analog form which is then converted into digital form for recording and transmitting to the ground station.

Remote sensing Data and utilization

The spectral information received by the sensor is recorded on the tape recorder on board the satellite or transmitted to the ground directly. This data received by the ground receiving station is subjected to preliminary processing and converted to usable products such as visual and digital products. Visual products or photographic hard copies are called images or imagery. An image consists of a number of pixels arranged in rows and columns, each pixel representing a corresponding unit area on the ground. Thus in an image each pixel is represented by a grey shade corresponding to the average reflectance of the ground resolution cell... The grey values vary between black and white. Individual band images are displayed or printed in black and white. A colour image can be produced by combining three separate black and white images acquired in three different spectral bands by assigning a primary colour (viz. red, green or blue), to each band. These colour images are called *colour composites*. The most commonly used colour composite is the one in which red colour is assigned to the near infrared band, green to the red band and blue to the green band. This is normally known as the *false colour composite* or *FCC* as the colours here do not represent the actual colours of the objects. Thus in an FCC vegetation is depicted in red colour.

The other kind of data product is the digital data product or *digital image*. In a digital image, each pixel is represented by three coordinates, two of them representing its location as x, y and the third, z representing its radiance value on a scale of 0 to 255 DN value. Based on the number of spectral bands, z values can be z1, z2... etc. The main advantage of digital data is that the image can be processed using image processing soft wares to correct various distortions and also to enhance the quality of the images.

Analysis of remote sensing data involves extraction of terrain information from them and preparation of thematic maps useful in various applications. There are two approaches to information extraction, visual interpretation and digital analysis.

Remote sensing applications in Bioresources Management

Broad area	Specific applications
Agriculture	Crop inventory, Crop acreage estimation, Crop condition assessment, Crop yield estimation, Pest management, Agricultural drought assessment
Forestry	Forest type mapping and bio-diversity conservation, Afforestation and deforestation monitoring, Forest management, Forest fire and risk mapping, Shifting cultivation, Grassland mapping, Plantation inventory, Urban Forestry

Land use/land cover	Landuse / land cover mapping, Wasteland mapping and monitoring, Urban sprawl mapping
Geology	Lithological and structural mapping, Geomorphological mapping, Mineral Exploration, Ground water targeting, Oil Exploration, Geo-technical Studies, Neo-tectonics
Soil studies	Soil resources mapping, Soil moisture estimation
Water resources	Hydrogeomorphological mapping, Surface water mapping and Monitoring, Flood and crop damage assessment, Reservoir sedimentation assessment, Drainage studies, Command area irrigation monitoring and management, Canal seepage detection, Snow melt run off study, Glacier inventory, Surface water pollution assessment
Environmental Studies	Environmental impact assessment, Land and water pollution, Land degradation

Geographic Information Systems (GIS)

GIS is an organized collection of hardware, software, geographic data and personnel designed to efficiently capture, store, update, manipulate and display all forms of geographically referenced information. In other words GIS is a system for capturing, storing, checking, integrating, manipulating, analyzing and displaying data which are spatially referenced to the Earth. This is normally considered to involve a spatially referenced computer database and appropriate applications software.

Components of GIS

A geographic information system is the combination of skilled persons, spatial and descriptive data, analytic methods, and computer software and hardware - all organized to automate, manage, and deliver information through geographic presentation.

People who build and use GIS: When you design a data model, build a software application, or write user documentation, it is important to be clear on the type of user your work is directed toward.

Data sources for GIS: A GIS processes any data that has a spatial component. This information is quite diverse - it can be aerial photographs or satellite imagery, a collection of terrain contours, digital maps of the built environment, or legal records of land ownership.

Procedures and analysis: The specialists that operate a GIS employ functions, procedures, and judgment. This collective human experience is an indispensable component of a GIS.

Computer hardware: Computers come in all sizes, from palm to mainframe. You can purchase GIS software for nearly every type of computer. The Internet is joining computers into a global network and is an important way to access data. Another trend is the increasing use of the Global Positioning System (GPS) to locate people in real time. Other hardware components can include scanner for scanning existing maps and images, printer for printing maps and other optional data input devices.

Software: There are different GIS software brought out by different companies around the world, which includes ArcINFO or ArcGIS, MapInfo, SPANS GIS, AutoCAD Map 2000, Geomedia Professional, GRASS etc.

GIS Capabilities

A good GIS system should be able to answer the following questions

§	Location	What is at?
§	Condition	Where is it?
§	Trend	What has changed since?
§	Routing	Which is the best way?
§	Pattern	What spatial patterns exist?
§	Modeling	What if?

The benefits of GIS include

Better information management
Higher quality analysis
Ability to carry out 'what if?' scenarios
Improve project efficiency

Principal Functions of GIS

Data Acquisition
Data base Management and Update
Analysis
Presenting Results

Sources of data for GIS

Existing Maps: The data for GIS may come for already existing secondary sources of data like road network map from PWD Roads Division, Electricity Supply Network Map from KSEB, Water Supply Network from KWA, Landuse Map from Town Planning Department, Ground Water Data from Ground Water Board etc.

Toposheets: One of the most accurate and reliable source of spatial information for GIS comes from toposheets published by Survey of India which is available for the whole of India in the various scales of 25,000, 50,000 and 250,000. It gives the basic data of an area like drainage, contour and landuse. The greatest advantages of toposheets are that they are georeferenced.

Remote Sensing Data: Remote sensing has made it possible to collect accurate and timely data on any surface feature on the earth's surface. Remote sensing data can be from sensors borne on space based platform like satellite, air based platform like high flying aircrafts or ground based platforms on high rise towers. Very high resolution remote sensing data is now available with the Indian Remote Sensing (IRS) series of satellites and it is available through National Remote Sensing Agency, Hyderabad.

Global Positioning System: It is a highly sophisticated technique of collecting the georeference of any feature on the earth's surface i.e. latitude, longitude, altitude and time of any local feature can be found out using an instrument called as Global Positioning System. It mainly consists of a constellation of 24 satellites belonging to the US Department of Defence. These satellites are continuously in orbit around the earth and any person who wants to find the latitude and longitude can buy a GPS User segment and power it on using two batteries which will then get linked to the satellites and give the readings. The readings from GPS in the form of digital tabular files can be directly downloaded to a GIS system and maps can be directly generated and used with other thematic layers taken maybe from other sources.

Analytical capabilities of GIS

Various Analyses can be done using GIS which includes the following

- Overlay
- Buffer Zones
- Network Operations
- Terrain Analysis
- Spatial Analysis & Modeling
- Geostatistical Operations

APPLICATIONS OF GIS IN BIORESOURCE MANAGEMENT

GIS in agriculture: GIS is used in a variety of agricultural applications such as managing crop yields, crop suitability analysis, monitoring crop rotation techniques, and projecting soil loss for individual farms or entire agricultural regions. Satellite images of land use have been combined with models of El Niño weather oscillation to predict agricultural effects. GPS (Global Positioning System) receivers are being applied in real time with portable GIS software to accurately apply chemicals for agricultural production. GIS is used to model non-point sources of pollution and the maps produced provide a visual display of soil salinity

GIS in the environment: GIS is used every day to help protect the environment. As an environmental professional, we can use GIS to produce maps, inventory species, measure environmental impact, or trace pollutants. The environmental applications for GIS are almost endless. GIS is being used for a complete evaluation of the construction of dams and its effects

on irrigation, hydropower, health, mining, education, tourism, and telecommunications Ecological balance models are combined with GIS software to provide tools for environmental management.

GIS in forestry: Today, managing forests is becoming a more complex and demanding challenge. With GIS, foresters can easily see the forest as an ecosystem and manage it responsibly. The construction and use of roads in a forested basin can contribute significantly to sediment deposition. GIS can be used for building road sediment models to establish maintenance plan, mapping and managing endangered species for Wildlife Service as well as to calculate colony areas and foraging zones.

GIS in geology: Geologists use GIS every day in a wide variety of applications. We can use GIS to study geologic features, analyze soils and strata, assess seismic information, or create 3-dimensional displays of geographic features.

GIS in hydrology: We can use GIS to study drainage systems, assess groundwater, and visualize watersheds, and in many other hydrologic applications. Population growth and agricultural expansion are placing demands on water management and systems to manage rivers, canals, drains, and pumps have been developed by different agencies. Hydraulic computer models are being used to reduce sanitary sewer overflows. When major rainstorms come, satellite imagery can be used to estimate rainfalls and assist in the operation of sewer pump stations. Hydrodynamic/pollutant transport models have been built to simulate the effects of multiple pollution sources under different conditions.

Oceanography, coastal zone, marine resources: The remotely sensed sea temperature data is being used to study oceanic fronts and eddies. And GIS is used for mapping the current shoreline, calculating change rates, and projecting shoreline erosion hazards.

GIS in risk management: A GIS can help with risk management and analysis by showing you which areas will be prone to natural or man-made disasters. Once identified, preventive measures can be developed that deal with the different scenarios.

These applications prove the diversity of GIS solutions. It is always surprising to discover how widely ranging the uses of GIS technologies are.

CONCLUSION

Geoinformatics is a modern technique which includes different tools like GIS, Remote sensing, GPS, etc. The last twenty years has seen a revolution in the field of Geoinformatics. This can be mainly attributed to the revolution in the IT industry which has brought computers as a tool for the common man. Most of the developing countries has gone ahead very much in this field by converting their national spatial and attribute data to the GIS platform and many countries are in the path of achieving it. India is a late entrant into the field, but since the last few years India has also achieved its share of growth in this field. The immediate need is to generate accurate and timely spatial and attribute data of the various thematic layers required for planning and development of the nation and its resources.

Bioinformatics - Application in Plant Biodiversity

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Bioinformatics represents a new growing area of science that uses computational approach to answer biological problems and application of computer technology to the management of biological information. This emerging area has already attained new dimensions mainly because of the gradual realization of the fact that both basic and applied researches in life science are increasingly depended upon the understanding of the biological processes at molecular level. The use of " Electrophoresis" to separate proteins by Teselius in 1933 and later the illustration of á-helix model of DNA by Watson and Crick in 1953 opened a new horizon in the molecular biology research. The first protein sequence of bovine insulin announced by Sanger in 1955 encouraged the scientists to work out protein sequences led to the establishment of Protein Data Bank (PDB) by Brookhaven in 1977. Similarly advances in the DNA sequencing methods led to a deluge of DNA sequences of many organisms. Initiation of human genome project in the mid 1980s to construct detailed genetic map and physical map of human genome and to determine the complete nucleotide sequences required new computational methods for analyzing genetic map and DNA sequence data.

Although the Bioinformatics has evolved as the application of computational tolls for easy handling, analysis , interpretation and modeling of genomic and proteomic data for easy understanding of biological process, now it is used for solving all kinds of biological problems in different areas of biological sciences such as biodiversity, ecology, taxonomy, physiology, cell biology, biochemistry, photochemistry etc.

The rich heritage of plant life and the golden diversity of plant resources of our country are being lost as the forest and natural areas are cleared for meeting the requirements of the increasing population. The great challenges facing the humanity are now to conserve and manage the natural resources including the biological diversity on a sustainable basis.

The Convention on Biological diversity (CBD, UNEP 1993) emphasized that each member nations should recognize the contribution of the people in the conservation and sustainable use of biological diversity. It also tells that the member nations should share the benefits derived out of the use of the materials from biological resources. CBD also advocates each member nations to devise *sui generis* system to protect their resources and safeguard the Intellectual Property Rights (IPRs). Article 15 of CBD on fundamental concepts, sovereign right over genetic resources, facilitating access between contracting parties, access subject to mutually agreed terms and access to prior informed consent would be possible only if we have a high quality documentation of our biological diversity, categorized in to different levels such as molecular sequences, gene diversity, individuals, species, higher taxa, habitats, ecosystems and biomes.

In this regard, we should know: What we hold? How much we hold? And how much it worth?

DOCUMENTING BIODIVERSITY AND BIORESOURCES ACCURATELY WITHIN A SHORTEST POSSIBLE WAY SHOULD BE THE HIGHEST PRIORITY.

Hence, the Bioinformatics Centre of Plant Biotechnology Division of TBGRI has taken the development of Bioinformatics tools for the Biodiversity Data Development and Management as a mandate for augmenting the R&D activities in Biodiversity Conservation and sustainable utilization.

BIOPROSPECTING

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The world at large harbors nearly 2,50,000 higher plant species, two-third of which in developing countries of the tropics. Of these about a third, that is 80,000 species are medicinal plants often used by the traditional societies for therapeutic purposes since ancient times. Traditional medicine is wide spread across the developing world as countries like India, China, Brazil and Indonesia have got over 1000-5000 years of medicinal plant use. Even today according to WHO estimates nearly 80 % of the world's population depends on traditional medicine for primary healthcare. The medicinal plants distributed in diverse climatic belts, phytogeographical zones and altitudinal gradients form rich sources of genetic and chemical variations which are not yet scored to any extent for purposes of industrial and pharmaceutical applications. In fact, hardly 5 % of the world's flora is subjected to any kind of prospecting. Even the limited screening based on ethnobotanical leads however, has yielded an arsenal of valuable drugs in modern medicine like the steroid diosgenin from *Dioscorea* species, anti- leukemic agents vincristine and vinblastine from *Catharanthus roseus* with an annual world market of about US$ 120 million, etoposide another anti-cancer agent from *Podophyllum peltatum* and the recent anticancerous drug taxol from *Taxus brevifolia* and camptothecin from *Camptotheca acuminata*.

India is a megadiversity centre with more than 8,000 among 17,000 higher plant species used in tribal medicine and other systems of traditional medicine like Ayurveda, Unani and Siddha. The medicinal plants of India are a rich source of genetic diversity which is one of India's strengths and bedrock for future bioindustrial applications.Like China, India is a traditional exporter of medicinal herbs and the current export earnings are to the tune of Rs 3000 crores which is only a fraction (~ 0.5 %) of the global trade in medicinal plant products. Unless the country establishes a strong biotechnological competence including genetic and chemical prospecting mechanisms and add value to the products significant economic benefits can not realized, however heightened the demand for primitive raw materials may be and whatever genotypes we may have. Since rich chemical diversity observed in Indian medicinal plants is a manifestation of genetic diversity, bio-prospecting entails isolation and characterization of genetic molecules (DNA, RNA, enzymes etc.), phytochemical evaluation and pharmacological assay procedures to ascertain specific properties of the compounds, thereby adding values to phytoproducts which normally go unnoticed. Prospecting of phytodiversity in India is an urgent need as nearly 27,000 hectares of forest land are lost annually and the remaining forest tracts are getting degraded in one way or other and species of economic importance over collected. Due to the very same reasons of endangerment and non-availability of plants from wild lands for drug preparations, bio-production of medicinals using tissue and cell cultures is equally important. In fact, in many instances bioprospecting may facilitate bioproduction of the newly identified bioactive substance. Though contributions of Indian scientists in tissue culture research are well recognized they are not particularly focused towards bio-production. Thrust given to bioprospecting and bio-production research would ensure conservation and sustainable utilization of native plant resources within the provisions of international instruments like convention of

Biological Diversity. It should be noted that the renowned plant wealth of India had never been scrutinized keeping in mind the economic wellbeing of our people.

Bioprospecting and Bioproduction: Current status of research in India

Bioprospecting

The history of medicine as presented in Table 1 attaches considerable significance to the continued use of plants or plant parts as source of conventional or allopathic medicine.

Table 1. History of Medicine

2000 BC	Here, eat this Root
1000 BC	The root is health then. Here, say this Prayer
1085 AD	That prayer is superstition. Here, drink this Potion
1940 AD	That potion is snake oil. Here, swallow this Pill
1960 AD	That pill is ineffective. Here, take this Antibiotic
2000 AD	That antibiotic does not work anymore. Here, eat this Root.

It should be noted however, among the developing countries, the technology needed for tapping the chemical genetic goldmine that the medicinal and aromatic plants represent is available only with a few developing countries like Brazil, China, India, South Korea and Mexico. In fact modern biotechnologies are not available with many African Countries south of Sahara, Nepal, Bangladesh etc.

In very recent years bioprospecting research in India is spearheaded by the Department of Biotechnology, Govt. of India. The identified thrust components efforts at national level are:

- Production of biomolecules for industrial and medicinal use
- Novel genes / promoters to address biotic and abiotic stress
- Genes for transcription factors
- Metabolic pathway engineering
- Nutritional enhancement
- Crop improvement including proteins, fats and carbohydrates
- Microbial biodiversity

As a result of this push given on a mission mode, lot of interest has been generated in the research circle leading to significant achievements. Some of the success stories are presented below:

(i) Stress tolerant gene

A. A gene tolerant to extreme cold temperature from a plant species of the Spiti valley of Himachal Pradesh has been identified, isolated, sequenced and cloned. The long term objective

would be the development of transgenic plants harboring cold induced genes under the control of cold induced promoter.

