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ENDANGERED DUNE ECOLOGY WITH ITS RISKY PHYTO-RESOURCES – A RED ALARM TO MANDERMONI-TAJPUR SECTOR OVER MIDNAPORE COAST IN WEST BENGAL

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ABSTRACT

The inherent natural systems of the coastal zone and examples of changes in their state, at least at local levels, are recognized in the scientific arena and across much of the wider community. The entire spectrum of coastal habitats – coral reefs, mangroves and tropical wetlands, sea grass systems, rocky shores and estuaries, salt marshes and sand dune communities, coastal forests and woodlands, estuarine and deeper shelf communities – are subject to pressures from humans and natural changes. Coastal dunes are characterized by a high ecological diversity, which is the result of a wide set of geomorphological features, environmental heterogeneity, and species variability. These ecosystems have a worldwide distribution covering almost all latitudes from tropical to polar. Sand dunes are natural guard wall and also natural purifier at coastline throughout the world. The sand dune constitutes different types of plants as well as phyto-resources with different habits but moreover all of the plants having stress tolerance capabilities and more or less soil binding capacity. However, in spite of this global abundance and their ecological and economic relevance, coastal dunes have been substantially altered by human activities, and many are already severely and irreversibly degraded. So, the sand dune demands immediate attention for conservation as the vegetation is going towards destruction due to the development and other anthropogenic activities along the coastal areas. The sand dune also needs further study as several morphological geo-environmental, chemo-taxonomical variations are already been observed under different physiological conditions.

This paper reports some preliminary study on the morphology and species found within the sand dune (including habit, habitat, morphological features, flowering time, floral biology, and some geo-environmental studies) along the coastal segments of Mandermoni and Tajpur over Midnapore coast in West Bengal. These coastal sand dune floras under tremendous anthropogenic pressure due to rapid elimination of sand dunes and its associated vegetations and because of this traditional knowledge with them, is also gradually diminishing. Such sensitive and useful ecosystems need immediate restoration, conservation actions and sustainable use of phyto-resources. Reasons behind the destruction of the sand dunes have been studied and the strategies have also been proposed for possible conservation and implementation of the sustainable use of sand dune vegetation in coastal areas for the benefit of farmers particularly for food, fodder and health aspects because, coastal dune floras have immense effect in dune stabilization and restoration. This paper depicts the composition and distribution of coastal sand dune floras including a total of 46 species surveyed during 2013 – 2016 using geo-ecological methodology along with direct interviews with ethnic groups adjacent to the dune vegetation, native traditional healers, Ayurvedic practitioners and botanists dealing with medicinal wild plants in selective coastal segments of Purba Medinipur. Finally, here, we attempt to address the issue and summarize the developments for dune sustainability as well as coastal stability from research efforts over the time, especially on drivers and pressures of change, and provide recommendations for focusing future research.

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INTRODUCTION

The coastal sand dunes (CSD) are unique and dynamic ecosystems between marine and terrestrial realms. They are the coastal armouring with bind of biota and sand grains. The

coastal sand dune flora has ecological significance and socio-economic values. Thus the present study provides the Phytoresources of coastal sand dune flora with reference to ecological, economic and medicinal importance of each plant species. Altogether a total of 103 species belonging to 94

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genera 37 families was recorded during November 2010 to December 2014. The survey has been done by adopting appropriate methodology by conducting direct interviews and information gained from native villagers of traditional base and Ayurvedic practitioners. As per distribution of sand dune flora is most abundant and richness in species composition at leeward dunes (37%) rather than hinterland dunes (28%), foredunes (18%) and marshy/saline areas (17%). In view of the greater ecological significance and socio-economic importance conservation management plans have been suggested for the protection, of this importance of sand dune flora of Visakhapatnam coast from natural and anthropogenic threats i.e. coastal erosion, cyclonic storms, developmental recreational projects. Sand dunes the very words conjure up images of vast seas of shifting sand barren of plants and hostile to human's habitation. In the Visakhapatnam, sand dunes are playing vital role like a coastal barriers. These are covered more by grasses and shrubs. Because of their unique characteristics dune areas have drawn the attention of many kinds of people. CSDs are dynamic, but fragile buffer zones of sand and vegetation are formed, where the following three characteristics can be found: large quantities of sand, persistent wind capable of moving the sand and suitable locations for sand to accumulate [11] Many plant species are able to colonize supralittoral sands, despite initially poor nutrient conditions, lack of moisture, and sometimes very high temperatures. Such colonization may, on sheltered beaches, begin at or just above the strandline - aided by accumulations of wrack and tidal litter, which reduce the sand temperature and increase its moisture content.

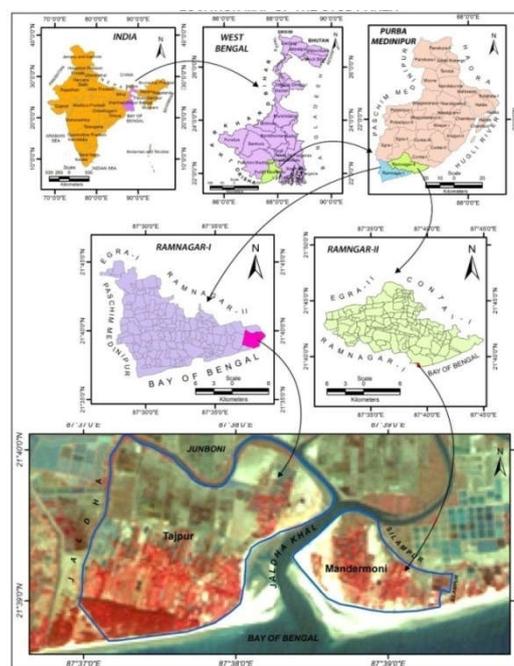
The sand dune floras are extremely important resources, which play a vital role in the medicinal, economic and social life nearby people. Higher up the shore, perennial grasses may be able to establish themselves, acting as a sand trap that may result in the establishment of a fore dune a meter or two in height. This ability to bind sand depends on the development of extensive horizontal and vertical rhizome systems. Much of the vegetation is found on coastal dunes and thus an understanding of their morphology is important. Coastal sand dunes (CSD) are unique and dynamic ecosystems between marine and terrestrial realms. They are the coastal armouring with bind of biota and sand grains. This CSD flora has not only medicinal value but also maintain the coastal and marine niche. These habitats have been severely affected by natural and anthropogenic activities resulting in loss of habitat and dependent flora and fauna thus such unique ecological systems have to be protected from degradation in order to conserve their native diversity and ecological functions.

The role of vegetation in dune formation is critical and is that of a wind trap, sand binder and dune stabilizer (Wagner 1964; Dahm et al. 2005). The foliage of dune plants breaks wind activity leading to less erosive activity on the lee side (Chapman 1976). Pioneer zone, intermediate zone and back zone / forest zone were recognized earlier in coastal dunes and later several workers found shore, fore dune, main dune with wind ward and lee ward slopes, wet dune slacks and back dunes with plateaus, holes that supporting grasslands scrub forests, thus portraying complex ecosystem diversity (Woodhouse 1978; Hesp 2004). Temperate coastal dunes are well studied and documented (Koske and Gemma 1997; Sridhar and

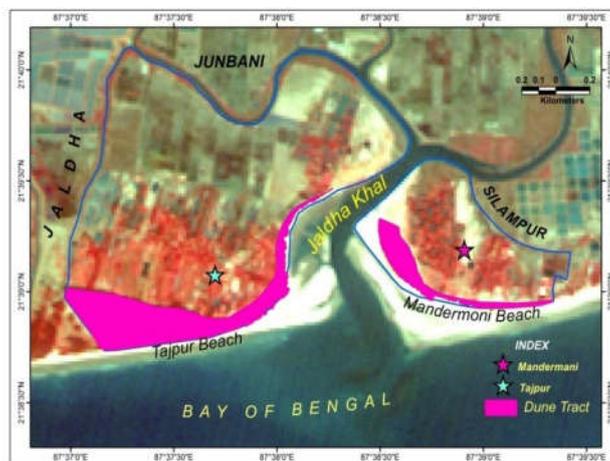
Bhagya 2007) as compared to studies on tropical coastal dunes (Kulkarni et al. 1997; Sridhar and Bhagya 2007).

