



Genome of Salt-secreting Mangrove Species Decoded

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Why in News

Recently, the scientists for the first time have decoded the reference-grade whole **genome sequence** of a highly salt-tolerant and salt-secreting mangrove species, *Avicennia marina*.

This study was led by the **Department of Biotechnology (DBT)-Institute of Life Sciences, Bhubaneswar**.

Key Points

- **Avicennia Marina:**
 - It is **one of the most prominent mangroves species** found in all mangrove formations in India.
 - It is a **salt-secreting and extraordinarily salt-tolerant mangrove** species that grows optimally in 75% seawater and tolerates >250% seawater.
 - It is **among the rare plant species, which can excrete 40% of the salt** through the salt glands in the leaves, besides its extraordinary capacity to exclude salt entry to the roots.
 - It is also **referred to as grey mangrove or white mangrove**.
- **Significance of Study:**
 - This study assumes significance as **agriculture productivity globally is affected due to abiotic stress factors** such as limited water availability and salinization of soil and water.
 - Availability of water is a significant challenge to crop production in dryland areas, accounting for 40% of the world's total land area.
 - Salinity is prevalent in 900 million hectares globally (with an estimated 6.73 million ha in India), and it is estimated to cause an annual loss of 27 billion USD.
 - The genomic resources generated in the study **will pave the way for researchers to study the potential of the identified genes for developing drought and salinity tolerant varieties** of important crop species of the coastal region that is significant for India with 7,500m of coastline and two major island systems.

Mangrove

- **About:**

- A mangrove is a **small tree or shrub that grows along coastlines**, taking root in salty sediments, often underwater.
- The word 'mangrove' **may refer to the habitat as a whole or to the trees and shrubs** in the mangrove swamp.
- Mangroves are **flowering trees, belonging to the families** Rhizophoraceae, Acanthaceae, Lythraceae, Combretaceae, and Arecaceae.

- **Features of Mangroves:**

- **Saline environment:** They can survive under extreme hostile environments such as high salt and low oxygen conditions.
- **Low oxygen:** Underground tissue of any plant needs oxygen for respiration. But in a mangrove environment, the oxygen in soil is limited or nil. Hence the mangrove root system absorbs oxygen from the atmosphere.
 - Mangroves have special roots for this purpose called **breathing roots or pneumatophores**.
 - These roots have numerous pores through which oxygen enters the underground tissues.
- **Succulent leaves:** Mangroves, like desert plants, store fresh water in thick succulent leaves.

A waxy coating on the leaves seals in water and minimises evaporation.
- **Viviparous:** Their seeds germinate while still attached to the parent tree. Once germinated, the seedling grows into a propagule.

The mature propagule then drops into the water and gets transported to a different spot, eventually taking root in a solid ground.

- **Threat:**

- **Constructions:** At least one third of all mangrove forests has been lost during the last few decades. Coastal development, including construction of shrimp farms, hotels, and other structures, is the primary threat to mangroves.

Mangrove forests are cleared to make room for agricultural land and human settlements.
- **Overharvesting:** Mangrove trees are used for firewood, construction wood, charcoal production, and animal fodder.

In some parts of the world, there has been overharvesting which is no longer sustainable.
- **Others:** Overfishing, pollution, and rising sea levels are the other threats to mangrove forests and their ecosystem.

- **Area Covered:**

- **Global:** Mangroves can be found in over 118 countries and territories in the **tropical and subtropical regions** of the world.
 - **Asia** has the **largest coverage of the world's mangroves**, followed by Africa, North and Central America, Oceania and South America.
 - Approximately 75% of the world's mangrove forests are found in just 15 countries.
- **India:**
 - According to the **State of Forest Report 2019**, mangrove cover in the country is 4,975 sq km, which is **0.15%** of the country's total geographical area.

Mangrove cover in the country **has increased by 54 sq km (1.10%)** as compared to the previous assessment (2017).
 - The deltas of the **Ganges, Mahanadi, Krishna, Godavari**, and the **Cauvery** rivers contain mangrove forests.
 - The **backwaters in Kerala** have a high density of mangrove forest.
 - The **Sundarbans** in West Bengal is the largest mangrove region in the world and a **UNESCO World Heritage Site**.

It spans from the **Hooghly River** in West Bengal to the **Baleswar River** in Bangladesh.
 - The **Bhitarkanika mangrove system** in Odisha is India's second largest mangrove forest.
 - **Pichavaram in Tamil Nadu** has a vast expanse of water covered with mangrove forests. It is home to many aquatic bird species.
 - **West Bengal** has **42.45%** of **India's mangrove cover**, followed by Gujarat 23.66% and A&N Islands 12.39%.

ECOSYSTEM SERVICES

The benefits people derive from mangroves



Wood

Its density makes mangrove wood a valued source of timber and fuel



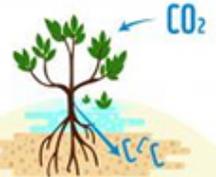
Livelihoods

120 million people living near mangroves¹



Mangrove ecosystem services

Worth US\$ 33,000–57,000 per hectare per year¹
x 14 million hectares²
= up to **US\$ 800 billion** per year



Climate regulation

Carbon storage potential of mangroves is **3–5x higher than that of tropical upland forest** due to strong carbon storage in the soil³; CO₂ released by global mangrove loss annually could be as high as the annual emissions of Australia⁴⁻⁵



Coastal protection

Restoring mangroves for coastal defence up to **5 times more** cost-effective than "grey infrastructure" such as breakwaters⁹



Water filtration

2–5 hectares of mangroves may treat the effluents of **1 hectare of aquaculture**⁸



Tourism

There are over **2,000** mangrove-related attractions globally, such as boat tours, boardwalks, kayaking and fishing⁷



Fisheries

More than **3000 fish species** are found in mangrove ecosystems⁶



Source: PIB