(ii) Salt Tolerant Gene

Betaine aldehyde dehydrogenase (BADH) gene has been isolated from the mangrove species, *Avicennia marina*. It was successfully integrated into tobacco system through *Agrobacterium* mediated transformation. Analysis of the transgenic tobacco plants confirmed the functional integration of this gene.

(iii) Novel enzymes

A novel superoxide dismutase (SOD) enzyme from a plant species of the Western Himalayan region has been identified and purified. The purified SOD enzyme retains its activity after autoclaving and has catalytic activity at subzero temperatures. This antioxidant enzyme has applications in medicinal, cosmetic and food industry.

(iv) Identification and characterization of HMG CoA reductase gene from *Andrographis paniculata*

HMG CoA Reductase (HMGR) is one of the key regulatory enzymes in the isoprenoid pathway which catalyses the conversion of HMG CoA to mevalonate. HMGR belongs to a multigene family and the gene size and the coding sequence of one of the genes is completed. This is the first report of DNA sequence of any gene from *A. paniculata.*

(v) Novel molecules

Two important molecules, catechin and epicatechin with potential industrial applications have been isolated from Acacia catechu

Bioproduction

About a dozen plant products of high value are now commercially produced through plant tissue and cell cultures as given below

Table 2. Products produced at industrial scale by plant tissue cultures

Product	Species	Company	Country
Shikonin	*Lithospermum erythrorhizon*	Mitsui	Japan
Berberine	*Coptis japonica*	Mitsui	Japan
Digoxin	*Digitalis lanata*	Boehringer	Germany
Rosmarinic acid	*Coleus blumei*	Nattermann	Germany
Geraniol	*Geranium spp.*	Kenebo	Japan
Purpurin	*Rubia akane*	Mitsui	Japan
Ginseosides	*Panax ginseng*	Nitton Denki	Japan
Phytovanilla	*Vanilla planifolia*	Exergenetics	USA

Although India does not figure among the countries with industrial applications of cell cultures, active research is being pursued in several laboratories. A species of Hypericum rich in the ant-retroviral compound hypericin raised. Besides, transformed hairy root cultures rich in ajmalicine, plumbagin and flavouring benzaldehydes have also been produced and are being scaled up.

Conclusion

Although economic benefits of bioprospecting and bioproduction research are yet to be realized in India, global developments are a strong indicator of how things would unfold in the future. The current resurgence of interest in green medicines has ushered in indigenous R& D efforts which are welcome and indispensable for protecting our rights over native plant resources in this patent era.

VISUAL DOCUMENTATION OF BIORESOURCES

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Indigenous traditional knowledge of natural resource management is vital for the maintenance of the worlds' biological resources. This dynamic concept has to reach the younger generation so that they can start viewing the environment as a web of social relationships between human beings and other species with which they share the space and resources including their rights to health and sustainable livelihoods.

It is contemplated that the future generations should aim to restore the natural balance between consumptive and regenerative processes occurring in nature in order to strengthen the interdependent relationships within ecological systems for the benefit of mankind.

Some of the ways in which the natural biodiversity can be studied and preserved for further use are highlighted in this lecture which includes preparation of plant herbaria, spore prints of mushrooms, taxidermy, photography etc.

Preparation of a plant herbarium

The first botanist to be credited as the inventor of the herbarium is Luca Ghini (1490-1556) from Bologna, Italy. He was a well known teacher who had a collection of about 300 specimens (in 1551), that were gummed on paper. Not much is currently known about his herbarium, which is now lost, even though the herbarium of Ghini's pupil Gherado Cibo is still preserved in Rome.

Then there are various references of a herbarium made by John Falconer, an Englishman who probably met Ghini in Italy. In the middle years of the sixteenth century three Ghini students, namely Aldrovandi and Cesalpino from Italy and Turner from England, also made their own herbaria. Cesalpino's herbarium, currently in Firenze, is very important as it can be compared with his book "De Plantis Libri XVI", which introduced a scientific approach to the study and classification of plants. More than twenty herbaria created before 1600 are currently preserved in various European cities. The first recorded publication dealing with making a herbarium is dated 1606, written by the Brussels native Adrian Spieghel. In "Isagoges", a botany treatise, we can read how to dry plants under a press and what kind of paper one should use, along with other accurate information. On the other hand, the first time the word "herbarium" has been used in the same way we intend it is in the book "Elemens" by Pitton de Tournefort. During the seventeenth century other herbaria were developed, such as the one in the Muséum National d'Histoire Naturelle in Paris. During that period, many collections of exotic plants were created, as a result of the many geographical explorations which took place. Some of these exotic herbaria have been of the greatest importance for the advancement of scientific knowledge of continents like Asia or Africa, and can be currently seen in a few European museums.

Almost all natural environments are suitable for searching for plants for the herbarium and, so you must not overlook places which could appear sterile and dry. You can always find good specimens during trips to the mountains, swamps, coast, and woods or wherever the climate and the temperature are not too extreme for plant survival.

The most convenient specimens to pick up are those which seem quite dry, and lacking any trace of surface moisture. For that reason, it is better not to look for plants during rainy days, or early in the morning. Also, the hottest hours during summer days should be avoided, as plants will not show their freshest appearance.

A herbarium with scientific merit usually relies on the plants which grow naturally in a specific geographic area, so it is important to distinguish between the wild species which actually are your object of interest from those who have grown after a human intervention, as happens for some garden flowers or most cultivated plants. Anyway it is also true that often a plant species previously introduced by man can continue to spontaneously grow outside its original artificial environment; in that case the plant can actually become a new element of the spontaneous flora and can consequently become part of a herbarium. During your excursions you will discover that it is not always easy to understand whether a plant is still an introduced species or has become a wild plant; a suggestion for that purpose could be of looking nearby for gardens or cultivated fields from which that particular plant might have originated, without having gained any level of actual spontaneity.

Some tools are rather important while picking up plants for your herbarium: A small knife, scissors, thorn-proof gloves and a small handy spade could be of great help. The collected specimens should be put into a strong bag made of cloth or polythene or similar material (plastic etc), the function of these containers being to protect plants from damage during your outing. If your excursion takes place in summertime or lasts for two or more days, it is better to bring a folder of approximately 45x30 cm or more. The folder must be made of cardboard or some other strong stuff, e.g. aluminum, and it must contain some old newspapers (the more plants you collect the more newspapers you need). The picked specimens must be arranged inside the folder between a few layers of paper, so that every plant has some paper on both sides. The closed folder does not have to press the specimens too firmly between the newspapers. If the plants are fleshy more newspapers are needed and you can also add some additional cardboard inside the folder. Small delicate plants should be placed inside smaller bags. A large waterproof bag can be carried too: it will carry aquatic plants and can be used to cover the folder in case of rain. The folder could be made in some different way too, for example a couple of plywood boards containing some newspapers, the boards can be kept together with some large rubber straps or ropes. Blotting paper can be used instead of newspapers, but the latter is much cheaper, as you do not have to buy it just for the purpose of the herbarium

If you wish your herbarium to have a scientific value is important that every plant is coupled with written information about the place and date of finding and the terrain characteristics. So while you are out looking for plants you either must remember the place you found each specimen, or add a label with written information to some or all the specimens. When you pick up plants from the natural environment, keep in mind that you will have to fix up all of them once you return home, and you will have to classify them too, in order to achieve a scientific value for your herbarium. Those operations require a substantial amount of time, so try not to collect so many specimens that you can not find the time to settle and study all of them. You will have to section and basically tear apart some flowers during your classification, so do not pick up just one or two flowers of each species when you are out looking for plants,

otherwise you could be forced either to sacrifice every flower for the classification job or to simply give up the classification.

Your herbarium could encourage the collection of many written data which can actually increase the botanical knowledge of certain geographical areas. Hence it is a good idea to write down various information regarding the specimens you are picking up; these notes not only will help the identification of the specimens, but also can be compared and added to the current botanical knowledge. A note-book can be used; otherwise a tape recorder with tapes and a number of batteries could make this work easier. This is a list of what you could record to add much valuable information to your herbarium:

Locality: be precise, if possible include the longitude and latitude and also a sketch map if useful

Habitat and ecology: terrain characteristics, vegetation type, associations with other plants

Plant habit: describe the overall size and shape of the plant (tree, bush, epiphyte etc.)

Stems and trunks: height and diameter; color, texture, thickness and hardness; the presence of thorns and spines

Leaves: deciduous or evergreen; color, texture and overall aspect; orientation; exudate or glands

Inflorescence and flowers: note of everything that could be undetected in prepared specimens; color; heterostylous, monoecious or dioecious; different behaviour (open / closed) during the day; exudate or glands; pollinators

Fruits and seeds: size, shape, color, texture; smell

Underground organs: take some samples or describe them (size and shape, tap root, tubers, bulb etc.)

Scent: record any particular scent, especially of cut parts and flowers

Sap or latex: note the color, smell, consistency etc.

Name: record the locally used name(s)

Uses: record the uses, getting confirmation

After you have found the name of the plant, you must hurry to go on to the drying process. Remember to work in a dry and ventilated room, avoiding damp, which could easily harm your specimens. Flowers and other plants parts must be dried up into a peculiar kind of press. It is not difficult to build a home-made press for that purpose, keeping in mind that what must be accomplished is to keep the specimens squeezed between layers of paper (newspapers or blotting paper) until they are totally devoid of the original content of water, that is dried. As for the folder previously mentioned, the upper and lower parts of the press might be made of heavy cardboard or thick plywood or equivalent material. The specimens will be placed between the layers of paper, which will be pressed by the two pieces of wood; these two pieces must be held tight by putting some heavy body on top, i.e. bricks or large books.

It is important that the plants are put under sufficient pressure; otherwise more time will be required to achieve a good desiccation, besides they could be damaged by dampness and moulds. Every specimen in the press must be linked with its own written data, the best you can do is to use a tag for each specimen, and you can attach the tag with string.

As circulating air is very important to get your specimens dried in a short time, it is better to add some corrugated cardboard sheet between the paper layers, so that some air can penetrate and speed up the drying process. Corrugated aluminum sheets are even more effective than cardboard. Bulky parts can directly be placed in contact with corrugated material to speed up drying. If no such material is available, keep the filled press size small. Instead of newspapers, someone recommends to use blotting paper together with tissue paper: at the base of the press you should place about three layers of blotting paper, then one layer of tissue paper (or paper handkerchiefs) on which the specimens will be placed, another layer of tissue paper and finally three layers of blotting paper; several such strata can be put in a single press for a good drying up! Anyway you must always be sure to have enough paper at home, also in case you need it for the folders you bring some during long trips; the large amount of paper you need suggests the use of newspapers, which are cheap and usually widely available.

Changing the paper is surely a very important step whose importance must not be underestimated, though it could become pretty boring if you happen to have many drying specimens! In the first three or four days a paper change should take place every day, then you can leave more time between two changes. If you neglect the change of paper the plants will take more time to loose their water content, besides they could be damaged if the paper stays wet for a few days. While changing the paper you must try to keep the specimens intact, besides you have to not mix up the tags or labels with the name and the other information regarding the drying plants. The minimum time required for complete drying ranges from two to four days or more. A single species could have some separate parts already dry when the other must stay in the press, just remember not to mix or loose some parts. Once a specimen has become dry and stiff, it can be placed into the herbarium.

One of the most difficult steps is gaining the right arrangement of the specimens in the herbarium. The arrangement must be carefully considered, since when you place the specimens into the press they will acquire a shape and appearance that will last after the drying process, and so be similar or identical to the specimen's shape in the herbarium. Because of size and thickness limitations, it will probably be necessary to remove certain branches, leaves and bunches of flowers or to carefully section them, always with the goal of obtaining a more suitable specimen to be placed in the press. Carry out this delicate job with the help of a knife and tweezers, trying to arrange the flowers in the best possible manner, letting them show the most natural shape and all their features. During this process care should be used to avoid the elimination of relevant elements, especially those which were important for the taxonomic classification. Any loose part may be kept inside paper envelopes which can be placed on the same mounting sheet as the specimen. Each species should also display both sides of its own leaves; if only one leaf is available, you may cut off a part, so that the other side can be observed. If you have more than one flower available, you can arrange some to show the back of the flower also. Depending on the size of your herbarium folders, you will be able to dry more or less large specimens; anyway it is almost sure that some plant will have to be cut or bent, due

to its excessive size. When bending a stem, form an acute angle and always try to give a not too unnatural appearance to the whole.

While arranging the specimens on the paper layers, various plants can be placed on the same piece of paper, but remember not to superimpose two or more specimens upon each other. It is better to choose specimens of the same thickens so that the pressure on that layer will be equally distributed. In case of thick plant parts, get uniformly thick ones and by building up the thinner sections of the arrangement with extra paper so that the layer with the plants will have approximately the same height.

Some plants have fleshy flowers (some orchids, iris, lilies etc.) that must be filled with cotton wool before being put to dry. Every time the paper is changed, the cotton wool should be replaced too. The parts can be dried separately and then the flowers will be reassembled with the help of gum Arabic. If the flowers are likely to stick to the folder and break when handled, you can detach them and dry them apart using tissue or non-absorbent toilet paper, opening their folders only when the flowers are well dry. Once the specimens have been dried, they will be mounted on a paper sheet. Doing so, you will display the specimens and its data in the most clear possible way, and the specimens will be carefully preserved being attached to strong mounting paper.

Each specimen must have a label on its own sheet, which should include the taxonomic denomination (at least family, genus and species) along with information on the date and place of collection. If you want, more details can be included, such as ecological notes about the locality. The name of the collector and of the individual who did the determination should be added too. Anyway read the "Recording Data" chapter to see what can be included in every single label. To write your labels it advisable to use permanent and water resistant ink (black or blue), otherwise a pencil can be used (medium lead).

The mounted specimens will be placed in bundles, which could be kept together with the help of strings or straps, besides it is better to have cardboard or millboard supports at top and bottom of the bundles, to gain further steadiness. Each bundle must have its own label so that you will be immediately able to recognize the contents of each particular group of specimens. The labels must be easy to read, so they will be placed on the outside of the bundle. Depending on the number of plants in each bundle and on the criteria chosen when dividing the collected plants into groups, you will write down the geographic origin or the taxonomic level (family, genus etc.) or whatever identifies every particular bundle. Your herbarium must follow a certain arrangement which will give some logical and scientific order to the collection. Again, you should look at the books to find how species, families and so on are currently arranged, and then you can divide your specimens into groups which will reflect the systematic arrangement. Note that there are various systematic arrangements that can be followed, it is up to you to opt for a recent (a maybe simple) one; you can ask some expert to have information about that topic. You could also choose to divide the specimens by their families (or even genera) alphabetically, or else you can group them geographically.

These collections of specimens should then be kept inside boxes or cabinets which should remain tightly closed and dust-proof. The best places you can choose for your herbarium should be safe from the danger of fire, floods and other accidents. The temperature should be

around 20°C and the humidity should not exceed 60%, in order to prevent fungal infections. Adequate ventilation is required, especially if the herbarium itself has a high concentration of insecticide or fungicide. A dry room is the best to avoid proliferation of insects and consequent damage. Naphthalene and paradichlorobenzene (PDB) are chemical repellents often used for preventing infestation; anyway they are very effective only at high concentrations, which increase the risks for human health. Other products which have been used in large herbaria are mercuric chloride, cresol and LPCP, but they are complicated to use, and the results can be dangerous to human health too.

Mushroom Spore prints

You need a compound microscope to see most spore features but spore colour can be seen by the naked eye with the help of a spore print. It's simple to make a spore print from a mushroom:

1. Remove the stem by cutting it where it meets the cap.
2. Put the cap on a piece of paper, gills facing down.
3. Cover the paper and cap with a bowl or tub of some sort - to maintain the humidity around the cap.
4. Leave it for a few hours and then remove the tub and cap.

If all's gone well you'll see something like this:

Over the hours, mature spores (and only mature spores) will have been released from the gills and fallen onto the paper. What you see in a spore print, such as the one pictured, is a mass of hundreds of thousands or millions of spores. In this quantity the colour is easy to see. The commonest spore colours are white and various shades of brown.

Note that the colour of the gills need not be the same as the colour of the spores.

If the spore print is very weak (or not there) put the cap back down and leave it overnight. Some species take a long time to build up a good spore deposit.

It's also possible that the cap had already started to dry out when you collected it. Put a couple of drops of water on the cap, or a damp cotton ball next to the cap before putting the tub over. It's hard to get spore prints from mushrooms with small, thin caps. They dry out very quickly.

