1. Details of Module and its structure

Module Detail	
Subject Name	Geography
Course Name	Geography 02 (Class XI, Semester - 2)
Module Name/Title	Natural Vegetation -Types of Forests – Part 2
Module Id	kegy_20502
Pre-requisites	Basic Knowledge about factors that influence the growth of Natural Vegetation
Objectives	After going through this module, the learners will be able to know about: • Various Systematic Classifications of Natural Vegetation of India prepared by Botanists • Types of Forests found in India
Keywords	Natural Vegetation, Tropical Evergreen and Semi Evergreen Forests, Tropical Deciduous Forests, Tropical Thorn Forests, Montane Forests, Littoral and Swamp Forests.

2. Development Team

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Table of Content:

Classification of Natural Vegetation:

Vegetation is one of the primary resources found in any geographical area. The knowledge regarding the vegetation composition, structure and distribution helps in management of forest resources.
The prime aim of vegetation classification is to group together plant communities that are similar. This helps simplifying the description in a given geographical area and arriving at a standard definition of such a vegetation type.
Classification of vegetation may be done on the basis of the following attributes:

- Taxonomic composition of community (groups classified on the basis of shared characteristics)
- Horizontal and vertical arrangement of plants
- Morphological traits (outward appearance of form or structure)
- Functional Traits (their ecological roles – how they interact with the environment and with other species)

Apart from these attributed, sometimes, some aspects of the vegetation which may be external to the vegetation itself, like the environmental or geographical conditions.

History of Vegetation Classification. Vegetation Classification has a very long history. It began in the 19th Century when classification was done on the basis of growth form of dominant species. In the 20th Century, taxonomic classification became important and in the 21st Century, plant community ecologists use a huge amount of data sets to classify vegetation types.

In India, forest were classified into 116 types in the year 1936 by Sir H.G. Champion which was later revised in 1968 by Sir H.G. Champion and S.K. Seth as ‘ A Revised Survey of Forest Types in India’. The study regrouped the forests into 16 broad categories. In the image presented below, the 16 categories are being presented.

Vegetation Types of India following Champion and Seth 1968

Sl. No	Vegetation Type	General composition	* Area in Sq. Km	%
1	Tropical wet evergreen forests	Dense Tall forests, entirely evergreen or nearly so	51,249	8.0
2	Tropical semi evergreen forests	Domants includes deciduous species but evergreens predominants	26,424	4.1
3	Tropical Moist deciduous forest	Dominants mainly deciduous but sub-dominants and lower story largely evergreen top canopy even and dense but 25m high	236,794	37.0
4	Tropical dry deciduous forest	Entirely deciduous or nearly so top canopy uneven rarely over 25 m high	186,620	28.6
5	Tropical throny/ scrub forests	Deciduous with low throny trees and xerophytes predominats top canopy more or less broken, less than 10 m high	16,491	2.6
6	Tropical dry evergreen forest	Hard leaved evergreen trees predominates with some deciduous emergent often dense but usually under 20 m high	1,404	0.2
7	Littoral and swampy forest	Mainly evergreens of varying density and height but always associated predominantly with wetness	4,046	0.6
8	Subtropical broad-leaved hill forests	Broad-leaved largely evergreen high forests	2,781	0.4
9	Subtropical pine forests	Pine associated predominates	42,377	6.6
10	Subtropical dry evergreen forests	Low xerophytic forest and scrubs	12,538	2.5
11	Montane wet temperate forests	Evergreen without coniferous species	23,365	3.6
12	Himalayan wet/ moist temperate forests	Evergreen forests mainly scleriphyllous oak and coniferous species	22,012	3.4
13	Himalayan dry temperate forests	Coniferous forests with sparse xerophytic undergrowth	312	-
14	Sub-alpine forests	Stunted deciduous or evergreen forests, usually close formation with or without confers		
15	Moist alpine	Low but often dense scrub of evergreen species	18,628	2.9
16	Dry alpine	Xerophytic scrub in open formation mostly of deciduous in nature		

Image 1: Vegetation Types of India following Champion and Seth, 1968.

