MSCBOT-608

M.Sc. IV Semester

ETHNOBOTANY




DEPARTMENT OF BOTANY
SCHOOL OF SCIENCES
UTTARAKHAND OPEN UNIVERSITY

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UNIT-1 ETHNOBOTANY: CONCEPT AND SCOPE

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1.1 OBJECTIVES

After going through this unit student will be able to-

- Define the ethnobotany and discuss the scope of the subject area covered by this discipline.
- to understand about the concept of Ethnobotany
- Discuss the historic roots of ethnobotany
- Discuss the role, importance and contribution of ethnomedicine, ethnopharmacology, ethnoecology, ethnogynaecology, ethnomycology, etc., in our modern civilization.

1.2 INTRODUCTION

Ethnobotany is the study of traditional plant used by indigenous people. Knowledge of ethnobotany is very ancient. It provides details on the traditional uses of plant resources that can be practiced to integrated tribal development. Stephen Powers in 1873 first coined the word “Aboriginal Botany” and explained in the form of simple definition as the “study of vegetation used by aboriginals for their various commodities such as food, shelter, medicine, textiles, ornaments, etc”. Based on this concept, the term "ethnobotany" was first used in 1895 by John William Harshberger, a botanist at the University of Pennsylvania, to refer to the use of plants by indigenous people. Since then, it has been defined as the traditional knowledge of indigenous communities, about surrounding plant diversity and how various individuals make use of indigenous plants located in their localities. The word is derived from the terms "ethno" the study of people and "botany" for the study of plants. Ethnobotany deals with the direct relationship of plants with man.

Ethnobotany is the scientific study of cultural practices and traditional knowledge in relation to religious, medicinal, and other uses of plants. Through years of consistent practice, one gains knowledge about using plants as medicine. The tribal people are the main repositories of traditional knowledge regarding the various applications of plants. The locals and traditional healers verbally transmitted their knowledge and beliefs about plants to generation after generation. The terms ethnobotany and traditional medicine are not similar. Traditional medicine's early roots must have been in ethnobotanical folklore, but it now includes a number of well-organized, unique systems of diagnosis and treatment. Ayurveda, Siddha, and Unani are the three traditional medical systems that are acknowledged in India. The study of foods, fibres, dyes, tans, other beneficial and harmful plants, taboos, avoidances, and even magicalo-religious beliefs about plants are all included in ethnobotany.
The term "ethno botany" has been given many different definitions, but the fundamental idea has remained largely the same and its application is increasing day by day.

According to Schultes (1962), ethno botany is referred to as the study of the relationships between the people of a primitive society and plants.
Alcom (1984) states that ethno botany is the study of contextualized plant use.
Jain (1987) elaborated it as the total natural and traditional relationship and interaction between man and his surrounding plant wealth.
Recently, Wickens (1990) defined Ethnobotany as the study of useful plants before they are commercially exploited and domesticated. In fact, ethno botany is the earliest plant knowledge that primitive and aboriginal people had acquired by sheer necessity, intuition, observation and experimentation in the forests.

Modern definition by Nancy Turner in1996, “Ethnobotany is the Science of people’s interactions with plants”.

Ethnobotany is the systematic study of human-plant interactions. It is not only the study of human "use" of plants; rather, ethnobotany places plants within their cultural context in specific communities, and peoples within their natural environment.

The ethnobotanical studies shed light on several unidentified useful plants as well as novel applications for many well-known plants that can be used to create new markets for certain plant-based products and agro-based industries. The direct or natural relationship between man and plants is now almost universally acknowledged. This includes the use of plants by both tribal and non-tribal people without any reference to developing or primitive societies. A multidisciplinary field of study, ethnobotany has applications in sociology, anthropology, taxonomy, photochemistry, archaeology, ecology, agriculture, medicine, linguistics, and other fields.

In the modern era, ethnobotany has grown to be an important and essential area of study and development in resource management, sustainable use, biodiversity conservation, and socioeconomic development. Botanists, social scientists, anthropologists, and practitioners of traditional medicines from all over the world are currently researching how people interact with plants in their natural environments.

This man-plant relationship can be broadly classified into two groups, viz. **(a) Abstract** and **(b) Concrete.**
(a) Abstract: The abstract relationship between man and plants includes folklore, taboos, avoidances, sacred plants, worship, and belief in the positive or negative properties of various plants. Folklore also includes similes and metaphors based on plants, in addition to fables, verses, and other references to plants.

(b) Concrete: The use of plants in fine arts and culture, such as paintings, carvings, and home decoration, as well as acts of domestication, conservation, improvement, or destruction, constitute the concrete relationship. Other domestic uses include food production, medicine, house construction, agricultural operations, trade, and exchange.

1.3 HISTORY OF ETHNOBOTANY

For hundreds of years, people have been fascinated by plants because of their medicinal benefits. Humans first became interested in plants out of a desire for food, shelter, and protection. Then he looked for treatments for injuries and illnesses among them. Medication science arose as a result of this. Plants have been utilised for health care by all civilizations and cultures. However, Indian and Chinese civilizations were even more developed during the middle Ages. Plants have been used for organised health care programmes for over 5000 years in India and China.

According to Rigveda, man learned to distinguish food plants from toxic plants by observing observant animals that track completely distinct plants. He gradually cultivated various wild plants to satisfy his fundamental needs. Domestication and large-scale cultivation were the outcome of identifying each plant's numerous possible uses. It was also the outcome of the constant man plant in the past (Pie *et. al*.).
A tablet listing doctor's prescriptions from about 3,000 B.C. and copies of ancient Egyptian records from 1550 B.C. are the first evidence of plants being used for medicinal purposes in the Western tradition. The systematic study of plants for medical purposes has a long history in the West, with roots in the cultures of the ancient Greeks, Romans, and Islamic foundation.

According to this tradition, the first person to make an effort to organize all of the plant knowledge that was at the time known to the Greek world was Dioscorides. In AD 77, the Greek surgeon Dioscorides published "*De Materia Medica*", which was a catalog of about 600 plants in the Mediterranean. It also included information on how the Greeks used the plants, especially for medicinal purposes. For the next 1,500 years, the work of Dioscorides acted as the standard reference on medicinal plants and the newly developed field of folk pharmacology in the West. Instead of using a nomenclature based on a plant, animal, or mineral, his method of organization involved grouping medicinal remedies according to the nature and source of the illness and the remedy itself.

In 1542 Leonhart Fuchs, a Renaissance artist, led the way back into the field. His "*De Historia Stirpium*" cataloged 400 plants native to Germany and Austria. John Ray (1686-1704) provided the first definition of "species" in his "*Historia Plantarum*": a species is a set of individuals who give rise through reproduction to new individuals similar to themselves.

In 1753 Carl Linnaeus wrote "*Species Plantarum*", which included information on about 5,900 plants. Linnaeus is famous for inventing the binomial method of nomenclature, in which all species get a two part name (genus, species).

Ethnomedicinal science has its origins in ancient India. This science originated in the Asian nation. In India, a brief relevance documented knowledge on the healing assets of 99 plants can be dated back to the Vedic period, which lasted from 3500 to 1800 BC. Ancient Indian Sanskrit literature like the Rigveda, Atharvaveda, Upanishads (ca 1000–600 BC), Mahabharata, and Puranas (ca 700–400 BC), among others, mention a variety of uses for plants. These ancient sources give useful information about Ethnomedicinal plants. The sacred Vedas, which include the "Rigveda" (1400-1800 BC) and the "Atharvaveda" (4500-2500 BC). In two Vedic periods, a list of some of the most notable Indian treatises is presented. There are 148 medicinal plants from the Rigveda and Atharvaveda. Then came the two most important works of the Indian treatment system: Charak and Susurk's work, Charak Vedic literature and Sushurta Vedic literature. There are 400-450 medicinal plants mentioned in Charak Vedic literature. "Vruksha Ayurveda" is the most ancient. Parasara wrote a book about the science of medicinal plants called "Vrikshayurveda." These include plants that are used for agricultural tools, food, fuel, and medicines. The functions of various Rudraksha (*Elaeocarpus ganitrus*) varieties in Lakshmipuran and Shivapuran deserve special attention. Sushruta Samhita (circa 500 BC), Charaka Samhita (ca 100 AD), and Ashtanga Hridaya Samhita (ca 200 AD) all mention the uses of about 1200 plant drugs, as well as their actions and specific therapeutic applications. There are many more references of plants are reported, but their identities have not yet been acknowledged. Manuscripts written on palm leaves contain information about additional plant-based medical traditions with roots in Buddhism.

Three traditional medical systems that acknowledged in India are Ayurveda, Siddha, and Unani.

(A) Ayurveda: Ayurveda is a complete scientific medicinal system that originated in India. The name writing suggests "info of life," which includes two Indo-Aryan terms, Ayu (life) and Veda (info of science). The four Vedas, regarded to be the earliest Indian literature (5000-1000 BC), contain knowledge on natural cures. Sushruta Vedic literature (which focuses on surgery) and Charaka Vedic literature (which focuses on internal medicine) were composed systematically and are considered classical works of writing. The most important data from Charaka Vedic literature and Sushurta Vedic literature was collected and updated in Astanga Sangraha and Astanga Hrdaya. Other ancient classics include Madhava Nidana (which focuses on ailment identification), Bhava Prakash (which focuses on further information about plants and food), and Sarngadhara Vedic literature (which focuses on formulation and measure from).
Ayurveda was divided into eight major clinical subdivision- Kayacikitsa (internal medicine), Shalya Tantra (Surgery), Salakya (disease of on top of clavicular origin), Kaumarabhrtya (paediatric medicine, OB and Gynaecology), Bhuta Vidya (psychiatry), Agada Tantra

(toxicology), Rasayana Tantra (rejuvenation and geriatrics), Vajikarana (aphrodisiac dazed and eugenics). Mafuva *et al*. (2014).

(B) Siddha: The Siddha system of medication is regarded as a magnificent activity and picture of Tamil culture, which developed in the southern and central areas of India. Siddha medicine originated in Dravidian culture and flourished during the Indus depression civilisation. Chinese alchemy, Taoism, and Taoist geophysics are regarded as the primary sources of inspiration for Siddha alchemy. The system is thought to have been developed in the past by eighteen siddhar (a class of Tamil sages). Though the Siddha system of medication is similar to writing in many ways, it has its own philosophy and thinking, holistic approach, and life style homeward measures (Tiwari *et al*., 1997).

(C) Unani: The Unani system of medication is a combination of ancient medicine systems from Egypt, Syria, Iran, China, Bharat, and a number of other east countries. It originated in the Balkan state and spread to the Arabian Peninsula. Unani medicine was introduced to Bharat by Arab and Persian settlers in the eleventh century, and the system gained popularity and expanded during Mughal rule. (Ansari *et al.*, 2006).

Indian Systems of Medicine (ISM): Although Ayurveda, Siddha, and Unani are the traditional medical systems in India, the government of India established AYUSH (Department of Ayurveda, Yoga and Naturopathy, Unani, Siddha, and Homoeopathy) in March 1995 as the Department of Indian Systems of Medicines and Homoeopathy in the Ministry of Health and Family Welfare.

Plants were the primary therapeutic agents utilised by humans until the mid-nineteenth century, and their function in pharmaceuticals is still relevant today. Public institutions such as the World Health Organisation and private pharmaceutical companies have begun to demand participation in ethnobotanical expeditions. The use of historical documents is essential for providing information that indicates the relationship between people and also the environment in the past. The discovery or retrieval of knowledge from manuscripts, books, or other sources supports a series of plant utilisation development, as an example within the problem of disease concept and cultural forms.

Sir Villium John's first wrote a book "Botanical observation on select plant". In 1810, John Fleming wpublished his book "Catalog of medicinal plants". In 1813 Against published a book "Materia Medica of Hindustan". In 1820 Roxburgh wrote a book titled "Flora Indica". In 1863 Dr. Dimak was printed a book name "Materia Medica of Western India". In 1868 Carrying printed a book "Farmacopeea India". In 1869 Dr. Mohiuddin Sarif printed a book "Supplement to the Farmacopeea of Indica". In 1895 Sir Joyerg Wott (Britisher) write a book and printed a

book “Dictionary of economic product of India”. From now on “endemic medicine of India” written by Kaneyala Dave and “Indigenous drugs of India” written by R.N.Chopra.

Kartika and Basu (1935) popularised Indian medicinal herbs. Chopra's gloss of Indian medicinal plants contains 1775 plants, and a few others contain over 3500 medicinal plants. Thus, our recent gift day data of Indian pharmacological medication accounts of around 3500 species of endemic and exotic crude medicine. The first book on Indian ethnobotany was “A Glimpse of Indian Ethnobotany” (Jain 1981).
Richard Evans Schultes, often referred to as the "**Father of Ethnobotany**”.
Dr. **Sudhanshu Kumar Jain** [**Dr. S. K. Jain**] in 1986 from NBRI Lucknow is known as “Father of Indian Ethnobotany” for his pioneering work in India.

1.4 CONCEPT OF ETHNOBOTANY

Ethnobotany is the scientific study of how people and plants interact. It describes and explain the complex relationships between cultures and uses of plants, with a focus on how various human societies use, manage, and view plants, for example, as foods, medicines, cosmetics, dyes, textiles, construction, tools, currency, clothing, in literature, rituals, and social life.

Ethnobotany has gained new significance and a new level of understanding as modern civilization has come to recognize the value of all plant-based products, including medicines, in daily life. The contribution of all early humans who used those specific plants to fulfill their hunger, heals their wounds, and learns about and evaluate the utility of various plants through frequent experimentation. It also takes into account the occasional harm done to people who unintentionally use poisonous plant parts. The four terms people, plants, relations, and uses can be computed to define ethnobotany.
It is the branch of science that studies "the interaction between a particular society and its surroundings, particularly the plant world. Current ethnobotanical studies among tribal populations have brought new information to the fore, which can be used to prepare the systematic collection of forest products and place in cottage industries, primarily of herbal drugs, to develop the economy of the tribes. The study of herbal remedies and medicines derived from plants, animals, or minerals and used to treat various diseases is known as ethnomedicine. It deals with information about social adaptability, unusual behaviour, disease, medical taxonomy, folk medical knowledge, and medical care systems.
The conservation of nature, culture, biological diversity, and the variety of traditional human cultures around the world is greatly helped by ethnobotany. It is Multidisciplinary science. The field of ethnobotany as it exists today is interdisciplinary, bringing together experts from various fields including botany, economics, landscape architecture, archaeology, geography, medicine, linguistics, anthropology, and pharmacology. These primarily consist of all forms of traditional knowledge and utilize plants in the production of items like food, fuel, clothing, medicines, dyes,

narcotics, stimulants, perfumes, various types of oil, cooking, papers, rubber, fibres, and decorations. The location and preservation of endangered and threatened plant species has also benefited from ethnobotanical surveys. Generally, wild plants are referred to as weeds and are considered undesirable and useless plant species. Ayurveda, on the other hand, stated that "No plant of this world is useless." Many different plants are used in Ayurvedic medicine to treat a wide range of illnesses, including Alzheimer's disease, AIDS, cancer, depression, nervous disorders, diabetes, digestive system diseases, genetic disorders, rheumatism, leprosy, skin diseases, liver diseases, malaria, and paralysis. Poor people living in rural and forest areas, where access to modern medical facilities is very difficult, depend mainly on wild plants for treatment. In various regions of India, the local population uses traditional medicines based on locally plants or animals. From the beginning of time, people have used medicinal plants to treat a variety of illnesses. The loss of the gene pool that is the source of many essential medicines today and the depletion of medicinal plants will limit the future potential for the production of natural drugs. In times of food crises, mostly rural communities depend on wild resources, including wild edible plants, to meet their food needs as well as for additional food supplements In order to keep the balance between population growth and agricultural productivity, especially in developing nations, it is recognised that there are many edible wild food plants that may be valuable for humans.

1.5 SCOPE OF ETHNOBOTANY

Ethnobotany is an extremely old scientific field. Several definitions have been attributed to ethnobotany, but its basic idea has not altered much, and the scope of ethnobotany is expanding by the day. It describes the traditional uses of plant resources and how they can be applied to integrated tribal development. Food processing, fibre and floss production, cordage and basketry, and the extraction of edible and non-edible oils, gum, resins, tannin, and dyes for the improvement of tribal communities can all benefit from ethnobotanical studies. These studies also shed light on a number of previously unknown useful plants as well as new applications for a variety of well-known plant sources.

The scope of ethnobotany has now significantly expanded with the development of new great views, both in terms of its theoretical contribution to the understanding of plant-human relationships and tribal people's practical knowledge of industry, agriculture, and medicine. The tribal people depend largely on forest flora to meet their daily needs as well as their basic health care requirements. The ethnobotanical study provides information about the conservation status of plants, such as rare, vulnerable, critically endangered, susceptible, endangered, and invasive weeds, which can be used to develop conservation strategies to lessen the loss of habitat of important species. It also opens the door to research into new drugs and chemical compounds found in plants. A number of works in ethnobotany have been done in recent years all over the world as it opens up conservation factors of most important plants.

The isolation of alkaloids such as morphine, quinine, and other effective drugs from plants in the early nineteenth century began a new era in the use of plant products in modern medicine. In the last thirty years or so, there has been a rise in interest in traditional medicines, ethnomedicine, and drugs derived from plants all over the world. Ethnobotany emerged as a distinct academic branch of natural science in the twentieth century. The scientific study of ethnic plants used by various indigenous peoples known as aboriginal natives, first people, original settlers, aadivasees, Vanya jaati (forest castes), Aadim Jaati (primitive castes), Jan Jaati (folk communities), and tribals has grown in popularity. More than a dozen books and thousands of research publications on ethno botany have been published worldwide.

1. It provides information on traditional uses of plant wealth that can be used in integrated tribal development. Ethnobotany provides information on how plants have been used traditionally; this information can help societies progress.
2. The study of ethnobotany introduces us on lesser-known but valuable plants and guide in understanding of numerous plants that are already familiar to us in different ways.
3. Even today, medicinal plants are almost the primary source of drugs for the majority of the world's population. Plant products account for approximately 25% of all prescribed medicines.
4**.** The ethnomedical data will be a valuable source of knowledge for chemists, pharmacologists, and herbal medicine practitioners for the isolation and detection of bioactive compounds used in contemporary medicine.
5. Prevent the loss of traditional knowledge as a result of modernization's impact.
6. Reduces the time required for the development of new medicines.
7. New food plants are being domesticated.
8. Treatment of various diseases using natural methods.
9. Biodiversity preservation and sustainable use.
10. Studying ethnobotany to make important contributions. For example, the study of indigenous food production and local medicinal knowledge offers the promise of practical implications for developing sustainable agriculture and discovering new medicines.
11-Shifting cultivation also referred to locally as "jhum cultivation," is a common practice among many tribes. In this kind of farming, a patch of land is cleared, crops are planted there, and when the soil loses its fertility after supporting one or two crops, the people move to another area of the forest and continue the process there.
12-For the vast majority of the world's population, medicinal plants serve as a source of medications. This is known as medico-ethno botany. This feature shows the importance of ethnobotany.
13-Over the past few decades, several drugs, including quinine, cocaine, digoxin, and taxol, have been found to be derived from plants in recent years.
14-The understanding of the relationship between plants and society has also led to the recent discovery of some bioactive substances, including artemisinin, gossypol, hypericin, etc.
15-The study of ethnobotany also promotes understanding of the relationship between human and plant interactions, cultural diversity, and biodiversity.

16-Ethnobotany study helps to provide information to administrators and scientists to help them initiate plans for the development and economic growth of tribal areas.

1.6 IMPORTANCE OF ETHNOBOTANY

The ethnobotanical studies shed light on some undiscovered useful plants and new applications for many well-known plants that can be exploited for creating new sources for some plant products and agro-based industries, such as food processing, fibres and floss, cordage and basketry, oil extraction for edible and non-edible products, gum, resins, tannin, and dye extraction for the benefit of tribal communities.

Herbal medicines have long been used by primitive societies in India. In fact, all traditional medical systems have their origins and roots in folk medicine or ethnomedicine. Knowledge of ethno botany is important in the primary health care and economy of our country's tribal and aboriginal populations, and it holds the potential for the discovery of new herbal drugs and sources of nutraceuticals, among other things. The study of ethno botany provides valuable information to scientists, planners, and administrators in the preparation of action plans for tribal economic emancipation and ecological development.

The tribal people primarily rely on forest flora to meet their daily needs. They gather and use a variety of wild plants from their local environment for food, medicine, fibres, oils, gums, tannins, and dyes. Ethno medicinal plants are used by tribal communities to treat diseases and disorders such as diarrhoea, dysentery, fever, headache, skin diseases, boils and blisters, rheumatism and gout, piles jaundice, ophthalmic diseases, toothache, bone fracture, snake bite, helminthic or worm infection, cuts and wounds, cough, cold, asthma, leprosy, and so on. The ethno medicinal data will be a valuable source of information for chemists, pharmacologists, and herbal medicine practitioners to detect and isolate bioactive compounds used in modern medicines. Many such so-called wonder drugs, including reserpine quinine, ephedrine, cocaine, emetine, khelline, colchicine, digitoxin, artemisin, podophyllotoxin' guguhpid, taxol, etc., have been discovered in recent decades from plants with vast ethnobotanical knowledge in tribal societies. The discovery of these plant alkaloids marked a new era in the application of natural plant compounds to modern medicine.

In the last thirty years or so, there has been a revival of interest in traditional medicines and drugs derived from plants all over the world. The roots of *Rauvolfia serpentina,* which has been used for more than a thousand years in Indian folk medicine to treat snake bite insanity, epilepsy, fever, and high blood pressure, have produced the tranquillizers rescinnamine and reserpine. The effectiveness of several phytopharmaceuticals derived from plants, including atropine (a pupil dilater), caffeine (a stimulant), berberin (used to treat gastrointestinal disorders), morphine (analgesic), digitoxin (a cardiac tonic), emetine (antiamoebic), quinine (antimalarial), ephedrine (anti asthmatic), reserpine (tranquillizer), Camptothecin, (antitumour), forskoline (hypotensive

and antispasmodic), vinblastine and Vincnstme (antileukaemic), with a wealth of folklore have been discovered. Several bioactive substances, including hypericine (an antiviral from *Hypericum perforatum*), taxol (an anticancer drug from *Taxus brevifolia*), artemisin (an antimalarial drug from *Artemisia annura*), gossypol (a male contraceptive from *Gossypium* spp.), and yue chukene (an antifertility agent from *Murraya penniculata*), have recently been discovered On the basis of ethnotherapeutic practices used in tribal and indigenous societies, additional efforts are being made in the search for potent herbal medicines.

A wide range of practical aspects of daily living can be investigated through ethnobotany. Plants are most well-known for their medical and alimentary purposes, but they are also utilised as raw materials to manufacture clothing (cotton, linen, etc.), utensils (wicker baskets), and so on. A great deal of information is generated in the immaterial space by the relationship between people and plants (belief, rituals, etc.). Knowledge of popular and traditional plant usage is essential for developing new medications and foods, which will improve the health and nutrition of many populations while also contributing to social and environmental well-being. Ethnobotany is a knowledge transmission from one generation to the next, from one territory to the next, and from one subject of study to the next.

The ethnobotanical inventory, scientists have developed some modern language to analyse traditional knowledge more efficiently and effectively. Some of the terminology that are used in ethnobotanical studies to analyse traditional medicine are as follows:

Traditional Botanical Knowledge (TBK): This reveals the study knowledge held by the non-industrial community. This includes any kind of knowledge, such as plant identification, processing, and management, material culture, and medicine.

Traditional Ecological Knowledge (TEK): It is a subset of indigenous knowledge that contains knowledge and ideas that have been passed down through generations through cultural transmission and are connected to human-environment interactions.

Indigenous Technical Knowledge (ITK): The technical knowledge possessed by traditional farmers, which includes understanding of agricultural plant practises, medicinal plants, plant toxins in pest management, and the application of diverse processing procedures in food preparation.

Modern Ethnobotany

Ethnobotany is now defined as "the study of how people of a particular culture and region make use of indigenous plants" in the most recent definition. Ethnobotany is a rapidly expanding science that attracts people with a wide range of academic backgrounds and interests. It is still primarily associated with Economic Botany, and is thus pursued in order to determine the potential economic value of various plants. The life of an explorer has a romantic allure, with the promise of discovering "gold" in the form of plants or animals as potential sources of lifesaving

drugs that could become important in the treatment of serious diseases such as AIDS and cancer. Plant ethnomedicinal discoveries may open the way for the identification of materials that can be meaningfully analyzed for chemical activity using appropriate biodirected assays. This approach to discovering new pharmaceuticals is woefully underutilized today, to the detriment of human health, and a number of new strategies should be considered for future advances in drug discovery. Native healers are frequently hesitant to accurately share their knowledge with outsiders. In interaction with traditional areas of science, ethnobotany provides several interrelated and interdisciplinary subjects involving aspects such as ethnomedicine, ethnoarchaeology, ethnobryology, ethnoecology, ethnoagriculture, ethnonarcotics, ethnopharmacology, and so on. The ethnobotanical research today is commonly aimed at identifying novel plants with economic potential.

Beginning in the twentieth century, the field of ethnobotany saw a transition from raw data compilation to a broader methodological and conceptual reorientation. Today, ethnobotany demands a wide variety of abilities:
1- ***Botanical training*** for plant specimen's identification and preservation.
2- ***Anthropological training*** is required to learn the cultural principles behind plant perception.
3- ***Linguistic training*** to transcribe local terminology and learn native morphology, syntax, and semantics.

1.5 ETHNOBOTANY AS AN INTERDISCIPLINARY SCIENCE

Ethnobotany is an interdisciplinary field that studies the interaction of plants and humans. In comparison to anthropology, archaeology, or botany, it is a relatively new field. The term economic botany also covers the majority of the field; however, whereas ethnobotany focuses on past and present plant usage; economic botany is also interested in future and commercial uses. The cultural aspects of human-plant interaction are not always regarded as the most important aspect of economic botany, despite being central to ethnobotany. Generally, anthropologists, botanists, and ethnobiologists play an important role in documenting traditional knowledge before it is lost due to cultural assimilation, globalisation, and environmental change. The term "paleoethnobotany" first emerged in the USA in the 1970s with the development of more advanced archaeological techniques; however, this term can lead to some misunderstandings because "paleobotany" includes the study of plant fossils, whereas "paleoethnobotany" is only concerned with how people used plants in the past. The term "ethnobiology" also includes the connections between the biota and both current and previous human societies. There are three main areas of research in this area: economic (how people use plants and animals), cognitive (how people understand and conceptualise plants and animals), and ecological (how people interact with plants and animals, especially in an evolutionary and coevolutionary framework).

Biologists, botanists, agriculturalists, horticulturists, foresters, anthropologists, pharmacists, chemists, archaeologists, historians, and/or economists who want to investigate various aspects of plant use usually combine their special knowledge. Plants and their ecology, as well as their cultural, social, and economic significance, are becoming increasingly popular topics. Although archaeologists are still uncommon in this field, there are many areas of study that ethnoarchaeology, ethnohistory, experimental archaeology, and archaeobotany have in common. Actually, a number of these subdisciplines share common goals, interests, and sometimes even methodology. For example, the study of living cultures from an archaeological perspective known as ethnoarchaeology can focus on plant use and livelihood in particular. Ethnoarchaeologists and ethnographers who work as or alongside ethnobotanists can also provide useful information to archaeologists. Dennell (1974), Hillmann (1984, 1985), Jones (1984, 1990), and Reddy (1997) used analytical approaches related to 'crop processing models' to reconstruct archaeobotanical data. They proved very useful for interpreting archaeological data, for example, by providing data on what might be expected for each type of by-product, the types of weed seeds, and so on. These ethnographic observations can be classified as ethnoarchaeology as well as ethnobotany because the main focus was crop processing, which is an important step in the human-plant relationship.

In recent years, several terms in ethnobotanical research have come into use. There are many subdisciplines of ethnobotany dealing with various aspects of tribal plants. These are discussed below.

1-Ethnotaxonomy: The study of traditional methods used by human scientists to name and classify plants in their language based on usage, habit, habitat, or other factors. For this, plant specimens must be collected, processed, and prepared, and voucher specimens must be identified.

2- Ethnoecology: It is the scientific study of how different groups of people in different regions know ecosystems around them, the surroundings in which they live, and their connection with them. It efforts a trustworthy and valid understanding of how humans have interacted with the environment and how these intricate relationships have been maintained across time.

3-Ethnopharmacology: The study of indigenous drugs' effects on humans and lab animals is covered by ethnopharmacology, along with the identification, description, observation, and experimental investigation of the ingredients used in various recipes made by native people.

4- **Ethnomedicine:** Ethnomedicine is a sub-field of medical anthropology that studies traditional medicines, not only those with documented sources (such as Traditional Chinese Medicine and Ayurveda), but also those whose knowledge and practices have been passed down orally over time.

5- **Ethnotoxicology:** Ethnotoxicology is the study of the use of various toxic plants in human societies as fish poison (Ichthyotoxic), arrow poisons, and so on.

6- **Ethnomusicology:** The study of tribal and indigenous music including its documentation, forms, and content is known as ethnomusicology.

7- **Archaeoethnobotany:** Archaeoethnobotany is the study of plant remains from ancient sites in order to understand human migration, origin, crop domestication, and so on.

8-Paleoethnobotany: It is the study of plant remains from archaeological locations. Major research themes include the recovery and identification of plant remains, the usage of wild plants, the origins of agriculture and domestication, and the co-evolution of human-plant relationships.

9- **Ethnogynaecology:** Ethnogynaecology is a emerging field that studies various diseases affecting women in tribal societies that are connected to sterility, conception, abortion, and other issues as well as the use of abortifacients.

10- **Ethnonarcotics:** The study of narcotics, snuff, hallucinogens, and other substances used in primitive societies is known as ethnonarcotics.

11-Ethnohorticulture: Ethnohorticulture is the study of the management of useful plants (such as fruits, vegetables, and ornamentals) in home gardens or orchards.

12-Ethnogastrology: The study of ethnic groups in relation to their food and eating habits is known as ethnogastrology. It also contains traditional dishes from various ethnic groups.

13-Ethnopediatrics: Ethnopediatrics is the study of the science of health care in children as it is practised by various ethnic groups.

14-Ethnoorthopaedics: The study of various ethnic tribes' and communities' knowledge of bone setting and healing is known as ethnoorthopaedics.

15-Ethnomycology: The study of traditional knowledge about mushrooms and other fungi is called ethnomycology.

16- Ethnoforestry: The study of human management of forests and forest trees is known as ethnoforestry.

17-Ethnoagroforestry: The study of land management for the simultaneous production of food, crops, and trees is known as ethnoagroforestry.

18-Ethno Medico Botany: The study of plants used as medicine among any particular group Delaware, folks, or race ethnobotanical features of any source of medicine.

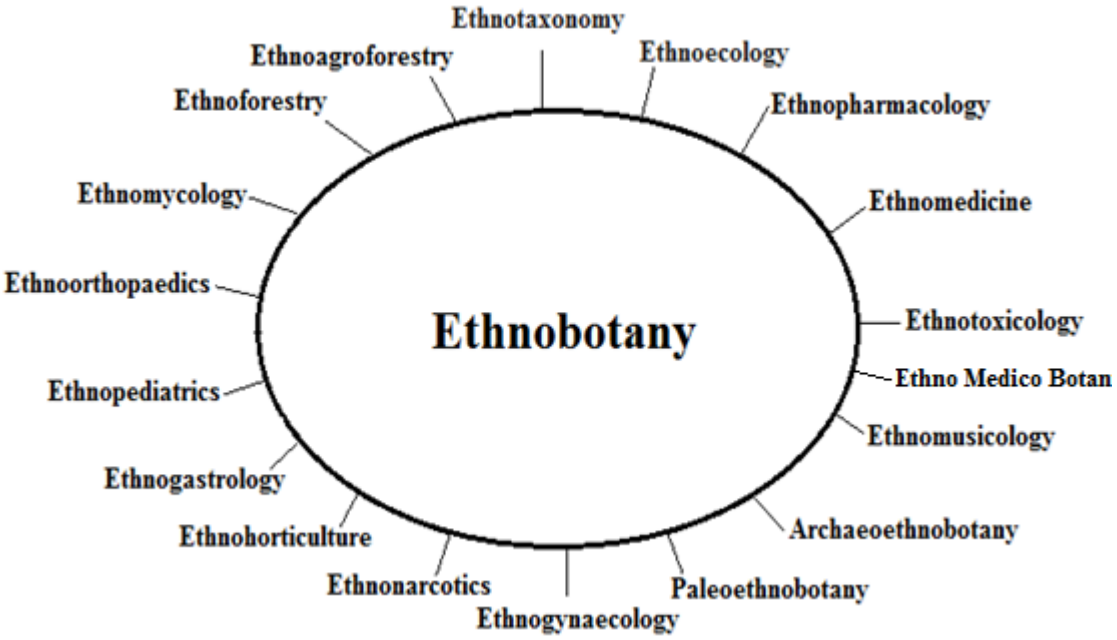


Fig.1.1 Subdisciplines of Ethnobotany

1.6 SUMMARY

Ethnobotany is the study of the interaction between plants and humans in diverse societies; this is a significant relationship for many tribal communities. Tribal people rely on forest products for the materials they require for daily existence, including supplies for their physical and health-related needs. Ethnomedicines are the roots of traditional medical systems in India and around the world. The preservation of indigenous plant knowledge should be one of the most significant recompenses. Ethnobotanical researchers have a moral commitment not only to preserve knowledge but also to return it to the people they study in a useful way. Ethnobotanists study a wide variety of concepts and methodologies, some of them are ethnomedicine, archaeoethnobotany, ethnopharmacology, ethnoecology, and ethnomycology. Ethnobotanical research is beneficial for agricultural, medicinal, culinary, and veterinary purposes.

1.7 GLOSSARY

Ethnobotany: The study of how communities make use of plants in their surroundings.
Indigenous: Living or occurring naturally in a specific place or environment.

Ayurveda: Ayurveda, often known as Ayurvedic medicine, is a system of traditional Indian medicine.

Siddha: It is a traditional healing practise that originated in South India and has been considered one of India's oldest medical systems.

Unani: Unani medicine, also known as Unani tibb, Arabian medicine, or Islamic medicine, is a traditional system of healing and health maintenance practised in South Asia. Unani medicine has its roots in the doctrines of the ancient Greek physicians Hippocrates and Galen.

Jhum cultivation: It is a traditional farming method that involves clearing land of trees and other vegetation, burning it, and then cultivating it for a fixed number of years.

1.8 SELF ASSESSMENT QUESTION

1.8.1 Multiple Choice Questions

1-Who first coined the term Ethnobotany?

(a) Sir Alexander Fleming (c) John W. Harshberger

(c) C.J. Alexocuplous (d) J.W Webster

2-The Word "Ethno" in Ethnobotany Refers To?

(a) Region- Locality- People (b) Culture

(c) Civilization (d) All Of Above

3-Traditional medical system that is acknowledged in India-

(a) Ayurveda (b) Siddha

(c) Unani (d) All Of Above

4- Who is known as the "Father of Indian Ethnobotany"?

(a) Dr. S.K.Jain (b) Dr. R.N.Chopra

(c) Dr. Kaneyala Dave (d) Dr. Basu

5- Botanical name of Rudraksha is-

(a) *Elaeocarpus ganitrus* (b) *Rauvolfia serpentine*

(c) *Azadirachta indica* (d) *Ocimum tenuiflorum*

6- The study of ancient concepts likes how human societies interact with their environment, both living and non-living is known as-

(a) Ethnotaxonomy (b) Ethnomedicine

(c) Ethnoecology (d) Paleoethnobotany

7- From which one of the following plant anticancer drug is obtained?
(a) *Taxus brevifolia* (b) *Hypericum perforatum*
(c) *Gossypium spp* (d) *Murraya penniculata*

8-Atropine is used as a-
(a) Cardiac tonic (b) Anti-malarial
(c) Pupil dilater (d) Stimulant

9-Reserpine is used as a-
(a) Tranquillizer (b) Antitumour
(c) Antileukaemic (d) antispasmodic

10- The study of the management of useful plants in home gardens or orchards is known as-
(a) Ethnoecology (b) Ethnohorticulture
(c) Ethnoforestry (d) Archaeoethnobotany

1.8.1 Answer Key: 1-(b), 2-(d), 3-(d), 4-(a), 5-(a), 6-(c), 7-(a), 8-(c), 9-(a), 10-(b)

1.9 REFERENCES

- A manual of Ethnobotany by S.K Jain, published by Scientific publishers Jodhpur.
- https://unacademy.com/content/upsc/study-material/biology/importance-of-ethnobotany/#:~:text=Ethnobotany%20can%20be%20defined%20as,the%20contextualised%20use%20of%20plants.
- https://tharaksimon.uccollege.edu.in/wp-content/uploads/sites/62/2018/02/Ethnobotany-notes.docx
- https://ischoolconnect.com/blog/types-and-applications-of-ethnobotany/
- https://www.bionity.com/en/encyclopedia/Ethnobotany.html
- https://ischoolconnect.com/blog/types-and-applications-of-ethnobotany/
- https://archive.org/stream/ethnobotany0000amri/ethnobotany0000amri_djvu.txt
- https://www.biologydiscussion.com/botany/ethno-botany-definitions-development-and-importance/7158
- https://ijcrt.org/papers/IJCRT2204320.pdf
- http://www.ub.edu/irbio/the-importance-of-ethnobotany-n-1028-en

1.10 SUGGESTED READINGS

- A manual of Ethnobotany by S.K Jain, published by Scientific publishers Jodhpur.

- Ethnobotany by Vinay Sharma & Afroz Alam published by Rastogi publication, Meerut
- Compendium of Indian Folk Medicine and Ethnobotany Vartika Jain and S K Jain, 2016. Deep Publications, New Delhi, India.

1.11 TERMINAL QUESTIONS

1.11.1Short Answer type Questions

1-Discuss about the concrete relationship in Ethnobotany.

2- Write a short note on the importance of Ethnobotany.

3- Write short note on:

(a) Archaeoethnobotany

(b) Abstract relationship

(c) Jhum cultivation

1.11.2 Long Answer type Questions

1- Write about the Interdisciplinary approach in Ethnobotany.

2- Define Ethnobotany. Describe the history and concept of Ethnobotany.

3- Explain in detail the significance of Ethnobotany.

4-Discuss about modern ethnobotany

UNIT-2 METHODS OF RESEARCH IN ETHNOBOTANY

Contents

2.1 OBJECTIVES

After reading this unit you will be able to:

- Explain the types of ethnobotanical research methods.
- Define the ethnobotanical study with the help of field work, herbaria, literature etc.
- Discuss the qualitative and quantitative research methods of ethnobotany

2.2 INTRODUCTION

Ethnobotany is a branch of biology that specifically examines how people and plants interact. It is the science which deals with the study of tribal (*Adivasis*) and rural people, with a view to unearth their deep and unique knowledge about the properties and uses of plants, to aid in our search for new herbal sources of food, drugs, etc. It also broadly covers the research, observation, and identification of the wide range of botanical species that are used to treat and prevent human and animal illnesses. It also looks at indigenous peoples' knowledge, attitudes, and customs (which could include cultural and religious practises) in relation to medicinal plants. It is an interdisciplinary science which involves *inter alia* the study of botany (mainly taxonomy and phytogeography), anthropology, sociology, medicobotany, ecology, pharmacology, and palaeobotany. Therefore, any general study in ethnobotany should give adequate emphasis on such relevant aspects.

The next question that immediately comes to our mind is- what are the main tools of study of this discipline? How can ethnobotany be studied? The main tools of study of this discipline, as is evident from the definition itself are field study, study with the help of herbaria, study of ancient literature, archeological remains, sculptures on temples, scriptures and ancient folklore. Therefore, anthropologists, ethnographers, linguists, and biologists began to focus more and more on ethnobiological issues.

2.3 TYPES OF ETHNOBOTANICAL RESEARCH METHODS

Ethnobotany is a branch of biology that specifically examines how people and plants interact. It also broadly covers the research, observation, and identification of the wide range of botanical species that are used to treat and prevent human and animal illnesses. It also looks at indigenous peoples' knowledge, attitudes, and customs (which could include cultural and religious practises) in relation to plants.

Even though people have always had a close contact with plants and many intellectuals have studied botany, few researchers have looked at an ethnic group's understanding of plants until the twentieth century. The following are a select few of the most influential ethnobotanical researchers and works that have helped spread botanical knowledge throughout time.

The Botanical Survey of India began organising ethnobotanical activities in India in 1969. Since that time, several tribal usage of plants have been documented (Jain, 1981).Numerous studies have been conducted on a variety of plant-related topics, including dyes, fiber, ethnomedicine, tans, narcotics, timber etc, by scientists like Bhandari (1974), Jain (1981a), Katewa and Guria (1997), Nargas and Trivedi (1999) Singh and Pandey (1980,1981,1982), and others.

Numerous ethnobiological techniques have recently been compiled into field manuals, most notably the "People and Plants Conservation Manuals" series produced by the World Wildlife Fund, UNESCO, and Kew Royal Botanic Gardens as part of the People and Plants Initiative (e.g., Martin 1995; Tuxill and Nabhan 1998; Cunningham 2000). The New York Botanical Garden created another much acclaimed methods manual (Alexiades 1996).

For many years, 'Field Methods' has been publishing articles either directly related to ethno-biological methods (Kendall et al. 1990), home gardens (Wichramasuriya and Pelto 1991; Vogl Lukasser, and Puri 2004), and knowledge of plant use (Reyes-Garcia et al. 2004) or indirectly through innovations in research techniques that are often used by ethno-biologists (e.g., relisting, triads, pile sorts, and cultural consensus analysis).

In this unit you will be able to understand and define different types of ethnobotanical research methods and also emphasis on qualitative and quantitative research methods. Some of the methods are given below:

2.3.1 ETHNOBOTANICAL FIELD WORK

Ethnobotanical field work is different from the routine field collections, which are done usually by taxonomists or flora writers. While taxonomists give emphasis on plants and their habitat, the ethnobotanists, in addition to these aspects, record the relationships of these plants with the local inhabitants. Therefore, the first step in ethnobotanical field work is to identify the local inhabitants of primitive societies and their regional jurisdiction, such as the *Khasi tribe* of *Khasi hills; Garo tribe of Garo hills; Nicobaris of the Car Nicobar islands*, etc Since the flora greatly varies from place to place and at different altitudes in our vast country, the plants used by the different tribes at different places are also quite varied. Therefore, considerable time and patience are required for ethnobotanical field work. Most tribes offer immense scope for ethnobotanical studies. But the tribals being very conservative by nature, it is difficult to gather much information in just one or two days' field work. One has to live for long duration in the area, freely mix with them, and acquire their confidence by respecting their rituals, ceremonies, etc. and preferably by learning even their language. It is only then that one can gather detailed and accurate information about plants used by them. By staying in a particular place for several years, one can also have a fair familiarity with local flora and the land, etc.

The well known ethnobotanist of the world, Dr. Richard Evans Schultes of Harvard University had to spend almost 12 years among the tribals in northwest Amazon, before he could publish his valuable ethnobotanical accounts (Schultes, 1956, 1962, 1963).

Similarly Dr. R. J. Rodin of Missouri Botanical Garden has botanised for more than 25 years before bringing out his account of the ethnobotany of the Kwanyama Ovambos. The entire Ovambo culture has been studied. Similarly very useful work has been done by others like Gunther (1945) on the Ethnobotany of Western Washington, Turner and Bell (1971) on the ethnobotany of the Coast Saltish Indians of Vancouver Island. In India, some field studies in tribal areas of Madhya Pradesh by Jain & his associates (1964a, 1965, and 1979), Bihar by Gupta (1963), Meghalaya by Rao & his associates (1981). Andaman and Nicobar Island by Bhargava (1981) have been conducted with some positive results. The work of Jain (1.c.) has greatly popularised this discipline in India; he has also discussed some field methods and problems for ethnobotanical studies (Jain 1964 b, 1965, 1967).

Field work forms an important tool in ethnobotanical studies. Valuable data can be collected with the help of knowledgeable local informants on plants or plant parts used, their processing, preparation and dosage, etc. for a particular ailment. Voucher specimens should also be collected during these field trips. One should be cautious during the field work not to record any cooked up information or second hand information. With some experience in any tribal area, one can suspect and exclude exaggerated or false information.

The next step is to contact an informant in the tribal area. Locating proper knowledgeable informants is not easy. In most tribes or villages, normally there will be one or two elders, who are familiar with the herbal medicines. These 'medicine men' are very resourceful and are called as 'Kaviraj' or by various terms in different tribes e.g. 'Gaita' among Gonds of Central India, Muthia ojha' among Lodhas of Bengal, 'Uche' among Mikirs and 'Amchis' among Ladakhis. These people are to be contacted for collecting information about medicinal herbs. Many time, even other people of the tribe help in collecting data about the plants used by them.

There are two ways of conducting ethnobotanical field work. In one the knowledgeable informants are taken to the field and along with the collection of plants for voucher specimens, uses of the plants as given by them is recorded. The other way is to collect all the plants of the village and surroundings and show to these informants one by one and record the information about them. The first procedure is always preferable. Often this task is not easy. Tribals by nature being conservative do not like to share the knowledge with others. Even with incentives it is difficult to collect information. This can be overcome only by gaining confidence that you are not misusing the information and that you are not going to come in the way of rightful earnings of the medicine man.

There are some tribals, who show enthusiasm and feel proud to share their knowledge with urban people.

It is necessary to interview the informants about the plants they use for particular ailment, such as for fracture or for headache. Alternatively, showing a particular plant, the disease for which it is applied may also be known. The data collected on a particular species can be verified by discussing about the same plant with some other tribals. This helps to bring out quite reliable

information not only on the species, but also dosage. During discussions, one should give a leading role to the informants and one should not contradict, what he says.

In majority of cases prescriptions are known to all tribals of the region, particularly for common ailments like cuts, fever, headache, etc. Only for serious ailments, the village medicine man is considered competent.

Data are to be recorded in the field book on the plant parts used, their collection, processing, preparation of the drug, its dosage and administration, etc. as given by the tribal informants. This information has to be brought on the label of herbarium sheets.

Voucher specimens are collected for authentication of information and future reference. The procedure of the collection of plants for herbarium purpose is the same as recommended by Jain & Rao (1978).

Local names' are very important in ethnobotanical studies. The tribals have their own names for all their plants and care should be taken to properly record these names, exactly as they are spelled. Sometimes through local names of plants the tribals distinguish even the closely allied species. With the help of local names it is possible to verify the uses with some other persons.

Experience has shown that the medicine men normally tend to be secretive in presence of some of their own people, whereas they are fully cooperative when asked in private. This is because the few prescriptions they know give them status and livelihood, and therefore, they do not like all people of the village to know these.

2.3.2 ETHNOBOTANICAL STUDY WITH THE HELP OF HERBARIA

Jain in his *Glimpses of Indian Ethnobotany* (Jain, 1981), has explained that next to field studies, Herbaria and Musea play an important role in ethnobotanical research.

A Herbarium is a store house of plants, pressed and mounted on a particular size of sheets. Here, plants from far and wide are collected and preserved, with detailed reports about uses of these plants on the labels attached to the sheets. Thus, herbarium serves the function of data bank on plants. According to Schultes (1963) "These reports have several advantages, unlike much of the literature they are, in the great part, first hand; they are attached to an actual plant specimen and therefore no problem concerning the proper identification of the plant; the ethnobotanical data are anchored down, through the information on the specimen label, to a definite locality and often times to specific people who employ the plants". Thus, if the large number of collections in any international or large herbarium are scrutinised sheet by sheet for ethnobotanical data, sitting at one place, one can gather much useful data on plants employed by different tribes in different countries.

The Herbarium of Royal Botanic Garden, Kew in U.K. today houses about 6.5 million sheets. The Harvard University Herbarium has about 1.5 million sheets. The Central National Herbarium at Calcutta has got more than 2.5 million sheets. Some of the herbarium labels yield very useful and unknown data about plants. Apart from the uses recorded on the labels, many a

time the local names are also recorded and with the help of these local names, we can identify the tribes and even verify the data through field studies.

The outstanding work of this type is that of Altschul (1968, 1970a, 1970b) who scrutinised several hundred thousand herbarium specimens of Harvard University Herbarium and recorded notes on 5178 less known or unknown uses. Very little work has been done on this aspect in India. Jain & Dam (1979) searched a part of about one hundred thousand specimens in ASSAM (Shillong) for recording ethnobotanical data. This field is yet open for research and provides immense scope for ethnobotanists particularly in our country.

Again two main kinds of study in this direction could be undertaken with the help of a Herbariumi such as:

1. To record the uses of plants in a particular locality or among a particular tribe,

2. To assess the use of a particular plant or a group of plants among several tribes.

Both types of study can be conducted with the aid of a well organised Herbarium like Central National Harbarium (CAL). A scrutiny of the material of Solanum in CAL by Jain revealed numerous unrecorded uses (Jain, 1981).

Some examples of new uses recorded from Herbarium sheets are the following. *Solanum crassipetalum*: Lepchas of Sikkim use this plant for foot and mouth disease of cattle. *Acacia farnesiana*: Juice of bark is used to relieve stomach pain. *Ocimum basilicum*: Leaves used in catarrous and other pulmonary affections.

2.3.3 ETHNOBOTANICAL STUDY WITH THE AID OF LITERATURE

In some ancient literature mention is frequently found about the plants which played role in the life and civilization of people of that time. Some such ancient literature is even unpublished and unknown to many people. Such old but recently unearthed literature can provide very useful data about plants used by people of those constraints days in different parts of the world. Several of these uses are again not known to modern world and it is of utmost importance to bring them to light. Literature survey therefore, can be a very useful tool in ethnobotanical researches. At times there are certain correct identification of the vernacular names with the botanical names. Marcus & Flannery, the two well known ethnobotanists (1978), said thus: "Botanical data in the 16th century documents are extremely rich; they are also frustrating because no Latin names are assigned to the plants involved."

The vast heritage of Vedic literature in India, which dates back to 2000 to 1000 B.C., contains valuable information regarding medicinal plants. Sarmah (1968-69) has listed about 248 botanical drugs from Atharveda & Rigveda itself. Singh and Chunekar (1972) have published a full glossary of medicinal plants included in the ancient classi cal works of *Charak Samhita, Sushurta samhita and Astanga Hridiyam*.

One of the outstanding recent works based on screening of literature in ethnobotanical research is the vast compilation by the Cancer Research Centre, for all anti-tumour plants cited in old texts and folk medicines from all over the world (Hartwell, 1964-71).

There arises, however, one practical problem in pin pointing the correct identity of botanical species mentioned in these ancient literatures. Many plants are mentioned in these works only by their common names, which vary from place to place. The famous 'Soma' in Hindu literature has been attributed to as many as 20 different species. Species like *Sarcostema* of Asclepiadaceae to *Anamirta muscaria* a fungus are referred to this. There are many more such examples of disputed identity. This itself forms an independent arena of research.

The question before us is why this confusion in identity has occurred? It is due to lack of authentic voucher specimens and lack of proper description or illustrations. Further the local names have also varied in different ages.

The primary task before us now is to fix the correct identity of these names mentioned in old literature. Some units of the Councils for Research in Ayurveda and Unani are engaged in this line of research. When we are able to know the correct identity of these local names of ancient classical literature, much valuable information will become available to us.

2.3.4 ARCHAEOLOGICAL REMAINS AND ETHNOBOTANY

Findings of plant remains at archaeological sites often reveal information about the uses of plants by man in ancient times. These remains include hard coated seeds, charcoal, twigs, timber etc. which y have been buried along with the man-made structures of these sites. The plants may have been either wild or cultivated and they can help in ascertaining the exact time of their domestication. These remains can also reveal certain informations on new sources of medicines, food, fibres, etc. (Vishnu Mittre, 1981).

2.3.5 SCULPTURES ON TEMPLES

India is a country of temples where almost every religion had flourished at one time or other. Therefore, the sculptures on these temples are a potential source of the valuable information about the uses of plants of those times. Many workers have attempted to analyse these writings. Mrs. Shakti Gupta has brought out a series of publication in which she has connected the sculpture of temples with the literature of that period and tried to give information on plants used by people of those days. However, there are several constraints in these studies also. Experienced and well trained archaeologists are needed to properly interpret these writings as well as paintings or sculptures. Details are given in later chapter.

2.3.6 FOLKLORE IN ETHNOBOTANICAL WORK

Several folklores especially folklore songs, proverbs, and tales which are passed on from one generation to the other, have references to certain interesting properties or aspects of plants. These uses, though not experimentally tested in modern laboratories have proved correct because

of the long years of trial and error method to which they were subjected. Careful study and analysis of these folklores in different cultures can provide much information on ethnobotany.

2.4 QUALITATIVE AND QUANTITATIVE RESEARCH METHODS OF ETHNOBOTANY

2.4.1 QUALITATIVE METHODS

Qualitative ethnobotanical data is primarily exploratory approach. It is used to gain an understanding of underlying reasons, opinions, and motivations. It provides insights into the problem or helps to develop ideas or hypotheses for potential quantitative research. Qualitative ethnobotany is also used to uncover trends in thought and opinions of local plant species diversity, and dive deeper into the problem, commonly in this method of ethnobotany the target sample size of the participant is typically small (Forrest et al., 2014 and Cohen & Crabtree, 2007).

Although quantitative survey data provides a solid base for ethnobotany, qualitative approach may yield more comprehensive and holistic views of traditional knowledge of communities on plants might be explored. The qualitative approach in ethnobotany allows studying the dynamic relationship between plants and peoples whereas quantitative ethnobotany consists of a systematic empirical study that provides data for statistical analysis. Quantitative and qualitative ethnobotany methods use different types of interviewing techniques (Cohen and Crabtree, 2007). There are different mechanisms of qualitative ethnobotanical approach that data or information regarding traditional knowledge of peoples to use plant resource for various purposes as well, some of which are mainly indicated in the following sections.

2.4.1.1 PARTICIPATORY RAPID APPRAISAL (PRA) APPROACH

The Participatory Rapid Appraisal (PRA) is considered as an educational method for all individuals to discover, analyze and evaluate the challenges and opportunities. It is a tool that enables the research team to collect information in a rapid and organized way to be used in evaluating the needs of the inhabitants and analyze the general situation. In this method it's more important to get better understanding of the complexity and depth of a certain subject more than getting actual statistical information of a list of tens of variables (Cohen and Crabtree, 2007). It is similar to conducting surveys, which are the most common social research methods; it is also concerned with understanding the specific qualitative differences as well as the societal opinions and attitudes in order to comprehend the ambiguous changes in local communities. This is the most important part of PRA as it is based on learning from the inhabitants of the local community. PRA is carried out inside the local community by the participation of all its members (Martin, 2004), though difficult to quantify, provides a valuable insight into the multiple meanings, dimensions and experiences of local people. It captures information that standard plant use methods are likely to miss.

Open-ended methods, such as unstructured interviews and discussion groups allow the emergence of issues and dimensions that are important to the community but not necessarily

known to the data collector, thus allowing unanticipated themes to be explored by the interviewer in this PRA approach (Miles and Huberman, 1994). Therefore, PRA is easily adopted and allowed real participation at the community level. Members of the local community shall be asked to give the names of the most renowned traditional peoples who owned the indigenous knowledge about plant species for different purposes like for medicinal purpose as being healers in the area, wild edible plant species and etc. as indicated in the document, the traditional healers are professional practitioners who could medicate the local people using ethnomedicinal plants and their products, moreover, verbal informal consent shall be collected from interviewees about all traditional healers. To do this, the interviews and discussions should be carried out by using the local language if the collector/s is/are not a native speaker of the respective community language during the PRA tasks (Alfred Maroyi, 2011).

2.4.1.2 PILE SORTING MECHANISMS OF DATA COLLECTION

A lot of other methods can be used to collect data. One of them is pile-sorting (Boer & Mashamba, 2007). Pile sorting or card methods is the one which is derived from cognitive anthropology, pile sorting is also one of the qualitative methodology designed to elicit how participants/communities evaluate their social experiences. This mechanism of data collection, commonly used in the social sciences (Miles and Huberman, 1994) and in various natural sciences is also too.

The pile sorting technique engages participants in sorting cards with words or pictures into piles that represent how they think about and categorize elements of interest. For pile-sorting, participants are asked to group items according to a certain criterion (Forrest et al., 2014). Typically, each name of an item, for example a plant, is written down on a card and participants are asked to group these items. In this kind of works, people can either choose the criterion or either a criterion for grouping the items is given to them. By letting the local people choose their own criteria for grouping items. When the views, values, concepts and perceptions of local people are used in the categorization process without interference of facilitator (Quintiliani et al., 2008) but the facilitator may provide participants labeled cards or may ask participants to label blank cards (Forrest et al., 2014). Pile sorting may be constrained in which participants organize cards according to categories determined by the facilitator, or, unconstrained when the participants organize cards according to categories that they determine, cards may be sorted a single time, or successive pile sorts may be performed in which participants apply new criteria to further divide previously defined categories (Edeoga et al., 2005). Data generated include visual representations of relationship. Less commonly, participants are asked to verbalize their thought processes and rationales concurrent with or after sorting the cards, and narrative data are elicited (Boer and Mashamba, 2007) which implies that pile sorting mechanisms is used in qualitative ethnobotany for those communities who are indigenously professional for their local obtained plant species for various types of ecosystems services for the sake of human wellbeing.

2.4.1.3 FOCUS GROUP DISCUSSIONS

A focus group discussion involves gathering people from similar backgrounds or experiences together to discuss a specific topic of the interest. It is a form of qualitative research where questions are asked about their perception's attitudes, beliefs, opinion or ideas (Quintiliani et al., 2008). In focus group discussion participants are free to talk with other group members; unlike other research methods it encourages discussions with other participants. Focus group is also a technique where a researcher/data collector about ethnobotany assembles a group of individuals to discuss a specific topic, aiming to draw from the complex personal experiences, beliefs, perceptions and attitudes of the participants through a moderated interaction (Quintiliani et al., 2008). It generally involves group interviewing in which a small group of usually 8 to 12 people. It is led by a moderator (interviewer) in a loosely structured discussion of various topics of interest.

The group's composition and the group discussion should be carefully planned to create a non-discouraging environment, so that participants feel free to talk openly and give honest opinions. Since participants are actively encouraged to not only express their own opinions, but also respond to other members and questions posed by the leader, focus groups offer a depth, and variety to the discussion that would not be available through surveys.

Focus group is a type of in-depth interview to be accomplished in a group, whose meetings present characteristics defined with respect to the proposal, size, composition, and interview procedures. The focus or object of analysis is the interaction inside the group of population/participants. The participants influence each other through their answers to the ideas and contributions during the discussion. The moderator stimulates discussion with comments. The fundamental data produced by this technique are the record of the group discussions and the moderator's reflections and comments.

The general characteristics of the Focus Group are people's involvement, a series of meetings, the homogeneity of participants with respect to data interests, the generation of qualitative data, and discussion focused on a topic, which is determined by the purpose of the duties.

This mechanisms of data collection is applicable in various fields like in ethnobotanical data, this approach could allow the communities to be participated freely like the types of questions that is prepared for such purposes of data collection should be open ended and semi structured questionnaire for the selected communities and then after they could act on it being in groups for instances, the general use of plants in the community (only plants that naturally grow there), more specific topics like one about plants used for food and beverages, medicinal plant etc. for which different sessions for group discussions might be necessary and the aim of focus group discussion perhaps be to establish a list of all useful plants. According the principles just like the pile sorting mechanisms participants shall list out all useful plant species they could think of, give their local names and clarify which parts of the plants they use and for which purpose, their growth location and whether they sell or trade the plant part or product and also the group shall

put extra information about plants on prepared sheets which should consists of names of plants with different columns.

Focus group discussion consists of four major steps like research design, data collection, analysis and reporting of results which is adopted from Morgan et al. 1998. Focus group discussion requires a team consisting of a skilled facilitator and an assistant (Forrest et al., 2014). The facilitator is central to the discussion not only by managing existing relationships but also by creating a relaxed and comfortable environment for unfamiliar participants. Similarly, the assistant's role includes observing non-verbal interactions and the impact of the group dynamics, and documenting the general content of the discussion, thereby supplementing the data (Boer and Mashamba, 2007; Narzary et al., 2013). Non-verbal data rely on the behavior and actions of respondent's pre-focus group discussion, during and post-focus group discussion. Non-verbal data provide "thicker" descriptions and interpretations compared to the sole use of FGD.

2.4.1.3.1 ADVANTAGE AND DISADVANTAGE OF FOCUS GROUP DISCUSSION (FGD)

As any things shall have its own drawbacks, the focus group discussion has also its pros as well as cons:

ADVANTAGE

- The trends of free and open discussion among the respondents results in generation of new ideas that can be very useful for decision
- Focus group is not static rather the moderator can bring any changes in order to better facilitate the discussion during the group discussion which allows better results in terms of information derived by a focus group.
- Expressions other than those in verbal form such as gestures and stimulated activities can provide researcher with useful insights.

DISADVANTAGE

- Though moderator can control the discussion, the extent to which he/she can control the discussion depends on his/her experience; inexperienced moderator may face problems in controlling some participants who try to dominate the group.
- Respondents may be hesitant to share some sensitive ideas and concerns publicly.
- Due to small sample size and heterogeneity of individuals, the findings may not be adequate to make projections or the composite picture of the situation.
- An FGD can be a very artificial set-up that influences the respondents to express and act unnaturally.

2.4.1.4 SEMI STRUCTURED QUESTIONNAIRE APPROACH OF QUALITATIVE ETHNOBOTANY

The semi-structured interview guide provides a clear set of instructions for interviewers and can provide reliable, comparable qualitative data (Palit and Gurung, 2008). Semi-structured interviews are often preceded by observation, informal and unstructured interviewing in order to allow the researchers to develop a keen understanding of the topic of interest necessary for developing relevant and meaningful semi-structured questions. The inclusion of open-ended questions and training of interviewers to follow relevant topics that may stray from the interview guide does, however, still provide the opportunity for identifying new ways of seeing and understanding the topic at hand.