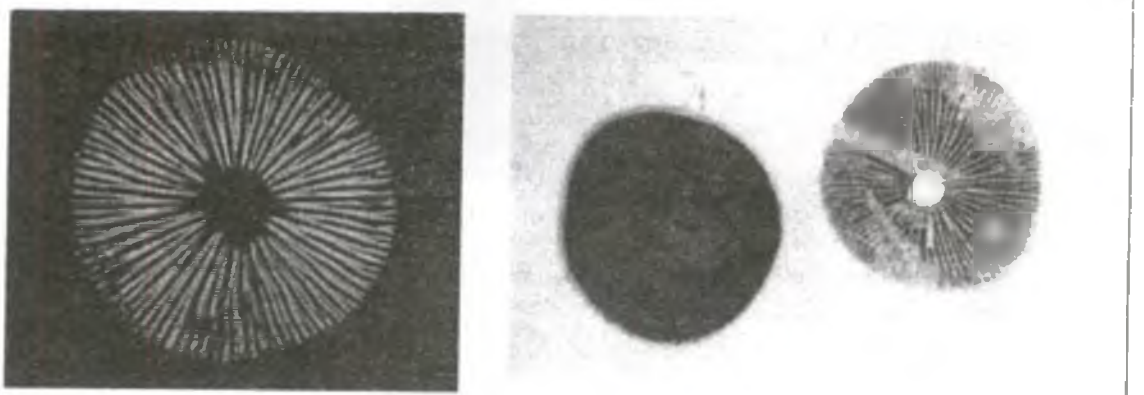
For example, you can put a section of coral fungus onto a sheet of paper, cover it and leave it for a few hours - just as you would a mushroom.

Once you have a mature mushroom, you are in a position to make a spore print and use it to continue cultivation of mushrooms. The cap should be harvested when the mushroom cap has become flat or is starting to invert.

Be careful to take a sterile spore print. The typical procedure is to cut the stalk off of a mature mushroom very close to the cap. A sterilized knife or razor blade is used to do this.

The cap is then laid on a sterile piece of tissue paper or card stock and a small glass set over it. The glass is needed for two reasons. First, it keeps the spore print insulated from

airborne contaminates. Secondly, it helps keep the humidity high so the mushroom cap can continue to live and drop its spores.



Spore prints, pale coloured spores on a dark background (left) or darker spores on a light background (right).

One note of caution. Some humidity usually needs to be allowed to escape. You want the environment inside the glass to be slightly less humid than the environment in which the mushroom was grown.

If you have problems getting a cap to drop its spores, try using a piece of paper for the print that fits entirely inside the glass and spreading out a wash cloth flat on the table. Let the edge of the glass seal to the wash cloth instead of the paper. This will usually allow enough humidity to escape to cause the cap to drop spores.

If everything goes well, after a day or two the cap will drop its spores. There will be a purple-brown dust underneath the cap.

Spore Print

Once you have a spore print on the paper, remove the glass and cap. Fold the spore print in half and seal the edges so air can not get in. A piece of scotch tape on each side will do nicely. The spores will stay viable for 18 months if they are kept in a cool, dry and dark spot.

If you place a small amount of desiccant in the bottom of a film container and place a cotton ball on top of the desiccant, you have an ideal container to keep the spore print.

The cotton ball will keep the desiccant from touching the spore print. Seal the spore print in the canister and place the canister in your refrigerator until you are ready to use it.

Note that if you want to be self sufficient, it is a good idea to have multiple spore prints and store them separately. You just never know when you are going to be surprised with a massive contamination problem or thermal death.

The safest thing to do is have a couple viable spore prints so it is easier to recover from disaster. A spore print is typically viable for about a year if it is stored in a cool, dark location. As a print ages, germination gets slower and this process becomes more prone to contamination.

PHOTOGRAPHIC DOCUMENTATION

The SLR cameras are in use now for scientific documentation because of its portability and ease of use and the availability of different ranges of lenses for different purposes.

The well known companies dealing with photographic equipments include Canon, Rolleiflex, Nikon, Pentax, Minolta, Olympus etc over the years 50mm lens has been established as the standard for the 35mm format as it gives relatively normal looking perspective with typical subjects. 50mm is also the length of the diagonal of the 35mm film format. Focusing determines the sharpness of different areas of the image. The camera's aperture is the hole thru which the light passes from the subject to the film. This aperture in a camera is adjustable from a tiny hole like a pinprick to the diameter of the lens itself.. This determines the quantity of light falling on the film.

Taking color pictures of each plant in its natural environment is also something which could substantially enrich the quality of your herbarium, not only aesthetically, but also from the scientific point of view. In that way the dried specimen can be placed together with one or more photographs, which are very helpful for bulky plants like trees or bushes, which obviously can not be entirely included in a herbarium! Also the habitat of a plant can be well described with a photograph, taking care not to be too distant from the nearby bushes or trees.

The suggested equipment is a 35 mm. single lens reflex camera, with a standard lens and a macro-lens, the latter very useful for close-ups of flowers and other specific features. Also a tripod can be very important if many close-ups have to be made, allowing the camera to remain steady. A tripod can also alleviate the need for a flash, which may be used when taking pictures in low light, but has the disadvantage of giving quite unnatural looking images. The speed of print films can range from 64 - 100 ISO to 200 or 400 if pictures in the woods are planned.

Each photograph you take should be recorded in a note-book to provide further data for the classification and to include in the herbarium. Be careful that your camera and films are not damaged by rough handling and do not become wet.

TAXIDERMY

Taxidermy is a general term describing the many methods of reproducing a life-like three-dimensional representation of an animal for permanent display. In some cases, the actual skin (including the fur, feathers or scales) of the specimen is preserved and mounted over an

artificial armature. In other cases, the specimen is reproduced completely with man-made materials.

The word "taxidermy" is derived from two ancient Greek words; ***taxis***, meaning movement; and ***derma***, meaning skin. Therefore, loosely translated, taxidermy means the movement of skin. This is a fairly appropriate definition as many taxidermy procedures involve removing the natural skin from the specimen, replacing this skin over an artificial body, and adjusting the skin until it appears life like .One of the most common techniques for modern taxidermists begins by freezing the animal's carcass in a large freezer, often a butcher's. The taxidermist then removes the skin, to be tanned and treated for later use. The remaining muscle fibre and bones are then submerged in plaster of paris to create a cast of the animal. With this cast, a fiberglass sculpture is created, onto which the fur or skin can be reattached. Glass eyes are then added to the display and also false teeth to get the original look.

A re-creation of a sailfish made entirely from man-made materials.

The modern practice of taxidermy incorporates many crafts, such as carpentry, woodworking, tanning, molding and casting; but it also requires artistic talent, including the art of sculpture, painting and drawing. In a modern deer head mount, for example, the only natural parts of the animal used are the antlers and the skin. All of the other organs and tissues are recreated with man-made materials. The eyes are made from glass, the eyelids are sculpted from clay, the soft tissues of the nose and mouth are sculpted from epoxy or wax, and the mannikin or "form" (which incorporates the anatomy of each muscle and vein) is made from polyurethane foam.

Today, some taxidermy mounts (most notably saltwater fish) do not contain *any* parts of the animal at all. They are completely re-created from man-made materials. This is ideal for catch-and-release anglers, who can release their gamefish unharmed, and can still have a life-sized trophy produced from a good color photo and measurements.

VISUAL DOCUMENTATION

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The recent education system in schools with project works starting from lower classes made an awareness about how to collect and document it in a presentable manner as project reports. For such projects students collect data and photographs of different subjects and such reports help to know more about each subject.

DOCUMENTATION

In general terms, documentation is any communicable material (such as text, video, audio, etc., or combinations thereof) used to explain some attributes of an object, system or procedure. It is often used to mean engineering or software documentation, which is usually paper, books or computer readable files (such as HTML pages) that describe the structure and components or on the other hand, operation, of a system/product.

VISUAL DOCUMENTATION

Information which accompanies a digital object to give background, context and history. Visual documents is a high tech tool for all programmers that will let you design, on a WYSIWYG environment and using the drop a drag method, the documents that you need to print with your projects. ie You design your document on the editor with any complexity, and Visual Documents will create in one step, in any language and free of royalties, ready to use Source Code to print your documents with professional quality.

DIGITAL TECHNOLOGY

In the past twenty years, most of the major technological breakthrough in consumer electronics have really been part of one larger breakthrough. When you get down to it, CDs, DVDs, HDTV (High Definition TV), MP3s and DVRs (Digital Video Recorder) are all built around the same basic process: converting conventional analogue information (represented by a fluctuating wave) into digital information represented by ones and zeros, or bits). This fundamental shift in technology totally changed how we handle visual and audio information; it completely redefined what is possible.

The digital camera is one of the most remarkable instances of this shift because it is so truly different from its predecessors. Conventional cameras depend entirely on chemical and mechanical processes - you don't even need electricity to operate them. On the other hand, all digital cameras have a built-in computer, and all of them record images electronically.

The new approach has been enormously successful. Since film still provides better picture quality, digital cameras have not completely replaced conventional cameras. But, as digital imaging technology has improved, digital cameras have rapidly become more popular.

SCANNER

Flat bed scanners, also called desktop scanners, are the most versatile and commonly used scanners.

The basic principle of a scanner is to analyze an image and process it in some way. Image and text capture (Optical Character Recognition or OCR) allow you to save information to a file on your computer.

If you want to take a picture and e-mail it to a friend you need the image to be represented in the language that computers recognize-bits and bytes. Essentially, a digital image is just a long string of Is and Os that represent all the tiny coloured dots or pixels that collectively make up the image.

You can take a photograph using a conventional film camera, process the film chemically, print it on to photographic paper and then use a digital scanner to sample the print.

HOW DIGITAL CAMERA WORKS

At its most basic level, this is all there is to a digital camera. Just like a conventional camera, it has a series of lenses that focus light to create an image of a scene. But instead of focusing this light into a piece of film, it focuses light on to a semiconductor device that records light electronically. A computer then breaks this electronic information down into digital data. All the fun and interesting features of digital cameras come as a direct result of this process.

Instead of film, a digital camera has a sensor that converts light into electrical charges. The image sensor employed by most digital cameras is a charge coupled device (CCD). Some cameras use complementary metal oxide semiconductor (CMOS) technology instead. Both CCD and CMOS image sensors convert light into electrons.

It takes several steps for a digital camera to take a picture. Here's a review of what happens in a CCD camera, from beginning to end.

- aim the camera at the subject and adjust the optical zoom to get closer or farther away.
- press lightly on the shutter release.
- The camera automatically focuses on the subject and takes a reading of the available light.
- The camera sets the aperture and shutter speed for optimal exposure.
- press the shutter release all the way.
- The camera resets the CCD and exposes it to the light, building up an electrical charge, until the shutter closes.
- The ADC measures the charge and creates a digital signal that represents the values of the charge at each pixel.
- A processor interpolates the data from the different pixels to create natural colour. On many cameras, it is possible to see the output on the LCD at this stage.
- A processor may perform a preset level of compression on the data . The information is stored in some form of memory device (probably a Flash memory card).

You used to have to wait for film to be developed before you could see your pictures. Not anymore. With a digital camera you can get instant results.

Adobe Photoshop is a high-end professional package. Each menu and each tool has lot to do. So only with thorough practical training we could study it fully.

Never misuse the features and facility and always make good use of it. Adobe PDF: Portable Document Format (PDF) is more secure, reliable electronic document distribution and exchange invented by Adobe.

We can't ban all technology because some people are misusing it. Digital camera, mobile camera etc. are very harmful for teens, as they can use it wrongly. So don't use technology for illegal purposes.

Use the latest technology only for constructive purposes.

EFFECTIVE PRESENTATIONS

There is no secret to develop an effective presentation. Establishing your objectives, planning and organizing your material, and using appropriate visual aids are the essential ingredients. The recipe for effective presentations calls for all the three ingredients and you must use them in the order in which they are presented here. By establishing your objectives first, you can prepare material that supports each objective. The use of visual aids will move you further towards your objectives by illustrating and emphasizing your ideas more effectively than words alone. Let's begin, then, at the beginning. As you start to design your presentation, you must ask yourself, 'What do I want to accomplish by making this presentation?'

ESTABLISHING THE OBJECTIVES

For any successful presentation, you must know your objectives. It is these objectives that drive your presentation and move the audience to your end goals. Your end goals may be that the attendees take a particular action, adopt a new perspective, or respond to facts and information. Establishing these goals requires careful planning. The key to designing your presentation is determining these objectives. After all, they become the foundation upon which your content, organization, and visual aids are built.

Establishing the objectives for your presentation requires an analysis of your own goals, as well as your audience's needs and expectations. By considering the nature of your audience, you can more easily determine what you will present and how you will present it. An audience analysis will enable you to.

- Select appropriate points of emphasis in you presentation
- Develop a useful level of details
- Choose and prepare appropriate visual aids
- Create a tone that is sensitive to your audience's circumstances.

Your presentation will ideally form a bridge between something you have and your audience wants. Let the audience analysis influence the form of information presented so you can create this bridge.

Keep in mind that the use of visual aids will help to produce effective one-way or two-way communication. Many factors are involved in choosing these visual aids, and the type of interaction you want to develop with the audience will influence your choice.

MICROSOFT POWERPOINT

Power Point is a presentation software program included as part of the Microsoft Office package which enables a user to create professional-looking slides, handouts, notes and outlines with relative ease.

According to Microsoft Corporation, some 30 million presentations are made with Power Point every day by all types of computer users including business people, educators, students and trainers. The simplicity and versatility has made Microsoft Power Point the most commonly used persuasion technology among the software programmes in the market.

With Power Point, users can add colour, images, sounds and motion to their text presentations.

Power Point is a complete presentation graphics package. It gives you everything you need to produce a professional-looking presentation. Power Point offers word processing, outlining, drawing, graphing, and presentation management tools; all designed to be easy to use and learn.

The following gives you a quick overview of what you can do in Power Point.

- When you create a presentation using Power Point, the presentation is made up of a series of slides.
- You can keep your entire presentation in a single file-all your slides, speaker's notes and audience handouts.
- You can import what you have created in other Microsoft products, such as Word and Excel into any of your slides.

GETTING STARTED AND WORKING IN POWER POINT

Auto Content Wizard: The first thing you will see when you click on the 'Auto Content Wizard' option is the following graphic. Click on 'NEXT' to begin customizing your presentation.

After you click 'NEXT', you will be asked some questions on the screen. You will be choosing the type of layout you wish your presentation to have. Answer the questions and the computer will provide you with a formatted presentation in which you will need only to fill in the blanks.

Design Template: Unlike the 'Auto Content Wizard' the 'Design Template' allows you to choose your own text layout while the computer provides your backgrounds and colours. The first screen prompts you to choose from a list of design templates. The design you choose can be used throughout your presentation. After choosing your design format you will be asked to select your text layout. The image below shows you the box that will ask you to make that choice. For more complete instructions on what to do ftom this point see the next section on 'Blank Presentations'. You can change the settings of your background once you start by selecting 'Common Tasks'. Apply Design Template.

Blank Presentation: The choice to be made here is one of text layout. The computer gives you 24 different layouts to choose from, including a blank slide. The blank slide allows you to be in total control of the format of the slide. You will choose where to place text, headings and graphics. For the other 23 slide choices, you will fill in the text spaces that the computer provides.

Creating a New Slide:- At any time the user can create a new slide to put in the presentation. Simply click 'New Slide' from Insert Menu.

Inserting Text into a Slide:- The easiest way to add text to a slide is to use one of the 23 text layouts that Power Point provides for the slides. When choosing to add a new slide to your presentation you should choose a layout that is appropriate for the text you want to show on that particular slide.

If you wish to add text where the slide layout does not are already a call for text you can do so by clicking 'Inser'and 'Text Box', then placing that new text box where you wish on your slide.

Changing Text Colour, Font and Point: Once you place text on your slide you can change the attributes of that text by clicking on 'Format' - 'Font'.

Inserting an Image: Teachers will find that inserting images into their presentations will be an invaluable resource. To insert an image click on 'Insert' -'Picture','Clip Art or From File'.

To insert the images you will need to find the image on your computer's hard drive.

Adding Animation to your Presentation: Adding animation to your images will enhance the quality and aesthetics of your presentation. To animate your images you will need to choose 'Slide Show'- 'Custom Animation'.

To animate images, first we must select them You will notice that only one of the images is selected. To select it, click in the open box next to each image you want to animate. You will also need to select the 'Start Animation' to set Information to initiate the image animation.

By clicking on the 'Effects' tab on the 'Custom Animation' dialog box we are able to manipulate the settings for the image's entr and exit of animation. In this instance we have set the animation to fly in from the bottom of the screen.

Changing the order of your animations:- Each slide in your presentation will have a number of animations. Animations will include all pieces of your slide show that are put by the user and made moveable. According to this definition, backgrounds are not animations.