Champion's classification has been further simplified by S S Negi (1990), which simplified the classification into 5 main types and included 16 sub-types within them.

Types of Forests found in India:

On the basis of predominant vegetation type and climatic conditions, Indian forests can be divided into the following groups.

1. Tropical Evergreen and Semi Evergreen Forests
2. Tropical Deciduous Forests
3. Tropical Thorn Forests
4. Montane Forests
5. Littoral and Swamp Forests

In the map presented below, the spatial extent of each of the forests has been demarcated.

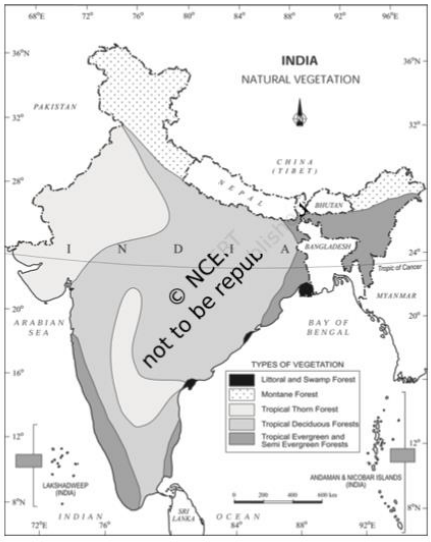

Image: 2. Map Types of Vegetation.

Each type of Natural Vegetation is being discussed in detail.

1. **Tropical Evergreen and Semi Evergreen Forests:**

   Tropical Evergreen forests are quintessential rain forests which can be found in regions which receive annual average rainfall of over 250 centimeters. The annual average temperature ranges between 25- 27 º C, and the annual average humidity remains above 77 percent. Rainfall occurs for a number of months in a year and the dry period is very short. Due to high temperature and humidity found in these forests, trees do not shed leaves all at once, rather, the trees keep shedding the leaves in small quantities throughout the year. Due to this reason the trees appear green throughout the year and thus the trees are termed as evergreen trees. The vegetation is very dense and the trees often grow up to the height of 45 meters. Some trees attain a height of almost 60 meters. Distinct four layers of plants can be found in a rainforest. The diagram below shows the arrangement of the plants in four layers:

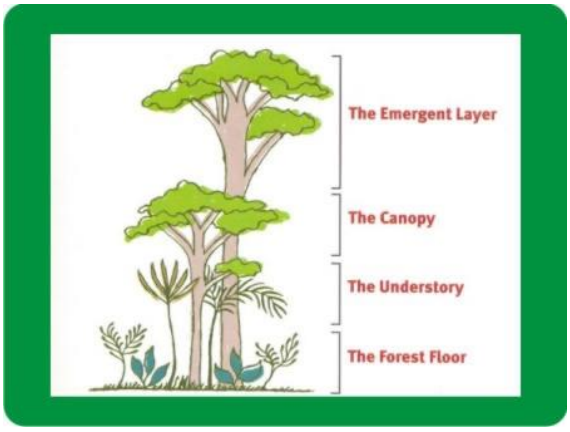

Image:2. Layers of vegetation in a Rainforest.

The emergent plants at the top comprises of the tallest trees, these trees are much taller than the trees in the canopy. The emergent layer is followed by the plants which form the canopy. The canopy is the thickest layer of the rainforest and is home to many birds and animals. The third layer is made up of the understory; which has shorter, young trees and many shrubs and bushes. The lowest layer comprises of the forest floor. It is this layer that the smaller plants and shrubs grow. The amount of sunlight that reaches the floor is very little and insects thrive in this layer. Evergreen forests are found in the western side Western Ghats between 500 to 1300 meters above sea level); Arunachal Pradesh, Upper Assam, Nagaland Manipur Mizoram and Tripura and Andaman and Nicobar Islands. Important species are: Mesua, White Cedar, Jamun, Toon, Aini, Ebony, Mahogany Callophylum.