Information will be collected from locals by free-listed observations and semi-structured interviews of people in public areas (generally in fields, tea houses, mosques, churches, village squares, etc.). Local people talked about the collected plants in the fields; the people of the respective area might be extremely generous in helping others whom they know this is because particularly Ethiopian people's are honest in taking newcomers in positive ways. In this step, we should give attention to obtain information from the oldest local people as much as possible for which one thing should be in account is we could only work with local people who speak the local languages and who is familiar with the people in the area and then by using local guidance, we could interview with these local people without much difficulty. Moreover, during the semi structured review we have to have guidance from local with different backgrounds that could speak the same language as local people, like from religious centers (churches/, mosques, leaders of villages and the members of the security services of the villages.

The field of ethnobotany has developed greatly during the last two decades. Originally, ethnobotany was based on qualitative methods, such as open ended and semi-structured interviews. Ethnobotany produced the compilation of lists of plants used together with a description of how plants were used. Although it could reveal a good range and depth of information (Forrest et al., 2014; Cohen and Crabtree, 2007), qualitative ethnobotany is unable to measure the importance of species, compare the relative usefulness of the plants, and rank the priorities of people (Ida Theilade et al., 2007; Krog et al., 2005). Moreover, semi-structured interviews approach of the qualitative ethnobotany sit halfway between a structured survey and an unstructured conversation.

Semi-structured interviews are also particularly useful for collecting information on people's ideas, opinions, or experiences. They are often used during needs assessment, program design or evaluation. Semi-structured interviews should not be used to collect numerical information, such the number of farmers using fertilizer in which quantitative survey is better.

2.4.2 QUANTITIVE METHODS

Quantitative techniques have been used in ethnobotany to compare the uses and the cultural importance of different plant taxa. These analyses are of great scientific interest as they reflect cultural value systems, and they may also aid in the conservation of biodiversity (Byg & Balslev 2001). It is expected that people will be motivated to conserve resources that are most important

to them, in contrast to resources perceived as less useful (Byg & Balslev, 2001; Garibaldi & Turner 2004).

The use of quantitative techniques to evaluate the relative importance of plants in a given culture is common in ethnobotanical literature. Ever since the publication of the Use-Value index proposed by Phillips and Gentry (1993), similar approaches have been widely used by many authors (Albuquerque *et al*., 2005; Cunha & Albu-querque, 2006; Galeano, 2000; Kvist *et al*., 2001). The most popular techniques (indices) are based on "informant consensus" - the degree of agreement among the different people interviewed concerning the use of a given resource (e.g., Byg & Balslev. 2001).

The standard quantitative tools are as follows:

- Relative Frequency of Citation (RFC)
- Consensus value for Plant Part (CPP)
- Informant Consensus Factor (*Fic*)
- Fidelity Level (FL%)
- Percentage of respondents who have knowledge regarding the use of species (PRK)
- Importance value [IVs]
- Use Values (UVs)
- Rank Order Priority (ROP)
- Informant Agreement Remedies (IAR)
- Cultural Significance Index (CSI)
- Simple Preference Ranking (SPR)
- Direct preference Ranking (DMR)
- Family Use Values (FUVs)

2.4.2.1 RELATIVE FREQUENCY OF CITATION (RFC)

It is an index which is obtained by division of the number of informants mentioning the use of species to the total number of informants who participated in the survey. Less weightage is given to the variables like the type of use or disease category. The most popularly used plant species will get the highest number for the citation-frequency among the community members (Tardio and Pardo-de-Santayana, 2008). This is calculated using the following formula.

RFC = FCs / N

Where, RFC = Relative Frequency of Citation

FCs = Number of informants who mentioned the use of species

N = Total number of informants.

Theoretically, it varies from zero to 1. When few informants quote the species a value close to zero is obtained. The upper limit one is seldom obtained, it is possible only when all the informants quote a particular species (Tardio and Pardo-de-Santayana, 2008).

2.4.2.2 CONSENSUS VALUE FOR PLANT PART (CPP)

It is the measure of the degree of agreement among informants concerning the plant part used (Monterio et al., 2006). The formula is as follows:

$$CPP = Px / Pt$$

Where Px = number of times a given plant part was cited

Pt = total number of citation of all parts.

2.4.2.3 INFORMANT CONSENSUS FACTOR (FIC)

It was developed by Trotter and Logan which tests the consistency of informant's knowledge regarding plants species for treating a particular illness category. This parameter accounts for the degree of agreement among the different informants interviewed concerning the use. Fic value also reveals the cultural coherence of the selection of medicinal plants for curing of certain disease category. This method helps the researcher in case of lesser familiarity with the community; lesser subjective thereby suitable for statistical analysis (Trotter and Logan, 1986). It is calculated as the number of mentions in each usage category (Nur) minus the number of taxa used in each category (Nt), divided by number of mentions in each usage category minus one.

$$Fic = Nur – Nt / Nt – 1$$

A citation of each plant is recorded separately and it is an event. Thus, the same plant and same informant may participate in many such events. A high Fic value indicates the use of relatively few species in a certain use category. Its value ranges between zero and 1.

The Fic value is near to zero indicates there is no exchange of information about their use, among the informants. In case of well defined usage information, its value reaches one. This indicates high effectiveness of the plant species among the inhabitants of a community (Trotter and Logan, 1986).

2.4.2.4 FIDELITY LEVEL (FL %)

It is used to quantify the percentage of informants who claim the use of a certain plant for the same major purpose and is calculated as (Friedman et al., 1986):

$$FL= Np / N \times 100$$

Where Np = number of informants who cited the species for a particular disease

N = total number of informants that cited the species to treat any given disease.

2.4.2.5 PRK

The percentage of respondents who have knowledge regarding the use of species (PRK) in the treatment of diseases was estimated using the formula (Friedman et al., 1986):

PRK = (No of people interviewed citing species / Total no of people interviewed) x 100

2.4.2.6 IMPORTANCE VALUES

Importance Values (IVs) measures the proportion of informants who regard a species as the most important (Byg and Baslev, 2001). It is calculated as:

$$\mathbf{IVs = Nis / N}$$

Where, Nis = Number of informants who considers the species important; N = total no. of informants.

2.4.2.7 USE VALUE (UV)

Use Value counts the importance of each plant on the basis of the number of different uses reported. The objective is to assess the importance of species in a community. Use value gives an idea about the important species used by a community (Phillips et al., 2004). It is calculated using the formula;

$$\mathbf{UVs = \Sigma\ Us / N}$$

Where, UVs = Use Value for the species

Σ Us = Sum of the uses mentioned for a species

N = Total number of informants

Many use-reports indicate high informant Use Values of a plant. This implies that the plant is important. Fewer reports results in the value approaching zero.

2.4.2.8 Rank Order Priority (ROP)

Rank Order Priority (ROP) of a plant species can be calculated as (Friedman et al., 1986):

$$\mathbf{ROP = FL \times RP}$$

Where, FL = Fidelity level,

RP = Relative Popularity; number of citations of a species divided by the number of citations of the most mentioned species.

2.4.2.9 Informant Agreement Remedies (IAR)

Informant Agreement Remedies (IAR) is an index to determine the importance of the individual species (Chellappandian et al., 2012). IAR was calculated by using formula:

$$\mathbf{IAR = Nr - Na / Nr - 1}$$

Where, Nr = the total number of citations registered for species

Na = the number of illness categories that are treated with this species.

2.4.2.10 CULTURAL SIGNIFICANCE INDEX (CSI)

Cultural Significance Index (CSI) was proposed by Turner, 1988. It was later modified by Stoffle *et. al.,* Lajones and Lemas, and da Silva *et. al*., in 1990, 2001 and 2006 respectively. It is calculated by formula:

$$\mathbf{CSI = \Sigma\ (I \times E \times C)\ CF}$$

Where, I = species management

E = preference of use

C = frequency of use

CF = Correction Factor. It is the number of citations of a species divided by the number of citations of the most mentioned species.

2.4.2.11 SIMPLE PREFERENCE RANKING (SPR)

Simple Preference Ranking (SPR) is the informants' simple preference for the medicinal plants used for treatment of a disease (Martin, 1995).

2.4.2.12 DIRECT MATRIX RANKING (DMR)

Direct Matrix Ranking (DMR) compares the use diversity of given plant species on the basis of the data collected from the informants (Martin, 1995).

2.4.2.13 FAMILY USE VALUES (FUVs)

It was first formulated by Phillips and Gentry, 1993. This index calculates the use value of a family and the formula is as follows:

$$\mathbf{FUVs = \Sigma\ UVs\ /\ Ns}$$

Where, FUVs = Family Use Value

Σ UVs = Sum of the Use Values of all the species quoted from a family

Ns = Total number of species quoted from the family

2.5 SUMMARY

Ethnobotany is a branch of biology that specifically examines how people and plants interact. It also broadly covers the research, observation, and identification of the wide range of botanical species that are used to treat and prevent human and animal illnesses. It also looks at indigenous peoples' knowledge, attitudes, and customs (which could include cultural and religious practises) in relation to plants. The main tools of study of this discipline, as is evident from the definition itself are field study, study with the help of herbaria, study of ancient literature, archeological

remains, sculptures on temples, scriptures and ancient folklore. Therefore, anthropologists, ethnographers, linguists, and biologists began to focus more and more on ethnobiological issues.

An essential step in the development of qualitative data-based literacy is the qualitative measurement and careful observation of concept properties. This strategy necessitates accurate observation and measurement of idea qualities in the communities, such as the assessment attitudes, knowledge, the level of adoption, and others. The accuracy of the qualitative data gathered in various ways might be impacted by the object's clarity while being seen.

This unit includes a variety of qualitative ethnobotanical data collection techniques, including pile sorting/card systems, PRA, semi-structured interviews, focus groups, and unstructured methods of data collection. The unstructured phase's goals are to discuss culturally suitable questions for testing hypotheses and to collect data on the context of the questionnaires' responses. Participant observation, free-listing, open-ended interviews, and the gathering of ethnobotanical specimens are the approaches employed during the unstructured phase. Another qualitative method of data collection is through focus groups, which bring people with similar backgrounds or experiences together to discuss a particular topic of interest. In this type of qualitative research, participants are questioned about their attitudes, beliefs, opinions, and ideas. Similar to this, the pile sorting technique asks participants to arrange objects based on a predetermined criterion by arranging cards with text or pictures into heaps that represent how they think about and categorise relevant aspects of interest.

Quantitative techniques have been used in ethnobotany to compare the uses and the cultural importance of different plant taxa. These analyses are of great scientific interest as they reflect cultural value systems, and they may also aid in the conservation of biodiversity. To enhance the indicative value of the ethnomedicinal study, suitable quantitative methods and approaches were used in the form of indices, such as relative frequency of citation (RFC), use report (based on illness, based on taxa), cultural importance (CI), and consensus factor of informants (Fic). Use-report values (UR) provide information on the total number of reported uses for each species. It is similar to the use value of a species, but for use report, the number of events (interviews), the process of asking one informant on one day about the uses they know for one species, is one because the respondents were interviewed only once. And response use values are broken down by the number of uses reported for each plant species part. Use-value index (UV) depicts the importance of each species for each informants. Use values are high when there are many useful reports for a plant representing its importance and come within reach to zero (0) when the use reports are low. Relative frequency citation (RFC) index reveals the usage importance of a particular species used by different informants. The index is calculated by dividing the total number of informants referring to a particular taxon with the total number of informants. Cultural importance index (CI) is estimated for each locality as the summation of Use-Report (UR) in every use category mentioned for a species in the locality divided by the total number of informants. This index provides an implication of the involvement of a particular taxon in the community, and a greater value signifies that a particular is widely distributed among

communities. Informant consensus factor (Fic) is used to test the consistency of information knowledge in treating a particular illness category. The values obtained are near one (1) for well defined selection criteria in the community and/or if the information is exchanged between the informants. A value approaching zero (0) represents that the plants are chosen randomly, and/or there is no information exchanged between the communities about their use.

2.6 SELF ASSESSMENT QUESTIONS

2.6.1 Multiple Choice Questions

1. Which are the tools of study of ethnobotanical research?
(a) Ancient literature (b) Herbaria
(c) Anthropology (d) All of the above

2. ……..is the first step in ethnobotanical study, in which to identify the local inhabitants of primitive societies and their regional jurisdiction.
(a) Field work (b) Cultural consensus
(b) Pile sorts (d) None of the above

3. There are some ways of conducting ethnobotanical field work, which are;
(a) Knowledgeable informants are taken to the field
(b) Collection of plants for voucher specimens
(c) Uses of the plants
(d) All of the above

4. The field of anthropology that studies cross-cultural knowledge and use of plants is called
(a) Ethnobotany (b) Forensic Anthropology
(c) Anthropology (d) All of the above

5. Findings of plant remains such as hard coated seeds, charcoal, twigs, timber etc. reveal information about the uses of plants by man in ancient times by
(a) Folklores (b) Archaeological remains
(c) Ancient literature (d) Both b & c

6. Which is primarily exploratory approach?
(a) Qualitative ethnobotanical data (b) Quantitative Uses of the plants
(c) Both a & b (d) None of the above

7. This approach may yield more comprehensive and holistic views of traditional knowledge of communities on plants.

(a) Qualitative ethnobotanical data (b) Quantitative Uses of the plants
(c) Both a & b (d) None of the above

8. This value reveals the cultural coherence of the selection of medicinal plants for curing of certain disease category.
(a) RFC (b) Fic
(c) UV (d) Ci

Answer key: 2.6.1: 1.(d); 2.(a); 3.(d); 4.(a); 5.(b); 6.(a); 7.(b); 8.(b)

2.7 REFERENCES

- Albuquerque, U.P., Andrade, L.H.C and Silva, A.C.O., 2005. Use of plant resources in a seasonal dry forest (northeastern Brazil). Acta Botanica Brasilica. 19:27-38.
- Alfred Maroyi, 2011. An ethnobotanical survey of medicinal plants used by the people in Nhema communal area, Zimbabwe. Journal of Ethnopharmacology. 136: 347-354.
- Altschul, S.V.R., 1968. Useful food Plants in Herbarium records. Econ. Bot. 22: 293-296.
- Altschul, S.V.R., 1970a. Ethnopediatric notes in the Harvard University Herbaria. Lloydia 33: 195-198.
- Altschul, S.V.R., 1970b. Ethnogynaecological notes in the Harvard University Herbaria, Bot. Mus. Leaft Harv, Univ. 22: 333-343.
- Bhargava, N., 1981. Plants in folk life and folk lore in Andaman and Nicobar Islands. In Jain S.K. (ed.) Glimpses of Indian Ethnobotany, 329-344.
- Byg, A. & Baslev, H., 2001. Diversity and use de palms in Zahamena, eastern Madagascar. Biodiversity and Conservation 10:951-970.
- Chellappandian M, Mutheeswaran P, Pandikumar P, Duraipandiyan V, Ignacimuthu S, Quantitative ethnobotany of traditional Siddha medical practitioners from Radhapuram taluk of Tirunelveli District, Tamil Nadu, India, J Ethnopharmacol, 143, 2012, 540-547.
- Cohen, D., Crabtree, B., 2007. Qualitative Research Guidelines Project Medicinal plants of the caatinga (semi-arid) vegetation of NE Brazil: A quantitative approach. J Ethnopharmacol. 114: 325-354.
- Cunha, L.V.F.C. and Albuquerque, U.P., 2006 Quantitative ethnobotany in an atlantic Forest fragment of northeastern Brazil – implications to conservation. *Environmental Monitoring and Assessment*. 114:1-25.
- Da Silva, V.A., Andrade, L.H.C., de Albuquerque, U.P., 2006.Revising the cultural significance index: The case of the Fulni-o in Northeastern Brazil, Field Methods, 18(1), 98–108.
- Edeoga, H.O., Okwu, D.E., Mbaebie, B.O., 2005. Phytochemical constituents of some Nigerian Medicinal plants. African Journal of Biotechnology. 4(7): 685-688.

- Forrest, K.K., Van Teijlingen, E., Pitchforth, E., 2014. The analysis of qualitative research data in family planning and reproductive health care. J Fam Plann Reprod Health Care 31(1): 40-43.
- Friedman, J., Yaniv, Z., Dafni, Palewith. D.,1986. A preliminary classification of healing potential of medicinal plants, based on a rational analysis of an ethnopharmacological field survey among Bedouins in the Negev desert, Israel, J Ethnopharmacol, 16, 275-287.
- Galeano, G., 2000. Forest use at the Pacific Coast of Choco, Colombia: a quantitative approach. Economic Botany 54:358-376.
- Garibaldi, A. and Turner, N., 2004. Cultural Keystone species: Implications for conservation and restoration. Ecology and Society 9(3):1.
- Gunther, E., 1945. Ethnobotany of Western Washington, Univ. Washing ton Publ. Anthrop, Washington. (2nd Ed. 1973).
- Gupta, S.P., 1963. An appraisal of Chota Nagpur tribal Pharmacopeia Bull. Bihar Trib. Res. Inst. 5 (2): 1-18.
- Hartwell, J.L., 1967-71. Plants used against cancer-A survey. Lloydia. 30: 379-436; 31: 71-170; 32: 79-107; 153-205; 247-296; 33:97- 194; 288-392: 34: 103-166; 204-255; 310-360; 386-425.
- https://www.ijps.ir/article_1926.html
- Ida Theilade, Hanne, H., Hansen, Mogens Krog, 2007. Ethnobotanical Knowledge: Implications for Participatory Forest Management. The Journal of Trans disciplinary Environmental Studies 6(1).
- Jain, S. K. and Dam, N., 1979. Some ethnobotanical notes from North- eastern India. Econ. Bot. 33: 52-56.
- Jain, S. K. and Rao, R.R., 1978. A Handbook of field and Herbarium methods Today and Tomarrow, Publishers New Delhi.
- Jain, S. K., (Ed) 1981. Glimpses of Indian Ethnobotany. Oxford & 1BH Co. New Delhi.
- Jain, S. K., 1964a. The role of a Botanist in folklore Research. Folklore 5: 145-150.
- Jain, S. K., 1964b. Wild plant foods of the tribals of Bastar (Madhya Pradesh), Proc. nation. Inst Sci. India 30B : 56-80.
- Jain, S. K., 1965. Medicinal plant lore of the tribals of Bastar. Econ. Bot. 19:236-250.
- Jain, S. K., 1967. Ethnobotany, its scope and study. Indian Mus Bull. 2:39-43.
- Jain, S.K., 2010. Manual of Ethnobotany. Rajasthan: Scientific Publishers.
- Krog, M., TheiladeI, Hansen, H.H., Ruffo, C.K., 2005. Estimating use-values and relative importance of trees to the Kaguru people of semi-arid Tanzania. Forests, Trees and Livelihoods 15(1): 25-40.
- Kushwaha, A., Jain, S., Bhojwani, K. and Kalyani, G., 2018. Concise Synopsis on Quantitative Ethnobotanical Tools for Medicinal Plant Analysis. Int. J. Pharm. Sci. Rev. Res., 48(1) 26: 128-132.
- Kvist, L.P., M.K. Andersen, J. Stagegaard, M. Hesselsoe & C. Llapapasca. 2001. Extraction from woody forest plants in flood plain communities in Amazonian Peru: use, choice,

evalutaion and conservation status of resources. Forest Ecology and Management 150:147-174.

- Marcus, J. and Flannery, V. Kent, 1978. Ethnoscience of the 16th Century valley. Zapotec. in Richard 1. Ford (ed.) The Nature & status of Ethnobotany, 51-79.
- Martin, G.J., 1995, Ethnobotany: Principles and applications, New York: John Wiley and Sons Ltd.
- Martin, G.J., 2004. Ethnobotany: A Methods Manual. Earthscan, London.
- Miles, M.B., Huberman, A.M., 1994 Qualitative Data Analysis: An Expanded Source Book. (2nd edn), Sage Publications, London.
- Monterio. J.M., Albuquerque, U.P, Lins-Neto E.M.F., Araujo, E.L., Amorim, E.L.C., 2006 Use patterns and knowledge of medicinal species among two rural communities in Brazil's semi-arid north eastern region. J Ethnopharmacol, 105, 173-186.
- Narzary, H., Brahma, S., Basumatary, S., 2013. Wild Edible Vegetables Consumed by Bodo Tribe of Kokrajhar District (Assam), North-East India. Archives of Applied Science Research 5: 182-190.
- Palit, D., Gurung, S., 2008. Some phytoremedies used traditionally by Gurungs in Darjeeling, west Bengal, India. Pleione 2: 175-181.
- Phillips, O., Gentry, A.H., Reynel, C., Wilkin, P., Galvez, D.B.C., 1994. Quantitative ethnomedicine and Amazonian conservation. Biodivers Conserv Biol., 8:225–48.
- Phillips, O. and Gentry, A.H., 1993. The useful plants of Tambopata, Peru: I. Statistical hypothesis tests with a new quantitative technique. Economic Botany 47:15-32.
- Quintiliani, L.M., Campbell, M.K., Haines, P.S., Webber, K.H., 2008. The use of the pile sort method in identifying groups of healthful lifestyle behaviors among female community college students. Journal of the American Dietetic Association 108(9): 1503-1507.
- Rao, R.R. & N.S., Jamir 1982. Ethnobotanical studies in Nagaland: Medicinal Plants. Econ. Bot. 36: 176-181.
- Rao, R.R. 1981 Ethnobotanical studies on the Flora of Meghalaya- Some interesting Reports of Herbal Medicines. In Jain, S.K. (ed.) Glimpses of Indian Ethnobotany, 137-148.
- Rao, R.R. and Hajra, P.K., 1986. Methods in research in Ethnobotany. In: Jain, S.K. (ed.) A manul of Ethnobotany, Scintific publisher, Jodhpur.
- Sarmah, D.C. 1968-69. Vedon men Dravya gun Shastra. J. Gujarat Ayruv. Univ. 2: 62-74.
- Schultes, R.E., 1956. The strange narcotic snuffs of Eastern Colombia: their sources, preparation and effect on an American botanist. London News 229: 520-521.
- Schultes, R.E., 1962. The role of the ethnobotanist in search for new medicinal plants. Lloydia 25: 257-266.
- Schultes, R.E., 1963. Plantae Colombianae - 16. plants as oral contrace- ptives in the northwest Amazan. Lloydia 26 : 67-74.
- Singh, B. and Chunekar, K. C., 1972. Glossary of vegetable drugs in Brahttayil. Chowkhamba Press, Varanasi.

- Takele Ashebo, 2019. A Review on the qualitative method of the study of People-Plants' relationship in their environment. Int J Environ Sci Nat Res., 22(1): 556078. DOI: 10.19080/IJESNR.2019.22.556078 029
- Tardio, J., Pardo-de-Santayana, M., 2008. Cultural importance indices: a comparative analysis based on the useful wild plants of southern Cantabria (northern Spain). Econ Bot., 62(1):24–39.
- Trotter, R.T., Logan, M.H., 1986. Informant consensus: a new approach for identifying potentially effective medicinal plants, In: Etkin NL, ed. Plants in indigenous medicine and diet, behavoiural approaches, Bredfort Hills, New York: Redgrave Publishing Company, 91-112.
- Turner, N.J., 1988. The importance of a rose: Evaluating the cultural significance of plants in Thompson and Lillooet Interior Salish, American Anthropologist, 90(2), 272– 290.
- Turner, N.C. and Bell, M.A.M., 1971. The Ethnobotany of the Coast Saltish Indian of Vancouver Island. Econ. Bot. 25: 63-104.
- Vishnu Mittre, 1981. Wild Plants in Indian Folklife: A Historical perspective. In Jain, S.K. (ed.) Glimpses of Indian Ethnobotany Oxford & IBH Co. New Delhi.

2.8 SUGGESTED READINGS

- Jain, S.K., 2010. Manual of Ethnobotany. Rajasthan: Scientific Publishers.
- Cunningham, A.B., 2001. Applied Ethnobotany: People, Wild Plant Use and Conservation.
- Earthscan, London.
- Martin, G.J., 1995. Ethnobotany: A Methods Manual. Chapman Hall.
- Schmidt, B.M., Cheng, D.M.K. (Eds.), 2017. Ethnobotany: A Phytochemical Perspective. John Wiley & Sons Ltd. Chichester, UK.
- Young, K.J., 2007. Ethnobotany. Infobase Publishing, New York.

2.9 TERMINAL QUESTIONS

2.9.1 Short Answer Type Questions

1- What methods are of research in ethnobotanical?

2- Define ethnobotanical study with the help of herbaria.

3- Write a short note on ethnobotanical field work.

4- Define PRA approach in ethnobotanical research.

5- What is focus group discussion? Dfine its advantages and disadvantage in ethnobotanical research.

2.9.2 Long Answer Type Questions

1. Give an account the types of ethnobotanical research methods.
2. Describe the ethnobotanical study with the help of field work, herbaria, literature etc.
3. Explain in detail about the qualitative measures of ethnobotanical research.
4. What is quantitative tool of ethnobotanical research? Define its type's in detail.

UNIT-3 ETHNOBOTANY- THE FACTOR AND ENDOGENOUS REGULATIONS

Contents

3.1 OBJECTIVES

After reading this unit you will be able to:-

- Basic fundamentals of tribal life.
- Life style and culture.
- Factor affecting life styles and culture in India.
- Role of technology in tribal life.
- Importance of climate change in the life of indigenous population.
- Importance of temples and sacred places.
- Role of sacred groves and their importance.

3.2 INTRODUCTION

In this chapter, we will discuss some basic aspect of ethnobotany and how different factor affected the indigenous peoples through ages. Their belief, lifestyle, culture, worshipping methods, sustainable use of local biodiversity was affected by modernization and how their status became vulnerable.

From the antiquity to present man has travelled a lot to be what he is today. Early man started his life as a food gatherer and completely depends on hunting and gathering, with his hits and trials he learn the way to use plant resources and start domesticate some animals and plants for the purpose of their sustainable life. Plants influenced the human civilization to a great extent or civilization progressed during the ages under the impact of plants. This led the aborigines or the primitive tribes to living in harmony and decorum with natural resources. This further evolves a unique pattern of knowledge to them and this empirical treasure of knowledge has been transfer from generation to generation through oral communication. Hurshbuger (1896) was the first to suggest the term Ethnobotany for such interaction of aboriginal or primitive people with plants. He further defined ethnobotany as a science in which study of plants, utilized by the primitive people is done. This definition is redefine by number of other worker time to time and according to Faulks (1958) ethnobotany is a science in which relationship between the societies of primitive people and the plants, surrounding them, is studied. In India this term was used by Kirtikar and Basu (1933) who stated that the ancient Hindus (Indians) should be given the credit for cultivating what is now called ethnobotany. Because of the following reasons, in Vedic period the curative properties of some herbs were documented in Rigveda, written between 4500 and 1600 B.C. This was followed by Atharva Veda, where the magico religious aspects and utilization of medicinal herbs were recorded. Detailed accounts of medicinal plants are also found in Chikitsa Sthanam of Sushruta Samhita written between 600 B.C. and 200 A.D. Besides this, as the civilization progresses, the primitive mans divided into groups and migrate to new locations to avoid competition. The groups then further progress and sets values, ethics, beliefs, rules of conduct, political and economic organisation and develop a culture & lifestyle of their

communities and generate “we feeling”. Indian has unique position in cultural and have an important place in the world. Its cultural history is a glorious chapter of human history and since ancient times, the glow of Indian culture was spread far and wide in various countries. The temples of India have unique architect, the worshipping methods and worshipping concept of Indian are different and scientific in its approach. Even when the Europe was struggling with stones and mud, our ancestors made these extraordinary constructions. In India the culture of sustainability was also very ancient primitive man use deity for the same and allot some forest patches to the deity and to avoid over hunting and to show the importance of some animals in the proper functioning of the ecosystem they connects animals with their deity.

3.3 LIFE STYLE AND CULTURE

A ’lifestyle’ is something which is the bridge between the ‘styles of living’ and ‘living conditions’. Many worker define lifestyle in number of ways according to Max Weber (1946) life style is a way of strengthening membership or obtaining this status. But, speaking on an individual's lifestyle, this represents a way of expressing one's own identity, being a method of distinction. In the words of Katz-Gero's (2007), lifestyle represents interests, opinions, behaviors, common behavioral guidelines and consistencies which are related to everyday life.

In more general lifestyle is the way of living of particular group with respect to the resource they have in relation to time. Further, life style is subject to change with changing conditions and requirements, for example in ancient time peoples put them self in danger or expose them self’s to negative impact to get food for them and their community, so in total they put them to danger for positive impact to their community or in other words hunting and gathering was the lifestyle of ethnic or nomadic peoples. But in present days lifestyles peoples put them self in negative impact such as smoking, use alcohol, drugs, prostitution etc as a behavior set up of their lifestyle. According to Aurora Szentagotai and Anca Tarau, the lifestyle concept refers to behaviors and decisions that are relevant to the person's quality of life in areas. For example set of high-risk behaviors for health, with reference to smoking, use alcohol, drug, prostitution or set of behaviors that have a positive impact on a person's health, such as practicing sports, yoga, dieting, etc.

3.3.1 Lifestyle with ages

If we explain the lifestyle of early man or nomadic man, we observe that the early man use simple stone instruments and lives in caves, there were no permanent settlements. They reside in natural caves during the monsoon rains and the winter season. But once the summer season comes, tribal societies divide up into individual family groups set a camp in the open, under overhanging rocks. Hunting and gathering was the mode their feeding style.

But, with the rising civilizations their lifestyle changes and they start making some materialistic possessions, the objects such as bows and arrows, a dagger, an axe, a digging stick, some pots and baskets, and a few tattered rags constitute most the belongings these peoples. Their

dwellings are now permanent thatched hut, leaf huts, followed by mud houses and then brick houses, from hunting, gathering to shifting on agriculture are observed as a change of lifestyle with ages.

In India, nomadic or tribal communities have been residing since the past and even in the present existence there are tribal groups throughout the country. Total five types (i) the Negro (ii) the Agney (iii) the Mangol (iv) the Dravid (v) the Aryan were the early settlers in India. Among these it is supposed that Negro race were the first of all came to India.

The common life style of early nomadic in India was, they were the groups of populations that are isolated from the rest of the world and dwell in forests and hilly areas. These peoples during their growth develop their own customs to face their day to day challenges of survival. There are many magical curer are supposed to be in the societies which cure illnesses due to supernatural causes. They survived on the basis of gathering and depending on wild resources such as hunting for food, cloth and shelter. Mostly they are nuclear families, consisting of a man, his wife, and their unmarried children. For all practical purposes, husband and wife are associates with equal rights.

Within their society they have some holdings hereditary rights to acquisition of land, and within its boundaries its members are granted rights to hunt and collect edible roots and tubers. The men and women are free to select their companions with whom they desire to be part of their day to day lives. Spouses can disconnect from each other without any formal procedures, but the kidnap of a woman who is still living with her husband is condemned of as morally wrong. Further, they believe that the supernatural powers have a definite role in their life and pay special attribute to these powers, worshipping these powers was also the important part of their life style.

3.3.2- Effect of rising civilization and modernization on traditional lifestyle

The effect of rising civilization and modernization was very strong on the lifestyle of the groups of the peoples of that time some of them are:

1. One of the big and important reason contributing changing lifestyle is that these old ethnic populations of ancient time throughout the world dwell in the last perfect regions of their time where the resources were in plenty (such as forests, minerals, and water). But with the global changes all the resources are now of the interest worldwide corporations, they are attempting to eliminate or shifting the long-established societies from their areas.
2. Traditional sovereignty over the hunting and gathering rights of the tribals has been restricted.
3. These new rule forces them to come out of their natural dwelling or from the forests to the common land. Example in India, Chhattisgarh tribal population shifted to new places due to mining reasons, which further changes their tribal life style.
4. The construction of big dams, pipelines, energy developments, military invasions have resulted in forcing the native dwellers to move out of their dwellings and areas results in changing their lifestyle and extinction of the tribal communities lifestyle.

5. The early group of communities largely depends upon the biological diversity their knowledge to sustain their livelihood, but with the globalization and use of biodiversity in a commercial way has generated global rules which change their lifestyle to long way from the ancient nomadic to permanent settlers.

3.3.3- Culture

Indian culture occupies an important place in the world. Life style and culture is unique possession of man and does not exist at the sub human level. The culture differentiates one community to other through ages. Community which is the assemblage or organized social life of a locality and every member of the community feels that he is dependent upon its community, both physically and psychologically and this community is which give people's "We-feeling".

Definition of culture

1. C.C. North is of the opinion that 'culture consists in the instruments constituted by man to assist him in satisfying his wants'.
2. Robert Bierstedt is of the opinion that 'culture is the complex whole that consists of all the ways we think and do any everything we have as member of society'.

Culture, is very broad term that includes all (values, ethics, beliefs, rules of conduct, political and economic organisation) that man has acquired in his life through ages, in other words it is entire 'social heritage' of a particular group. In more general way we can say 'culture is a way of life'. The language we speak, the food we eat, the rule of conduct we follow, the god we worship, the things we do, all these things we have from one ancestor as a social heritage. Further, music, literature, architecture, sculpture, philosophy, religion and science can be seen as aspects of culture, which human achieves with its social group with time.

Indian culture is diverse in many ways and many reasons contribute in the diversity of the religions (Geographical and demographical diversity). Demographical diversity in Indian is due to fact that the Indian population is a mixed and evolved product of five different races (i) the Negro (ii) the Agney (iii) the Mangol (iv) the Dravid and (v) the Aryan.

(i) **The Negro:** According to many hypotheses, Negros was the first to come India, probably from the west and South Africa. During their journey to India they travel Arabian Peninsula, Iran and Baluchistan and then finally reached India and from India to Australia though Malaysia and Indonesia and its supposed that some units of these Negros settled down there. But with the second coming race in India Agney (who ruined all negros) this race comes to its end, but chromosomes studies confirms that inhabitants are still found in some of the South Indian regions and people as Cochin-Travancore's hilly tribes 'Kadar', 'Palayan', 'Assanans', Agnail, Naga Tribe and Bahrain Rajmahalian Tribes.

(ii) **The Agney:** The second race come to India was Agney and they are supposed to come from Palestine. According to several hypotheses, it is believed that during the Mauryan dynasty some Aagrieics were still living at that time at the bottom of the Indus.

(iii) **The Mangols:** Mangols or the Kirata, have their origin from the east China and reached India about 1000 B.C. Their existence in India was first described in the Yajurveda and the Atharvaveda they were supposed to living on the edges of the south Himalayas and in the eastern India. The Kirantis and the Ladakhis of Kashmir, the Lechpas of Darjeeling, the Kashtriyas of Tripura and Manipur and the Akkas of North Assam are the descendents of the Kirata.

(iv) **The Dravidians:** The Dravidians, which are considered as one of the most cultured and ancient race in the world, belongs to the Mediterranean and came tp India around 3500 B.C. from Mediterranean Sea through the way of Iran, Afghanistan, and Baluchistan. In India, approximate little less than the half of the Indian people has evolved out of the Dravidians and owe a significant contribution in the culture of India.

(v) **The Aryans:** The Aryans or the 'Nordic' and this word were first coined by well known Indologist Maxmueller in 1856. It has been a centre of great controversy whether these people were the original dweller of the country or they migrated from somewhere else. But, according to many hypotheses it is controversly believed that Aryans took place in the southern Russia and from Russia they reach India via Iran.

3.3.4- Characteristics of culture

Culture and society is one and the same. Culture is closely linked with the every aspect of the life. It is not a material that we must add to our bodies or must have with us but, a feel of breeze. Which make human- human, without culture there would be no humans. Some important characteristics of culture are as:

1. **Culture is learned:** Culture is not inheritance material and one cannot get it through inheritance, but men have to learn it socially. These are learnt from family members, from the group and the society in which we live. In other words, shaking hands or saying thanks or wishing someone by saying namaskar, driving car, playing etc all these characters can be learn by individual from their society in which they lives.
2. **Culture is shared**: Culture is something that an individual alone cannot possess it is shared and believed or practiced by a group of people. For example, beliefs, value, custom, tradition etc.
3. **Culture is transmissive and changing**: Culture is dynamic in nature and is capable of being transmit from one generation to another, but at the same time it changes with the ever growing population with respect to time and demand of the population. Thus with time the culture transmits from one generation to another with some addition and deletions or few thoughts or traditions are lost and new cultural traits are added. No culture remains constant. For example, culture and belief of Vedic period is changed over the time to present. Even if our forefathers came back to see Indian culture of Indian society today they would be bewildered to the witness the vast changes that have taken place.
4. **Culture is integrated:** Culture in it, is the core of society beliefs and connects the one aspect of the society to the other. For examples the society is closely connected with its value system i.e., religion, tradition, beliefs etc.

5. **Culture is cumulative:** Culture grows or exist in continuous, with the growth in response to time, more and more knowledge is added in the particular culture. For example our ancestor adapted them self to their local material medica and develop a culture of using them to support their life in maximize way. According to Robert Bierstedt, the culture is 'the memory of human race'.
6. **Culture is diverse**: Culture varies from population to population or in other words, varies from society to society. Every society has its own customs, philosophies, ideology, rule of conduct which may attributed to the place of their origin or other geographical conditions.

3.3.5- Cause of cultural changes

When we look back or examine our past we observe that the culture has been changed with time to support the growth. Some of the beliefs, customs that were common in past were modified or replaced. For examples in latest past, Raja Ram Mohan Roy attacked the practice of sati, other cultural rules like remarriage of Widows etc. Here are some important reasons for cultural changes.

1. Cultural changes are introduced in the society as a result of, more accumulation of knowledge, innovation and discoveries.
2. Cultural eclecticism, this type of changes arise when a portion of the society confronted by the rules and customs of their society.
3. Some time society adopt some new customs without completely abandon their traditional customs.
4. Cultural diffusion is also one of the important aspects of the cultural change in this type elements are borrowed from another society and incorporated into the culture of the recipient group.
5. Some time due to increase in the size of the society, migration takes place and encountering new abode new custom rule are to be made to survive in the new area.
6. Wars among the societies also result in the cultural change in which dominant or powerful society attack the weaker group and then weaker group is often obliged to acquire cultural elements from the dominant group. This process of extensive borrowing in the context of superordinate-subordinate relations between societies is called acculturation.
7. Globalization is also one of the reasons in change in the interest of culture.

3.3.6- Effect of external agency

To explain the effect of different external agency one could cite this statement that "No society has existed in isolation, or remained uninfluenced by the other societies it came in contact with". India besides its demographical diversity, always remain the open center of invasion where invasion happened time to time than any other country, which alter and change the lifestyle and culture of the country. This results in having a mixed culture or diverse culture. Or in other words different invaders, tribes, races have enriched India's culture. The Aryans brought with them forms of agricultural products, new gods and beliefs and with Turkish conquest came gunpowder, cavalry came to India. Persian and Mughal conquest brought new melodies, musical

instruments, new musical forms (dastan and ghazals) and paintings. Paper, glass-making techniques, and water-wheel are some of the elements of civilization which came from outside. Thus we can say that it is a culture of unity in diversity.

3.4 CLIMATE CHANGE AND ITS EFFECT

Climate is traditionally defined as the description in terms of the mean and variability of relevant atmospheric variables such as temperature, precipitation and wind. Climate can be viewed as synthesis or aggregation of weather of a particular area. According to World Meteorological Organisation (WMO), 30 years period is the classical period for performing the statistics used to define the climate.

Climate change refers to a shift in average weather conditions, including measures such as temperature, humidity, rainfall, cloudiness and wind patterns and changes in the frequency or severity of these conditions. Climate change is the topic of hot discussion throughout the globe and many measures has been taken to control the causes of climate changes i.e., Kyoto protocol, Paris agreement, Copenhagen etc. Climate change results, changes in extreme heat, increased rainfall, changes in the availability of food and freshwater, rising sea levels and loss of biodiversity and nature.

3.4.1- Effect of climate change on ethnic population

Ethnic peoples or tribal peoples contributes approximate no greenhouse gases, but are among the first to experience the direct impacts of climate change. Not only the effect of adverse effect of climate change, but also the adverse effect of causes that change the climate, such as deforestation, land degradation and pollution from mining and oil and gas extraction. Ethnic peoples are approximate totally depended on forest and other natural resource to meet there livelihood. The changing climate is directly threatened the living of ethnic peoples by number of ways, such as threats to their livelihoods, cultures, identities, ways of life, enhancing their existing socioeconomic vulnerabilities. Further, this should be highlight that the risks that climate change poses for ethnic peoples is differs from the risks that it poses for other groups in society, including the poor, because ethnic peoples share six characteristics that are not hold or express by any other community .

1. First characteristic that ethnic peoples only have, ethnic peoples are among the poorest of the poor, because they dwell in those ecosystems which are generally hits by natural forces. For example, assets and livelihoods may be destroyed because of natural disasters food-borne, water-borne and vector-borne diseases may spread under the impact of heat-waves, floods or droughts, crop failure may be caused by changing rainfall patterns these entire factors make them poor to poorest.
2. Second characteristic, for their livelihood they depend on renewable natural resources most of them are at the risk of climate variability and extremes.

3. Third, they live in complex cultural relationship with their ecosystems in which they resides and the ecosystems or geographical regions they resides are most exposed to the impacts of climate change such as forest fire, drought or other.
4. Fourth, ethnic peoples are always under the pressure of migration or forced migration which further exacerbates social and economic vulnerabilities.
5. Fifth, gender inequality, majorly the ethnic female i.e., women and young girls have more responsibilities to ensure food security, with the changing climate and insecurity regarding their livelihood, they are seeking out employment in the informal economy in rural areas to domestic work in urban areas and many time results in the exploitation, marginalization and sexual violence with them.
6. Sixth, and lastly, many ethnic communities continue to face exclusion from decision-making processes, often lacking recognition and institutional support.

3.5 ROLE OF TECHNOLOGY

Technology in simple words can be explained as the use of tools to facilitate or giving easiness to the society. In more professional way technology can be defined as the purposeful application of information in the design, production, and utilization of goods and services, and in the organization of human activities. It is the use of scientific knowledge for practical purposes or applications, to serve the society. Since antiquity, the human has used technology beings started with the conversion of natural resources into simple tools i.e., discovery of wheels in early civilization was the premier invention of technology of that time which forms the basic concept of today's wheel industry which serve to mankind and without which one can imagine his daily life. With the progress of civilization over time new and new discoveries and technology add into the daily life of the man and very vital to human beings for survival and development. This technology greatly influenced the life of indigenous peoples in every sphere of their life.

1. **Impact on Arts and Crafts**: The ethnic peoples engage themselves in one or cart work which was unrecognized so long, but with the modern technology and crafts of the tribal peoples start gaining recognition. As a result of communication and media technology the age old traditional ideas of the tribal people are well known throughout the world.
2. **Impact on Occupations:** Generally ethnic populations are depending on natural resources for their livelihood, but with the introduction of modern technology they give up their parental works and migrate to new places where they include them in informal works such as working in factories, furniture houses, some skilled tribal start making, bamboo crafts and utility articles, embroidery and tailoring, carpentry, smithy, repairs of cycles and motor cycles etc.
3. **Impact on agriculture and economy:** The aboriginal tribes are jungle dwellers who used to habituate with shifting cultivation. But with the shifting modern technology, they are encouraged to used scientific methods in their agriculture practices, such as use of tractors, pump set machines for irrigation during dry seasons, use of rice huller to remove the outer

husks of grains of rice instead of foot operated rice pounder, use of Chemical fertilizers, insecticides and pesticides etc for bumper production. This further result in enhancing their economy and improving their quality of life.

3.6 LAND USE AND LAND COVER CHANGE

'Land Use and Land Cover Change' is the topic of hot debate in the present century. Man is the late comer between the existence types on the earth and his impact on Earth is vast and unprecedented. Man has mastered his surroundings utilizing or changes in land cover and land use. According to the FAO concept, land use defines the human things to do which are immediately associated to land, making use of its resources, or having an impact on land use. His capacity of altering the earth system for his needs and greeds, results into significant global changes including all environmental changes occur in the meantime. The indicators of these changes are conversion of forest into agricultural land, shifting of agricultural land into urbanization, loss of biodiversity, recreational areas and industrial developments. The ultimate few centuries witnessed wild human intervention of land resources. Earth is the habitat for hundreds of thousands of existence varieties together with man. Man can't exist by my-self on the earth. So the need of time is using the land resources with sustainable methods.

As our unit is focuses on the land and land cover changes with the concept of ethnic population to present day, these changes can be studied under these heading, changing its life from food gatherer to food producer and from nomadic life to permanent settlements.

Food Gatherers and Hunters

Primitive man of 'old stone age' has no knowledge of domesticating the animals and there was no concept of the farming. They lives in small groups of populations approximate 0.00425 person per square kilometer and they were unable to form a permanent settlements because their entire time was occupied in food gathering, hunting and trapping animals, they have direct struggle for existence against carnivorous animals. The evidence suggested that the farming began in the 'middle stone age' and this shift them from food gatherer to food producers, by this time they selected and domesticated some crops for regular cultivation. These change the human societies in very rapid manner. The pace of these changes got accelerated with developing animal husbandry and agriculture and then by industrialization. In present world there are only few tribal populations of Africa's mainland who live exclusively by food collection and hunting. In India, the Sentinel tribes of Andaman Island present a classical example of this kind of economy.

Shifting Cultivation

The concept of shifting cultivation was developed and adopted first by 'middle stone age' people's, this was the transformative time when the primitive man which was food gather or hunter transform to food producer. They with their hits and trials in the field of agriculture,

started cultivation by a special technique presently known as shifting cultivation or jhoom or jhum cultivation, 'slash and burn' and 'bush fallow' etc. In different parts of the world 'Shifting cultivation' named differently termed as Ladcmg in Indonesia, Caingin in Philippines, Milpa in Central America and Mexico, Ray in Vietnam, Conuco in Venezuela, Roca in Brazil, Masole in the Congo and Central Africa. Shifting cultivation has been described as an economy of which the main characteristics are rotation of fields rather than rotation of crops. In this type of cultivation they select a plot of forest land, the selected plot is then clear by cutting all type of trees and plants after which seed were sown. In this way the selected forest patch was use for 3-4 years and when the fertility of the land reduces then the forest patch is abandoned for several years. This type of cultivation is widely practiced in many parts of the world and this is primitive type of adaptation by the early tribal groups or primitive form of soil utilization, usually of tropical rain forests and bush areas of Central Africa, Central America and Southeast Asia. In India, this type of cultivation was very prevalent in the tribal regions of North-East India, Bihar, Orissa, Madhya Pradesh etc.

Settled Agriculture

In later with the permanent settlements and development in agriculture, the settled agriculture system was adopted by the tribal populations. This was practiced by a majority of tribal population in middle, western and southern regions of the country. In those areas, where due to topographical or some other factor settled agriculture was not possible, to protect forests government and some other NGOs taken many initiatives to switch the shifting cultivation to settled cultivation. By introducing more cash crops in those areas which further increase their economic and social conditions.

3.7 TEMPLES AND SACRED PLACES

The word 'temple' is derived from the Latin word "templum" means a sacred precinct. According to the definition temple is a structure reserved for religious or spiritual activities, such as prayer and sacrifice or analogous rites. Temple has their unique places in every civilization, and every society.

The traces of temples can be found in almost every civilization. Early religious temples in Mesopotamia were made up of reed structures that housed an image of a deity. Later, the mud brick as a building material was used in the construction of temples. Temples in Egyptian culture was initially constructed as was in Mesopotamia, but later the use of mud brick appeared almost spontaneously followed temples constructed by the combination of mud brick and ever-increasing amounts of stone and finally replacing all the use of stone as a construction material, the ruins of that can still be examined today. Egyptian temples were the most cosmic in both intent and design.

In Indus valley and Harappans civilizations, it seems to lack any temples or places of worships but Harappans worships mother goddess who symbolized fertility so no temples construction is reported. The vedic tradition wholly given to the worship through Yajnas had hardly any scope for the image. The history of Indian temples came approximate near to Mauryan period. The literature on Indian temple architecture broadly classifies them into three orders. The terms Nagara (Northern style), Dravida (Southern style) and Vesard (Hybrid stylewhich is seen in the Deccan) indicate a tendency to highlight typological features of temples and their geographical distribution.

In general means, a temple can be regarded as a place or model of cosmos where one could find oneself or relocate oneself in cosmic plan. Temple as a miniature of the cosmos, it can be considered as representing the cosmic rhythms. The role of temples in the life and socio-culture of the peoples was not only exists in history but also in present the practices and traditions of temples have greatly influence and gives continuity to traditional values.

Traditionally, the temple is a sacred structure and also an indicative of abode of gods or goddesses and named differently in different cultures but the main theme remains the same, for example in Egyptian culture term pr wr, "great house," was used and denoted both a temple and a royal palace. Sumerian use the term is e-gal, meaning "big house". Marduk's temples at Babylon were called Esagila, "house whose top is high". Initially, from all literatures it seems that a simple word, house was used to monumental temple. But later temple was decidedly set apart, not as the normal house of an individual, but as the dwelling place of the deity. Besides, this was defined that all who came into contact with the temple, were designated as "holy" or "sacred".

Not only the builed structure are considered as sacred or abode of god and goddess but in many cultures the Mountains are regarded as sacred space and they are often considered to be natural temples, Garden of Eden, Mount Sinai, Mount Zion, Mount Hamon, and Mount Zaphon, Mount Olympus, Mount Othrys and Mount Athos (Greece), Mount Koya (Japan) Mount Kailash and India, Gavardhan parvat (Uttar Pradesh), Mount Meru and Nanda Devi (Uttarakhand), Dhosi Hills (Haryana), Triumala (Andhra Pradesh) Trikuta hills (Jammu and Kashmir) all fit the qualifications of a cosmic mountain.

3.7.1 Role of temple in society

No human society exists without the belief in supernatural entities like gods and spirits. From every civilization the traces or the roots of their belief have been reported. Most if not all religions have mythology, cosmology, theology or ethics related to earth, nature and land. The religious phenomena are deep-rooted in each and every known human society either the present or those were present before. Both Temple and religion is closely associated with each one. It could not be separated from the Society. God and Goddesses played a vital role in the spiritualism in the universe. Besides that, the temples are not only the abode of God and place of worship, but they are also the "Cradle of Knowledge", art, architecture and culture.

3.7.2 Hindu Temples and Culture

Temples specifically the Hindu temples are commonly known as Mandir in Hindi and derived from the Sanskrit word Mandira, Mandir is again named differently different parts of India as koil or Kovil in Tamil, devasthana in Kanada and devalaya in Telugu. In India the temples are found everywhere varying from small villages to the metropolitan cities. They are not the place of only worship but act as a centre for intellectual and artistic life. From the past the complexes of the temples are used as place for the recitation and listing the folk tales i.e., Ramayana, Shri Bhagwat Geeta, Mahabharata and other religious debates. Performing rituals dances and music is also the part of worship in Hinduism. Besides this, organizing "Free food for all" of some special days and many other activities gave the people more knowledge about the traditions and made them appreciate the order practices. Temple provided means of livelihood for a large number of persons who are associated to them and greatly influence the economic life of the community surrounding it.

The general outline of approximate all Hindu temple is can be explained as the Garbhagriha the innermost chamber of the temple where the image of the deity is present, visitors are not allowed inside the garbhagriha in most of the temples and only the priests perform the rituals and worship. Mandapa' is the pillared hall in front of the garbhagriha for the assembly of the devotees. It is used by the devotees to sit, pray, chant, meditate and watch the priests performing the rituals. The shrine was roofed with a pyramidal spire or vertically attenuated dome like structure known as Sikhara and the temple as a whole was raised on a massive plinth and was often surrounded by subsidiary shrines and by an enclosing wall pierced by one or more gigantic gateway towers or Gopurams.

3.7.3 Some important temples of India

Badrinath Temple (Chamoli, Uttarakhand), Sun Temple (Konark, Odisha), Somnath Temple (Somnath, Gujarat), Kedarnath Temple (Rudraprayag, Uttarakhand), Sanchi Stupa (Sanchi, Madhya Pradesh), Ramanathaswamy Temple (Rameshwaram, Tamil Nadu), Vaishno Devi Temple (Katra, Jammu and Kahsmir), Siddhivinayak Temple (Mumbai, Maharashtra), Gangotri Temple (Uttarkashi, Uttarakhand), Kashi Vishwanath Temple (Varanasi, Uttar Pradesh), Shri Jagannath Temple (Puri, Odisha), Yamunotri Temple (Uttarkashi, Uttarakhand), Amarnath Cave Temple (Anantnag, Jammu and Kashmir), Lingaraja Temple (Bhubaneswar, Odisha), Tirupati Balaji Temple (Tirumala, Andhra Pradesh), Khajuraho Temple (Khajuraho, Madhya Pradesh), Virupaksha Temple (Hampi, Karnataka), Shirdi Sai Baba Temple (Shirdi, Maharashtra), Shri Padmanabhaswamy (Thiruvananthapuram, Kerala), Dwarkadhish Temple (Dwarka, Gujarat), Mahabodhi Temple (Gaya, Bihar), , Neelkanth Mahadev (Rishikesh, Uttarakhand), Golden Temple (Amritsar, Punjab), Kamakhya Temple (Guwahati, Assam), Padmanabhaswamy (Thiruvananthapuram, Kerala), Ramanathaswamy Temple (Rameshwaram, Tamil Nadu), Meenakshi Temple (Madurai, Tamil Nadu), Mahabaleshwar (Gokarna, Karnataka), Annapoorneshwari (Horanadu, Karnataka), Ranganathaswamy (Trichy, Tamil Nadu), Venkateshwara Temple (Tirupati, Andhra Pradesh), Arunachaleswar Temple (Thiruvannamalai, Tamil Nadu), Brihadeeswarar Temple (Thanjavur, Tamil Nadu).

3.7.4- Sacred place

The term 'sacred place' implies to the places, which are in some way holy, venerated or consecrated. These sites are connected with some religious beliefs or the sites of spiritual purpose. Each and every country exception to Antarctica has their sacred places or sacred sites. Sacred places can be divided into two types the natural sacred sites and the built sites.

1. Most of the these sacred sites are natural sacred sites and consist of all types of natural features, for example mountains (Govardhan Parvat, Uttar Pardesh), hills (Trikuta hills, Jammu; Aravali hills, Rajasthan), forests (Bhujani, Uttarakhand; Western Ghats) , rivers (Ganges, Yamuna, Kaveri, Godaveri, Narmada etc) lakes (Pushkar, Manimahesh, Mansar Sheshnag etc), caves (Shri Amarnath cave, Ellora cave), and springs (Tapt Kund of Badrinath, Roman sacred spring). Besides these, many sacred sites are primarily built places temples, shrines, mosques and churches etc. One of the classical examples of the sacred place is Nidhivan (Vrindavan, Mathura, Uttar Pradesh): One of the most important and sacred kunj or sacred place dedicated to deity divine couple Radha and Krishn along with their gopies. It is the common belief that still deity performs Ras Leela and hence also called Ras Sthali.

3.7.5- Causes of decline of these natural sacred sites are as:

1. Globalization directly affect he custodian of these sacred sites due to its dominant economic model thus ultimately detaching the custodian from ecological realities and affecting or destroying these natural sacred sites.
2. The erosion of traditional culture with the modernity, result in the decline in spiritual values.
3. Increasing human population pushing them toward the forest to fill their demand, results in increased conflict over resources.
4. Industrialization of agriculture and forestry.
5. Due to more and more constructions of cities and transport networks in the forest area the ecosystem are damaging.

3.7.6- Some important sacred places of Uttarakhand

Uttarakhand, "land of God" is full of sacred places some of them are as

1. **Panch Kedar**: There are five highland pilgrimages. The first one is Kedarnath (3553 MASL and one have to track 14 km to reach Kedarnath) and the other Kedars are Tungnath (3680 MASL, 4 km track), Madhyamaheshwar (3497 MASL, 24 km track), Rudranath (2286 MASL, 20 km track) and Kalpeshwar (2134 MASL, 2 km track).
2. **Panch Badris**: This includes Badrinath (3415 MASL), Bhavishya Badri (2744 MASL, 6 km track), Yogdhyan Badri (1829 MASL) and Vrida Badri (1380 MASL, 7 km track).
3. **Panch Prayag**: Vishnuprayag (Dauli Ganga meets with the Alaknanda River), Nandprayag (Nandakini and Alaknanda Rivers), Karnprayag (Pindar River meets with the Alaknanda River), Rudraprayag (Mandakini meets with the Alaknanda river) and Devprayag (Bhagirathi and Alaknanda rivers meet and from this place, after confluence of the Bhagirathi and Alaknanda rivers, it is called 'the Mother Ganga').

3.7.7- Role of temple and sacred places in Ethnobotany

The ethnic peoples, fortunately the tribal societies throughout the world live in complete harmony with the nature. The sustainable natural resource management is driven by the beliefs and behaviors of human communities. They develop their own beliefs and notions to conserve the surrounding plants and other resources and made number of taboos or methods to conserve biodiversity. Few examples of such taboos or methods are:

1. Dedicating the forest, lake or river on the name of deities.
2. In Bangladesh, pond is dedicated to Muslim saint, where the only surviving population of *Trionyx nigricans,* afreshwater turtle is found.
3. Temple also have role in conservation, one such example is a 2500 year old tree popularly known as Amar Kalpavriksha (*Morus serrata*) at Joshimath.
4. Two Hydrozoa spp were reported from sacred Mansar lake, Jammu and Kashmir.
5. Freshwater lakes of Nigeria, lake Esiribi and lake Adigbe have sacred species which are believed to be the embodiments of gods and ancestral spirits, therefore have an elevated status within these societies. For example, crocodiles (*Osteolaemus tetraspis*), are well protected in these lake and the belief of the people is that the crocodile is their brother and if someone accidentally kill, the full obsequies like human funeral rites and when killed intentionally the culprit is made to replace a live crocodile for the dead one.
6. The grounds of Shinto temples of Japan provide virtually the only sites of ancient lowland forests, which for sometimes deliberately preserved to provide building material for temples.
7. The 'secret sites' of the Dani in Irian Jaya, In Indonesia, have a floristic composition that is almost identical to that of primary forest.

Number of trees are planted in many sacred places and protected by the peoples due to their different belives, forexample, the Bodhi tree (*Ficus religiosa*), is protected and it is the believe of the peoples that under this tree Buddha attained enlightenment. Similar to this *Ficus carica* is protected because people's believe that this is the first plant mentioned in the Bible where the Prophet Amos was a 'Shepherd and dresser of Sycamores. In Ireland solitary thorn trees (*Crataegus monogyna*) are associated with fairies as a meeting tree. The Hindu trinity of Brahma, Vishnu and Maheshvara are believed to live among the sacred fig trees and Tulsi (*Ocimum sanctum*) has a special place among women. One can recognize the sacredness of Tulsi plant by observing the rituals in which this plant is marry to lord Vishnu. Similar to this in some parts of Nepal tree marriage is practiced, for example to *Ficus religiosa,* or *Azadirachta indica.*

3.8 SACRED GROVES AND COMMUNITY PROTOCOL

Since antiquity, human have association with plants. In every civilization, since they entered a civilized phase, they start depending on plant for three basic needs i.e., food, shelter and cloths. Besides this, they worship natural forces and this concept later evolved into concept of Gods and goddesses, in order to appease these divine powers they started worshipping them by designating patches of forest, or designate tree as holy.

In India, the tradition of nature worship and conservation is an important aspect of sacred customs and practices, with its roots from ancient India or early civilizations, the concept of worshiping tree is even mentioned in Rig-Veda. Nature worship and conservation was the integral part of indigenous communities in and around the forest areas. One such important practice of environmental conservation is dedicating patches of forest to some local deities and spirits. These dedicated forest land or pocket is called as sacred groves. More specifically, sacred groves may describe as "Tracts of virgin forest with rich diversity, which have been protected by the local people from centuries for their cultural and religious beliefs and taboos".

Every sacred grove carries its own legends, lore, and myths which form the integral part of the sacred grove. These dedicated patches of vegetation on the name of Gods, ancestral spirits are revered by local inhabitants as the deity's sacred territory. All forms of vegetation including shrubs, trees and climbers are believed to be protected of the reigning deity of that grove. Even the removal of dead parts of trees may be a taboo in some cases.

The local communities protect and maintain sacred grove as a part of their religious and cultural values. Owing to social protection, these groves support a rich collection of plants and animals including some rare and endemic taxa. Today, sacred groves in many areas represent the only surviving examples of near climax vegetation kept pristine. These groves are scattered throughout India and within India the highest number of sacred groves has been reported from Himachal Pradesh followed by Kerala and Chhattisgarh. These sacred groves are named different in different states of India i.e., in Bihar these groves named as Sarnas, in Himachal Pradesh as Dev van, Karnataka (Devarakadu Kalam), Kerala (Kavu), Madhya Pradesh (Dev van), Maharashtra (Devrai, Devrahati or Dev van), Manipur (Lai Umang) Meghalaya (Khasi terms are Law Kyntang or Law Lyngdoh). Rajasthan (Oran), Tamil Nadu and Kerala (Sarpa Kavu or Kavu).

In the words of M. S. Swaminathan, "Unlike, a botanical garden where a wide range of trees and plants are collected and cultivated for the purpose of education and enjoyment, the sacred groves are one method of expressing the gratitude of human families to the trees which sustain and supports life under a given agro-ecological condition"

3.8.1- Ritual and Myths associated with sacred groves

The origin of sacred groves is generally based on traditional religious and cultural beliefs. Depending upon the community structure and socio-culture setup the ritual of the deity varies widely from sacred grove to grove. But the common myth in many sacred groves is the belief that the deity and the spirits of their ancestors live in these groves from time immemorial and conservation of such landscapes as such will bring them blessings of the deity in the form of good harvest of crops, wealth of the community and prevent community to be hit by any famine, but any harm to these groves will invite the wrath of concerning deity which could bring epidemic diseases, famine, natural calamities and invasion of enemies.