Most slide shows will include multiple animations per slide. You can always manipulate which of the animations appear first on the slide by changing the order in which they are listed in the custom Animation dialog box. You may decide to change the order of the animations but realize that unclicking and reclicking all of the animations will get tiring and wasteful. If this is the case you may simply click on the animation you want to manipulate in the 'Animation Order' box and click on the up or down arrow to the right. This will change the order in which the animation appears in the slide show on this particular slide.

Inserting a Sound:- Many presentations are given more personal touch with the addition of sound into the slide show. To add a sound file to your slide click on 'insert' 'Movies and Sounds', 'Sound From File'. You will always have the option of setting the sound to play however you wish, by clicking on 'Slide Show' - 'Custom Animation'.

Clicking the 'Play using animation order' you will allow the s01Uld to be played in its order in the slide show.

Creating a Background:- Backgrounds add colour and life to your slides. When you decide to create a slide from a blank template you will see the default background on the page. To change this default you should choose 'Format'- Background.

Using 'Gradient', 'Texture', 'Pattern', 'Picture'. Power Point allows you to create a solid colour background as well as a number of different background effects. By choosing 'Format'. Background, then choosing 'Fill Effects' from the colour pull down menu you can manipulate the available background effects.

Reordering Your Slides:- Presentations may need to be reordered at some point in time due to a different audience or a change in schedule. Reordering your slides to fit your specific needs is very simple.

The first step in reordering your slides is to select the slide you wish to move. You select a slide by clicking once on the small slide graphic in between the slide number and it's title.

After selecting the slide you wish to move, hold you left mouse button down and drag that slide either up or down depending on the desired placement.

Transition Effects and Timing:- As a presentation progresses from slide to slide there are effects that the user can put in place that will personalize how the slides look while changing from one to the next. To change these settings the user should click on 'Slide Show' - 'Slide Transition'.

Dialog box will allow the user to change the settings for transition effects. By clicking on 'Apply' the settings you choose will only take place on the slide you have selected. By clicking on 'Apply to All' the settings will effect the whole slide show.

VIEWING SLIDES

Slide View:- This shows the layout of the individual slide the user is working on.

Outline View:- This shows the layout of the entire presentation. You will see the titles of the slides as well as an outline version of the content of the various slides.

Slide Sorter View:- This screen will show you the actual image of each slide in smaller form. This is helpful for moving slides and checking whole layout quickly.

Notes Page View:- This allows you to type notes for each page for use during the presentation.

Slide Show View:- This is a shortcut that will initiate the slide show for previewing. Use function key F5.

Controlling the Slide Transition During the Presentation

There are multiple ways to tell the computer for transition from one slide to the next during your presentation. Depending on the situation you may decide to enable an automatic transition based on time or wish to control the flow of presentation by using either the keyboard or mouse.

Using an automatic transition: Clicking on 'Slide Show' - 'Slide Transition' will allow you to set a time interval for slide transition.

Using the Keyboard to Control Slide Transition: All you need to do to control slide transition using the keyboard is chck any key on the keyboard of the computer when a change should be made on the slide. The presentation will not transition trom slide to slide without a button on the keyboard being pushed unless the user, had chosen the auto transition option explained above. 'Page UP' key will show next slide and 'Page Down' goes to previous slide.

Using the Mouse to Control Slide Transition

Follow the same steps shown above to get to the Slide Transition dialog box ('Slide Show' - 'Slide Transition'). Once you see the image shown below, click 'On Mouse Click' to set the presentation to only respond to a mouse click to transition trom slide to slide.

BASIC WEB CONCEPT

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INTRODUCTION

What is tbe Web?

In a nutshell, the web is a whole bunch of interconnected computers talking to one another. The computers (on the web) are typically connected by phone lines, digital satellite signals, cables, and other types of data-transfer mechanisms. A 'data-transfer mechanism' is a way to move information trom point A to point B to point C and so on.

The computers that make up the web can be connected all the time and they can be connected only periodically. The computers that are connected all the time are typically called a 'server'. which have a special software installed called 'server' software.

What is the function of server software/programmes?

Server software is created to 'serve' web pages and web sites. Basically, the server computer has a bunch of web sites loaded on it and it just waits for people (via web browsers) to request or ask for a particular page. When the browser requests a page the server sends it out.

How does the web surfer find a web site?

The short answer is: by typing in the URL or in other words, the web site address. So for example, if you want to find the web site www.kerala.com, you would type in the address into your web browser's address bar or may use your favourites' or 'bookmarks' link to Kerala site.

There are other ways to find web sites (like search engines) but behind the scenes web sites are all being found by going to the web site's official address. That brings us our last nerd detail: how does a website get an official address so that the rest of the web can find it?

Registering your domain name

If you ever wondered what the heck registering a domain was all about... .you probably figured it out by now! But just in case - registering a domain name gets you an official address for your web site on the World Wide Web. With this 'official' address, the rest of the web can find you.

Like your home address is unique in the real world, there also can't be any duplicate addresses on the Internet, otherwise no one would know where to go! In other words, domain names are unique addresses on the web.

Why does registering a domain name cost money?

If you want to have your own unique address on the web, your own domain name, will cost a few bucks for each year you want to 'own' the name. The cost of registering a domain name ranges from less than Rs. 500 per year. You can register a domain from 1 to 10 years.

The reason for the cost is that the central 'address book' of all the world's domain names needs to be updated - somebody has got to pay for that!

That leads us to our *last* bit of nerd information: when you type in a website's domain name or click on a link that takes you to that domain name, your browser starts asking servers where that particular domain name is on the web and the severs are then able to tell the browser where to go by referring to the giant address book.

Building a web site

Summary of the process of creating a web site

The 10 steps to take to build and bring a website 'live' on the World Wide Web are as follows.

1. Define the purpose of the web site

When starting a web site project, you must first clarify what the goals of the website are. Knowing your goals will impact the choices you make when putting the web site together and ultimately contribute to its success or failure.

This may sound obvious, but many web sites seemed to have been put together without the goal kept in mind. The result is a messy web site that is disorganized and harder to build and maintain.

So if, for example, the goal is to create an e-commerce web site that sells products, then as a web site designer you have to consider things like the following:

1. Do you need credit card processing capabilities?
2. Are you going to need a shopping cart system to take orders?
3. How many items will be sold on the web site?

This is just one example. The point to take way is that by defining the purpose you can better prepare and get the right tools/people for the job.

2. Diagram the structure of the website.

A simple diagram helps to visualize the web site for both you and your client-this assuming someone has hired you to build a website. Nothing special is really needed, just a series of boxes representing each page in the site with lines connecting them showing the linking strategy. A pyramid scheme is usually used to show the hierarchy of a web site from the splash/home page down*.

Note: The terms 'splash page' and 'home page' are used interchangeably most of the time. There is a subtle difference from the perspective of an old-time web nerd, but for the rest of the world, it basically is the first page someone hits when they visit a website.

3. Write out the text for the web site

Before you start writing any HTML.(Hyper Text Markup Language), you should (in your favourite word processor) write out all the text that you need to include in the website. Doing so will help you with the design process.

Another thing you should do is to make sure that the text is finalized before it gets to the web site, it is much easier to correct things in a word processor than in an HTML page.

4. Choose a basic layout that will be used on all pages

Armed with your website diagram and your web site's text (complete text!) you can now choose a basic layout for your pages. You can go crazy with some funky artsy web site (and sometimes it can work), but most of the time you should use standard layouts that people are used to:

1. Left side navigation.
2. Top navigation.
3. Right side navigation

When in doubt, think of how books are laid out.

5. Choose the basic colour scheme and fonts for the site

Your next task is to start considering the basic colours and fonts that you're going to use. You want to choose a style that fits the subject of the web site. For example: pink doesn't do well for a hardware store, may be some steel blues instead! The point to take away is to establish the style of the web site before you start creating pages, otherwise you may find yourself doing pages over again.

6. Build out the website

With the before-mentioned completed, you're ready to actually start creating your web pages. So what you need to do is:

1. Take the structure you developed in steps 1 to 4 to create your web pages.
2. Link the web pages together.

Now is the time for you to practice little and actually build a small web site! If you can't think of something, create one on your favourite movie with a page for each main character.

Remember that you only get good at doing something by doing it!.

7. Choose a domain name

Once your website is built, you will need to get it on the web-that means you need a domain name.

All websites need a domain name, and your choice of a domain name can impact on how many people find your website, so choose carefully! Here are some points to remember when considering your choice of a domain name:

- Domain names that tell you something about the web site are food for search engines and they help clue people in, too. If for example you were building a website for a hardware store, a domain name like 'discount Hardware. Com' is pretty good it tells you everything about the web site immediately. If you called it 'big Steel.com' instead, you can argue that we are not giving such a clear message of what the web site is about.

- Search engines such as Google will look at several elements of your web site to try and determine what your website is about. One of those key elements is the domain name; Google will look for keywords in the domain name that help the 'google bot' (Google's automated snooper software) to categorize your web site.

One question that is asked often enough is whether the domain name has to have the same name as the business it is representing - the answer is no.

The process of creating a web site- continued

8. Register your domain name

Today you have many more options for domains; in the past, businesses could only register com's because .net and .org domains where reserved for special types of organizations. Those old restrictions are now gone, and there are a wide variety of extensions you can choose from:

.com,.net, .org, .tv, .biz, and several others include country codes like .ind (India) . ca (Canada),..us (USA), .co.uk (United Kingdom) etc

In terms of the search engines, it makes no difference which ending (extension) you use.

How do you know if a domain is already taken?

The quickest way to figure this out is to type in the domain name in your browser and see if it takes you anywhere. This is not always useful though because many domains have been bought but have no website!

That means the best way to figure this out is to go to your registrar. Every registrar will have a form where you can check to see if domains names are available just by typing it in.

The best thing about going to the registrar is that when you type in a domain name you are interested in their systems will not only tell you if the .com is available, they will also give you the scoop on all the other variations - a big time saver.

9. Find a hosting company: what to look for in A host

Today, hosting web sites cost much less than what they did just a few years ago, and that's a good thing. You can go from zero cost hosting to very pricey solutions, depending on your web site's needs.

What can affect the cost of hosting a website ?

- Traffic - more traffic can cost you more per month. But for this to affect you, you would have to have a pretty popular web site. Since you are just starting out, it won't be a problem.
- Extra features/services - you may need to use a database (for e-commerce) or need many e-mail accounts, extra disk space to store all you websites files. Each host will have a list of plans that you can choose from depending on your needs.

In the end you have to choose the hosting company and hosting plan that is best suited for Your web site. Cheaper is not always best, but it may be good enough for you.

10. Upload your website to the hosting company's server

Once you created your web site, paid for your domain name, and picked your hosting company, it's time to upload the web site on to your host server for the world to see. Typically, you would use something called FTP (File Transfer Protocol) to do this; your hosting company should be able to help you with the details when setting up your account.

Some quick tips to remember

1. Keeping web pages small - under 60 k
2. Keeping content headers (H2 tags) clear and to the point.
3. Keep paragraphs small.
4. Keep contact information (e-mail, phone) easily found in same place on all pages.
5. Keep look and structure of the web pages consistent across all pages.
6. Provide a 'Home' button to take the user back to the cover (a.k.a.: splash, h o m e) page of the website.
7. Make sure links are always underlined. (Don't use CSS (Cascading Style Sheets) to remove the underline: big mistake if you do since people assume that underlined texts are links).
8. The company logo should appear on every page in the same spot and it should always be a link back to the home page.

Now that we have a good idea of what building a website is all about, we can move on to the next subject: Using Cascading Style Sheets (otherwise known as CSS) to help us make our pages look great!

Building your first web page

In this 'hands-on' module we will be building our first web page in no time. We just need to quickly cover a couple of points beforehand to help get our feet on the ground.

The three ways you can build a web page

1. Use a pre-made template: WHAT IS WEB DESIGN TEMPLATE ?

Web site design templates are pre-made web designs which can be customized to reflect your company's branding. Website design templates can be found in various formats like Photoshop and HTML. Many times these templates are compatible with HTML editors like Go Live, Front Page, and Dream weaver.

Web site templates can be very useful; they can be used by experienced web designers to 'jump-start' the creation of a website. They are also a way for people to put out great looking web sites quickly with little or no knowledge of HTML and web design.

2. Use an HTML editor like Front Page or Dream weaver.:

HTML editors make building web pages feel like (to a certain extent) creating a document in Microsoft Word... .it's made pretty easy. But the downside is that you loose a certain amount of control of what you are doing and in some cases become dependent on the program.

3. Hand-code your HTML in a text editor like Notepad

That means you type in the HTML code yourself, because it's the quickest way to learn how to build web pages, and it is arguably the best way because you have the most control over what you are doing.

What are HTML tags?

HTML tags are specifically formatted text that creates 'markers' for web browser to read and interpret. These 'markers' tell the web browser what and how to display things on the web page. Tags are placed in and around text and images (text and images are some of the 'things') that You want to have appear in your web pages.

ജൈവ വൈവിധ്യവും ജൈവ വൈവിധ്യാധിഷ്ഠിത പരമ്പരാഗത നാട്ടറിവുകളുടെ ബൗദ്ധിക സ്വത്തവകാശ സംരക്ഷണവും

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ഒരു ആഗോള സമ്പദ് വ്യവസ്ഥയിലേയ്ക്ക് ലോകം നീങ്ങിക്കൊണ്ടിരിക്കുന്ന ഈ കാലഘട്ടത്തിൽ ശാസ്ത്ര സാങ്കേതിക വിദ്യയിലും, അറിവിലും മികച്ച് നിൽക്കുന്നത് ആരാണോ അവർ വിജയിക്കുന്നു. നമുക്ക് ബൃഹത്തായ ജൈവ വൈവിധ്യവും അതിലധിഷ്ഠിതായി നിലനിൽക്കുന്ന വിലപ്പെട്ട നാട്ടറിവുകളും ഉണ്ടെന്ന് പറഞ്ഞിട്ട് കാര്യമില്ല. മറിച്ച് അതിന്മേൽ അവകാശം നേടിയെടുക്കാനുള്ള കഴിവ് നാം ആർജ്ജിക്കണം. അല്ലാതെ വന്നാൽ നമ്മുടെ ജൈവ സമ്പത്തും നാട്ടറിവുകളും ആർക്കും ചൂഷണം ചെയ്യാം എന്ന അവസ്ഥ കൈവരും. ഇവിടെ വേണ്ടത് നാട്ടറിവിന്റെ സംരക്ഷണവും, അതിനെ ആധാരമാക്കിക്കൊണ്ടുള്ള ശാസ്ത്രപഠനങ്ങളും, നൂതന പ്രക്രിയകളുടെ (Process) രൂപകല്പനകളും, പുത്തൻ ഉൽപ്പന്നങ്ങളുടെ നിർമ്മാണവും അതിന്റെ സാങ്കേതിക വിദ്യാ കൈമാറ്റം തുടങ്ങിടയവയും ഒപ്പം അതിലൂടെ ലഭ്യമാകുന്ന സാമ്പത്തിക ലാഭത്തിന്റെ തുല്യവും, നീതി പൂർവ്വകവുമായ പങ്ക് വയ്ക്കലുമാണ്. മാനവരാശിയുടെ നിലനിൽപ്പിന് അടിസ്ഥാനഘടകമായി വർത്തിക്കുന്ന ആഹാര സുരക്ഷയും ആരോഗ്യസുരക്ഷയും ജൈവവൈവിധ്യത്തിലധിഷ്ഠിതമാണ്. മനുഷ്യന് വേണ്ട ഭക്ഷണം, വസ്ത്രം, പാർപ്പിടം, ഔഷധം തുടങ്ങിയവക്കെല്ലാം ആധാരം അമൂല്യമായ നമ്മുടെ ജൈവസമ്പത്താണ്. ആയതിനാലാണ് ജൈവ വൈവിധ്യസംരക്ഷണം മാനവരാശിയുടെ സംരക്ഷണം എന്ന് പറയുന്നത്.