Image:3. Mesua Tree (Ironwood)

Source: https://commons.wikimedia.org/wiki/File:Mesua_ferrea_tree_DSC1265.jpg

Image:4 Evergreen Rainforest of Kerala

Source: https://commons.wikimedia.org/wiki/File:Forests,idduki_dist.kerala_-_panoramio.jpg

The Semi Evergreen Forests are found in the relatively drier areas of tropical evergreen forests. The rainfall ranges between 200 to 250 centimeters per annum while the mean average temperature varies between 24 to 27 º C. The relative humidity is around 75 percent. The regions where these trees may be found are, Western Ghats, Assam, lower slopes of the Eastern Himalayas, Odisha and Andamans. The semi-evergreen forests are less dense than the evergreen forests and have a variety of species. Important species are:Semul. Mundani, Indian Chestnut, Champaetc,

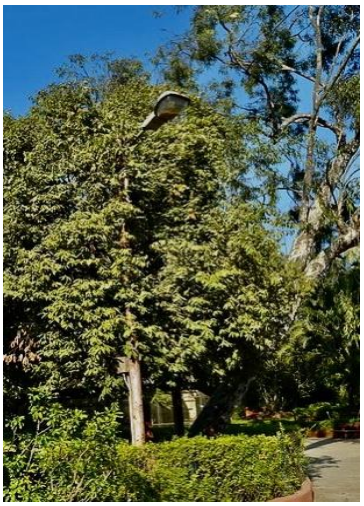

Image: 4. Indian Chestnut Tree

Source: https://commons.wikimedia.org/wiki/File:Nahor_(Assamese-_নাহৰ)_(2209471360).jpg

During the colonial period, the British had begun large scale felling of these forests, which led to many changes in the species found in these forests. One example is, the Oak forests of Garhwal and Kumaon were replaced with Chir Pines as the timber was used to make sleepers as a part of construction of railway lines.

Image 5. Sleepers of Railway tracks

Source: https://www.pxfuel.com/en/free-photo-onhvd

Forests were also cleared for introducing plantation agriculture for growing tea and coffee. With these activities, began the commercial use of these forests.

2. **Tropical Deciduous Forests:** These are the most commonly and extensively found forests in India. These forests are also known as Monsoon Forests and they can be further classified into two categories: the moist deciduous forests and the dry deciduous forests.

   Moist Deciduous Forests are found in areas that have rainfall ranging between 100 – 200 centimeters. The trees rise to upto 20 to 60 meters in height and also have a very thick undergrowth. These trees are found along Sahyadris, Most of Odisha, Chhattisgarh and a strip along Siwaliks including Bhabhar and Terai. The trees drop their leaves for 6-8 weeks during April-May. Teak, Sal, Shisham, Hurra, Mahua, Amla, Semul, Kusum and Sandalwood are the main types of trees found in the region.

   Dry Deciduous Forests are also spread over vast areas of the country where rainfall ranges between 70 to 100 centimeters. These forests share boundary with moist deciduous types where the rainfall is higher and with dry thorn forests where the rainfall is low. When compared to the Moist Deciduous type, the trees found in the Dry Deciduous forests appear to be more stunted and widely spaced. This is one of the reasons why these forests are said to have a 'parkland landscape'; where open spaces of grassy land may be found with taller trees in and around it.

Parkland Landscape

An area that is covered with thick green grasses and well grown trees in a open clearing is known as Parkland Landscape. Parkland landscape is a commonly observed feature in Dry Deciduous Forests; but are confined to areas that receive moderate rainfall like the peninsular plateau and the northern regions of the Indian plains but may not be found in drier areas of southern parts of Rajasthan

The species that are found in these forests are the same as those found in the Moist type. During the dry season, the trees shed their leaves and appear bare. The forest looks like a vast grassland during those times. The areas of Dry Deciduous forests are, wetter areas of the Peninsula and the plains of Uttar Pradesh and Bihar. In Rajasthan, the same forest type exhibits very scanty vegetation owing to low rainfall and overgrazing.

Deciduous forests are economically highly significant. Many important timber tree species are found here. Sal is one such important timber tree, as it resists burning and can easily adapt to different soil types. Pure stands of Sal are found with shrubby

undergrowth making exploitation of the timber less cumbersome. Sal is used for construction work.