3.8.2- Status of sacred groves in World

Sacred groves are small patch of vegetation, which has traditionally been protected by local communities and can range in size from less than one-hectare up to a few kilometers. These represent relic vegetation of the locally preserve in its original form with minimal disturbance. This conservation of the entire vegetation is associated with some local deity or sprits. The presence of sacred groves in many parts of the world is very common and nature worship is predominant in many societies of the world. In Africa, sacred groves exist widely in almost every sub-Saharan section of the continent. Thousand of sacred groves are present in Europe, but with the change in cultural interest these are depleting at alarming rates. Sacred groves are also reported from Egypt, Zimbabwe, China, Japan, Korea, Nepal, Bhutan, Bangladesh, and Central Australia.

3.8.3- Status of sacred groves in India

India one of the mega diversity center, is a country with rich biodiversity due to varied physiographic and climatic regimes. The wide spectrum of habitat ranges from tropical rainforests to alpine vegetation and coastal wetlands to desert scrubs. India not only harvests diversity in vegetation, but also having 427 groups and 700 communities of tribal population. This results in rich cultural heritage of conservation of nature and natural resources. Since antiquity, India is the land of worshipping, in India not only God or Goddess were worshipped but animals, mountain, rivers and plant to and they have equal status as God. This eco-centric approach results in rich biological, cultural and symbol of productivity and prosperity. The Term sacred comes from the latin word Sacer ("set off, restricted"). Sacred groves are patches of natural vegetation surviving in the man-modified landscapes. Sacred groves are small patches in size from few hectors to few kilometers. Number of attempts has been made to documents the sacred groves of India and it was estimated that their number varies from 13000- one lakh. Each and every village has its own sacred patch of forest or sacred temples. The maximum sacred groves are reported in the Western Ghats, North eastern India, Aravalli hills, central Himalaya and central India.

3.8.4- Important sacred groves of Uttarakhand

Uttarakhand, one of the biodiversity rich state located in Western Himalayas, popularly known as 'Dev Bhumi, or "land of god". The state has unique landscape and rich cultural heritage, which further support more than 1000 sacred groves. Some of the important sacred groves are Haryalidevi, Tungnath, Surkanda, Chiplakedar, Binsar, Tarkeswar, Tapovan, Dewal Chandrabadni and Nagdev sacred groves.

3.8.5- Importance of sacred groves

The importance of sacred groves in this regard is the self imposed restriction by the local communities what can be termed as informal protected areas. This type of self imposed rules and regulations are very effective and can be use as valuable model of biodiversity conservation.

These type of conservation is comes under the in-situ biodiversity conservation as these are voluntarily protected by the people on the religious and cultural aspects. The interest in sacred natural sites from the perspective of nature conservation lies in the components of biological diversity that they harbor.

Some facts that make sacred groves such important aspect in conservation biology are listed as follows:

1. They are regarded as virgin forests devoted to their deities and some time a temple stands on these sacred sites.
2. The sensible use of these protected areas harbor large number of plant species and signify rich vegetation.
3. They Represents a dynamic ecosystem as they occur under a multiplicity of ecological situations.
4. They are rich repositories of biological diversity and preserve many rare medicinal plants with high economic value, along with many climbers.
5. They act as a nursery and storehouse of many of the local Ayurvedic, tribal and folk medicines.
6. Botanically these are indeed of treasure troves and constitute a natural heritage because most endangered and rare species have found in these pockets. For example sacred groves of Meghalaya were surveyed and worker suggested that these groves have 500 rare and endangered species which are confined only to these groves.
7. Pondicherry, with sacred groves containing tree species not found elsewhere in the region. Besides this these sacred sites protecting remnants of tropical dry evergreen forest.
8. In Western Ghats, the sacred groves are appear to be the last refuge for arboreal birds and mammals and supporting rich climax vegetation including many rare plants.
9. In Kenya, the kaya forests are the remnants of a tropical forest ecosystem rich in rare hardwood trees and shrubs.
10. In northern Morocco sacred forests protected by the locals, have a distinct stand structure and species composition, and are considered as remnants of the original forests of the region
11. The remnants of formerly widespread deciduous dry forest still found in the sacred forests of Burkina Faso (Africa).
12. These sacred sites provide habitat for regional fauna and flora.

3.8.6- Threats to Sacred Groves

There are several key threats that have led to the reduction in size or lack of protection of sacred forests in India

1. One of the main reasons for degrading the sacred grooves on the country were historic forest policy of India this policy took away local rights to the forests. This results in losing interest to conserve the land that does not belong to them.
2. In many other cases, encroachment of numerous sacred groves to harvest or grow natural products degraded the scared groves for example as in case of Karnataka many groves were encroached to grow coffee.

3. Globalization, migration, change in the society structure, composition and cultural over time also weekend the belief of the modern generations towards the scared groves.

3.8.7- The sustainable development of these sacred groves needs specific conservation strategies which are outlined as under:

1. Government should make some programs to educate the local to protect their wild resources.
2. More Van Panchayat should be formulated to conserve their local forest resporces.
3. The area under such groves should be identify and marked into zones, trespassing, seedling eradication, germplasm collection, plucking of flowers and cattle grazing should be prohibited should be protected from the core zones.
4. A buffer zone should also be identified where the entry of visitors may be allowed but with certain restrictions.
5. If the sacred groves have some temple, shrine or tree, the n visitor should allow only on the commitment that they are not going to pollute or destroy the site and if someone caught then should be penalized.
6. The boundary should be fencing with only one entry to completely block or avoid trespassing and cattle grazing.
7. The socio-cultural programs to the nearby villager should organize to educate them the importance of these groves.

3.9 SUMMARY

In this chapter we learn, what lifestyle and culture is and how it is changed over time, how climate and technology changed the life of indigenous peoples and what are the role of temples, sacred places and sacred groves in the life of the human population. A 'lifestyle' is something which is the bridge between the 'styles of living' and 'living conditions' while the culture is entire social heritage of the group which they harbor over the time since ages. In India, nomadic or tribal communities have been residing since the past and even in the present existence there are tribal groups throughout the country. Total five types (i) the Negro (ii) the Agney (iii) the Mangol (iv) the Dravid (v) the Aryan were the early settlers in India. Among these it is supposed that Negro race were the first of all came to India. If we explain the lifestyle of early man or nomadic man, we observe that the early man use simple stone instruments and lives in caves, there were no permanent settlements. They reside in natural caves during the monsoon rains and the winter season. But once the summer season comes, tribal societies divide up into individual family groups set a camp in the open, under overhanging rocks. Further, the Life style and culture is unique possession of man and does not exist at the sub human level. The culture differentiates one community to other through ages and Indian culture occupies an important place in the world.

Climate is traditionally defined as the description in terms of the mean and variability of relevant atmospheric variables such as temperature, precipitation and wind. Climate can be viewed as

synthesis or aggregation of weather of a particular area. According to World Meteorological Organisation (WMO), 30 years period is the classical period for performing the statistics used to define the climate. Climate change refers to a shift in average weather conditions. Ethnic peoples or tribal peoples contributes approximate no greenhouse gases, but are among the first to experience the direct impacts of climate change. Technology can be defined as the purposeful application of information in the design, production, and utilization of goods and services, and in the organization of human activities. This further, facilitates and revolutionized the life of the indigenous peoples. 'Land Use and Land Cover Change' is the topic of hot debate in the present century. Man is the late comer between the existence types on the earth and his impact on Earth is vast and unprecedented. Man has mastered his surroundings utilizing or changes in land cover and land use. He masters the use of land in such a way that from the food gatherer to he became food producer and with sustainable use of soil from the shifting cultivation to the permanent settlers.

The word 'temple' is derived from the Latin word "templum" means a sacred precinct. According to the definition temple is a structure reserved for religious or spiritual activities, such as prayer and sacrifice or analogous rites. Temple has their unique places in every civilization, and every society. The traces of temples can be found in almost every civilization. No human society exists without the belief in supernatural entities like gods and spirits. From every civilization the traces or the roots of their belief have been reported. Most if not all religions have mythology, cosmology, theology or ethics related to earth, nature and land. The term 'sacred place' implies to the places, which are in some way holy, venerated or consecrated. These sites are connected with some religious beliefs or the sites of spiritual purpose.

Sacred groves may describe as "Tracts of virgin forest with rich diversity, which have been protected by the local people from centuries for their cultural and religious beliefs and taboos". The importance of sacred groves in this regard is the self imposed restriction by the local communities what can be termed as informal protected areas. This type of self imposed rules and regulations are very effective and can be use as valuable model of biodiversity conservation. But due to increasing population and decreasing cultural interest, these groves are under serious threats.

3.10 GLOSSARY

Climate change: Climate change refers to a shift in average weather conditions, including measures such as temperature, humidity, rainfall, cloudiness and wind patterns and changes in the frequency or severity of these conditions.
Climate: Climate is traditionally defined as the description in terms of the mean and variability of relevant atmospheric variables such as temperature, precipitation and wind.
Culture: Culture consists in the instruments constituted by man to assist him in satisfying his wants'.

Dravidians: The Dravidians, which are considered as one of the most cultured and ancient race in the world.

Ethnobotany: Ethnobotany is a science in which relationship between the societies of primitive people and the plants, surrounding them, is studied.

Ethnoecology: Ethnoecology, studies the interactions of local people with the natural environment.

Ethnogynaecology: Ethnogynaecology is an emerging discipline that deals with various diseases among women in tribal societies, related to sterility, conception, abortion, etc., and use of abortifacients.

Ethnomedicine: Ethnomedicine includes research that deals with medicines derived from plants, animals, minerals, etc., and used in the treatment of various diseases and ailments, based on indigenous pharmacopoeia, folklore and herbal charms.

Ethnonarcotics: Ethnonarcotics is the study of the use of narcotics, snuffs, hallucinogens, etc., in primitive societies

Ethnopharmacology: Ethnopharmacology deals with the identification, description, observations and experimental investigations of the ingredients used in various recipes prepared by aborigines, and the effects of indigenous drugs on laboratory animals and man.

Ethnotoxicology: Ethnotoxicology deals with the use of various toxic plants as fish poison (Ichthyotoxic), arrow poisons, etc., in human societies.

Ethnozoology: Ethnozoology is the study of complex relationships between people and animals, which includes human relationships with and use of domesticated animals, and management of wild animals for hunting and other uses

Lifestyle: Lifestyle represents interests, opinions, behaviors, common behavioral guidelines and consistencies which are related to everyday life.

Sacred groves: Tracts of virgin forest with rich diversity, which have been protected by the local people from centuries for their cultural and religious beliefs and taboos.

Sacred place: The term implies to the places, which are in some way holy, venerated or consecrated. These sites are connected with some religious beliefs or the sites of spiritual purpose.

Shifting cultivation: Shifting cultivation has been described as an economy of which the main characteristics are rotation of fields rather than rotation of crops.

Socioethnobotany: The study of the social aspects of the use of plants –motivated by a desire to understand how to best compensate the societies from which information about plant uses was obtained.

Technology: Technology in simple words can be explained as the use of tools to facilitate or giving easiness to the society.

Temple: Temple is a structure reserved for religious or spiritual activities, such as prayer and sacrifice or analogous rites.

3.11 SELF ASSESSMENT QUESTION

3.11.1 Very short answer type questions

1. What you mean by ethnobotany?
2. What is climate change?
3. Name any four sacred groves from Uttarakhand.
4. Name four factors responsible for climate change?
5. What you mean by land cover change.
6. Define community protocol.
7. Name any four sacred places in India.

3.11.2- Multiple choice questions

1-The Term Ethnobotany Was First Coined By.

(a) Sir Alexander Fleming (b) John W. Harshberger
(c) C. C.J. Alexocuplous (d) J.W Webster

2-The concept and idea of Greeks that walnut could be used to heal ailments of the human brain is known.

(a) Doctrine of Signatures (b) Doctrine of Homeopathy
(c) Doctrine of Allelopathy (d) B and C

3-Which among the following temples of India is known as Black Pagoda?

(a) Sun Temple, Konark (b) Brihadeeswara Temple, Tanjore
(c) Lord Jagannath Temple, Puri (d) Meenakshi Temple, Madurai

4-The famous "Ganga Sagar Mela", an annual fair is held in which state of India?

(a) Bihar (b) Uttar Pradesh
(c) Jharkhand (d) West Bengal

5-Sacred groves are

(a) The part of large forest that have been left untouched by the people on the name of deity or sprits.
(b) A place of animal grazing
(c) Forest reserve of cultivating medicinal plants
(d) None of the above

6- Sacred groves are found in

(a) Western Ghats (b) Aravalli hills
(c) Jaintia hills (d) All of the above

7- Which race first came in India?
(a) the Dravid (b) the Agney
(c) the Negro (d) the Aryan

8-The essential feature of shifting cultivation is
(a) Crop rotation (b) Field rotation
(c) Single cropping (d) Use of plenty of fertilizer

9-The Khajuraho temple locate in
(a) Guwahati, Assam (b) Varanasi, Uttar Pardesh
(c) Chattarapur, Madhya Pradesh (d) Ujjain, Madhya Pradesh

10-The Kamakhya temple is located in
(a) Agartala (b) Guwahati
(c) Kohima (d) Imphal

11-Sacred grove is named in Kerala as
(a) Sarnas (b) Dev van
(c) Kavu (d) Oran

3.11.2 Answers Key:- 1-(b), 2-(a), 3-(a), 4-(d), 5-(a), 6-(d), 7-(c), 8-(b), 9-(c), 10-(b), 11-(c).

3.12 REFERENCES

- Anthwal, A., Gupta, N., Sharma, A., Anthwal, S., & Kim, K. H. (2010). Conserving biodiversity through traditional beliefs in sacred groves in Uttarakhand Himalaya, India. Resources, Conservation and Recycling, 54(11), 962-971.
- Appadurai, A. (1977). Kings, sects and temples in south India, 1350-1700 AD. The Indian Economic & Social History Review, 14(1), 47-73.
- Bhattacharyya, S. Transformation of Tribal People in India: Various Factors. International Journal for Multidisciplinary Research 3 (1): 118-123
- Choudhury, A., Asan, O., & Choudhury, M. M. (2021). Mobile health technology to improve maternal health awareness in tribal populations: mobile for mothers. Journal of the American Medical Informatics Association, 28(11), 2467-2474.
- Das, N. K. (2006). Cultural diversity, religious syncretism and people of India: An anthropological interpretation. Bangladesh e-journal of Sociology, 3(2), 32-52.
- Gadgil, M., & Vartak, V. D. (1975). Sacred groves of India-a plea for continued conservation. Journal of the Bombay Natural History Society, 72(2), 314-320.

- Ghildiyal, J. C., Savita, B., & Rakhi, J. (2010). A contribution to the floristic diversity of Tarkeshwar sacred grove in Garhwal Himalaya, India. Journal of Economic and Taxonomic Botany, 34(2), 244-256.
- Joshi, N. V., Gadgil, M., & Patil, S. (1993). Exploring cultural diversity of the people of India. Current Science, 10-17.
- Megha, R., Vasistha, H. B., Manhas, R. K., & Mridula, N. (2011). Sacred forest of Kunjapuri Siddhapeeth, Uttarakhand, India. Tropical Ecology, 52(2), 219-221.
- Mohanty, R., Tripathy, B. K., & Panda, T. (2012). Role of Temples And Other Holy Places In Plant Conservation of Odisha, India. International Journal of Conservation Science, 3(4). 3.1-308.
- Morrison, K. D. (2010). Dharmic projects, imperial reservoirs, and new temples of India: an historical perspective on dams in India. Conservation and Society, 8(3), 182-195.
- Nguyen, T. A., Nguyen, B. T., Van Ta, H., Nguyen, N. T. P., Hoang, H. T., Nguyen, Q. P., & Hens, L. (2021). Livelihood vulnerability to climate change in the mountains of Northern Vietnam: comparing the Hmong and the Dzao ethnic minority populations. Environment, Development and Sustainability, 1-21.
- Norton-Smith, K., Lynn, K., Chief, K., Cozzetto, K., Donatuto, J., Redsteer, M. H., ... & Whyte, K. P. (2016). Climate change and indigenous peoples: a synthesis of current impacts and experiences. United States Department of Agriculture, Forest Service, Pacific Northwest Research Station.
- Pooja, J., & Ghildiyal, J. C. (2014). Traditional and Medicinal Importance of *Ocimum Tenuiflorum* in Bhabar Region of Uttarakhand. Journal of Functional and Environmental Botany, 4(1): 33-36.
- Rawat, L. (2014). Role of sacred groves in ameliorating microclimate: A case study of Nagdev temple forest of Pauri Garhwal, Uttarakhand Himalaya, India. International Journal of Biodiversity and Conservation, 6(1), 50-58.
- Sharma, S., & Kumar, R. (2021). Sacred groves of India: repositories of a rich heritage and tools for biodiversity conservation. Journal of Forestry Research, 32, 899-916.
- Singh, H., Husain, T., Agnihotri, P., Pande, P. C., & Khatoon, S. (2014). An ethnobotanical study of medicinal plants used in sacred groves of Kumaon Himalaya, Uttarakhand, India. Journal of Ethnopharmacology, 154(1), 98-108.
- Singh, K. R. B., Fernandes, M., Sarkar, T., & Sridevi, P. (2019). Assessment and analysis of lifestyle disease burden in tribes of central India. J Infect Non Infect Dis, 4: 1-7.
- Stebbins, R. A. (1997). Lifestyle as a generic concept in ethnographic research. Quality and Quantity, 31(4), 347-360.
- Vidyarthi, L. P., & Rai, B. K. (1977). *The tribal culture of India*. Concept Publishing Company.
- Williams, J. (2012). The impact of climate change on indigenous people–the implications for the cultural, spiritual, economic and legal rights of indigenous people. The International Journal of Human Rights, 16(4), 648-688.

3.13 SUGGESTED READINGS

- Chapman, M. (1996). Preface: Social anthropology, business studies, and cultural issues. International Studies of Management & Organization, 26(4), 3-29.
- Jain, S. K. (1986). Ethnobotany. Interdisciplinary Science Reviews, 11(3), 285-292.
- Jain, S. K. (2010). Manual of ethnobotany. Scientific publishers.
- Jain, S. K., & Mudgal, V. (1999). A handbook of ethnobotany. Bishen Singh Mahendra Pal Singh (BSMPS).
- Malekandathil, P (2010) Maritime India: Trade, Religion and Polity in the Indian Ocean, Primus Books, Delhi.
- Roy, I.B. (2016) Anthropology: The Study of Man, S. Chand & co Ltd.
- Shankar, R. C. N (2015) Sociology of Indian Society, S. Chand & Ltd, ISBN: 9788121924030
- Srinivas, M. N., & Panini, M. N. (1973). The development of sociology and social anthropology in India. Sociological bulletin, 22(2), 179-215.

3.14 TERMINAL QUESTIONS

3.14.1-Short answer type questions

1. Write a note on shifting cultivation.
2. Write a short note on importance of sacred groves.
3. Write down the importance of temple to society.
4. Write in brief the characteristic of culture.
5. Discuss in brief about the cause of declining sacred groves.
6. Point out the main point that leads to the change of cultural believes.
7. Discuss the importance of culture to society.

3.14.2-Long answer type questions

1. What you mean by culture? How culture changed with time in India.
2. What are sacred groves? Why they are important and what are the reasons of their decline?
3. Temples are our lost past glory justify you answer.
4. Discuss how climate change effects the indigenous population.
5. What are the sacred places? Discuss any two sacred places of Uttarakhand.
6. Discuss in brief how lifestyle and culture evolved over the time.
7. Discuss the land cover changes with respect to indigenous population.
8. What is ethnobotany? How climate and land cover changes the life style of ethnic peoples.

BLOCK-2 ETHNOBOTANY IN PRACTICE

UNIT-4 MEDICO-ETHNOBOTANY

Contents

4.1 OBJECTIVES

Reading of this section will let you know:-

- Definition and meaning of Medico-ethnobotany.
- Indigenous knowledge about the traditional healthcare practices.
- Different systems of indigenous medicine.
- Use of plants in traditional healthcare practices.
- Importance of Traditional medicinal knowledge systemsfor distantly located personnel and preservation of undocumented traditional knowledge as well as herbal plants.
- Natural resources and their conservation.

4.2 INTRODUCTION

The use of plants and animals as source of medicine is as old as humanity. People of all cultures have always depended on plants for their primary needs (food, clothing, shelter, warmth, medicines, etc.), and learned its diverse applications in course of time. During nomadic roaming, this knowledge was exchanged with neighbouring tribes, friends, and foe, and was gradually improved and expanded upon. Thus, plant knowledge has been passed around the world and plants themselves have spread along as well.

The relationship between plants and human cultures is not limited to the use of plants for food, clothing and shelter but also includes their use for religious ceremonies, ornamentation and health care (Schultes, 1992).Current knowledge on medicinal plants as a source for relief from illness dates to the early civilization and embedded in indigenous cultures which is now eroding with urbanisation. Decline in cultural diversity has resulted in the erosion of human knowledge on medicinal plant species, their distribution, management, preservation and methods of formulation. So, the documentation of this knowledge is a must to help preserve biodiversity and time gained experience in medicines.

From prehistoric times, India has been the home of great civilization and culture. It has a rich treasure of archaeological sculptures of antiquity, which can be of great value in tracing the plants which were used during early civilization. Sithole (1976) described about 40 such plants from the gateways of the Great Stupa at Sanchi and the railing of Bharhutstupa, belonging to the first and second century B.C., respectively. Our ancient literature can also be tapped for information on medicinal plants. No authentic record of any kind except a few archaeological sculptures of Mohenjo-Daro is available from the pre-vedic period. But, our oldest Vedic literature, Rigveda and Atharvaveda, which date back to 2000 to 1000 B.C., contain valuable information regarding medicinal plants of that period. Our puranas and Ayurvedic literature are main source of knowledge of medicinal plants. The prerequisite for all these studies are diligent gathering and pooling of tribal knowledge and other ethnic groups are available in the works of ayurveda and other indigenous medicinal system.

4.3 MEDICO-ETHNOBOTANY

Medico-ethnobotany also called as Medical-ethnobotany. Medico-ethnobotany is the study of medicinal plants used by a group of people. Medico-ethnobotany is a branch of ethnobotany and can be defined as "The branch of ethnobotany which deals with the traditional systems of medicine or folk lore medicines is called medico-ethnobotany". Folk systems survive as an oral tradition among innumerable rural and tribal communities of India.

Plants have always played a key role in the history of life on Earth and have served as with medicinal properties since prehistoric times. Medicinal plants are either critical constituents of many modem drugs or provide templates for synthetic analogous molecules. A consolidated study to document the plants used by ethnic communities was launched by the Ministry of Environment and Forests, Government of India in the form of All India Coordinated Research Project on Ethnobiology. As a result, about 8000 plant species have been documented which are used for medicinal purposes.

4.4 SYSTEMS OF INDIGENOUS MEDICINES AND THEIR AVAILABILITY

Indigenous medicinal system comprises medical aspects of traditional knowledge that developed over generations within the folk beliefs of various societies, before the era of modern medicine. Indigenous medicine also known as traditional or folk medicine.

Indian traditional medicinal system is a one of the oldest traditional medicinal systems in the world. The term Indigenous medicine in strict sense can be used for Ayurveda and Siddha which are truly Indian in origin and development, and also used for Unani and Homeopathy systems. The main Indian systems of indigenous medicine are Ayurveda, Siddha, Unani, yoga and homeopathy (AYUSH).The systems evolved with time, as foreign invaders, travellers, missionaries came and they brought with them practices being followed in their countries. These got assimilated into the culture of the local inhabitants.

Government of India has set up a National Level Policy for growth, promote and development of the Traditional System of Indian Medicine. The Ministry of AYUSH has created the separate Departments for Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homoeopathy collectively known as AYUSH.The Central Council of Indian Medicine (CCIM), a statutory body established in 1971 under the Department of Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homoeopathy (AYUSH), monitors higher education in areas of Indian medicine including Ayurveda, Unani, and other traditional medical systems.

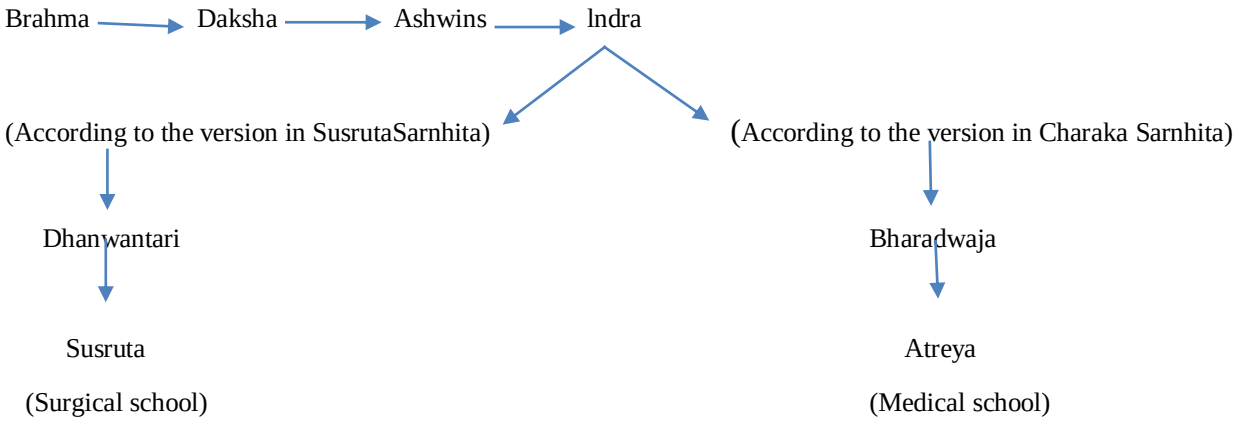
4.4.1 Ayurvedic System of Indigenous Medicine

Ayurveda is popular and ancient medical system of India. The word Ayurveda is composed of two words Ayus (life) and Veda (from Sanskrit root 'Vid' to know) - meaning science of life or knowledge of life and longevity. Our knowledge of Ayurveda comes from the extent classical treatises like Charakasamhita, also called as Agnivesasamhita by the name of Agnivesa, disciple of Atreya who was the first compiler, Susruta samhita, Astangasangraha of Vriddha Vagbhata, Astangahridya of Vagbhata etc. Of the works listed the Charaka Samhita. a comprehensive and monumental work, a massive compendium of medical knowledge with many chapters, dealt at length with therapeutic medicine. Equally voluminous work, Susrutasamhita while providing prime place for surgery also dealt with fundamental postulates, embryology, anatomy, pathology, therapeutics, psychiatry, toxicology and a variety of other subjects. About 100 kinds of surgical instruments, blunt as well as sharp including scalpels, scissors, probes, trocars, specula, forceps with different shapes etc. were mentioned.

Perhaps due to remote scope of human involvement in origin of medicine, the compilers have assigned divine origin to Ayurveda. It is considered to be as old as Vedas, the repositories of recorded knowledge. According to some, this is considered as a part of Atharvaveda, and some consider this as an Upaveda meaning 'Supplementary Veda'. There is yet another view that it represents the fifth Veda. Regardless of the various views it would appear that the development of Ayurveda was coeval with the evolution of Indian civilization and culture. The Indus Valley Civilization of Harappa culture (2500-1500 BC), Vedic period (1500-800 BC), Brahmanic and Upanishadic period (800-600 BC, Buddhist period (600-B.C.-200 AD).Post Buddhist period (after 200 AD) are the cognisable epochs in the study of healing art. The compilers of Ayurveda held that the science of healing as one without the beginning and the first promulgation of Ayurveda was by the Gods. Texts and tradition attribute origin of Ayurveda to Brahma, the creator of universe. Daksha Prajapati, the progenitor obtained in its entire, as promulgated by Brahma. The Aswini Kumaras (the twin sons of the Sun God), the celestial physicians in turn learnt from Daksha Prajapati and from them Lord Indra acquired. lndra was approached by Sage Bharadwaja for this beneficial lore for the sake of humanity.

One finds in works of Charakasamhita and Susrutasamhita interesting revelations relating to beginning of Ayurveda or its tradition of the heavenly origin which may perhaps be taken as of the divine guidance. The main classical Ayurveda texts begin with accounts of the transmission of medical knowledge from the gods to sages, and then to human physicians. It will be of interest to know the occasion when the great sages met at the foot of Himalayas. Sage Bharadwaja imparted his knowledge to the noble galaxy of sages. Atreya, who was among them taught the science of life to his disciples who later prepared their individual compendia of medicine. The one such is Agnivesha Samhita (later revised by Charaka arid came to be known as Charaka Samhita).According to Srimad Bhagavata Purana. It was Bhagawan Dhanwantari who revealed Ayurveda to the world. Setting aside its legendary origin, one finds that Ayurveda had already attained a high degree of development even as early as the period of Atreya (1500 BC) when

knowledge flowing from different specialised fields of fundamental and applied sciences, was already integrated, generalised and principles enunciated. It will be interesting to note that medical school with Atreya thought and surgical school with Dhanwantari thought have come out as early as that time. On the basis of the above description, it is clear that Ayurveda is probably the earliest medical science that laid stress on a blending of physical, mental, social, moral and spiritual welfare. The genealogy of those connected with both the schools of thought is as below:



(Source: Raghunathan: 6 Bulletin Ind. Inst. of Hist. Med. Vol. XIV)

4.4.1.1-Ashtang Ayurveda (Octopartite divisions of Ayurveda):

Ayurveda has eight major disciplines (branches). They are called '8 branches of Ayurveda'. These eight major branches are collectively known as **Ashtang Ayurveda** in ayurvedic terminology. They are also called Eight Branches of Ayurveda and Eight Components of Ayurveda in English. The eight branches are as hereunder:

1. Kayachikitsa (Internal medicine)
2. Balachikitsa or Kaumarabhritya; also known as (Paediatrics)
3. Bhutavidya or Grahachikitsa (Psychiatry)
4. Salyatantra (Surgery)
5. Salakya Tantra (Otto-rhino-Iaryngology and ophthalmology)
6. Agad Tantra or Visatantra (Toxicology)
7. Rasayanatantra (Geriatrics)
8. Vajikaranatantra (Knowledge of Virilities including therapeutics of male sterility)

1. Kayachikitsa (Internal medicine)

The word Chikitsa means treatment, here, the meaning of Kaya is Agni, which is the digestive fire, and treatment of disease due to metabolism problem of the body is called Kayachikitsa.

This is really the overall management and covers all other branches as well. Basically, Agni is responsible for the conversion of food into body elements. Diseases arise from malfunction of the Agni and therefore, if the Agni is set right again, then the patients get cured. The treatment may be external and internal.

2. Kaumarabhritya: Also known as Balachikitsa (Paediatrics)

The word Bala Roga means Child disease, this branch deals with diseases of children. It is a special branch, because children need a special type of treatment. In this the care of mother and baby has been discussed. The doses are low and the drugs are light.

3. Bhutavidya or Grahachikitsa (Psychiatry)

There are mythological tales about demons, meaning grahas. This branch deals with the diseases caused by demons and treatment of disease of mind. The branch is not much in practice today and requires research.

4. Salyatantra or Salyachikitsa (Surgery)

It is also called shalya Rog chikitsa. Shalya means foreign or surgery and roga means disease. This is actually a branch surgery, where the disease due to external trauma is treated surgically. This has a wider application in war. **In past time** this branch deals with the diseases that are caused by a foreign body like an arrow or a sword, etc. Now a day the accident injuries are treated by this branch.

5. Shalakya Tantra

It is also called Urdhvaanga Chikitsa and deals with the treatment of most of diseases of the ear, nose, throat, and eye. Shalaka is a rod-like instrument, which is used during treatment of eyes and ears. Therefore, salakyachikitsa, belongs to Otorhinolaryngology (ENT) [**Ophthalmology** (Eye), Otology (Ear), Rhinology (Nose)] as per modern medical science.

6. Agad Tantra

Agad tantra also kwon as Damstra Chikitsa. Damstra Chikitsa or Agada Tantra is the branch of toxicology in Ayurveda that deals with treatments and prevention of toxins in the body. It dealt with poisoning from animals, plants, vegetables, or metals or man-made poison.

7. Rasayan Tantra or Jar Chikitsa

This branch of Ayurveda deals with diseases and illnesses related to aging, as well as science of longevity and rejuvenation. Jara Chikitsa includes healing modalities to achieve longevity, better memory, youthfulness, brightness, positive emotions and virtues, strength, immunity and vitality. Rasayana works to improve dosha imbalances, rekindle digestive Agni and restore health with use of diet and herbal medication.

8. Vajikaran Chikitsa

This branch of Ayurveda is related to sexual health, virility, and offspring. Ayurveda accords that sex is an integral part of human life. Vajikaran Chikitsa is concerned with the health of reproductive organs and treatment for related illnesses. The field explicitly focuses on virility, strength, potency, pleasure, herbal medicines, and treatments. All the treatments and medication are designed to ensure the proper functioning of reproductive organs and fertility.

4.4.1.2-The Theory Ayurvedic Treatment

The basic theories of Ayurvedic treatments are the five elements theory and the three humoralisms theory. The five elements theory is a natural philosophy in Vedic culture that is used in medicine to explain human physiology. The five elements theory holds that everything in the world is composed of five basic elements—Prithvi (earth), Jala (water), Agni (fire), Vayu (air), and Akasha (ether)—that supplement the corresponding elements in the human body after being ingested.

According to the three humoralisms theory, there are three kinds of humoralisms—(Tridosha) Vata (gas), Pitta (bile), and Kapha (mucus)—the balance of which determines the health and disease status of the human body. Disease is caused by internal and external factors leading to an imbalance of the three humoralisms, and the treatment is to restore their balance by means of medicine and diet therapy.

4.4.2 -Siddha System of medicine

Siddha is an ancient Indian traditional treatment system which evolved in South India. The Siddha System of Medicine is a contribution of the Dravidian culture, which is one of the oldest cultures in world. Siddha is the most popular, widely practiced and culturally accepted system in Tamil Nadu. Ancient Tamil Civilization has contributed a lot and has left behind a relevant health care system to the world. The Siddha texts are in Tamil language and the system is practiced mainly in the Tamil-speaking parts of the world.

According to ancient literature of Siddha, it is said that the system of this medicine originated from Hindu God Shiva who taught it to his consort Parvati. Parvati then passed it on to Nandi and Nandi taught about it to nine Devtas.

It is based on the texts written by 18 Siddhars. There are different opinions on the constitution of 18 Siddhars. The Siddhars are not only from Tamil Nadu, but have also come from other countries. The entire knowledge is documented in the form of poems in Tamil.

According to the ancient Siddha texts, a human body is made up of several elements. It is a microscopic component of the universe. The elements that form a human body are the earth (*Munn*), fire (*Thee*), water (*Neer*), air (*vayu*) and space (*Akash*). Siddha medicine believes that three humors namely Vatam, Pittam and Kapam that are responsible for the health of human beings and any disturbance in the equilibrium of these humors result in ill health.

4.4.3 -Unani System of Medicine

Unani medicine is one of the ancient systems of medicine. The history of Unani system of medicine can be traced back to ancient Egypt and Babylon. Egyptians and Babylonians made use of medicinal plants as a remedy for ailments and played an important role in the history of Unani Medicine. The Greek developed this art of medicine drawing upon the medical knowledge of Egyptians and Babylonians. The Greek developed, it as a systematic science, so this system named Unani system of medicine.

The term Yunani or Unani means Greek. Unani system of medicine, as a systematic medicinal system, originated in Greece and nurtured by the Greek philosopher, physician Hippocrates (460–377 B.C.). Due to this transition from Greeks to Arabs, it is called as Greco-Arab medicine. Arab and Persian elaborations upon the Greek system of medicine. This system is also called Perso-Arabic medicinal system. Persian are predominant ethnic group of Iran (formerly known as Persia). Arab and Persian scholars and physicians like Rabban Tabari (775-890 AD), Al Razi (865-925 AD) and Ibn-e-Sina (980-1037 AD) raised Unani System of Medicine to the great heights.

Unani medicine interacted with Indian Buddhist medicine at the time of Alexander's invasion of India. When Mongols attacked Persian and Central Asian regions, many of the experts and physicians of the Unani Tib fled to India. Cures of disorders related to almost all organs and organ systems of the body are present in Unani medicine. Unani medicines are very effective in many diseases, such as oral disease, throat infections, Breathing Problems, Skin Problems, Reproductive and Gastrointestinal disorders etc.

4.4.4- Homeopathy

Homeopathy is the alternative approach in the field of medicine where the treatment of the patient is taken care of by providing highly diluted substances. Homeopathy triggers the patient's natural system of healing the illness. The process is based upon specific symptoms that are shown in each patient differently, and the doctor matches it with that of the most appropriate medicine.

The word Homeopathy originates from two Greek words 'Homeo' which means 'similar' and 'Pathos' which stands for 'treatment by the same.' The method of treatment was developed by a

German scientist named Dr.Christian Samuel Hahnemannin 1796. Homeopathy based on his doctrine of like cures like. Throughout the 19th century, dozens of homeopathic institutions appeared in Europe and the United States. It is a recognized medical system in India through the **Homeopathy Central Council Act, 1973.**

The Indian government has recognized homeopathy as a medicine and set up the Central Council of Homeopathy (CCH) to regulate its education and practice. At present, homeopathy is the third most popular method of medical treatment in India, after allopathy and ayurveda.

4.4.5 - Yoga and Naturopathy

Naturopathy is not just a system of medicine but a way of life based mainly on the ancient practice of the application of the simple laws of nature. It is call to "RETURN TO NATURE". Naturopathy provides not only a simple practical approach to the management of disease, but a firm theoretical basis which is applicable to all the holistic medical uses.

The word yoga means 'unity' or 'oneness' and is derived from the Sanskrit word *Yuj* which means to 'to join'. The unity or joining is described in spiritual terms as the union of the individual consciousness with the universal consciousness. Yoga is the science of right living and, as such, is intended to be incorporated in daily life. It works on all aspects of the person such as the physical, vital, mental, emotional, psychic and spiritual.

Yoga and Naturopathy is based on various drugless treatments like Acupuncture, acupressure, Yoga and meditation, fasting therapy, Diet and nutrition, mud therapy, hydrotherapy, chairopractice and Osteopathy, Manipulation therapy, exercise and electrotherapy, reflexology, counseling and lots more.

Yoga is an ancient art of loving has now been developed s a separate medical science. Maharshi Patanjali propounded it in a systemic form: which consists of eight components namely retrains, observance of austerity, physical postures, breathing exercises, retraining of sense organs, contemplation, pranayamas, meditation and Samadhi. These steps in the practices of yoga have potential in improvement of social behaviour, improvement of physical health, improvement of better circulation of oxygenated blood in bloody, retraining the sense organs and thereby the mind and in inducing tranquillity and serenity in the mind. The practice of yoga prevents psychosomatic disorders\disease and improves individual's resistance and ability to endure stressful situations.

4.5 NATURAL RESOURCES

Natural resources are materials that are found in nature or created by nature. These resources are materials available on the planet that can be used to keep people alive and meet their needs. Minerals, water, wind, air, solar energy, soil, all types of vegetation or forest and wildlife are the best examples of natural resources.

4.5.1-Types of Natural resources

Natural resources are of two types:

1. Renewable Resources or Exhaustible Resources: Renewable resources are substances available in large amounts in nature. These resources are infinite and can be repeatedly used—for example, water, air, sunlight, etc. The light coming from the Sun, air, wind, and water. All of those resources are the ones that seem to stay here, no matter how much of them we use.

2. Non-Renewable Resources or Inexhaustible Resources: These resources are also available in nature but are limited. They may end after continuous usage—for example, minerals, oil and natural gas, coal, etc.

Minerals we find inside Earth are non-renewable, because some of them took millions of years to form, and people's needs are higher than the ability of those minerals to form again. Fossil fuels, as well, the need for them is great, and the rate at which we spend them will, sooner or later, deplete them completely.

Basis of Classification	Renewable Resources	Non-Renewable Resources
Definition	These resources are naturally available in large amounts and can be used again and again.	These resources are available in limited amounts so cannot be used again and again.
Depletion	These resources can never be exhausted.	These are energy resources and will be depleted over time.
Environmental Impact	They have low carbon emissions, so they are environmentally friendly.	They have high carbon emissions and can harm the environment.
Cost	These resources have a very low cost.	These resources have a high cost.

4.5.2-Natural resources of Medicinal Plants

Medicinal plants often become the source of advanced materials for the manufacture of new effective medicines that improve the quality and duration of life. About 50000 species of plants are used in medicine worldwide. The vast majority or about 80% of medicinal plants are still harvested in wild while overharvesting is one of the most serious proximate threats when extracting Medicinal plants.

Mass cultivation of Medicinal plants lead to development of areas with natural vegetation and loss of biodiversity. So conservation strategies now include also utilization of Medicinal plants

from wild populations in a sustainable manner and perfection of laws which should control this process. The vegetation type where wild plants are collected, their resources, abundance and growth rate are determinants for the sustainability of their utilization. The mode of sustainable use can be elaborated for many medicinal plants which grow with great abundance in such a way that their populations can recovery after collection of raw materials. This approach allows exploiting the potentialities of natural reserves of medicinal plant's raw materials without depletion of their populations.

Herbal medicine or phytomedicine is the use of plants for medicinal and therapeutic purpose for curing of diseases and improve human health. Plants have secondary metabolites called phytochemicals ('Phyto from Greek - meaning 'plant').These compounds protect plants against microbial infections or infestations by pests. Phytochemicals are active ingredients which possess therapeutic properties that are considered as a medicine or drug. Herbal medicine is widely practiced worldwide, and few are also promoted by WHO. For centuries, people have turned to natural remedies to cure common ailments such as colds, allergy, upset stomachs and toothaches and the trend is constantly increasing. Thus, there has been a shift in universal trend from syntheticto herbal formulation of plants with medicinal properties.

4.5.3- Conservation of natural resources

Vegetarian foods contain high amounts of various "super Plants have free radical scavenging molecules, including flavonoids, phynolics, anthocynins and vitamins, which show antioxidant like activity . It has been reported that the antioxidant property of phytochemicals maybe mitigated the oxidative stress in the biological system. Medicines, which we can say 'Return to Nature' for the prevention of diseases and ailments, Nature has been a source.

Conservation of natural resources is very important as natural resources are essential for human survival, yet not all natural resources are renewable. The tremendous increase in climate change due to human activity, particularly the usage of fossil fuels is resulting in depletion of native plants. By conserving our natural resources, we can have a more positive impact on our natural environment to conserve biodiversity. Chief ways to conserve natural resources is by use of renewable energy, e.g., using solar, wind, and hydro energy which has potential to significantly reduce dependence on non-renewable energy resources.

4.6 SUMMARY

Plants have always played a key role in the history of life on Earth. Plants provide our food, materials for shelter, fuel to warm us, medicine for health cure apart from providing food to animals and habitat for wildlife and often neglected insects. Plants have always played a key role as medicinal agents in all societies since prehistoric times. Current knowledge on medicinal plants as a source for relief from illness dates back to the early civilization. This type of

traditional knowledge is called indigenous medicinal system that developed over generations within the folk beliefs of various societies.

The term Indigenous medicine in strict sense can be used for Ayurveda and Siddha, because both are very ancient in India, but Unani, homeopathy, yoga and naturopathy are also popular medicinal systems in India.Ayurveda have assigned divine origin and considered to be as old as Vedas. According to some, this is considered as a part of Atharvaveda, and some consider this as an Upaveda meaning 'Supplementary Veda'. The core knowledge is documented by Charaka, and Sushruta Sanhitas, in compendiums written by them. This system is also based on three humor principles namely, Vatha, Pitha and Kapha which would exist in equilibrium for a healthy living. This system uses more of herbs and few animal parts as drug sources.

The other most popular indigenous system of medicine in India is Siddha, which evolved in South India. The Siddha texts are in Tamil language and the system is practiced mainly in the Tamil-speaking parts. It is based on the texts written by 18 Siddhars. The entire knowledge is documented in the form of poems in Tamil. Unani medicine is one of the ancient systems of medicine. The Greek developed, it as a systematic science, so this system named Unani system of medicine. This system was originated in Greece by the Greek philosopher, physician Hippocrates (460–377 B.C.). The concepts of Unani medicine are based on four Akhlat (Humours), Dam (Blood), Balgham (Phlegm), Safra (Yellow Bile), and Sauda (Black Bile). Each should be in balanced condition for healthy person.

Homeopathy is another alternative approach of the medicinal system. The method of treatment of Homeopathy, was developed by a German scientist Dr. Christian Samuel Hahnemann in 1796. Homeopathy based on his doctrine of like cures like. The treatment of the patient is taken care of by providing highly diluted substances. Yoga and Naturopathy is based on various drugless treatments.

4.7 GLOSSARY

Agad Tantra : Toxicology
Bhutavidya : Psychiatry
Humoralisms : Tridosha, theory of the body humors
Indigenous medicines: Traditional system of medicine
Kaumarabhritya : Paediatrics
Kayachikitsa : Internal medicine
Medico ethnobotany : Study of medicinal plant by the group of people
Phytomedicine : Herbal Medicine
Rasayanatantra : Geriatrics, or science of rejuvenation.
Salakya Tantra : Ophthalmology, Otology, Rhinology
Salyatantra : Surgery
Vajikaranatantra : Knowledge of the health of reproductive organs, includes therapeutics

of male sterility.

Visatantra : Toxicology

4.8 SELF ASSESSMENT QUESTION

4.8.1 Multiple choice Questions

1-Who is known as the father of homeopathy?

(a) Aristotal (b) Samule Hahnemann

(c) Hippokrates (d) Darwin

2-The major disciplines (branches) of Ayurveda are:

(a) Four (b) Five

(c) Eight (d) Ten

3-Siddha system of medicine originates from:

(a) Tamil culture (b) Bengali culture

(c) Punjabi culture (d) Uttrakhandi culture

4-Types of humaralism in Ayurveda are:

(a)Three (b) Five

(c) Eight (d) Four

5- Urdhvaanga Chikitsa in Ayurveda also called:

(a) Shalakya Tantra (b) Agadtantra

(c) ShalyaChikitsa (d) Rasayan Tantra

4.8.1 Answer Key: 1-(b), 2- (c), 3-(a), 4-(a), 5-(a)

4.9 REFERENCES

- K. RAGHUNATHAN, INDIGENOUS SYSTEMS OF MEDICINE IN INDIA, Bull. Ind. Inst. Hist. Med. Vol. XIV. pp, 1-13.
- Jabin, Farkhunda. “Guiding tool in Unani Tibb for maintenance and preservation of health: a review study.” African Journal of Traditional, Complementary and Alternative Medicines 8.5S (2011): 140-143.
- Husain, Ahmad, et al. “Unani Medicine and Stability Studies—A Short Communication.” Pharmacognosy Journal 2.16 (2010): 59-60.

- Ubbarayappa, B. V. "The roots of ancient medicine: an historical outline." Journal of Biosciences 26.2 (2001): 135-143.
- Ethnobotany Role In Relation To Medicinal Plants In India By Ashwani Kumar
- Pandey,A.K&Tripathy,Y.C.Ethnobotany and its relevance in contemporary research. Journal of Medicinal Plants Studies 2017;5(3):123-129.

4.10 SUGGESTED READINGS

- Jain SK, Manual of Ethnobotany, (2016), Scientific Publishers, Jodhpur, India.
- Shults Richard and Reis siri von, Ethnobotany, evolution of a Discipiline, (1995) Champman and Hall,Lundun.
- Trivedi P.C. Ethnobotany, Avishkar publishers, Jaipur, Rajasthan, India.

4.11 TERMINAL QUESTIONS

4.11.1 Short answer type Questions

1. What is indigenous system of medicine?
2. What is Ayurveda system of medicine?
3. What is Ashtang Ayurveda?
4. What is Siddha system of medicine?
5. What is Homeopathy system of medicine? Who proposed it?
6. Which medicinal system regarded as 'Doctrine of like cures like' comment?
7. Comment on different types of indigenous system of medicine in India?
8. What are different types of natural resources?
9. Give an account of medicinal plant and natural resources?
10. Comment on conservation of natural resources?

4.11.2 Long answer type Questions

1-What do you know about indigenous system of Medicine? Describe about any popular indigenous medicinal system of India?

2- Describe the historical development of Ayurveda System.

3-What is the basis of healing therapies in Ayurveda. Describe about Ashtang Ayurveda.

4- Describe Siddha system of Medicine? Who are Siddhars?

5-Describe history of Unani system of medicine in brief, with the role and importance of Unani medicinal system at present in India.

6-What is the theory and history of homeopathy? Describe the present scenario of homeopathy system in India?

7-What are natural resources? Describe the different types of natural resources?

UNIT-5 TRIBALS AND ETHNOMEDICINES, PHYTOMEDICINES AND MODERN MEDICINES

Contents

5.1 OBJECTIVE

After the study of this unit students will get knowledge about the tribes, and tribal states.

- Their habit
- Tribal's use plants as a folklore medicine for remedies
- Knowledge about Ethnobotany
- Knowledge about Pharmacognosy

5.2 INTRODUCTION

Our ancestors use medicinal plants as old as mankind itself, their controlled application, isolation, and characterization of their active substances. All the plants contain different type of metabolites which is beneficial in different type of diseases. It is fact that extractive plant isolates and isolated active substances played a major role in the development of modern pharmacotherapy. Most of the isolated compounds are still used today, and some are the served as a model for the synthesis of a large number of drugs.

In India 8% of the geographical area of North- India consists of eight states, namely Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Tripura, and Sikkim, there are around 225 tribal communities and represent one of the biodiversity hotspots of the world with the richest plant diversity in India. Most of the tribal economies are engaged in subsistence agriculture and have developed a great knowledge of the use of plants and plant production in curing various ailments. The population has a deep belief in their native folklore medicine for remedies. They also collect various plants from the nearby forest for food, fodder, fuel, furniture, handicraft, and for the treatment of different ailments, and depend on local medical practitioners, popularly known as *Ochoi*. The *Ochoi* possesses very rich knowledge about the diagnosis and treatment of serious to minor diseases, and are generally specialists in the art of traditional folk medicine in their community. They also perform various magical rites and worship for the treatment of diseases Their knowledge is passed on from generation to generation by oral tradition, and much of the traditional knowledge has been kept secret from outsider's world. With the passage of time, traditional knowledge is vanishing rapidly due to a lack of documentation, and loss of interest in the younger generations Each community has its unique socio-cultural heritage, language, and food habits various studies have presented initial documentation of medicinal plants and their utilization by indigenous tribes on the region. Tribal people use medicinal herbs as remedies and health approaches free from side effects caused by synthetic chemicals. Recently, considerable attention has been paid to utilizing eco-friendly plant-based medicinal products for the prevention and cure of different human diseases.

Around 80% of the world's population has faith in traditional medicine. Officially 3000 plants recognize in India for their medicinal value. In rural India, 70% of the population is dependent on traditional Ayurvedic medicine. But for more popularity of Indian traditional Medicine it is necessary to increase marketing in the International market. And for International marketing evaluate the therapeutic potential of the drug as per WHO guidelines. Tribal people have their own way of selecting the plant, preparation methods, and fixingindications for the use of herbal medicine. Ethnobotanical studies are the best way to revealing of locally important plant species and plant-based drugs.

5.3 ETHNOMEDICINE

Ethnomedicine is a branch of medic of medical anthropology that deals with the origin of disease causes and treatment according to certain groups of people. The ethnomedicine aspect is an aspect that appears along with the development of human culture. In the field of medical anthropology, ethnomedicine gives rise to various terminologies. This branch is often called folk medicine, or primitive medicine, however, ethnomedicine is considered more appropriate.

The study of nature resources traditionally used to cure or manage ailments in diverse ethnic cultures is collectively termed "Ethnomedicine" Leopold Glück known as the father of Ethno Medicine. His published work on traditional medical uses of plants done by rural people in Bosnia (1896) has to be considered the first modern ethnobotanical work. And German physician Sarajevo at the end of the 19th century known as the father of modern ethnobotany.

From the ancient time our ancestors were usingmost of the plants, plant extracts, decoctions, or pastes are equally used by tribals and folklore traditions in India for the treatment of cuts and wounds. Active constituents play a role in the disease's cure via the activation of antioxidative enzymes, rupture the cell wall of bacteria, and play the role of chemopreventive through the regulation of cellular pathways.And Aloe vera Humectants in aloe vera bind moisture to the skin. Using it as a moisturizer can help stimulate both collagen and elastin fibers, boosting the elasticity of your skin. This could mean fewer fine lines and wrinkles.

India has a rich source of knowledge from the Vedas and the tradition of plant-based knowledge of health care. Indian tribals have been using plant or animal products used for medicine preparation and all these medicines are known as ethno- medicine and the plants which are used for that purpose are known as ethnobotany.

Ethnomedicine can broadlybe defined as the use of plants by humans as medicines, more accurately, it is called ethnobotanical medicine.Around 200,000 plant species are known all over the world. The World Health Organization has listed 21 000 plant species possessing medicinal properties in the world. In India about 2,500 plant species are used for medicinal purposes by traditional healers. All the research scholars use the different parts of plants which was used by local people of the plains or hilly areas in different aspects.

In India, the indigenous groups have their own food habit religious rites, distinct cultures, and a rich knowledge of traditional medicine. All the states have their own religious festivals to protect Plant biodiversity conservation like in Uttarakhand Phool Dei and Harela is the examples.

5.4 HISTORY: USE OF TRADITIONAL HERBAL MEDICINES

'Traditional' use of herbal medicines implies substantial historical use, and this is certainly true for many products that are available as 'traditional herbal medicines'. In many developing countries, a large proportion of the population relies on traditional practitioners and their armamentarium of medicinal plants in order to meet health care needs. Even modern medicine also exists side by side withsuch traditional practices, and herbal medicines have often maintained their popularity for historical and cultural reasons and the belief of local people. Such products are available commercially worldwide. An example is the use of ephedra (= Ma huang) for weight loss or athletic performance enhancement (Shaw, 1998).

The uses of medicinal plants and their preparation of drugs have been found on a Sumerianclay slab in Nagpur around 5000 years old. It comprised 12 recipes for drug preparation referring to over 250 various plants, some of them alkaloids such as poppy, henbane, and mandrake.

Chinese Writer Emperor Shen Nung circa 2500 BC wrote a book on root and grasses "Pen T' Sao" about 365 drugs (dried parts of medicinal plants), many of which are used even nowadays such as the following: *Rheirhisoma*, camphor, *Theae folium, Podophyllum*, the great yellow gentian, ginseng, jimson weed, cinnamon bark, and ephedra.

The Indian holy book Vedas mentions treatment with plants, which are abundant in that country. Numerous spice plants used even today originate from India: nutmeg, pepper, clove, etc.

Legislative criteria to establish traditionally used herbal medicines as part of approved health care therapies faces several difficulties. In a survey conducted across 129 countries, WHO reported the following issues regarding herbal medicines: lack of research data, appropriate mechanisms for control of herbal medicines, education and training, expertise within the national health authorities and control agency, information sharing, safety monitoring, and methods to evaluate their safety and efficacy. The support needed from different countries includes information sharing on regulatory issues, workshops on herbal medicines safety monitoring, general guidelines on research and evaluation of herbal medicines, provision of databases, herbal medicine regulation workshops, and international meetings.

National policies are the basis for defining the role of traditional medicines in national health care programs, ensuring that the necessary regulatory and legal mechanisms are established for promoting and maintaining good practice, assuring the authenticity, safety, and efficacy of traditional medicines and therapies, and providing equitable access to health care resources and their resource information (WHO, 2005). Another fundamental requirement is the harmonization

of the market for herbal medicines for industry, health professionals, and consumers (Mahady, 2001).

5.5 USE OF MEDICINAL PLANTS

The use of medicinal plants in the prevention and treatment of various diseases is known since ancient times. Documents of exquisite value show that herbs were extensively used by the human population throughout history. Since ancient times, people have sought safety and relief for their health problems with medicines from nature. Prehistoric men used a particular type of medicinal plantthat was already used by their ancestors. Over time, the use of herbal medicines and other natural products has developed on the basis of both positive and negative experiences. Neem Oil works as a natural substitute for anti-aging products and as a protective agent against skin damage caused by UV rays. It deeply penetrates the skin to restore moisture, enhance elasticity, smooth wrinkles, stimulate collagen production, and heal cracks caused by dryness.And coconut oil *protects the skin and has many antioxidants* that make it ideal for healing the skin. In addition, the antimicrobial properties balance out

5.6 INDIAN TRADITIONAL MEDICINE

Ayurveda is a medical system primarily practiced in India that has been known for nearly5000 years. It includes diet and herbal remedies while emphasizing the body, mind, and spirit in disease prevention and treatment.

TRADITIONAL MEDICINE
knowledge + skill+ practices based on the theories+ beliefs, and experiences indigenous to different cultures, whether it is explicable or not = used in the maintenance of health as well as in the prevention, diagnosis, improvement, or treatment of physical and mental illness World Health Organization (http://www.who.int/topics/traditional_medicine/en/).

Scope of Ethnomedicine

Ethnomedicine deals with information pertaining to social adaptation, deviant behavior, illness, disease, medical taxonomy, folk medical knowledge, and systems of medical care.

5.7 DIFFERENT METHODS OF PREPARATION OF TRADITIONAL MEDICINES

It included different methods which are applicable for the preparation of ethno – medicine like decoctions, infusions, or fresh plant material orally for most reported ailments, application of plant extracts and paste directly on wounds and infected areas of skin; snuffing the powdered

plant material for headaches and nose infections; smoking the powdered plant material for respiratory.

Commonly used methods in the extraction of medicinal plants

(i) Maceration. ...
(ii) Infusion. ...
(iii) Digestion. ...
(iv) Decoction. ...
(v) Percolation. ...

*(i) MACERATION***:** This is an extraction procedure in which coarsely powdered drug material, either leaves or stem bark or root bark, is placed inside a container; the menstruum is poured on top until completely covered the drug material. The container is then closed and kept for at least three days.

(ii) INFUSION: This is an extraction process such as maceration. The drug material is grinded into fine powder, and then placed inside a clean container. The extraction solvent hot or cold is then poured on top of the drug material, soaked, and kept for a short period of time. This method is suitable for extraction bioactive constituents that are readily soluble. In addition, it is an appropriate method for preparation of fresh extract before use. The solvent to sample ratio is usually 4:1 or 16:1 depending on the intended use.

Infusions are generally made from the softer parts of herbs like the flowers, tops and leaves, and decoctions are made from the harder or woodier parts of herbs like bark, lichens, hard fruits, larger seeds, and roots.

(iii) DIGESTION: This is an extraction method that involves the use of moderate heat during extraction process. The solvent of extraction is poured into a clean container followed by powdered drug material. The mixture is placed over water bath or in an oven at a temperature about 50^{o} C. Heat was applied throughout the extraction process to decrease the viscosity of extraction solvent and enhance the removal of secondary metabolites. This method is suitable for plant materials that are readily soluble.

(iv) DECOCTION: This is a process that involves continuous hot extraction using specified volume of water as a solvent. A dried, grinded, and powdered plant material is placed into a clean container. Water is then poured and stirred. Heat is then applied throughout the process to hasten the extraction. The process is lasted for a short duration usually about 15min. The ratio of solvent to crude drug is usually 4:1 or 16:1. It is used for extraction of water soluble and heat stable plant material.

Fig.5.1 Decoction

[Source:https://www.google.com/search?q=the+preparation+of+ethno+%E2%80%93+medicine+like+decoctions (retrieved on 10 Jul 2023)]

1. Take 25g of processed herb per 500ml water.
2. Pour 500ml of cold water onto the herb. It is important to begin with cold water to allow complete extraction of the soluble constituents as the water gradually heats.
3. If time allows, let the herb macerate (soak) for a few hours prior to heating
4. Cover the container and slowly bring the ingredients to a boil
5. Decrease the heat and simmer for 10 to 15 minutes. The harder the material, the longer it will need to be simmered for.
6. After decoction press the herb hard to remove all of the solution
7. Allow the decoction to cool, and then strain the liquid.

(v) PERCOLATION

The apparatus used in this process is called a percolator. It is a narrow-cone-shaped glass vessel with openings at both ends. A dried, grinded, and finely powdered plant material is moistened with the solvent of extraction in a clean container. More quantity of solvent is added, and the mixture is kept for a period of 4h. Subsequently, the content is then transferred into percolator with the lower end closed and allow to stand for a period of 24h. The solvent of extraction is then poured from the top until the drug material is completely saturated. The lower part of the percolator is then opened, and the liquid allowed to drip slowly. Some quantity of solvent was added continuously, and the extraction taken place by gravitational force, pushing the solvent through the drug material downward.

The detail of plant parts used in herbal medicines is as follows:

1. Roots—i.e., the fleshy or woody roots of many African plant species aremedicinal. Most of the active ingredients are usually sequestered in the root bark rather than the woody inner part.
2. Bulbs A bulb is an underground structure made up of numerous leaves of fleshy scales, e.g., *Allium sativa* (garlic) and *Allium cepa* (onions).

3. Rhizomes—Woody or fleshy underground stem that grows horizontally and brings out their leaves above the ground, e.g., *Zingiber officinale* (ginger), which is used for respiratory problems; *Imperata cylindrica* (spear grass) for potency in men and *Curcuma*, an antioxidant, anti-inflammatory, and anticancer drug
4. Tubers—Swollen fleshy underground structures which form from stems/roots, e.g., potatoes and yams such as *Dioscoreadumetorum (ona-(igbo))* for diabetes and *Gloriosa superba* for cancer.
5. Bark—The outer protective layer of the tree stem or trunk. It contains highly concentrated phytochemicals with profound medicinal properties. A host of plants have barks of high medicinal value.
6. Leaves, stems, and flowers of many plants are also medicinal.
7. Fruits and seeds also contain highly active phytochemicals and essential oils.
8. Gums, exudates, and nectars, which are secreted by plants to deter insects and grazing animals and to seal off wounds, are very useful in the pharmaceutical industries.

Sale of herbs in form of dried or fresh plant parts is as lucrative as the prepared medicines. They are usually displayed in markets and sold with instructions on how to prepare them for maximum efficacy.