ഭൂമിയിലുള്ള സമസ്ത ജീവജാലങ്ങളിലും ദൃശ്യമാകുന്ന വിവിധതയുടെ സമഗ്രദർശനമാണ് ജൈവ വൈവിധ്യം അഥവാ ബയോഡൈവേഴ്സിറ്റി. കുറച്ചുകൂടി സരളമായി പറഞ്ഞാൽ ഭൂമിയിലെ വിവിധങ്ങളായ എല്ലാ സസ്യങ്ങളും, മൃഗങ്ങളും, സൂക്ഷ്മജീവികളും ഒക്കെച്ചേർന്ന ജൈവ സമ്പന്നതയെയാണ് ജൈവ വൈവിധ്യം എന്ന പദം കൊണ്ട് അർഥമാക്കപ്പെടുന്നത്. ലോകത്ത് ജൈവ വൈവിധ്യത്തിന്റെ കാര്യത്തിൽ മുൻപന്തിയിൽ നിൽക്കുന്ന രാജ്യങ്ങളിലൊന്നാണ് ഇന്ത്യ. മുൻപന്തിയിലുള്ള നമ്മുടെ ജൈവ വൈവിധ്യത്തിന് മേൽ വികസിതരാജ്യങ്ങളുടെ കൺ പതിഞ്ഞതിന് ഉദാഹരണമാണ് അടുത്ത കാലത്ത് അമേരിക്ക നടത്തിയ ചില പേറ്റന്റുകൾ. നമ്മുടെ നാട്ടറിവുകളെ ആധാരമാക്കി ജൈവ വസ്തുക്കളിൽ നടത്തിയ പഠനങ്ങളുടെ അടിസ്ഥാനത്തിൽ ഉൽപ്പാദിപ്പിക്കുന്ന നൂതന ഉൽപ്പന്നങ്ങൾക്കാണ് പേറ്റന്റ് നൽകിയിരിക്കുന്നത്. അതിനവർ പഠനവിധേയമാക്കിയ ചില സസ്യങ്ങളിൽ ഒന്നാണ് വേപ്പ്. നോക്കുമ്പോൾ ഓരോ രാജ്യത്തിന്റേയും വിഭവങ്ങൾ മറ്റൊരു രാജ്യത്തിന് എടുക്കാനും, ഗവേഷണം നടത്താനും, നൂതന ഉൽപ്പന്നങ്ങൾ നിർമ്മിച്ച് പേറ്റന്റ് എടുക്കാനേ കഴിയുകയുള്ളൂ. മാത്രവുമല്ല, ജനിതക വിഭവങ്ങളെ ആധാരമാക്കി വ്യാവസായികാടിസ്ഥാനത്തിൽ നൂതന ഉൽപ്പന്നങ്ങൾ നിർമ്മിക്കുന്നുവെങ്കിൽ അതിൽ നിന്നുള്ള ആദായം പരസ്പരം പങ്ക് വയ്ക്കുകയും വേണം. കണ്ടെത്തപ്പെടുന്ന സൂക്ഷ്മജീവികളിലും, സൂക്ഷ്മജീവി സംബന്ധിയായ പ്രക്രിയകളിലും സസ്യജാതികളിലും ഉടമ്പടി അംഗീകരിച്ച രാജ്യങ്ങൾക്ക് ബൗദ്ധിക സ്വത്തവകാശം നൽകണമെന്നാണ് Trips അനുശാസിക്കുന്നത്. ഇത്തരം പ്രയോജനങ്ങൾ അമേരിക്ക പോലുള്ള രാജ്യങ്ങൾ മുതലാക്കുന്ന ജൈവ വൈവിധ്യത്തിൽ അഗ്രഗണ്യസ്ഥാനമുള്ള നമ്മുടെ രാജ്യത്തിന്റെ സാദ്ധ്യതകൾ ഏറെയാണ്.

ആയതിനാൽ സംയോജിതവും, സമന്വിതവുമായ രീതിയിൽ പുതിയ പുതിയ കണ്ടെത്തലുകൾ നടത്തി ജനിതക വിഭവങ്ങളിലും അവയിലധിഷ്ഠിതമായ നാട്ടറിവിലും അധികാരം സ്ഥാനിച്ച്, മനുഷ്യനാവശ്യമായ പല നൂതന ഉൽപ്പന്നങ്ങൾക്കും ജന്മം നൽകി പേറ്റന്റ് സമ്പാദിച്ച് നൂതന ആഗോള സാമ്പത്തിക വ്യവസ്ഥയിൽ നാം ഭാഗഭാക്കുകളാകേണ്ടിയിരിക്കുന്നു. ഇതിന് അമാന്തിച്ചാൽ പുരോഗതിയുടെ കാര്യത്തിൽ മറ്റ് രാജ്യങ്ങളുടെ വളരെ പിന്നിലാകും. ഈ അവസ്ഥ സംജാ

തമാകാതിരിക്കാൻ നമ്മുടെ ജനിതക വിഭവങ്ങളെ തിരിച്ചറിയണം. ഈ തിരിച്ചറിയലിന് ഒരു പുതിയ മാനം കണ്ടെത്തലാണ് ജൈവ വൈവിധ്യ രജിസ്റ്റർ നിർമ്മാണം.

ഒരു വീട്ടിൽ എന്തെല്ലാം സാധനങ്ങൾ ഉണ്ട് എന്ന് ലിസ്റ്റ് ചെയ്യുന്നതുപോലെ നമ്മുടെ ഗ്രാമ പഞ്ചായത്തിൽ, ബ്ലോക്ക് തലത്തിൽ, ജില്ലാ തലത്തിൽ, സംസ്ഥാനത്തിൽ, രാജ്യത്ത് ആകമാനമായി ലഭ്യമായിട്ടുള്ള ജൈവസമ്പന്നതയെ തിരിച്ചറിയാനുള്ള മാർഗ്ഗമാണ് ജൈവ വൈവിധ്യ രജിസ്റ്റർ നിർമ്മാണം. വിഭവങ്ങൾ അറിഞ്ഞാൽ മാത്രമേ ശാസ്ത്രജ്ഞന്മാരുടെയും ഗവേഷണ സ്ഥാപനങ്ങളുടെയും സഹായത്തോടെ ഗവേഷണം നടത്താനും പുതിയ കണ്ടെത്തലുകൾ നടത്താനും വ്യാപാരാടിസ്ഥാനത്തിൽ വികസിപ്പിച്ചെടുക്കാൻ കഴിയുന്ന നൂനത ഉൽപ്പന്നങ്ങൾ നിർമ്മിക്കാനും, പേറ്റന്റ് സമ്പാദിക്കാനും അതിലൂടെ പുതിയ സാമ്പത്തിക ക്രമത്തിന് നാന്ദികുറിക്കാനും സാധിക്കുകയുള്ളൂ.

വിവരശേഖരണം എവിടെനിന്ന്, എപ്പോൾ, എങ്ങനെ തുടങ്ങണം?

ജൈവ വൈവിധ്യ വിവര ശേഖരണം താഴെ തട്ടിൽ നിന്ന് തുടങ്ങണമെന്ന് പറയുമ്പോൾ ഇത്തരം വിവരശേഖരണങ്ങളുടെ ഏറ്റവും ചെറിയ യൂണിറ്റായി എടുക്കാവുന്നത് നമ്മുടെ ഗ്രാമ പഞ്ചായത്തുകൾ തന്നെ. ഓരോ ഗ്രാമപഞ്ചായത്തിന്റേയും ജൈവ വൈവിധ്യ രജിസ്റ്ററിനെ ആസ്പദമാക്കി വിവര സാങ്കേതിക വിദ്യയുടെ സഹായത്തോടെ ഉണ്ടാക്കുന്ന ഡേറ്റാ ബേസുകൾ ആ പഞ്ചായത്തിലെ ജൈവവൈവിധ്യത്തെ ഒറ്റനോട്ടത്തിൽ വ്യക്തമാക്കുന്ന തരത്തിലുള്ളതും, ഗവേഷകരേയും വ്യാപാരികളേയും ഒറ്റനോട്ടത്തിൽ ആകർഷിക്കാൻ പോന്നരീതിയിൽ സജ്ജീകരിക്കപ്പെട്ടതുമായിരിക്കണം. രഹസ്യ സ്വഭാവമുള്ള വിവരങ്ങൾ കോഡ് ചെയ്തിരിക്കണം. വിഭവങ്ങളും വിവരങ്ങളും വ്യാപാരാടിസ്ഥാനത്തിൽ ആവശ്യപ്പെടുന്നവരിൽ നിന്ന് ഉടമ്പടികൾ വയ്ക്കാം. നിശ്ചിത തുക ഈടാക്കാം. ഉൽപ്പന്നങ്ങൾ നിർമ്മിക്കുന്നവരിൽ നിന്ന് ആദായവും, റോയൽറ്റിയും നേടാം. ഇപ്രകാരം നീതിപൂർവ്വമായ പങ്കുവയ്ക്കലിലൂടെ ലഭ്യമാകുന്ന സാമ്പത്തിക ലാഭത്താൽ പ്രദേശത്തിന്റെ/പഞ്ചായത്തിന്റെ മുഖച്ഛായ തന്നെ മാറ്റി എടുക്കാനും കഴിയും. ഇതിന് വേണ്ടത് ഒരുമയും, കൂട്ടായ ശ്രമവും, പരസ്പര ധാരണയുമാണ്. പ്രകൃത്യാ വളരുന്ന സസ്യ-ജന്തു ജാതികളുടെ പട്ടിക തയ്യാറാക്കിക്കഴിയുമ്പോൾ തന്നെ വിഭവങ്ങളുടെ ഒരു ഏകദേശ രൂപം കൈവരുന്നു. കാലാകാലങ്ങളിൽ ഉണ്ടാകുന്ന മാറ്റങ്ങളും മറ്റ് കാര്യങ്ങളും ഡേറ്റാബേയ്സിൽ ചേർത്ത് സമയാസമയങ്ങളിൽ നിരീക്ഷിക്കുന്നതിന് നമുക്ക് കഴിയും. കൂടാതെ ഈ വിഭവങ്ങളെ ആധാരമാക്കിക്കൊണ്ടുള്ള വികസന പ്രവർത്തനങ്ങൾക്ക് അനുയോജ്യമായ നൂതന പ്രോജക്ടുകളുടെ രൂപീകരണവും നടപ്പാക്കലുമെല്ലാം സാധിക്കും.

നാട്ടറിവ്

നാട്ടറിവിന്റെ മഹത്വം നാടിന്റെ നന്മയ്ക്ക് എന്ന ആശയം സാക്ഷാത്ക്കരിക്കുന്നതിന് ജൈവ വൈവിധ്യ രജിസ്റ്റർ നിർമ്മാണം ഏറെ സഹായകമാണ്. സാമൂഹിക-സാംസ്ക്കാരിക-ചികിത്സാരംഗങ്ങളുമായി അഭേദ്യബന്ധം പുലർത്തിപ്പോന്ന നാട്ടറിവുകൾ അനുഭവത്തിന്റെ ആകെ തുകയാണ്. ആധുനിക യുഗത്തിൽ നടന്ന പല കണ്ടുപിടിത്തങ്ങൾക്കും പിൻബലം നാട്ടറിവുകളായിരുന്നു. ഇത്തരം നാട്ടറിവുകളുടെ പ്രാധാന്യം കണക്കിലെടുത്താണ് നാശോന്മുഖമായിക്കൊണ്ടിരിക്കുന്ന നാട്ടറിവുകളുടെ ശേഖരണവും, സംരക്ഷണവും ജന പങ്കാളിത്തത്തോടെ നടത്താൻ ജൈവ വൈവിധ്യ രജിസ്റ്റർ നിർമ്മാണം വിഭാവനം ചെയ്യുന്നത്. ബന്ധപ്പെട്ട വിവരങ്ങൾ ശേഖരിച്ച് ജൈവവൈവിധ്യ രജിസ്റ്ററിൽ രേഖപ്പെടുത്തി ബയോ ഡൈവേഴ്സിറ്റി മാനേജ്മെന്റ് കമ്മിറ്റിയുടെ മേൽനോട്ടത്തിൽ ഗ്രാമപഞ്ചായത്തിൽ സൂക്ഷിക്കേണ്ടതാണ്. ഇവിടേയും രഹസ്യസ്വഭാവമുള്ള വിവരങ്ങൾ കോഡ് ചെയ്യണം. അല്ലെങ്കിൽ അത് പബ്ലിക് ഡൊമയിനിൽ ആയിപ്പോകും. അങ്ങനെയാവുമ്പോൾ അറിവിനെ ആധാരമാക്കി ആർക്കും പഠിക്കാം, നൂതന ഉൽപ്പന്നങ്ങൾ ഉണ്ടാക്കാം. നിലവിലുള്ള നിയമത്തിലൂടെ തടയാനും കഴിയുകയില്ല. ആയതിനാൽ നാട്ടറിവുകൾ ശാസ്ത്രീയമായി ശേഖരിക്കുന്ന വേളയിൽ അറിവുകളെ കുറിക്കപ്പെട്ടത്/പറഞ്ഞ് തന്നത് (Disclosed) ഭാഗികമായി കുറിക്കപ്പെട്ടത്/പഞ്ഞുതന്നത് (Partially disclosed) കുറിക്കപ്പെടാത്തത്/പറഞ്ഞ് തരാത്തത് (Undisclosed)എന്നിങ്ങനെ മൂന്ന് വിഭാഗങ്ങളിൽ വേർതിരിച്ച് സൂക്ഷിക്കാം. ഇതിലൂടെ നാട്ടറിവു

കൾ ചൂഷണം ചെയ്യുന്നത് തടയാനും, ജനസമ്മതിയോടെ ഗവേഷണത്തിന് അനുയോജ്യമായവ തെരഞ്ഞെടുക്കാനും സാധിക്കുന്നു. ഗവേഷണത്തിലൂടെ ലഭ്യമാകുന്ന ഉപലബ്ധികളുടെ അടിസ്ഥാനത്തിൽ സാമ്പത്തിക ലാഭം നീതിപൂർവ്വകമായി പങ്ക് വയ്ക്കുന്നതിനും (Benefit), ബൗദ്ധിക സ്വത്തവകാശം (iPR) സംരക്ഷിക്കുന്നതിനും സാധിക്കും. ഇതിന് ഒരു ഉത്തര ഉദാഹരണമാണ് കാണിക്കാരുടെ ആരോഗ്യപച്ച എന്ന ഔഷധ സസ്യത്തെ ആധാരമാക്കി TBGRI നടത്തിയ പഠനങ്ങളും ജീവനി എന്ന ഔഷധത്തിന്റെ നിർമ്മാണവും സാങ്കേതിക വിദ്യ കൈമാറി കിട്ടിയ ധനത്തിന്റെ നീതിപൂർവ്വമായ പങ്കുവയ്ക്കലും അതിലൂടെ ആദിവാസികളുടെ ബൗദ്ധിക സ്വത്തവകാശത്തിന് കിട്ടിയ അംഗീകാരവും. ഈ രംഗത്ത് ഈ സംരംഭത്തെ ലോകത്തെ ആദ്യ മാതൃകയായിട്ടാണ് വിശേഷിപ്പിക്കുന്നത്.

എന്താണ് ബൗദ്ധിക സ്വത്തവകാശം

ഒരു വ്യക്തിയുടെ ബുദ്ധിയിൽ നിന്നും ഉടലെടുത്ത ആശയത്തെ ആധാരമാക്കിക്കൊണ്ട് ഉപയോഗസാദ്ധ്യതയുള്ള ഒരു നൂതന ഉൽപ്പന്നം ഉണ്ടാക്കുമ്പോൾ അയാളുടെ ആശയത്തിനും, ഉൽപ്പന്നത്തിനുമുള്ള ഉടമസ്ഥാവകാശത്തെയാണ് ബൗദ്ധിക സ്വത്തവകാശം എന്ന പദം കൊണ്ട് അർത്ഥമാക്കുന്നത്. വ്യക്തിയുടെ അനുമതി ഇല്ലാതെ ഇത് മറ്റുള്ളവർ എടുക്കുകയോ, വിൽക്കുകയോ ചെയ്യുന്നതിൽ നിന്നും ഈ ഉടമസ്ഥാവകാശം സംരക്ഷണം നൽകുന്നു. അനുമതിയോടെ എടുക്കുകയാണെങ്കിൽ കരാർ പ്രകാരം നൽകാനുദ്ദേശിക്കുന്ന ലൈസൻസ് ഫീ, റോയൽറ്റി തുടങ്ങിയ കാര്യങ്ങളിൽ ധാരണാപത്രം ഒപ്പുവച്ച് നിയമസാധുതനേടിയിരിക്കേണ്ടതാണ്. ചുരുക്കിപറഞ്ഞാൽ ബൗദ്ധികസ്വത്തവകാശം താൽക്കാലികമായി സംരക്ഷിക്കാനുള്ള ഒരു മാർഗ്ഗമാണ് പേറ്റന്റ്. പേറ്റന്റ് പോലെ തന്നെ ബൗദ്ധികസ്വത്തവാകശം സംരക്ഷിക്കുന്നതിനുള്ള മറ്റ് മാർഗ്ഗങ്ങളാണ് രജിസ്റ്റേർഡ് ഡിസൈൻ, ട്രേഡ് മാർക്ക്, പ്ലാന്റ് വെറൈറ്റി (പുതിയതായി ജന്മം നൽകുന്ന സസ്യ ഇനങ്ങൾ), കോപ്പിറൈറ്റ്, ട്രേഡ് സീക്രറ്റ് എന്നിവ. അതത് രാജ്യങ്ങൾ കാലാകാലങ്ങളിൽ കരുപ്പിടിപ്പിച്ചെടുത്തിട്ടുള്ളതും അംഗീകരിക്കപ്പെട്ടിട്ടുള്ളതുമായ നിയമങ്ങളിലധിഷ്ഠിതമായാണ് ഇത്തരം സംരക്ഷണോപാധികൾ നിലനിൽക്കുന്നത്. ബൗദ്ധിക സ്വത്തുക്കളെ രണ്ടായി തരംതിരിക്കാം. ആദ്യവിഭാഗത്തിൽ വ്യാവസായിക സ്വത്തുക്കളെയാണ് ഉൾപ്പെടുത്തിയിരിക്കുന്നത്. ഇതിൽ നൂതന കണ്ടുപിടിത്തങ്ങൾ (പ്രക്രിയകൾ, ഉൽപ്പന്നങ്ങൾ, ഉപകരണങ്ങൾ) ഇൻഡസ്ട്രീയൽ ഡിസൈൻ (ആകൃതി രൂപാന്തരണം), മുദ്രകൾ, കച്ചവടസാധനങ്ങൾ തിരിച്ചറിയാനുള്ള വ്യാപാരനാമം (ട്രേഡ് നെയിംസ്) എന്നിവ. അടുത്തകാലത്തായി വ്യാവസായിക സ്വത്തുക്കളുടെ നിർവ്വചന വ്യാപ്തി കൂട്ടിയിട്ടുണ്ട്. ഇതിലുൾപ്പെടുന്ന മറ്റ് കാര്യങ്ങളാണ് സവിശേഷതയോടുകൂടിയ ഭൂമിശാസ്ത്രപരമായ സൂചനകളുടെ സംരക്ഷണം (പ്രത്യേകിച്ചും സ്ഥാനം/ജാതി എന്നിവയുടെ ഉറവിടം), പുതിയതായി രൂപപ്പെടുന്ന സസ്യ ഇനങ്ങൾ, ലേ ഔട്ട് ഡിസൈനുകൾ തുടങ്ങിയവ.