The Ecological roles and functions of coastal dunes include: essential store of sediments, protecting the land behind them from storm erosion and potential sea level rise; filter for rainwater and groundwater and in some situations, provided aquatic habitats such as dune lakes; protection of islands from storm surges, hurricanes and erosion; trapping of the windblown sand and prevention of sand being blown further inland by the vegetation; habitats for specially adapted plants, birds, and animals-several of which are now rare or endangered; a range of unique landforms and processes which have intrinsic value and are of scientific interest; and nesting sites for sea turtles and birds. This paper aims to generate a baseline data on coastal sand dune vegetation in the Midnapore coast, with special reference to Tajpur-Mandermoni coastline.

Geographical location of the Study Area



Map No 1 Location Map of the Study Area



Map No 2 Coastal Dune Tract of Mandermoni-Tajpur Tourism Sector

India is blessed by a long shoreline enclosing the Nation from three sides- East, South and West. Compared to the western part, the eastern coast of the Indian subcontinent, experience

lots of dynamism in terms of the coastal stability (Chatterjee, 1995). West Bengal has a substantially long coastline of almost 325 kilometers (including islands) characterized by high floral and faunal biodiversity, diverse geomorphic features and anthropogenic intrusions (Bhattacharya, 2001, Bhattacharya *et al.*, 2003). The area selected for this study is Mandermoni-Tajpur Coastal Sector, the part of this extensive shoreline of Bay of Bengal along the West Bengal coast. The Bengal coastal stretch is about 50-60 km long extending from Talsari to Khejuri including Digha-Sankarpur tract, the Pichhabani inlet, Tajpur-Mandarmani coast, Dadanpatrabar-Junput sector and Hijili-Khejuri segment, which is known for straightness of the coastline, flatness and compactness of the beach (Gupta, 1970). This region is traversed by two irrigation canals viz. Khadalgobra and Ramnagar Canals, which jointly discharge water into the sea at the point known as Digha Mohana, as a result of which an estuarine zone is created in this area. The Midnapore Coast is also discontinued by Jatranala, Pichhabani and Jaldha inlets. About 40km east from Digha town near Nij Kasaba(Khejuri), is Rasulpur river which opens onto the Hooghly estuary. Geographically this vast coast line contains a great geomorphic and biochemical diversity in respect of landforms, soil texture, marine plants and animals. The latitudinal and longitudinal stretch of Mandermoni-Tajpur coastline is about 21°38'30"N to 21°40'00"N and 87°30'00"E to 87°39'30"E respectively.

Geomorphological Processes of Coastal Sand Dune System

- The lithosphere and the processes that occur within it is the dominant sphere operating in the accretion cycle on Coastal Sand Dunes
- The significance of the lithosphere is demonstrated by the fact that the the name of this ecosystem, sand dune, is named after the lithosphere component rather than the dominant vegetation.
- The diagram below shows the different zones that make up the lithosphere on Coastal Sand Dunes.

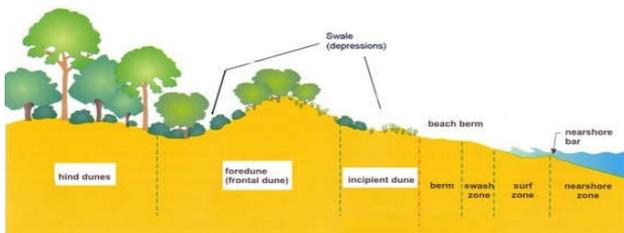


Figure 1 Geomorphological Zones of the Coastal Sand Dune System

- The major component that makes up the material for the accretion cycle to operate on Coastal Dune Systems is sand.
- One source of sand is calcium carbonate which comes from the shells of dead sea animals.
- However, the major source of sand is the material that has been weathered and eroded from rock elsewhere.
- The source originates from inland an area which is transported by rivers whilst the other source comes from coastal cliffs which are bombarded by waves and moved by currents.
- Thus, weathering and erosive processes that occur in the lithosphere are important functions in the development of Coastal Sand Dunes.

Sand dune formation

- The formation of dunes is a dynamic (constantly changing) process.
- Sand is eroded from dunes by storms, wind and waves.
- To maintain the sand budget, sand also accretes (collects) on dunes.
- Plants have an important role to play in this process.

Biogeographical Processes of Dune Ecology

Colonisation and Succession on Coastal Dune Systems

Colonisation is the first organisms to inhabit a bare patch of the lithosphere. Succession is the sequence of organisms that succeed after each other in an ecosystem until it reaches a climax community. Most Dune vegetation has started in the same humble way. A stray piece of floating vegetation is deposited high above the tide line onto the berm or sand ridge by a storm; it might be a straggle of seaweed or parts of a mangrove plant, small potential nuclei for the seeding of a dune. Trapped by drying sand around them they in turn become catchments for further windblown sand that eventually creates a tiny mound around it: a mini dune.

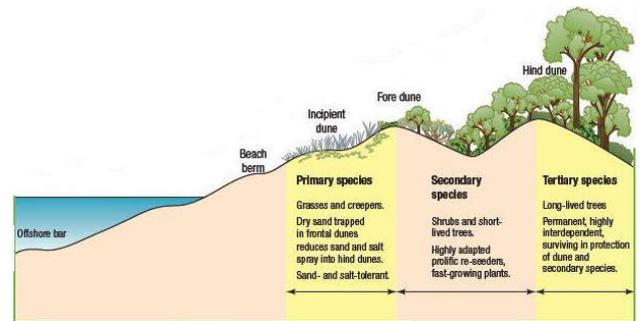


Figure 2 Colonization and Succession on Coastal Dune System

The sea weed brings with it passengers that feed on the tiny algae attached to its surface. Sea birds come together on bare areas like beaches on which they rest from the harsh coastal conditions. These are spots, especially if there are raised areas where they can detect predators easily. They also like to eat small crustaceans.

The little mound now receives bird droppings rich in nutrients such as nitrates and phosphates, good plant food. Inevitably some of these beach "pimples" will stop the wind blowing tumble weeds, which often carry the seeds of resilient grasses called spinifex. Soon after, it germinates to establish a root hold and spreads web like rhizomes (creeping stems) to capture the mound and other rolling tumble weeds in it's first act of sand stabilisation and dune formation. These are the pioneer colonisers of sand dunes and are the primary species in the succession process.

The mini dunes around are joined together by the hopping action of wind blown beach sand (called saltation) birds, debris from storm and those amazing sand holding grasses that are around all year round (perennial) called Spinifex improves local conditions for other binders such as pig face and the goatsfoot vine to join the battle for stabilisation. Together with time, isolation and minimal interference they help create the first thin skin of coastal protection called a primary dune. This

primary vegetation is the foundation and gives the stability for other vegetation to build up on.

This whole evolutionary give and take processes of dune formation and its protective establishment and sustenance of

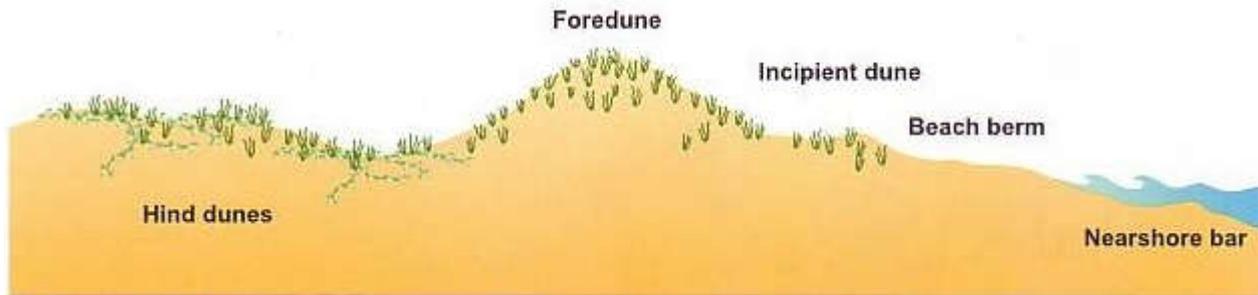


Figure 3 Stage-I of Succession (Primary Species: Grasses and Creepers)

Overtime, and with the help of the prevailing south easterly wind, the sand spinifex accumulate to form a green fuzzy ridge. This creates a low natural wall of defense (incipient fore dune and fore dune) against intense invasion from the sea. Behind this wall a snug valley, called a swale, nurtures conditions for nutrients to build up and other plants to develop. The salt and wind loving pioneers of the fore dunes that helped establish this swale now gives to new varieties of plants. Low sand holding shrubs like coastal acacias and banksias which have evolved to be able for growing in areas with poor soils and accumulating phosphates and adaptations against salt wind and severe dehydration.

developing coastal forest is called succession, the journey of the dune.