Fig.5.2:-photograph of an herbalist displaying his herbs for sale

Fig. https://www.google.com/search?rlz=1C1YQLS_enIN984IN984&sxsrf=AB5stBgBuHCO8sBt0w_L0MSGp57m0U5FYw:1688703760228&q=pics+of+tribal+people+with+herbal+medicine&tbm=isch&chips=q:pics+of+tribal+people+with+herbal+medicine,online_chips:tribal+health:MtTtSLXVn7Y%3D&usg=AI4_-kTkf-LK-mvkNvzKfjoI131t5zXJHA&sa=X&ved=2ahUKEwiJgYne3_v_AhU9a2wGHb3jATYQgIoDKAJ6BAgYEBo&biw=1366&bih=625&dpr=1#imgrc=Ey6vuwYbOwiAhM retrieved on 7Jul 23.

5.8 TRADITIONAL MEDICINE AND ITS RELATIONSHIP WITH MODERN MEDICINE

Plants have been the primary source of most medicines in the world, and they still continue to provide mankind with new remedies. Natural products and their derivatives represent more than 50% of all drugs in clinical use, of which higher plants contribute more than 25%. These are no doubt more important in developing countries but quite relevant in industrialized world in the sense that pharmaceutical industries have come to consider them as a source or lead in the chemical synthesis of modern pharmaceuticals. These plants which had been used traditionally for ages have through improved scientific expertise been the sources of important drugs E Ajmalicine for the disorders and reserpine for high blood pressure and mentalillness both from *Rauvolfia serpentina,* L-Dopa for parkinsonism is obtained from Mucuna species, vinblastine and vincristinetreatmentof circulatory used for the treatment of leukemia from *Catharanthus roseus* etc.

ADVANTAGES AND DISADVANTAGES OF TRADITIONAL HERBAL MEDICINE

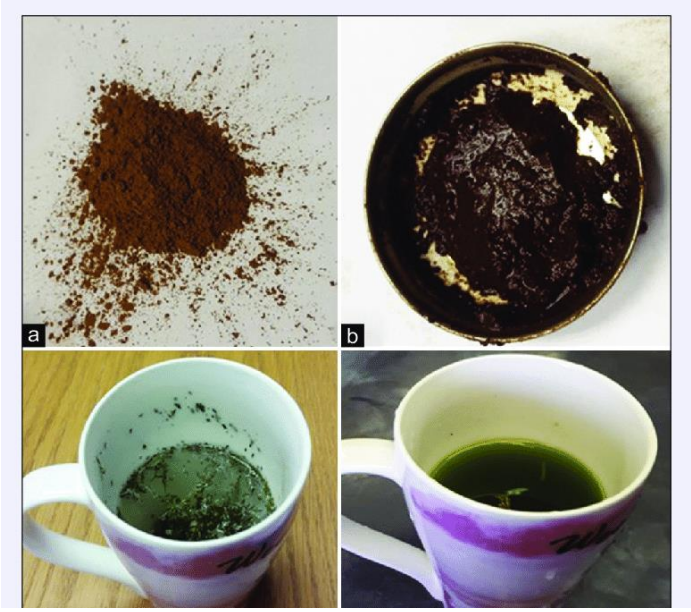
Both Western or traditional medicine come with their own challenges. Currently, there are many western drugs on the market which have several side effects, in spite of their scientific claims. In like manner, African traditional herbal medicine or healing processes also have their own challenges.

Advantages

Herbal medicine is “holistic” in the sense that it addresses issues of the soul, spirit, and body. It is cheap and easily accessible to most people, especially the rural population. It is also considered to be a lot safer than orthodox medicine, being natural in origin.

Disadvantages

Some of the disadvantages include improper diagnosis which could be misleading. The dosage is most often vague and the medicines are prepared under unhygienic conditions, as evidenced by microbial contamination of many herbal preparations sold in the markets.The knowledge is still shrouded in secrecy and not easily disseminated. Some of the practices which involve rituals and divinations are beyond the scope of non-traditionalists such as Christians who find it incomprehensible, unacceptable, and difficult to access such services.



Precautions when choosing herbal supplements

- Educate yourself. ...
- If you use herbal supplements, follow label instructions carefully and use the prescribed dosage only. ...
- Work with a professional. ...
- Watch for side effects. ...
- Be alert for allergic reactions. ...
- Research the company whose herbs you are taking.

Table-1: Plants used by Tharu Tribe for indigenous medicinal uses

FAMILY	BOTANICAL NAME	LOCAL NAME	DISEASE CURED	PU
Euphorbiaccae	*Acalypha indica* L.	Kuphi	Ear Problem	LF
Amaranthaceae	*Achyranthes aspera* L	Chattisa/Chircita	Boils	LF,RT
Rutaeae	*Aegle marmelos* (L.) Corea	Bel	Cholera	FR
Mimosaceae	*Albizia lebbeck* (L.) Benth	Siris	Boils	LF
Lilaceae	*Allium sativum* L.	Lehsun	Diarrhoea	BU
Apocynaceae	*Alstonia scholaris* (L.) R.Br	Chitwan	Cholera	BRK
Lamiaceae	*Anisomeles indica* (L.) Kuntze	Basingo	Gastric complaints	LF
Annonaceae	*Annona squamosa* L.	Sitaphal	Boils	LF
Papaveraceae	*Argemone maxicana* L.	Pili kantiya	Digestive disorder	SD
Euphorbiaccae	*Balioselia retusa (permum momnatum*	Danti/Vanchura	Asthama	LF

	(Willd) Mull-Arg			
Acanthaceae	*Barleria prionitis* L.	Pila bansa	Skin ailment	LF
Basellaceae	*Basella rubra* L.	Poy	Cold and cough	LF
Bombacaceae	*Bombax ceiba* L.	Semal	Burns	RT
Euphorbiaccae	*Bridelia retusa* (L.) Sprengel	Khaja	Abdominal pain	RT
Euphorbiaccae	*Bryophyllum pinnatum* (Lam) Oxen	Patharchut	Headache	LF
Asteraceae	*Caesulia axillaris* Roxb	Gorghanta	Cuts	FLW
Fabaceae	*Cajanus cajan* (L.) Huth	Arhar	Cholera	LF
Asclepidiaceae	*Calotropis procera* (L.) Dryander	Aankha	Boils	LF,FLW
Cannabinaceae	*Cannabis sativa* L.	Bhang	Dysentery	LF
Caesalpiniaceae	*Cassia tora* L.	Kasonji	Cold and Cough	LF
Menispermaceae	*Cissampelos pareira* L.	Madrachi	Bodyache	LF
Verbenaceae	*Clerodendrum viscosum Ventenat*	Bhatar	Cuts	LF
Cucurbitaceae	*Coccinia grandis* (L.) Voigt	Kanduri	Cholera	LF
Cucurbitaceae	*Cucumis sativus* L.	Kheera	Fever	LF

Abbreviation: Lf-leaf, RT-root, FRT-fruit, BRK-bark, SD-seed, FLW- flower, PU-parts used. (Source: Sharma et al 2011, "Medicinal plant used for primary health care by Tharu tribe of Udham singh nagar"; international journal Med. Arom. Plants.)

Table-2: Plants used by Bhotia Tribe for indigenous medicinal uses

BOTANICAL NAME	LOCAL NAME	FAMILY	USES
Aconitum heterophyllum Wall.	Atees	Ranunculaceae	Half tablespoon ground dry root is taken with boiled water during fever. Root is also chewed and sucked twice a day to control abdominal pain and vomiting.
Acorus calamus L.	Gurbach	Araceae	Dry root boiled with mustard oil is applied on the sprain region
Allium cepa L.	Piyaj	Liliaceae	Water extract of crushed/ground onion is given to control vomiting
Allium sativum L.	Lehsun	Liliaceae	Till (*Sesamum indicum L)* oil heated with spilled bulbs of garlic after cooling is poured in to the ear to reduce earache.
Allium stracheyi Baker.	Jambu	Liliaceae	A clean cloth dipped into leaf decoction is applied on wound
Brassica campestris L.	Sarsoun	Brassicaceae	Hot mustard oil is applied on the burns
Bergenia ligulata (Wall) Engl.	Pashanbhed	Saxifragaceae	Dry rhizome is chewed to remove kidney stone
Capsium annum L.	Mirch	Solanaceae	Paste is applied on the part of the body bitten by dog.
Carum carvi L.	Thoya or kala jeera	Apiaceae	Fried powdered seeds are taken with boiled water to relieve from indigestion.
Morus alba L.	Shahtoot	Moraceae	Fruit juice is taken against cough and

			cold.
Myristica fragrans Houtt.	Jayphal	Myristicaceae	Fruit paste is applied on neck or chest to get relief from cough.
Psidium guajava L.	Amrood	Myrtaceae	Leaves are chewed to get relief from blisters in mouth.
Punica granatum L.	Anar	Lythraceae	Leaves are boiled in half litre of water with ten rose leaves till the extract is reduced to half of its volume. Filtered extract with some butter is given for curing epilepsy / hysteria.
Rosa sp.	Gulab	Rosaceae	Leaf paste is applied on boils and ulcers. Juice extracted from leaves of red rose is taken against urine infection of children.
Saussurea obvallata Wall.	Brahmakamal	Asteraceae	Seed oil is applied on the head twice a day as a remedy for headache and mental problems. Flower is also cooked with taga misri and taken against urine tracts infection.

(Source: Prasanna k Samal ,et al 2010, "Indigenous medical practices of Bhotia tribal community in Indian central Himalaya", Indian Journal of Traditional Knowledge Pp,140-144)

5.9 THE PHYTOMEDICINES AND MODERN MEDICINES: ROLE; CLASSIFICATION OF DRUGS; UTILIZATION PRACTICES

Phytomedicine can be defined as an herbal medicine with therapeutic and healing properties. The use of plants for therapeutic purposes is one of the oldest practices of humankind. Preliminary sources of traditional folk knowledge based on the use of herbs in China dates back to around 3000 BC. There are three major areas, namely, food (foodstuffs), medicine (folk and traditional medicines), and research (phytochemical analysis), that predominantly find an immense use of herbal preparations and products and hence can be explored further. Phytomedicines (plant-derived drugs) express a vast array of biological activities and therefore, phytomedicines have been practiced worldwide since ancient times for the prevention and treatment of diseases. Chemical and biological barriers like insolubility, hydrophobicity, low bioavailability, and high toxicity restrict the application of such imperative phytomedicines. According to the World Health Organization (WHO), approximately 80% of the world's population uses plants to treat basic illnesses, mostly in the form of extracts or their active ingredients. The most common causes of adulteration are products with undeclared potent pharmaceutical substances, substitution or misidentification with toxic plant species, incorrect doses, and interactions with conventional medicines. Herbal medicine, also called botanical medicine or phytomedicine, refers to using a plant's seeds, berries, roots, leaves, bark, or flowers for medicinal purposes. Herbalism has a long tradition of use outside conventional medicine.

A medicinal plant is any plant which, in one or more of its organs, contains substances that can be used for therapeutic purposes or which are precursors for the synthesis of useful drugs. A number of plants have been used in traditional medicine for many years. Some do seem to work although there may not be sufficient scientific data (double-blind trials, for example) to confirm their efficacy. Such plants should qualify as medicinal plants. The term 'crude drugs of natural or biological origin' is used by pharmacists and pharmacologists to describe whole plants or parts of plants which have medicinal properties.

They have specific pharmacological effects on human health. Many of these substances have anti-inflammatory, anti-allergic, antioxidant, antimicrobial, antispasmodic, anti-aging, antidiabetic, and many other therapeutic effects.
Herbal medicine is also known as alternative medicine, phytomedicine, or botanical medicine. The practice of herbal medicine can be traced back to the beginning of civilization. This ancient practice started off as very crude and primitive sometimes bordering on being magical, but over the centuries, it has undergone numerous modifications and improvements leading to what it is today.

Phyto-medicine, also known as herbal medicine or botanical medicine, involves the use of plants and plant extracts for medicinal purposes. This traditional form of medicine has been practiced for thousands of years in various cultures around the world. In recent times, there has been a resurgence of interest in phytomedicine due to its potential economic and medical benefits. Here are some details about the economic potential of phyto-medicine and its role in the modern medical system:

1. Natural and Holistic Approach: A holistic approach to health is used in phytomedicine, which emphasises the well-being of the whole person. It frequently promotes dietary changes and lifestyle modifications, which may enhance long-term health.

2. Rich Biodiversity: Many regions of the world, particularly tropical and subtropical areas, are home to a wide variety of plant species with potential medicinal properties. This biodiversity provides a vast resource for the development of new pharmaceuticals and health products.

3. Pharmaceutical Industry: Phyto-medicines serve as a source of inspiration for the pharmaceutical industry. Plant compounds have been the basis for the development of numerous drugs, including aspirin (from *Willow* bark), quinine (from *Cinchona* bark), and morphine (from *Opium*-poppy). Pharmaceutical companies are continually exploring plant extracts for the discovery of new medicines.

4. Alternative and Complementary Medicine: Phyto-medicines are often used as complementary or alternative treatments for various health conditions. This has created a growing market for herbal supplements, teas, and other natural products, contributing to the economic growth of the herbal products industry.

5. Cultural and Traditional Practices: In many cultures, traditional herbal remedies continue to be widely used alongside modern medicine. This provides economic opportunities for those who grow, harvest, process, and sell medicinal plants.

6. Bioprospecting: Bioprospecting involves the systematic search for bioactive compounds in plants, and it has the potential to yield valuable discoveries. Pharmaceutical and biotechnology companies invest in bioprospecting to find new drugs or therapeutic agents.

7. Research and Development: Scientific research into the efficacy and safety of phyto-medicines is ongoing. This research generates jobs in the fields of botany, pharmacology, and clinical research, contributing to the economy.

8. Nutraceuticals: Many phyto-medicines are also used in the production of nutraceuticals—products that combine elements of nutrition and pharmaceuticals. These products often target specific health conditions and have a growing market.

9. Sustainable and Eco-Friendly Agricultural Practices: The cultivation of medicinal plants can promote sustainable agricultural practices. This can include organic farming methods, which are environmentally friendly and can generate income for farmers.

10. Safety Profile: When used responsibly and under the guidance of knowledgeable practitioners, many herbal remedies have a relatively low risk of adverse effects compared to some synthetic pharmaceutical drugs. However, it's essential to use them correctly and be aware of potential interactions with other medications.

11. Rich Source of Bioactive Compounds: Plants contain a wide array of bioactive compounds, such as alkaloids, flavonoids, polyphenols, and essential oils, which can have therapeutic properties. These compounds can be isolated and studied for their potential pharmacological effects.

12. Global Trade: The global trade in herbal medicines and medicinal plants is substantial. Export and import of these products contribute to international trade and can benefit countries with rich herbal traditions.

13. Integration into Modern Medicine: Some phyto-medicines are being integrated into modern medical systems. For example, herbal supplements are sometimes recommended by healthcare professionals to complement conventional treatments.

Although, phytomedicine has many potential applications, it is crucial to use caution and recognise its limitations. Not all herbal treatments are safe or effective for every individual or conditions. The effectiveness and safety of particular plants are still being studied, and while taking herbal remedies, especially for serious medical illnesses, it is essential to follow the advice of experienced healthcare specialists. Additionally, local variations in regulatory oversight and quality control of herbal products highlight the significance of sourcing products from reliable suppliers.

Herbal medicines or phytomedicines in the form of plant-based or plant-derived products are highly acclaimed for their proven efficacy in diabetes management in several clinical and preclinical studies worldwide.

1-Plants or plant parts used medicinally in galenical preparations (e.g. decoctions, infusions, etc.) e.g. Cascara bark.

2-Plants used for extraction of pure substances either for direct medicinal use or for the hemi-synthesis of medicinal compounds (e.g. hemi-synthesis of sex hormones from diosgenin obtained from *Dioscorea* yams);

3- Food, spice, and perfumery plants used medicinally, e.g. ginger;

4- Microscopic plants, e.g. fungi, actinomycetes, used for isolation of drugs, especially antibiotics. Examples are ergot (*Claviceps purpurea* growing on rye) or *Streptomyces griseus.*

5-Fiber plants, e.g. cotton, flax, jute, used for the preparation of surgical dressings.

6-The use of traditional medicine and medicinal plants in most developing countries, as a normative basis for the maintenance of good health, has been widely observed (UNESCO, 1996). Furthermore, an increasing reliance on the use of medicinal plants in the industrialised societies has been traced to the extraction and development of several drugs and chemotherapeutics from these plants as well as from traditionally used rural herbal remedies (UNESCO, 1998). Moreover, in these societies, herbal remedies have become more popular in the treatment of minor ailments, and also on account of the increasing costs of personal health maintenance. Indeed, the market and public demand has been so great that there is a great risk that many medicinal plants today face either extinction or loss of genetic diversity.

Classification of Drug

Drug classification is based on key parameters like solubility, dissolution rate and permeability, which control absorption.

Class I Drugs:- Absorption is maximum,

Class II Drugs:- Solubility limited,

Class III Drugs:- Permeability limited,

Class IV Drugs :-Poorly absorbable mentioned

Role in Modern Medical System

Numerous compounds found in plants, referred to as phytochemicals, have been shown to have anti-cancer, anti-metabolic, and anti-degenerative effects. For both humans and animals, these chemical-based natural sources are of utmost importance. A potential use for these chemical components is to combine herbal formulations with phytomedicine, in which one or more herbs are provided in specific amounts to provide benefits for cosmetic purposes, help in disease diagnosis, and lessen disease severity. Due to their rapid therapeutic effect, they were also utilised as antibiotics or analgesics, and their application in allopathic medicine is rapidly growing.

Many of people are still using phytomedicine because of the fewer side effects and achieved popularity as compared to synthetic drugs. Pharmacology is another word for a therapeutic plant's functions and how it interacts with the body. They include alkaloids, anthraquinones, anthocyanins, cardiac glycosides, coumarins, cyanogenic glycosides, glucosilinates, flavonoids, phenols, saponins, and tannins. Essential oils, which are highly significant in medical botany, are produced by several phytochemicals that are taken from plants. These oils are extremely complex substances that could include 100 or more different components. Resin and gums are closely connected to essential oils, which have potent antibacterial properties. Therefore, there is a need to study and conserve the flora of our world and its important phytochemicals.

Numerous examples demonstrate how phytomedicine, or herbal medicine, contributes in diverse ways to modern medical systems. The following are some of the main functions of herbal medicine in the modern medical system:

Antimicrobial Effects: *Tea tree oil* has natural antimicrobial properties and is used externally to treat bacterial and fungal diseases of the skin like acne and fungal infections (Carson et al., 2006).

Antioxidant Properties: *Green tea* contains catechins, which have high properties, Green tea extracts are used for their potential in reducing the risk of chronic diseases like cancer and cardiovascular disease (Arab and Il'Yasova, 2014).

Complementary and Integrative Medicine: By offering more therapeutic alternatives, phytomedicine augments conventional medicine. For example, St. John's wort (*Hypericum perforatum*) is used alongside prescription medications in some cases of mild to moderate depression (Linde et al., 2008). Its usefulness in elevating mood has been supported by some studies.

Cancer Supportive Care: Some herbal supplements, including Ginger and Turmeric, may reduce chemotherapy-related nausea and enhance the general health of cancer patients. *Curcumin*, a compound in turmeric, is under investigation for its potential anticancer properties.

Digestive Health: *Peppermint oil* is used to improve symptoms of irritable bowel syndrome (IBS) by relaxing the muscles of the gastrointestinal tract. According to Khanna et al. (2014), *Ginger* is another herb that helps with nausea and indigestion.

Immune Support: *Echinacea* is a well-known herb utilised to boost immunity, reduce the severity and length of the common cold, and support the immune system. It is available in a number of forms, such as capsules, teas, and tinctures (Shah et al., 2007).

Mental Health and Relaxation: *Lavender* is well known for its soothing and relaxing effects. It’s essential oil is used in aromatherapy and relaxation practices to reduce anxiety and promote better sleep.

Pain Management: Herbal remedies are effective for pain relief. According to Mason et al. (2004), *Capsaicin*, a compound produced from chilli peppers, is applied topically to treat pain caused on by neuropathy and osteoarthritis.

Respiratory Health: In order to treat respiratory symptoms like cough and congestion, herbal remedies like *Eucalyptus* and *Peppermint* are frequently employed (Kehrl et al., 2004). Cough drops and throat lozenges frequently contain menthol from peppermint.

Skin Conditions: Due to its hydrating and anti-inflammatory qualities, *Aloe vera* gel is frequently used to treat sunburn and numerous skin conditions. (Surjushe et al., 2008) It is also utilised in cosmetic items.

Traditional Medicine Systems: Herbal medicines play a significant role in traditional systems like Traditional Chinese Medicine (TCM) and Ayurveda. For instance, TCM uses herbs like ginseng and astragalus for a variety of health issues.

Wound Healing: Marigold (*Calendula*) is well known for its wound-healing therapeutic properties. It is used as an external ointments and creams to promote the healing of minor cuts, burns, and skin irritations (Preethi and Kuttan, 2009).

These instances highlight the various functions of phytomedicine in modern medical systems, from curing particular medical disorders to enhancing general health. But it's crucial to use herbal treatments under the supervision of medical specialists and with an awareness of any possible drug interactions or underlying health issues.

Uses

There is an increase of interest in the pharmaceutical industry to develop new medications from plants. Phytomedicine research has employed high-throughput screening methods and the increasingly popular “reverse pharmacology” methods.

Health promotion, disease prevention and chronic disease management are proactive approaches to health care that stresses prevention at different points along the health care continuum. Health promotion and disease prevention strategies focus on keeping people well and preventing diseases from occurring.

These strategies are referred to as primary prevention activities. Prevention is categorized into three levels (Commission on Chronic Illness, 1957):

1-Primary Prevention, which seeks to decrease the number of new cases of a disorder or illness. At this level of prevention, we have:

(a) Health promotion/education, and

(b) Specific protective measures (such as immunization)

2-Secondary Prevention, which seeks to lower the rate of established cases of a disorder or illness in the population (prevalence). This level essentially involves measures that ensure early diagnosis (such as screening) and prompt management.

3-Tertiary Prevention, which seeks to decrease the amount of disability associated with an existing disorder. This level involves:
(a) Disability limitation and
(b) Rehabilitation

The secondary and tertiary prevention activities focus on maintaining the health of individuals with chronic conditions, delaying progression of their conditions, and preventing complications.

5.10 SUMMARY

Ethno medicine is a traditional knowledge which should be preserved as is thought to be vanished in near future. Large scale exploitation of natural resources and dependency on chemical resources development by human beings open a path for future insecurity of natural resources and ultimately loss of human lives. Ethno medicine will be a good option for future generation as it is a technique which involves sustainable use of natural. Mostly, the plant leaves are used as raw material for medicine through direct consumption (juice of the plant parts) or by boiling, which is the most common way of preparation. Ethnomedicine. Ethno medicine has expanded its research focus by examining topics such as perception of the culture and disability and change in indigenous or traditional healing system as a result of globalization. A medicinal plant is any plant which, in one or more of its organs, contains substances that can be used for therapeutic purposes or which are precursors for the synthesis of useful drugs. A number of plants have been used in traditional medicine for many years. Some do seem to work although there may not be sufficient scientific data (double-blind trials, for example) to confirm their efficacy. Such plants should qualify as medicinal plants. The term 'crude drugs of natural or biological origin' is used by pharmacists and pharmacologists to describe whole plants or parts of plants which have medicinal properties.

5.11 SELF ASSESSMENT QUESTIONS

5.11.1 Multiple Choice Questions

1- The word herb is derived from-
(a) Herbarium (b) Herba
(c) Herbeum (d) Harba

2-Identification test of herbs includes.
(a) Macroscopic character (b) Chemical reaction
(c) Microscopic character (d) All the above

3- Processing of herbal raw materials include.

(a) Primary processing (b) Specific processing
(c) Drawing (d) All the above

4- Herbal drug preparations are prepared by …..
(a) Decoction (b) Infusion
(c) Maceration (d) All the above

5-The study of use of medicinal plants are known as…..
(a) Herbarium (b) Pharmacognosy
(c) Herbalism (d) None of the above

6-Herbs are defined as plants with…..
(a) Aromatic property (b) Flavouring properties
(c) Medicinal properties (d) All the above

7-The first literature having the concept of Ayurveda is …..
(a) Atharvaveda (b) Charka Samhita
(c) Sushruta Samhita (d) All the above

8-Ayurvedic literature which aimed on surgery is…..
(a) Atharvaveda (b) Charka Samhita
(c) Sushruta Samhita (d) All the above

9- According to Ayurveda there are how many stages of disease?
(a) Two (b) Four
(c) Five (d) Six

10-Homeopathy system of medicines is based on the principle of ……..
(a) Law of similar (b) Minimum dose
(c) Totality of symptoms (d) All the above

11-Classical Ayurvedic formulation includes……
(a) Ark (b) Bhasma
(c) Churna (d) All the above

12-Herbal granules which are used in Ayurveda is…..
(a) Churna (b) Pak
(c) Bhasma (d) Ghrita

13-Vati is another name of……
(a) Resins (b) Oils
(c) Powders (d) Tablets

14-Ark contains…….
(a) Herbal juices (b) Powder drugs
(c) Medicated butter (d) Distillates of herbs

15- Which of the following Nutraceutical is used in the treatment of cancer?
(a) Green tea (b) Garlic
(c) Ginseng (d) All the above

16-Alfalfa is useful in…..
(a) Prevent cancer (b) Help in digestion
(c) Reduce weight (d) None of the above

17- Ginger is useful in….
(a) Prevent cancer (b) Help in digestion
(c) Reduce Cholesterol (d) All the above

18-Common name of fenugreek is…….
(a) Methi (b) Garlic
(c) Saffron (d) None of the above

19. Health benefits of Spirulina are ….
(a) Reduce cholesterol (b) Prevent cancer
(c) Treat allergy (d) All the above

20. Ashwagandha is useful in treatment of……
(a) Blood sugar (b) Cancer
(c) Stress management (d) All the above

21. Garlic shows side effect like……..
(a) Diarrhoea (b) Heart burn
(c) Bleeding (d) All the above

22. Pepper should be avoided in…….
(a) Diabetes (b) Pregnancy
(c) Surgery (d) All the above

23. Stevia is an example of……
(a) Colorant (b) Binder
(c) Sweetener (d) Thickening agent

24. Flavours and perfumes are…
(a) Oils (b) Volatile oils
(c) Essential oils (d) Lipids

25. Traditional herbal formulation include:
(a) Syrups (b) Tablets
(c) Mixtures (d) All the above

26. Syrups are prepared by…….
(a) Solution with heating (b) Agitation without heating
(c) Both a and b (d) None of the above

27. Lycopene is present in…..
(a) Tomatoes (b) Papayas
(c) Watermelon (d) All the above

28. Garlic use as Nutraceutical food in
(a) Cardiovascular disease (b) Cancer
(c) Irritable bowel syndrome (d) All the above

29. Garlic has been effective against
(a) Gram positive (b) Gram negative
(c) Acid-fast bacteria (d) All the above

30-Synonym of Ashwagandha
(a) Indian ginseng (b) Poison gooseberry
(c) Winter cherry (d) All the above

31-Who is the father of Homeopathy system of medicine?
(a) Samuel Hahnemann (b) Hippocrates
(c) Theodotus (d) Charaka

5.11.1 Answer Key: 1-(b), 2-(d), 3-(d), 4-(d), 5-(c), 6-(d), 7-(b), 8-(c), 9-(d), 10-(d), 11-(d), 12-(b), 13-(d), 14-(d), 15-(d), 16-(a), 17-(d), 18-(a), 19-(a), 20-(c), 21-(d), 22-(a), 23-(c), 24-(d), 25-(d), 26-(c), 27-(d), 28-(a), 29-(d), 30-(d), 31-(a)

5.12 REFERENCES

- Akerele O. Traditional medicine: Nature's medicinal Bounty: Don't throw it away. World Health Forum. 1993;4:390-395
- Ayyanar M, Ignacimuthu S. Herbal medicines for wound healing among tribal people in South India: ethnobotanical and scientific evidences. *Int J Appl Res Nat Prod.* 2009;2:29–42. [Google Scholar)
- Bhattacharjee SK. *Hand book of medicinal plants.* Jaipur: Pointer Publishers; 2001. pp. 18–25. [Google Scholar]
- Bottcher H. *Miracle drugs.* Zagreb: Zora; 1965. pp. 23–139. [Google Scholar] [Ref list]
- Das et al., 2009, 2. Kelly K. *History of medicine.* New York: Facts on file; 2009. pp. 29–50. [Google Scholar] [Ref list]
- Gamble JS, Fischer CE. *Flora of presidency of Madras.* London: Adlard and Son. Ltd; 1936. [Google Scholar]
- Ingle KP, Deshmukh AG, Padole DA, Dudhare MS, Moharil MP, Khelurkar VC. Phytochemicals: Extraction methods, identification, and detection of bioactive compounds from plant extracts. *J PharmacognPhytochem.* 2017;6:32–6. [Google Scholar] [Ref list]
- Fransworth NR. Ethnopharmacology and drug development. *Cipa Found Symp.* 1994;185:42–51. [PubMed] [Google Scholar]
- Glesinger L. *Medicine through centuries.* Zagreb: Zora; 1954. pp. 21–38. [Google Scholar] [Ref list]Iwu MM, Igboko OA, Onwuchekwa AA, Okonji CO. Evaluation of the antihepatotoxic activity of the bioflavonoids of garcinia kola seeds. Journal of Ethnopharmacology. 1967;21:127-238.
- Hamman O. The Joint ICUN-WWF plants conservation programme and its interest in medicinal plants. In: Akerele et al., editors. Conservation of Medicinal Plants. Cambridge: Cambridge University Press; 1991. pp. 199-212.
- Hema ES, Sivadasan M, Anil KN. Studies on edible species of *Amaranthaceae* and *Araceae* used by *Kuruma* and *Paniya* tribes in Wayanad district, Kerala, India. *Ethnobotany.* 2006;18:122–126. [Google Scholar]
- Hooker JD. *Flora of British India.* London: L. Reeve & Co; 1875. [Google Scholar]
- Mbele M, Hull R, Dlamini Z. African medicinal plants and their derivatives: Current efforts towards potential anti-cancer drugs. Experimental and Molecular Pathology. 2017;103:121-134.
- Morgan, K. (2002) Medicine of the Gods: Basic Principles of Ayurvedic Medicine [http://www.compulink.co.uk/?mandrake/ayurveda.htm
- Majumdar, C. & G. Gupta. (2006). Applying NOAA Recommendation: A Contingent Valuation Study of Desirable Quality Water in Kolkata, India. Journal of Social and Economic Development, 8(1), 15-28.
- Street RA, Prinsloo G. Commercially important medicinal plants of South Africa: A review. Journal of Chemistry. 2013:205048. DOI: 10.1155/2013/205048.
- Shaw D. Risks or remedies? Safety aspects of herbal remedies. J. Roy. Soc. Med. 1998;91:294–296. [PMC free article] [PubMed] [Reference list].

- Saikat Sen, Raja Chakraborty, Biplab De & N. Devanna (2011).An ethnobotanical survey of medicinal plants used by ethnic people in West and South district of Tripura, India. *Journal of Forestry Research* volume 22, pages417–426.
- Tucakov J. *Healing with plants – phytotherapy.* Beograd: Culture; 1971. pp. 180–90. [Google Scholar] [Ref list]
- Wiart C. *Etnopharmacology of medicinal plants.* New Jersey: Humana Press; 2006. pp. 1–50. [Google Scholar] [Ref list]

5.13 TERMINAL QUESTIONS

5.13.1 Very Short Answer Type Questions

1. What is the meaning of Phytomedicine?
2. What is the role of Phytomedicine?
3. What are the methods of Phytomedicine?
4. What are the benefits of phytomedicines?
5. What is herbal medicine or Phytomedicine?
6. What is the difference between homeopathy and phytotherapy?
7. Which is better Ayurveda or homeopathy?

5.13.2 Short Answer Type Questions

1. Discuss precautions during use of herbal medicinal products.
2. What are the optimum storage practices for medicinal plant products?
3. How is clove oil used as medicinal oil?
4. What properties of *Curcuma longa* make it suitable for use as poultice?
5. Give the method for preparation of amla powder used for the medicinal purposes.
6. Identify the properties of *Oscimum santum* to be used as medicinal juice.
7. What parts of *Trigonella foenum-graecum* are used for medicinal purposes?
8. What is Decoction? How is it made?
9. What do you mean by Quality Assurance?
10. Write a brief note on various aromatic plants and their medicinal uses?
11. Give a brief introduction of processing related to medicinal plants?
12. What various precautions we should take during the use of herbal medicines products?
13. Write brief note on importance of quality control and quality assurance for herbal plants?
14. Give brief introduction of some important medicinal plants whose plant part is used herbal medicine?
15. What are the principles of treatment in homeopathic medicine?
16. Explain non pharmacopeias' parameters of quality control of herbal drugs.
17. How many branches and specialisation in Ayurveda?
18. What are modern methods of manufacture of traditional Ayurvedic formulations?
19. What do you mean by aromatherapy?

20. What are the factor affecting cultivation of herbal drugs?
21. What is the basic concept of Ayush system?
22. What is the traditional medicine used in India?
23. What is your opinion on herbal parenteral formulation?
24. What is the definition of cultivation of medicinal plant?

5.13.3 Long Answer Type Questions

1- Explain the utilisation of *Embelica officinalis* and *Allium sativum* as herbal powder.
2- Explain the various medicinal properties of *Azadirachta indica* and Aloe Vera employed for their utilisation as herbal decoction. Which ailments are they suitable for?
3- Discuss how plant parts can be used as surgical fibres and wound dressing, taking two plants as example.
4- Explain why *Gwarpatha* and *Azadirachta indica* are used for making lotions?
5- How are coconut oil and neem oil medicinally important? Discuss their properties?
6- What precautions should be taken while using herbal medicinal products?
7- Write a detailed note on human health and importance of balance diet.
8- How are the following plants important as drugs- a) Black Pepper b) Giloy
9- Define the medicinal plants? Describe historical background of Indian medicinal plants, their present and future needs in India?
10- Write an essay on cultivation practice of five important medicinal plants of Madhya Pradesh along their harvesting, storage, Marketing and demand?
11- How plant parts used as powder? Write the notes on medicinal importance of following plants: a) Amla b) Fenugreek c) Cinnamon d) Black Pepper
12- Write an essay on Indian traditional knowledge of Ayurvedic medicines in tribal areas Of Madhya Pradesh and its need of documents?
13- Explain the need for quality control of raw materials and extract .Describe WHO guidelines for quality control of herbal drugs?
14- Explain the importance of phyto pharmacological screening in herbal drug development? 15- Explain how the quality safety and efficacy of herbal medicine can be evaluated?
16-What are you understand by biodiversity .Which factor is affecting it?
17- What are the advantages of patenting natural product ?explain with example.
18- Write different method for processing herbal raw material and explain storage of herbal drug with example?
19- What are the challenges faced by the Ayush system with respect to its integration in the main stream medical system?
20- What are the methods used for cultivating of crude drugs?
21- Which model in mice is better to observe and study anti-cancer activity of a herbal formulation?
22- Define herbal technology? Write the scope and uses of herbal medicines in Indian traditional system?

23- Give a brief account of the major herbs used as herbal medicines?
24- How will you identify Indian Gooseberry also write its pharmacognosy?
25- What do you mean by secondary metabolites write the phytochemicals screening test of alkaloids and flavonoids?
26- Write about the techniques used for the extraction of various herbal plants?
27- What are herb & Herbal medicine? Write in brief about herbal cosmetics.

UNIT-6 PHYTOPHARMACEUTICAL DRUGS AND PHYTOREPELLENTS

Contents

6.1 OBJECTIVES

This unit provides a brief overview on phytopharmaceuticals drugs and phytorepellents (pesticides). After reading this unit you will be able to:

- Explain the phyto-pharmaceuticals and phytorepellents
- Define the types and medical applications of phytopharmaceuticals
- Define antibiotic and their uses
- Discuss about bio-pesticides and their classification.

6.2 INTRODUCTION

In previous units, we learnt about the ethnomedicine, phytomedicines and modern medicine. Phytomedicines, commonly referred to as herbal pharmaceuticals, are drugs derived from plants. They only contain one or more herbal compounds, herbal preparations, or mixtures of those as active components. Consequently, a phytomedicine, or phytopharmaceutical, is a complex mixture produced from plant sources that is utilised as a medicine or drug. In contrast to synthetic drugs containing chemically active substances, phytopharmaceutical drugs are composed of a wide range of natural compounds that activate or modify various target systems in an organism. Therefore, standardized medicinal plant extracts are utilised to ensure consistency in efficacy and safety. Evidence-based phytotherapy uses randomised controlled clinical trials to demonstrate its efficacy and safety. Compared to synthetic pharmaceuticals, herbal medicines are generally well-tolerated and offer a better benefit-risk balance. Therefore, first-line therapy for a variety of diseases and indications is evidence-based phytopharmaceuticals, which are increasingly referenced in clinical practise guidelines. Thus, in this unit we will highlight and cover the phyto-pharmaceuticals drugs and phytorepellents (bio-pesticides and their classification and antibiotics and its uses). We will also give emphasis to types and applications of phytopharmaceuticals.

6.3 PHYTOPHARMACEUTICALS

The word phytopharmaceutical comes from the Greek words *phyton*, which means plant, and *pharmakon*, which means medicine. In real meaning, these are herbal remedies made from ingredients like dried plant parts, leaves, blossoms, herbs, bark, or roots that have historically been used to treat undesirable diseases or illnesses. According to Bhatt (2016), they are described as a pure and formalised portion, such as an extract of a medicinal herb or its component that contains about four biologically active or phytochemical substances for use either internally or externally by living organisms for the detection, diagnosis, minimization, or containment of disease. The majority of herbal preparations available today are optimised extracts from natural

components using well-known extraction solvents, drug extract ratios, and processing procedures that result in a pharmacologically-active dry extract.

Contrary to synthetic medications, which are made up of a single, chemically active ingredient, phytopharmaceuticals are complex mixes of hundreds of different natural ingredients. Several isolated lead compounds are known to be pharmacologically active among them, while others are still being studied by scientists. The complex interactions of active ingredients in herbal medicines with their molecular target structures, such as receptors, enzymes, and transport systems, are what give them their therapeutic effects. Traditional academic medicine has its roots in herbal medicine as well. Even today, over 70% of medicines still include active chemicals that were first obtained from natural substances.

Many well-known active ingredients, like the analgesic morphine, the cardiac glycoside digoxin, and the anticholinergic drug atropine, are derived from plants. These isolated chemicals, however, are no longer regarded as phytopharmaceuticals because they are either created by chemical synthesis or are isolated and refined for use as single substances.

6.4 PHYTOPHARMACEUTICALS: TYPES AND MEDICAL APPLICATIONS

Phytochemicals include alkaloids, coumarins, volatile oils, tannins, resins, gums, polyphenols, terpenoids, phytosterols, and organosulfur compounds. Several of the most significant phytopharmaceuticals include anthocyanidins, carotenoids, phytoestrogens, lycopene, favonoids, terpenoids, limonoids, glucosinolates, polyphenols, isofavonoids, phytosterols, omega-3 fatty acids, resveratrol, and probiotics. They have distinct pharmacological effects that have an impact on human health (Singh *et al*. 2019). Many of these substances possess pharmacological qualities that are antibacterial, anti-inflammatory, anti-aging, anti-allergic, antioxidant, antispasmodic, antidiabetic, and a host of other medical benefits.

The most frequently noticed and studied phytochemical groups are polyphenols (Somani *et al*. 2015). In terms of antioxidant and prooxidant capabilities, 8,000 polyphenolic compounds have been identified so far (Ferguson 2001). Polyphenols have been shown to play a role in inducing apoptosis, inhibiting cell proliferation, migration, and the invasion of cancer cells at higher dosages, while at lower doses, they have been shown to scavenge free radicals in living organisms. In the words of Ferrazzano *et al*. (2011), polyphenols are chemical compounds that include one or more aromatic rings and one or more hydroxyl groups. Based on their chemical makeup, they are separated into four groups: phenolic acids, isofavones, favonoids, and stilbenes. Here some of the following phytoconstituents of therapeutic significance are describe:

6.4.1 ALKALOIDS

Alkaloids are organic compounds that occur naturally; they are most frequently found in plants, such as marine algae, and on a very rare occasion in animals (such as the poisonous secretions of

fire ants, ladybirds, and toads). They are mainly found in berries, bark, fruits, roots, and leaves of seed-bearing plants. Alkaloids frequently contain heterocyclic rings with at least one nitrogen atom. As a result of their basic nature, these are referred to as alkaloids (alkali-like). Alkaloids have a remarkable physiological impact on people and other animals. These are the main ingredients in many therapeutic plants and medications made from plants.

They vary from other groups of natural products in their structural variety and varied physiological actions. Alkaloids, such as atropine, strychnine, caffeine, nicotine, morphine, codeine, cocaine, and others, are created by nature and are utilised by humans for both medical and non-medical purposes. Alkaloids are generally stable substances that build up as byproducts of several biosynthetic pathways, most of which begin with common amino acids like lysine, ornithine, tyrosine, tryptophan, and others. These chemicals are typically colourless, however numerous colourful alkaloids have also been identified, for example Sanguinarine salt is copper-red, betanidin is red, and berberine is yellow (Kokate *et al.*, 2005). These are crystalline solids with a ring structure, fixed melting points, and a bitter flavour.

In plants they may exists in a free state, as salt or N-oxides, and are incredibly infrequently discovered as glycosides (Biswas and Sharia, 1978; Kashiwaba *et al*., 2000). The majority of alkaloids also contain oxygen along with the atoms carbon, hydrogen, and nitrogen. Only handfuls are oxygen-free, including coniine from hemlock (*Conium maculatum*) and nicotine from tobacco (*Nicotiana tabacum*). For example, strychnine hydrochloride is more soluble in water than in organic solvents but the free bases are readily soluble in organic solvents when they are salts.

6.4.1.1 DISTRIBUTION AND OCCURRENCE

Alkaloids are generally occur in all parts of the plant such as in seeds (Poppy), in fruits (Piper), in leaves (Belladonna), in roots (Rauwolfia), in rhizomes and roots (Ipecac), in corms (Colchicum) and in bark (Cinchona). However, sometimes alkaloids only accumulate in a single organ, while being absent from other organs. For instance, the edible tubers of the potato plant are free of alkaloids, whilst the green sections contain the toxic alkaloid solanine. Alkaloids are not always synthesised in the organ in which they collect. For instance, nicotine in tobacco is synthesised in the roots and then transported to the leaves, where it accumulates (Harborne and Herbert, 1995). More than 10,000 alkaloids have been found from various sources since the French pharmacy Derosne isolated the first alkaloid narcotine in 1803 and the Hanoverian apothecary Serturner discovered morphine in 1806 (Evans, 2006).

Alkaloids are commonly found in the orders Centrospermae, Magnoliales, Ranunculales, Papaverales, Rosales, Rutales, Gentiales, Tubiflorae and Campanulales. In lower plants, true alkaloids are quite rare. The bioactive alkaloids taxus, lycopodium, and ephedra are well known among the Pteridophytes and Gymnosperms. The two most well-known alkaloids isolated from fungi are lysergic acid and gliotoxin, which contains sulphur.

6.4.1.2 CLASSIFICATION OF ALKALOIDS

1. **TAXONOMICAL CLASSIFICATION**

This categorization is based on the distribution of alkaloids in different plant families, such as solanaceous or papilionaceous alkaloids. Sometimes they are categorised according to the name of the genus in which they are found, such as ephedra, cinchona, etc.

2. BIOSYNTHETIC CLASSIFICATION

This process highlights the precursor that the plant uses to biosynthesize alkaloids. Therefore, if multiple alkaloids with distinct taxonomic distributions and physiological activities are formed from the same precursor, they can all be classed together, for example, all indole alkaloids from tryptophan. The same classes of alkaloids, including ornithine, lysine, tyrosine, phenylalanine, tryptophan, etc., are generated from precursor amino acids.

3. PHARMACOLOGICAL CLASSIFICATION

This classification is based on the physiological or biological effects of alkaloids on animals, such as central nervous system (CNS) stimulants or depressants, sympathomimetics, analgesics, purgatives, etc. The chemical makeup of alkaloids is not taken into account by this method. Alkaloids can have many physiological effects while yet sharing the same chemical structure, for example, morphine is a narcotic-analgesic whereas quinidine is a heart depressant.

4. CHEMICAL CLASSIFICATION

The most often used classification system for alkaloids is this one. Three groups make up the alkaloids' classification.

a. True alkaloids: These are made from amino acids and have a heterocyclic ring with nitrogen.

b. Proto alkaloids: These come from amino acids and don't have heterocyclic rings with nitrogen, like colchicine.

c. Pseudo alkaloids: These are produced from terpenoids or purines but not amino acids and have a heterocyclic ring with nitrogen.

6.4.1.3 ROLE OF ALKALOIDS IN PLANTS

Over one hundred distinct alkaloids may be present in a single plant species, and their concentrations may range from a tiny portion to as much as 10% of the dry weight. Due to their high level of toxicity, the majority of alkaloids have the potential to play a role in a plant's chemical arsenal of defences against herbivores and microorganisms (Levin, 1976; Levin and York, 1978). For example, nicotine present in tobacco leaves inhibits the growth of tobacco hornworm larvae. Nicotine in pure form is also applied as an effective insecticide in greenhouses. In addition, alkaloids have also been suggested to function as a form of nitrogen storage or as a defence against ultraviolet radiation damage. Some phytochemists suggested that alkaloids are by-products of normal plant metabolism. It has been suggested that alkaloids may

have a role in the defence of the plant against singlet oxygen (1O2), which is damaging to all living organisms and is produced in plant tissues (Larson and Marley, 1984; Larson, 1988) in presence of light. It is also thought that alkaloids may provide a means of defence against insects and animals. Alkaloids may also be a reservoir (Wink and Michael, 1999) for molecules that plants often use. Some plant derived alkaloids and its activity and products are given in table 6.1.

Table: 6.1 List of plant origin alkaloids with their activity and products (Source: Roy, A. 2017)

Name of Alkaloid	Plant Name	Activity	Name of Products
Atropine	*Atropa belladonna*	Antidote	Abdominol, Espasmo, Protecor,
Ajmaline	*Rauwolfia serpentine*	Anti-arrhythmic	Aritmina, Gilurytmal, Rauwopur,
Berberine	*Berberis vulgaris*	Bacillary dysentery	Kollyr, Murine, Sedacollyre
Codeine	*Papaver somniferum*	Analgesic (Painkiller)	Antituss, Codicaps, Tussipax
Colchicine	*Colchicum autumnale*	Gout remedy	ColBenemid, Colgout, Verban
Caffeine	*Coffea arabica*	Stimulant	Agevis, Thomapyrine, Vomex A
Deserpidine	*Rauvolfia canescens*	Anti-hypertensive, Tranquilizer	Enduronyl
Ephedrine	*Ephedra sinica*	Anti-asthmatics	Bronchicum, Peripherin
Ementine	*Carapichea ipecacuanha*	Anti-protozoal	Cophylac, Ipecac, Rectopyrine
Lobeline	*Lobelia inflate*	Expectorants	Citotal, Lobatox, Stopsmoke
Morphine	*Papaver somniferum*	Pain relief, diarrhea	Duromorph, Oramprph,
Noscapine	*Papaver somniferum*	Anti-tussive	Bequitusin, Degoran, Tussisedal
Nicotine	*Nicotiana tobacum*	Stimulant	Nicabate, Nicorette, Stubit
Vincristine	*Catharanthus roseus*	Anti-cancer	Marqibo, Navelbine, Oncovin
Sanguinarine	*Sanguinaria Canadensis*	Antibacterial activity	Toothpastes and mouthwashes
Pelletierine	*Punica granatum*	Anthelmintics	Pelletierine tannate USP
Pilocarpine	*Pilocarpus pennatifolius*	Myotics	Frikton, Salegen, Vistacarpin
Quinidine	*Cinchona officinalis*	Antirrhythmic	Cardioquin, Duraquin, Quindex,
Reserpine	*Rauwolfia serpentine*	Antihypertensive	Abicol, Briserin, Sandril
Rescinnamine	*Rauvolfia serpentina*	Antihypertensive	Detensitral, Rauwopur
Tubocurarin-e	*Chondrodendron tomentosum*	Muscle relaxant	Jexin, Tubarine
Vinblastine	*Catharanthus roseus*	Antitumor	Periblastine, Velban, Velsar

Vincamine	*Vinca minor*	Anti-hypertensive	Aethroma, Pervin, Vincimax
Yohimbine	*Pausinystalia yohimbe*	Stimulant, aphrodisiac	Aphrodyne, Pasuma,

6.4.2 COUMARINS

Coumarins are derived from 1, 2-benzopyrones. These compounds can be found in higher plants, where they come from the main phenylpropanoid pathway and go through a variety of changes (Harborne, 1999). The numerous bioactivities of coumarins continue to draw attention. Some naturally occurring coumarins have been employed in human medicine, whereas 4-hydroxycoumarins are well-known examples of microbial alteration that gave rise to the first generation compounds produced along with aspirin and heparin as anticoagulants (Mueller, 2004). Additional uses may be made possible by recent advancements in a number of therapeutic areas, such as the symptomatic treatment of multiple sclerosis, photochemotherapy for T cell lymphoma, chemotherapy for drug-resistant tumours, organ transplantation, and the treatment of smokers for nicotine addiction.

6.4.2.1 DISTRIBUTION AND OCCURRENCE

According to Keating and O'Kennedy (1997), coumarin and its derivatives are a significant class of organic substances that are found throughout the natural world. Coumarins are secondary metabolites found in higher plants, few microorganisms (bacteria and fungi), and sponges. It is well renowned for having a scent that is similar to vanilla. Although the biggest concentration is typically in fruits and flowers, they can be found in the integument of seeds, fruits, flowers, roots, leaves, and stems.

Originally, coumarin was isolated from the seed of *Dipteryx odorata* which belongs to family Fabaceae. It was reported from many other families of plants, including Fabaceae i.e., Tonka bean (*Coumarouna odorata*) or sweetclover (*Melilotus alba*), Lamiaceae i.e., lavender (*Lavandula officinalis*), and Lauraceae i.e., cinnamon (*Cinnamonum verum*). Natural coumarins are generally unsaturated lactones and comprise another class of compounds C6C3. Structurally, they are considered derivatives of the ortho-hydroxy-cinnamic acid.

6.4.2.2 CLASSIFICATION OF COUMARIN

There are different classifications for the coumarin derivatives. Generally, they can be chemically classified according to the most common cores: simple coumarins, complex coumarins, and various coumarins. According to Borges *et al*. (2009), more complex coumarins are typically fused with other heterocycles. As a result, according to Venugopala *et al*. (2013), they can be divided into six different categories: simple coumarins, furocoumarins, dihydrofurocoumarins, pyranocoumarins (linear and angular), phenylcoumarins, and biscoumarins. As previously stated, a large number of coumarins, particularly plants, have been found in natural sources (Hoult & Paya, 1996; Iranshahi *et al*., 2009). Simple hydroxycoumarins,

furocoumarins and isofurocoumarins, pyranocoumarins, biscoumarins, and dihydroisocoumarins are some of the main coumarin constituents isolated from plants.

6.4.2.3 COUMARINS IN ETHNOMEDICINAL PLANTS AND THEIR PROPERTIES

The groups of plants that are rich in coumarin contain many valuable species that are frequently utilised as food for humans and animals as well as medicinal and aromatic herbs (Table 6.2). Among them are species whose biological activity has been well investigated and in which coumarins are one of the key active ingredients. Coumarins of significant pharmacological value have been identified from other botanical families in various geographical locations. Numerous coumarins with properties including anti-inflammatory, anticoagulant, antibacterial, antifungal, antiviral, anticancer, anti-hypertensive, antitubercular, anticonvulsant, anti-adipogenic, Cytochrome P450 inhibiting, anti-hyperglycemic, antioxidant, and neuroprotective were presented by Venugopala *et al.* (2013). Recent studies (Galvano *et al.*, 2001; Kostova, 2005) summarise and emphasise developments in the application of coumarins, particularly with regard to their antioxidant and anticancer characteristics.

Table: 6.2 List of plant origin Coumarin with botanical name and uses (Source: Matos *et al.*, 2015)

Name of coumarin	Botanical Name /Common Name	Family	Uses
Imperatorin, Bergapten, Oxypeucedanin, Marmesin, Xanthotoxin, Isopimpinellin	*Ammi majus* (Bishop's flower)	Apiaceae	Medicinal
Pyrano Coumarins	*A. visnaga* (Tooth pick weed)	Apiaceae	Medicinal
Aesculetin, Bergapten, Scopoletin	*Anethum graveolens* (Dill)	Apiaceae	Medicinal and food
Angelicin, Osthol, Bergapten, Isoimperatorin Umbelliferone,	*Angelica archangelica* (Angelica)	Apiaceae	Medicinal and food
Apigravin, Apiumetin, Apiumoside, Bergapten, Celerin, Celereoside	*Apium graveolens* (Celery)	Apiaceae	Medicinal and food
Umbelliferone	*Coraindrum sativum* (Corinder)	Apiaceae	Medicinal and food
Escopoloetina, Bergapten	*Cuminum cyminum* (Cumin)	Apiaceae	Medicinal and food
Umbelliferone, Esculetin, Bergapten, Seselin	*Foeniculum vulgare* (Fennel)	Apiaceae	Medicinal and food
Umbelliferone, Coumarin-sesquiterpene complexes e.g. Asacoumarin A & B	*Ferula assafoetida* (Asafoetida)	Apiaceae	Medicinal and food
Sesquiterpenic coumarin ethers	*Aegle marmelos* (Bael fruit)	Rutaceae	Medicinal and food
Sscopoletin, Umbelliferone, Bergamotin	*Citrus limonum* (Lemon tree)	Rutaceae	Medicinal and food

Herniarin, Scopoletin	*C. sinensis* (Orange tree)	Rutaceae	Medicinal and food
Xanthyletin, Xanthoxyletin,	*Zanthoxilum americanum* (Northern Prickly Ash)	Rutaceae	Medicinal
Coumarins (0.35%)	*Achillea millefolium* (Yarrow)	Asteraceae	Medicinal
1-2 Benzopirone	*Ageratum conyzoides* (Mexican ageratum)	Asteraceae	Medicinal
Scopoletin-7-glucoside	*Chamaemelum nobile* (Roman Chamomile)	Asteraceae	Medicinal and food
Umbelliferone and its methyl ether, Heniarin	*Matricaria recutita* (Chamomille)	Asteraceae	Medicinal and food
Coumarins (0.2–0.6%): 7-glucosil-umbeliferone	*Hieracium pilosela* (MouseEar)	Asteraceae	Medicinal
Coumarins (35,000 ppm)	*Dipteryx odorata* (*Coumarouna odorata*) (Tonka Bean, Coumaru)	Fabaceae	Medicinal
Coumarins (0.4–1%)	*Melilotus officinalis* (Yellow Sweet Clover)	Fabaceae	Medicinal
Glycyrin, Heniarin, Liqcoumarin, Umbelliferone	*Glycyrriza glabra* (Liquorice)	Fabaceae	Medicinal and food
Coumarins	*Myroxylon balsamum* (BalsamTolu)	Fabaceae	Medicinal
Coumarins	*Trigonella foenum-graecum* (Fenugreek)	Fabaceae	Medicinal and food
Coumarins	*Morus alba* (White Mullberry)	Moraceae	Medicinal
Coumarins	*Dorstenia brasiliensis*	Moraceae	Medicinal
Daphnetin, Daphnin, Acetylumbelliferone, Daphnoretin	*Daphne gnidium* (Flax-leaveddaphne)	Thymelaceae	--
Umbelliferone, Escopoletin	*Hypericum perforatum* (SaintJohn Wort)	Hypericaceae	Medicinal
Aesculetin, Aesculin	*Ocimum basilicum* (Basil)	Lamiaceae	Medicinal and food
Esculetin	*Salvia officinalis* (GardenSage)	Lamiaceae	Medicinal
Coumarins	*Cinnamomum cassia (C. aromaticum)* (Chinese cinnamon	Lauraceae	Medicinal and food

6.4.3 VOLATILE OILS

Volatile oils, which are the odorous components present in many plant sections, evaporate when exposed to air at room temperature. Volatile oils, such as peppermint oil, lemon grass oil, clove oil, citronella oil, caraway oil, etc., are also referred to as essential oils since they give plants their distinctive essence or fragrance. They can be extracted using a variety of techniques, including distillation, expression, enfleurage, enzymatic hydrolysis, and solvent extraction. They can be found throughout the entire plant or in any part of the plant, including the inflorescence,

flowers, fruits, leaves, bark peel; hairs modified parenchyma cells, in tubes, in lysigenous or schizogenous cavities.

Chemically, volatile oils are mixes of monoterpenes and sesquiterpenes that can be simple hydrocarbons, alcohols, ketones, aldehydes, phenols, ethers, oxides, esters, acids, aromatic, or aliphatic molecules chemically speaking. They are colourless while they are fresh, but oxidation causes them to deepen in colour after prolonged standing. They dissolve in organic solvents but are immiscible with water. They have high refractive index and optically active.

6.4.3.1 DISTRIBUTION AND OCCURRENCE

Volatile oils are frequently found in the species of Labiateae, Rutaceae, Piperaceae, Zingiberaceae, Umbelliferae etc. These occur in special secretary cells such as glandular hairs in Piperaceae family; Special tubes in pericarp of fruit of Umbelliferae family; Lysigenous (these cavities develop in the centre and formed as a result of cell lysis,) and schizogenous cavities (these cavities are formed due to large spaces between the cells) in stem of Pinaceae family. In individual plants, they may occur in all tissues e.g. petals of rose flower, bark of cinnamon, fruit of coriander, and leaves of peppermint

6.4.3.2 SIGNIFICANCE OF VOLATILE OILS

Volatile oils have enormous significance for both plants and human. Some of them are utilised for their medicinal effects, such as antibacterial, antifungal, antispasmodic, and antiseptic, while others are employed as flavouring agents or as scents in a variety of pharmaceutical formulations. They may function in plants as insect attractants that aid in flower cross-pollination or, in other instances, as insect repellents that keep insects away and spare the plants from being harmed. The following are a few uses for volatile oils:

1-Therapeutic Applications (Aromatherapy)

Aromatherapy is a type of alternative treatment that affects a person's health by utilising volatile liquid plant components known as essential Oils and other aromatic chemicals from plants. When handled carefully and responsibly, a plant's pure essence has been noticed to provide advantages that are both psychological and physical.

2-Pharmacological uses of volatile oil: The volatile oils are used against different diseases/ailments such as:

a) **Anti-inflammatory**: When applied to the skin, they are utilised as anti-irritants in rheumatism and inflammation, such as winter green oil (methyl salicylate + menthol).

b) **Carminative:** They have a carminative effect (relieve in digestion), such as fennel, coriander, and cardamom volatile oils.

c) **Expectorant:** Oil of eucalyptus is an effective expectorant.

d) **Local Anesthetics**: When applied to teeth, they serve as local anaesthetics, such as clove oil.

e) **Antibacterial:** Certain oils, including rosemary, clove, lemon, cinnamon, and thyme, have been proven to have antibacterial properties through *in-vitro* testing.

f) **Antiviral:** Volatile oil extracted from peppermint, ginger and thyme are reported to be effective against Herpes virus.

g) **Anxiolytic:** Lemon oil, lavender oil and rose oil relieve against anxiety.

h) **Antispasmotic:** Lavender oil, fennel oil and cardamom oil have sapamolytic effect.

i) **Anthelmentics**: Some are employed as anthelmentics (vermifuge) e.g. Chenopodium oil.

j) **Nasal Decongestants:** They are used as nasal decongestant e.g. menthol and camphor.

6.4.4 TANNINS

The word "tannin," which comes from the French word "tanin" (a substance that causes tanning), is used to refer to a variety of naturally occurring polyphenols. However, the term is also frequently used to refer to any large polyphenolic compound that has enough hydroxyls and other suitable groups (such as carboxyls) to form strong complexes with proteins and other macromolecules. They taste astringent and unpleasant and are soluble in water. According to Bate Smith and Swain (1962), tannins can range in molecular weight from 500 to over 3000 and can be divided into two main groups: Humic acids and Fulvic acids. Although having simplified, these structures reveal the complexity of tannins. These massive organic compounds are composed of the building blocks Gallic acid, Guaiacyl, Syringyl, and Cresylic moieties (Kunin, 1986).

Tannins are amorphous yellowish or light brown aggregates that resemble powder, flakes, or sponges. Plant polyphenols called tannins are astringent and bitter; they either attach to and precipitate proteins or shrink them. Following the ingestion of red wine, strong tea, or an unripened fruit, the tongue feels dry and puckery due to the tannins' astringency (McGee, 2004).

6.4.4.1 DISTRIBUTION AND OCCURRENCE

Tannins are distributed all over the plant kingdom. Tannins are formed upon the decomposition of vegetation. In the tissues of leaves, buds, seeds, roots, and stems, tannins can be detected. As an illustration of where tannins are present in stem tissue, consider how frequently they appear in tree growth regions like secondary phloem and xylem as well as the layer between the cortex and epidermis. The heartwood of conifers contains them as well.

It's interesting to note that tannins are present practically everywhere on Earth, in all kinds of environments. Lower plants such as algae, fungi and mosses do not contain much tannin. The percentage of tannins present in the plants, however, varies. While they are present in significant proportions in some plants, many others have too little of them. Tannins are typically found in

high amounts in the bark of trees, where they serve as a barrier for microorganisms and defend the tree.

6.4.4.2 CLASSIFICATION OF TANNINS

Tannins are classified into two groups on the basis of their ability to be hydrolysed.

1. Hydrolyzable tannin

There is a carbohydrate (often D-glucose) at the centre of each hydrolyzable tannin molecule. With phenolic groups like gallic acid (found in gallotannins) or ellagic acid (found in ellagitannins), the carbohydrate's hydroxyl groups are partially or entirely esterified. Hydrolyzable tannins are hydrolyzed by weak acids or weak bases to produce carbohydrate and phenolic acids. Examples of gallotannins are the gallic acid esters of glucose in tannic acid ($C_{76}H_{52}O_{46}$), which is present in the leaves and bark of numerous plant species, including red maple (*Acer rubrum*), Chinese nutgall (*Rhus chinensis*), sumac (*Rhus coriaria*), etc.