രണ്ടാമത്തെ വിഭാഗത്തിൽ വരുന്നവയാണ് കോപ്പിറൈറ്റ്. ഇതിലുൾപ്പെടുന്ന കാര്യങ്ങളാണ് സാഹിത്യ രചനകൾ, സംഗീതം (രചനകൾക്കൊപ്പമുള്ള അനുബന്ധ പദങ്ങൾ), നാടകം (രചനകൾക്കൊപ്പമുള്ള അനുബന്ധ സംഗീതം), മൂകാഭിനയം/മൂകനാടകം, നൃത്ത സംവിധാന ജോലികൾ, ചിത്രരചന, രേഖാചിത്രം, ശിൽപജോലികൾ, മോഷൻ പിക്ചർ, മറ്റ് ആഡിയോ വിഷ്വൽ ജോലികൾ, ശബ്ദ ലേഖനം, വാസ്തുശിൽപജോലികൾ ആദിയായവ. ഇത്തരം ബൗദ്ധിക സ്വത്തവകാശങ്ങളെ സംരക്ഷിക്കുന്നതിനുവേണ്ടിയുള്ള ലോക ബൗദ്ധിക സ്വത്ത് അവകാശ സംഘടന (World Intellecutal Property Right Organisation-WIPRO) 1967-ൽ രൂപം കൊള്ളുകയുണ്ടായി. അന്ന് സ്റ്റോക്ക് ഹോമിൽ കൂടിയ സമ്മേളനത്തിൽ കുറപിടിപ്പിച്ച ആർട്ടിക്കിൾ 8-ലെ നിർവ്വചന പ്രകാരം ബൗദ്ധിക സ്വത്തവകാശത്തിനുള്ളിൽ ബന്ധപ്പെട്ടുവരുന്ന കാര്യങ്ങളാണ് (1) സാഹിത്യ രചന-ചിത്രരചന (2) പ്രകടനം നടത്തുന്ന കലാകാരന്റെ അവകാശം, ഫോണോഗ്രാം പ്രസരണങ്ങൾ (3) മനുഷ്യന്റെ ഇടപെടലുകളിലൂടെ എല്ലാ രംഗത്തും കണ്ടെത്തുന്ന നൂതന കണ്ടുപിടിത്തങ്ങൾ (4) ശാസ്ത്രീയ കണ്ടുപിടിത്തങ്ങൾ (Scientific Works), വ്യാവസായിക രൂപ കല്പനകൾ (Industrial Design) (6) വ്യാപാര മുദ്ര (Trade marks), സേവനമുദ്ര (Service marks), കച്ചവട നാമങ്ങൾ, പദവികൾ (commercial names & designation) (7) അനൗചിത്യത്തോടെ നടത്തുന്ന മാത്സര്യ

തന്ത്രങ്ങൾക്കെതിരെയുള്ള സംരക്ഷണം (protection against unfair competiton) (8) വ്യാവസായിക-ശാസ്ത്ര-സാഹിത്യ ചിത്ര രചനാരംഗങ്ങളിൽ നടന്നു വരുന്ന ബൗദ്ധികപരമായ പ്രവർത്തനങ്ങൾക്കുള്ള അവകാശം എന്നിവ.

മറ്റു സ്വത്തുക്കൾ നാം കൈവശം വയ്ക്കുന്നതുപോലെ തന്നെ ബൗദ്ധികസ്വത്തും നമ്മുടെ കൈവശം വയ്ക്കാം. ഒരാളുടെ സ്വന്തം സ്വത്തു പോലെ തന്നെ കാത്തുസൂക്ഷിക്കാനും, മേടിക്കാനും കൊടുക്കാനുമെല്ലാം കഴിയും. കൂടാതെ ഒരാളുടെ സ്വത്ത് ആധികാരികതയോടെയല്ലാതെ മറ്റുള്ളവർ കവർന്നെടുത്ത് വിൽക്കുന്നത് തടയാനും കഴിയും. മറ്റ് സ്വത്തുക്കളും, ബൗദ്ധിക സ്വത്തും തമ്മിലുള്ള കാതലായ വ്യത്യാസമെന്തെന്നാൽ ബൗദ്ധിക സ്വത്ത് തൊട്ടറിയാൻ കഴിയാത്തതും, സൂക്ഷ്മരൂപത്തിൽ അതിന്റേതായ രീതിയിൽ ഒരു നിർവ്വചനം കൊടുക്കാൻ കഴിയാത്തതും, സൂക്ഷ്മരൂപത്തിൽ അതിന്റേതായ രീതിയിൽ ഒരു നിർവ്വചനം കൊടുക്കാൻ കഴിയാത്തതുമാണ്. ആയതിനാൽ ബൗദ്ധിക സ്വത്ത് ദൃഷ്ടിഗോചരമായ വഴിയിലൂടെ ആശയപ്രകാശം നടത്തിയാലേ അതിന് സംരക്ഷണം ഉറപ്പ് വരുത്താൻ കഴിയൂ. സാധാരണ സ്വത്ത് സംരക്ഷണത്തിനുള്ള നിയമങ്ങൾ ഉള്ളതുപോലെ തന്നെ ബൗദ്ധിക സ്വത്തിനുള്ള വ്യതിരിക്തമായ സംരക്ഷണ ഉപാധികളും, നിയമങ്ങളും കൂടുതലായി നമുക്ക് കരുപ്പിടിപ്പിക്കേണ്ടിയിരിക്കുന്നു.

ഈ ബൗദ്ധിക സ്വത്തവകാശ സംരക്ഷണത്തിലെ പ്രധാന കണ്ണിയായ പേറ്റന്റിനെക്കുറിച്ച് കൂടുതൽ അറിയാൻ ശ്രമിക്കാം.

എന്താണ് പേറ്റന്റ്?

ഇതുവരെ സ്പഷ്ടമാക്കപ്പെട്ടിട്ടില്ലാത്തതും ശാസ്ത്ര സാങ്കേതിക വിജ്ഞാനത്തിന്റെ സഹായത്തോടെ കണ്ടു പിടിക്കപ്പെടുന്നതുമായ കണ്ടെത്തലുകൾക്കാണ് പേറ്റന്റ് നൽകുന്നത്. എന്നാൽ കേവലം ഒരു കണ്ടെത്തലിന് പേറ്റന്റ് ലഭിക്കുകയല്ല. ഉദാഹരണത്തിന് ഒരു ഔഷധ സസ്യത്തിലുള്ള രാസഘടകങ്ങൾ വേർതിരിച്ചെടുക്കുന്നത് കണ്ടെത്തലാണ്. എന്നാൽ ഇത് പ്രകൃതിജന്യമായ ചെടിയിൽ നിലകൊള്ളുന്ന വസ്തു ആയതിനാൽ പേറ്റന്റിന് അർഹമല്ല. എന്നാൽ ആ രാസഘടകത്തെ ആധാരമാക്കി ഉപയോഗ സാദ്ധ്യതയുള്ള ഒരു നൂതന ഉൽപ്പന്നം ഉണ്ടാക്കിയെടുക്കാൻ ഒരു വ്യക്തിക്കോ, വ്യക്തികൾക്കോ കഴിഞ്ഞാൽ അതിന്റെ പ്രോസസ്സ് പേറ്റന്റോ (പ്രക്രിയാ പേറ്റന്റ്), പ്രോഡക്റ്റ് പേറ്റന്റോ (ഉൽപ്പന്ന പേറ്റന്റ്) എടുക്കാം. അങ്ങനെവരുമ്പോൾ വ്യവസ്ഥകളനുസരിച്ച് ഇത്തരം കണ്ടെത്തലുകൾക്ക് താൽക്കാലിക കുത്തകാവകാശം ഒരു വ്യക്തിക്കോ, വ്യക്തികൾക്കോ ലഭ്യമാക്കുന്ന പ്രക്രിയയെയാണ് പേറ്റന്റ് നേടൽ എന്ന പദം കൊണ്ട് അർത്ഥമാക്കുന്നത്. ഈ അവകാശങ്ങൾ മറ്റുള്ളവർ കവർന്നെടുത്താൽ നിയമത്തിലൂടെ അത് തിരികെ നേടിയെടുക്കാനുള്ള അവകാശവും വ്യക്തികൾക്കുണ്ട്. ഉൽപ്പന്ന പേറ്റന്റും, പ്രക്രിയാ പേറ്റന്റുമാണ് ഇന്ന് നിലവിലുള്ളത്. പ്രകൃതിദത്തമായി ലഭ്യമാകുന്ന ജൈവ-അജൈവ വസ്തുക്കളെ അപ്പടി പേറ്റന്റ് ചെയ്യാൻ ആർക്കും കഴിയില്ല. വേപ്പ്, മഞ്ഞൾ, ചക്കരക്കൊല്ലി എന്നീ ഔഷധസസ്യങ്ങൾ പേറ്റന്റ് ചെയ്തു എന്നറിയുന്നത് ശരിയല്ല. എന്നാൽ അതിൽ നിന്നും കണ്ടെത്തിയ, ഇതുവരെ സമ്പുഷ്ടമാക്കപ്പെട്ടിട്ടില്ലാത്ത ഗുണവിശേഷമുള്ള നവീനരീതിയിലൂടെ നിർമ്മിച്ച നൂതന ഉൽപ്പന്നങ്ങൾ പേറ്റന്റ് ചെയ്യാവുന്നതാണ്. ജനിതക പരിഷ്ക്കരണത്തിലൂടെ രൂപപ്പെടുത്തിയെടുക്കുന്ന പുതിയ ഇനം ചെടികളും, സൂക്ഷ്മാണുക്കളും അപ്പടി പേറ്റന്റ് ചെയ്യാൻ നിലവിലുള്ള നിയമം തടസ്സമല്ല.

ഫാർമസ്യൂട്ടിക്കലുകളെ (ഔഷധ നിർമ്മാണ വ്യവസായം) സംബന്ധിച്ചിടത്തോളം ബൗദ്ധികസ്വത്തവകാശത്തിന്റെ പ്രസക്തി പേറ്റന്റുകളിലധിഷ്ഠിതമാണ്. വ്യാവസായിക രംഗത്തെ നൂതന കണ്ടുപിടിത്തങ്ങളെ സംരക്ഷിക്കുകയാണിതിന്റെ പ്രാഥമിക ലക്ഷ്യം. ഓരോ രാജ്യത്തും നിലകൊള്ളുന്ന നിയമമനുസരിച്ച് 15 മുതൽ 20 വർഷം വരെ കഴിയുമ്പോൾ പേറ്റന്റിന്റെ പ്രസക്തി നഷ്ടപ്പെടുന്നു. കാരണം അതിന് ശേഷം മറ്റൊരാൾക്ക് കണ്ടുപിടിത്തങ്ങളുടെ ഉടമയുടെ അനുമതി ഇല്ലാതെ ഉൽപ്പന്നങ്ങളുണ്ടാക്കാനും വിൽക്കാനും സാധിക്കും. എന്നാൽ പലപ്പോഴും പുതിയ പുതിയ കണ്ടുപിടിത്തങ്ങളുണ്ടാവുമ്പോൾ പഴയവയ്ക്ക് പ്രസക്തി ഇല്ലാതെയാവുന്നു എന്നത് ഇവിടെ സ്മരണീയമാണ്.

പേറ്റന്റ് വ്യവസ്ഥകളുടെ ചരിത്രം

പേറ്റന്റിന്റെ കഥ തുടങ്ങുന്നത് ഇറ്റലിയിൽ നിന്നാണ്. പേറ്റന്റ് ആദ്യമായി ലഭിക്കുന്നത് Flippo Brunelleschi എന്ന വ്യക്തിക്കാണെന്നാണ് ചരിത്ര രേഖകൾ വ്യക്തമാക്കുന്നത്. 1421-ൽ റിപ്പബ്ലിക്ക് ഓഫ് ഫ്ളോരൻസിലാണ് ഇത് നടന്നത്. പത്തേമാരിയിൽ ഘടിപ്പിക്കാവുന്ന ഒരു പ്രത്യേകതരം ഗിയർ രൂപകൽപ്പന ചെയ്ത് പ്രയോഗത്തിൽ കൊണ്ടുവന്നതിന് മൂന്ന് വർഷത്തേക്കാണ് ഫ്ളിപ്പോയ്ക്ക് പേറ്റന്റ് നൽകിയത്. പേറ്റന്റിനെക്കുറിച്ചുള്ള നിയമശാസനം ആദ്യമായി നിലവിൽ വന്നത്. 1474-ൽ വെനീഷ്യൻ നിയമത്തിലാണ്. ഇത്തരം വ്യവസ്ഥകൾ പിന്നീട് പശ്ചിമയൂറോപ്യൻ രാജ്യങ്ങളിലേയ്ക്ക് കൊണ്ടുവരപ്പെട്ടു. ഇംഗ്ലണ്ടിൽ ഒന്നാമത്തെ എലിസബത്ത് രാജ്ഞിയുടെ കാലത്ത് അതായത് 1553-1603 വരെയുള്ള കാലഘട്ടത്തിൽ അവരുടെ മന്ത്രി (Lord Burghley) യ്ക്ക് പേറ്റന്റ് അവകാശം നൽകികൊണ്ടുള്ള ഒരു പരമ്പര തന്നെ ഉണ്ടായെന്നു വേണം പറയാൻ. ഇതിന് പിന്നിലെ മുഖ്യ ലക്ഷ്യം വിദേശീയരായ കണ്ടുപിടിത്തക്കാരെ ഇംഗ്ലണ്ടിലേയ്ക്ക് ആകർഷിക്കുകയായിരുന്നു. പേറ്റന്റ് നിയമം ആദ്യമായി ഇന്ത്യയിൽ തുടങ്ങുന്നത് 1856-ലെ Act on Protection of Inventions വഴിയാണ്. 1852-ലെ ബ്രിട്ടീഷ് പേറ്റന്റ് നിയമമായിരുന്നു ഇതിനടിസ്ഥാനം. 1959 വരെ ഉള്ള കാല ഘട്ടത്തിൽ ഒൻപത് പ്രാവശ്യം പേറ്റന്റ് നിയമത്തിൽ പുതിയ പല ആക്റ്റുകൾ ചേർക്കപ്പെടുകയും, ഭേദഗതികൾ കൊണ്ടുവരികയും ചെയ്തിട്ടുണ്ട്. കോപ്പിറൈറ്റുകളുമായി ബന്ധപ്പെട്ട കാര്യങ്ങളാണ് അക്കാലത്ത് കൂടുതലായി കൊണ്ടുവന്നതും ഭേദഗതി ചെയ്തതും. 1967ലാണ് പാർലമെന്റിൽ ആദ്യമായി പേറ്റന്റ് ബിൽ കൊണ്ടുവരുന്നത്. 1970-ൽ ഇന്ത്യൻ പേറ്റന്റ് ആക്റ്റ് നിലവിൽ വന്നു. 1994-ൽ 1970-ലെ പേറ്റന്റ് ഭേദഗതി ചെയ്യാനുള്ള ഓർഡിനൻസ് ഉണ്ടാക്കി. ഗാട്ട് കരാറിലെ വ്യവസ്ഥകളെ ഉൾക്കൊള്ളിച്ചിട്ടുള്ള ഭേദഗതികൾ വരുത്താൻ ശ്രമം തുടങ്ങി. 1999-ൽ 1970-ലെ പേറ്റന്റ് ഭേദഗതി ബിൽ രാജ്യസഭയിൽ അവതരിപ്പിച്ചു. തുടർന്ന് പേറ്റന്റ് അമന്റ്മെന്റ് ആക്ട് 2002, പേറ്റന്റ് റൂൾസ് 2003 (May 20,2003) പ്രാബല്യത്തിൽ വന്നു. ഇതേ സമയം തന്നെ ബയോളജിക്കൽ ഡൈവേഴ്സിറ്റി ആക്ട് 2002-ഉം, ബയോളജിക്കൽ ഡൈവേഴ്സിറ്റി റൂൾസ് 2004-ഉം പ്രാബല്യത്തിൽ വന്ന് കഴിഞ്ഞു. ഇതിന് മുമ്പ് 2001-ലെ തന്നെ പുതിയ സസ്യ ഇനങ്ങളുടേയും, കർഷകരുടേയും അവകാശ സംരക്ഷണത്തിനുള്ള The protetion of plant varieties and farmers act നിലവിൽ വന്ന് കഴിഞ്ഞിരിക്കുന്നു.