Teak is the other important specie which is commercially viable. Like Sal trees Teak is also resistant to burning, it is termite resistant and can regenerate quickly. Teak is valued for furniture as it has a smooth finish.

Sandalwood is the other valuable specie found in the Monsoon forests. It is an aromatic wood and it extensively used for making soaps and extracting oil.

Image: 6. Sal Forest

Source:https://commons.wikimedia.org/wiki/File:Shorea_robusta_-_Simurali_2011-10-05_050368.JPG

Image: 7. Teak Forest

Source: https://www.needpix.com/photo/109089/teak-forests-dandeli-karnataka-india-wild

Image :8. Sandalwood Tree

Source:https://commons.wikimedia.org/wiki/File:(Pterocarpus_santalinus)_red_sandalwood_tree_at_IG_Zoo_Park_in_Visakhapatnam_03.jpg

3. **Tropical Thorn Forest:** In areas where the average annual rainfall is recorded below 50 centimeters; average annual temperature ranging between 25-35 ºC and humidity below 50 percent, Tropical Thorn Forest may be found. These areas include; semi-arid areas of south west Punjab, Haryana, Haryana, Rajasthan, Gujarat, Madhya Pradesh and Uttar Pradesh. This vegetation type includes low widely scattered trees and bush. Acacias and Euphorbias are common. Xerophytic plants are capable of adapting themselves to the climatic and edaphic factors found in these regions. Wild date palm is common in valleys. Due to differences in soils, a great variety of vegetation may be found under this category. Some of the common sub types are; riverine woodlands, open and thorny scrub and dune and saline vegetation. Khair and Sissoo occur along the banks of rivers in North India. Neem, Peepal and Ber are also found along the course of water bodies. Babool is found in the flood plains in central parts and coarse grasses and acacias predominate on the saline soils of the Ganga plains. In gravelly dry soils of Siwalik ranges, bamboo grows abundantly. The Aravalli ranges are densely covered by Khardhai forest which degenerates towards the west as the soils becomes increasingly sandy and the amount of precipitation declines. Paleobotanists believe that the Thar region was more wooded in the prehistoric times, but due to decrease in the amount of rainfall received in the area coupled with overgrazing, has reduced the area to a barren sandy tract of land with very sparse vegetation. The vegetation is mostly xerophytic; the dry thorny bushes have long roots to draw water from the soiland have waxy stems to minimize water loss through transpiration. Tall grasses, known as Tussocky grass which grows upto 2 meters in height can be seen in the area.

Did you know?

1. **Xerophytic Vegetation** - species of plant that has adaptations to survive in an environment with little liquid water, such as a desert. Xerophytes are adapted to conserve water, store large quantities of water, during dry periods. Xerophytes such as cacti are capable of withstanding extended periods of dry conditions as they have deep-spreading roots and capacity to store water. The leaves are waxy and thorny that prevents loss of water and moisture. Even their fleshy stems can store water

2. **Edaphic Factors** - The factors which relate to structure and composition of soil are called edaphic factors. Soil composition, organic matter, soil water, soil air and soil organisms are examples of edaphic factors.

Image: 9. Khair Tree

Source:https://commons.wikimedia.org/wiki/File:Khair_(Hindi-खैर)_(3624128603).jpg

Image: 10 Babool

Source:https://hi.m.wikipedia.org/wiki/चित्र:Babool_(Acacia_nilotica)_flowers_at_Hodal_W_IMG_1248.jpg

4. **Montane Forest:** In the upland areas, like mountains and hills, natural vegetation forms changes its type and form with increasing altitude and decreasing temperature and moisture. Apart from the altitude, the aspect of slope; whether the slope faces the Sun or not also influences the vegetation type found on uplands. In India, Montane Forests may be classified into two groups; the Northern Mountain Forests and the Southern Mountain Forests.

   i. Northern Mountain Forests: A great variety of natural vegetation types may be observed within the Northern Mountain Forests. In the Himalayas, succession of vegetation from tropical to tundra type can be observed with increasing height.