2. Non-hydrolysable or condensed tannins

Condensed tannins, often referred to as proanthocyanidins, are polymers made up of 2 to 50 (or more) flavonoid units that are connected by carbon-carbon bonds and are resistant to hydrolysis. Although the majority of condensed tannins and hydrolyzable tannins are water soluble, only a small number of very large condensed tannin types are insoluble (Wheeler, 1979). According to Haslam (1989) and Ping et al. (2011), commercial sources of condensed tannins include Quebracho wood (*Schinopsis lorentzii*), mimosa bark (*Acacia mollissima*), grape seeds (*Vitis vinifera*), pine barks, and spruce (*Picea* spp) barks.

6.3.4.3 USES OF TANNINS

Tannins are very important to humans. This section lists a few applications for tannins, including:

1) Tannins have potential as therapeutic ingredients in anti-diarrheal, hemostatic, and anti-hemorrhoidal. The anti-inflammatory properties of tannins help in reducing the symptoms of irritable bowel syndrome, esophagitis, enteritis, and gastritis.
2) They are not only cure burns and stop bleeding, but they also prevent infection while enabling the wound to continue internally healing (they provide a protective layer by precipitating the proteins from exposed tissues)
3) Tannins have been used to treat kidney issues, skin ulcers, tiredness, haemorrhaging, diarrhoea, dysentery, and sore throats right away.
4) Tannins have antiparasitic and microbial activity-inhibiting properties (Kolodziej & Kiderlen, 2005; Funatogawa *et al.*, 2004).
5) Tannins can also be helpful when administered to the mucosal lining of the mouth (Stephane *et al.*, 2004).

Pseudotannins

Pseudo-tannins are low molecular weight compounds associated with other compounds. Unlike hydrolysable and condensed tannins, they do not alter colour during the Goldbeater skin test, and they cannot be employed as tanning agents. Examples of pseudotannins include the catechins in cocoa and the chlorogenic acid found in coffee, nux vomica, ipecacuanha, and nux acid.Chlorogenic acid in coffee and nux vomica, ipecacuanha acid in ipecacuanha and catechins in cocoa are examples of pseudotannins. The drug is first extracted with water, then this extract is treated with ammonia solution before being exposed to air, which slowly leads the formation of a green colour.

Tannins Rich Foods

- **Tea:** Tea plant (*Camellia sinensis*) contains high natural amount of tannin. Tea leaf will have an astringent flavour when steeped in hot water known as a "tart" flavour. Tannins are the flavouring agents in tea. *Catechins* and *other flavonoids* are responsible for this. Tea "tannins" are chemically distinct from other types of plant tannins such as tannic acid (Hamilton-Miller, 1995).
- **Beer:** High amounts of tannins are present in the some beers. The quality of the yeast and other elements affect the tannin content of beer. Less bitter foods have fewer types of tannin, while more bitter foods contain more.
- **Wine:** Wine, especially red wine, contains tannins as well (mostly condensed tannins). There are numerous sources of tannins in wine, and each one has a unique set of tactile characteristics. Wine tannins are extracted from grape skins, stems, seeds and the kind of winemaking used greatly influences how they are extracted.

6.4.5 RESINS AND GUMS

The resins are hydrocarbon secretions from the specialized cavities of many plant species, especially coniferous trees. They are amorphous, solid or semisolid compounds with complex chemical makeup. These are believed to be end products of metabolism and are typically acquired as exudates from plants. Plants create resins and associated resinous compounds either naturally during growth or as a response to injury. They usually occur in schizogenous or schizolysigenous cavities or ducts. Resins frequently exist in uniform mixture with other plant-based compounds. These are collectively referred to as resin mixtures. Oleoresins, oleo-gum-resins, and balsams are resin combinations that are significant in the pharmaceutical industry.

In plants, they formed in specific duct-like structures and are secreted in response to injury or stress. The resins extracted from the bark of trees are transparent or translucent solids, semi-solids, or liquid substances and have a tendency to harden when exposed to air. These are soluble in common solvents like alcohol, turpentine, and ether but insoluble in water. Plants like *Vateria*

indica, Canarium strictum, Pinus spp., *Shorea robusta,* and *Gardenia resinifera* are the sources of the majority of resins.

All natural resins are derived from plants, with the exception of lac, which is the sole natural resin of animal origin and is produced by the lac insects (Thombare *et al*., 2022). *Kerria lacca* is the bug species that is most frequently cultivated for the production of lac resin. The sap of some trees and shrubs, including Kusum (*Schleichera oleosa*), Palas (*Butea monosperma*), Ber (*Ziziphus* sp.), Semialata (*Flemingia semialata*), and other minor hosts, is the food source for lac insects, which live as parasites. India, Thailand, China, Myanmar, Bangladesh, Malaya, and Vietnam generate the most of it (Srivastava and Thombare, 2023).

6.4.5.1Gums

The category of plant compounds known as gums is primarily created by a process known as gummosis, which involves the breakdown of plant cellulose. Unlike resins, gums can dissolve in water but are insoluble in alcohol and other organic solvents (Giri *et al*., 2008). The production of gum is widespread among tree species. Trees that produce a significant amount of gum include *Sterculia urens, Acacia nilotica, Anogeissus latifolia, Lannea coromandelica, Butea monosperma,* and *Azadirachta indica*. The seeds of several plants, including cluster bean (*Cyamopsis tetragonoloba*), *cassia tora*, etc., can also be used to make gum.

Gum-resins: They are a combination of gum and resin that contain traits common to both categories. Gum resins contain small amounts of essential oils and colouring materials. These are often secreted by plants found in dry areas. The *Boswellia serrata* tree, also known as Salaiguggul, is the source of the most widely used gum-resin.

Oleo-gum resins: Plant extracts in the form of oleo-gum resins are semi-solid. These are homogeneous mixtures of volatile oil, gum, resin, and trace amounts of other materials. Guggul (*Commiphora wightii*) and Asafoetida (*Ferula asafoetida* L.) are examples of oleo-gum resins.

Natural resins and gums (NRGs) serve a variety of medical purposes as well as the sociocultural, spiritual, and health demands of communities. The gums and resins harvested from the trees are used in local medicine to treat injuries, neurological conditions, and other ailments. Some important resins and gums yielding plant are listed in table 6.3.

Table 6.3 Important resins and gums yielding plant and it's used as traditional medicines (Source: Thombare *et al*., 2023)

S.N.	Botanical Name	Common Name	Family	Diseases Cured
A	**Resin yielding plants**			
1	*Canarium strictum*	Black dammar	Sapindaceae	Diarrhoea and dysentery.
2	*Vateria indica*	White dammar	Dipterocarpaceae	Cough, chronic bronchitis, throat troubles, skin eruptions, crack infection, ulcers, and

3	*Shorea robusta*	Sal	Dipterocarpaceae	Burning of the eyes, itching, wounds, ulcers, neuralgia, burns, fractures, fever, diarrhoea, dysentery, obesity.
4	*Gardenia resinifera*	Dikamali	Rubiaceae	Headache, running nose, intestinal worms, and piles
5	*Pinus spp.*	Chir pine, Blue pine, etc.	Pinaceae	Wounds, bloat
B	**Gum yielding plants**			
6	*Acacia senegal*	Gum Arabic tree	Fabaceae	Diabetes and digestive disorders
7	*Acacia leucophloea*	White bark acacia	Fabaceae	Intermittent fever
8	*Acacia nilotica*	Babu	Fabaceae	Headache
9	*Aegle marmelos*	Bael	Rutaceae	Diarrhoea and dysentery
10	*Anogeissus latifolia*	Gum ghatti	Combretaceae	Menorrhoea
11	*Astragalus sarcocolla*	Anzaroot	Fabaceae	Joint pain
12	*Azadirachta indica*	Neem	Meliaceae	Constipation
13	*Bombax ceiba*	Semal	Bombacaceae	Toothache
14	*Boswellia ovalifoliolata*	Salai guggul	Burseraceae	Postnatal complaints
15	*Buchanania axillaris*	Cuddapah Almond	Anacardiaceae	Rheumatism
16	*Buchanania lanzan*	Chironji	Anacardiaceae	Intercostal pain, toothache
17	*Butea monosperma*	Palas	Fabaceae	Sores, ulcers, boils, etc
18	*Caesalpinia crista*	Crested fever nut	Fabaceae	Stomach disorders
19	*Cassia tora*	Cakunda	Fabaceae	Skin diseases, asthma etc.
20	*Cassia sieberiana*	Drumstick tree	Leguminosae	Sores
21	*Ceiba pentandra*	White Silk-cotton tree	Malvaceae	Bowel complaints, uterine bleeding, dysentery and diarrhoea
22	*Coccinia grandis*	Ivy gourd	Cucurbitaceae	Eye disease
23	*Cochlospermum religiosum*	Katira	Cochlospermacea e	Cough and gonorrhoea
24	*Feronia limonia*	Wood apple	Rutaceae	Dysentery and diarrhoea
25	*Moringa oleifera*	Sahjan	Moringaceae	Ear pain, dental caries
26	*Plantago ovata*	Isabgol	Plantaginaceae	Constipation and diarrhoea
27	*Pterocarpus marsupium*	Indian Kino Tree	Fabaceae	Toothache
28	*Tamarindus indica*	*Tamarind*	Fabaceae	Stomach ache, constipation, etc
29	*Terminalia bellirica*	Baheda	Combretaceae	Urinary disorders

30	*Terminalia tomentosa*	Asan	Combretaceae	Burns and swellings
C	**Gum-Resins / Oleo-resin yielding plants**			
31	*Boswellia serrata*	Indian frankincense	Burseraceae	Rheumatoid arthritis, asthma, inflammatory, bowel disease, and skin diseases
32	*Commiphora wightii*	Guggul	Burseraceae	Joint pain, thrombosis, chronic bronchitis
33	*Convolvulus scammonia*	Sakmonia	Convolvulaceae	Dropsy
34	*Ferula asafoetida*	Hing	Apiaceae	Hysteria, dental carries, scorpion sting, etc
35	*Mangifera indica*	Mango	Anacardiaceae	Scabies and parasitic diseases of the skin
D	**Animal origin natural resin**			
36	*Kerria lacca*	Lac insect	Tachardiidae	Dysentery, diarrhoea, internal bleeding disorders, cough, hiccup, jaundice, obesity, skin diseases, leprosy, renal and spleen disorders, backache problems, joint disorders, ulceration, epilepsy, and chicken pox.

6.5 *PHYTOREPELLENTS: PESTICIDES AND ANTIBIOTICS*

Phytorepellents are substances derived from plants that have a tendency to deter or repel specific pests, such as insects, animals, or microbes. They are also known as phytochemicals and plant-based repellents. These organic repellents are used for a variety of things, such as safeguarding crops from pests, minimising insect bites, and discouraging undesired animals from entering specific areas. Phytorepellents are seen as an environmentally friendly and frequently safer alternative to synthetic chemical repellents. Some characteristics of phytorepellents are following:

1. They are naturally occurring chemicals in plants that act as a defense against pests (Natural pest deterrents).
2. It includes a wide variety of chemical substances, including as phenolics, alkaloids, terpenoids, and essential oils. These chemicals with pest-repelling capabilities may be produced in different numbers by different plant species.
3. Phytorepellents work through various mechanisms. They can interfere with the feeding and digestion of herbivores, disrupt their reproductive cycles, or deter them through their odor or taste.

4. They are mostly used in agriculture; it is natural alternatives to synthetic pesticides. They can be used in integrated pest management (IPM) strategies to reduce the reliance on chemical pesticides.
5. They frequently have fewer negative effects on non-target species and ecosystems, which can lead to more sustainable and environmentally friendly pest management

Some Examples of phytorepellents:

- **Citronella:** Citronella oil is a well-known plant-based insect repellent that is used for repelling off mosquitoes and other flying insects. It is obtained from various species of *Cymbopogon* grass. For outdoor activities, citronella candles, oils, and sprays are frequently utilised.
- **Catnip (*Nepeta cataria*):** Catnip contains a compound called nepetalactone, which is known to repel mosquitoes, flies, and other insects. It's used in some natural insect repellent products.
- **Garlic:** Pests including mosquitoes, aphids, and garden pests are all discouraged by the use of repellents made of garlic. Garlic sprays and solutions can be applied to plants and gardens.
- **Marigold:** A few types of marigold, like *Tagetes erecta*, have potent scents that can keep nematodes and other soil pests away. They are frequently used in vegetable gardens as companion plants.
- **Neem:** Neem oil, which is made from the seeds of the neem tree (*Azadirachta indica*), has ingredients that are effective at keeping a variety of pests away, such as insects, mites, and nematodes, at bay. It is used in agriculture, horticulture, and personal care products.
- **Pyrethrum:** Pyrethrum is an extract made from the blooms of some *Chrysanthemum* species, particularly *Tanacetum cinerariifolium* and *Tanacetum coccineum*. It is an ingredient in insecticides and insect repellant sprays because it contains pyrethrins, which are naturally occurring insecticidal chemicals.
- **Peppermint and Spearmint:** Rodents and insects can be repelled by the essential oils of peppermint and spearmint. They are employed to keep household pests like mice and ants at bay.

6.5.1 PESTICIDES

Pesticides are chemical compounds used to kill pests that are derived from natural resources like microorganisms, plants, and specific minerals. Generally, a pesticide is a chemical or a biological agent such as a virus, bacterium, antimicrobial, or disinfectant that repels, renders ineffective, or kills pests.

Pesticides have existed for a long time. To save their crops from insects and other pests, many ancient civilizations has been using pesticides. Ancient Sumerians used elemental sulfur to protect their crops from insects. Whereas, Medieval farmers experimented with chemicals using arsenic, lead on common crops. The Chinese used arsenic and mercury compounds to control body lice and other pests. While the Greeks and Romans used oil, ash, sulfur, and other materials to protect themselves, their livestock, and their crops from various pests. This use of pesticides is so common that the term pesticide is often treated as synonymous with plant protection product. It is commonly used to eliminate or control a variety of agricultural pests that can damage crops and livestock and reduce farm productivity. The most commonly applied pesticides are insecticides to kill insects, herbicides to kill weeds, rodenticides to kill rodents, and fungicides to control fungi, mould, and mildew.

What are pesticides?

A Pesticide is any substance or mixture of substances used to prevent, destroy, repel, mitigate or regulate the growth of any form of life designated as pest and any substance or mixture of substances intended for use as a plant regulator, defoliant, or desiccant. The pest can be insects, plant pathogens, weeds, mollusks, fish, nematodes (roundworms) and microbes that compete with humans for food, destroy property, spread diseases or are seen as a nuisance. The following pesticides are grouped by types of pests they kill or used to control such as *Algicides* for *Algae; Avicides-Birds; Bactericides-bacteria*; *Herbicides–unwanted plants; Insecticides–insect pests; Fungicides–fungal disease; Molluscicide- Molluscks (snails,* slugs) *Nematicides-Nematodes (roundworms); Piscicides-Fish; Miticides- mites* and *ticks; Rodenticide-Rodents (Rats and mice)* etc.

Pesticides include a variety of compounds, such as insecticides, fungicides, herbicides, rodenticides, molluscicides, nematicides, plant growth regulators, and others. After the 1960s, advanced nations prohibited or placed restrictions on the use of Organochlorine (OC) pesticides, which were used to combat diseases including malaria and typhus. The 1960s saw the introduction of Organophosphate (OP) insecticides, the 1970s saw the introduction of carbamates, the 1980s saw the introduction of pyrethroids, and the 1970s to 1980s witnessed the introduction of herbicides and fungicides, all of which had a significant impact on pest control and agricultural productivity.

Ideally a pesticide must be lethal to the targeted pests, but not to non-target species, including man. Unfortunately, this is not the case, so the controversy of use and abuse of pesticides has surfaced. Insecticides have been used by society for thousands of years. The major motivation for using insecticides was their role in controlling vector borne diseases like malaria, yellow fever etc. A pesticide should ideally be lethal to the targeted pests, but not to non-target species, including man. Since ancient times, people have utilised insecticides. The primary reason for utilising pesticides was their ability to combat vector-borne diseases like malaria and yellow fever, among others. The second primary principal was use of insecticides to prevent destruction

of food crops (about one-third of the world's crop yield) by pests or weeds during growth, harvesting and storage.

In this section you will be learn about the pesticides of biological origin which is known as bio-pesticides.

6.5.1.1 BIO-PESTICIDES

Bio-pesticides are substances that are used to manage infections and pests and are made from natural substances such as minerals, bacteria, plants, and animals. Bio-pesticides are defined by the USEPA (2008) as pesticides that have microbiological pesticides, plant-incorporated protectants, and biochemical pesticides as active ingredients. The word "biopesticide" is misused all over the world. Therefore, International Biocontrol Manufacturer's Association (IBMA) and International Organisation for Biocontrol (IOBC, 2008) adopted the word "biocontrol" in place of "bio-pesticides" (Guillon, 2003).

6.5.1.2 CLASSIFICATION OF BIO-PESTICIDES

The bio-pesticides can be categorised in a variety of ways depending on their mode of action, physical and chemical characteristics, physical nature, active ingredient, mode of application, based on target pest, etc., but the most commonly used and convenient classification is based on their source. A general classification based on the source of the bio-pesticides is shown in figure 6.1.

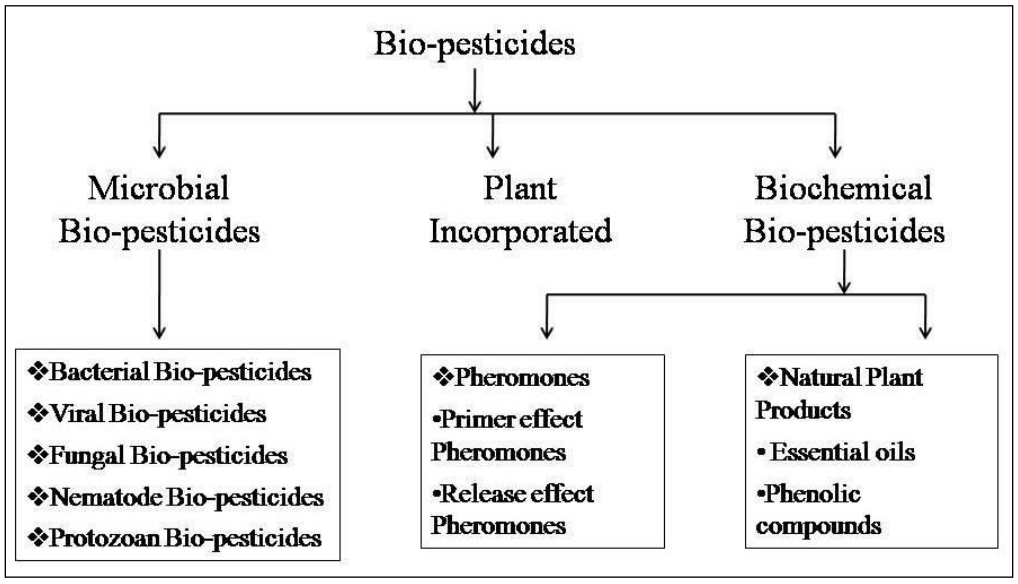


Fig. 6.1 Classification of Biopesticides

Biopesticides are categorised into three main groups:

i) MICROBIAL PESTICIDES

Microorganisms such as bacteria, fungi, viruses, or protozoa are the main component of microbial pesticides. Microbial pesticides can control many different kinds of pests, although

each separate active ingredient is relatively specific for its target pests. They are also known to control the insect by releasing a toxic substance that prevents the pest from growing. For instance, certain fungus kill particular insects, while others control particular weeds. There are approximately 200 microbial bio-pesticides available in more than thirty countries with their affiliation to Organization for Economic Co-operation and Development (OECD).

The most extensively used microbial pesticides are subspecies and strains of *Bacillus thuringiensis* (*Bt*). This bacterium creates several protein combinations, each of which particularly kills one or a small number of related species of insect larvae. Some *Bt* components specifically target the flies and mosquito larvae while others are more effective against the moth larvae that are found on plants.

ii) PLANT INCORPORATED-PROTECTANTS (PIPS)

Plant Incorporated-Protectants (PIPs) are pesticidal compounds that are produced by plants as a result of genetic modification with a particular gene able to produce the corresponding compound. These crops and plants are also known as GM crops since they include alien genes from several species. The *Bacillus thuringiensis* (*Bt*) gene was isolated from bacteria and introduced into crop and plant genetic material, making it the most commonly utilised genetic material. When the pest feeds on the *Bt* transgenic plant, the plant begins to produce poisonous cry proteins that work as insecticide. The Bt-cotton, Bt-brinjal, Bt-tomato, Bt-corn, etc. are typical examples. Genetically modified (GM) crops were first only somewhat accepted, but over the past 15 years, this acceptance has improved significantly.

iii) BIOCHEMICAL BIO-PESTICIDES

Biochemical bio-pesticides are compounds made from natural sources that operate non-toxically against the target pest. The category of biochemical bio-pesticides also includes compounds that attract or repel pests, disrupt pest growth or breeding, or interfere with other biological processes. Depending on how they work, the biochemical bio-pesticides can be broadly categorised into two kinds.

a) Pheromones

b) Natural Plant Products (Essential Oils, Phenolic compounds etc.)

a) Pheromones: Pheromones are volatile chemicals discharged by living organisms used to send messages to individuals - usually of the opposite sex of the same species. Pheromones released by one organism travel through the air or water medium and reach the second organism of same species, where they are detected by the receiver. Pheromones can be anything from tiny hydrophobic molecules to water-soluble peptides. These are divided into two groups:

i) Primer effect Pheromones: These pheromones are regulated through the gustatory (test) sensilla and induce the chain of the physiological effects. They have very limited value in insect pest control.

ii) Release effect Pheromones: These pheromones are regulated through the olfactory (smell) sensilla. The sex, aggregation and alarm pheromones comes under this category and widely used in the insect pest management.

b) Natural Plant Products (Essential Oils, Phenolic Compounds etc.)

Since ancient times, plants have been used as insecticides. Plant parts such as leaves, petals, stems, roots, and others were employed in prehistoric agricultural fields and storage as insecticides or insect repellents. Leaves of *Azadirachta indica*, flower buds of *Chrysanthemum* species, parts of *Eucalyptus* species, and *Ocimum* plants are only a few examples of plants that have traditionally been employed for their pesticidal capabilities. Many higher plants are capable of synthesising and producing a wide variety of secondary metabolites. These metabolites have the potential to be isolated and employed as insecticides. These typical plant compounds, which are categorised as essential/volatile oils and phenolics, are as follows:

i) Essential Oils: Essential oils (EOs) are secondary plant metabolites that can be found in various parts of the plant, including the leaves, roots, wood, bark, stem, flowers, and fruits. The fragrance or aroma of these substances is caused about due to the presence of several types of complex chemical molecules that can be categorised as *monoterpines, sesquiterpene, phenols*, *simple alcohols, ketones, coumarins*, etc. They have a volatile character. These have been referred to as weed killers, possible fungal, fungus, and microbe growth inhibitors, as well as insect and moth larvae and larval growth inhibitors. Essential Oils and their pure constituents, such as eucalyptol, menthol, eugenol, ocimine, and myrcene, are considered to be botanical pesticides because they have pesticidal characteristics. The following benefits are associated with using EOs as botanical pesticides:

- Eco Friendly: It is not hazardous to humans or other non-target creatures.
- High efficacy against a wide range of illnesses and pests those are significant to both agriculture and medicine.
- Multiple modes of action; the development of resistance is less likely because each blend contains a large number of active substances.
- Due to the low toxicity of the residues, there is little risk to health during application.

ii) Phenolic compounds and other biochemicals: In addition to essential oils, plant products such as pyrethrins, nicotine, picrotoxin, propolis, azadirachtin, and fusapyrone, among others, are used to manage insect pests. Pyrethrins are naturally occurring organic compounds derived from bud of the *Chrysanthemum cinerariifolium* flower, known for their potent insecticidal property. Another naturally occurring resinous compound is called propolis, which is derived from Poplar (*Populus deltoides*) and Fir tree (evergreen coniferous trees belonging to the genus Abies in the family Pinaceae) leaf buds and bark. Protein, amino acids, vitamins, minerals, and flavonoids are all present in propolis. It possesses antibacterial, antifungal, and antibiotic properties. In the past, people have employed nicotine and picrotoxin as pesticides. Both have neurotoxic effects on

nerve synapses and axons. Azadirachtin is a different widely utilised plant product made from neem seed kernels. It made a significant contribution to the creation of numerous commercial bio-pesticide formulations.

There are more than 100 commercial products made with azadirachtin that are successfully used throughout the world, including Margosan-O, Bio-neem, Azatin, Neemies, Safer's ENI, Wellgro, RD-Repelin, Neemguard, Neemark, Neemazal, Nimbin, and Nimbicidine. Other natural substances used commercially for pest control include juvenile hormones, are -asarone, ryanodine, and others.

6.5.1.3 PLANT WEALTH AS A SOURCE OF BIO-PESTICIDES

India's vast biodiversity offers several kinds of naturally occurring phytopesticides that can be employed efficiently on a broad scale in agriculture. They have minimal residual effects and are less harmful to humans and the environment than synthetic pesticides. Approximately 6000 plant species have been examined, and more than 2500 plant species from 235 families were found to produce metabolites useful in pest management strategies. According to Das (2014), the Asteraceae, Euphorbiaceae, Apocynaceae, Myrtaceae, Fabaceae, Meliaceae (maximum), Ranunculaceae, and Rosaceae plant families are the most significant plant groups that contain phytopesticide plants. The members of the plant families Solanaceae, Miliaceae, Asteraceae, Cladophoraceae, Labiatae, Oocystaceae, and Rutaceae perform a variety of larval, adulticidal, and repellent behaviours (Ghosh *et al*., 2012). The Annonaceae, Apiaceae, Lamiaceae, and Asteraceae families are a few more promising ones.

6.5.1.4 COMMERCIAL STATUS OF BIO-PESTICIDES

Insecticide plant products have been widely commercialised since the 1950s with the introduction of rotenone from *Lonchocarpus* sp, nicotine from *Nicotiana tabacum*, derris from *Derris elliptica*, and pyrethrum from flowers of *Chrysanthemum cinerariaefolium* (Isman, 2008). According to Grainage and Ahmed (1988) and Coats (1994), they are among the earliest chemicals employed to control important insects for agriculture and medicine. Recent data show that phytocompounds account for up to 1% of the global pesticide market (Anupam *et al.*, 2012). About 80% of the botanicals used worldwide are controlled by phytopesticides, one of which being pyrethrins. Most common Phytopesticides used in market are listed in Table 6.4.

6.5.1.5 ADVANTAGES OF PHYTO-PESTICIDES

The application of plant compounds in the form of pesticides has many advantages and some of them are inherently effective, eco-friendly, less hazardous to human and animal health, economical, less toxic to non-target species and restrict resistance development in the target organism (Regina *et al.,* 2014). In addition Phyto-pesticides prevent the dumping of thousands of tons of synthetic pesticides on the earth. Thus, they are safer to the user and environment because they are biodegradable and break down into harmless compounds in the presence of sunlight within hours or days. Thereby, largely results in avoiding the pollution problems. These offer the following advantages:

Table 6.4: List of Some common plant product used as bio-pesticides (Source: Bhan et al., 2019)

Plant Name and Family	Plant product used as bio-pesticides	Target pests
Citrus spp. Rutaceae	d-Limonene and Linalool	Fleas, aphids, mites, fire ants, several types of flies, paper wasps and house crickets
Azadirachta indica Meliaceae	Azadirachtin/Neem oil Neem cake Neem powder Bionimbecidine(GreenGold)	A variety of sucking and chewing insect (caterpillars, aphids, thrips, maize weevils), nematodes
Chrysanthemum cinerariaefolium Asteraceae	Pyrethrum / Pyrethrins	Ants, aphids, roaches, fleas, flies, and ticks
Lonchocarpus spp and Derris eliptica Fabaceae	Rotenone	Leaf-feeding insects, such as aphids, beetles (asparagus beetle, bean leaf beetle, Colorado potato beetle, cucumber beetle, flea beetle, strawberry leaf beetle, and others) leafhopper, red spider mite, caterpillars, fleas and lice on animals
Ryania speciosa Flacourtiaceae	Ryania	Caterpillars (European corn borer, corn earworm and others), beetles, bugs, aphids and thrips
Shoenocaulon officinale Melanthiaceae	Sabadilla	Bugs, thrips, caterpillars, leaf hoppers, blister beetles and flies
Nicotiana tabaccum Solanaceae	Nicotine	Aphids, thrips, mites, bugs, leafhoppers

The use of plant compounds as pesticides has many benefits, some of which include inherent efficacy, environmental friendliness, decreased risk to human and animal health, economic benefit, reduced toxicity to non-target species, and restriction of the emergence of resistance in the target organism (Regina *et al.,* 2014). Additionally, phytopesticides stop the release of countless tonnes of synthetic pesticides into the environment. They degrade into harmless substances in the presence of sunshine within hours or days, making them safer for the environment and the user. Therefore, the pollution issues are mainly avoided. These provide the following benefits such as:

- Able to decompose naturally (biodegradable).
- Effective in low concentrations and long-term pest control.
- Non-toxic and non-pathogenic nature towards targets.

- Microbial biopesticide residues have no negative effects on living things (zero or minimal residual effects).
- Potential use in Integrated Pest Management (IPM) and suitability for organic farming.
- Specificity towards a certain insect pest is made possible by a narrow spectrum of action or less chances to develop resistance by pests.
- These support plant growth and crop productivity by not harming beneficial insects for the environment, such as pollinators and soil microflora.

6.5.2 ANTIBIOTICS

The term "antibiotic" was coined from the term "antibiosis," which obviously means "against life." (‘anti’ means against and ‘bios’ means life). Numerous "definitions" of an antibiotic have been proposed over the years, the following ones are listed. The definition of an antibiotic that is most frequently used in scientific literature is "an organic chemical substance produced by a plant, an animal, or a micro-organism that has the ability to inhibit or kill, specifically, other microorganisms."

Investigations since 1943 have revealed that many plants, plant parts, and plant extracts have therapeutic properties (a fact that primitive man knew) and contain antibiotic agents (a fact that primitive man may have suspected), such as the anti-infective characteristic features of fungi and moulds usually observed in various food products like: mouldy bread, yoghurt, and soybean curds, and other similar materials to wounds and boils to control their infection. One may think of this type of traditional treatment as a folk medicine approach to antibiotic therapy. So yet, only a few numbers of antibiotics in pure form have been identified from the higher plants. Plant physiologists, bacteriologists, chemists, and medical professionals must work together and pool their respective expertise in order to identify, isolate, characterise, and evaluate antibiotics.

Penicillin was one of the most well-known medicines by 1940 after Alexander Fleming identified antibacterial chemicals from *Penicillium notatum* in 1929. Numerous researchers succeeded in isolating antibiotics from other microbes, for example; Rene Dubos who isolated two antibiotics, *gramicidin* and *tryocidine*, from a soil bacterium, *Bacillus brevis* (Pelczar *et al.*, 1986). Well-known antibiotics like *actinomycin, amphotericin, chloramphenicol, erythromycin, kanamycin, neomycin, gentamicin, streptomycin*, and *tetracycline* are generated by a class of microbes called actinomycetes. *Penicillin, griseofulvin*, and *cephalosporin* are examples of antibiotics produced by the aspergillate group of fungi. *Bacillus* is a genus of bacteria that generates antibiotics like *polymyxin B* and *bacitracin*. Additionally, ergot alkaloids can be extracted from a fungus in its dormant stage.

The discovery and use of natural substances as antimicrobials is greatly impacted by microbes. *Streptomycin, aureomycin*, and *chloromycetin* were later antibiotics that were discovered as a result of the penicillin discovery (Trease, 1972). Although higher plants have also served as a source of antibiotics, the majority of therapeutically utilised antibiotics are generated by fungi or

soil microbes (Trease, 1972). Examples of these are the bacteriostatic and antifugicidal properties of Lichens, the antibiotic action of allinine in *Allium sativum* (garlic), or the antimicrobial action berberines in goldenseal (*Hydrastis canadensis*) (Trease, 1972). Plant based antimicrobials represent a vast untapped source for medicines. Continued and further exploration of plant antimicrobials needs to occur.

In fact, the most effective and magnificent class of life saving antibiotics comprise of a plethora of active substances that are found to be effective on either Gram +ve or Gram –ve micro-organisms; besides the ones that are invariably known as the broad-spectrum antibiotics. In general, three well-known processes—fermentation, semi-synthetic chemistry, and synthetic chemistry—are used to produce antibiotics on a wide scale.

The first two processes mentioned above have recently experienced a great boost in production rate as well as improvements in yield and purity due to the introduction of a tremendous quantum jump and diversification in the specific field of "biotechnology." The fermentation procedure is yet further divided into two types: surface method; submerged method. The second approach, which has a significantly higher efficiency cap and is employed commercially, merits mentioning at this point. Many completely newer, purer, and high-yielding microbial strains have been discovered, attempted, and evaluated over time for evaluating their antibiotic producing strength in addition to the effectiveness in their extraction.

6.5.2.1 USES OF ANTIBIOTICS

Antibiotics are widely used as drugs to combat bacterial diseases. Examples are penicillin, obtained from the mould fungus *Penicillium notatum* and active against staphylococcal infections and many other gram-positive bacteria, and streptomycin, obtained from the actinomycete bacterium *Streptomyces griseas* and used to treat tuberculosis. Biosynthesis of antibiotics may be from amino acids (e.g. penicillin), sugars (e.g. streptomycin), or from acetate or propionate (e.g. tetracyclines). Commercial production is usually by large scale culture of the appropriate organism though some simple antibiotics, e.g. chloramphenicol, are cheaper to produce by artificial synthesis.

Plants based antimicrobials have enormous therapeutic potential. They are effective in the treatment of infectious diseases while simultaneously mitigating many of the side effects that are often associated with synthetic antimicrobials. They are effective, yet gentle. Many plants have tropisms to specific organs or systems in the body. Phytomedicines usually have multiple effects on the body. Their actions often act beyond the symptomatic treatment of disease. An example of this is *Hydrastis canadensis*. It has not only antimicrobial activity, but also increases blood supply to the spleen promoting optimal activity of the spleen to release mediating compounds (Murray, 1995).

6.6 SUMMARY

The word phytopharmaceutical comes from the Greek words *phyton*, which means plant, and *pharmakon*, which means medicine. In real meaning, these are herbal remedies made from ingredients like dried plant parts, leaves, blossoms, herbs, bark, or roots that have historically been used to treat undesirable diseases or illnesses. According to Bhatt (2016), they are described as a pure and formalised portion, such as an extract of a medicinal herb or its component that contains about four biologically active or phytochemical substances for use either internally or externally by living organisms for the detection, diagnosis, minimization, or containment of disease. Phytochemicals include coumarins, volatile oils, alkaloids, tannins, resins, gums, polyphenols, terpenoids, phytosterols, and organosulfur compounds. Several of the most significant phytopharmaceuticals include anthocyanidins, carotenoids, phytoestrogens, lycopene, favonoids, terpenoids, limonoids, glucosinolates, polyphenols, isofavonoids, phytosterols, omega-3 fatty acids, resveratrol, and probiotics. They have distinct pharmacological effects that have an impact on human health.

Phytorepellents are substance derived from plants that have a tendency to deter or repel specific pests, such as insects, animals, or microbes. They are also known as phytochemicals and plant-based repellents. These organic repellents are used for a variety of things, such as safeguarding crops from pests, minimising insect bites, and discouraging undesired animals from entering specific areas. In line with the increased interest in sustainable agriculture and minimising the negative environmental effects of chemical pesticides, phytorepellents constitute an eco-friendly solution to pest management. To achieve the best outcomes, it is necessary to fully grasp the unique pest-repelling characteristics of various plants and to incorporate them into pest management plans.

6.7 SELF ASSESSMENT QUESTIONS

6.7.1 Multiple Choice Questions

1. ----------contain one or more herbal compounds, herbal preparations, or mixtures of those as active components.

(a) Phytomedicine (b) Synthetic drugs
(c) Secondary metabolites (d) None of the above

2. ----------is a complex mixture produced from plant sources that is utilised as a drug.

(a) Phytopharmaceutical (b) Herbal medicine
(c) Phytomedicine (d) All of the above

3. Alkaloids are obtained from

(a) Poppy seeds (b) Rauwolfia roots

(c) Belladonna leaves (d) All of the above

4. The most well-known sulfur-containing alkaloids isolated from fungi are
(a) Lysergic acid and Gliotoxin (b) Aflatoxins and Gliotoxin
(c) Aflatoxins and Ochratoxin A (d) None of the above

5. Ephedrine obtained from-
(a) *Ephedra sinica* (b) *Lobelia inflate*
(c) *Catharanthus roseus* (d) *Cinchona officinalis*

6. Initially, Coumarin was isolated from the seed of----------
(a) *Cuminum cyminum* (b) *Ammi majus*
(c) *Dipteryx odorata* (d) *Melilotus officinalis*

7. Species of Labiateae, Rutaceae, Piperaceae, Zingiberaceae and Umbelliferae are mainly sources of
(a) Alkaloids (b) Volatile oils
(c) Gums (d) Tanin

8. The astringent taste and unpleasant odour and soluble in water are characteristics of
(a) Tannins (b) Gums
(c) Coumarins (d) Both A & B

6.7.1 Answer key: 1.(a); 2.(d); 3.(d); 4.(a); 5.(a); 6.(c); 7.(b); 8.(a)

6.8 REFERENCES

- Anupam, G., Nandita, C., Goutam, C., 2012. Plant extracts as potential mosquito Larvicides. Indian Journal of Medical Research; 135:581-598.
- Bate-Smith and Swain, 1962. Flavonoid compounds. In: Comparative biochemistry. Florkin M Mason HS (Eds), Vol III, Academic Press, New-York, 75-809.
- Bhatt, A., 2016. Phytopharmaceuticals: A new drug class regulated in India. *Perspectives in Clinical Research*, *7*(2), 59.
- Bhan, S., Mohan, L., and Srivastava, C.N. 2019. Phytopesticides of Indian origin. Journal of Entomology and Zoology Studies, 7(3): 641-643.
- Biswas G. K. and Sharia G. S., Indian J. For., 1 (1), 66, 1978.
- Borges F, Roleira F, Milhazes N, Uriarte E, Santana L. 2009. Simple coumarins: Privileged scaffolds in medicinal chemistry. Front Med Chem Biol Inter., ;4:23-85. DOI: 10.2174/978160805207310904010023.

- Coats, J.R., 1994. Risks from natural versus synthetic insecticides. Annual Review Entomology; 39:489-15.
- Das, S.K., 2014. Recent development and future of botanical pesticides in India. Popular Kheti; 2(2):93-99.
- Datta, S., Saxena, D.B., 2001. Pesticidal properties of Parthenon from *Parthenium hysterophorus* and related compounds. Pest Management Science; 57:24-28.
- Evans W. C., Trease and Evans' Pharmacognosy, 15th ed., W.B. Saunders Company, Elsevier Singapore, 2006.
- Ferguson, L. R., 2001. Role of plant polyphenols in genomic stability. *Mutation Research/Fundamental and Molecular Mechanisms of Mutagenesis*, *475*(1–2), 89–111.
- Ferrazzano, G. F., Amato, I., Ingenito, A., Zarrelli, A., Pinto, G., & Pollio, A., 2011. Plant polyphenols and their anti-cariogenic properties: A review. *Molecules*, *16*(2), 1486–1507.
- Funatogawa, K., Hayashi, S., Shimomura, H., Yoshida, T., Hatano, T., Ito H et al., 2004. Antibacterial activity of hydrolysable tannins derived frommmedicinal plants against Helicobacter pylori. Microbiol. Immunol, 48(4):251-261.
- Galvano F, Piva A, Ritieni A, Galvano G. Dietary strategies to counteract the effects of mycotoxins: A review. Journal of food protection. 2001;64(1):120-31.
- Ghosh, A., Chowdhury, N., Chandra, G., 2012 Plant extracts as potential mosquito Larvicides. Indian Journal of Medical Research; 135:581-598.
- Giri, S. K., Prasad, N., Pandey, S. K., Prasad, M. and Baboo, B., 2008. Natural resins and gums of commercial importance–At a glance, (ICAR-Indian Institute of Natural Resins and Gums, Ranchi, Jharkhand).
- Grainage, M. and Ahmed, S., 1988. Handbook of plants with pest control properties. New York: Wiley; 470.
- Guillon, M. L. 2003. Regulation of biological control agents in Europe. In: Roettger U, Reinhold M (eds) International symposium on biopesticides for developing countries. CATIE, Turrialba, pp 143–147.
- Hamilton-Miller, J.M., 1995. Antimicrobial properties of tea (*Camellia sinensis* L.). Antimicrobial Agents Chemother; 39(11):2375-2377.
- Harborne, J. B. 1999. Natural Coumarins chemistry and biochemistry, Verlag.
- Harborne, J. B. and Herbert B., eds. Phytochemical Dictionary: A Handbook of Bioactive Compounds from Plants. Bristol: Taylor & Francis, 1995.
- Haslam, E., 1989. Plant Polyphenols, Vegetable Tannins Revisited. Cambridge University Press, Cambridge, UK .
- Hoult J, Paya M. 1996. Pharmacological and biochemical actions of simple coumarins: natural products with therapeutic potential. General Pharmacology., 27(4):713-22. DOI:10.1016/0306-3623(95)02112-4.
- https://agritech.tnau.ac.in/farm_enterprises/Farm%20enterprises_%20bio%20pesticides.html
- https://www.epa.gov/ingredients-used-pesticide-products/what-are-biopesticides

- Iranshahi M, Askari M, Sahebkar A, Hadjipavlou-Litina D. 2009. Evaluation of antioxidant, anti-inflammatory and lipoxygenase inhibitory activities of the prenylated coumarin umbelliprenin. DARU., ;17(2):99-103.
- Isman, M.B., 2008. Perspective botanical insecticide: for riche, for poorer. Pest Management Science; 64:8-11.
- Kashiwaba N., Ono M., Toda J., Sujuki H. and Sano T., 2000. Aporphine glycosides from Stephania cepharantha seeds J. Nat. Prod., 63(4): 477.
- Keating G.J., O'Kennedy R., 1997. The chemistry and occurrence of coumarins. O'Kennedy RTRD, editor. England: John Wiley & Sons West Sussex.
- Kokate, C.K., A.P. Purohit and S.B. Gokhale, 2005. Pharmacognosy. Nirali Prakashan, 30th Edn.
- Kolodziej, H., Kiderlen, A.F., 2005. Antileishmanial activity and immune modulatory effects of tannins and related compounds on Leishmania parasitised RAW 264.7 cells. Phytochemistry, 66:2056–2071.
- Kostova, I., 2005. Synthetic and natural coumarins as cytotoxic agents. Current Medicinal Chemistry - Anti-Cancer Agents., 5(1):29-46. DOI:10.2174/1568011053352550.
- Kunin, R. 1986. The Role of Organic Matter in Water Treatment - A Universal Theory. Amber - Hi - Lites.
- Larson R. A. and Marley K. M., 1984. *Phytochemistry*, **23**, 2351, 1984.
- Larson R. A., 1988. *Phytochemistry*, **27**, 969.
- Levin D. A. and York B. M., 1978. *Biochem. Syst. Ecol.*, **6**, 61.
- Levin D. A., 1976. *Amer. Natur.*, **110**, 261.
- McGee, H., 2004. On Food and Cooking. Simon & Schuster, New York, 714.
- Matos, M.J., Santana, L., Uriarte, E., Abreu, O.A., Molina, E., and Yordi, E. G. 2015. Coumarins- An Important Class of Phytochemicals. http://dx.doi.org/10.5772/59982.
- Mishra, S., Thombare, N., Ali, M. and Swami, S., 2018. Applications of biopolymeric gels in agricultural sector, In: Polymer gels, (Springer, Singapore), p. 185-228.
- Mueller, B. N. 2004. Plant generation agents, aspirin, heparin and coumarins. Best Pract. Res. Clin Haematology, 17: 23-53.
- Murray, M., 1995. The healing power of herbs. Prima Publishing. Rocklin, CA. p. 162–171.
- Pelczar, M. J., Chan, E. C. S and N. R. Krieg (1986). Microbiology. McGraw-Hill International 5th Edition
- Ping, L., Laurent Chrusciel, L., Navarrete, P., Pizzi, A., 2011. "Extraction of condensed tannins from grape pomace for use as wood adhesives". Industrial Crops and Products. 33: 253–257.
- Regina, W., Mwanauta, Kelvin Mtei, A., Patrick Ndakidemi, A., 2014. Prospective bioactive compounds from *Vernonia amygdalina, Lippia javanica, Dysphania ambrosioides* and *Tithonia diversifolia* in controlling legume insect pests. Agricultural Sciences; 5:1129-1139.

- Roy, A. 2017. A review on the alkaloids an important therapeutic compound from plants. International Journal of Plant Biotechnology, 3(2).
- Singh, A., Sengar, R. S., Singh, A. K., Singh, S., Kumar, A., & Ahmad, K., 2019. Impact of genetic engineering on agriculture food crops. *Biotech Today: An International Journal of Biological Sciences*, *9*(1), 17–24.
- Somani, S. J., Modi, K. P., Majumdar, A. S., & Sadarani, B. N., 2015. Phytochemicals and their potential usefulness in infammatory bowel disease. *Phytotherapy Research*, *29*(3), 339–350.
- Srivastava, S. and Thombare, N., 2017. Safety assessment of shellac as food additive through long term toxicity study, Trends Biosci, 10 (2): 733-740.
- Stephane, Q., Tatiana, V., Diana, K., Michael, J., Patrick, P., Christian, B. et al., 2004. Main structural and stereochemical aspects of the antiherpetic activity ofnnonahydroxyterphenoyl-containing Cglycosidic ellagitannins. Chemistry & biodiversity, 1(2):247-58.
- Thombare, N., Kumar, S., Kumari, U., Sakare, P., Yogi, R. K., et al., 2022. Shellac as a multifunctional biopolymer: A review on properties, applications and future potential, Int J Biol Macromol, 215: 203-223.
- Thombare, N., Kumari, U., Sakare, P., Chowdhury, A. R., Lohot, V. D. and Prasad. P., 2023. Indigenous technical knowledge on the medicinal uses of natural resins and gums in India. Indian Journal of Traditional Knowledge, 22 (2):40-349, DOI: 10.56042/ijtk.v22i2.52363.
- Trease, G. and Evans, W., 1972. Pharmacognosy, Univ. Press, Aberdeen, Great Britain. p. 161-163.
- Venugopala KN, Rashmi V, Odhav B. 2013. Review on Natural Coumarin Lead Compounds for Their Pharmacological Activity. BioMed Research International, 1-14. DOI:10.1155/2013/963248.
- Wheeler, S.R., 1979. Tea and Tannins. Science; 204 6-8.
- Wink, Michael, 1999. ed. *Biochemistry of Plant Secondary Metabolism*. Sheffield, UK, and Boca Raton, FL: Sheffield Academic Press and CRC Press, 1999.

6.9 SUGGESTED READINGS

- Harborne, J. B. 1999. Natural Coumarins chemistry and biochemistry, Verlag.
- Kar, Ashutosh. 2003. Pharmacognosy and Pharmacobiotechnology, New age international (P) Limited, Publishers, New Delhi.
- Singh, A. (2018). The future of phytopharmaceuticals. www.pharmabiz.com/News Details. aspx?aid=110880 &sid=9.
- Kokate, C.K., A.P. Purohit and S.B. Gokhale, 2005. Pharmacognosy. Nirali Prakashan, 30th Edn.
- Pandey, M., Debnath, M., Gupta, S. and Chikara, K. (2011). Phytomedicine: An ancient approach turning into future potential source of therapeutics, 3(2), pp. 27-37.

- Venketeshwer Rao, (2012). Phytochemicals: A Global Perspective of Their Role in Nutrition and Health Published by CRC Press.

6.10 TERMINAL QUESTIONS

6.10.1 Short Answer Type Questions

1. What is phytopharmaceuticals?
2. Write a short note on volatile oils and its significance.
3. Briefly describe about resins and gums with examples and it's used as traditional medicines
4. What do you understand by Pesticides?
5. Write a short note on plant wealth as a source of bio-pesticides

6.10.2 Long Answer Type Questions

1. Give a detail account on phytopharmaceuticals. Explain its types and applications.
2. What are phytochemicals? Describe phytoconstituents and therapeutic significance of alkaloids and coumarins.
3. Describe about any three phytoconstituents with their classifications and therapeutic uses.
4. What do you understand by bio-pesticides? Define its classification, sources and advantages.
5. What are phytorepellents? Explain about antibiotics and its uses.

UNIT-7 ETHNOBOTANY- CONSERVATION OF SACRED PLANTS

Contents

7.1 OBJECTIVES

The main objective of this unit is to gain knowledge about the sacred plants used in ancient Indian culture and to promote awareness about the spirituality of trees being worshiped in our culture. Trees are often seen as symbols or manifestations of divine knowledge. They have the power to bestow eternal life or renew the life force. It is a strong and popular method of plant conservation. Our ancestors believe that they're indebted to trees. Our ancestors were wise and dedicated themselves to conserving the tree wealth of our country by worshiping. Going through this unit will make you aware of:

1. Spiritual applications of ethnobotany.
2. Introduction to Sacred plants
3. Tree worship and its historic roots in our culture.
4. Scientific basis of spiritual considerations of tree worship.
5. Our common sacred/spiritual plants.
6. Tree worship, the strong and popular method of plant conservation.

7.2 INTRODUCTION

Ethnobotany is a vast field that encompasses myriad different uses of plants, ranging from their most mundane purposes to their spiritual significance. Plants are known to enrich our surroundings and live with freshness and positivity. Among the various natural objects of adoration, trees took an early place. Their beauty, their nature as a provider of basic needs for human life (Food, shelter, clothing, medicine, etc.), their grandeur as forests, their grateful shades in a hot climate, and their mysterious form of life, suggest them as the abodes of departed spirit or of the existing agencies of the creator. Due to this reason, humans started tree worship.

Tree worship is one of the earliest forms of religion in ancient India. It was through the worship of the trees that man attempted to approach and propitiate God. Before man developed agriculture, he lived mostly on leaves, bark, fruits, and seeds from trees. He used implements made from it for use in peace and war. It was from wood that he obtained fire to cook food, warm his cave dwellings, and scare away wild animals

An image, a temple, a stone, or a tree may thus become an object of adoration and when sanctified by time, the indolence of the human mind too gladly contents itself with any idol that previous generations have been content to venerate. Apart from these, it was the beauty of their flowers that excited his imagination. He used to offer fruits, flowers, leaves, and twigs to spiritual power or God.

As the intellect progressed with time, among the early races of the world Greeks, Aryans, and the Hebrews, contributed towards its development. The Ancient Aryans worshiped nature. Plants, trees, and other elements were always revered and several rituals were connected to them. In the

Indus valley civilization, tree worship was highly evolved. Painted pottery of the Indus valley often includes pictures of Palms and Pipal. Among the seal of Mohan-jo-daro, one is depicting a stylist pipal tree with two heads of unicorns emerging from its stem.

Vedic seers have praised the forces of nature. Tree worship was very common in the Vedic age. In Vedic literature, the plants are Lord of Vedic Sookts (Hymns)and are used in different types of Yagya and Homas (sacrifice). Every Sookt (hymn) of the Vedas has a distinct Devata (deity) and a Rishi (poet).The Devata of a Sookt is one whose praises have been sung in that Sookt. We see a whole Mandala of Rig Veda is devoted to Soma (plant) worship. The Soma, which is a plant according to Rigveda, is described as a deity. In Rigveda, 120 Sookts have described the soma. The whole 9th mandala of Rigveda and 6 hymns of other mandalasare devoted to the praise of this plant. Aswath (Pipal) tree is worshipped since the Vedic days. In Atharvaveda many plants are the deity of Sookts. Such as Aswath vanaspati (Athrvaveda 3/6-7), Apamarg vanaspati (Athrvaved 4/17-19), Madhu Vanaspati (Athrvaveda 1/34) etc. Banyan tree is frequently mentioned in the Atharvaveda. Its wood was used for making sacrificial bowls. These practices of our Vedic seers helped and promoted plant conservation.

In the Puranic periods, the understanding of the man-plant relationship is found in a highly evolved form. According to Puranas, many plants have originated from different Gods. The Varah Purana (172/39) says that "One who plants a peepal (*Ficus religiosa*), one neem (*Azadirecta indica*), one vat (*Ficus benghalensis*), two pomegranates (*Punica granatum*), two orange (*Citrus reticulata*), five mango tree (*Mangifera indica*) and ten flowering plants or creepers shall never go to hell. Agnipurana says about the plantation of trees and the creation of different types of gardens. The Matsya Purana says about the "Van Mahotsava". Van Mahotsava is a tree plantation ceremony. Matsya Purana also says that a tree equals 10 sons. "A pond equals ten wells, and a reservoir equal ten ponds, A son equal ten reservoirs and a tree equal ten sons"(Matsya Purana 154:512).Some of the Puranas also mentioned plant parts like flowers, leaves, fruits, Gums, and resins required for worshiping God, thus these plants and plant parts became objects of Veneration.

As per Vedic Jyotisha,a person can become free of ailments, physical, social, and economic problems by planting a plant or tree as per the native's birth Nakshatra (constellation) and Rashi (Zodiac sign).Different plants have been identified with 27 Nakshatra (stars or constellations) and also Navagrahas, each of these celestial bodies also has a presiding deity.

Plants have been used in magico-religious beliefs science in remote past. Magico-religious beliefs as a system of good or evil faith and worship of supernatural beings and explaining everything in this universe as an act of supernatural beings. Propitiation or appeasement of supernatural beings is considered essential for the betterment of an individual or society. Many plants are conserved in their natural habitat by tribals or villagers due to the magico-religious belief that they are the habitat of God and Goddess.

Except for the conservation of isolated trees, there exists a practice of worship of nature in the form of a cluster of trees or forest patches known as sacred groves. Sacred groves are generally considered the abode of God, Goddesses, Spirits, or supernatural objects. They are worshipped, managed, and protected by specific communities. It is believed that the existence of sacred groves dates to several thousand years when human society was in the pre-agrarian stage. In India, sacred groves are of pre-Vedic origin. Science the sacred groves are the abode of the deity, and people don't cut any plant from the group. Even lifting of dead plant specimens or leaf litter is strictly prohibited. Preservation of sacred groves is an ancient strategy for the sustainable use of natural resources.

Plants are often connected with culture since ancient times, these trees do not just have religious value, but also various other values associated with them. The faith in spiritual power in particular trees or parts of trees used as an object of adoration and worship by the people has been given, sole conservation of those plants.

7.3 SCIENTIFIC BASIS OF SPIRITUAL CONSIDERATIONS

Religion, medicine, and healthcare have been related in one way or another in all population groups since the beginning of recorded history. In ancient times our priests or Purohits (who were the masters in Hindu rituals and religion etc.) also were the Vaidyas (Doctors or Traditional physicians). *Vaidya* is a Sanskrit word meaning "physician." Specifically, it refers to a practitioner of Ayurvedic medicine. It indicates that religion and the health care system were directly related to each other in ancient India. Only in recent times have these systems of healing been separated, and this separation has occurred largely in highly developed nations; in many developing countries, there is little or no such separation. It means spiritual consideration directly related to our health care system and religion.

Spirituality is the science of consciousness, involving the mind, body, and spirit relationship. Spirituality can be described as finding meaning and purpose in life. Spirituality is distinguished from all other things such as humanism, values, morals, and mental health—by its connection to that which is sacred, the *transcendent*. The transcendent is that which is outside of the self, and yet also within the self.

Spirituality includes both a search for the transcendent and the discovery of the transcendent and so involves traveling along the path that leads from non-consideration to questioning to either staunch non belief or belief, and if belief, then ultimately to devotion and finally, surrender. Thus, our definition of spirituality is very similar to religion and there is clearly an overlap. Spiritual issues play a prominent role in humans. Studies have demonstrated a positive connection between a human's spirituality and health outcomes, including quality of life, depression, anxiety, hopefulness, and the ability to cope with illness.

As a result of spiritual beliefs, many communities have given a special status to natural sites such as mountains, rivers, lakes, caves, forest groves, trees, coastal waters, and entire islands. They may be perceived as abodes of deities and ancestral spirits. Many cultures and religions have recognized notable spiritual significance surrounding the origin, existence, and use of certain plants. Some plants have special sacred value in these cultures. These sacred plants are worshiped and ritualistically employed in respective cultures. There are some stories that suggest that God had provided certain sacred plants as a way of helping man heal. These plants have valuable medicinal properties. Those beliefs give sacred places to plants, and humans started to worship them. Planting a tree with deep spiritual meaning allows you to tap into its energies daily. One can go and sit next to the tree every day during meditation or simply stroke its bark and leaves, asking for love and protection before one starts the day.

7.4 SPIRITUAL PLANT SPECIES

Plants provide food, fodder, medicine, timber, shelter, and clothing. Indeed, the tree is the highest and noblest production of plant kingdom just as man is the highest in the animal kingdom. Thus, it is natural that the two highest and natural production of nature were bound to come closer and closer.

Many cultures and religions alike have recognized notable spiritual significance surrounding the origin, existence, and use of certain plants. The cultures some plants have sacred value and are worshiped by the people. The plants that are worshiped celebrated ritualistically employed, feared, or otherwise held sacred, have proven to become very prominently displayed throughout the history of their respective cultures. They can be found proudly portrayed in painting and artwork, literature, folklore, storytelling, etc.

There are some stories that suggest the Gods have provided certain sacred plants as a way of helping man heal. Sometimes the natives believed the gods provided the plant specifically to promote celebration and social events. Due to specific medicinal properties, their producing nature, their role in social contribution and spiritual significance, the plants are considered sacred to a religion or culture.

7.4.1-Bargad (*Ficus bengalensis*)

Botanical Name : *Ficus benghalensis*
Family : Moraceae
Vernacular Name: Vat, Nyagrodh, Bargad, Bod etc.

Botanical description: The tree is generally a very large evergreen tree with broad and thick leaves, having numerous aerial roots too. These roots further become accessory trunks. The wood

Fig. 7.1 Sacred Banyan (*Ficus benghalensis*)

of the assessor trunks is stronger than the main stem.

Sacred Value: The banyan tree is the venerated tree in Hinduism and a symbol of immortality. The Banyan tree has been mentioned in our Vedas. The Banyan tree is venerated in Buddhism and Jainism also. The leaf of the Banyan tree is used for Panch Pallava (Five leaves) in every ritual of Hindu. These five leaves are Vargad (*Ficus benghalensis*), Pipal (*Ficus religiosa*), Pilkhan (*Ficus virens*), Gular (*Ficus racemosa*) and Mango (*Mangifera indica*). Leaves of the five sacred plants are decorated on the small water-containing copper or soil utensil, which is called Kalash. Kalash pooja is very common, just after Ganesh Pooja in all rituals.

Fig. 7.2 Banyan tree: Magha Nakshtra tree

This tree is often planted in temples and places of public worship like village yards because of its sacred nature. Women worship the banyan tree, for the long life of their husband and his prosperity. On the Poornima (full moon) of the month of Jyeshta, the Sumangalafasts and circumambulates the Banyan tree praying for her husband's longevity.This tree is especially worshiped and wrapped with Rakshasutra (thread) around its branches, on the occasion of Vat Savitri Varta. Women worship this tree to honour the memory of Sati Savitri, who was the wife of Satyawan according to Indian methodology.

Fig.7.3 Banyan tree: Rishabhdevtrithankara tree, Planted in Jain trinthankarvatika

Traditionally it is also believed that the Banyan tree is the god of Nakshatra (Constellation) Magha. The God of Magha is Pitar (ancestors). So, the banyan tree is planted in Nakshatra Vaika, as a representative of Magha and his god Pitar. According to Indian astrology, there is 27 nakshatra (constellation), nine grahs (planets), and 12 zodiacs (rashi). As per Astrology, there is a particular plant related to every nakshatra/planet/Zodiac, if anyone grows and take care of related plants or tree then the good result can be seen in life.

In Jainism, the banyan tree is related to Tirthankara Rishabhdev. In Jain tirthankara Vatika this plant represents tirthakara. This tree is

also highly regarded in Buddhism as it is believed that Gautam Buddha sat under this tree for seven days after he attained enlightenment to absorb his new found realization.

Fig. 7.6 Pipal tree: Anantnath Trithankara tree in Jain trithankar

7.4.2-Pipal (*Ficus religiosa*)

Botanical Name : *Ficus religiosa*
Family : Moraceae
Vernacular Name : Pipal, Ashvatha, Bodhi tree, Pipulu, Pipili etc.

Botanical description: It is a large deciduous tree found throughout India. Epiphytic when young. Leaves broadly ovate, dark green with shining, the tree is known for its heart-shaped leaves, that have long narrowing tips (long caudate). Stem is buttressed near the base, cylindrical further up. Flowers minute, unisexual, fruit a fig, subglobose, dark purple when ripe.

Fig: 7.5 *Ficus religiosa* Plated as a Rashi tree

Sacred Value: Hindus in India spiritually regarded Pipal tree as the holy tree. Millions of Hindus for centuries have worshiped several trees of which pipal is supreme. Pipal is described, as Ashvatha in Rigveda and Atharvaveda. In Atharvaveda Ashvatha (Pipal) described as a God of sookta. Pipal is also described in Srimad Bhagavat Gita, in 10^{th} chapter 26^{th} sloka, in 15^{th} chapter 2^{nd} and 3^{rd} slokas. In the 10^{th} chapter, 26^{th} sloka of Bhagavad Gita Lord Krishna says, "Of all trees I am Ashvatha."

Our Upanishads and Puranas also made mention of the pipal tree. In Upanishad, to clearly define the difference between the body and soul, the fruit of pipal is used as a classic example. Skanda Purana says that the person who cuts the tree surely goes to hell.