The Vegetation Zones

On dune systems that have had minimal human impact there has been distinctive vegetation zones observed.

- This zonation resembles SUCCESSION and is a classic Biogeographical process.
- The geomorphological zones and the vegetation zones are closely related.

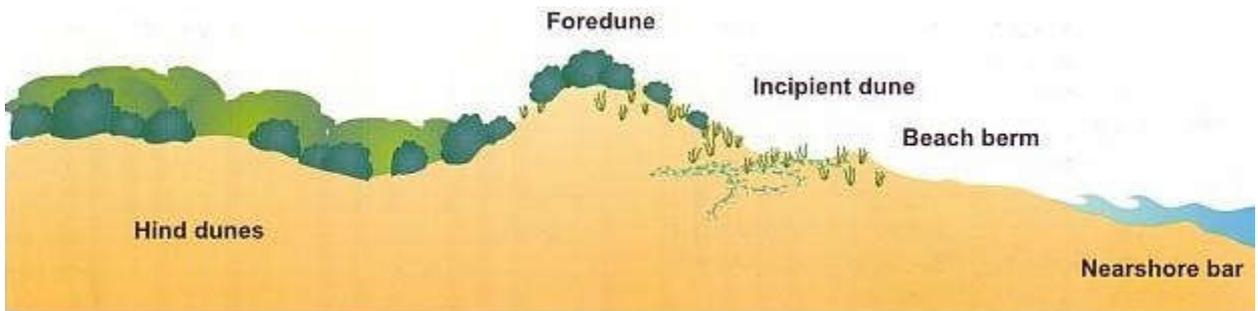


Figure 4 Stage-II of Succession (Secondary Species: Shrubs and Short-lived Trees)

Meanwhile in front of the primary dune new mini dunes continue to form. Overtime the sea levels drop and the old fore dunes are becomes the hind dunes which is a highly vegetated sand hill called a secondary dune. As sea levels continue to drop over the last glacial period, tertiary dunes form. The original dune has become a biodiversed coastal forest.

Vegetation as a Wind Barrier

- Another role vegetation plays in the accretion cycle is wind protection, especially for the not so resilient Hind Dune vegetation.

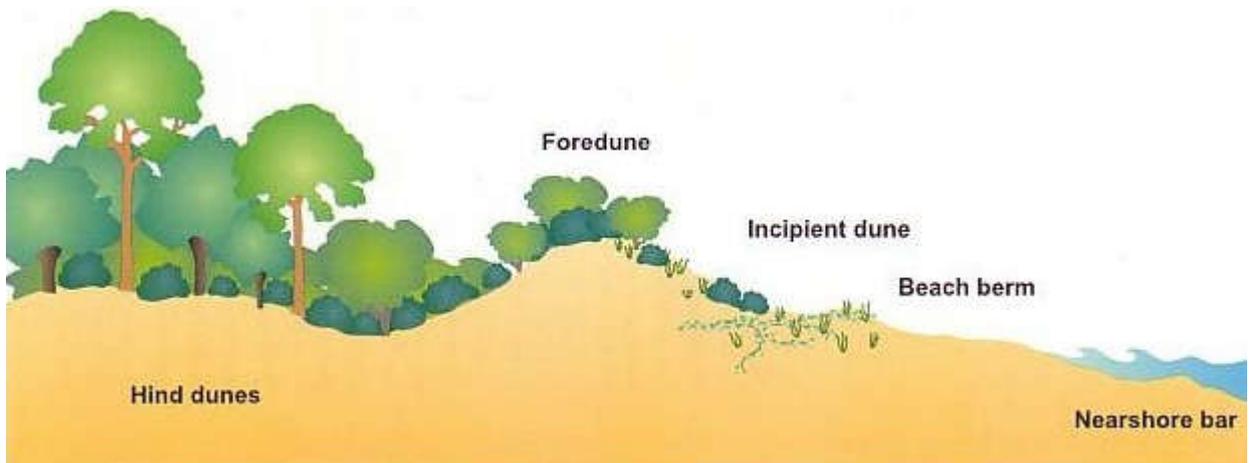


Figure-5 Stage-III of Succession (Tertiary Species: Long-lived Trees)

Table 1 Relation among Geomorphological Zonation, Vegetation Zonation and Biogeographical Processes

Geomorphological Zone	Vegetation Zone	Invasion, succession and resilience
Incipient Fore dune	Primary Vegetation Zone	The first plants to colonize the harsh incipient fore dune area are primary species. These specialized plants have become resilient to salt spray, sand blasting from strong winds and the occasional bombardment by waves. Examples at Stockton include the introduced marram grass, sand spinifex and various species of pig face. The strong root systems of the low-growing plants play a role in stabilizing the incipient fore dune and fore dune zone. The plants can withstand burial and have deep roots.
Fore dune	Secondary Vegetation Zone	The Fore dune area vegetation contains secondary species. These are usually shrubs and small trees and these help stabilize the Fore dune sand mass. Species such as Banksias are native at Stockton.
Hind Dune	Tertiary Vegetation Zone	In this vegetation zone trees tend to dominate. Here the vegetation is protected from the wind and salt spray, and the soils are characterized with organic matter (humus). The type of vegetation depends on the local climate.

- Wind generally blows in from the ocean. The first wall of defence is the primary vegetation found on the incipient fore dune. The grasses try and hold much of the sand in place.
- The next line of defence is the secondary vegetation on the fore dune. This is made up of sturdy shrubs that are resilient to the salty wind. The wind is deflected up and over fore dune to move much of the strong salty wind over the not so resilient vegetation in the hind dune area.
- The figure below highlights how the different vegetation zones work as a wind barrier.

Vegetation Zonation

The aggregation of plants on coastal sand dunes forms, in general, three zones of vegetative cover:

1. **Pioneer stage:** A pioneer zone with primary stabilizing plants consisting mainly of herbaceous species. Seeds are blown in by the wind or washed in by the sea. The rooting conditions are poor due to drought, strong winds, salty seawater immersion and alkaline conditions created by sea shells. The wind moves sand in the dunes and this allows rainwater to soak through rapidly.

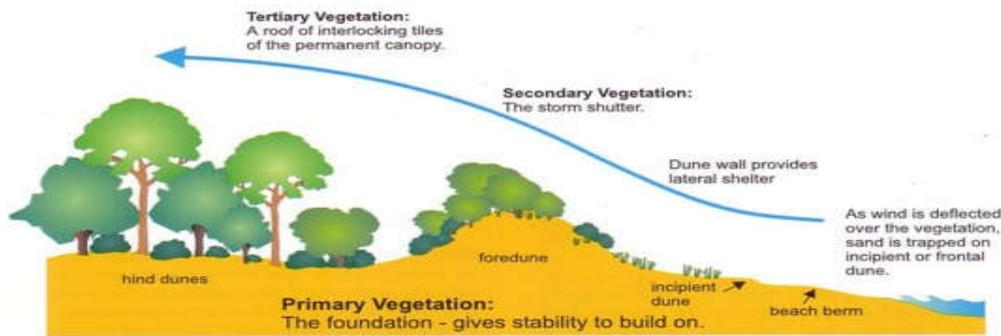


Figure 6 The Foundation of Vegetation for the Stability of Coastal Sand Dune System

Table 2 Dune and Vegetation Characteristics with Dune Morphology

Characteristics	Mobile Dunes		Fixed Dunes		Woodlands
	Embryo and Fore Dunes	Yellow Dunes	Grey Dunes	Dune Slack	
Dune Characteristics	<ul style="list-style-type: none"> • On shore winds, • Seaweeds (humus build up), • Sand building up, • Transient, • Alkaline Sand, etc. 	<ul style="list-style-type: none"> • Surface continually blown away and replenished by fresh sand • Reduced wind speed • Top of dunes above high tide level • Salt intolerant, • Thrives on being buried by sand, • In rolled leaves, • Underground rhizomes to stabilize sand. 	<ul style="list-style-type: none"> • Increased humus contents, • Surface lichens, • Sand no longer accumulating • Marram grass not able to compete well 	<ul style="list-style-type: none"> • Damp, low lying hollows, • High water table in winter, • Soil acidic and pH variable 	<ul style="list-style-type: none"> • Acid soil and increased organic matter content, • Nutrient rich, • Shelter developed
Vegetation Characteristics	<ul style="list-style-type: none"> • Scattered individuals, • Low growing prostrate habitat, • Waxy leaves, • Salt tolerant. 	<ul style="list-style-type: none"> • Many plants now co-exist, • Mainly perennial, • Stabilizing plants liking increased organic matter content 	<ul style="list-style-type: none"> • Moisture loving plants 	<ul style="list-style-type: none"> • Acid loving plants co-existing, • Woody perennial plus understory species. 	