   Wet Hill Forests**:** Dense and high wet hill forests are found at 1000 to 2000 m height in the eastern Himalayas. Evergreen Oak, Chestnut, Ash and Beech are found along with Sal trees at lower heights. Climbers and Epiphytes are common in these forests.

Epiphyte: An epiphyte is an organism that grows on the surface of a plant and derives its moisture and nutrients from the air, rain, water or from debris accumulating around it.

Sub-Tropical Pine Forests: are found mainly in Meghalaya and Punvanchal. Chir Pines and stunted Oak trees are found in these forests.

Image:12. Chir Pine

Source: https://commons.wikimedia.org/wiki/File:Pine_tree_from_Dharamshala.JPG

Sub-Tropical Dry Evergreen Forests: Found in the Himalayan foothills of Kashmir, Wild olives and Phulai trees dominate in these forests.

Image: 13. Phulai

Source: https://commons.wikimedia.org/wiki/File:Flowers-Acacia_modesta.JPG

Moist Temperate Forests: cover the entire Himalayan range where average annual rainfall ranges between 100 to 250 centimeters and the elevation is between 1500 to 3300 meters. Pine, Cedar, Silver Fir and Spruce are found in open forests with shrubby undergrowth of Oak, Rhododendron and Laurel as undergrowth. Pure strands of are Deodar are found in the western parts and is an important source of timber.

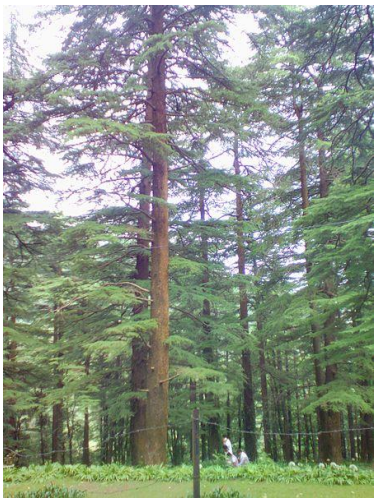

Image:14. Deodar Tree

Source:https://commons.wikimedia.org/wiki/File:Deodar_cedar_tree_himachal_pradesh_,_india.jpg

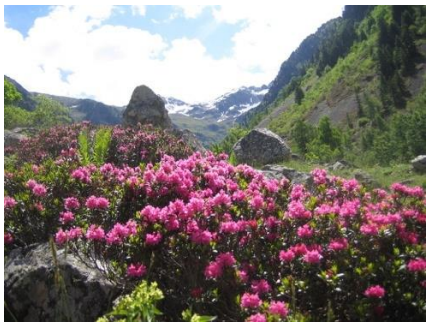

Image:15. Rhododendrons

Source: https://en.wikipedia.org/wiki/Rhododendron#/media/File:Alpenroos.jpg

Dry Temperate Forests: An open xerophytic forest with Deodar, Junipers and Chilgozah are as dominant trees and scattered Oak and Ash are found in the inner Himalayas where rainfall is below 100 centimeters a year.

Image: 16. Junipers

Source: https://commons.wikimedia.org/wiki/File:Juniperus_chinensis_at_Akola,_India7.jpg

Alpine Forests: Elevation above 2800 meters till 3600 meters in Himalayas are dominated by Alpine Forests. These are largely covered with dense shrubby forest of Silver firs, Junipers, Pine and Rhododendron. The trees turn dwarfy and stunted as a result of growing in higher altitude. Temperate grasslands that existed earlier have been gradually replaced by pastures. The drier areas of Kullu and Kangra have xerophytic variants along with sub-tropical species.

ii. Southern Mountain Forests: Southern Mountain Forests too can be classified into two distinct groups. The Wet Hill Forests and the Wet Temperate Forests. Wet Hill Forests: are found over the Nilgiris and Palani hills in the south at elevation between 1070 to 1525 meters. The species are stunted versions of the rainforests. Wet Temperate Forests: These forests may be found in slopes above 1500 meters in Nilgirs, Palani and Anaimalai. The local name of these forests is 'Sholas'. The Shola forest is dense with a lot of under growth accompanied with ferns, mosses and epiphytes. Magnolia, Laurel, Elm are important species found in these forests.