Pipal is the first known depicted tree in India. A seal discovered at Mohenjodaro, one of the cite of Indus Valley civilization (3000 BC-1700 BC) depict the pipal being the worshiped. The pipal tree is considered sacred to Buddhists also, as prince Siddhartha received enlightenment in Bodh Gaya, under the pipal tree and became the Buddha. Due to this, it is called the Bodhi tree or the tree of enlightenment.

Women tie cotton threads around their trunks or fasten red strips of red materials to their lower branches. Beneath this tree, are placed the rough stones which form the shrine of many village gods.

Panchpallava (Five leaves) is used in every ritual in Hindu methodology inKalash pooja (Varun pooja). These five leaves are *Ficus religiosa* (Pipal), *Ficus benghalensis* (Vargad), *Ficus virens* (Pilkhan), *Ficus racemose* (Gular), and *Mangifera indica* (Mango). The bunch of Leaves of these five sacred plants is decorated on the water-containing copper or clay soil utensil (Kalash).This Kalash also contains the powder of certain medicinal plants.

If a Hindu or Buddhist sees a Peepal tree during the journey, he will probably take off his shoes and walk a few steps around the tree from right to left, called *Pradakshina.* After the crimination in Hindu culture, the special ritual performed is called *Pipal Paan i*(to water the Pipal tree) in which all close relatives worship the Pipal tree and offer milk and water to the tree.
From ancient times to nowadays pipal is widely planted in village yards and temple premises. Women worship this tree as a symbol of fertility and prosperity.

Nowadays, the pipal tree is the most sacred tree in Hindu, Jain, and Bodh cultures. In Jainism, pipal is the tree related to Tirthankra Anantnath. The marriage of Pipal with Tulsi is very common in our society. The Pipal tree is specially worshipped every Saturday and Monday when the particularly new moon falls (Amawashya).

7.4.3-Padum (*Prunus cerasoides*)

Botanical Name : *Prunus cerasoides*
Family : Rosaceae
Vernacular Name : Padam, Padmak, Panyan.

Botanical description: *Prunus cerasoides* is a medium size deciduous tree. Brownish-grey and smooth bark, ovate, acuminate, doubly serrate, and glabrous leaves. Red coloured flowers gradually fading become nearly pinkish-white. Fruits are ovoid yellow, which turns red as it ripens.

Fig. 7.7 Pudum Tree (Prunus cerasoides)

Sacred Value: The Padum tree is a sacred tree in Uttrakhand and many other parts of India. Leaves and twinges of Padum tree are used in the occasion of entrance in newly formed house (Griha Pravesh). The twinges of Pudum (Panya) tree used in the formation of marriage mandap with other plants. The collection of their twigs, doing according to the astrologically selected good time (muhurta). Narankar Deveta is a famous totem (Kuldevta) in Uttrakhand. On the occasion of the worship of this totem, the tree of Pudum, first-day worships and invited Gods with musical instruments (Damru, Dhol etc.) and Jagar by the villagers. The next day the twigs of this tree collect. The twigs of Pudum (Panya) are also used in the worship of kuldevta Nag. Due to this, Pudum is sacred tree in our society.

7.4.4- Banana (*Musa spp.*)

Botanical Name : *Musa paradisiaca*
Family : Musaceae
Vernacular Name : Kadli, kela, Kyala etc.

Botanical description: Banana tree is a large, perennial, monocotyledonous herb that arises from large, subterranean rhizomes (usually called "corms"), from which the plant is perpetuated by sprouts or suckers. Rhizome or corm is an underground stem with numerous meristems (growing points) from which the pseudo-stems, flowering and fruiting stalks, and fibrous roots arise. In the tropics the stems are annual that is, they die after perfecting the fruit, and new stems are developed from buds in the rootstock. Leaves are large. The flower of the banana is also known as the "Banana blossom". Cultivated varieties are typically seedless.

Fig.7.8 Marriage Mandap of Banana tree with branches of Sal, chir, Pudum, pipal, Vat etc.

Sacred Value: In all the important festivals and occasions of Hindus, the serving of bananas plays a prominent part. The entire banana plant is considered sacred, and it is known as 'Kadali' in the Sanskrit language. It is believed that Banana trunk denotes good luck and prosperity. The leaves of banana are used in the formation of religious temporary erection, which is called Mandap. Such as the Satyanarayan Katha mandap, Bhagwat Katha Mandap, Marriage Mandap etc.

Fig.7.9 Worship of Banana Tree Near Temple

Traditionally in Himachal Pradesh, Uttar Pradesh, Uttarakhand, and many other states the marriage Mandaps are very common. With other plants, Banana tree in this Mandap is necessary. In this mandap the 16 pillars are stablished, among them the first is banana tree with fruits, and worshiped by the Yajman as Bramha.

In Tamil marriages, banana plants are tied on both sides of the entrance of houses to bless the newlyweds to be useful to each other. According to the belief, the tree symbolizes that the married life of the couple would be joyful, healthy, evergreen relationship and love between them would be endless. The couple would be showered with all the prosperity of the world and with children.

Banana fruits are offered to God and Goddesses as Naivedyam or Bhog. Lord Ganesh is fond of banana leaves and gets appeased by the offering of leaves during Ganpati puja. Durga Puja, a grand festival of Bengalis, the form of Goddess is created with the banana plant. This form of Goddess known as Kola Bou is considered as the bride of Lord Ganesha. She is given a bath before evening and placed next to Lord Ganesha. According to astrologythe tree is considered equivalent to Jupiter (Brihaspati). So, Astrologists suggest that planting and watering of banana tree, may be helpful to get benefit from planet Jupiter and Ketu.

7.4.5-Tulsi (*Ocimum*)

Botanical Name : *Ocimumsanctum*
Family : Lamiaceae
Vernacular Name: Vrinda, Tulsi, Haripriya, Vishnu Ballabha, Bahumanjari, Gramya etc.

Botanical description: Tulsi is a many-branched shrubby plant, has with the quadrangular hairy stem. Leaves are green, simple, opposite, short petiole, ovate, and have a slightly toothed margin with a typical aromatic smell.

Fig.7.10 Tulsi worship at the corner of Home

Sacred Value: *Tulsi* is a sacred plant. It is

planted in the courtyard of houses or temples. According to the Aryan myth a woman devotee of Vishnu called Tulsi, desired God as her husband. Lakshmi the consort of Vishnu, unable to bear the idea of a rival, changed 'Tulsi' into a plant. But Vishnu impressed by the woman's devotion but angry with Lakshmi, assumed the form of Shaligram (Ammonite stone) and consorted to Tulsi eternally. The plant (Tulsi) and the stone (Shaligram) are married annually.

The term Haripriya uses for Tulsi, and it denotes that Tulsi is dear to Lord Vishnu. The plant is daily watered and worshipped in the morning and evening by placing an oil lamp (Diya) at the base of this plant. It is very common ritual in our homes. During the month of Kartik the worship of the *tulsi* is famous traditional ritual in India. Tulsi diwas is also celebrated in Kartik month. "Tulsi Vivah" is a ceremonial festival performed in many parts of the country. Tulsi weds Pipal is a common ritual in our villages.

In Padam Puran, the Tulsi describes as the avatar of Lord Vishnu. The same is also described in other Puranas such as Shiv Purana, Brahmand Purana, Garud Purana etc. According to Padmpurana even the soil around the Tulsi plant is holy. It is believed that water with leaves of Tulsi becomes as holy as the water of the Ganga.

Tulsi is considered as incarnation of Laxmi and Radha. Radha is Krishna's beloved. Radha's another name is Vrinda. Tulsi is also called Vrinda. So Mathura forest where Krishna played in his childhood with Radha is called Vrindavan (The garden of Radha or Tulsi).

7.4.6-Doob (*Cynodon dactylon*)

Botanical Name: *Cynodon dactylon*
Family : Poaceae
Vernacular Name : Dubda, Doorva, Dubulu, Doob ghas etc.

Botanical description: Cynodon is a perennial grass, forms thick mats by means of stolons and rhizomes.The grass creeps along the ground with its stolons and roots wherever a node touches the ground.Soscums (stems) take root at the lower nodes. The leaf blade is flattened with a sharp tip and may be hairy or glabrous (hairless). The inflorescence consists of 3-7 slender spikes. Each spike 2–5 cm long. It is common in disturbed areas such as gardens, roadsides, grazing fields, uncultivated lands etc.

Sacred Value: Doob or Doorva (*Cynodon*) has been a part of Hindu rituals since Vedic times. Doovra first described in Rigveda (10/148/8), hence it is a God of Sookt (Sooktdevta). In Rigveda the flowering doorva described in residential areas. In the Atharwa Veda it is said "May doorva, which rose from the water of life, which has a hundred roots and hundred stems, efface a hundred of my sins and prolong my existence on earth for a hundred years''. In Hinduism, it is considered important in the worship of Lord Ganesha. A clump of 21 shoots of this grass is usually offered during Ganesh puja (worship).In Uttarakhand the clump of doob also implants on the symbol of Ganesh and Ashtvashudhara, which is made of cow dung. It is very common in all Hindu rituals.

Fig.7.12 Cynodon on Symbol of Ganesha and Asht Vasudhara

On the occasion of marriage (vivah), Yagyopaveet and tonsure ceremony (Chaul/Choodakarm/Mundan Sanskar) the bunch of doorva used to give Vana during mangal snan (auspicious bath). The paste for this auspicious bath contain rhizomes of *Curcuma longa* and *Curcuma zedoria*, seeds of *Brassica campestris,* stem and leaves of *Rubia manjishta, Cynodon dactylon,* and flour of *Hordeum vulgare.* This paste first is applied on the bride and bridegroom by the two bunches of doo (*Cynodon dactylon*). Doorva is a plant of Rahu. In Navgarh Vatika the doorva is planted for Rahu and in the sacrificial ceremony, used for Rahu.

Fig. 7.13 Clump Bunches of Doob used for Vana in Mangal Snan (auspicious bath)

A unique festival called Doorva Ashtami, dedicated to this grass, is celebrated on the 8th day of Shukla Paksha of Bhadra month (September) of the Hindu calendar. In Doorva Astami the

Bengali Hindus wear a bunch of Doorva with red thread, on their arms as a mark of prosperity and long life.

7.4.7-Pati (*Artemisia* spp.)

Botanical Name : *Artemisia nilagrica*
Family : Asteraceae
Vernacular Name : Dona, Damnak, Kunju (Garhwal), Pati (Kumaun) etc.

Botanical description: A tall shrub like aromatic herb. Usually, 1-2.5 m high. Ovate, lobed, pinnatified leaves. Flower heads small, ovoid, panicledreceme, Fruit a minute achene.

Sacred Value: Artemisia (Pati or kunju) plant is considered sacred. The leaves of Kunju or Pati are frequently used in pooja all over Uttarakhand and other hilly states of India. It is also an alternative to flowers, which offer to God. The Leaves are offered to Lord Ganpati, Varun Devta, ShodasMatrica, Vasundharadevta, Navgrhadevta etc. during any religious ceremony of Uttrakhand. Its leaves are also used in the sacrificial ceremony (Hawan).

7.4.8-Dhatura (*Datura alba* and *D. stramonium)*

Botanical Name : *Datura stramonium*
Family : Solanaceae
Vernacular Name : Dhatura, Dhaturu, Kanak, Unmattetc.

Botanical description: Dhatura plant is an annual busy plant, up to about 1 m. high. Usually found in hills of Northwest Himalayas, up to an altitude of 2500 metres. Sinulate or lobulate leaves are 7-13 cm. long. Flowers 7-10 cm. long, white, and purple. Fruit an ovoid capsule, covered with pickles, four valved, seeds numerous, reinformed.

Fig. 7.14 Datura plant

Sacred Value: The leaves and flowers of this plant is offered to Lord Vishnu on Vakunth Chaturdashi varta and Ganesh to Siddhi Vinayak Varta. According to Vaman Puarana the plant is said to have originated from to heart of Maheshwara. So, in Shiv pooja or Rudri Pooja and on Mahashivratri Varta the leaves and flowers of Dhatura are offered to Lord Mahadev. The root of Dhatura is used in Mool shanti Pooja.

Fig.7.15 Datura fruits used for Worship of Lord Shiva

7.4.9-Bel (*Agle marmelos*)

Botanical Name : *Agel marmelos*
Family : Rutaceae
Vernacular Name : Bel, Bael,vilv, Bilv etc.

Botanical description: A moderate sized tree, trifoliate leaves, gland dotted, 2.5 cm long spines. Sweet scented greenish white flowers, fruits usually 2.5 cm in diameter, globose, grey, or yellowish, numerous seeds embedded in thick orange coloured thick pulp.

Fig.7.15 Bel Tree

Sacred Value: Bel tree dedicated to Lord Shiva, whose worship cannot be completed without its leaves. It is sacred to the Trimurti, being a represented of Lord Shiva. Trishul or the trident is considered symbolic of creation, destruction and preservation, the powers attributed to Lord Shiva. The leaves constitute an essential element to worship. On the annual Shivratri day an all-night vigil is kept, and special worship is offered with leaves to this tree in Shiva temples. Apart from the leaves the fruit also is credited with wish-granting properties.

Fig. 7.16 Leaves of Bel offered to Lord Shiva

During Navratri, the Durga pooja is main festival. It is believed that the Goddess Durga is invoked to descend to the earth through the newly sprouting vilva tree. The leaves are offered to Mata Durga, while fruit and twigs are used in the performance of Homa or Havan. The plant is associated with the sun and one of the constellations Chitra (Chitra nakshatra).
The leaves are also offered to Lord Ganpati to Sankastha Chaturthi Varta, Satyanarayana on Shree Satyanarayana Varta, Goddess Lakshmi on Lakshmi Varta, and Lord Vishnu on Shree Ananta Padmanabhan Varta.

7.4.10-Khejri (*Prosopis cinerania*)

Botanical Name : *Prosopis cinerania*
Family : Mimosaceae
Vernacular Name : Shami, Khejra, Khejri etc

Botanical description: *P. cineraria* is a small tree, usually up to 10m high. The tree has conical spines and a spreading crown. Branches are slender, glabrous, with compressed, straight, and scattered prickles. Leaves bipinnate, usually with two pairs of pinnae. Axillary spikes, yellowish flowers 4 mm long. Fruit a Pod, Pods turgid, straight, 10-15 seeded.

Fig. 7.17 Shami plant in Navgrah vatica

Sacred Value: *Prosopis cineraria* is described in the Vedas as the name of Shami. A Rigvedic Legend says that Pururuvas the ancestor of the Lunar race of Kings, which included the Kurus and Pandvas, generated the primeval fire by rubbing the two branches of the Shami and Ashvatha (*Ficus religiosa*) trees together. The wood instruments for primeval fire of Yagya are called Adharayani (Shami wood) and Uttrayani (Pipal wood). According to Satpath Brahmana (11/5/1/15) the primeval fire produces by the rubbing of Sami's Adharayani and Pipal's Uttrayani.

In sacrifice fire (Hawan) the wood of Shami is used for Saturn and included in Navgraha Samidha. Shami plant is planted in Navgrah Vatikaand Rashivatika as a abode of Saturn.
According to the astrologers the plant is also associated with the constellation Dhanista whose presiding deity is Vasu.

Shami plant is also associated to Pandvas. It is believed that Five Pandavas hung up their arms when they entered Virat Nagari in disguise. On the tree, the arms turned to snakes and remained untouched till the owners returned. So the Shami tree is worshipped on Dussehra (Ashwin Shukl Dashami).

In Himachal Pradesh, the tree is revered very generally, more especially in the part where it forms a chief feature in the larger flora of the great arid grazing grounds. It is commonly selected to mark the abode or to shelter the shrine of the deity. In the desert state of Rajasthan, the Bishnoi'stillers of the sandy soil and herdsmen tend the groves of tall trees around their villages as lovingly as they would their own children. This tradition has been mentioned by this peasant community for many years. Bishnoi movement is the best example to specify protects the sacred Shami tree. In September 1730, Maharaja Abhay Singh of Jodhpur decided to build a new

palace. He decided to cut down some 'Khejdi' trees (Shami trees). The "Bishnois" of Khejadi village objected to the cutting of 'Khejdi' trees. Anxious to protect the trees, a woman named Amrita Devi hugged a tree to stop them. Her family then adopted the same strategy, as did other local people when the news spread. She told the soldiers that she considered their actions to be an insult to her faith and that she was prepared to die to save the trees. The soldiers did indeed kill her and others. A total of 360 people from 84 villages died resisting the onslaught. At last, Abhay Singh was informed of what was going on and intervened to stop the massacre. The villagers since then planted 'khejadi' trees around an ancient tree that had survived the onslaught by the Maharaja's men. Since then no tree is allowed to be cut there. The Bhils and Naikas of Gujarat worship 'Shami' as they consider it as a holy tree. The tree is also worshipped during Dussehra.

7.5 SUMMARY

Plants provide food, fodder, medicine, timber, shelter, and clothing. Plants are known to enrich our surroundings and lives with freshness and positivity. Plants are producer in our food chain. Before man developed agriculture, he lived mostly on fruits and seeds of trees. He used implements made from it for peace and war. It was from the wood that he obtained fire to cook his food and to warm his cave dwellings.

To honor their beauty, their nature as a provider of basic needs, their medicinal values, their grandeur as forests, their grateful shads in a hot climate, and their mysterious form of life perhaps humans gave sacred places to plants and started tree worship.

It was through the worship of the trees that man attempted to approach and propitiate God. A tree may thus become an object of adoration and when sanctified by time, the indolence of the human mind too gladly contents itself with any idol that previous generations have been content to venerate. Passes of time gradually generation to generation tree worship may thus become a strong and popular method of plant conservation.

In Indus valley civilization, tree worship is highly evolved. Painted pottery of Indus valley often includes Palms, Pipal and other plants. In the Vedas trees are Devtas (God) of many Sookts. As per Vedic Jyotisha person can become free of ailments, physical, social, and economic problems by planting a plant or tree as per the native's birth Nakshatra (constellation) and Rashi (Zodiac sign).

Religion, medicine, and healthcare have been related in one way or another in all population groups since the beginning of recorded history. Because plants are source of food, medicine, shelter and many other basic requirements of human, so this is perhaps one of the reasons why our ancestor considered trees as equivalent to gods, goddesses, constellations, zodiac signs, and totems and revered them as divine elements. Ultimately tree worship became a part of our religion, culture, and rituals.

There are many plants and their parts whose are used in different rituals. To ensure their availability human gave them special conservation. Such as Pati, Doob, Andropogon, Haldi, Sumaya, Van Haldi, Dhatura, Banana, Padam etc. Some trees are very sacred in society and are worshipped for example Pipal, Bargad, Tulsi, Bel, Khejdi, Pilkhan, Goolar etc. Pipal was sacred plant in Indus valley civilization and is sacred in Hinduism, Jainism, and Buddhism also.

Same as above, Sacred groves are small forest areas that are left untouched by the local inhabitants to be conserved by the local village folk deities and are of special spiritual significance to them. The concept and beliefs of sacred trees and groves of forests are one of the best practices to conserve the natural resources. Preservation, repair, or restoration of plant population through above sacred believes, is the sole method of plant conservation on the earth.

7.6 GLOSSARY

Adhrayani: Wood of Shami tree, used for primeval fire of Yagya.
Adoration: Deep love and respect or Worship.
Ashvatha: Vedic and Sanskrit name of pipal tree.
Idol: An image or other material object representing a deity/God.
Jain TrithankaraVatika: Garden of 24 planets represented to 24 Jain Trithankaras.
Kalash: Utensil of Clay or copper, filled with water and powder of certain medicinal plants.
Kuldevta: Totem, the ancestral deities that are worshipped by particular clans.
Mandap: A canopy or a platform decorated for marriage.
Nakshatra Vatika: Garden of 27plants, each plant related to a constellation.
Narankar: A totem, worshiped in hilly villages of Uttarakhand.
NavgrahVatika: Garden of 9 planets represented by the plants.
PanchPallavas: Bunch of leaves of Mango, Pipal, Vat, Pilkhan& Gular on the Kalash.
Pradakshina: Circumambulation around the tree.
Rashi Vatika: Garden of 12 zodoics, represented by the plants.
Uttrayani: Wood of Pipal tree, used for primeval fire of Yagya, applied on upper side of Adhrayani.
***Vaidya*:** Ayurvedic Physician.

7.7 SELF ASSESSMENT QUESTION

7.7.1 Multiple choice Questions

1-Which plant is known as 'Bodhi vriksh' in Buddism?

(a) *Ficus rasemosa* (b) *Ficus virens*
(c) *Ficus benghalensis* (d) *Ficus lecor*

2- How many leaves are used in "Panchpallava":
(a) Four (b) Five
(c) Eight (d) Ten
3- 'Aswatha' is the vedic/ Sanskrit name of:
(a) *Ficus religiosa* (b) *Agele marmelos*
(c) *Ficus benghalensis* (d) *Prosopis cineraria*

4-Which planet represents by Sami (*Prosopis cineraria*) in Navgrah Vatika:
(a)Rahu (b) Ketu
(c) Saturn (d) Sun

5- Which plant is mostly planted in the courtyard of home?
(a) *Agle marmelos* (b) *Prunus cerasoid*
(c) *Prosopis cineraria* (d) *Ocimum sanctum*

6- Which one of the following Plant is related to Bishnoi movement?
(a) *Ficus religiosa* (b) *Agele marmelos*
(c) *Ficus benghalensis* (d) *Prosopis cineraria*

7-Bel tree, fruits and leaves are mostly offered to:
(a)Lord Ganesha (b) Lord Shiva
(c) Lord Saturn (d) Lord Sun

8- Which plant is used in Uttarakhand for the worship of famous totem Narankar:
(a) *Ficus religiosa* (b) *Ficus benghalensis*
(c) *Prosopis cineraria* (d) *Prunus cerasoides*

9- Which planet represent by Pipal tree:
(a) Rahu (b) Saturn
(c) Jupiter (d) Ketu

10-Which Plant's clump bunches are used to give vana during mangal snan (auspicious bath) in Uttarakhand:
(a) Ocimum (b) Musa
(c) *Cynodon dactylon* (d) *Aegle marmelos*

7.7.1. Answer Key: 1-(c), 2-(b), 3-(a), 4-(c), 5-(d), 6-(d), 7-(b), 8-(d), 9-(c), 10-(c)

7.8 REFERENCES

- Bennet S.S.R., Gupta P.C. and Raw Vijendra, Venerated plants, Indian Council of Forest Research, FRI Press Dehradun.
- Gupta S.M (1971), Plants Myths and traditions of India, Leiden Netherlands.
- Randhawa M.S. (1964), The cult of trees and tree worship in Buddhist-Hindu sculpture, All India fine arts and craft society New Delhi.
- Sinha B.C. (1997), Tree worship in Ancient India, Books today New delhi.
- Sensharma, P (1989), Plants in Indian Puranas, an ethnobatanical investigation, Navya Prakash culcutta.
- Pandey,B.P. (1989),Sacred plants of India, shree publishing House New Delhi.

7.9 SUGGESTED READINGS

- Bebni D. C. (2007), Dharmik anusthanon men prayuktpadpon ka vaigyanikvivechan, Uttarakhand Sanskrit Akadami Haridwar.
- Bennet S.S.R., Gupta P.C. and Raw Vijendra, Venerated plants, Indian Council of Forest Research, FRI Press Dehnradun.

7.10 TERMINAL QUESTIONS

7.10.1 Short answer type Questions

1. What are sacred plants?
2. What is the scientific basis of spiritual consideration?
3. What is Panchpallava?
4. Why humans started tree worship in early times?
5. Comment on common plants that are sacred in Buddhism, Jainism and Hinduism?
6. Comments on the conservation of sacred plants.
7. Which plants are commonly used in Mandap formation of marriage and how are used for?
8. What are Navgrah Vatika and Rashi Vatika?
9. What is the sacred value of Tulsi (Ocimum)?
10. What was Bishnoi movement, related of *Prosopis cineraria*?

7.10.2 Long answer type Questions

1. What do you know about sacred plants? Describe any twopopular sacred plants?
2. Describe sacred plants of India, having common sacred values in Jainism, Buddhism, and Hinduism.
3. What is the basis of tree worship? Describe any two sacred trees?
4. Describe the role of tree worship in the conservation of plants.
5. What is the scientific basis of spiritual consideration? Give a brief botanical and religious

description of two sacred plants, which are included in your syllabus?

6. Describe the botanical description and sacred value of any three of the following.

(i) Ficus religiosa (ii) Ficus benghalensis (iii) Prosopis cineraria (iv) Musa paradisiaca (v) Ocimum sanctum

7. Describe the brief botanical description and religious myths of *Prosopis cineraria* with the description of the related Bishnoi movement.

8. Write an essay on the conservation of sacred plants.

9. Describe the sacred value of Cynodon and Artemesia.

10. Describe the sacred use of any two plants of the family Moraceae.

BLOCK-3 ETHNOBOTANY AND CONSERVATION

UNIT-8 THE ETHNIC GROUPS AND ETHNOBOTANICAL STUDIES

Contents

8.1 OBJECTIVES

The main objective of this unit is to explain ethnic groups and ethnicity. This unit is to expand awareness about the intricate relationship between culture, plants, humans, and our environment. After going through this unit, you will be able to:

- Define ethnobotany, terminology of ethnobotany and historic roots of ethnobotany.
- Understand and discuss about different Ethnic and Tribal groups of India.
- Introduction about tools and techniques of ethnobotanical study.
- Brief discussion about our old literature.

8.2 INTRODUCTION

Since the beginning of civilization, people have been using plants to provide them food, shelter, medicines, as well as the materials for construction and the manufacture of crafts and tools and many other products like fuel, paints, poison, etc. Plants often have ritual characters and are used because of their variety of properties. Nowadays their chemical and genetic characters are increasingly explored for human benefits. It had been possible due to ethnobotanical studies that have provided us with plenty of information about plants both useful and harmful.

Ethnobotany is the study of how people of a particular culture and region make the use of indigenous plants. Ethnobotanists explore how plants are used for food, shelter, medicine, clothing, hunting, and religious ceremonies. In broad terms, ethnobotany is the study of the interrelationship between plants and people. The two major parts of ethnobotany are encapsulated in the word itself; ethno, 'the study of people', and botany, 'the study of plants'.

The term ethnobotany was suggested by John Harshberger in 1896 to delimit a specific field of botany and to describe plant uses. In India, it was Dr. S. K. Jain, affectionately known as "*Father of Indian Ethnobotany*" who made pioneering investigations.

Fig. 8.1: Dr. S. K. Jain

Dr. Sudhanshu Kumar Jain was born on June 30, 1926 in Amroha. He belonged to a farmer's family. His first formal education was class 5 in 1933 in his hometown, Seohara and High School from Baraut, Meerut. Dr. Jain graduated in 1943 and did his M.Sc. from Allahabad University in 1946. He started his job as an Assistant professor in Botany. Later, he joined the Botanical Survey of India (BSI) at the Pune Regional Centre as systematic botanist from 1956 to 1960. He also served as economic botanist at BSI Allahabad and Kolkata, from 1960 to 1971. He retired as a director of BSI. He has been Chief Editor of *Flora of India* series

(1978-84) and *Ethnobotany* (an international journal of the Society of Ethnobotanists). He wrote his famous book **'***Dictionary of Indian Folk Medicine and Ethnobotany*.' During a turmeric (*Curcuma longa*) patent case in 1995, this book was used as evidence in US courts and helped India win the turmeric patent case. He was renowned Ethnobotanist with global recognition and popularly known as the "**Father of Indian Ethnobotany**". Dr. Jain died on April 20, 2021, at age of 94.

8.3 ETHNIC GROUPS

A group of people who share a similar culture (beliefs, values, and behaviours), language, religion, ancestry etc. that is often handed down from one generation to the next, is called ethnic group or Ethnicity. It means an ethnic group, or an ethnicity, is a category of people who identify with each other based on such common similarities. They may come from the same country or live together in the same area. Ethnic is a related term of ethnicity. Ethnic is an ethnic person, who is a member of an ethnic group or a member of an immigrant community (foreigner) while ethnicity is the common characteristics (mostly language and culture) of a group of people. Ethnic identity refers to a commitment to particular ethnic groups. It's important to note that different people show different levels and ways of committing to their ethnic group. But Ethnicity is an example of cultural and social identity. Ethnicity is usually an inherited status based on the society in which one lives.

Therefore an 'ethnic group' has been defined as a group that regards itself or is regarded by others as a distinct community by virtue of certain characteristics that will help to distinguish the group from the surrounding community. Anthropologists and Ethnologists have often used the term "ethnic", pertaining to ethnography and ethnology. It was used for a biological self-perpetuating group, sharing cultural values, communication and distinctness from other groups.

India is a diverse multi-ethnic country. India is home to thousands of ethnic and tribal groups. There is slight difference between ethnic groups and tribals. The key difference between ethnic group and tribe is that people belonging to one ethnic group share similar religious, linguistic and cultural identity but they can live in different places, whereas typical tribes comprise of a set of related families having similar tastes, ideology, religious and dialectic identity, most frequently living together in one place.

India is home to all the major racial groupings. People can be divided according to race and ethnicity. It is a concept that refers to a shared culture and a way of life. Race is a grouping of people based on physical qualities and permanent distinguishing biogenetic characteristics. It means Race is a biological division based on physical characteristics. But Ethnicity is the grouping of people based mainly on cultural characteristics or cultural identity. Ethnicity recognizes differences between people mostly on the basis of language and shared culture.

In India, more than 68 million people belonging to ethnic groups and tribal communities are derived from six racial stocks namely - Negroid, Proto- Australoid, Mongoloid, Mediterranean, West Breachy and Nordic exist in different part of the country. The three major ethnic groups of India are Indo-Aryan, Dravidian and Mongoloids. These major ethnic groups are diversified into many ethnic groups and tribes. They make India a most ethnically diverse country on the earth.

The Indo-Aryans dominate in India. Each of the Indo-Aryan ethnic groups has their own language. The Indo-Aryans are the most diverse group of people in India. Hindi, Bengali, Gujarati, Kashmiri, Assamese, Konkani, Marathi, Punjabi etc. are diverse ethnic groups of Indo-Aryans. In south India the main Dravidian Ethnic groups are, Tamil, Telugu, Kannada, Malayalam and Tulu. In north east India, there are many indigenous ethnic groups, they speak various languages of multiple language families (Indo-Aryan, Sino-Tibetan, Austroasiatic etc.). The ethnic groups across India can be divided into three distinct Zones, according to their geographical residing area, Hill region, Arid &semi arid zones and Peninsular India.

8.3.1-Hill region

The Indian subcontinent has seven principal mountain ranges and the largest of all is the Himalayas that lies in the northern part of India. Most of the part of Himalaya in India is located in the hilly areas of Jammu and Kashmir, Manipur, Himachal Pradesh, Uttarakhand, Sikkim, West Bengal, Arunachal Pradesh, Nagaland, and Meghalaya. These states comprise most hilly area of northern, central and eastern India. In terms of its diversity of people and languages, the greater Himalayan region is most complex. According to our epics and Puranas, the native inhabitants of the Himalayan region were the Kinnars, Kiratas, Gandharv, Kulinds and later Khasas. Today, the Himalayan population can be classified into three major ethnic types, namely Aryans, Mongoloids and Negroids. These ethnic types comprise so many ethnic and tribal groups. There are hundreds of different languages spoken in the Himalayas. The various ethnic and tribal groups of the Jammu and Kashmir, Uttarakhand, Himachal Pradesh and Northeast have their particular geographical boundaries and specific areas.

The most common way to define an ethnic group is by language. Language plays an important role in ethnic identification in India. Most Indians speak a language belonging to the families that are either Indo-Aryan, Dravidian, Sino-Tibetan or Austroasiatic. The languages spoken in Hilly regions of India, are related to Indo-Aryan and Sino-Tibetan families. Indo-Aryan languages are spoken in northern and central India while Sino-Tibetan in North-East India. Ethno-linguistic basis, the main ethnic groups of hill regions are Bengalis, Khasi, Kashmiris, Assamese, Naga, Ahom, Aimol, Chakma, Garhwali, Kumauni etc. Ethno-linguistic group is a group of people that share a common language, common ethnicity, and cultural heritage.

Bengalis are the largest ethnic group in South Asia and third largest ethnic group of the world. They speak Bengali, an Indo-Aryan language. In India most of the Bengalis live in west Bengal, Tripura, Meghalaya and Manipur. **Khasi** is an ethnic group of Meghalaya and adjacent region of

Assam, in north-eastern India. Khasi people from the majority of the population of the eastern part of Meghalaya, that is Khasi Hills.

The **Assamese people** are an ethnolinguistic group is associated with the Assamese language, the easternmost Indo-Aryan language, and most Assamese people live in the Brahmaputra valley of Assam. The **Naga** is large group, which comprises many ethnic groups of Nagaland and Manipur. Each group speaks distinct Naga languages of Sino-Tibetan family. The **Angam is** are a major Naga ethnic group native to the Northeast Indian state of Nagaland and Manipur. Traditionally, the Angami Nagas are hill people depending basically on cultivation of wet rice and livestock-rearing.

The **Ahom**, or **Tai-Ahom** is an ethnic group in Assam and Arunachal Pradesh. The Tai speaking people came from the Guangxi region of China. The **Aimol** people are an ethnic group living mainly in Manipur and in parts of Mizoram, Tripura, Nagaland and Assam in India. They speak Aimol language which is a Kuki-Chin -Mizo language (Sino-Tibetan language). This trans Himalayan language is spoken in northeastern India. Most speakers of these languages are known as **Mizo** in Mizoram and Manipur. **Chakma** is the second-largest ethnic group in Mizoram. They also live in Arunachal Pradesh, Tripura and Assam. They speak Chakma language, which is an Indo-Aryan language.

Kashmiris are an ethnic group native to the Kashmir Valley, who speak Kashmiri, an Indo-Aryan language. **Dogra people**, are an Indo-Aryan ethno-linguistic group in India. They live in Jammu and adjacent area and they speak Dogri language. There are a large number of Pashto-speaking **Pakhtuns** in the Indian states of Assam, West Bengal and Jammu and Kashmir. They are also inhabited in some places of Bihar, Punjab, UP and MP.

The Himalayan region inhabited by people, commonly known as '**Paharis**' comprise of variety of subgroups which share basic cultural patterns but show local differences in such features as dialect, ceremonial forms, deities worshipped, house styles, dress and ornamentation, range of castes, and rules of marriage. Himanchali are a major ethnolinguistic group of Himanchal Pradesh. In Uttarakhand the **Garhwali people** are an ethnolinguistic group native to the Garhwal and **Kumaonis** are native to Kumaon region. Who speak Garhwali and Kumauni respectively. They are Indo-Aryan ethno-linguistic groups. They inhabited mainly Central Himalayan region. The Paharis comprise of different tribal communities, which share their specific culture, life style and dialects.

The Tribals/Tribes are called Scheduled Tribes as they are included in one of the Schedules of the Constitution of India. The framers of the Constitution took note of the fact that certain communities in India were suffering from extreme social, educational and economic backwardness. They needed special consideration for safeguarding their interests and for their socio-economic development. These communities were notified as **Scheduled Tribes** as per provisions contained in **Clause 1** of **Articles 342** of the Constitution. Many ethnic and social

groups are included as Schedules tribes. According to census 2011, number of individual ethnic groups, etc. notified as Scheduled Tribes in India is 705.Bhot, Gaddi, Gujjar, Jad, Kinnara, Lahaula, Pangwala, Swangla, Beda and Gara in Himanchal Pradesh and Tharu, Buksa, Jaunsari, Bhotiya and Raji in Uttarakhand are examples of Schedules tribes. Balti, Bakarwal, Gaddi and

S.No.	States	Name of Tribes

Gujjar are main tribals of Jammu, Kashmir and Ladakh.

1.	**Arunachal Pradesh**	Abor, Aka, Apatani, Nyishi, Galo, Khampti, Khowa, Mishmi, Idu, Taroan, Momba, Sherdukpe, Singpho, Hrusso, Tagin, Khamba , Adi.
2.	**Assam**	Khasis, Chakma, Dimasa, Gangte, Garos, Hajong, Chutiya,. Lakher, Man, Mizo (Lushai), Karbi, Naga, Pawi, Syntheng, Lakung
		jjar, Jad, Kinnara, Lahaula, Pangwala, ra.
		Brokpa, Drokpa, Dard, Shin Changpa, a, Gujjar, Bakarwal, Gaddi, Sippi.
		ami, Chiru, Chothe, Gangte, Hmar, Kabui, Kacha Naga, Liangmai, Zeme, Koirao, Kom, Lamgang, Mao, Maram, Maring, nsang, Moyon, Paite, Purum, Ralte, Sema, khul, Thadou, Vaiphei Zou, Poumai, Naga, Tarao, Kharam Kuki, Mate.
6.	**Meghalaya**	Chakma, Dimasa, Kachari, Garo, Hajong, Hmar, Khasi, Kuki, Lakher, Man, Tai, Mizo, Mikir, Naga, Pawi, SyntengBoro, Koch, Raba, Rava.
7.	**Mizoram**	Chakma, Dimasa (Kachari), Garo, Hajong, Hmar Khasi and Jaintia, Lakher, Man, Mizo (Lushai), Mikir, Naga, Pawi, Synteng, Paite.
8.	**Nagaland**	Nagas, Angami, Sema, Garo, Kuki, Kachari, Mikir
9.	**Sikkim**	Bhutia, Limboo, Tamang, Lepchas.
10.	**Tripura**	Bhil, Bhutia, Chaimal, Chakma, Garoo, Halam, Lepcha, Lushai, Mag, Munda, Kaur, Noatia, Orang, Riang, Santal, Tripuri, Ucha.
11.	**Uttarakhand**	Tharu, Jaunsari, Bhotias, Buksa, Raji.
12.	**West Bengal**	Asur, Baiga, Bedia,Bhumij,Bhutia, Sherpa, Birhor, Birjia, Chakma Chero, Chik Baraik, Garo, Gond Gorait, Hajang, Ho, Karmali, Kharwar, Khond, Kisan, Kora Korwa Lepcha, Lodha, Kheria, Lohara, Magh, Mahali, Mahli, Mal Pahariya Mech, Mru, Munda, Nagesia, Oraon Parhaiya, Rabha, Santal, SauriaPaharia, Savar, Limbu (Subba) Tamang.

Table-8.1 Showing the state-wise name of tribes

(Source: Ministry of tribal affairs Govt. of India)

Gaddi in Himachal Pradesh and **Bhotia** in Uttarakhand are traditionally nomads, engaged in trans-human activities while Janissaries and Balti are engaged in primitive agricultural activities. Nomadic pastoralism has been portrayed as one of the great advances in the evolution of mankind.

People who specialize in livestock production requiring periodic movements of their herds are known as nomadic pastoralists or simply nomads. Nomadic pastoralists move overlong

distances with their animals. They live on milk and other pastoral products. They also exchanged wool, ghee, etc., with settled agriculturists for grain, cloth, utensils and other products.

Fig. 8.2 ***Nomadic Pastoralism of Bhotia tribe with their herd***

Just as some travel for herding, many others travel out of their valleys and across the ranges for selling their wares at lowland markets, buying at the same time, goods that they cannot access in the closed high-altitude valleys. Sheep, Goat and Yak wool is main source of trading. Traditionally it was common in all ethnic and tribal groups of hill regions.

Gaddi, Bakarwal, Balti, Bhot, Gujjar etc. are main tribal groups in Jammu, Kashmir, Ladakh and Himanchal Pradesh. The Gujjar tribe that is found in the region are pastoral nomads. The tribe was originally from the Jammu region, but now the Gujjars roam around the hills of the Garhwal and Kumaon regions also. They head up to the region of Bhabar and other plain area, in the winter which is covered in dry forests. Then in the summertime, they move to the meadows of the Bugyals of hill regions. Himalayan tribal women usually enjoy a much greater level of freedom and participate equally with the men in agricultural practices and in cultural activities. Mountain regions had developed a rich base of indigenous traditional knowledge that is being rapidly eroded under the forces of modernization.

Fig. 8.3 Nomadic Pastoralism of Gujjar tribe

The Northeast India is the eastern most hilly region of the country which comprises of the eight sister states Assam, Arunachal Pradesh, Manipur, Meghalaya, Tripura, Mizoram, Nagaland and Sikkim. There are many ethnic communities in the Northeast. The hills states in the region like Arunachal Pradesh, Meghalaya, Mizoram and Nagaland are predominantly inhabited by native tribal communities with a degree of diversity even within the ethnic groups. Ministry of tribal affairs of govt. of India, provides state wise list of scheduled tribes in India.

Apatanis, Mishmis and Buguns in Arunachal Pradesh are settled agriculturist tribals. Sherdukpens and khatmis tribals of this state are agriculturist and traders, are Buddhist. The Khatmis is main tribe in Assam also. Kukis is mongoloid tribe in Assam. They adapt the method of shifting cultivation and, also make handicraft items from bamboo.

Garo, Khasi and Jantiyas are main tribes of Meghalaya, who reside in the foothills as well as within the mountain ranges of Garo, Khasi and Jaintia hills. Garo are descendent of Bodo family

from Tibeto-Burman race while the khasis and Jaintiyas are claimed to have belonged to the proto Austroloid Monkhmer race. Mostly the tribals of Meghalaya follow maternal linage.

Lepcha is the main tribe of Sikkim state. They live in infertile land surface of hilly reason of high altitude. They lead their life in harsh and adverse geographical and environmental conditions. Traditionally, the polyandry custom was common occurrence amongst Lepchas, till few decades ago. But this custom has now been abolished and now they follow monogamy. Lepchas are also based partly on agriculture, for their livelihood, but they could never become totally dependent on agriculture because of infertile land surface in their surroundings. However the cultivation of cardamom (Ilaichi) is most significant in their agricultural practices. They involve themselves as labourers in tea estates and other fields.

Manipur is largely inhabited by four types of tribes, along with other tribes. **Meities** and **Pangals** inhabit the lower regions of the valley, while the hilly regions of Manipur are mainly populated by Naga and Kuki tribes. Kuki tribe is main tribal groups of Mizoram. The other main tribes of Mizoram are Pawi, Chakma and Mizo. Agriculture is main occupation of these tribal groups in Mizoram and Manipur. The Chakma tribe is also found in Tripura state. The Chakma tribal group is usually possesses faith in the Buddhist tradition and language of this tribe is very much related to Bengali language. Traditionally, they are good cultivators. Animal husbandry, basket making, horticulture, fishing and weaving are the subsidiary occupation of this tribe. Bhil, Bhutia, Garoo, Halam, Lepcha, Munda, Orang, Riang, Santal and Tripuri are the other main tribal groups of Tripura. Tripuri is one of the oldest tribe of Tripura, which comprises the 50% of total population of Tripura. Tribals of Tripura primarily depend on farming, which forms their base of economy.

Naga is main tribe of Nagaland. Naga is one of the most prominent tribes of our country. The Naga tribe belongs to Mongolian race and speaks Sino-Tibetan language. The Naga is subdivided into various sects or subgroups. Each sect has its own identity and recognition independently. The tribes of Nagaland, include the hilly tribes, engage their selves in farming activities. Shifting cultivation is common in the most of tribals in North East.

West Bengal state is the abode of numerous tribes who reside in the rural parts of the state. Bhutia tribes, one of the prominent tribes residing in West Bengal, are mostly found in hilly districts of West Bengal, including Darjeeling and Kalimpong. The Bhutia tribes are mostly farmers, producing several vegetables and fruits. The Mru tribes are mostly found in various areas of the Jalpaiguri district of West Bengal. The occupations of the Mru tribes are mainly agriculture. Other tribes of west Bengal are Garo, Munda, Lepchas, Lohara, Oraon, Santhal etc.

Historical records suggest that the tribes of Uttarakhand are earliest settlers of this region of North India. Uttarakhand have 5 major tribes identified by the Government of India. They are Tharus, Jaunsaris, Buksas, Bhotiya and Raji. According to the 2011 Population Census, the tribal population of Uttarakhand stands at 291903 with Tharu being the largest tribe followed by Jaunsari, Buksa, Bhotia and Ban Raji.

Tharu

Tharu is the largest tribal group of the Uttarakhand state. They are mostly inhabitants of the terai area of Uttarakhand. They are concentrated in the Eastern region of Terai and trace their ancestry to Tibet. Outside Uttarakhand, they are spread in Uttar Pradesh, Bihar, and Nepal. This Terai region has difficult geographical and climatic situation. Moreover, the condition were not friendly, with plenty of mosquitoes were there. However, Tharus got themselves completely adjusted to these ruthless conditions long back. Tharus are metrical and live in large joint families. Their language is known as Tharu language. However, Tharu language is slowly disappearing from this region, replaced by Hindi and its local dialects. Agriculture is their main occupation. Besides this those who do not own their land, work as agricultural labours on another's land. Tharus believe in their local deities.

Jaunsari

Jaunsari is the second largest group of the Uttarakhand. They are spread over more than 365 villages. This region is also known as Jaunsar-Bawar. It is a remote hilly area of Dehradun district. They speak Jaunsari, a dialect of Western Pahari language. The Jaunsari group is identified to be one of the rare polyandrous societies in the world. Polyandrous means a woman having more than one husbands. As they believe they are the direct descendants of Pandavas. The temple of Pandavas is observed in every village. Pandow or Pandvana dance is performed by them.

The economy of Jaunsaris is completely based on agriculture and allied sectors like animal husbandry. Their socio-cultural traditions, truly reflect their exclusive dependence on agriculture.With the development of education, many are being employed in government and non-government organizations.

Buksa

Buksa, also known as Bhoksa, are concentrated in the Kumaon division with a main population living in Nainital district along the strip of Ramnagar to Dineshpur with some population in, Kotdwar-bhabar of Pauri Garhwal. However, Boksa mainly live in Gadarpur, Bajpur, Kashipur and Ramnagar areas of Western terai region. They speak Buksa, a dialect of Western Pahari language. Their economy is mainly based on agriculture. Besides this they are also engaged as labourers and dependent on forest products. The Boksa are adversely affected due to arrival of outsiders in their native Terai land. Their land has been grabbed directly or indirectly by these outsiders, and they are residing with a small piece of land in the Terai region. Buksa worship Kali, Durga, Mahadev, and other local deities. They usually worship Lord Ganesh for seeking protection against wild elephants.

Bhotiya

Bhotiya is concentrated in the Kumaon and Garhwal region of the Uttarakhand state. Their population includes Shaukas of Kumaon; and Tolchhas and Marchhas of Garhwal. They are mainly distributed in river valleys of Uttarakhand. They are recognized by different names. Such as Shauka, Johaari, Daarmi, Tolcha, Marchha, and Jaad. These various sub-groups may have slight variations among them in their cultural traditions.

Joharis and Marchhas, which are comparatively sound on economic grounds, consider themselves of higher status in comparison to others. Usually, they prefer to settle in the river valleys which enable them to perform some agricultural practices and they may carry on their trade activities also through the passes made by these rivers. They trace their roots back to Tibet. Majority of them follow Hinduism with a small percentage following Buddhism. They are the most advanced tribal society in the Uttarakhand state. Bhotiyas lead a semi-nomadic life because of climatic conditions and trade needs. Hence, herds of sheep and goats are their main property and major means of their livelihood. They move to one pasture land to another. Carrying their baggage, utensils, and herds of cattle along with them.

Raji

Raji is the smallest tribal group of Uttarakhand. They are concentrated around Ascot in southern Pithoragarh. The Rajis are also known as Vanrawats or Ban Rajis. Raji tribals inhabit in the dense and remote forests of this region. The term 'Raj Kiraat' and 'Bankhania Rawats' are also used for Raji tribals. They depend on forest products for their livelihood. They are known for their matriarchal culture with a woman as the head of their society. They speak Rawat, a Sino-Tibetan language. Their language is totally different. However, with the increased interaction to outside world, nowadays they can easily understand ordinary Hindi and Kumaoni languages. Long back, their livelihood was mainly based on hunting of wild beasts and storage of forest products. However, making of wooden vessels had been their traditional occupation. They are on the verge of extinction.

Fig. 8.5 Raji is doing wooden work

8.3.2-Arid and Semi-arid region

Arid regions receive little precipitation, less than 25 centimeters of rain per year while Semi-arid regions receive 25 to 50 centimeters of rain per

year. The northern arid and semiarid regions in India comprise largely of the desert of Rajasthan, the Rann of Kutch and the semi-arid regions of Punjab, Gujarat and the part of central India.

Maithili people, are an Indo-Aryan ethno-linguistic group, inhabit the Mithila region, which comprises North Bihar and parts of Jharkhand. The **Gujarati people** or **Gujaratis** and **Punjabis** are an Indo-Aryan ethnolinguistic group who reside in Gujarat and Punjab respectively. The **Marathi people** (**Marathis)** are also, an Indo-Aryan ethnolinguistic group in Maharashtra. **Jat** people are an ethnic group of northern India. Jats constituted about one-fourth of the populations of Punjab and Haryana. They are also spread in Rajasthan, Delhi, Uttar Pradesh, etc.

Gond, Bhil, Kol, Santhals, Munda, Meena, Banjara, Chenchus, Muria, Halba etc. are the main tribals of arid and semi-arid regions of India.The **Bhil** are one of the largest tribes**,** living in Chhattisgarh, Gujarat, Karnataka, Madhya Pradesh, Maharashtra, Andhra Pradesh and Rajasthan. The name is derived from the word 'billu', which means bow. The term Bhil is used to refer to "various ethnic communities" living in the forests and hills of Rajasthan's southern parts and surrounding regions of western India, highlighting the "popularity of the bow and arrow as a weapon among these groups".

Table-2: Tribes of Arid and Semi-arid regions, India (State wise List)

S.No.	States	Name of Tribes
1.	**Bihar**	Asur, Baiga, Banjara, Bathudi, Bedia, Omitted, Binjhia, Birhor, Birjia, Chero, Chik Baraik, Gond, Gorait, Ho, Karmali Kharia, Kharwar, Khond, Kisan, Kora, Korwa, Lohara, Mahli, Paharia, Munda, Patar, Parhaiya, Santal, SauriaPaharia Savar, Kawar, Kol,Tharu.
2.	**Chhattisgarh**	Agariya, Andh, Baiga, Bhaina, Bhumiya, Bhattra, Bhil, Bhil Mina, Bhunjia, Biar, Binjhwar, Birhul, Damor, DhanwarGadaba, Gond, Halba, Kamar,Karku Kawar, Khairwar, Kharia, Kondh, Kol, Kolam, Korku, Korwa, Majhi, Majhwar, Mawasi, Munda, Oraon, Pao, Pardhan, Pardhi, Parja, Sahariya, Saonta, Saur Sawar, Sonr.
3.	**Gujarat**	Barda, Bharwad, Bhil, Charan, Chaudhri (in Surat and Valsad districts), ChodharaDhanka, Dhodia, Dubla, Gond, Kathodi, Kokna, Omitted, Koli,Kunbi, Naikda, Padhar, Omitted, Pardhi, Patelia, Pomla Rabari, Rathawa, Siddi, Omitted, Bhil, Tadvi Bhil, Padvi.
4.	**Jharkhand**	Asur, Baiga, Banjara, Bathudi, Bedia, Binjhia, Birhor, Birjia, Chero, Chik Baraik, Gond, Gorait, Ho, Karmali, Kharia, Kharwar, Khond, Kisan (Nagesia) Kora, Korwa, Lohra, Mahli, Paharia, Munda, Oraon, Parhaiya, Santhal SauriaPaharia, Savar, Bhumij, Kawar , Kol.
5.	**Karnataka**	Adiyan, Barda, Bavacha, Bhil, Chenchu, Chodhara, Dubla, Gamit, Gond, Gowdalu, Hakkipikki, Hasalaru, Irular, Iruliga, Jenu Kuruba, Kadu Kuruba,Kammara, Kaniyan, Kokna, Koli, Konda, Koraga ,Kota,Koya, Kudiya, .Kuruba, Maha Malasar, Malaikudi,,Malasar, Malayekandi, Maleru Maratha, Kurumans,

		Maha Malasar ,MalaikudiMalasar, MalayekandiMaleru,.Maratha (in Coorg district), Marati (in south Kanara district), Meda, Naikda, Palliyan, Paniyan, Pardhi, Patelia , Rathawa,SholagaSoligaru, Toda, Varli, Vitolia, Kotwalia, Barodia, Yerava Siddi.
6.	**Madhya Pradesh**	Agariya, Andh, Baiga, Bhaina, Bharia, Bhattra, Bhil, Bhil Mina, Bhunjia, Biar, Biyar, Binjhwar, Birhul, Birhor, Damor, Damaria, Dhanwar ,Gadaba, Gadba Gond, Halba, Kamar, Karku, Kawar, Khairwar, Kharia, Kondh, Kol Kolam, Korku, Korwa, Majhi, Majhwar, Mawasi, Omitted, Munda, Nagesia, . Oraon, Panika, Pao, Pardhan, Pathari, Pardhi, Parja, Sahariya, Saonta, Saur, Sonr.
7.	**Maharashtra**	Andh, Baiga, Barda, Bavacha, Bamcha, Bhaina, Bharia, Bhunjia, Binjhwar, Birhul, Birhor, Omitted, Dhanka, Dhanwar, Dhodia, Dubla, Gamit, Gond, Halba, Kamar, Kathodi, Kawar, Khairwar, Kharia, Kokna, Kol, Kolam, Koli Dhor, Koli Mahadev, Koli Malhar, Kondh, Korku, Koya, Nagesia, Naikda, Mizo, Oraon, .Pardhan, Pardhi, Parja, Patelia, PomlaRathawa, Sawar, Thakur, Omitted, Varli, Vitolia.
8.	**Rajasthan**	Bhil. Bhil Meena, Dhanka, Damor, Garasia, Kathodi, Kokna, Patelia, Meena, Naikda, Seharia.
9.	**Uttar Pradesh**	Bhotia, Buksa, Jaunsari, Raji, Tharu, Gond, Kharwar, Saharya, Parahiya, Baiga, Pankha, Agariya, Patari, .Chero, Bhuiya.

(Source: Ministry of tribal affairs Govt. of India)

Bhil bowmen even found a reference in the great epics Mahabharta and Ramayana. Traditionally, experts in guerrilla warfare, most of them today are farmers and agricultural labourers. They are also skilled sculptors.

The **Gonds** are one of the largest ethnic groups in India. They are spread across the states of Madhya Pradesh, Maharashtra, Chhattisgarh, Uttar Pradesh, Telangana, Andhra Pradesh, Bihar and Odisha. They speak Gondi language which is a Dravidian language. Gonds are agriculturists and choose to live on the river beds close to forests. They love hunting and wild meats are their favorites. Gonds have a rich tradition of tribal arts and crafts that includes pottery, basket-making, body-tattooing, and floor-painting. The unique and one of a kind ghotul marriage tradition of the Gonds is renowned all across the world. A ghotul is a tribal youth dormitory in form of a spacious hut surrounded by earthen or wooden walls. A ghotul is a sacred place where no wrongs can be committed. The Gonds venerate plants and animals, especially the Saja tree and Mahua tree.

Santhal tribe is the third largest tribal group of India. Santals are the largest tribe in the Jharkhand state of India in terms of population and are also found in the states of Assam, Tripura, Bihar, Chhattisgarh, Odisha and West Bengal. They speak Santhali and Mundali language. The occupation of the Santhals revolves around the forests in which they reside. Their basic needs are fulfilled from the trees and plants of the forests. They are also engaged in

hunting, fishing and cultivation for their livelihood. They possess unique skills in making musical equipment, mats and baskets from the plants. A characteristic feature of a Santal village is a sacred grove. These sacred groves also called *Jaher* or *Santal Sthal*, situated on the edge of the village where many spirits live and where a series of annual festivals take place.

Banjara is nomadic tribal community, native of Rajasthan but now they are spread out all over Indian subcontinent. Previously these tribals were involved in nomadic habit who used to move from place to place for the trade of salt, spices and serials. They are wanderers by nature. Although now a day's most of them adopted permanent settling habits. **Kanjars** are nomadic tribals. They are closely related with Banjara. Basically Kanjars are considered as criminal nomadic tribe. They inhabited some districts of Rajasthan and adjacent regions of Madhya Pradesh.

Meena tribe is dominant over large part of Rajasthan and also inhabited in Haryana and UP. They are farmer. Meena tribe has high literacy rate and have occupied important government jobs. Sahariya tribe of Rajasthan is more primitive and backward tribe. They inhabit in remote and dense forests. Sahariya have been forest dwellers, therefore their means of livelihood had been hunting of wild animals, collection of wild fruits and storage of other forest produces. However most of them now have adopted permanently settled agriculture. The third largest tribe of Rajasthan is Garasiatirbe. These tribals live in hill slopes. Permanent and settled agriculture is the prime occupation of Garasias.

Gadia Lohars are well known nomadic tribe of Rajasthan. They are indigenous community of wandering blacksmiths. They proudly mention the association of their forefathers with the brave Maharana Pratap. The major occupation of this society is to repair iron articles.

8.3.3-Peninsular India

South India is also known as Dakshin Bharat or Peninsular India. The Peninsula is in shape of a vast inverted triangle, bounded on the west by the Arabian Sea, on the east by the Bay of Bengal, on the south by the Indian Ocean and on the north by the Vindhya and Satpura ranges. Peninsula is also sometimes defined as a piece of land bordered by water on three of its sides. The Peninsular Plateau is one of the oldest landforms of earth.

The peninsular states include Maharashtra, Odisha, Karnataka, Goa, Telangana, Andhra Pradesh, Kerala, Tamil Nadu as well as the union territories of Lakshadweep and Puducherry. In South India Dravidian languages are spoken by majority of the population. Almost all Dravidians live in South India. Each Dravidian language is associated with a separate ethnicity. The most widely spoken Dravidian languages in South India are Telugu, Tamil, Kannada and Malayalam. They all are major ethnolinguistic groups in Peninsular India. Dravidian people are native speakers of the Dravidian languages in the Indian Subcontinent. **Five Major Dravidian Ethnic groups** in India are, **Tamil, Telugu, Kannada, Malayalam** and **Tulu.**

Telugu people also called **Telugus** or **Telugu vaaru**, are an ethnolinguistic group who speak the Telugu language and are native to the Indian states of Andhra Pradesh, Telangana and the Yanam district of Puducherry. They are the largest of the four major Dravidian groups in terms of population.

The **Tamils** are a Dravidian ethnolinguistic group of south India. Tamils are native to Tamil Nadu and Puducherry in South India. They speak Tamil language. It is the official language of the Indian state of Tamil Nadu and the union territory of Puducherry (Pondicherry). Tamil is one of the longest-surviving classical languages of India.

The **Kannada people** are a Dravidian ethno-linguistic group who trace their ancestry to the South Indian state of Karnataka in India and its surrounding regions. The **Kannada people** are also called **Kannaḍigaru** and often referred to in English as **Kannadigas.** Kannada literature is mostly composed of poems and treatises on religious works. Kannada architecture was very rich and dominated by stone-carved sculptured palaces and temples.

The **Tulu people** or **Tuluvas** are an ethno-linguistic group from Southern India. They are native speakers of the Tulu language and the region they traditionally inhabit is known as Tulu Nadu. This region comprises the districts of South Kannada and Udupi in Karnataka and Kasargod district of Kerala.

These ethnolingustic groups of South India, comprise numerous tribal groups. The ethnic consciousness and awareness that still prevails amongst the tribes, is mirrored through the activities and celebrations that they perform. Kannada and Tamil are dominant languages with the South Indian tribes. The **Todas** tribes occupy central position amongst Tamil Nadu tribes. They have been in isolated condition, far away from the modern society in some cases even today. They are a shepherd community. Animal husbandry had been their basic source of livelihood since last many years. **Badagas** is the largest tribal group of Tamil Nadu. It is an agricultural community of Nilgiri district in Tamil Nadu. They are engaged in tea and potatocultivation. Their language is the mixture of Tamil and Kannada.

Kotas, **Kurumbas** and **Irular** are other main tribals of Tamil Nadu. **Kotas** are expert ironsmiths, potters, andcarpenters. They are known for their colourful folk dance. **Kurumba tribes** were mainly hunter gathers. But now a day's they are working as labourer in tea and coffee plantation. The Kurumba speak distinctive Kurumba language. The **Irular tribe** of Tamil Nadu is the second largest tribe and is similar to the Kurumba in many ways. They are forest dwellers as they collect honey, fruits, herbs, roots, gum, dyes, etc. The Irular (Uandenrali) tribe is also a main tribe of Kerela state. The Urali tribals, inhabit in dense forest make their huts and houses on branches of gigantic trees, called 'Irumdom'. The Pandiyan (Paniyan) tribals of Kerala are a worker community. Monogamy is generally practiced in this tribe.

Hakki pikki tribe is an important tribe of Karnataka. The birth of this tribal community has rich history, which also establishes a relation with the famous Rana prathap Singh. Kadu Kuruba, Kattunayakam, Sholaga, Toda etc. are the other main tribals of Karnataka. **Kadu Kuruba** tribe has got the rich tradition of worshiping stone and their predecessors with lots of festivity and enthusiasm. Apart from these, the **Kattunayakam** tribe is said to be the descendants of the Pallavas. Collection of food is one of the chief professional activities of the Kattunayakam tribes they have inclination towards religious values and ethnicity. **Sholaga** tribe, follower of Hindu religion, also has a belonging to the Kannada group. They speak the language of Sholaga. **Toda** tribal group has drawn the attention of many people by their wonderful house, good clothes, and ennobled language.

The **Chenchus** are the main tribe of Peninsular India. They spread in Andhra Pradesh, Telangana, Karnataka and Odisha. Many Chenchuslive dense Nallamala forest of Andhra Pradesh. Traditionally hunting and gathering was their main occupation. Some Chenchus collect forest products for sale to the non-tribal people. The tribals and nomads of Andhra Pradesh are settled mostly in hilly and forest regions of the state. The Gadabas, Savaras and Koyas belonging to the hilly areas bear the complex features of Mongolids and Australids. They are basically honest and truthful. The **Savaras** have excellent skills in irrigation. They use remarkable traditional engineering skills to supply water. The occupation of **Gadabas** is hunting, fishing and weaving the cloths. The word 'Koya' means hill dweller. The **Koyas** choose occupations like Carpentry, basket making and blacksmith. An There are certain nomadic tribes in Andhra Pradesh. Traditionally they were folk song singer. They came out of traditional professions and got into agricultural work to make a better living.