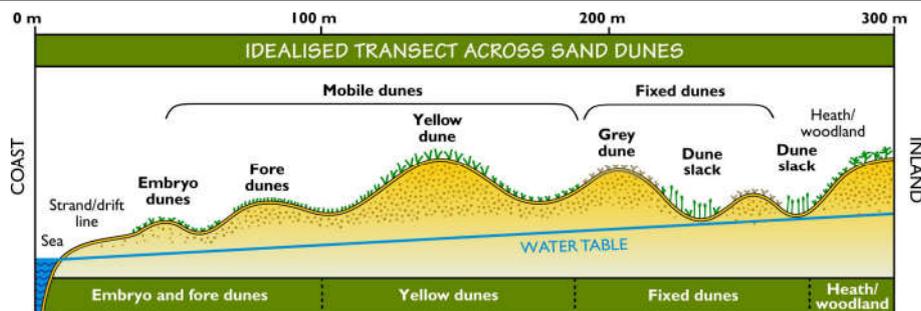


Figure 7 Idealized Transect across Coastal Sand Dune

2. **Building stage:** A woodland (or scrub) zone with secondary stabilizing plants consisting of shrubs, vines, stunted trees and a few associated herbs and grasses. Plants trap sand and grow with it, binding the sand together with their roots. The humus created by decaying pioneer plants creates more fertile growing conditions, and the soil becomes less alkaline as pioneer plants grow and trap rainwater less hardy plants can now grow and start to shade out the pioneers. As plants colonize the dunes, the sand disappears and the dunes change colour - from yellow to grey.
3. **Climax stage:** Taller plants (such as trees) and more complex plant species (like moorland heathers) can now grow. Plants from earlier stages die out because of competition for light and water. When the water table reaches, or nearly reaches the surface, dune slacks can occur. Plants which are specially adapted to be water-tolerant grow here. A forest (or coastal heath zone with tertiary stabilizing plants composed of low shrubs and stunted trees) variation in vegetation zonation landward across coastal sand dunes is associated with decreases in the degree of exposure to salt spray, strong winds and sandblast, and with improvement in the nutrient status and moisture content of developing dune soils.

Major Sand Dune Ecosystem Services

Table 3 Major Sand Dune Ecosystem Services in the Study Area

Major Sand Dune Ecosystem Services	Sub-services		
1. Provisioning Services	Fresh water	Drinking water Irrigation	
		Food (e.g. crops, fruit, fish)	
	Fibre and fuel (timber, wool, etc.)	Grass/reeds Wool Timber	
		Breeding stock	
	Genetic resources	Biochemicals, natural medicines, pharmaceuticals	
	Ornamental resources (e.g. shells, flowers, etc.)		
	2. Mineral extraction	Sand extraction	
		3. Landscape suitable for industrial use	Fishing, Fish Farming, Fish Frying & Manufacturing
	Air quality regulation		
	4. Regulating Services	Climate regulation (local temperature/precipitation, GHG sequestration, etc)	
Water regulation (water storage, recharging and discharging)			
Natural hazard regulation (i.e. storm protection)			
Pest regulation			
Disease regulation			
Erosion regulation			
Water purification and waste treatment		For drinking water Purification of groundwater	
5. Cultural Services		Pollination	
		Cultural heritage	
		Recreation and tourism	
	Aesthetic value		
	Spiritual and religious value		
	Inspiration of art, folklore, architecture, etc.		
6. Supporting Services	Social relations (e.g. fishing, grazing or cropping communities)		
	Educational resource		
	Soil formation		
	Primary production		
	Nutrient cycling		
	Water recycling		
7. Supporting Services	Photosynthesis (production of atmospheric oxygen)		

Roles of Dune Vegetation/ Flora

Dune vegetation is pretty amazing!

What can dune vegetation do?

- Reduce wind erosion by decreasing wind speed at ground level.
- Build up sand dunes, reducing the amount of damage during a storm.
- Reduce wave erosion.
- Tolerate a hostile environment of high winds, salt spray, sand blast, covering by sand, sandy soil and little water.

Importance of fore dune plants

- Fore dune plants like *Spinifex sericeus* and *Ficinia spiralis*, trap wind-blown sand in the fore dunes.
- This sand serves as a reservoir for the beach during periods of wave erosion.
- In the absence of sand trapping dune vegetation, wind-blown sand from the beach moves inland and is lost to the beach/dune system.
- Sand remains mobile and loose in the system, so can be moved along the beach in long shore drift currents.

Plants behind the fore dune

- The area behind the fore dune is sometimes called the mid or back dune (shown as Zone B, C or D in the diagram).
- Plants here gradually replace the fore dune plants as soil conditions improve and conditions become less harsh (e.g. decreased exposure to salt spray and sand blast).
- These plants play a lesser role in dune formation.

In severe storms dune plants sometimes get washed away. It's a natural part of the dune formation process. Their remnants are left to re-grow.

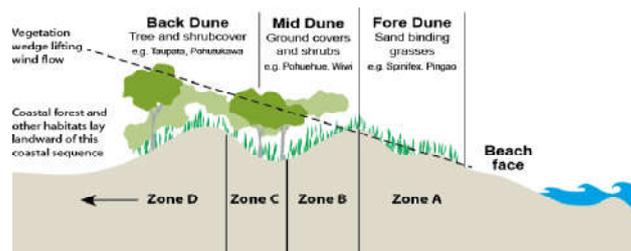


Figure 8 Vegetation Zones across the Coastal Dune Ecosystem

Maintaining the sand budget

Keeping sand dunes healthy means the sand budget needs to be maintained-plants are an important part of this process.

The natural storm cut and beach recovery processes

Post storm recovery is aided by sand binding plants colonizing the dune scarp, trapping wind-blown sand to repair the dune. Healthy dunes with good vegetation can buffer the effects of storms