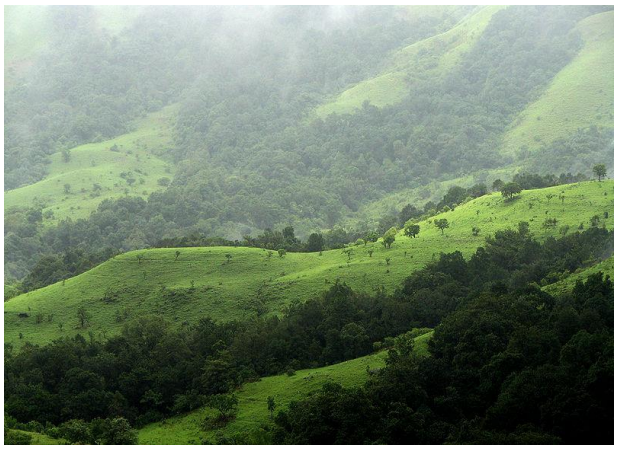

Image:17. Shola Forest and Grasslands

Source:https://upload.wikimedia.org/wikipedia/commons/3/3c/Shola_Grasslands_and_forests_in_the_Kudremukh_National_Park%2C_Western_Ghats%2C_Karnataka.jpg

5. Littoral and Swamp Forests: Littoral and Swamp forests are one of the most specialized Tropical natural vegetation types. India has a rich variety of Wetland habitats. Wetlands develop under specific hydrological regimes. Wetlands are lands transitional regions between terrestrial and aquatic systems where the water table is usually at or near the surface of the land is covered by shallow water. Wetlands must have the following attributes:

a. At least periodically the land supports hydrophytes
b. The substrate is undrained hydrate soil
c. The substrate is non-soil and is saturated with water or covered with shallow water

Definitions:

Hydrophyte – plant that grows partly or wholly in water

Substrate- is non-soil with water or covered with shallow water

Hydrate Soil – soil saturated with water

The following chart shows the types of wetlands that are found in India.