Banjara, Chenchus, Andh, Pradhan, Bhil, Gonds etc. are the main tribes of Telangana. The Banjara are also called **Lambada** in Telangana. **Pradhan tribe** inhabit the Adilabad district of Telagana. They are traditional bards. They perform folk songs and folk tales at various festivals. The **Andh tribe** live in hilly reason of Adilabad district of Telangana. Most of the **Andh** communities are lived in Maharashtra, Andhra Pradesh, Karnataka, Madhya Pradesh, Chhattisgarh, Gujarat, Keral and Goa. Andh people make their living through farming or as factory workers. However, a few are still surviving on hunting, finishing, petting, and living in forest lands.

The native tribal people of the Andaman Islands are scattered all over the Andaman and Nicobar Islands and few tribes do not prefer to have contact with the rest of the world and stay away in the dense forests. The Onge, Sentinelese and Shompen are main Andamanese tribal groups. They are traditionally hunter-gatherers and fishers. The native Andamanese people speak the tribal languages. These all tribal groups are Particularly **Vulnerable Tribal Groups.** Particularly Vulnerable Tribal Groups (PVTG) as identified by the Centre Government, are those tribal

groups, that depend on hunting for food, have pre-agriculture level technologies, zero or negative population growth, and extremely low levels of literacy.

Shompen is the only Particularly **Vulnerable Tribal Group** in the regionwith **Mongoloid** features**.**The **other** have **Negroid** features.The Shompen practice a hunter gather subsistence economy. They froze fruits and forest food. They also keep pigs, farm yams, roots, vegetable and tobacco. Men usually carried bow and arrows.

The **Sentinelese,** also known as the Sentineli, live on North Sentinel Island in the Andaman Islands. The Sentinelese appears to have consistently refused any interaction with the outside world. They are unfriendly to outsiders and have killed people who approached or landed on the island. They are designated as a Scheduled Tribe of India.

The **Jarawas,** are recognised as an Adivasi group of Andaman, in India. Along with other indigenous Andamanese peoples, they have inhabited the islands for several thousand years. The Jarawa also maintain a steadfast independence and refuse most attempts at contact. But now some Jarawas have become regular visitors at settlements, where they trade, interact with tourists, get medical aid, and even send their children to school.

The **Onge** are one of the tribes of India's Andaman Islands. The onge is reduced to less than 100 people. Their lifestyle is quite similar to that nomadic people. The main demographic troubles of Onge is, perhaps they are one of the least fertile and most sterile people in the world.

The tribal groups of Goa are Siddi, Varli, Dhodia and Naikda. The Siddis are a tribal group inhabiting India. Members are descended from Bantu peoples from Southeast Africa that were brought to the Indian subcontinent as slaves by Portuguese merchants and Arab traders. Varli people live mostly in Goa and Nashik, Thane, and Dhule regions in the state of Maharashtra. Varli speak in an unwritten language that is from the southern zone of the Indo Aryan tribal languages. Dhodia tribes are located in Goa, Dadra and Nagar Haveli and Daman and Diu. They also inhabit in Madhya Pradesh, Gujarat, Maharashtra, Karnataka and Rajasthan. The Naikda area scheduled tribe found in Goa, Gujarat and Maharashtra.

Table-3: Tribes of Peninsular India

S.No.	States	Name of Ethnic communities/ Tribes
1.	**Andhra Pradesh**	Asur, Baiga, Banjara, Bathudi, Bedia, Binjhia, Birhor, Birjia, Chero, Chik Baraik, Gond, Gorait, Ho, Karmali, Kharia, Kharwar, Khond, Kisan (Nagesia) Kora, Korwa, Lohra,

		Mahli, Paharia, Munda, Oraon, Parhaiya, Santhal SauriaPaharia, Savar, Bhumij, Kawar , Kol.
2.	**Andaman and Nicobar**	Adiyan, Barda, Bavacha, Bhil, Chenchu, Chodhara, Dubla, Gamit, Gond, Gowdalu, Hakkipikki, Hasalaru, Irular, Iruliga, Jenu Kuruba, Kadu Kuruba,Kammara, Kaniyan, Kokna, Koli, Konda, Koraga ,Kota,Koya, Kudiya, .Kuruba, Maha Malasar, Malaikudi,,Malasar, Malayekandi, Maleru Maratha, Kurumans, Maha Malasar ,MalaikudiMalasar, MalayekandiMaleru,.Maratha (in Coorg district), Marati (in south Kanara district), Meda, Naikda, Palliyan, Paniyan, Pardhi, Patelia , Rathawa,SholagaSoligaru, Toda, Varli, Vitolia, Kotwalia, Barodia, Yerava Siddi.
3.	**Goa**	Asur, Baiga, Banjara, Bathudi, Bedia, Binjhia, Birhor, Birjia, Chero, Chik Baraik, Gond, Gorait, Ho, Karmali, Kharia, Kharwar, Khond, Kisan (Nagesia) Kora, Korwa, Lohra, Mahli, Paharia, Munda, Oraon, Parhaiya, Santhal SauriaPaharia, Savar, Bhumij, Kawar , Kol.
4.	**Karnataka**	Adiyan, Barda, Bavacha, Bhil, Chenchu, Chodhara, Dubla, Gamit, Gond, Gowdalu, Hakkipikki, Hasalaru, Irular, Iruliga, Jenu Kuruba, Kadu Kuruba,Kammara, Kaniyan, Kokna, Koli, Konda, Koraga ,Kota,Koya, Kudiya, .Kuruba, Maha Malasar, Malaikudi,,Malasar, Malayekandi, Maleru Maratha, Kurumans, Maha Malasar ,MalaikudiMalasar, MalayekandiMaleru,.Maratha (in Coorg district), Marati (in south Kanara district), Meda, Naikda, Palliyan, Paniyan, Pardhi, Patelia , Rathawa, SholagaSoligaru, Toda, Varli, Vitolia, Kotwalia, Barodia, Yerava Siddi.
5.	**Kerala**	Asur, Baiga, Banjara, Bathudi, Bedia, Binjhia, Birhor, Birjia, Chero, Chik Baraik, Gond, Gorait, Ho, Karmali, Kharia, Kharwar, Khond, Kisan (Nagesia) Kora, Korwa, Lohra, Mahli, Paharia, Munda, Oraon, Parhaiya, Santhal SauriaPaharia, Savar, Bhumij, Kawar , Kol.
6.	**Odisha**	Adiyan, Barda, Bavacha, Bhil, Chenchu, Chodhara, Dubla, Gamit, Gond, Gowdalu, Hakkipikki, Hasalaru, Irular, Iruliga, Jenu Kuruba, Kadu Kuruba,Kammara, Kaniyan, Kokna, Koli, Konda, Koraga ,Kota,Koya, Kudiya, .Kuruba, Maha Malasar, Malaikudi,,Malasar, Malayekandi, Maleru Maratha, Kurumans, Maha Malasar ,MalaikudiMalasar, MalayekandiMaleru,.Maratha (in Coorg district), Marati (in south Kanara district), Meda, Naikda, Palliyan, Paniyan, Pardhi, Patelia , Rathawa,SholagaSoligaru, Toda, Varli, Vitolia, Kotwalia, Barodia, Yerava Siddi.
7.	**Tamil Nadu**	Asur, Baiga, Banjara, Bathudi, Bedia, Binjhia, Birhor, Birjia, Chero, Chik Baraik, Gond, Gorait, Ho, Karmali, Kharia, Kharwar, Khond, Kisan (Nagesia) Kora, Korwa, Lohra, Mahli, Paharia, Munda, Oraon, Parhaiya, Santhal

		SauriaPaharia, Savar, Bhumij, Kawar , Kol.
8.	**Telangana**	Adiyan, Barda, Bavacha, Bhil, Chenchu, Chodhara, Dubla, Gamit, Gond, Gowdalu, Hakkipikki, Hasalaru, Irular, Iruliga, Jenu Kuruba, Kadu Kuruba,Kammara, Kaniyan, Kokna, Koli, Konda, Koraga ,Kota,Koya, Kudiya, .Kuruba, Maha Malasar, Malaikudi,,Malasar, Malayekandi, Maleru Maratha, Kurumans, Maha Malasar ,Malaikudi Malasar, MalayekandiMaleru,.Maratha (in Coorg district), Marati (in south Kanara district), Meda, Naikda, Palliyan, Paniyan, Pardhi, Patelia , Rathawa,SholagaSoligaru, Toda, Varli, Vitolia, Kotwalia, Barodia, Yerava Siddi.

(Source: Ministry of tribal affairs Govt. of India)

8.5 ETHNIC GROUPS AND PLANTS

The India is multi-ethnic country. These ethnic groups mostly the indigenous tribals live close in the vicinity of forests and have managed and conserved the biodiversity of their localities since long time. The tribes use plants in their day-to-daylife, as plants are a non-separable component to them. The tribals living in different parts of India use plant species of forest floras for food, fodder, fibres house building, fuels, medicines, beverages, oils, gums, resins, dyes, basketry, timber and wood works, musical instruments, fish poisons, religious ceremonies, narcotics etc.

These tribals take shelter from forest and utilize wild edible plants both raw and cooked. The flower and fruits are generally eaten raw while tubers, leaves and seeds are cooked. Tribals utilize forest produce, forest timber and fuelwood. *Ocimum sanctum* (Tulsi), *Curcuma longa* (Haldi), *Emblica officinalis* (Amla), *Tamarindus indica* (Imli), *Agle marmelous* (Bel), *Artocarpus heterophylum* (Kathal), *Cynodon dactylon* (Doob), *Ficus religiosa* (Pipal), *Mangifera indica* (Mango) *F. benghalensis* (Bargad), *Dioscoria spp.* etc are the most commonly used by almost all the tribes of India. These tribals are living in forest since ages and have developed a kind of affinity with forests. Many plants are conserved in their natural habitat by tribals due to magico - religious belief that they are habitat of god and goddess.

The tribal have a deep belief in their native traditional medicine to cure diseases as plant have some special power in them. Plants are a rich source of various chemical and bio active compound as it is synthesized in plant cells. These bioactive compounds have the capacity of healing diseases. The secondary metabolites synthesized in plants like tannin, flavonoids, alkaloids, saponin, steroids etc. have antioxidant, anti-bacterial, anti-microbial properties which play an important role in prevention and cure of different diseases, in the life of ethnic and indigenous people.

Tribals worship trees and flowers as they believe that God and Godesses reside in them. The ethnic and indigenous people have conserved several plants and endangered cultivars of agricultural crops such as rice, maize, millets, grains, legumes, fruits and vegetables which have

originated under diverse agro-ecological climates in north-east, Himalayan region, central and peninsular region of India. The ethnic and indigenous people depend upon several wild species for fruits, seeds, bulbs, roots and tubers which are used for edible purposes. Tribals follow environmental conservation rule in harvesting edible plants which establishes ecological prudence. Tubers of edible plants like those of *Dioscorea spp.* are harvested by tribals when the leaves of the vine turn yellow and have physiologically matured. The wild tubers are dig carefully avoiding damage to associated species.

Primitive and indigenous people have been using several plants for combating disease from centuries and are found wide acceptance in traditional medicinal use. The root, stem and leaves of some plants are powdered and paste is prepared and applied by tribals for cure of different disease. These plants are conserved by tribal herbal healers in natural forests for treatment of different types of diseases. The ethnic people of India have played a vital role in preserving bio-diversity of several virgin forests and have conserved several flora and fauna in sacred groves otherwise these flora and fauna might have disappeared from natural ecosystem. Some other factors such as taboos, belief system, cultural manifestations, rites, and rituals also are best mode of conservation of biodiversity by the ethnic people.

Sacred grooves are the best examples of conservation pattern of flora by ethnic groups. Sacred grooves are patches of natural vegetation demarcated by ancient societies and protected since religious practices and cultural traditions. A sacred grove is any grove of trees that are of special religious importance to a particular culture. Sacred grooves are mostly regenerated around places of worship. The interference of all kind of human activities are prohibited in sacred groves. Sacred groves help in the protection of many rare, threatened, and endemic species of plants and animals found in an area. The sacred groves are the natural forests which are located in North-East, Central and Peninsular India. Around 14,000 sacred groves have been reported from all over India, which act as reservoirs of rare fauna, and flora. Although experts believe that the total number of sacred groves could much higher to reported number.

A taboo refers to a religious practice that restricts certain behavior, activity, or relationship with, places, or plants. A taboo is something a culture considers forbidden. Taboos help to regulate moral order in the society. Ethnic people conserve the plants and animal in religious taboos. Some cultural manifestations are the best examples of interrelation between plants and ethnic groups. Van Mahotsava and Spring festival are conducted by certain ethic groups in India. During such festival the villagers were allowed to enter the sacred groove and worship the dieties only on the condition, that they should not harm the animals and plants. Some ethnic groups are planted the sacred plants at the occasion of van Mahotsava. Harela in Uttarakhand is an example of interrelation between plants and ethnic group or villagers.

Plants and trees are considered dear to the gods and planting trees is considered as a religious ritual, according to the mythologies, planting and protecting the trees can help people lead

better life with the blessing of Devta. Such belief in any ethnic or religious group is a key to plant protection and indicates healthy human-plant relationship. The Bishnois are an Indian religious group with a solid commitment to protecting the environment. In 1730 AD, a small village Khejdi, of Jodhpur in Rajasthan witnessed probably the first and most fierce environment protection movement in the history of the country. Amrita Devi, a Bishnoi woman, led 363 villagers in protest against the felling of Khejri trees to build a palace for the Maharaja of Marwar. Maharaja Abhay Singh's soldiers brutally killed Amrita Devi and her followers, but their sacrifice prompted him to order that no other trees should be cut.

India in the present scenario is rich in biodiversity. The indigenous people have helped in conservation of bio-diversity. Conservation of diversity, sustainable management, propagation of such valued flora and their in-situ as well as ex-situ conservation are the need of this century. Conservation of flora by ethnic people is a best method of conservation of biodiversity. In sacred forests as well as in localities dominated by ethnic people needs to be surveyed for identification of plants associated with various ethno-botanical uses, for a method of conservation. This belief system played an important role in the socio-religious aspects. The tribal people also beliefs in performing rituals and magico-religious activity not only to get a healthy and prosperous life but also to conserve the biodiversity of the surroundings. Protection of plant is based on the cultural and megico-religious beliefs by ethnic people and villagers, is the best, easy and socially acceptable method of plant conservation.

8.5 ETHNOBOTANICAL STUDIES

Ethnobotany is the study of interrelationships between human cultures and plants. It also creates an awareness of the link between biodiversity and cultural diversity. Ethnobotanical fieldwork is different from the routine field collections, which are done usually by taxonomist giving emphasis to plants and their habitat. The ethnobotanists, in addition to these aspects, record the relationship of these plants with the local inhabitants. Ethnobotanists play a key role in exploring these kinds of information from indigenous people which creates a gateway for formulating novel drugs and other requirements of humans. Ethnobotany has now emerged as a discipline by itself that studies all types of interrelations between people and plants. Therefore ethnobotany, the research field of science, has been widely used in documenting the indigenous knowledge of using plants and providing an inventory of useful plants from local ethnic people.

Plants that are used as traditional herbal medicine in different countries are an important part of these studies. However, in some countries, ethnobotanical studies have been used for the discovery of new medicinal uses and development of pharmaceutical industry. In general, experiences gained from ethnobotanical approaches of traditional medicinal studies in many countries have helped development of new drug. At the same time, in many cases, over-harvesting, degradation of medicinal plants, and loss of indigenous traditional knowledge from local communities is common problems in these resource areas. Issues of indigenous knowledge,

intellectual property rights, and uncontrolled transboundary trade in medicinal plants occur frequently in the region. It has been reported that about 20,000 plant species are found in Indian flora having different medicinal properties and many more have other ethnobotanical importance.

Ethnobotanical research can be considered as connecting link of medicine both past and present in term of plants and the traditional societies. It is an important tool in development of pharmaceuticals and medicine industry. In addition to its traditional roles in economic botany and exploration of human cognition, ethno-botanical study and research is very important. There are certain tools and techniques applied for such ethnobotanical study.

8.5.1 Tools and techniques

In India the ethnobotanical work in an organized way was started by Botanical Survey of India in 1969. Since then uses of plants by the tribal are being recorded for a variety of purposes. Considerable number of works has been done on several aspects of plants viz. ethnomedicine, dyes, tans, narcotics, fiber, timber etc. Ethnobotanical studies require all or some steps for collection of ethnobotanical knowledge from society. For such study the collection and documentation of ethnobotanical data is necessary. Some equipments are necessary for the collection of data during field work.

8.5.1.1 Equipment for ethnobotanical studies/ Field work

The equipments for fieldwork in ethnobotanical studies are very common. For the collection of any ethnobotanical data during field work, some equipment should be always with us.

1- Camera/ Mobile for picture /video sequences, with sufficient batteries.
2- Black marker pen, 15-cm scale, and a miniature whiteboard to indicate date, location, and name of plant in the image itself.
3- Plant press with all the required materials (such as labels, pencils, newspaper, cardboard, ventilators, dryers, etc.), including scissors, a trowel, and plant clippers to harvest the plant.
4- List of names and contact details (address, telephone number) of all our respondents in the study area.
5- A large plastic sheet, tarpaulin, or poncho to cover ourselves and all our equipment in case of unexpected rain, especially if the study places are in remote areas (mostly sacred groves are located in remote areas).
6- Relevant field guides and reference books for on the spot identification of unknown plant species.
7- Copies of letters of introduction (in plastic covers) that explain our aims and methods, with details of our identity and institutional background, including a telephone number where we can be reached if someone has questions or wishes to discuss the project.

8- A map of the study area, preferably topographic and high resolution; a remotely sensed image or aerial photographs of the whole study area. Phone/ Mobile according to available signals of study area and contact number of subject experts.
9- Empty plastic and paper bags of all shapes and sizes, wire twists, duct tape or other means to seal bags and boxes, and a permanent pen to store and label seeds and other artifacts.
10- Insect repellent (mosquitoes can make field research in tropical forest area torturous) and suntan lotion etc.

8.5.1.2 Collection of ethnobotanical data

Collection and Compilation of Socioeconomic data of the study area is essentialrequirement of ethnobotanical studies. For the Socio-economic study following parameters may be considered.
1. Profile of the households (Type of family).
2. Religion and caste profile (ST, SC, OBC, others).
3. Agricultural Land, Crops cultivated and Livestocks.
4. Irrigation and transport facilities.
5. Drinking water and toilet facilities.
6. Availability of Electricity and use of fuel.
7. Awareness about local health tradition among the tribes.
8. Knowledge about medicinal plants for home remedies.
9. Use of home remedies
10. Assessment of treatment other than home remedies.
11. Comparison of cost of home remedies and other treatment method adopted by tribal.

8.5.1.3 Manners of collection of ethnobotanical data

Ethnobotanical data may be collected in different manners i.e., by enquiry, observation, interview, and participation. The methodology used for collecting the ethnobotanical information can be divided into following three major categories: -

A. **Direct Approach:** This includes the intensive field survey among tribal and remote areas of a region. The fieldwork is conducted in several tribal areas and takes few days. During the stay, their daily activities should be closely observed and interpersonal contacts are established by participating in several of their social and religious ceremonies such as marriages, rituals and curing sessions. Some informants can be selected from tribal study area.

The ethnobotanical data (local name, mode of preparation, medicinal uses) are collected through questionnaire, interviews and discussions among the tribal practitioners in their local language. Our questionnaire allows descriptive responses on the prescribed plant, such as part of the plant used, medicinal uses, detailed information about mode of preparation (i.e., decoction, paste, powder and juice), form of usage either fresh or dried and mixtures of other plants used as ingredients. Finally the ethnobotanists prepare result from obtained data.

B. Indirect Approach: It included collection of information from literature, museums, herbarium etc. In some ancient literature mention is frequently found about the plants which played role in the life and civilization of people of that time. Some such ancient literature is even unpublished and unknown to many people. Such old but recently unearthed literature can provide very useful data about plants used by people of those days in different parts of the world. Several of these uses are again not known to modern world and it is of most importance to bring them to light. Literature survey therefore, can be a very useful tool in ethnobotanical researches. At time there are certain constants in correct identification of the vernacular names with the botanical names.

The vast heritage of Vedic literature in India, which dates back to 2000 to 1000 BC contains valuable information regarding medicinal plants. Same as our Puranas, Ayurvedic literature and other literatures related to different traditional systems of medicine are very useful and valuable sources of information for ethnobotanists.

Museums and Herbaria may be very useful to collect ethnobotanical data through indirect approach. Museum is an institution where artistic, acheological and educational materials are exhibited to the public. Findings of plant remains are collected in museum. Ethnobotanical research work is presented as one of the core activities of such museums. Herbarium is a storehouse of plants, pressed and mounted on a particular size of seeds. Here plants from far and wide are collected and preserved, with detailed reports about uses of these plants on the labels attached to the seeds. Thus, herbarium serves the function of data bank of plant.

C. Miscellaneous: Some information is also collected after discussion with the non-tribal e.g. village headman, spiritual leader, ozha, vaidhya, hakims, priests, teacher, physicians, veterinary doctor, social worker, postal authorities and Ayurvedic doctors etc.

The ethnobotanical survey includes plant collections, informal interviews with the inhabitants and the implementation of the ethnographic method of free listing and semi-structured interviews (Weller and Romney, 1998) or it may be done by following the methodology of Cotton (1996). The survey may involve individuals like:

1. Village Head man and old experienced person /Village resource persons.
2. Middle men or interpreter.
3. Men and women working in the field
4. Men and women in weekly markets and in other common places.
5. Local forest officers.
6. Baidyas, Sirahas, Guniyas, Gaytas and knowledgeable women.
7. Traditional birth attendant (Dai).
8. Traditional bone setter (haddibaidh), religious teachers etc.

8.5.1.4 Interviewing and Interviewing Protocol

Interviewing is a dynamic process involving spoken interactions between two or more people. The interview in its various forms constitutes the basis of most ethnobotanical data collection.

The way in which interview is conducted and presented, and the answers recorded, all have significant impact on the quality, quantity and meaning of the data collected.

The value of interviewing as a tool of inquiry depends on the context in which it takes place and on the interviewer's skills. Ethnobotanists should develop sensitivity and respect when individuals show shyness or reserve on certain subjects, personal boundaries often change as people get to know each other. The best information is obtained over extended periods of time, where mutual trust and understanding can develop, allowing the researcher to cross check his or her observations repeatedly. The ethnobotanist needs to identify culture-bound features for to build rapport. During the early stage of rapport building, it is best to discuss familiar subjects or plants. Ethnobotanist should not expect all people to share their knowledge. Good interviewers are aware at the pace at which people feel comfortable in establishing a relationship and sharing their knowledge.

8.5.1.5 Documentation of the Information

Information may be documented disease wise use of plants/plant parts for the preparation of drug. The cost of the treatment per episode/per disease should be noted. The information may be cross checked by the other informants in the same locality for verification of medicinal claims by the first informants. This practice results in credibility of data regarding the use of plants and statements of informants.

The documentation of the information obtained from folk healers and Vaidyas may be documented under following heads:

1. Name of the disease.
2. Name of the plant
3. Vernacular name.
4. Family name
5. Plant part used.
6. Habit of the plant
7. Other ingredients used.
8. Drug preparation.
9. Drug application and its effectiveness.
10. Cost of treatment / episode.

8.6 ANCIENT LITERATURE

There are various written accounts in which the usefulness of plants is mentioned. Perhaps the earliest use of herbal plants is documented in the Vedas around 1500 to 800 B.C.which represents the oldest repository of human knowledge, and comprises many plant species. The old literature includes mainly literature related to Vedic period (1500-800 BC), Brahmanic and Upanishadic period (800-600 BC), Buddhist period (600-B.C.-200 AD). Post Buddhist period (after 200 AD) and our ayurvedic literature. Ayurveda is a traditional medicine system practiced

widely in India and Nepal. Sanskrit is language of the Vedas however Buddhism and Jainism adopted other literary languages (Pali and Ardhamagadhi, respectively).

Vedas are composed in Vedic Sanskrit; the texts constitute the oldest layer of Sanskrit literature and the oldest scriptures of Hinduism. There are four Vedas Reg Veda, Yajur Veda, Sama Veda and Atharva Veda. The Rigveda represents earliest sacred book of India. It is oldest and biggest amongst all Vedas. This Samhita (compilation) is unique in its nature. The whole of the Rig Veda Samhita is in a form of verses, known as Rik (Rig), Rik is the name given to those mantras which are meant for praising the deities. The collection of Riks is known as Rigved Samhita. The Rigved Samhita contains about 10,552 mantras, classified into ten Mandals. Each mandala is divided in several sections called Anuvakas, each Anuvaka consist number of hymns, called Suktas and each Sukta is made up of number of verses called riks. It means the Sukata is a group of mantras (hymns). The deities of some Suktas, in Rig Veda are plants, e.g. Soma is the deity of 48thSukta of the 8th Mandala of Rigveda. The Samhita of Rig Veda comprises 10 Mandalas, 85 Anuvakas, 1,028 Suktas and 10,552 Mantras.
Yajurved Samhita is quite different from Rigved Samhita. It is principally in prose form. The word Yajus means sacrifice (Yagya or Yajna). Yajurved is a ritual Veda. Its priest is called Adhvaryu. Adhvaryu priest had to practically do all the ritualistic workin the sacrifice. Many plants and their parts are used in sacrifice.

Samaveda literally means the mantras that can be sung poetically. We know that Samaveda is a musical scripture. It can also be called the primary source of Indian music. The mantras of Samaveda are sung during a yajna, special rituals (anushthan), and Havana. Samaveda's priest is called Udgata. Samaveda Samhita is mainly the song book of Udgata.

The Atharvaveda is the youngest of the Veda quartet. It is believed that two groups of rishis, the Atharvanas and the Angirasa, composed the Atharva Veda. In fact, that is where its oldest name, Ātharvāṅgirasa, comes from, according to its own verse 10.7.20, was Atharvangirasah, a compound of Atharvan and Angiras. The Atharva Veda is the oldest literary monument of Indian medicine. It is believed to be the origin of Ayurveda, the Indian science of medicine. The hymns in the Atharva Veda are dedicated to prolonging life and healing illnesses, seeking cures from herbs. There are a series of Mantras related to cure various physical and mental diseases. Another class of hymns includes prayers for protection from the bite of snakes or injurious insects. We find mention and application of medicines and medicinal herbs. This feature distinguishes the Atharvaveda from the rest of the Vedas.

Brahmanas, Aranyakas, and Upaniṣhadas are also included in Vedik literature. The Brahmanas consist of details about the meaning of Vedic hymns and their applications. Every Veda has several Brahmanas attached to it. For e.g. Aitareya Brahmana and Kaushitaki Brahmana related to Rigveda, Taittiriya and Shatpatha Brahmanas to Yajur Veda, Tandya and Jaiminiya Brahmanas to Sama Veda and Gopath Brahmana related to Atharvaveda. The Brāhmaṇās, also discuss and explain how to perform the Yagyan (yajñas) or rituals. The names of plants, trees

and their products that are specifically used in the Yaganya and homa are elaborately described in the Brahmans. The Aranyakas which are the manuscripts recited in the forests or forest treatises, giving symbolic interpretations of the yajñas and the Upaniṣads, which are the philosophical writings that deal with the wisdom leading to liberation (mokṣa). Thus, these form the basis of an independent system, or darśana, called 'Vēdānta', the culmination of the Vēdas.

In China, Sheng-Nong's Herbal book is suggested to be one of the earliest sources of folk knowledge on the use of herbs; it comprises 365 plants, animals, and minerals used as medication from the period of Sheng-Nong (3000 B.C.). The system of Unani Medicine in South and West Asia also has very long tradition and is being practiced in different countries. The roots of Unani system of medicine are found in ancient Egypt. The studies of Papyri clearly show the ability of Egyptians in the field of medicine before 1500 BC.Papyrus (plural: papyri) have been used in Egypt as sheets to write document. Papyrus material was prepared in ancient Egypt from the pithy stem of a water plant. *Unani* system of medicine systematically originated in Greece and was introduced by Hippocrates; a famous philosopher and physician during the 460–366 BC period. Ultimately the Greek, Arab and Persian developed the Unani system of Medicine and related literature also.

Ayurveda is about 5,000-year-old system of natural healing originated in India's ancient Vedic culture. Most material relating to the health and diseases are available in Atharva Veda. However, Rig Veda which is the earliest Veda also mentions about diseases and medicinal plants. Three ancient books of ayurveda are Charaka Samhita, Sushruta Samhita and Astanga Hridaya written in Sanskrit, more than 2,000 years ago, are considered the main texts on Ayurvedic medicine.

In the post-Vedic Indian literature there is enough evidence to show that botany developed as an independent science on which was based the science of medicine, agriculture (as embodied in the Kṛṣi-Parāśara) and Horticulture (as illustrated in the Upavana-vinoda). Krishi-Parashara (400 BC) probably is the first-ever 'textbook' on agriculture in which the information is logically organized in chapters while Upavana-Vinoda is a Sanskrit Treatise on Arbori-horticulture. This science was known as the Vṛkṣāyurvēda, also compiled by Parāśara.

According to the World Health Organization (WHO), more than 80% of the world's population relies on traditional herbal medicine for their primary health care needs. These valuable herbal traditions found in developing countries have always been considered an important component of the cultural heritage of the world. This indigenous knowledge about medicinal plants has been used from time immemorial for healing process.

8.7 SUMMARY

A group of people who share a similar beliefs, values, and behaviours, language, religion, ancestry etc. that is often handed down from one generation to the next; is called ethnic group. The three major ethnic groups of India are Indo-Aryan, Dravidian and Mongoloids. These major ethnic groups are diversified into many ethnic groups and tribes. The Indo-Aryans dominated in India. Each of the Indo-Aryan ethnic groups has their own language. The Indo-Aryans are the most diverse group of people in India. Bengali, Gujarati, Kashmiri, Assamese, Konkani, Marathi, Punjabi etc. are diverse ethnic groups of Indo-Aryans. In south India the main Dravidian Ethnic groups are Tamil, Telugu, Kannada, Malayalam, and Tulu. In North East India, there are many indigenous ethnic groups; they speak various languages of multiple languages, mostly related to Indo-Aryan, Sino-Tibetan, and Austroasiatic families. Many ethnic and social groups are notified as Scheduled Tribes as per provisions of the Indian Constitution. According to three distinct geographical Zones of India, we can study of these tribes as, tribes of Hill region, Arid &semi-arid zones and Peninsular India.

Bhot, Gaddi, Gujjar, Jad, Kinnara, Lahaula, Pangwala, Swangla, Tharu, Jaunsari, Bhotias, Buksa, Raji. Asur, Chakma, Garo, Khasi, Kuki, Tai, Mizo, Naga etc. are main tribes of hill regions of India. Bhil, Meena, Tharu, Gond, Santhal, Banjara, Asur, Baiga, Khond, Paharia, Munda, Oraon, Kol etc. are main tribes of arid and semiarid regions of India. Andh, Chenchu, Paniyan, Pardhi, Hakkipikki, Irular, Toda, Varli, Vitolia, Kotwalia, Barodia, Yerava Siddi, Pradhan, Shompen, Sentinelese, Jarawas, Onge etc. are the main tribal groups of Peninsular India.

The ethnic people mostly the indigenous tribals live close in the vicinity of forests and have managed and conserved the biodiversity of their localities since long time. Sacred grooves, Taboos, Sacred plants, tree worship culture etc. are the best examples of conservation pattern of f lora by ethnic groups. Our old literature is a good source of knowledge about the traditional uses of plants. The old literature includes mainly literature related to Vedic and our ayurvedic literature. Ayurveda is about 5,000-year-old system of natural healing.

8.8 GLOSSARY

Adhvaryu: Priest of Yajurveda.
Ethnicity: A cultural and social identity of an ethic group.
Ethnobotany: It is the study of how people of a particular culture and region make the use of indigenous plants.
Ethnolinguistic group: A group of People that is unified by both a common ethnicity and language.
Jaher: Sacred grove of Santhal Tribe or Santal Sthal.
Nomads: A group of people, who are Roaming about from place to place frequently.
Nomadic Pastoralism: A a way of life of pastoralists, in which they engage periodic movements with their livestock, to find pasturage for their animals.

Race: A group of people has specific physical qualities and biogenetic characteristics.
Rik: Rik is the name of Rigvedic mantra.
Sukata : Sukata is a group of vedic mantras (hymns).
Taboo: A religious practice or custom, that restricts a certain behavior or activity.
Udgata: Priest of Samaveda.

8.9 SELF-ASSESSMENT QUESTION

8.9.1 Multiple choice Questions

1-Shompens belong to:
(a) Uttrakhand (b) Andaman and Nicobar
(c) Bihar (d) Manipur

2. The Dravidian Linguistic group belongs to:
(a) Easten India (b) South India
(c) North India (d) North East India

3. Tribals in the terai regions of Uttrakhand are called:
(a) Boksha (b) Lepcha
(c) Dogra (d) Raji

4. The tribal community living in the hills of the Jamu and Kasmir valley is:
(a) Gujjar (b) Naga
(c) Raji (d) Bhil

5. The book 'Dictionary of Indian Folk Medicine and Ethnobotany" was written by:
(a) G. R. Rao (b) S. K. Jain
(c) P. K Gupta (d) Hashberger

6. Which of the following tribe is the smallest tribal group of Uttarakhand.
(a) Bhotiya (b) Bhoksha
(c) Raji (d) Naga

7- Any informationfor ethnic uses is considered more consistent and reliable:
(a) Different use reported from same location
(b) Same use reported from different locations
(c) Different use from different locations
(d) No use from any location

8. The priest of the Samaveda is called:

(a) Udgata (b) Adhavaryu
(c) Hota (d) Rishi

9. Sacred Groves are:
(a) parts of forests that have been left untouched by the local people.
(b) places for grazing animals.
(c) forests earmarked for commercial felling of trees.
(d) forests used for planting trees with medicinal properties.

10. According to our epics and Puranas, the native inhabitants of the Himalayan region were:
(a) Kinnars and Kiratas (b) Bhil
(c) Gond (d) Santhal

8.9.1 Answer Key: 1-(b), 2-(b), 3-(a), 4-(a), 5-(b), 6-(c), 7-(b), 8-(a), 9-(a), 10-(a)

8.10 REFERENCES

- Boddupalli R S (2021**),** Traditional knowledge of botany and agriculture revealed in the Veda, Samhitas, Brahmanas, Aranyakas and Upanishads. Indian Journal of Traditional Knowledge, Vol 20(1), January 2021, pp 284-297.
- Chauhan Kanika, Role of Ethnobotany on Indian Society: A Review (2020), Journal of Arts, Culture, Philosophy, Religion, Language and Literature e-ISSN: 2457-0346, Volume-4, Issue-2, May-August, 2020; pp. 109-111.
- Jain Neha (2016), Northeast India's Multi-Ethnicities: Dominant Issues and Problems, Volume-III, Issue-II September 2016 276. Page No. 275-285, Scholar Publications, Karimganj, Assam, India.
- JhaSantosh Kumar (Edition: 2018), Research Methodology in Ethnobotany, Advances In Ethnobotany (pp.169-191), Satish Serial Publishing House, Delhi.
- Panigrahi Sonia, "Ethnobotany: A strategy for conservation of plant" ()Annals of the Romanian Society for Cell Biology 25(6):1370-1377.
- Puri, Rajindra K, Christian R., Vogl-LukasserInstitute for Organic Farming,University for Natural Resources and Applied Life Sciences Vienna.
- Pushpagandhan P. (1994) Ethnobiology in India. A status report, Ministry of Environment and Forest, GOI, New Delhi.Ethnic Diversity in Central and Western Himalaya.
- Sharma and Alam (2019), Ethnobotany, Rastogi Publication, Meerut.
- Vogl Christian R.. & Vogl -Lukasserb Brigitte (2004), Tools and Methods for Data Collection in Ethnobotanical Studies of Homegardens, Institute for Organic Farming, University for Natural Resources and Applied Life Sciences Vienna.

8.11 SUGGESTED READING

- Ethnobotany, Sharma and Alam (2018-19), Rastogi Publications, Meerut.
- Mannual of Ethnobotany, S. K. Jain (2010), Scientific publishers, India.

8.12 TERMINAL QUESTIONS

8.12.1 Short answer type Questions

1. What kinds of exchanges took place between nomadic pastoralists and settled agriculturists?
2. Who are Lepta?
3. Write the names of various major tribes of Uttarakhand.
4. Write measure characteristic of bhotia tribe.
5. Write measure characteristic of nomadic tribes of hill regions of India.
6. Discuss about the Chenchus tribe in south India.
7. Which tribes are considered as nomadic tribal community?
8. What is nomadic pastoralism?
9. Describe in short about the tribes of Andaman and Nikobar?
10. Write a brief accounts on Gonds.

8.12.2 Long answer type Questions

1. What is Ethnic group and Ethnicity? Discuss the tribal of Uttarakhand.
2. Describe the major tribes of Peninsular India.
3. Discuss tribal setting in India.
4. Discuss the tribal setting in Hill regions of India.
5. Describe the major tribes of Arid and Semiarid states of India.
6. Describe about the tribes of Andaman and Nicobar.
7. Describe about the Ancient literature of India.
8. What is Ethnobotany. Describe about the different tools and techniques of Ethnobotanical studies.
10. Describe the contribution of Tribals in the conservation of forest.

UNIT-9 IUCN AND ETHNOBOTANICAL SPECIES

Contents

9.1 OBJECTIVES

This unit provides a brief overview on IUCN and its principles and status of ethnobotanical important species of Uttarakhand, which falls under IUCN category. After reading this unit you will be able to:

- Know about IUCN and explain IUCN Red List of threatened species.
- Explain about objectives, uses and importance of IUCN and IUCN Red list.
- Define the IUCN principles.
- Discuss about the status of ethnobotanically important species of Uttarakhand.

9.2 INTRODUCTION

In previous unit, we learnt about the ethnic groups and ethnobotanical studies of flora of different region of India. In this unit we will focus on IUCN and its principles and cover the status of ethnobotanically important species of Uttarakhand. The International Union for the Conservation of Nature (IUCN) is the world's main authority on the conservation status of species. Its goal is to promote the conservation of the nature and the sustainable use of natural resources. The "IUCN Red List," commonly known as the IUCN Red List of Threatened Species, is a widely accepted and systematic approach of assessing the conservation status of various plant and animal species. It is a worldwide organisation that maintains the Red List and is committed to ensuring the sustainable management of natural resources. In 1994, the IUCN introduced this assessment framework. It includes precise criteria and groups the conservation status of each individual species based on the likelihood that the species will become extinct.

Thus, in this unit we will highlight and cover the objectives, uses and importance and principles of IUCN; Red List of threatened species. We will also give emphasis on status of ethnobotanically important species of Uttarakhand.

9.3 INTERNATIONAL UNION FOR CONSERVATION OF NATURE (IUCN)

The International Union for Conservation of Nature (IUCN), now known as the International Union for Conservation of Nature and Natural Resources (IUCN), formerly called World Conservation Union, is a network of environmental organisations that was first established in October 05, 1948 in Fontainebleau, France, under the name International Union for the Protection of Nature. Its mission is to promote the conservation of nature and sustainable use of natural resources. It was renamed the World Conservation Union (IUCN) from 1990 to 2008 and the International Union for Conservation of Nature and Natural Resources (IUCN) in 1956. It is the oldest international environmental organisation in existence. Its main office is in Gland, Switzerland.

The IUCN operates or maintains hundreds of field projects globally, supports and takes part in national conservation legislation, policies, and practices through its member organisations. The IUCN's efforts are divided into a number of theme-based programmes, ranging from business and biodiversity to forest preservation to water and wetlands protection. Additionally, special initiatives use the efforts of several programmes to address particular concerns, such climate change, conservation, and poverty reduction. More than 1,400 governmental and nongovernmental organisations representing more than 170 nations are members of the IUCN. It is governed by a democratically elected council, which is chosen by member organizations at each World Conservation Congress. Several nations, organisations, foundations, member organisations, and businesses support the IUCN financially.

The **IUCN Red List** of Threatened Species, which was established in 1964 and is also known as the IUCN Red List or Red Data List, which is the most comprehensive global inventory of the conservation status of biological species

9.3.1 IUCN RED LIST OF THREATENED SPECIES

The IUCN Red List of threatened species, also referred to as the "IUCN Red List," is a systematic and widely recognized system for assessing the conservation status of plant and animal species. It is a worldwide organisation devoted to the preservation and sustainable exploitation of natural resources, maintains the Red List. This assessment framework was introduced by IUCN in 1994. According to the probability that a species would go extinct, it comprises clear criteria and categories the conservation status of each particular species.

The IUCN approach evaluates the extinction risk of a given species using a set of five quantitative criteria. The criteria take into account numerous facets of a species' population size, distribution, and trends as well as the particular risks it confronts. The objective is to present a thorough evaluation of a species vulnerability to extinction. A species is classified into one of several groups after being closely examined. Three of the categories- CR, EN, and VU are additionally included in the more general definition of "threatened". The IUCN Red List uses specific nine categories to assess and categorize species based on their conservation status:

Nine categories in the IUCN Red List

- **NE: Has not yet been evaluated against the criteria**
- **DD:** Not enough data to assess its risk of extinction.
- **LC:** Considered to have a low risk of extinction.
- **NT:** Likely to become endangered soon.
- **VU:** Face a high risk of extinction in the wild
- **EN:** High risk of extinction in the wild.
- **CR:** Extremely high risk of extinction in the wild.
- **EW:** Only to survive in captivity outside its former geographic distribution.
- **EX:** Known individuals remaining

Least Concern (LC): Species in this category are considered to have a low risk of extinction. They may be widespread and have stable populations.

Near Threatened (NT): These species are not currently at high risk. But in the near future they may face risks such as habitat loss or climate change.

Vulnerable (VU): Species in this category face a high risk of extinction in the wild if the threats they are experiencing continue.

Endangered (EN): Endangered species possess a very high risk of extinction if their current threats persist. Therefore, action on conservation is urgently required.

Critically Endangered (CR): Species in this category that possess an extremely high risk of extinction as a result of rapid population declines, and it is necessary to take immediate and extensive conservation efforts.

Extinct in the Wild (EW): These species may only continue to exist in captivity or as artificially supported populations located far outside of their former geographic distribution. They no longer exist in the wild.

Extinct (EX): Species that are considered to be extinct, with no individuals remaining.

Data Deficient (DD): This category is applied when there is not enough data to accurately determine a species' conservation status.

Not evaluated (NE): Under this category species does not yet exist evaluated against the criteria

The IUCN Red List is continually updated as new data becomes available, and species assessments are reviewed and revised. It is a useful tool for scientists, conservationists, and policymakers to monitor the biodiversity of the world and set priorities for conservation activities.

9.3.2 OBJECTIVES OF IUCN

The IUCN red list gives taxonomic data, distribution information, and conservation status of species that are facing a high risk of worldwide extinction. The following objectives are pursued by:

- To give scientific data on the status of species and subspecies on a worldwide scale.
- To address the issues and raise awareness about the extinction of species and biodiversity.
- To design a layout for the preservation of biodiversity.

9.3.3 IMPORTANT FUNCTIONS OF IUCN RED LIST

The IUCN Red List serves a number of important functions.

1. **Evaluation of Conservation Status**: It evaluates and classifies species according to their risk of extinction. The extent of danger or risk of a species is revealed through the Red List.

2. **Promoting Awareness**: The Red List draws attention to species that are threatened or endangered, which helps disseminate awareness about the need for conservation efforts and the current state of the world's biodiversity.
3. **Conservation Strategy**: The Red List provides information on conservation priorities and methods. It helps determine which habitats and species demand immediate attention and conservation.
4. **Policy and Decision-Making**: The Red List is used by governments, conservation groups, and policymakers to make educated decisions about resource allocation, land use, and environmental legislation.

9.3.4 USES OF THE IUCN RED LIST DATA

The information cited in the IUCN Red List is used by various organizations in the following ways:

- The information from the Red List is used by international agreements like CITES and the Ramsar Convention to make significant decisions in accordance with the laws of nature as and when necessary.
- The IUCN Red List data is used by the World Bank Group performance standard to assess the chance that massive infrastructure projects and international initiatives may harm biodiversity.
- National parks and sanctuaries use this information regularly to update important regulations for parks.

9.4 THE IUCN PRINCIPLES

The International Union for Conservation of Nature (IUCN) is a global organisation devoted to the conservation of nature and the sustainable use of natural resources. Its goals and operating principles direct its mission and actions. The IUCN's principle enumerates its core values, which include the following:

1. **Ecosystem Approach:** IUCN places more emphasis on protecting entire ecosystems than specific species. Ecosystem health is essential for biodiversity and human welfare.
2. **Capacity Building:** IUCN supports strengthening conservation and sustainable development capacity by assisting local communities and organisations in acquiring the abilities and information required to successfully deal with environmental issues.
3. **Economic Viability:** IUCN acknowledges the significance of economic factors in conservation. It aims to show that conservation may be both economically and environmentally sustainable.

4. **Equity and Social Inclusivity (Empowerment**): IUCN recognizes that local knowledge and engagement are of the utmost importance for sustainable conservation and works to empower people and communities to take part in conservation initiatives.
5. **Global Perspective:** The scope of IUCN's work is worldwide. As that many environmental issues beyond national borders, it addresses conservation challenges at the global, regional, and local levels.
6. **Holistic Approach:** IUCN approaches conservation holistically, understanding that social and ecological aspects of conservation are frequently related with environmental challenges. Its work takes into account the intricate relationships between nature and human well-being.
7. **Inclusivity and Collaboration:** IUCN supports collaboration with governments, government agencies, academic institutions, NGOs, indigenous peoples, local populations, and other stakeholders. It encourages collaboration and joint efforts to address the problems facing global conservation.
8. **Independence:** IUCN upholds its independence and neutrality, free from political, economic, or ideological forces that would compromise its dedication to conservation and sustainability.
9. **Pragmatism:** IUCN acknowledges that practical and flexible techniques are frequently needed for conservation. It accepts novel approaches and acknowledges that conservation objectives might have to change over time.
10. **Precautionary Principle:** IUCN supports the precautionary principle, which states that proactive steps should be done to prevent harm rather than waiting for clear evidence of harm when there is uncertainty or possible risk to the environment.
11. **Science-Based Approach:** IUCN focuses on scientific research and knowledge to inform its conservation efforts. It works together with scientists, professionals, and organisations to collect data and develop policies and strategies that are based on scientific study.
12. **Sustainability:** IUCN advocates the sustainable use of natural resources, as people depend on these resources for their livelihoods. Its objective is to strike a balance between environmental protection and sustainable use.
13. **Transparency and Accountability:** The IUCN functions with transparency and accountability in its decision-making processes. It is committed to informing its members and the general public about its operations and results.

IUCN's work in areas like conservation planning, species protection, ecosystem management, sustainable development, and policy advocacy is guided by these principles. The organisation is essential in developing international conservation initiatives and promoting a positive relationship of humans and nature.

9.5 *STATUS OF ETHNOBOTANICALLY IMPORTANT SPECIES OF UTTARAKHAND*

Only 54 of the known species in Uttarakhand have been evaluated as of the most recent IUCN Red List 2020-21, of which only 14 species are threatened. There are four species that are classified as **Critically Endangered (CR)** species are *Aucklandia costus* Falc. (syn. *Saussurea costus* (Falc.) Lipsch.), *Gentiana kurroo* Royle, *Lilium polyphyllum* D. Don and *Nardostachys jatamansi* (D.Don) DC. **Endangered species (EN)** are *Aconitum heterophyllum* Wall. ex Royle, *Angelica glauca* Edgew., *Cypripedium elegans* Rchb.f., *C. himalaicum* Rolfe, and *Pittosporum eriocarpum* Royle. **Vulnerable species (VU)** are *Aconitum violaceum* Jacquem. ex Stapf, *Cypripedium cordigerum* D. Don, *Dalbergia latifolia*, *Dienia muscifera* Lindl. (syn *Malaxis muscifera* (Lindl.) Kuntze), and *Ulmus wallichiana* Planch. Thirty-one species are evaluated but not found threatened and accordingly categorized as Least Concern (LC, 30 spp.) or Near Threatened (NT, 01 sp.). Nine species could not be evaluated for lack of sufficient data and categorized as Data Deficient (DD).

IUCN Red List of threatened species is revised and updated thrice in each calendar year and country-wise

Additionally, 256 species selected as threatened in various sources that require rapid assessment in accordance with recent IUCN recommendations in order to understand their real situation in nature have not been evaluated by the IUCN Red List.

Following a recent review, three medicinal plant species found in the Himalayas have been added to the IUCN Red List of Threatened species such as:

- ***Meizotropis pellita*** **(Patwa) – CR**
- ***Fritillaria cirrhosa*** **(Kakoli) – VU**
- ***Dactylorhiza hatagirea*** **(Salampanja) - EN**

Uttarakhand, India, is known for its rich ethnobotanical heritage, with several plant species of cultural, traditional, and medicinal importance (Table-9.1). The status of ethnobotanically important species in Uttarakhand can vary, but many of these plants face challenges due to habitat loss, overharvesting, and changing environmental conditions. The conservation statuses of some ethnobotanically important threatened species in the Himalayan region of Uttarakhand are given below:

9.5.1 BRAHMA KAMAL (*Saussurea obvallata* (DC.) Edgew.)

Saussurea obvallata (DC.) Edgew., often called "Brahma Kamal" or "King of Himalayan Herbs," is a member of the Asteraceae family. It is native to the Himalayan area, which includes nations like India, Nepal, and Bhutan. It is known for its beautiful, large, white, and fragrant flowers, which have elevated it to a revered cultural and spiritual plant in the area. Some significant characteristics of *Saussurea obvallata* are given below:

Description: The plant develops a single, long flowering stalk that can grow to a height of up to 40–50 cm, and its base is covered with broad, rosette-like leaves. The flowers resemble daisies and have white petals with a yellow centre. In the Himalayan region, it is often found at high altitudes, frequently at elevations of 4,000 metres (13,000 feet) or above. It thrives in alpine and subalpine regions.

Conservation Status: Due to overfishing and habitat degradation, it is classified as a threatened species and is protected in some locations.

Ethnomedicinal Uses: Different plant parts have been utilised by traditional medical systems in the Himalayan region for their potential therapeutic benefits. It is believed to have medicinal properties such as anti-inflammatory and antibacterial effects. The plant is considered as sacred plant by various communities and is significant from both a cultural and religious standpoint in the area. It is utilised in a number of religious rituals and is frequently connected to Lord Brahma in Hinduism.

Cultivation: Due to its particular environmental requirements, *Saussurea obvallata* can be difficult to grow. It needs a soil that drains well and a cool, alpine climate. It is frequently cultivated from seeds.

9.5.2 KUTKI (*Picrorhiza kurroa* Royle ex Benth)

Picrorhiza kurroa Royle ex Benth, locally known as Kutki, is a small, perennial herbaceous plant that is native to the Himalayan alpine areas, which include India, Nepal, and Tibet. Because of its therapeutic characteristics this plant has been utilised in traditional medical practices, particularly in Ayurveda. It has the following notable characteristics and details:

Description: *Picrorhiza kurroa* is a perennial herb and belongs of the Scrophulariaceae family. It grows low to the ground and doesn't typically develop into a tall, woody shrub or tree. Leaves are lance-shaped, serrated or toothed appearance and grow near the base in a rosette fashion. Rhizome is thick, fleshy, and grows horizontally underground. The rhizome, or underground stem, is the most valuable part of the plant in terms of medicinal use. It produces small, tubular, and pale blue to violet flowers. These flowers can be found growing on a central stalk that rises above the basal leaves.

It is native to the alpine regions of the Himalayas. It is present in nations like India, Nepal, Bhutan, and Tibet. Although it can be found at even greater elevations, these places are normally between 3,000 and 4,000 metres (9,800 and 13,00 ft) above sea level.

Ethnomedicinal Uses: Rhizome or underground stem of *Picrorhiza kurroa* is used in traditional medicine system- Ayurveda. It is said to have a number of therapeutic characteristics and is used to treat a number of healthcare issues. Its use as a liver tonic, immune system booster, anti-inflammatory agent, and digestive stimulant are just a few of the potential advantages.

Kutkin or kutkoside are the main chemical constituents of *Picrorhiza kurroa* that give it its therapeutic effects. These elements are thought to play a role in the plant's anti-inflammatory and hepatoprotective properties.

Conservation Status: *Picrorhiza kurroa* is considered as threatened and is protected in some places as a result of overharvesting and habitat degradation. Efforts are being made to promote sustainable harvesting and cultivation practices.

Cultivation: It is a cold-climate plant that normally thrives in the Himalayan region at great heights. It is a difficult plant to grow and is frequently harvested from the wild. It's crucial to use sustainable harvesting methods to safeguard this plant and its habitat.

9.5.3 HIMALAYAN YEW (*Taxus wallichiana* Zucc.)

Taxus wallichiana Zucc., usually known as the Himalayan yew, is a species of coniferous tree, belongs to family Taxaceae. It is native to the Himalayan region like India, Nepal, Bhutan, Pakistan, and Tibet. Some key characteristics of *Taxus wallichiana* is given below:

Description: It is an evergreen tree that can grow to a height of 20 to 30 metres (65 to 100 feet). It produces tiny, fleshy, red or orange arils that encase its seeds and has dark green, needle-like leaves. The tree's bark ranges in colour from brown to reddish brown and becoming scaly with age. Usually found in the temperate and subalpine parts of the Himalayas, this species can be found growing at altitudes between 1,500 metres (4,900 feet) and 4,000 metres (13,000 feet) above sea level. It has an excellent tolerance for the harsh conditions noticed in high mountain locations.

Ethnomedicinal Uses: Taxol, a substance with potent anti-cancer activity, is found in the bark of *Taxus wallichiana*. Taxol is used in the treatment of various types of cancer, like breast, ovarian, and lung cancer. It is revered and has cultural importance in some areas. It is frequently connected to sacred trees and is employed in a number of rituals and ceremonies.

Conservation Status: Due to overharvesting and habitat degradation, *Taxus wallichiana* has been identified as endangered or threatened in several places. The tree is valued for both its timber and, more significantly, for its taxol-rich bark, which is used to treat cancer. In order to protect this species, efforts are being done to encourage conservation and ethical harvesting methods.

Cultivation: *Taxus wallichiana* is usually cultivated from seeds or by rooting cuttings, however propagation can be difficult. The slow growth of this tree makes it less suitable for large-scale commercial forestry compared to faster-growing conifer species.

9.5.4 MITHA/VISH (*Aconitum balfourii* Stapf.)

Aconitum balfourii Stapf. is a species of the *Aconitum* genus, sometimes known as aconite, monkshood, or wolfsbane. Some salient features of *Aconitum balfourii* is listed below:

Description: *Aconitum balfourii* Stapf. is a biennial or perennial herbaceous plant with unusual palmately split leaves and tall spikes of hooded, helmet-like blue-purple flowers, inflorescence up to 30 cm long, many-flowered, with yellowish tomentum. It is native to the Himalayan region, particularly found in Sub-alpine, shady, moist slopes, (3000-4000m) Uttarakhand to Nepal. Wide but sparsely distributed. Chamoli, Pithoragarh, Milum.

Ethnomedicinal Uses: The roots contain the alkaloid pseudaconitine, which is highly toxic and biologically 1.5 times as active as aconitine. In traditional Tibetan and Ayurvedic medicine systems, the roots of *Aconitum balfourii* have been used for a number of purposes, including the relief of pain, rheumatism, against neuralgia, fever and bone complaints also used in gastric disorders, leprosy, swelling and sciatica and wound. Some areas have employed it with great caution for its potential medical benefits. It is not advised to use it without appropriate medical supervision, nevertheless, due to its severe toxicity.

Toxicity: *Aconitum balfourii* is extremely toxic, just like many other species in the *Aconitum* genus. Alkaloids found in the plant, like aconitine, have lethal effects if consumed. Due to its toxicity, different plant parts were usually utilised sparingly and frequently only in extremely diluted forms in traditional medicine. This plant should be handled carefully, and no part of it should be consumed.

Conservation Status: The conservation status of *Aconitum balfourii* may vary depending on its specific location. Some populations may be threatened due to habitat destruction and over-harvesting, while others may be more stable. It is exclusively found in sparsely populated alpine areas that also suffer from a daily population decline, so this species categorised under critically endangered category of IUCN.

Cultivation: *Aconitum balfourii* is not commonly cultivated as an ornamental plant due to its toxic nature. It is primarily found in its natural habitat in the Himalayas. The Department of Forests mandates *in-situ* conservation. The species is normally protected in national parks (Valley of Flowers National Park, Nanda Devi National Park, and Govind National Park of Uttarakhand), and it warrants special conservation measures in sanctuaries, Reserved Forest, and Biosphere Reserve.

9.5.5 Atis/Ativisha (*Aconitum heterophyllum* Wall.ex Royale)

Atis or Ativisha (*Aconitum heterophyllum* Wall.ex Royale), a medicinal flowering plant belongs to Ranunculaceae family. It is native to the Himalayas and can be found in nations like India, Nepal, and Bhutan. The main reason this plant has historically been used in Ayurvedic and other traditional medical systems is because of its potential medicinal properties.

Description: It is a perennial herbaceous plant normally grows a height of 60–120 cm. Similar to other *Aconitum* species, it has deeply lobed, dark green leaves and gorgeous, blue to violet, helmet-shaped blooms. Roots paired, 2.5 – cm long, tuberous. Stems erect simple or branched, 90–120cm high. Leaves are of various forms; basal leaves long petioled (10-12cm); cordate or

ovate, upper leaves sessile, ovate, elongate or varied in shape; sharply toothed, sessile or shortly petioled and stem clasping. Commonly found in open slopes in sub alpine and alpine areas between 2500- 3500m. and distributed from Jammu & Kashmir, Himachal Pradesh and Uttarakhand to Pakistan and Nepal.

Ethnomedicinal Uses: Traditional medicine makes extensive use of *Aconitum heterophyllum*, especially in Ayurveda, where it is referred to as "Ativisha." It is mostly used as a plant for medicine. Traditionally it is used for the treatment of fevers, stomach issues, and respiratory ailments.

Traditional medicine mostly uses the root of *Aconitum heterophyllum*. It contains a variety of bioactive compounds, including alkaloids, diterpenoids, and glycosides. Although some of the alkaloids in this plant are thought to have medical use, they are also extremely toxic and must be carefully treated to lessen their toxicity.

Conservation Status: Due to over-harvesting and habitat destruction, some populations of *Aconitum heterophyllum* are at risk, therefore it has become one of the most highly threatened medicinal plant species that is showing a steady decline in wild populations.

Cultivation: It is grown in some regions to satisfy the demand for conventional medicine. To keep the plant from being too toxic and to assure its safety for medical usage, proper growing and processing methods are essential.

9.5.6 *Aconitum violaceum* Jacq.ex Stapf.

Aconitum violaceum Jacq.ex Stapf. is a threatened high altitude medicinal plant, belongs to family Ranunculaceae. This perennial herbaceous plant is native to the Himalayan region and is found in countries such as India, Nepal, and Bhutan. Some important characteristics are given below:

Description: *Aconitum violaceum* is a herbaceous plant that can grow up to 1-2 meters in height. It produces tall, erect stems with deeply lobed, dark green leaves. Roots are tuberous, 2-3 cm long and paired. Leaves very few, 1 or 2 at the bases of the stem and 1 or 2 higher upon the stem; Inflorescence a short raceme or reduced to a solitary flower; bracts small, linear. Flowers are blue or violet and hairy. Mostly found grows on alpine meadows throughout Himalaya, from 3500-4500 m. in Jammu & Kashmir, Himachal Pradesh and Uttarakhand, Pakistan and Nepal. It prefers cool, moist, and shady habitats, often growing alongside streams or in forested areas. The plant is known for its distinctive, hood-shaped flowers, which are typically violet to purple in color.

Ethnomedicinal Uses: Despite its great toxicity, several traditional medical systems have employed *Aconitum violaceum* for specific therapeutic properties, such as pain treatment and fever reduction, in highly controlled and diluted forms. Roots contain the alkaloid-indoconitine, and it is tonic and is used in cough, cold, stomach pain, fever, bronchitis, epilepsy, headache,

inflammations, snake-bite, renal pain and rheumatism. However, due to the plant's toxicity, such usages are extremely dangerous and are not advised.

Conservation Status: The conservation status of *Aconitum violaceum* may vary depending on its specific location. Some populations may be threatened due to habitat destruction and over-harvesting, while others may be more stable.

Cultivation: To address the need for traditional medicine, *Aconitum violaceum* is being grown under controlled conditions in some regions. To reduce the plant's toxicity and guarantee its safety for medical usage, proper growing and processing methods are crucial.

9.5.7. INDIAN GENTIAN (*Gentiana kurroo* Royle)

Gentiana kurroo Royle is a species of flowering plant, which belongs to Gentianaceae family. It is also referred to as Kurroo, Karvi, Kamalphul, or Indian Gentian. Especially in Ayurvedic medicine, *Gentiana kurroo* is utilised in a variety of herbal formulations for its traditional medicinal uses.

Description: *Gentiana kurroo* Royle is a perennial spreading herb. The plant has lance-shaped leaves, basal leaves10–12 cm, linear-lanceolate, extremely bitter in taste. Roots are branched, white, fleshy and stout. Flowers are deep blue, spotted with green and white in the throat, usually two or more on a stem, sometimes solitary. The flowers of *Gentiana kurroo* are visible from August to October. It is native to the Himalayan region and mostly found in India, Nepal, and Bhutan. It is mostly found precipitous south and south-west facing limestone outcrops at approximate altitudes of 1700 -2100 m.