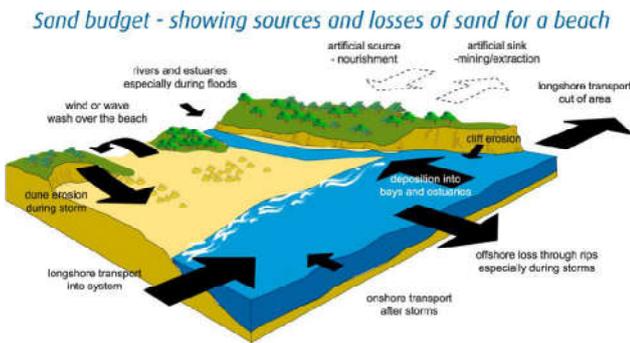


Figure 9 Dune Vegetation to maintain the Sand Budget

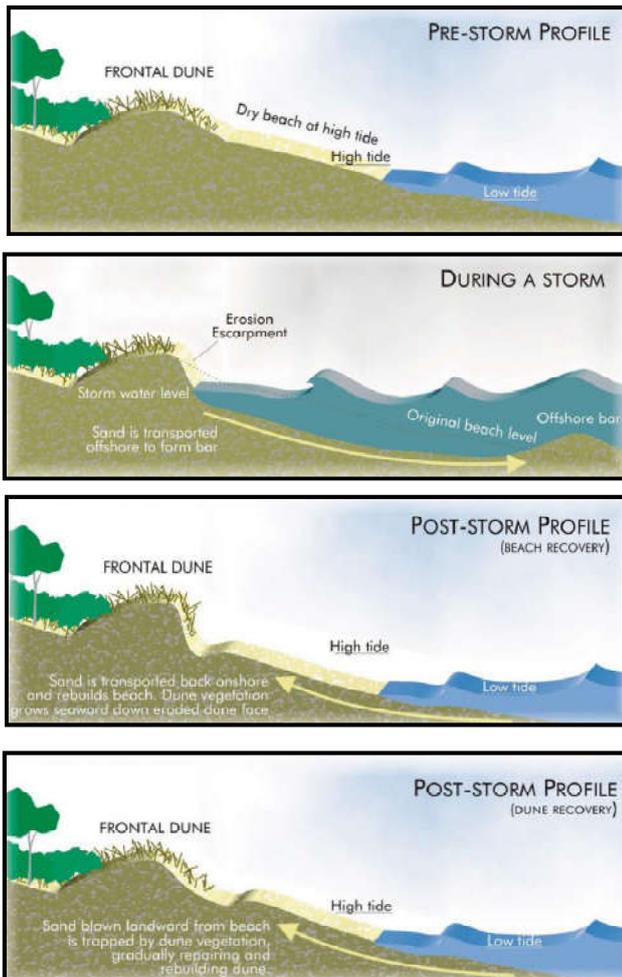


Figure 10, 11, 12 & 13 The natural storm cut and beach recovery processes by dune vegetation

Importance of Dune Phyto-resources

46 plant species have been listed in the following table. Most of the plants are natural. Some are manmade. Some manmade plants have become natural like *Acacia moniliformis*, *Anacardium occidentale* & *Casuarinas equisetifolia*. Plants of sand dune have significant role in ecosystem. A prominent plant succession is found on sand dune and sand dune vegetation has a great role to stabilize sand dune. *Cynodon dactylon*, *Indigofera dendroides*, *Ipomoea pes-caprae*, *Lippia nodiflora*, *Evovulus nummlarius* & *glycosmis pentaphylla* are the main sand dune stabilizer. Main business of Digha, Sankarpur, Mandarmoni is hotel marketing. The byproduct of tourism and hotel marketing is pollution, mainly plastic

pollution. There are no proper waste management system and drainage system.

Table 4 Ability and Inability of Coastal Sand Dune Vegetation

Dune vegetation can	Dune vegetation cannot
prevent wind erosion by decreasing wind speed at ground level	prevent direct wave erosion – dune sand is not strongly bound by roots under wave attack
build up sand dunes and thus reduce the extent of recession produced by a storm	survive direct wave attack – much of the seaward vegetation will be destroyed in a storm
reduce wave erosion caused by over wash where dense vegetation exists	tolerate excessive physical damage caused by people, stock or vehicles
regenerate naturally after storm damage, where dune management allows	tolerate mismanagement such as mowing, which destroys some species and juveniles of others, and top soiling, which prevents free drainage and is unsuitable for growth of many natural dune species
tolerate a hostile environment of high winds, salt spray, sandblast, covering by sand, sandy soil and little water	tolerate overfertilising, which can be toxic to some species
accept massive movements of the dunes, both vertically and horizontally	tolerate introduction of unsuitable plant species – some undesirable plants as palm trees, do not reduce wind erosion and accelerate wave erosion when they fall
function as a self-supporting community where plants are mutually dependent for protection and nutrient supply	tolerate burning, Beach mining, farming including grazing stock on the beach
provide habitat and increase biodiversity	tolerate residential development too close to the beach
	tolerate recreational activities such as 4-wheel drives and sand boarding

So it is threat to ecosystem. Illegal housing for hotel business plants are destroying and sand dune are abolishing day by day, this is a great threat to ecosystem to near future. As the plants and sand dune are destroying day by day, a great disaster may be occurred at the time of storm, flood, tsunami etc. *Cynodon dactylon*, *Indigofera dendroides*, *Ipomoea pes-caprae*, *Lippia nodiflora*, *Evovulus nummlarius* & *Glycosmis pentaphylla* are the primary successor on sand dune and *Casuarinas equisetifolia*, *Albizia lebbek*, *Anacardium occidentale*, *Allophylus cobbe* & *Azadirachta indica* are the secondary successor on sand dune. This should be notified that our study on specifically coastal sand dune ecosystem. So, we have studied most specific vegetation which is directly and deeply related to dune ecology. But, outside those, there are many important plant species at the backside coastal morphology which are indirectly related to dune ecosystem, although they are significant to whole of the coastal ecosystem.

Causes of the Degradation and Destruction of Dune Ecology

1. After the preliminary study we can conclude that the coastal vulnerability at this area is mainly due to human disturbance. The survey along the coastal line of Mandermoni-Tajpur of Midnapore coast clearly reveals and proves the aforesaid testimonial. The steady virginity and the dune vegetation of Mandermoni coast has recently been smashed due to gigantic constructions and other civilized interventions although the honorable high court of West Bengal (India) has already given stay order to stop the constructions at Mandermoni.

Table 5 List of Proper Dune Vegetation and their phyto-medicinal uses

Sl. No.	Scientific Name	Family	Habitat/ Character	Uses
1.	<i>Acalypha indica</i> L.	Euphorbiaceae	On sand dune	A leaf paste ,mixed with common salt, is use to cure eczema and chest pain The pulped leaves, or an extraction or decoction of them, as well as a decoction of the roots and the bark, are used in the treatment of stomach-aches and fevers. A disease inside the mouths of children is also treated with it. The scraped bark is applied to rigid abdomen, the bark to burns.
2.	<i>Allophylus cobbe</i> Raensch	Sapindaceae	Good sand dune stabilizer	The wood is reported to be very hard but not very durable: it is mainly used as a timber for temporary structures and indoors. The wood is used for fuel. The seed is used as a poultice for broken bones. The plant is astringent, diaphoretic, diuretic, emollient, febrifuge and galactagogue. It is used internally in the treatment of internal bleeding, diarrhoea and excessive menstruation. It is also used in the treatment of snake bites. Applied externally, it is used to treat ulcerated mouths, vaginal discharges, nosebleeds and a range of skin problems including wounds, eczema, boils and burns. The plant can be used fresh or it can also be harvested when coming into flower and dried for later use.
3.	<i>Amaranthus spinosus</i> L.	Amaranthaceae	On sand dune	The ash of the plant, combined with water, is used to wash sores. The sap is used as an eye wash to treat ophthalmia and convulsions in children. The root is diuretic, emmenagogue, febrifuge and galactagogue. It is also used, often combined with the root juice of <i>Dichrophia integra</i> and <i>Rubus ellipticus</i> , to treat stomach disorders and, on its own, to treat indigestion and vomiting that occur after eating unusual foods. A paste of the root is used in the treatment of menorrhagia, gonorrhoea, eczema and colic. It helps to remove pus from boils. It is used to treat toothache.
4.	<i>Anacardium occidentale</i> L.	Anacardiaceae	Sand dune stabilizer	and use the fruits, bark, and leaves for many other purposes including anti-fungal activity, for sores and rashes, or as an antipyretic, and for anti diarrheal applications.
5.	<i>Argemone Mexicana</i>	Papaveraceae	common plant on sand dune throughout the coastal line	<i>Argemone mexicana</i> is used by traditional healers to treat malaria. The whole plant is used to make a tea and as much tea as possible is drunk until symptoms disappear. Biodiesel production from <i>A. mexicana</i> seed oil using crystalline manganese carbonate has been demonstrated.
6.	<i>Axonopus compressus</i> (Sw.) P.Beauv	Poaceae	Sand dune grass	Medicines: vermifuges Medicines: cutaneous, subcutaneous parasitic infection Agri-horticulture: ornamental, cultivated or partially tended Agri-horticulture: fodder Agri-horticulture: land conservation
7.	<i>Boerhavia diffusa</i>	Nyctaginaceae	common herb on sand dune	<i>B. diffusa</i> can be used as a fodder for livestock, but has the potential for contaminating seed stocks, and may harbor pathogens for certain crops, such as eggplants.
8.	<i>Bulbostylis barbata</i> Roth.	Cyperaceae	Potent soil binding species.	sand binder plant species
9.	<i>Cassia absus</i> L. (Chaksu)	Fabaceae	Sand dune stabilizer	Used externally as a paste or collyrium in eye diseases like conjunctivitis, trachoma, Chronic dacryocystitis. Externally used as paste for wound healing, skin diseases like ringworm. Used internally in the form of decoction to treat diseases like irritable bowel syndrome, diarrhea with blood. Used internally in powder form to treat renal stones, difficulty in micturition. Used internally in the form of kashaya to stop internal bleeding. Used internally in the form of kashaya to treat poison of plant and animal origin. Chaksu seeds or its soaked seed powder is administered for the treatment of hypertension. <i>Senna alata</i> is often called the ringworm bush because of its very effective fungicidal properties, for treating ringworm and other fungal infections of the skin. The leaves are ground in a mortar to obtain a kind of "green cotton wool". This is mixed with the same amount of vegetable oil and rubbed on the affected area two or three times a day. A fresh preparation is made every day. Its active ingredients include the yellow chrysophanic acid.
10.	<i>Cassia alata</i> (L.) Roxb.	Fabaceae	Sand dune stabilizer	Roots are use in treating snake bites. Seeds and leaves are use to cure skin diseases.
11.	<i>Cassia occidentalis</i> L.	Fabaceae	Sand dune stabilizer	Wood is used for house posts, rafters and masts of country made crafts, for fencing. Bark is a tonic and astringent, useful in diarrhoea and dysentery
12.	<i>Casuarinas equisetifolia</i> L.	Casuarinaceae	Sand dune stabilizer	It is used for relieving muscle pain, depression of the central nervous system, also used for applying to wasp stings and to heal wounds. Its application ranges widely from the prevention of diabetes to treatment of stomach ache.
13.	<i>Catharanthus roseus</i>	Apocynaceae	common sand dune plant/ herb	Used as treatment of infertility
14.	<i>Cleome viscosa</i> L.	Cleomaceae	Sand dune stabilizer	In Ayurvedic and Siddha traditional medicines, the leaves and roots of <i>C. infortunatum</i> are used as herbal remedy for alopecia, asthma, cough, diarrhoea, rheumatism, fever and skin diseases. It is also known to have hepato-protective and antimicrobial activities. The roots and bark of stem of this plant prepared as decoction and given in the dose of 60-80 ml twice daily for respiratory diseases, fever, periodic fever, cough, bronchial asthma, etc. The leaves are ground well and applied externally to induce ripening of ulcers and swellings. A paste of leaves and roots are applied externally over skin diseases especially fungal infections and alopecia. Fresh leaves are given for diarrhoea, liver disorders and headache.
15.	<i>Clerodendrum infortunatum</i> L.	Lamiaceae	Sand dune shrub	The leaf and root are widely used as antidandruff, antipyretic, ascaricide, laxative, vermifuge, and in treatments of convulsion, diabetes, gravel, malaria, scabies, skin diseases, sore, spasm, scorpion sting, snake bite and tumor.