പ്രസ്തുത നിയമങ്ങളുടെ ചുവട് പിടിച്ചാവണം ഇനി നമുക്ക് മുന്നോട്ട് നോക്കേണ്ടത്.

1. Annexure
Medicinal and other economically important plants of Kerala

Sl. No.	Botanical name & family	Malayalam name	Distribution in Kerala	Useful parts	Active principles/ useful derivatives	Important properties/local uses
1	*Abrus precatorius* L. Papilionaccae	Kunni	Cultivated occasionally; found wild in forest plantations	Leaf, seed, root	Abrine, abralin, abrine	Blood purifier, sedative contraceptive, abortifacient aphrodisiac, antipyretic
2	*Acorus calamus* L. Araceae	Vayampu	Marshy / swampy places in the high ranges of Munnar and vicinity above 800 m. altitude	Rhizhome	Acorin, essential oil	Emetic, stomachic, digestive, antidote, insectifuge
3	*Actinodaphene hookeri* Meissn.; Lauraceae	Malavirinji	Evergreen and semi-evergreen forests	Leaf, seed	Actinodaphnine	Antidiabetic, diuretic; sprains
4	*Adhatoda zeylanica* Medicus; Acanthaceac	Adalodakam	Common in plains and moist mixed deciduous forests, also in evergreen forests	Leaf, root, rarely flower	Vasicine, essential oil	Expectorant, asthma, bronchitis, rheumatism
5	*Aegle marmelos* (L.) Correa.; Rutaceae	Koovalam	Grown in homestead or temple gardens	Fruit (ripe and unripe), root bark	Marmalosin, essential oil	Dysentery, fever, catarrh
6	*Aerva lanata* (L.) Juss.; Amaranthaceae	Cherula	In plains and moist or dry mixed deciduous forests at medium elevations	Whole plant, root	-	Diuretic, anthelminthic
7.	*Alangium salvifolium* (L.f.) Wang; Alangiaceae	Ankolam	Moist mixed deciduous forests	Fruit, leaf; root	Alangine	Purgative, antipyretic, anthelminthic; rheumatism
8	*Albizia lebbeck* (L.) Benth;.Mimosaceae	Nenmenivaka	Moist mixed deciduous forests	Stem, root, gum bark, seed	Saponin, tannin	Astringent, antidote, asthma anthelminthic; ophthalmia
9	*Aloe vera* (L.) Burm.f. Liliaceae	Kumari	Cultivated	Root, juice of the plant	Aloin, isobarbalain, emodin	Stomachic, purgative, piles, fever, menstrual suppressions
10	*Alpinia galanga* (L.) Willd;.Zingiberacea	Aratha	Evergreen forests; mostly cultivated	Rhizhome	Essential oil	Rheumatism, fever, catarrh, diabetes, heptic disorders

11	*Alstonia scholaris* (L,) R.Br; .Apocynaceae	Ezhilampala	Moist mixed deciduous forests	Stem bark	Echitenine, ditamine echitamine, echitamidine	Vermifuge, antidysenteric, diarrhoea, ulcer, antidote to snake bite
12	*Amaranthus spinosus L.* Amaranthaceae	Mullanchera	In the plains as a weed in paddy fields	Plant, leaf, root		Laxative
13	*Anacardium occidentale* L; Anacardiaceae	Parankimavu	Cultivated and naturalized in coastal areas	Bark, root, nut	Cardol, anacardic acid	Astringent, antidiarrhoeal, nutritive, purgative, leprosy
14	*Anamirta cocculus* (L.) W. & A; Menispermaceae	Polla	Evergreen and semi-evergreen forests	Leaf, fruit	Picrotoxin	Antipyretic, expectorant; rheumatism
15	*Andrographis paniculata* (Burm..f.) Nees Acanthaccae	Kiriyath/ Nilaveppu	Coastal plains, Moist mixed deciduous forests and scrub jungles	Whole plant, leaf, root	Andrographlioloide, neoandrographoloide	Bitter stomachic, tonic, bacillary dysentery; anthelminthic
16.	*Anisomeles malabarica* (L.) R. Br.; Lamiaceae	Karimthumpa	Moist mixed deciduous forests	Whole plant, leaf	Alkaloid, essential oil	Antipyretic, rheumatism, dyspepsia, catarrah
17	*Anthocephalus chinensis* (Lam.) Walp; Rubiaccae	Kadampu	Semi-evergreen forests, especially along the banks of rivers or streams	Stem bark, leaf	Active principle similar to cinchotamic acid	Febrifuge, astringent, antidysenteric
18	*Antiaris toxicaria* (Pers.) Lesch.; Moracene	Maravuri	Evergreen and semi-evergreen forests	Latex, seed	Antiarin,antiaresin, toxicarin	Febrifuge, antidysenetric
19	*Aphnamixis polystachya* (Wall.) Parker; Meliaceae	Chemmaram	Evergreen and semi-evergreen forests	Stem, bark, seed	Fixed oil	Astringent, stomachic; hepatic disorders, rheumatism
20	*Areca catechu* L. Arecaceae	Kamuku	Cultivated	Nut	Arecaine, arecoline	Anthelminthic, aphrodisiac
21	*Aristolochia indica* L. Aristolochiaceae	Garudakodi/ Karalakam	Semi-evergreen or moist mixed deciduous forests	Root, leaf	Aristolochin	Emmenagogue, antipyretic, antidote for snake poison
22	*Aristolochia tagala.* Cham.; Aristolochiaceae	Pathala-garudakodi	Evergreen and semi-evergreen forests	Whole plant		Bowel complaints

23	*Asparagus racemosus* Willd.; Liliaceae	Satavari	Semi-evergeen and moist mixed deciduous forests	Root	Sarsapogenin	Diuretic, aphrodisiac. antiseptic, antidysenteric; tuberculosis, leprosy
24	*Azadirachta indica* A. Juss.; Meliaceae	Vepu	Mostly cultivated, occasionally wild in dry deciduous forests	Bark, leaf, fruit, seed, root	Azadirachtin	Bitter tonic, astringent insecticide
25	*Bacopa monnieri* (L.) Pennell; Scrophulariaceae	Brahmi	Wet, damp, marshy areas throughout Kerala	Whole plant, stem, leaf	Brahmine, herpestine	Brain tonic, diuretic; asthma, epilepsy
26	*Bambusa arundinaceae* (Retz.) Willd; Poaceae	Mula	Moist or dry mixed deciduous forests and bamboo brakes	Leaf, stem, root	Cholin, betaine	Tonic, expectorant, antipyretic, anthelminthic
27	*Biophytum sensitivum* (L.).DC.; Oxalidaceae	Mukkutti	In plains and moist mixed deciduous forests	Leaf, root, seed		Astringent, antipyretic, antiseptic
28	*Boerrhavia* diffusa L. Nyctaginaceae	Thazhuthama	Acommon weed along coastal plains and dry or moist mixed deciduous forests	Root	Punarnavine	Diuretic, laxative, asthma, expectorant, jaundice
29	*Bombax ceiba* L. Bombacaceae	Elavu	Semi-evergreen and moist deciduous forests	Gum, root, fruit	Catechutannic acid	Aphrodisiac, antidysentric antidiarrhoea, haemostatic
30	*Borassus flabellifer* L. Arecaceae	Karimpana	Naturalized in coastal plains and occasionally wild in dry or moist deciduous forests	Juice of the plant fruit pulp, root		Restorative, diuretic stimulant, nutritive
31	*Butea monosperma* (Lam) Taub.; Papilionaceae	Plasu	Dry mixed deciduous forests	Stem, bark, leaf, flower, seed	Butein, butrin	Astringent, aphrodisiac anthelminthic, diuretic
32	*Calophyllum inophyllum* L.; Clusiaceae	Punna	A common riverine tree along coastal regions and also in semi-evergreen forests	Bark, leaf, seed	Seed oil, aromatic resin	Astringent, emetic, purgative, skin diseases and rheumatism
33	*Calotropis gigantea* (L.) R. Br.; Asclepiadaceae	Erikku	Common along the plains and also in dry mixed deciduous forests and scrubs	Root bark, leaf, flower	Calotropin calotoxin	Antidysenteric, antipyretic, expectorant, fever, cold, purgative, asthma
34	*Calycopteris floribunda* Lam.; Combretaceae	Pullani	Moist mixed deciduous forests & scrub jungles	Leaf	Calycopterin	Astringent, anthelminthic, antidysenteric, malaria, ulcer

35	*Cardiospermum halicacabum* L.; Sapindaceae	Uzhinja	Naturalized; common in plains, especially in waste lands	Whole plant, leaf, root	Saponin	Diaphoretic, diuretic, emmenogogue; rheumatism, nervous disorders
36	*Cassia fistula* L. Caesalpiniaceae	Kanikonna	Moist mixed deciduous forests, also in cultivation	Root bark, seed, leaf	Anthraquinone derivatives	Astringent, laxative, cathartic, febrifuge, purgative, rheumatism, skin diseases
37	*Catunaregam spiniosum* (Thunb..) Tiruvengadum Rubiaceae	Katra/ Mlankara	Moist and dry mixed deciduous forests	Bark, fruit	Essential oil saponin, acid resin	Astringent, anthelminthic abortifacient, aphrodisiac. antipyretic, ulcer, leprosy
38	*Celastrus paniculatus* Willd.; Celastraceae	Kilitheenipanji	Dry and moist mixed deciduous forests	Bark, seed	Celastrine, Paniculatine	Abortifacient, emmenagogue diuretic, rheumatism, leprosy, Asthma, memory enhancer
39	*Centella asiatica* (L.) Urban; Apiaceae	Kudakan/ Kudangal	In wet marshy places throughout the plains and also in secondary forests	Whole plant, leaf	Asiaticoside, hydrocotvline	Alterative, memory enhancer, brain tonic. Leprosy, skin diseases, tuberculosis
40	*Cinnamomum verum* Presl.; Lauraceae	Karuva/ Vayana	Evergreen forests	Bark	Essential oil, eugenol,	Aromatic, astringent ,nausea stomachic; carminative, □iarrhea, heart diseases
41	*Cissampelos pareira* L. Menispermaceae	Malathangi	Moist mixed deciduous forests and scrub jungles	Root, leaf	Scepeerine berberine, cissampeline	Diuretic, purgative, stomachic, antidiarrhoeal
42	*Clerodendrum viscosum* Vent.; Verbenaceae	Peruku	In plains and degraded forest areas and plantations	Leaf, flower, root	Clerodin	Vermifuge, antimalarial; tumors, skin diseases, antidote for snakebite/ scorpion sting
43	*Clitoria* ternatea L. Papilionaceae	Sankupshpam	Moist mixed deciduous forests, also cultivated in home gardens	Whole plant, root, root bark, seed	Fixed oil, tannins resins	Purgative, cathartic, diuretic, laxative;antidote to snake bite

44	*Coscinium fenestratum* (Gaertn.) Colebr. Menispermaceae	Maramanjal	Evergreen forests	Root, wood, bark	Berberine, saponin	Bitter tonic, stomachic ophthalmia, antidote snake poison, diabetes
45	*Curculig orchioides* Gaertn;.Liliaceae	Nilappana	Semi-evergreen, moist deciduous forests and high altitude grasslands	Rhizome	Alcohol, tannin, starch	Diuretic, aphrodisiac, demulcent; piles jaundice, skin diseases
46	*Curcuma aromatica* Salisb.; Zingiberacea	Kasthurimanjal	Cultivated	Rhizome	Essential oil	Tonic, carminative, scabies, eruption of small pox, improving skin complexion
47	*Curcuma* longa L. Zingiberaceae	Manjal	Cultivated, very rare in wild	Rhizome	Curcumine, essential oil	Antiseptic, anthelminthic carminative, sprains and wounds
48	*Curcuma zedoaria* (Christm.) Rose. Zingiberaceae	Kachuri-kizhangu,	Cultivated and naturalized	Rhizome	Essential oil	Stomachic, diuretic, stimulant antiseptic, carminative
49	*Cuscuta reflexa* Roxb. Convolvulaceae	Akasavalli/ Moodillathali	In the plains, mostly in dry mixed deciduous forests and scrub jungles	Stem, seed	Cuscutin, cuscutalin	Carminative, anthelminthic alterative, purgative; fever
50	*Cyclea peltata* (Lam.) Hook. f.& Thoms. Menispermaceae	Padakizhangu/ Padathali	Dry and moist mixed deciduous forests and scrub jungles	Leaf, root	d-Tetradrine, dl-Tetradrine iso-chondrodendrine	Sedative, antipyretic, acitidy, enteric; jaundice. asthma
51	*Cynodon dactylon* (L.) Pers.; Poaceae	Karuka	Forest plantations and openings in all forest types	Whole plant, root	Digestive nutrients, proteins & hydrocyanic acid	Diuretic, intiseptic, astringent, antidiarrhoeal, venereal diseases
52	*Desmodium gangeticum* (L.). DC. Papilionaceae	Orila	Evergreen and moist mixed deciduous forests	Root	-	Astringent, diuretic, fever, antidiarrhoeal, biliousness, cough, vomiting, asthma
53	*Dioscorea bulbifera.* L.; Dioscoreaceae	Kattukachil	Semi-evergreen and moist mixed deciduous forests	Stem tuber	Poisonous glucosides	Aphrodisiac, stomachic, piles, anthelminthic, expectorant; syphilis, ulcers

54	*Eclipta prostrata* (L.) L. Asteraceae	Kayonni	Wet, marshy places in the plains, mostly as a weed	Whole plant, leaf, root	Ecliptine	Tonic, deobsturent in hepatic and spleen enlargements,
55.	*Elettaria cardamomum* (L.) Maton; Zingiberaceae	Elam	Evergreen forests above 800m; cultivated	Seed	Essential oil	Purgative, antiseptic, jaundice Aromatic, stomachic, diuretic, carminative, antibacterial
56	*Embelia ribes* Burm.f. Myrsinaceae	Vizhal	Low and high altitude evergreen forests	Dried fruit, root, seed	Embelic acid, christembine	Vermifuge, astringent antibacterial, fever
57	*Embelia tsjeriam cottam* (Roem. ex Schult) DC. Myrsinaceae	Vizhalari	Dry and moist mixed deciduous forests	Fruit, dried bark of root	Embelin	Antispasmodic, carminative, anthelmintic, piles, toothache
58	*Entada phaseoloides* (L.) Merr.; Mimosaceae	Malamanchadi	Evergreen and semi-evergreen forests	Stem, bark, seed	Saponin, glucosides alkaloids	Antiinflamatory, ulcers and post natal treatment
59	*Evolvulus alsinoides* (L.) L.; Convolvulaccae	Vishnukranti	Common in open and grassy places	Whole plant, leaf	Alkaloid	Tonic, febrifuge, antidysentric anthelminthic
60	*Ficus benghalensis* L. Moraccae	Peral	Mostly planted, occasionally wild in secondary forests	Latex, bark, leaf, seed	-	Astringent, antidysenteric, antidiarrhoeal, antidiabetic
61	*Ficus microcarpa* L,*f.* Moraceae	Ithi	Semi-evergreen and moist mixed deciduous forests	Leaf, root	-	Stomachic, aperient, fever
62	*Ficus racemosa* L. Moraceac	Athi	Semi-evergreen and moist mixed deciduous forests	Bark, root, leaf, fruit, latex	-	Astringent, antidiabetic, antidysenteric
63	*Ficus religiosa* L. Moraceae	Arayal	Often planted in temples or as an avenue tree	Bark, fruit, seed, leaf	-	Astringent, laxative, cooling, alterative, purgative, scabies
64	*Garcinia gummigutta* (L.). Robs; Clusiaceae	Kodampuli	Tropical evergreen forests.	Fruit	2, hydroxycitric acid, resin	Antiseptic, purgative, piles rheumatism, bowel complaint
65	*Gloriosa superba* L. Liliaceae	Menthonni	Semi-evergreen, dry and moist mixed deciduous forests and scrub jungles	Root	Superbine, gloriosine, colchicine	Purgative, anthelminthic gonorrhoea, leprosy, antidote for snake/scorpion