Ethnomedicinal Uses: *Gentiana kurroo* Royle has a long history of use in traditional medicine systems. The entire plant is used, especially the roots is valued for its bitter properties and believed to have various medicinal benefits. The bitterness of *Gentiana kurroo* is due to the presence of bitter substances, such as iridoids and xanthones. These compounds are thought to be responsible for the plant's medicinal properties. In Ayurvedic medicine, it is known to be very beneficial as a liver tonic febrifuge, anthelmintic, blood-purifier, carminative, digestive effects and is used for the treatment of diabetes, digestive disorder, hepatic disorder, bronchial asthma, and urinary infection.

Conservation Status: Some *Gentiana kurroo* populations are threatened by habitat loss and overharvesting of wild populations for medicinal purposes. Depending on the location, this species' conservation status may change.

Cultivation: To address the need for traditional medicine, efforts have been made to grow *Gentiana kurroo* in controlled conditions. Cultivation can help protect the natural populations of the plant and guarantee a steady supply for medicinal purposes.

9.5.8 JATAMANSI/ SPIKENARD (*Nardostachys jatamansi* DC.)

Nardostachys jatamansi DC., commonly known as Jatamansi or Spikenard, is a perennial herbaceous plant, belongs to family Valerianaceae. This plant is well-known for its aromatic root, which has been employed in flavouring, perfumery, and traditional medicine.

Description: It is a small, herbaceous, perennial plant with aromatic rootstock that grows to a height of around 20-60 cm. Leaves elliptic, lanceolate, or spathulate, rising mostly from the rootstock that is clothed in remnant fibre nets of old leaves. Flowers purple to white in dense heads/clusters. The entire plant gives out a strong odour and root is the most valuable portion of the plant. It is used in both traditional medicine and perfumery due to its distinctive, earthy, and woody strong aroma. It is indigenous to the Himalayan region and can be found at heights of 3400–4200 m in moist alpine rocky slopes of the state and is becoming extremely rare to find in places. It is distributed in like India, Nepal, Tibet, and Bhutan.

Ethnomedicinal Uses: *Nardostachys jatamansi* has a long history of use in traditional medicine systems, especially Ayurveda. The rhizome and the oil from the rhizome can be employed to treat hysteria, sleeplessness, dysmenorrhea, skin conditions, throat problems, lumbago, ulcers, rheumatism, paralysis, and other conditions. They are used as tonics, stimulants, anti-spasmodics, diuretics, emmenagogues, stomachics, and laxatives. Traditionally it is used as a hair tonic to treat hair loss and said to promote mental calmness.

The essential oils in the root of *Nardostachys jatamansi*, which include substances like valeranone, jatamansone, and calarene, help to give it its therapeutic and fragrant effects.

Conservation Status: Some populations of *Nardostachys jatamansi* are in danger due to overharvesting for its prized root and habitat degradation. To safeguard and successfully manage this species, conservation actions have been put in place.

Cultivation: In some areas, attempts have been undertaken to grow *Nardostachys jatamansi* under controlled conditions in order to satisfy the market for traditional medicine and the fragrance business while preserving wild populations.

9.5.9 Patwa (*Meizotropis pellita* (Hook. f. ex Prain) Sanjappa)

Meizotropis pellita (Hook. f. ex Prain) Sanjappa) is a species of flowering shrub or small tree belongs to Verbenaceae family, also known as Patwa or the Five-leaved Chaste tree. It is indigenous to several sections of Southeast Asia as well as India, Nepal, and other parts of Asia. Patwa has a long history of use in traditional medicine due to its possible therapeutic characteristics.

Description: *Meizotropis pellita* is a shrub or small tree with stout woody perennial rootstock that can reach heights of 3-5 meters. Leaves, stems, inflorescence and pods densely clothed with spreading white or pale brown tomentum. It has simple, opposite leaves with serrated margins.

The leaves are typically five-lobed. Flowers are small, fragrant, bright-redin colour, tubular and arranged in erect terminal and auxiliary simple racemes.

Ethnomedicinal Uses: It is widely used in conventional medical practices, such as Ayurveda and traditional Chinese medicine. It is used to treat a number of illnesses and appreciated for its potential therapeutic effects. The plant contains various phytochemicals, such as Alkaloids, flavonoids, and essential oils are just a few of the phytochemicals the plant has, which are considered to be an essential component that gives it its medicinal properties.

Conservation: *Meizotropis pellita* natural populations may be the subject of conservation efforts in some areas, especially if the plant is endangered as a result of overharvesting or habitat degradation.

Cultivation: It is frequently grown for both ornamental and therapeutic purposes. To guarantee a steady supply and encourage its usage in traditional medicine, proper growing methods are crucial.

9.5.10 *Angelica glauca* Edgew

Angelica glauca Edgew is perennial, herbaceous plant in the Apiaceae family. This plant, also known as "Choru," is indigenous to the Himalayan region and is most frequently found in India, Nepal, and Bhutan. Some important characteristics about *Angelica glauca* is given below:

Description: *Angelica glauca* Edgew is herbaceous plant that can grow up to 1-2 meters in height. It has distinctive large, compound leaves with serrated edges, and stems of the plant are often purple in color. Flowers are small, greenish-white or yellowish flowers arranged in umbrella-like clusters. It is often found in alpine and sub-alpine regions in the Himalayas, growing in cool, moist, and shady habitats, such as forested areas or along streams.

Ethnomedicinal Uses: Various parts of *Angelica glauca* are used for their possible medicinal properties in traditional medical systems, particularly in the Himalayan region. The herb may have diuretic, anti-inflammatory, and digestive effects. As a general health tonic, it is also utilised in several conventional treatments for digestive and respiratory ailments. It contains a variety of phytochemicals, such as flavonoids, coumarins, and essential oils. These substances are thought to play a part in its possible therapeutic qualities.

Conservation Status: *Angelica glauca,* like many other plants in the Himalayan region, may be threatened by habitat loss and overharvesting for traditional medicinal purposes. Depending on where it is found, this species' conservation status may change.

Cultivation: Various efforts have been undertaken to grow *Angelica glauca* in regulated conditions to meet the demand for traditional medicine and support conservation efforts.

9.5.11 KAKOLI (*Fritillaria cirrhosa* D. Don)

Fritillaria cirrhosa D. Don, commonly known as Himalayan Fritillary and Kakoli (Hindi, is a flowering plant that belongs to the Liliaceae family. It is native to various regions in Asia,

including China, Bhutan, India, Nepal, and Tibet. In traditional Chinese and Tibetan medicine, it has been utilised for respiratory disorders primarily due to its possible therapeutic benefits. The following salient features of *Fritillaria cirrhosa* are given below:

Description: Himalayan Fritillary is a perennial herb and grows high in the Himalayas. Stems are 15-60 cm tall. It produces a single stem with lance-shaped leaves which are oppositely arranged (7-11 in numbers), and sometimes also 3- or 4-whorled and alternate. Flowers are borne in groups of 1-3, subtended by 3 leaves like bracts. The flowers are pendulous, bell-shaped, yellowish-green to brownish-purple, slightly or heavily spotted with purple, and may-June are the months of flowering.

In the Himalayas, the Yellow Himalayan Fritillary can be found in alpine thickets, meadows, flood fields, and damp areas at an elevation of 3200-4600 m. May through July are the months of flowering.

Ethnomedicinal Uses: The *Fritillaria cirrhosa* plant's bulb has been used traditionally as medicine. It is frequently used in traditional Chinese medicine to treat ailments including coughs, bronchitis, and other respiratory illnesses since it is thought to have potential advantages for the respiratory system. It serves comparable functions in Tibetan medicine as well. Its bulbs contain various bioactive compounds, such as alkaloids and steroidal saponins, which are considered to be a factor in the plant's therapeutic benefits.

Conservation Status: Some populations of *Fritillaria cirrhosa* may be in endangered due to habitat degradation and overharvesting for its therapeutic bulbs. The conservation status of this species may vary depending on the region.

Cultivation: Various efforts have been made to cultivate *Fritillaria cirrhosa* in restricted environments to meet the demand for traditional medicine and to protect wild populations.

9.5.12 SALAM PANJA (*Dactylorhiza hatagirea* (D.Don) Soo)

Dactylorhiza hatagirea (D.Don) Soo, is commonly known as the "Himalayan marsh orchid" It is locally called 'salam panja' or 'hatta Jaddi'. It is a species of orchid generally found in the Himalayan region, including countries like India, Nepal, Bhutan, and Tibet, at altitudes of 2,800-4,000m. This orchid is known for its beautiful, intricate flowers and has cultural, traditional, and potential medicinal significance. Some key characteristics of *Dactylorhiza hatagirea* are following:

Description: It is a terrestrial orchid that normally reaches a height of 20 to 50 cm. Oval-shaped leaves and striking magenta to purple blooms are produced by this plant. The flowers have a striking, complex appearance and are frequently clustered in a dense spike. It favours cool, moist environments and frequently found in grasslands, marshy places, and alpine and sub-alpine meadows in the Himalayan region.

Ethnomedicinal Uses: In the Himalayan region, *Dactylorhiza hatagirea* has cultural and traditional value. It is considered as a love symbol in various cultures and is employed in rituals

and ceremonies. Its tubers are employed in traditional herbal medicines for a variety of reasons, including boosting vigour, stamina, and general wellbeing. It is also traditionally thought to have aphrodisiac characteristics.

Conservation Status: Some populations of *Dactylorhiza hatagirea* are threatened by overharvesting for its tubers, habitat loss, and climate change. Depending on the area, this orchid's conservation status varies.

Cultivation: To address the need for traditional use while safeguarding wild populations, *Dactylorhiza hatagirea* has been cultivated in carefully regulated conditions. Proper cultivation techniques are crucial for ensuring a sustainable supply.

Due to many factors, such as conservation efforts, habitat protection, and climate change, these species' conservation status is subject to change over time. Government officials and local and international organisations are working together to safeguard these critically important ethnobotanical species in Uttarakhand and protect their natural habitats.

Table 9.1 Some ethnobotanically important threatened species of Uttarakhand

S.N.	Botanical Name	Common Name/ Local	Family	Medicinal Uses
1.	*Aconitum balfourii* Stapf.	Mitha/vish	Ranunculaceae	Root paste is applied for rheumatism, against neuralgia, fever, gastric disorders, leprosy, swelling and sciatica and wound.
2.	*Aconitum heterophyllum* Wall.ex Royale.	Atis/Patis/Ativish	Ranunculaceae	Roots are used to cure abdominal pain, dysentery, diabetes, diarrhoea, dyspepsia, fever, cough, cold, colic, headache, piles, hysteria, throat infection, vomiting
3.	*Aconitum violaceum* Jacq. ex Stapf.	Doodh Atis, Chhota Atis	Ranunculaceae	Roots are used in cough, cold, stomach pain, inflammations, fever, bronchitis, epilepsy, headache, snake-bite, rheumatism
4.	*Angelica glauca* Edgew	Choru	Apiaceae	Roots are used in digestive, respiratory ailments and health tonic and as a herbal tea
5.	*Cyathea spinulosa* Wall.ex Hook.	Sala tree	Cyatheaceae	Often used for Ornamental purpose
6.	*Dactylorhiza hatagirea* (D.Don) Soo	Salam panja or Hatta Jaddi	Orchidaceae	Tubers are used in traditional herbal medicines as boosting vigour, stamina, and general
7.	*Diplomeris hirsuta* (Lindl.) Lindl.	Snow Orchid	Orchidaceae	Ornamental potential
8.	*Fritillaria cirrhosa* D. Don	Himalayan Fritillary/ Kakoli	Liliaceae	Bulb used to treat ailments including coughs, bronchitis, and other respiratory illnesses.

9.	*Gentiana kurroo* Royle	Karvi, Kamalphul, Nilkanth/ Karru	Gentianaceae	Roots are used as anthelmintic, blood-purifier, bronchial asthma, diabetes, digestive & hepatic disorder, liver tonic and urinary infection
10.	*Indopiptadenia oudhensis* (Brandis) Brenan	Genti	Mimosaceae	Economic potential
11.	*Meizotropis pellita* (Hook. f. ex Prain) Sanjappa	Patwa	Fabaceae	Ornamental potential
12.	*Pecteilis gigantea* (J.E. Sm.) Rafi n. syn: *Orchis gigantea*	Butterfly Orchid, Lady Susan's Orchid	Orchidaceae	Ornamental potential
13.	*Phaius tancarvilleae* (Banks et L. Herit.) Blume	Nun's Orchid	Orchidaceae	Ornamental Plant in gardens
14.	*Pinguicula alpina* Linn.	Alpine butt erwort	Lentibulariaceae	Carnivorous plant
15.	*Picrorhiza kurroa* Royle ex Benth	Kataki/Kutki	Scrophulariaceae	Its use as a liver tonic, immune system booster, anti-inflammatory agent, and digestive stimulant
16.	*Schrebera swietenioides* Roxb	Banpalas or Banda, Mokha, Weaver's Beam Tree/	Oleaceae	Leaves are used as stomachic troubles, urinary discharges; Bark used for treating boils and burns and the roots as a cure for leprosy
17.	*Saussurea obvallata* (DC.) Edgew.	Brahma Kamal	Asteraceae	Anti-inflammatory and antibacterial effects, sacred plant and utilised in a number of religious rituals
18.	*Turpinia nepalensis* Wall. ex W. & A.	Thali	Staphyleaceae	Economic potential (Wood carving)
19.	*Trachycarpus takil* Becc.	Thakal or Jhagerau	Arecaceae	Avenue plant
20.	*Taxus wallichiana* Zucc.	Himalayan yew	Taxaceae	Used in the treatment of various types of cancer, like breast, ovarian, and lung cancer.

9.6 SUMMARY

The International Union for Conservation of Nature (IUCN), now known as the International Union for Conservation of Nature and Natural Resources (IUCN), formerly called World Conservation Union, is a network of environmental organisations that was first established in October 1948 in Fontainebleau, France, under the name International Union for the Protection of

Nature. Its mission is to promote the conservation of nature and sustainable use of natural resources.

The IUCN Red List of threatened species, also referred to as the "IUCN Red List," is a systematic and widely recognized system for assessing the conservation status of plant and animal species. It is a worldwide organisation devoted to the preservation and sustainable exploitation of natural resources, maintains the Red List.

The IUCN's principle enumerates its core values and work in areas like conservation planning, species protection, ecosystem management, sustainable development, and policy advocacy is guided by these principles. The organisation is essential in developing international conservation initiatives and promoting a positive relationship of humans and nature.

9.7 SELF- ASSESSMENT QUESTIONS

9.7.1 Multiple Choice Questions

1. The International Union for Conservation of Nature (IUCN) was established on
(a) September 05, 1946 (b) October 05, 1948
(c) October 05, 1946 (d) February 05, 1948

2. The IUCN Red List of threatened species was founded in
(a) 1946 (b) 1948
(c) 1964 (d) None of the above

3. IUCN headquarter is located at
(a) Gland, Switzerland (b) New York, USA
(c) Paris, France (d) Vienna, Austria

4. IUCN stands for
(a) International Union for Conservation of nutrients
(b) International Union for Conservation of Nature
(c) International Union for chemical nomenclature
(d) Both a & b

5. IUCN Red List," is a systematic and widely recognized system for assessing the conservation status of-
(a) Animals (b) Plants
(c) Fungi (d) All of the above

6. The IUCN Red List uses specific_____ categories to assess and categorize species based on their conservation status.
(a) Six (b) Eleven
(c) Nine (d) Three

7. IUCN Red List of threatened species is revised and updated _____in each calendar year.

(a) Thrice (b) Twice

(c) Each Year (d) None of the above

8. _____species possess an extremely high risk of extinction as a result of rapid population declines.

(a) Vulnerable (b) Endangered

(c) Critically Endangered (d) Least Concern

9.7.1: Answer key

1.(b); 2.(c); 3.(a); 4.(b); 5.(d); 6.(c); 7.(a); 8.(c)

9.8 REFERENCES

- https://optimizeias.com/three-himalayan-medicinal-plants-enter-iucn-list/
- https://www.britannica.com/topic/International-Union-for-Conservation-of-Nature
- https://iucn.org/our-union/members/iucn-members.
- https://sbb.uk.gov.in/files/books/Threatened_Species_Book-CTP.pdf
- IUCN Red List (2020). The IUCN Red List of Threatened Species Version 2020-1. Available at https://www.iucnredlist.org/, accessed several times.
- Rawat, D.S., Chandra, S., and Chaturvedi, P. (2022). Threatened flora of Uttarakhand: an update. Journal of Threatened Taxa 14(12): 22309–22328. https:// doi.org/10.11609 /jott.6330.14.12.22309-22328.
- India State of Forest Report (2019). Published by Forest Survey of India, Dehradun, 167 pp. Available at http://fsi.nic.in/isfr-volume-I,accessed several times.
- IUCN Red List Categories and Criteria: 3.1 Version (2012). International, Union for Conservation of Nature, Gland, Switzerland, UK. Available at https://portals.iucn.org /library/node/10315, Accessed several times in 2020.
- Nayar, M.P. & A.R.K. Sastry (eds.) (1987, 88, 90). Red Data Book of Indian Plants Vols- 1-3. Botanical Survey of India, Calcutta. 367 pp, 268 pp, 271 pp.
- Rana, S.K. & G.S. Rawat (2017). Database of Himalayan plants based on published floras during a century. Data 2(4): 36; https://doi. org/10.3390/data2040036.

9.9 SUGGESTED READINGS

- Uniyal, B.P., J.R. Sharma, U. Choudhery & D.K. Singh (2007). Flowering Plants of Uttarakhand (A Checklist). Bishen Singh Mahendra Pal Singh, Dehradun, 404 pp.

- Shah, R. (ed.) (2016). Threatened Species of Uttarakhand. ebook, published by Uttarakhand Biodiversity Board, Dehradun, India, 76 pp. Available https://sbb.uk.gov.in/pages/display/88-books, accessed several times in 2020.

9.10 TERMINAL QUESTIONS

9.10.1 Short Answer Type Questions

1- Write a short note on IUCN
2- What is IUCN Red List of threatened species?
3- Define the IUCN principles.
4- Write a short note on nine categories of IUCN Red List

9.10.2 Long Answer Type Questions

1- What is IUCN Red List of threatened species? Give a detail account on objectives, uses and importance of IUCN and IUCN Red list.
2- Discuss about the status of ethnobotanically important species of Uttarakhand with any 05 examples.

UNIT-10 ETHNOBOTANY AND CONSERVATION OF PLANT RESOURCES

Contents

10.1 OBJECTIVES

After reading this unit you will be able to -

- Understand the Ethnobotany, its modern approaches in India and abroad.
- How we can conserve plant resources to maintain sustainability

10.2 INTRODUCTION

Plant diversity is a gift of nature to humankind, they are the first originated in the form of cyanobacteria i.e. blue green algae and created the environment better suited for the emergence of other highly developed organisms during the course of evolution. Plants are rich source of diet for the human population. Besides, they are the main component of herbal medicines for most of the tribal communities who are residing in the forests and in the remote areas. Additionally, they serve as the chief ingredient of Ayurveda. Therefore it is necessary to study the ethnobotanical aspects of plant diversity and strategies to conserve it.

10.3 ETHNOBOTANY

It is defined as scientific study of traditional knowledge and customs of people in relation to medicinal, religious and other uses of plants.

We humans are dependent on plants from ancient time. Plant diversity provide us food, shelter, clean air, water, a variety of edible fruits etc. Most of the human population are residing in the rural areas or villages and in the variety of forests as tribal communities. These communities are entirely dependent upon forests and their products to make their livelihood. Plants are not only contributed to make their living however, they are the integral part of their different magico-religious practices and rituals, in which plants are worshipped or treated as signs of God and Goddess. Although ethnobotany in its wide use is the interaction between man, plants and the environment. However, the term ethnobotany is widely used in relation to medicinal plants, their uses and conservation. Ethnobotanical study had been carried out as old as human civilization itself.

The term ethnobotany is the combination of two greek words, ethos which means “people” and botany which means “herbs”, therefore, it includes the study of plants used by primitive communities for their food, medicines, religious ceremonies and their spiritual as well as intellectual cultures.

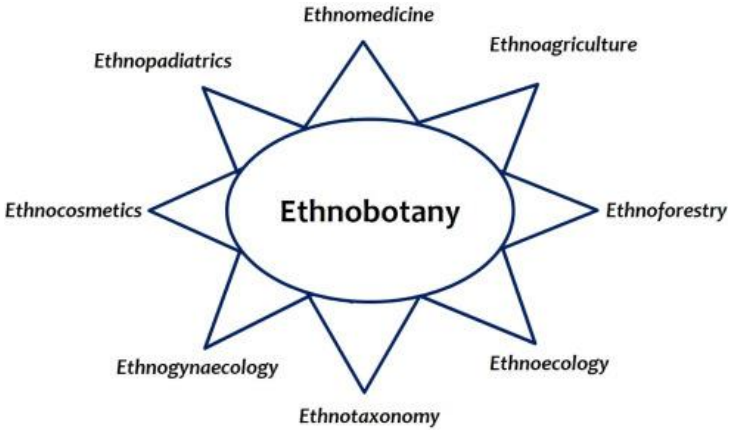


Fig.10.1: General overview of Ethnobotany

Plants are not only for fundamental human needs but also for medicinal therapies from the beginning of humanity. Various diseases are becoming more prevalent in many developing countries and their financial costs are quite high. Majority of the people in tribal communities much rely on plant based medications. Ethnobotany has long been important in the development of innovation medications and it is becoming important in the development of strategies and measures for residual forest conservation and recovery.

10.3.1- Scope of Ethnobotany

Ethnobotanical studies provide information regarding conservation status of plants which can be helpful to formulate conservation strategies to mitigate loss of habitat to the important indigenous plant resources. The study also acts as an important tool in the field of nutrition, health care, social customs, mythological association and biodiversity conservation. The conservation strategies lead to research innovations, which open gateway for the discovery of new drugs, phytochemicals and their associated medicines production.

Table-1 Some important plants used by tribal communities as food due to their nutritional value

S. No	Name of the plant species	Common name	Family	Parts consumed
1.	*Oxalis corniculata* Linn.	*Khatti buti*	Oxalidaceae	Leaves
2.	*Rhus parviflora* Roxb.	*Raitung*	Anacardiaceae	Fruits
3.	*Moringa oleifera* Lam.	*Sehjana*	Moringaceae	Leaves, Flowers
4.	*Bauhinia vahlii* Wt. & Arn.	*Mahul,Seldey*	Caesalpiniaceae	Seeds
5.	*Cassia fistula* Linn.	*Amaltas*	Caesalpiniaceae	Flowers
6.	*Cassia obtusifolia* Linn.	*Panwar*	Caesalpiniaceae	Leaves
7.	*Prosopis cineraria* Linn.	*Shami, Kshenkur*	Mimosaceae	Pods, Bark
8.	*Boerhavia diffusa* Linn.	*Punarnava*	Nyctaginaceae	Pods, Bark
9.	*Achyranthes aspera* Linn.	*Latjeera,Chirchita*	Amaranthaceae	Seeds
10.	*Amaranthus viridis* Linn.	Chaulai	Amaranthaceae	Leaves

10.3.2- Modern ethnobotanical approach

The modern ethnobotanical approaches were evolved or started in the USA and that's why it has been considered as the prominent centre for the modern ethnobotanical study (Botanical Museum of the Harvard University in Massachusetts). According to WHO (World Health Organization) report in the year 2000 it has mentioned that about 21,000 plant species for their medicinal values are being used throughout the world.

In Nigeria about 80 % inhabitants are entirely dependent on herbal medicines. Since countries like Nigeria, Ghana and Zambia are still economically weak and most of the inhabitants are living in villages as underprivileged, and therefore they are much closed to the forests and their products. They used herbal medicines against ailments.

In a report it has also been observed that about 60 % of the children disorders in these places have been cured by the herbal treatment. For e.g. disease like Malaria which is quite common in these places had been cured through this method. A total of about 38 medicinal plants species are reported to be effective against malaria which includes *Morinda lucida, Lawsonia inermis, Citrus medica, Morinda morindiocles* etc.

Similarly, in Nepal more than 85 % people are rely and dependent on herbal medications. It has been revealed that about 1700 species are commonly practiced in the traditional system of medicines. These medicines are commonly used for the treatment of diseases like rheumatism, bronchitis, urinary infection, dysentery etc.

Table- 2: Plants commonly used by the tribal communities against diseases

	Botanical name	Family	Part used	Uses
1	*Achyranthes aspera*	Amaranthaceae	All parts	Diarrhoea and dysentery
2	*Amorphophallus commutatus*	Araceae	Tubers	Rhizome used in piles, For treating gram +ve and gram –ve bacterial infections
3	*Azadirachta indica*	Meliaceae	leaves, fruits,	Against tapeworms, rheumatism
4	*Bauhinia racemosa*	Caesalpiniaceae	stem bark, flowers	Worm infestation, skin diseases, bleeding disorders
5	*Bombax ceiba*	Bombacaceae	Bark	Bark and Thorns is used for wounds, ulcers, skin diseases, hemorrhoids, urinary calculus, cystitis, inflammations, cough and bronchitis
6	*Bridelia retusa*	Euphorbiaceae	Bark	Bark is used for removal of urinary concretions
7	*Butea monosperma*	Papilionaceae	Flower, and seeds	Palash flowers are used to remove body toxins. Inflammation, Sprain, Swelling due to any reason. seeds of palash tree are anthelmintic and laxative, flowers to cure urinary complaints
8	*Carissa carandas*	Apocynaceae	Fruit	Scabies, intestinal worms, pruritus,

10.3.3- Ethnobotanical studies in India

India is one of the major megafloristic zones in the globe. Due to its topography it serves as the homeland of diverse flora. There is tremendous scope of ethnobotanical study and to gain its

knowledge from the vast heritage of Vedic literature dating back to 2000-1000 BC. The first book on Indian ethnobotany was "Glimpses of Ethnobotany". It has estimated that more than 43 % of the total flowering plants of medicinal importance are grown in India alone and about 70 % population are entirely rely on herbs.

According to some recent studies done by MoEF (Ministry of Environment and forests, Government of India) under All India Coordinate Research Project Ethnobiology (AICRPF), the results have shown that more than 10,000 wild plants are used by the ethnic communities in the country in various therapies and miscellaneous uses. Among these 800 plants are used by the tribal people for different medicinal purposes. According to WHO, India alone contributed to the 27% of the total medicinal plant species of the World. Therefore, it has represented as one of the most important collection centres.

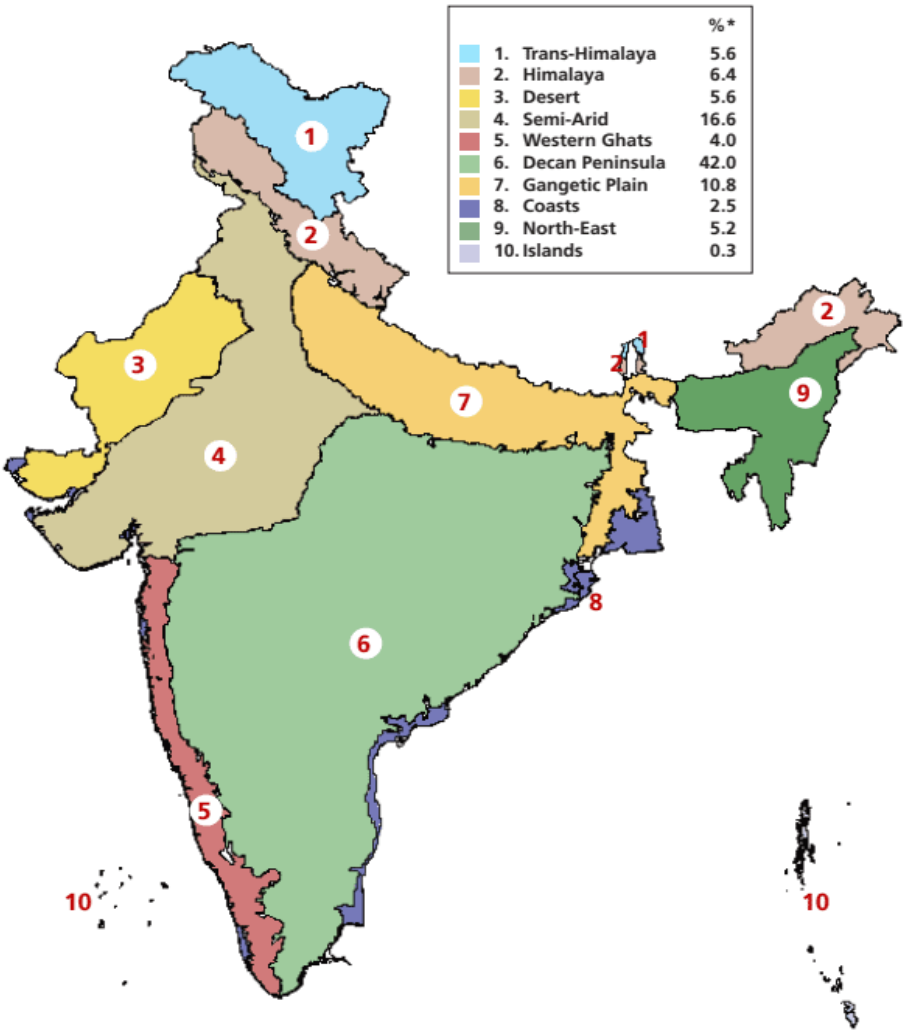


Fig.10.2- Indian map showing its biogeographical zones

Botanical survey of India has initiated recording and documentation of ethnobotanical knowledge of all tribes belonging to the states of Madhya Pradesh, Andhra Pradesh, Sikkim,

Uttarakhand, Himachal Pradesh, West Bengal, Rajasthan, Tripura, Chhattisgarh, Nagaland, Assam, Jammu and Kashmir and Andaman and Nicobar Island.

Amongst these areas North East Himalaya is one of the biodiversity hotspots. North East India represent by 8 beautiful states (Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura)and constituted about 8 % of the geographical area of the country. In these states about 180 tribal communities are found for e.g. Galong tribes in Arunachal Pradesh, Khasi tribes in Meghalaya, Kuki tribes in Manipur etc.

Fig.10.3 Rough layout of Indian Map representing major tribal communities distributed in its different states

These tribes use plants to cure several diseases like piles, chickenpox, jaundice, asthma etc. Deccan peninsula or central India serves as richest biodiversity zone in the country. Here the tribal communities and forest dwellers are the main components to maintain ecological balance. The Gond and Bheel tribes of Madhya Pradesh use about 32 medicinal plants belonging to 18 families and 26 genera. In Odisha, Pacharia tribe uses about 49 angiospermic plants having therapeutic importance, which are belonging to 29 families and 45 genera.

Uttarakhand is a part of North West Himalaya and also known for its wide range of biodiversity mainly of herbs and medicinal plants (about which we can read in the episodes of holy book Ramayana). Here about 57 plants of medicinal importance are extensively used for making therapeutic drugs or medicines. Similarly, in Kashmir which is a part of Trans-Himalaya, here about 329 plants species of medicinal importance have been documented in a book "Ethnobotany and plants of Trans-Himalaya". Out of which in an approximation 108 species are highly useful for the treatment of diabetes, fever, blood pressure, respiratory problems, joint pains etc.

Table-10.3 List of some common plants which are used by the tribal communities of Uttarakhand against different ailments

Botanical Name	Local Name	Family
1. Arthritis		
Aconitum balfourii Stapf	Meetha bish	Ranunculaceae
Actaea acuminata Wallich ex Royle	Mameeru	Ranunculaceae
Astragalus candolleanus Royle ex Benth.	Rudravanti	Fabaceae
Betula utilis D. Don	Bhoj	Betulaceae
Bombax ceiba L.	Semal	Bombacaceae
Cedrus deodara (Roxb. ex D. Don) G. Don	Deewar	Pinaceae
Dactylorhiza hatagirea (D. Don) Soo	Hatta-jari	Orchidaceae
Datura stramonium L.	Dhatura	Solanaceae
Nardostachys grandiflora DC.	Jatamanshi	Valerianaceae
Prunus cerasoides D. Don	Payyan	Rosaceae
2. Bone fractures		
Juglans regia L.	Akhore	Juglandaceae
Taxus baccata L.	Thuner	Taxaceae
3. Bronchitis and asthma		
Acorus calamus L.	Bauj	Araceae
Arctium lappa L.	Kooth	Asteraceae
Berginia ciliata (Haw.) Sternb.	Silpari	Saxifragaceae
Coleus forskahlii (Willd) Briquet in Engler	Fiwain	Lamiaceae
Ephedra gerardiana Wallich ex Stapf	Jorgantha	Ephedraceae
Heracleum lanatum Michaux	Kakriya	Apiaceae
Paris polyphylla J.E. Smith	Satwa	Liliaceae
Pleurospermum candollei (DC.) C. B. Clarke	Dhania ghas	Apiaceae
Rosa brunonii Lindl.	Kunjeer	Rosaceae
Saussurea lappa (Decne.)Sch. Bip.	Kuth	Asteraceae
Solidago virgaurea L.	Pinja-phool	Asreraceae
Swertia chirayita (Roxb. ex Flem.) Karsten	Chirayata	Gentianaceae
Thymus linearis Benth. ex Benth	Janglijawan	Lamiaceae
4.Cold and cough		
Aconitum heterophyllum Wallich ex Royle	Atish	Ranunculaceae
Agrimonia pilosa Ledebour	Lesukuria	Rosaceae
Angelica glauca Edgw.	Choru	Apiaceae
Bergenia ciliata (Haw.) Sternb.	Silpari	Saxifragaceae
Fritillaria roylei Hook.	Kakul	Liliaceae
Heracleum lanatum Michaux	Kakriya	Apiaceae
Nardostachys grandiflora DC.	Jatamanshi	Valerianaceae
Origanum vulgare L.	Bantulsi	Lamiaceae
Paeonia emodi Wall. ex Royle	Chandra	Paeoniaceae
Rosa brunonii Lindl.	Kunjeer	Rosaceae

10.3.4- Importance of Ethnobotany

As we are becoming urban dwellers on an alarming rate, that leads to urbanization and deterioration of environment. Due to the loss of biodiversity to fulfil our requirements of dwelling therefore, it is necessary to maintain a data base or study of indigenous plants which are at the threat. The threat is much severe that indigenous knowledge of plant diversity and their products can be disappeared forever.

Ethnobotanical study has proved boon in this regard to conserve our knowledge for the next generation. It is based on scientific inventories, utilization and conservation of medicinal, religious and sacred plants within and outside the tribal communities.

Proper identification, their classification and the plant's parts which are used for medicinal purposes have been listed in the studies. During the course of study, it may introduce new plants to human and their further benefits in research and commercialization.

The documentation of the plants is essential to maintain an ethanobotanical database, to generate new ethanobotanical knowledge about the area for future use.

10.3.5- Use of Ethnobotany

The main aim of ethnoboatany is to know and explore different plants which can be used as food, fodder, clothing, shelter, fuel etc. and how they can be used for the medicinal purposes to cure different ailments or diseases associated with humans and animals. Plants like *Withania somnifera* belongs to the family of Solanaceae. It is widely used by the locals, especially in India, as a medicinal plant. *W. somnifera* is rich in alkaloid and steroidal lactone that account for various pharmacological activities. *W. somnifera* is prepared by boiling and crushing the leaves and roots to make a tonic poultice, juice, and paste to treat bacterial infections and bruises. It is effective as anti-Parkinson's, anti-Alzheimer's, cardioprotective, antidiabetic, antiarthritic, and antibacterial properties. *W. somnifera* is a valuable plant that has been used in traditional medicine systems for a long time and is supported by its wide range of pharmacological activities. The extensive medicinal uses of *W. somnifera* are a sign of its great potential. Similarly *Rauwolfia serpentina* historically had been used to treat snakebites, insomnia, hypertension (high blood pressure), and insanity. Andhra Pradesh is the major cultivator of *Rauwolfia.*

Besides, comparative study at the species level provides better understanding of the plant diversity to take up as a direct source of medicine. For this purpose various ethnobotanical indices are used in terms of region wise, inter tribe or inter communities, biotic and abiotic components within the environment or ecosystem of study.

The survey for comparative study includes common name, local name, scientific name of the plant, the plant's part used for medico-religious purpose. Several quantitative tools such as RFC (Relative Frequency Citation), Use Value (UV), Informant Consensus Factor (ICF), Rank Order Priority (ROP) indices are used.

Problems occurs during ethnobotanical survey

The following problems occur for ethnobotanist during the field survey:

1- During the ethnobotanical survey people are reluctant to give information regarding their traditional knowledge on plants and its benefit.

2- As the indigenous traditional knowledge is not documented and transfers generation to generation verbally, loss of information occurs.

3- Difficulty in finding the right persons who possess the Indigenous knowledge and the local people might be prejudiced against officials dealing with land records or income tax and hence might be wary of researchers too.

4- Researches may be unable to understand the dialectical nomenclature used by local people to describe plant species.

5- The traditional healers and the elderly people have enough knowledge on plants but they have a fear of over exposure of these plants for commercial applications by medicine and drug industry.

6- Due to modernization the tribal are become more civilized and thus are not willing to resides in villages and move towards the city ignoring their traditional values, customs and belief.

7- Some time it is also difficult to identify the plants correctly from its local name and confusion occurs over the Latin name of the plant during documentation.

Strategies to overcome the problems

1- During ethnobotanical survey the informant should be taken into confidence that the indigenous knowledge given by the tribes will not cause over exposure of plants.

2- Irrespective of the modernization, the importance of medicinal plants and their uses in the developing countries must be taken seriously. It can be achieved properly using bioinformatics tools and techniques.

3- Conducting group meetings in order to promote awareness and to motivate local people to share their knowledge.

4- Conducting location specific peripatetic group meetings, demonstrations, and farm and home visits in order to address local people's problems and priorities (e.g.insects, disease) could oblige local people to reciprocate by sharing knowledge.

5- Using extension teaching methods and aids helps to educate local people and appropriate counseling ensures availability of the required knowledge.

6- Arranging scouting competitions for local people (women, farmers, and children etc.) and selecting winners should be awarded with rewards/incentives that motivate local people to share their ITK.

7- The social economical standard of the tribal people should be improved as it reduced their move towards the city for livelihood.

8- The research capability in the field of traditional medicinal plants should be strengthen with proper documentation, identification and conservation of the important plants.

9- Government laws and policy will be helpful in needed conservation practices.

10- Informing local people about publishing documented innovations of local people in newsletters/journals acknowledging the identity of the innovator(s) and popularizing their innovations.

10.4 CONSERVATION OF PLANT RESOURCES

Plant conservation refers to the practices of protecting and preserving plant species, their habitats and their ecosystems to ensure their survival for future generation use. Therefore, plant conservation is essential for the sustainable future. It is also essential both wild and cultivated forms.

It can be achieved by following ways:

Sustainable agriculture: Plant crops must be planted and choose in such a way that maximizes the productivity while minimizing negative impacts to the environment. It includes practices like crop rotation, organic farming, reduce pesticides in use etc.

Forest management: Use forest sustainably by balancing resource extraction with conservation. This includes selective logging, reforestation and protection of endangered species. The management also leads to viability of species within the ecosystem.

Medicinal plant conservation: The conservation of wild medicinal plants or any other such threatened species can be tackled by scientific techniques as well as social actions. They include, discouraging cutting down indigenous trees and encouraging the local people to plant fast-growing exotic and indigenous trees for domestic use, the inauguration of a national tree planting day and the creation of nature reserves.The Indian agency responsible for the conservation and sustainable use of medicinal plants is Indian Council of Medicinal Research, New Delhi.

Threats to plant diversity

Habitat loss, fragmentation and degradation

Habitat loss and associated fragmentation is the biggest single threat to plant diversity. Deforestation is the main cause of habitat loss, fragmentation and degradation. It is caused to fulfil our requirement of dwelling, as the population is increasing in an alarming rate. People are more shifting in the nuclear family which increases the demand of housing, transportation etc.

Invasive species

Invasive alien species are another potential threat to native plant diversity. A recent study showed that more than 13,000 species about 3.9% of the world's vascular plant flora have become naturalized somewhere outside their native range as a result of human activity. The acclimatization of invasive species leads to the extinction of native once.

Overexploitation

Overexploitation of the whole plant or enough of it to reduce the chance of survival is the most important threat to plant species. It is usually more or less species-specific, although some species can be lumped together for specific uses, for example dipterocarps with similar wood in the timber trade or plants with similar properties in the medicine trade. Phenological changes leads to destruction and extinction.

Air pollution and nitrogen deposition

Every plant on Earth today is exposed to an atmosphere that differs significantly in composition from any that its ancestors would have experienced. Changes in the concentration of the major greenhouse gases (CO_2, CH_4, N_2O), but other air-borne pollutants can also impact plant diversity. Presence of these pollutants in the environment is the major cause of smog and fog that leads to the death of certain plant species and thus reduces the plant diversity.

Climate change

The impacts of anthropogenic climate change are also complex and unpredictable, and even more pervasive. After around 1°C of global warming so far, many temperate zone plants are leafing and flowering earlier in spring and less consistently, delaying leaf fall in autumn. Some species have extended their ranges towards the poles and/or to higher altitudes, although other species have not done so. Growth rates have generally increased where temperature is limiting and decreased where water is. All these changing behaviour in plant physiology leads to their extinction.

10.4.1- Conservation strategies

In-situ conservation

1-In-situ conservation is the process of preserving threatened plants or animal species in their natural habitats. National parks, wildlife sanctuaries, natural reserves, biosphere reserves, and sacred grooves are examples of in-situ conservation techniques. In addition to ensuring the sustainability of the environment and ecology, this method safeguards the local population also.

2- Besides, the preservation of genetic resources in naturally occurring populations of a plant or animal species is known as in-situ conservation.

3- Additionally, it keeps the material where it was originally discovered and preserves the natural process of evolution which is not the case in ex-situ preservation.

4- Biosphere reserves, national parks, sanctuaries, reserved forests, protected forests, and nature reserves are all forms of legal protection for ecologically distinct and biodiversity-rich locations in India.

5- It also helps to make national strategy for the preservation of genetic variation in its natural habitat for e.g. Turkey is the first nation to make national strategy in this regard.

Ex-situ conservation

It is the preservation of plants outside their natural habitats in a confined zone. Ex-situ conservation simply means off-site conservation. There are multiple ways included in this type of approach to conserve plants and preserve their genetics, such as gene banks, botanical gardens, seed banks, cryopreservation etc.

Ex-situ conservation has several purposes, which include:

1- Through it we can produce material for conservation biology research.

2- It helps in the collection and storage of germplasm, which can be used in the future.

3- The techniques under ex-situ help to breed species whose seeds are recalcitrant and cannot be kept in a seed bank.

4- It also provides materials for conservation education and display, which are valuable to understand the conservation practices and importance amongst the younger generation.

5- Protect threatened germplasm to increase the level of biodiversity.

6- Produce materials to assist with reintroduction, habitat restoration, reinforcement, and management.

7- Supply a variety of materials in order to reduce or eliminate wild collecting pressure.

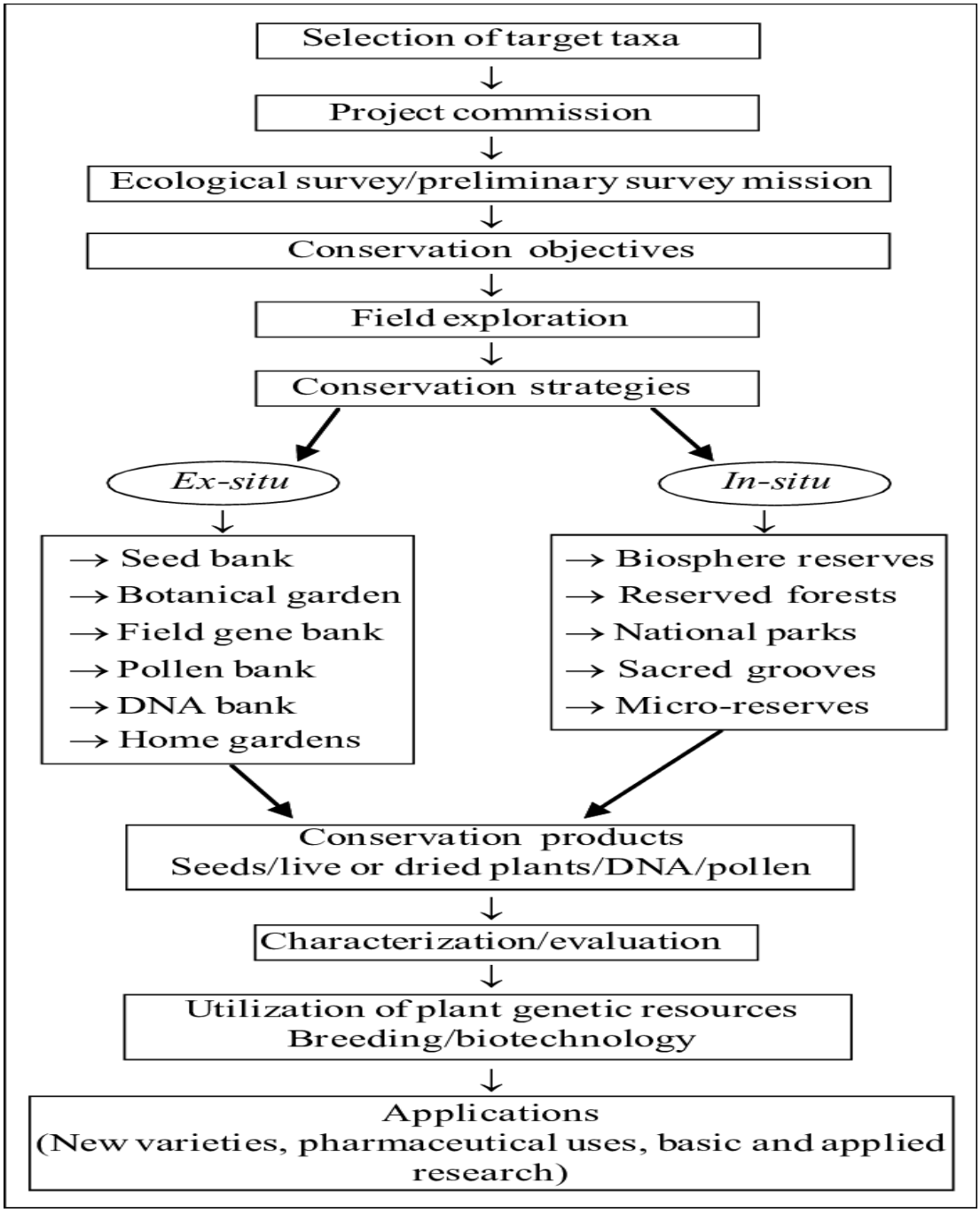


Fig.10.4- Strategies for the conservation of plant resources

10.4.2- Sacred groves

Sacred groves preserve a rich religious and socio-cultural heritage of Indian biodiversity from primeval times, due to their values. They act as a connective bridge between man and nature. Groves help to improve soil quality, replenish water resources and are pivotal for biodiversity conservation of plants and animals including rare, endemic, threatened, vulnerable species and

ethnobotanical importance. Most of India's sacred groves are associated with a deity or a spiritual power, who protects the grove and local people. Vegetation cover of these groves has traditional ethnobotanical value, especially in the field of ethnomedicine, which accounts for the conservation of groves over the years. Numerous plant species from sacred groves are used according to tradition and culture to prevent or cure various health problems. However, modernisation, industrialisation, increased encroachment and misuse of forest resources increasingly threaten sacred groves. These treasures of nature must be conserved by formulating and applying new laws and policies while creating awareness among people about the value of sacred groves. Such an important act is "The Biological Diversity Act, 2002"

The Biological Diversity Act, 2002

The act was enacted in 2002, it **aims at the conservation of biological resources,** managing its **sustainable use** and **enabling fair and equitable sharingbenefits** arising out of the use and knowledge of biological resources with the local communities. The Act prohibits the following activities without the prior approval from the **National Biodiversity Authority:**

- Any person or organisation (either based in India or not) obtaining any biological resource occurring in India for its research or commercial utilisation.
- The transfer of the results of any research relating to any biological resources occurring in, or obtained from, India.
- The claim of any intellectual property rights on any invention based on the research made on the biological resources obtained from India.

Importance of sacred groves in biodiversity conservation

- They serve as storehouses of genetic diversity
- As repositories of valuable genetic resources of rare, endangered, vulnerable, threatened and endemic plant and animal species, wild relatives of domesticated plant species and remnants of the primeval undisturbed forests, thus serve as a sanctuary for in situ conservation of genetic resources.
- Identification of plants listed under different categories such as rare, endemic, threatened, vulnerable, endangered in IUCN (International Union for Conservation of Nature and Natural Resources) Red list in sacred groves suggests that these plants exist in these groves and can be regenerated if they vanish in nearby forests.

Threats to sacred groves

- Diminishing traditional beliefs due to modernization
- Untouchability is also leading towards a dwindling participation of lower castes is negligible
- Heavy tourist influx and their non-eco-friendly behaviour deteriorates the values and the virginity of nature
- Fragmentation of families taking care of sacred grooves

- Anthropogenic factors like-Population explosion**,** Encroachment of groves for industrialization**,** Sacred groves cleared for cultivating cash crops**,** Deforestation, habitat destruction etc.

Management of sacred groves

Understanding ownership of the groves has become an absolute necessity as it provides insightsdirectly and indirectly about the proximate and ultimate drivers that affect the overall area and thestatus of the groves. The nature of ownership provides insights into

(i) The degree and kind of intervention allowed in the grove

(ii) The framing of rules and regulations (as a code of conduct) and norms of behaviour

(iii) Punishment of offenders

Types of ownership in sacred groves

1. Village councils (panchayat)
2. Temple trusts
3. Local forest department
4. Individual families

There are more than 100 000 sacred groves around the world, mainly concentrated in India, Nepal, South America, Japan and parts of Africa, some of which serving even as microbiosphere reserves.

Fig.10.5- Distribution of scared groves in India

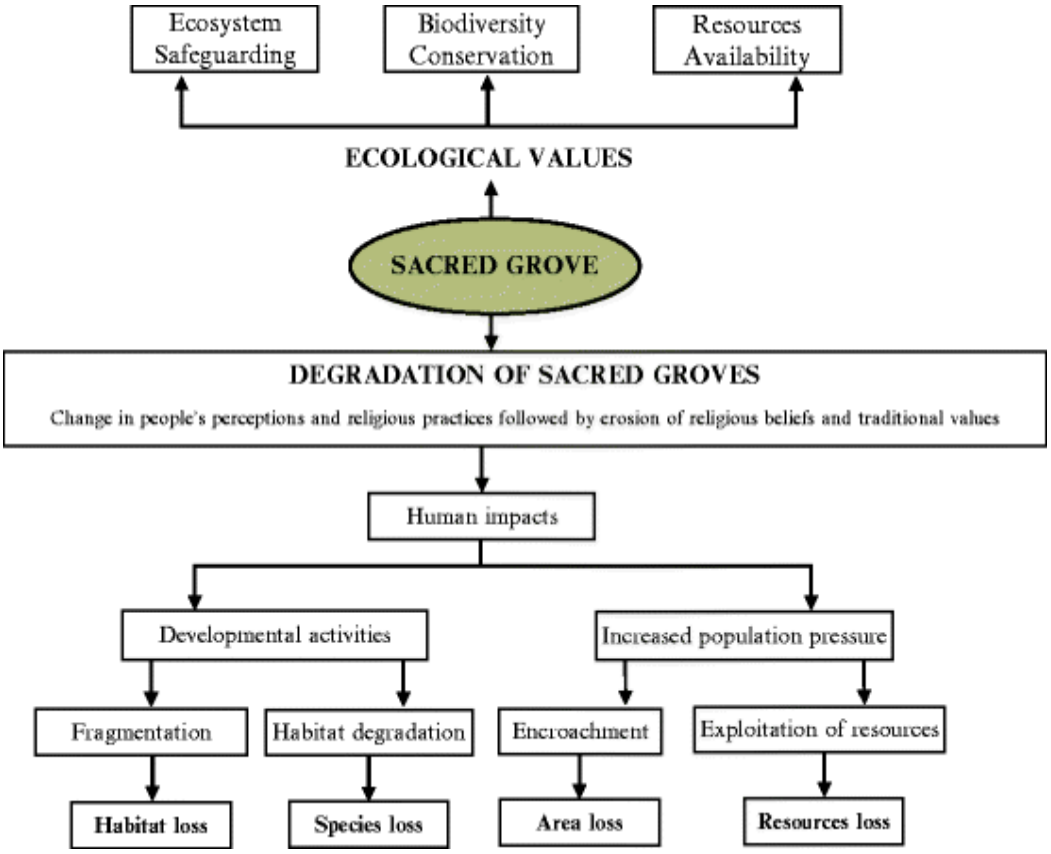


Fig.10.6- Generalised flow chart related to sacred grove

Table-10.4- Location of some sacred groves and their common names (in India)

Location	Name for Sacred Groves
Bihar	*Sarnas*
Himachal Pradesh	*Dev van*
Karnataka	*Devarakadu*
Kerala	*Kavu*
Madhya Pradesh	*Dev*
Maharashtra	*Deorais* or *Deovani* *Devarai* or Devrahati
Manipur	*Lai Umang*
Meghalaya	*Law Kyntang* or *Law Lyngdoh. Khlaw U Blei* or *Khloo Blai. Asong Khosi*
Rajasthan	*Oran*
Sikkim	*Gumpa forests*
Tamil Nadu and Kerala	*Sarpa Kavu* or *Kavu*
Uttara Kannada (northern Karnataka)	*Kans*

10.4.3- Importance of Herbarium in Ethnobotanical studies

Herbarium is defined as the collection of completely dried, properly pressed, perfectly mounted plant specimens on the herbarium sheets. The plants are usually collected in situ (during field excursion from their natural habitats), identified by experts, pressed, and then carefully mounted to standardised herbarium sheets (41 cm by 29 cm or 11.5 inches by 16.5 inches) in such a way that all major morphological characteristics are visible (both sides of the leaves and the floral structures). The mounted plants are labelled with their proper scientific names, the name of the collector, and, usually, information about where they were collected and how they grew and general observations. The specimens are commonly filed in cases according to families and genera in their sequencing and are available for ready reference. About in an approximation there are more than 3500 herbariums available in the world which contain about more than 397,000,000 specimens, mostly used by mycologists, plant pathologists, taxonomists, and health scientists".

Fig.10.7- Standard Herbarium sheet mounted with the plant specimen along with relevant details

Function of Herbarium

1. Act as a source of information about plants.
2. Help in research and teaching activities.
3. Help in the accurate identification of plants.
4. Also provide information about the plants that are collected worldwide, in one place.
5. The specimens in the herbaria are used as a source of material for chemo-taxonomical and anatomical studies.

Importance of Herbarium

1. It is a source of knowledge of flora of a region or a locality or a country.
2. It is a data store in which the information of plants is available.
3. The correct identification of plants is understood by the type specimen.
4. It provides materials for taxonomists and anatomists.
5. Pollen or microspore is preserved up to nearly 200 years without undergoing any changes in morphological features.
6. It is very useful to study cytology, structure of DNA, numerical taxonomy chemo-taxonomy etc.
7. It acts as a reservoir of gene pool studies.

Use of Herbarium in Biodiversity and conservation

Biodiversity is defined as the variety and variability of all living organism from all sources including terrestrial, marine and other aquatic systems and the ecological complexes of which they are apart, this includes diversity within species, between the species and of different ecosystems. Authentic identification of species is pre-requisite for formulation and implementation of any research and management projects. Herbarium has invaluable role in correct identification of species and it is a databank for the biodiversity. Herbarium of the Forest Research Institute internationally known, as the Dehradun Herbarium (DD) is the only herbarium in the country engaged in survey, collection and identification of forestry species which is directly associated with ethnobotanical studies. The herbarium serves an important role as a ready reference for rare and threatened plant diversity of the country (about more than 3,50,000 specimens are present in the herbarium). The Herbarium is a scientific collection composed by plants samples proceeding from several ecosystems. It provides a record and a reference about flora from a specific region. Herbarium serves as a tool for conserving the biodiversity interms of scientific studies, applied research and activities, education and training. The use of herbarium will help conserve biodiversity are under the threat of extinction. It also preserves information on biodiversity data.

The largest herbarium in India is located at Kolkata “The Central National Herbarium (CAL), popularly known as CNH or Calcutta herbarium” is the oldest and largest herbaria in India in Shibpur on the west bank of the river Ganga. It covers around 273 acres of land having more than 30,00,000 herbarium specimens persevered in different herbaria located in the different

parts of the country. Historically it was known as The Acharya Jagdish Chandra Bose Botanic Garden. It was established in the year 1787. The main attraction of the garden is the presence of the second largest canopy in the world formed by the 'Great Banyan Tree.'

10.5 SUMMARY

Ethnobotany is the study of interaction of plants and animals including human beings for their better survival and sustainability, since the relationship of plants for the survival of other organisms is irreplaceable. They are the producers that convert solar energy into chemical energy through photosynthesis and fulfil the requirement of food, fodder, medicines etc. for the other organisms. In India majority of the population lies in the remote areas such as villages, inside the forests as tribal communities, who are mainly dependent on plants and their products. With increasing population in an alarming rate people are shifting to the new places for better housing, transportation etc. and to fulfil their requirements there is tremendous degradation of plant diversity is occurring in the form of deforestation. Plants had made the environment for the existence of other organisms on the earth and their survival will ensure the sustenance, and continuity of others. Therefore, it is necessary to conserve plant diversity by adopting in-situ and ex-situ conservation, consistently and co-ordinately along with the concept of sustainable development.

10.6 GLOSSARY

Abiotic: Non-living factors that influence plant growth, function and survival (for example, soil, water, amount of sunlight, nutrients, etc.).
Acclimatize: Harden off a plant so that it can survive under low humidity conditions.
Bioinformatics: An interdisciplinary field of science that combines biology, computer science, mathematics, and statistics to analyse and interpret biological data.
Biotic: Living factors that influence plant growth, function and survival (for example, predators, fungi, pollinators).
Conservation Status: A formal designation of endangered or threatened status at a state, federal, or international level.
Cryopreservation: Preserving tissues by storing in liquid nitrogen at temperatures below –130°C.
DNA Banking: Long-term storage of an individual's genetic material. In plants, leaves are common tissue that can be stored.
Ex Situ: Offsite, away from the wild population, usually referring to collection held in nursery or botanic garden.
Germplasm: Living seeds or tissues from which plants can be grown.
Herbarium: It is the collection of completely dried, properly pressed, perfectly mounted plant specimens on the herbarium sheets.

In Vitro: Micropropagation; plant tissues grown on nutritional medium in a sterile humid glass or plastic container.
Phenology: The timing of key life history events in a plant's life, such as flowering or fruiting.
Sequencing: Refers to genetic procedure to determine the composition and order of genes of an individual as in genotyping.
Taxon: A taxonomic group of any rank, such as a species, family, or class. Sometimes this term is used rather than species, because it will encompass varieties and subspecies.
Viability: Ability to live and survive successfully.

10.7 SELF ASSESSMENT QUESTIONS

10.7.1- Multiple choice questions

1. Main source of income for tribal communities in India, who are practicing ethnobotanical approaches-
(a) Forest tourism (b) Medicinal plants collection and their sale
(c) Agriculture (d) Fishing and recreation

2. *Rauwolfia* is chiefly grown on large scale by-
(a) Kerala (b) Maharashtra
(c) Tamil Nadu (d) Andhra Pradesh

3. Which law governs the collection, distribution and trade of medicinal plants?
(a) Biological diversity Act
(b) Wildlife Protection Act
(c) Ayurvedic, Siddha and Unani Drugs Technical Advisory Board
(d) Forest Conservation Act

4. The Indian agency responsible for the conservation and sustainable use of medicinal plants-
(a) Indian Council of Medicinal Research
(b) National Medicinal Plant Board
(c) Ministry of Ayush
(d) Central Council for Research in Ayurvedic Sciences

5. Which tribal community in India extensively use Ethnobotanical knowledge in their daily life?
(a) Gond tribe (b) Bodo tribe
(c) Santhal tribe (d) Munda tribe

10.7.1 Answer Key: **1. (b), 2. (d), 3. (a), 4. (b), 5. (a)**

10.8 REFERENCES

- Chowdhary, H.J. and Murti, S.K. (2000). Palnt Diversity and Conservation in India: An overview. ISBN: 8121102243.
- Maheshwari, J.K. (2003). Ethnobotany and Medicinal plants of Indian subcontinent. ISBN: 9788172332211.
- Pullalah, T., Krishnamurthy, K.V. and Bahadur, B. (2017). Ethnobotany of India. Vol. 5. ISBN: 9781315186627.
- Varghese, A., Oommen, M.A., Paul, M.M. and Nath, S. (2022). Sustainable use of Biodiversity conservation in India. ISBN: 9781032290836.

10.9 SUGGESTED READINGS

- Maheshwari, J.K. (2003). Ethnobotany and Medicinal plants of Indian subcontinent. ISBN: 9788172332211.
- Pullalah, T., Krishnamurthy, K.V. and Bahadur, B. (2017). Ethnobotany of India. Vol. 5. ISBN: 9781315186627.
- Varghese, A., Oommen, M.A., Paul, M.M. and Nath, S. (2022). Sustainable use of Biodiversity conservation in India. ISBN: 9781032290836.

10.10 TERMINAL QUESTIONS

10.10.1 Short Answers questions

1. What are the different factor that leads to the plant biodiversity loss?
2. What are the main problems faced during the Ethnobotanical studies?
3. Write down common and scientific names of five plants which are extensively used by tribal communities as food plants.
4. Differentiate between Ethnobotany and Economic botany.
5. What are the major roles of herbarium in Ethnobotanical studies?

10.10.2 Long answer questions

1. Explain with examples role of Ethnobotany in conservation of plants.
2. Describe in detail about the role of ethnic groups in conservation of plant resources.
3. What are sacred groves? How they help in Ethnobotanical studies?
4. Explain different conservation strategies for the conservation of plant resources.

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