16.	<i>Hydrophylax maritima</i> L.f.	Rubiaceae	Good Sand binder species	It is a good sand binder and protect the coast from erosion
17.	<i>Indigofera dendroides</i> Jacq.	Fabaceae	Good sand dune stabilizer	Several species of this group are used to alleviate pain. The herbs are generally regarded as an analgesic with anti-inflammatory activity, rather than an anodyne. <i>Indigofera articulata</i> (Khedaiish in Arabic) was used for toothache, and <i>Indigofera oblongifolia</i> (hasr in Arabic) was used as an anti-inflammatory for insect stings, snakebites, and swellings.
18.	<i>Ipomoea pes-caprae</i> (L.) R.Br.	Convolvulaceae	Good sand dune stabilizer	It is a sand binder; leaves and roots are useful for gonorrhoea, rheumatism, skin infection and stomach ache.
19.	<i>Jatropha gossypifolia</i> L.	Euphorbiaceae	Sand dune vegetation	Roots are used for leprosy; bark decoction as emmenagogue; leaves to cure stomach ache, venereal diseases and as blood purifier.
20.	<i>Lantana camara</i> L.	Verbenaceae	Good sand dune stabilizer	<i>L. camara</i> is used in traditional herbal medicines for treating a variety of ailments, including cancer, skin itches, leprosy, rabies, chicken pox, measles, asthma and ulcers. The plant is anodyne, antibacterial, astringent, carminative, deobstruent, diuretic, emmenagogue, emollient, febrifuge, parasiticide and refrigerant. It is said to be useful in the treatment of blenorhoea, lithiasis, ischuria, constipation and pain in the knees. It is used in the treatment of hookworm. An infusion is drunk as a post-partum tonic. The juice of the plant is cooling and is used to relieve minor gastric troubles, fevers, coughs and colds. The aroma of the inhaled plant is breathed in to treat coughs and colds. A poultice of the fresh plant is applied to ripen boils. A paste or poultice is also applied to swollen cervical glands, to erysipelas, burns, and to chronic indolent ulcers. The juice of the root is used in the treatment of gastric troubles.
21.	<i>Lippia nodiflora</i> (L.) Greene	Verbenaceae	Sand dune vegetation	
22.	<i>Launaea sermentosa</i> (Willd.)	Asteraceae	Sand binder species	Good sand binder and plant juice is applied for the treatment of Rheumatism.
23.	<i>Martynia annua</i> L.	Martyniaceae	Sand dune vegetation	It is used in Indian traditional medicines for epilepsy, inflammation and tuberculosis.
24.	<i>Melastoma malabathricum</i> L.	Melastomataceae	Sand dune vegetation	Ethnopharmacologically, the leaves, shoots, barks, seeds, and roots of <i>M. malabathricum</i> have been used to treat diarrhoea, dysentery, hemorrhoids, cuts and wounds, toothache, and stomachache.
25.	<i>Mitracarpus hirtus</i> (L.) DC.	Rubiaceae	Sand dune herb	The dried leaves are said to heal old ulcers rapidly. The plant is an antidote for arrow poison.
26.	<i>Mollugo pentaphylla</i> L.	Molluginaceae	Sand dune herb	The plant is antipyretic, antiseptic, appetizer, emmenagogue, laxative and stomachic. The plant is a component of an important folk medicine in Taiwan, which is used as an anticancer, antitoxic and diuretic agent. The leaves are used to make a soup that is said to promote the appetite. They are also used to treat sprue and mouth infections. A decoction of the roots is used to treat eye diseases. The whole plant is burnt to make a mosquito repellent.
27.	<i>Ocimum americanum</i> L.	Lamiaceae	Sand dune herb	Decoction of the leaf is used for checking nose bleeding and malarial fever. Leaf paste is used as a cure for parasitical skin diseases. Tea or infusion of the leaf is used in fever, indigestion and diarrhoea. Dried plant is burnt as mosquito repellent. The leaves are pounded, soaked in warm water and the liquid drunk to treat stomach disorders. They are used externally as a poultice to treat sores and sore eyes. The entire plant is used in decoction as an anthelmintic, antirheumatic, depurative, diaphoretic, digestive, diuretic, febrifuge, pectoral and stomachic. it is a common ingredient in mixtures used internally to treat remittent fevers, gastric irritation, nervous depression and as a tonic. It is also used to treat jaundice and other liver conditions. it is used to treat viral infections, cancer, acne, boils, appendicitis, hepatitis, eye problems and bleeding. The juice of the plant is applied to the hands and feet to cool them when the patient has a fever.
28.	<i>Oldenlandia corymbosa</i> L.	Rubiaceae	Sand dune herb	It has medicinal uses for its Antioxidant activities and Antispermatic effect. The fruits of <i>Opuntia</i> species (prickly pears) rich in betanin and isobetanin are considered a better source of food colorants. The fruits of <i>O. dillenii</i> have as foodstuffs a number of advantageous properties: Their tight skin is spineless and attractively coloured. The juicy and purple flesh encloses edible seeds, and both constituents contain besides fibre also low molecular health-promoting substances in relatively high amounts.
29.	<i>Opuntia dillenii</i> (Ker Gawl.) L.D.Benson	Cactaceae	Sand dune herb	
30.	<i>Panicum repens</i> L.	Poaceae	Sand binder species	This species also a dangerous weed but this species could be used for soil erosion control.
31.	<i>Petalium murex</i> L.	Pedaliaceae	Sand dune vegetation	The mucilaginous infusion formed from leaves, fruits or seeds in water or milk is used in the treatment of urinogenital diseases such as Gonorrhoea, dysuria etc.
32.	<i>Phyllanthus niruri</i> L.	Phyllanthaceae	Sand dune vegetation	it is used for problems of the stomach, genitourinary system, liver, kidney and spleen. <i>P. niruri</i> has been investigated for its potential medicinal benefits, especially in terms of blocking kidney stone formation and anti-hepatitis B activity.
33.	<i>Sesuvium portulacastrum</i> (L.) L.	Aizoaceae	Good dune stabilizer	A very good sand binder. Young plants are edible after boiling to remove the excess salt.
34.	<i>Spinifex littoreus</i> (Burm.f.) Merr.	Poaceae	Good dune stabilizing grass	It is an excellent soil binder. Dried grass is used as fuel.
35.	<i>Vitex negundo</i> L.	Lamiaceae	Sand dune vegetation	<i>Vitex negundo</i> is used for treating stored garlic against pests and as a cough remedy. Roots and leaves are used in eczema, ringworm and other skin diseases, liver disorders, spleen enlargement, rheumatic pain, gout, abscess, backache; seeds are used as vermicide. This plant is also proved for its cardioprotective property. It is also used to control population of mosquitoes.