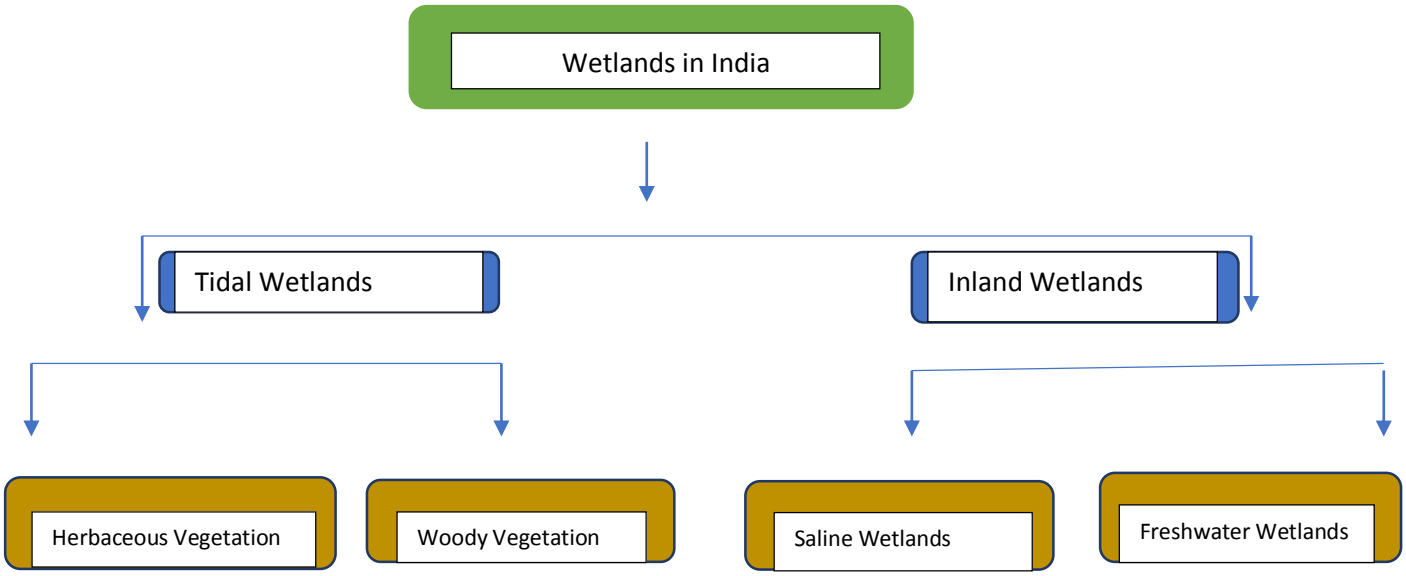

Image 18: Flowchart showing Different types of Wetlands found in India.

The different types of wetlands that have been shown in the flowchart above develop under specific hydrological regimes.

Although a few freshwater sites were listed in Project Aqua, it was only after India became a signatory to the Ramsar Convention in 1981, that efforts were made to prepare a comprehensive inventory on wetlands.

Ramsar Convention

The Ramsar Convention on Wetlands of International importance especially as Waterfowl Habitat is an international treaty for the conservation and sustainable use of wetlands. It is also known as the Convention on Wetlands. It is named after the city of Ramsar in Iran, where the Convention was signed in 1971.

The table below shows the list of wet lands in India that have been indentified by the Ramsar Convention.

1	Wular lake	Jammu
2	Hokersar	Jammu
3	Surinsar- Mansar Lakes	Kashmir
4	Tsomoriri	Ladakh
5	Chandra Taal	Himachal Pradesh
6	Pong Dam Lake	Himachal Pradesh
7	Renuka Lake	Himachal Pradesh
8	Harike Wetland	Punjab
9	Kanjli Wetland	Punjab
10	Ropar Wetland	Punjab
11	Nangal Wildlife Sanctuary	Punjab
12	Beas Conservation Reserve	Punjab
13	Keshopur-Miani Community Reserve	Punjab
14	Upper Ganga (Brijghat to Narora stretch)	Uttar Pradesh
15	Nawabganj Bird Sanctuary	Uttar Pradesh
16	Parvati Agra Bird Sanctuary	Uttar Pradesh
17	Saman Bird Sanctuary	Uttar Pradesh
18	Samaspur Bird Sanctuary	Uttar Pradesh
19	Sandi Bird Sanctuary	Uttar Pradesh
20	SarsaiNawarJheel	Uttar Pradesh
21	Keoladeo National Park	Rajasthan
22	Sambhar Lake	Rajasthan
23	Nalsarovar Bird Sanctuary	Gujarat
24	Bhoj Wetland	Madhya Pradesh
25	NandurMadhameshwar Bird Sanctuary	Maharashtra
26	DeeporBeel	Assam
27	Loktak Lake	Manipur
28	Rudrasagar Lake	Tripura
29	East Kolkata Wetlands	West Bengal
30	Sundarban Wetland	West Bengal
31	Chilika Lake	Odisha
32	Bhitar Kanika Mangroves	Odisha
33	Kolleru Lake	Andhra Pradesh
34	Point Calimere Wildlife & Bird Sanctuary	Tamil Nadu
35	Ashtamudi Wetland	Kerala
36	Sasthamkotta Lake	Kerala
37	VembanadKol Wetland	Kerala

The type of natural vegetation found in deltaic regions are called mangoves. On the tide washed coasts where mud and silt have accumulated, dense mangrove forests grow which have peculiar characteristics. The trunk of the Mangrove tree is supported by stilt like structured root systems.

When the high tide inundates the forest floor, these stilt-like roots get submerged under water. The seaward channels and islands of deltas of the Ganga, Mahanadi, Godavari and Krishna are lined with belts of dense tidal forests which grow in brackish as well as fresh water. The great Sundarbans delta is covered by sundari trees which provide hard durable timber is used for construction and building purposes. Canes and palms are also found in low swamps.

Image 19: Sundari Tree

Source: https://commons.wikimedia.org/wiki/File:Sundarbans_02.jpg

Wetlands in India have co-evolved along with human involvement in the habitat and role of human beings in shaping the wetlands cannot be overlooked.