66	*Gmelina arborea* Roxb. Verbenaceae	Kumizhu	Semi-evergreen and moist mixed deciduous forests	Leaf		Demulcent, gonorrhoea, cough and ulcers
67	*Gymnea sylvestre* (Retz.) Roem.; Asclepiadaceae	Chakkarakolli	Moist mixed deciduous forests	Leaf	Gymnemic acid	Antidiabetic
68	*Helicteres isora* L. Sterculiaceae	Idamipiri-valampiri	Semi-evergreen and moist mixed deciduous forests	Bark, fruit, root	Phytosterol, saponin	Antidysenteric, scabies antidiarrhoeal, antiinflamatory
69	*Hemidesmus indicus* (Wilid.) Schultes Asclepiadaceae	Narunandi/ Nannari	Dry and moist mixed deciduous and semi-evergreen forests	Root	Essential oils, saponins	Demuleent, diuretic; fever, skin diseases, rheumatism, syphilis Leucorrhoea
70	*Heracleum candolleanum* Gamble; Apiaceae	Chittelam	Montane grasslands above 1000 m	Seed, rhizome	-	Expectorant, rheumatism, sedative, breathing troubles
71	*Holarrhena pubescens* (Buch-Ham.) G. Don f. Apocynaceae	Kudakappala	Moist mixed deciduous forests and secondary forests	Stem bark, seed	Conessine, holarrhimine	Astringent, febrifuge, antidysenteric, anthelminthi
72	*Holoptelia integrifolia* (Roxb.) Planch; Ulmaceae	Aaval	Evergreen forests	Bark	Fatty oil	Rheumatism, swellings
73	*Holostemma adakodien* (Roxb.) Schum.; Asclepiadaceae	Adapathiyan	Dry or moist mixed deciduous forests	Root	-	Tonic, aphrodisiac, diabetes ophthalmia, spermatorrhoea
74	*Hydnocarpus macrocarpa* (Bedd.) Warb Flacourtiaceae	Malankurnmatti/ Vellanangu	Evergreen and semi-evergreen forests	Seed	Oil	Skin diseases
75	*Ipomoea pes-tigridis* L. Convolvulaceae	Pulichuvadi	Grasslands and open places	Root	Resin	Purgative, boils & carbuncle
76	*Ixora coccinea* L. Rubiaceae	Chethi	Evergreen and semi-evergreen forests, also in cultivation	Flower	Acrid aroimatic oil, tannin, fatty acids	Dysentery, dysmenorrhoea

77	**Janakia arayalpathra* Joseph. et Chandras. Periplocaceae	Amrithapala	Evergreen forests at hill tops	Tuberous roots	Milky latex	Anti ulcer, jaundice
78	*Kaempferia galanga* L. Zingiberaceae	Kacholam	Cultivated, very scarce in wild	Rhizome	Essential oil	Stimulant, diuretic carminative, expectorant
79	*Luffa acutangula* (L.) Roxb. Cucurbitaceae	Puichenga	Cultivated and naturalized	Fruit, seed	Cucurbitacin B, D, G & H, oleanolic acid	Laxative, purgative skin diseases, asthma, spleen disorders
80	*Madhuca indica* Gmel. Sapotaceae	Ilippa	Evergreen and semi-evergreen forests	Flower, bark	Saponin	Astringent, tonic, piles, apetizer
81	*Madhuca longifolia* (Koenig) Mc. Bride; Sapotaccae	Nattilippa	Evergreen and semi-evergreen forests	Bark, flower, seeds gummy juice	Poisonous saponin, essential oil	Antipruritic, laxative, anthelminthic, rheumatism
82	*Mallotus philippensis* (Lam.) Muell-Arg.; Euphorbiaccae	Kurangu-manjal	Moist mixed deciduous forests, semi-evergreen forests	Leaf, glands and hairs of fruit	Rottlerin, isolottlerine, resin, wax	Apetizer, antiseptic, anthelminthic
83	*Mesua ferrea* L. Clusiaceae	Nagamaram/ Churuli/ Nanku	Evergreen forests	Flower, fruit, leaf	Essential oil	Astringent, stomachic, sudorific, antidote for snake poison, antidysenteric
84	*Moringa oleifera* Lam. Moringaceae	Muringa	Cultivated	Root, root bark, stem bark, fruit, flower, seed oil	Moringine, moringinine	Stimulant, aphrodisiac abortifacient, cardiac & circulatory tonic, sedative, hepatic & spleen disorder, rheumatism, dental caries, venereal diseases
85	*Murraya koenigii* (L.) Sprengel; Rutaccae	Curryvepu	Often cultivated in home garden	Stem bark, root, leaf	Koenigin, essential oil	Stomachic, antidysenteric, febrifuge
86	*Myristica malabarica* Lam. Myristicaceae	Kattujathi	Evergreen forests, Myristica swamps	Seed	Essential oil	Analgesic, indolent, ulcers
87	*Nelumbo nucifera* Gaertn. Nelumbonaceae	Thamara	Fresh water bodies	Flower, seed, root, leaf	Nelumbine	All parts cooling, astringent anthelminthic, cardiac tonic, leprosy & other skin diseases

88	**Nilgirianthus ciliatus* (Nees) syn. Bremek; Acanthaceae	Karim-kurinji	Tropical evergreen forests	Leaf, root, seed, bark		Diuretic, gout, lumbago pain killer, dropsy, rheumatism, gonorrhoea, spermatorrhoea
89	*Ocimum basilicum* L. Lamiaceae	Thrithavu	Often cultivated in gardens	Flower, seed, root, leaf	Essential oil containing linalool & traces of eugenol	Carminative, diuretic, antidysenteric, stomachic antidiarrhoeal
90	*Ocimum tenuiflorum* L. Lamiaceae	Tulasi	Cultivated and naturalized	Leaf, seed, root whole plant	Essential oil containing eugenol, carvone, methyl chavicol, caryophyllene,	Diaphoretic, expectorant, stomachic, bronchitis, catarrh, hepatic disorders
91	*Operculina turpethum* (L.) Silva; Convolvulaceae	Trikolpa-konna	Grasslands and waste places	Root, flower	Turpethin, glycosidic resin	Purgative, antibacterial, antidote for snakebite/ scorpion sting
92	*Oroxylum indicum* (L.) Benth, ex Kurz; Bignoniaceae	Palaka-payyani	Evergreen and moist mixed deciduous forest above 600 m.	Bark, fruit, seed	Oroxvlin	Astringent, tonic, rheumatism antidiarrhoeal, atitidysente
93	*Oxalis corniculata* L. Oxalidaccae	Puliyarila	Wet, marshy places in the plains and hills	Leaf, whole plant	Acid potassium oxalate	Cooling, refrigerent, stomachic, scurvy
94	*Phyllanthus emblica* L. Euphorbiaceae	Nelli	Dry and moist mixed deciduous forests	Fruit	Vitamin C	Refrigerent, diuretic, laxative antidysenteric, antidiarrhoeal, Antiinflamatory, asthma, bronchitis, jaundice,dyspepsia
95	*Phyllanthus fraternus* Webster; Euphorbiaceae	Kizharnelli	Common in the plains and moist mixed deciduous forests	Whole plant, leaf, root	Phyllanthin, hypophyllanthin,	Diuretic, genito-urinal and hepatic disorders (jaundice)
96	*Piper longum* L. Piperaceae	Thippali	Evergreen, semi-evergreen and moist mixed deciduous forests	Dried unripe fruit, root	Piperine, pipula triacontane, dihydro stigmasterol	Pungent, aphrodisiac, laxative, stomachic, cough bronchitis, carminative

97	*Piper nigrum* L. Piperacacae	Kurumulaku	Evergreen and semi-evergreen forests; cultivated and wild	Fruit	Piperine,chavicine	Aromatic, stimulant, fever, stomachic, sore throat, piles
98	*Plumbago zeylanica* L. Plumbaginaceae	Velutlia koduveli	Dry mixed deciduous forest and also in cultivation	Root, root bark	Plumbagin	Anticancerous, antibacterial antifungal, piles, skin diseases
99	*Pongamia pinnata* (L.) Pierre Papilionaceac	Ungu, Pongu	Semi-evergreen forest, and also planted as avenue tree	Seed, bark, leaf fruit	Karanjin, Pongamol, glabrin	Piles, ulcers, urinary diseases, blood purifier
100	*Quisqualis indica* L. Combretaceae	Rangoon--valli	Scrub jungles, highly naturalized	Seed	Quisqualic acid	Anthelminthic
101	*Rauvolfia serpentina* (L.) Benth. ex Kurz., Apocynaceae	Sarpagandhi	Moist mixed deciduous forests	Root, leaf	Ajmalicine, reserpine Rescinnamine	Circulatory disorders, antihypertensive, tranquilizer
102	*Rubia cordifolia* L. Rubiaceae	Maiichatti	Semi-evergreen and moist mixed deciduous forests	Root	Manjustin	Tonic, alterative, astringent, antidote to cobra venom, scorpion sting
103	*Salacia reticulata* Wight Hippocrataceae	Ekanayakam		Root bark		Diabetes, gonorrhoea, rheumatism & skin disease
104	*Santalum* album L. Santalaceae	Chandanam	Dry mixed deciduous forests	Wood, bark	Oil from heartwood santalenes, betulic acid B-setosterol, fatty oil, triterpenoid from bark	Cooling, alexiteric, antipyretic aphrodisiac, diaphoretic, skin diseases, headache, urithritis
105	*Saraca asoca* (Roxb.) Willd. Ceasalpiniaceae	Asokam	Occasional in evergreen forests; cultivated	Bark, flower	Tannin-catechol	Anti inflammatory, antidiabetic menstrual disorders, piles, leucorrhoea, scabies
106	*Semicarpus anacardium* L.*f.* Anacardiaceae	Alakku-cheru	Moist mixed deciduous forests	Nut, bark	Anacardic acid, cardol, catechol, anacardol	Vermifuge, rheumatism, venereal and skin diseases
107	*Sida* cordifolia L. Malvaceae	Valiya-kurumthotti	Dry mixed deciduous forests and secondary forests	Root bark, seed whole plant	Alkaloid identical to ephedrine	Spermatorrhoea, dysentery, gonorrhoea, tetanus, facial Paralysis, leucorrhoea
108	*Spilanthes calva* DC. svn. *S. acmella* auct. non (Linn) Murr.; Asteraceae	Kuppa-manjal	In wet areas of plains and waste places	Flower, seed	Spilanthol, sterol	Pungent, toothache, salivation, anaesthetic for stammering in children

109	*Stereospermum colaris* (Dill.) Mabb.; Bignoniaceae	Pathiri	Moist mixed deciduous forests, up to 1300 m altitude	Root, leaf, flower		Febrifuge
110	*Strychnos nuxvomica* L. Loganiaceae	Kanjiram	Moist and dry mixed deciduous forests	Root bark, leaf, seed, wood	Strychnine, brucine, loganin	Nervine tonic, stimulant, ulcers, epilepsy, dysenteric, fever, dyspepsia, colii (Poisonous in excess doses)
111	*Terimnalia arjuna* W. & A. Combretaceae	Neer-maruthu	Evergreen forests; mostly on the banks of rivers and streams	Leaf, bark, fruit essential oil	Arjunine	Cardiac tonic, heart diseases
112	*Terininalia bellerica* (Gaertn.) Roxb.; Combretaceae	Thanni	Evergreen and semi-evergreen forests	Fruit	Tannin	Bitter, astringent, laxative, antipyretic, purgative, piles, diarrhoea, biliousness
113	*Teminalia chebula* Retz.. Combretaccae	Kadukka	Evergreen, semi-evergreen forests	Fruit, bark	Chebulinic acid	Astringent, laxative, diuretic, alterative, cardiac tonic; antiseptic, ulcers, dental caries
114	*Tinospora cordi,folia* (Wilid.) Miers ex Hook.f. & Thoms. Menispermaceae	Chittamruth	Semi-evergreen and moist mixed deciduous forests	Whole plant, fruit	Beriberine	Diabetes, rheumatism, jaundice, general disabilities
115	*Toddalia asiatica* (L.) Lam. Rutaccae	Kakatodaii	All types of forests	Root bark	Essential oil, beriberine	Tonic, stimulant, antipyretic
116	*Tribulus terrestris* L. Zygophyllaceae	Njerinjil	Dry mixed deciduous forests and in the plains	Fruit	Alkaloid, essential oil, resin	Diuretic, aphrodisiac, urinary & kidney disorders
117	*Trichopus zeylanicus* ssp.. *travancoricus* Burk. ex. Narayanan; Trichopodaccae	Arogya-pacha	Moist mixed deciduous and evergreen forests whole plant	Tender fruit,		Antifatigue, immunostimulant
118	*Trichosanthes cucumeriana* L. Cucurbitaceae	Kattu-padavalam	Moist mixed deciduous and evergreen forests	Leaf, stem, root, fruit	Fatty acids	Febrifuge, cardiac tonic, antipyretic, anthelminthic, bilious disorders
119	*Tylophora indica* (Burm. *f.*) Asclepiadaceae	Vallippala	Evergreen and semi-evergreen forests	Leaf	Tylophorine, tylophorinine	Emetic, expectorant anti-asthmatic

120	*Vanda tessellate* (Roxb.) Hook.f. ex G.Don Orchidaceae	Maravazha	Epiphytic on evergreen forest trees	Root, leaf		Rheumatism and allied nervous disorders
121	*Vciteria indica* L, Dipterocarpaceac	Payani, Vellapayin	Evergreen, semi-evergreen forests	Fruit, bark	Essential oil, resin (damar resin)	Tonic, carminative, cough antibacterial, anaemia, ear disorders, leprosy, diarrhoea, rheumatism
122	*Vetiveria zizanioides* (L.) Nash; Poaceae	Ramacham	Grasslands, dry mixed deciduous forests	Root	Essential oil, sesquiterpene	Refrigerant, febrifuge, diaphoretic, stimulant, stomachic, anthelminthic, emmenagogue, fever
123	*Withania somnifera* Dunal Solanaceae	Ashwa-gandha	Cultivated	Root, leaf, fruit, seed	Withanaloid	Diuretic, alterative, narcotic, Abortifacient, rheumatism
124	*Zingiber officinale* Rosc. Zingiberaceae	Inji	Cultivated, very rarely in wild	Rhizome	Essential oil with camphene, zingiberine β phellandrine	Stimulant, carminative; dyspepsia, flatulent colic
125	*Zingiber* zerumbet Rosc. ex Smith; Zingiberaceae	Kattinji	Moist mixed deciduous and evergreen forests	Rhizome	Essential oil, volatile oil containing citral, zingiberine	As of *Z. ofticinale*
126	*Zizyphus mauritiana* Lam. Rhamnaceae	Elantha	Dry mixed deciduous forests	Leaf, fruit, root bark		Antidiarrhoeal, antiseptic antipyretic
127	*Zizyphus oenoplea* (L.) Miller Rhamnaceae	Vantudali, Kottavalli	Dry and moist mixed deciduous forests	Root, bark, fruit		Antiseptic, fruit used as an ingredient of stomachache pills

Annexure II
LIST OF PARTICIPANTS

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Annexure III
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28	Sri. Alumthara Krishnan Pillai & Sri. S. Shivaprasad	Rangaprabhath, Venjaramoodu	9447903291 0472-2820355
29	Sri. Biju Prabhakar	Director, Edusat, Trivandrum	

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3	Dr. Satheesh Chandran Nair,	Environmental Activist, Trivandrum	
4	Er. Jose Ebenizer	Asst. Executive Engineer, Training Centre, KSEB,Chackai	9447133530