36.	<i>Coccinia grandis</i> (L.) Voigt	Cucurbitaceae	Sand dune Climber plant	In traditional medicine, fruits have been used to treat leprosy, fever, asthma, bronchitis, and jaundice. The plant is used to counter infertility in women. In India it is said to be beneficial for leprosy. The sap is used for the treatment of eye ailments, sore throat and burns and as a topical application for thrush in infants. The plant is used as a poultice for sore feet. The leaves are pounded and soaked in warm water and then the solution is drunk to treat diarrhea. A decoction of the root is used for the relief of stomach disorders. The liquid contained in the flowering spathe is used to treat eye complaints.
37.	<i>Commelina benghalensis</i> L.	Commelinaceae	Sand dune vegetation	The plant is used in traditional medicine to treat urinary problems and to reduce fever. An infusion of the plant is used to bathe children in order to prevent skin infections and also to treat thrush. Boiled with salt, it is used to treat eczema and other skin problems. A poultice made of the roots is applied to painful swelling of joints. An extract of the leaves is taken as a vermifuge.
38.	<i>Crotalaria pallida</i> Aiton	Fabaceae	Sand dune stabilizer	Traditionally, this plant is used to treat liver disorders, skin diseases including ring worm infection, to cure the swelling of body, bronchitis and asthma. Bark and roots of <i>C. bonplandianum</i> are alterative and chologogue. Leaves of this plant are medicinally used for the treatment of cut and wounds, venereal sores and cholera. The seeds are used for the treatment of jaundice, acute constipation, abdominal dropsy and internal abscesses. Fresh juice of the plant is used in headache. Pharmacological activities reported for this plant are antimicrobial, antioxidant, cytotoxic and wound healing.
39.	<i>Croton bonplandianum</i> Baill	Euphorbiaceae	Sand dune stabilizer	Drinking the juice empty stomach in the morning is good in normalizing the sugar level. Bermuda grass for immunity: Doob grass is used to enhance immunity of the body. <i>Cynodon dactylon</i> contains a bio-chemical compound called cynodon dactylon protein fractions (cdpf), which helps to enhance immunity of the body.
40.	<i>Cynodon dactylon</i> (L.) Pers.	Poaceae	Good sand dune stabilizer	It has a long history of use as a herbal medicine, being especially well-known as a treatment for chest complaints, including asthma, cough, tuberculosis and bronchitis. The whole plant, but especially the leaves and seed, is abortifacient, anaesthetic, anodyne, antiasthmatic, antispasmodic, antitussive, bronchodilator, hallucinogenic, hypnotic and mydriatic. It has a wide range of applications, including in the treatment of asthma, epilepsy, hysteria, insanity, heart diseases, fever with catarrh, diarrhoea, skin diseases etc. Different parts of the plant are used in various preparations for sedating patients with mental disorders. The seed oil is used for massaging painful body parts. An extract of the flowers is used as an anaesthetic.
41.	<i>Datura metel</i> L.	Solanaceae	Sand dune shrub	The whole plant, but especially the root, is anthelmintic, astringent, depurative, diuretic, febrifuge, laxative and sudorific. It is used in the treatment of bladder disorders, liver complaints, relieve pain caused by straining the abdominal muscles etc. it is also used in the treatment of influenza, hypertension, oliguria and retention of urine. The plant is applied externally to open wounds to stop bleeding. The whole plant is boiled with black sage for use in a sitting bath to treat fevers, colds, malaria, and for post-childbirth cleansing of a mother. The plant can be used fresh or dried. The fresh leaf juice is used as an anthelmintic, and is also prescribed for women after giving birth. A poultice of the leaves is applied to sprains and back pains. A decoction of the macerated leaves is used to treat skin rashes. A decoction of the roots is used to treat fevers and asthma.
42.	<i>Eleusine indica</i> (L.) Gaertn.	Poaceae	Sand dune vegetation	The plant is reduced to ash, which is spread over cuts, burns and the like in order to clean them and promote healing. The inflorescence, either in flower or in seed, is reduced to ash or, like the vegetative parts, is used for its curative properties, in this instance being mixed with castor-oil and applied to whitlows. Maturation is rapid. An infusion of the plant is taken as a treatment for stomach-pains. The straw is woven into mats for covering food, and also into a coarse cordage.
43.	<i>Eragrostis ciliaris</i> (L.) R.Br.	Poaceae	Sand dune vegetation	Roundleaf Bindweed purifies blood and also improve memory power.
44.	<i>Evolvulus nummularius</i> (L.)L.	Convolvulaceae	Good sand dune stabilizer	The leaves are used in the treatment of diarrhea. The bark is used in the treatment of haematuria, menorrhagia, and haemoptysis. The fruit is used in the treatment of haematuria, menorrhagia, and haemoptysis. A fluid that exudes from the cut roots of the tree is considered to be a powerful tonic when drunk for several days together. The root is chewed as a treatment for tonsillitis.
45.	<i>Ficus racemosa</i> L.	Moraceae	Sand dune vegetation	The plant is often used in traditional medicine. Glycozolidol, a carbazole alkaloid isolated from the roots, is active against some gram-positive and gram-negative bacteria. Leaf and stem bark extracts have been shown to have a healing effect upon damaged liver tissue. Extracts of the root bark have been shown to exhibit significant activity in the treatment of diarrhoea. An ethanol extract was found to be more effective at lower dosages than an aqueous extract. A steam distillate of the leaves has shown high antifungal activity against <i>Cladosporium cladosporioides</i> , but no activity against <i>Staphylococcus aureus</i> or <i>Escherichia coli</i> . A decoction of the roots is taken to treat bilious attacks. A decoction of roots and leaves is taken for intestinal trouble. An infusion of leaves and roots is given after childbirth as a protective medicine. The leaves are considered appetitive, stomachic and an infusion of roasted leaves is prescribed for women after delivery as an appetizer. Juice of the leaves is used in fever, liver complaints and as a vermifuge. A paste of the leaves, mixed with ginger, is applied for eczema and skin affections. A decoction of the roots is given for facial inflammation.
46.	<i>Glycosmis pentaphylla</i> (Retz.) DC.	Rutaceae	Good sand dune stabilizer	

2. Various natural forces influencing coastal sand dune vegetation include sea level changes, wind regime, worm wind blow and movement of dunes, storms and climatic changes. Global warming and climatic changes (for example, increase in sea level) has direct impact on coastal sand dune vegetation.
3. Several human interferences (industrialization, pollution, waste disposal, harbours, roads, sand mining, sea-facing, commercial or social forestry, construction of resorts and beach tourism) cause destabilization of coastal sand dune and severely influence the dune ecosystem.
4. In these places, the vegetation itself is the target of exploitation. It is the source of fuel-wood and charcoal. Some coastal species were once harvested for their valuable woods (*Casuarina equisetifolia* etc). Wildlife habitats are destroyed as beach ridges and dunes are cleared for planting coconut palms, groundnuts, Grasses are often planted under the palms to serve as pasture for cattle, and wetlands are drained, killing off forests.
5. Since 2003, tourist has come to regard the Mandermoni seashore as one of the prime vacation spot at the Eastern coast of India. Summer homes and seaside resorts have had a tremendous impact on the vegetation of beaches and sandy coastal plains. Unfortunately, government often provides incentives for developing the areas. The dune vegetation of these places are noticeably destroyed and facing a serious erosion problem every year during the Monsoon time.
6. Stone fencing at different places of this coast like eastern coastline in India reduce the input of nutrients to the sand dunes. These construction activities adversely affected sand dune vegetation specifically disturbing the biogeochemical cycle, microbial activities.

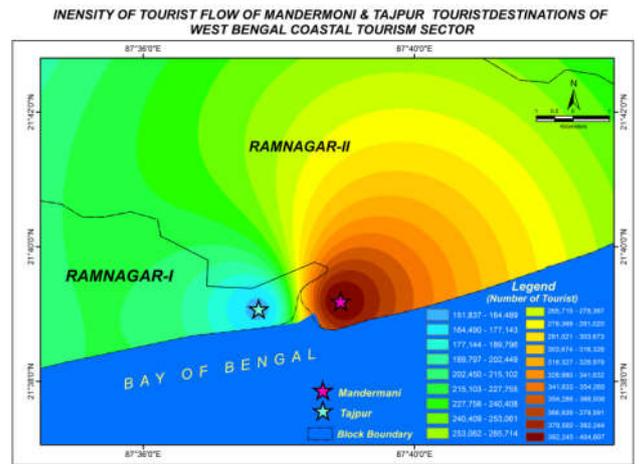


Figure- 3 & 4 Tourist Destinations and Tourist Flow in the Study Area

Mostly talking the harshest detrimental grounds of coastal vegetation in this particular area is the anthropogenic activities. In Mandermoni and Tajpur areas of Midnapore Coast, West Bengal the growing scale urban development carried out on the fore dunes during the tourist boom caused the destruction of many dune ecosystems. As a result of such a gigantic dune occupation, Tazpur and Mandermoni of the coast line of West Bengal show signs of erosive patterns particularly

Table 6 Anthropogenic Causes and Its Impacts on Dune Ecosystem

Human Activities	Impacts on Sand dune Ecosystem
<ul style="list-style-type: none"> • Disruption of Sediment (sand) Flow • Coastal Development through infrastructural development • Recreation use throughout the year • Tourism Development permanently • Cattle Grazing • Introduction of weeds and pests and • Sand mining • Intensive and extensive commercial fishing and fish manufacturing activities • New trend towards coastal urbanization or rurbanization • Crackpot land use changing and planning and conversion of dune landscape • Free frog settlement expansion and sprawl on and around dune environment 	<ul style="list-style-type: none"> • Habitat loss • Habitat fragmentation • Devegetation and loss of species as well as biodiversity • Local and regional connectivity • Hydrology and water quality • Road traffic • Rubbish and waste dumping • Plastic pollution • Noise • Predation by feral animals • Weed dispersal

Management Practices of Coastal Dune Systems

The sand dune ecosystem should be managed by local groups. In more recent times, management of the ecosystem is divided between the various governmental agencies and departments responsible for particular aspects of the ecosystem.

Maintenance of Genetic Diversity (Biodiversity)

- Protection of biodiversity on coastal sand dunes requires consideration of how different species interact with other species, with the non-living environment and with other ecosystems. For Coastal Sand Dune Systems are very interdependent thus making them vulnerable.
- The various geomorphic and vegetation zones of the dune system provide habitats for a variety of species. Destruction of these habitats leads to a cascading effect whereby various species become threatened, endangered or sometimes extinct. This upsets the balance of the sand dunes.
- The biodiversity on coastal sand dunes helps create a special character of the coastal zone producing an environment with which many people can identify.

Intrinsic Values

- For indigenous people it holds a spiritual connection where various animals act as totems.

- Coastal Dunes provide habitats that support unique plants and animals.
- Coastal dunes are very attractive which draws people to live near them.
- Their beauty draws people for recreational use.

The need to allow natural change to proceed

- Sand dunes are dynamic ecosystems (meaning much occurs in them). The accumulation of sand and its subsequent erosion continues on an endless cycle.

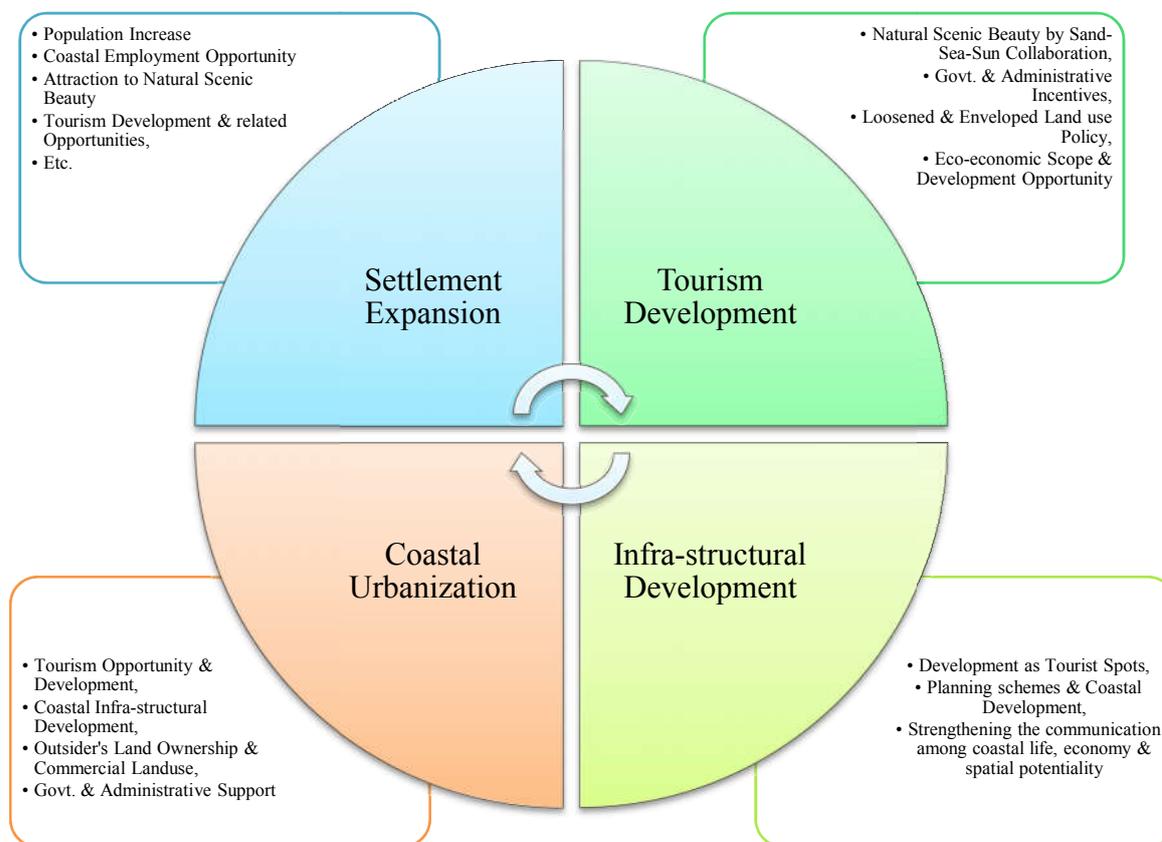


Figure 14 Anthropogenic Causes & Sub-causes for Dune Destruction at the Study Area

Utility Values

- For indigenous people it is acted as ready available food supply.
- Coastal Dunes protect the beach from powerful storm waves by acting as a buffer zone.
- The sediment stored on Dunes help replenish sand lost during storms on beaches.
- They contain valuable minerals. At Stockton minerals used for building titanium Steele is found.
- Recreational use has lead to tourist operations thus enhancing local economies.
- Location behind beaches makes them popular for coastal development.(economic value)

Heritage Value

- Many dune systems hold records of past climatic and sea changes in the layers beneath them. The Stockton Bight Sand Dune System provides one of the most comprehensive and most accessible records in New South Wales.
- Dune Systems provide excellent archaeological sites from Aboriginal which provides an unique record of traditional cultural history.

The succession of plants helps maintain equilibrium. Humans have impacted on this natural process and as a consequence many sand dune ecosystems have been destroyed.

- What is more prolific is that since the accretion cycle has been affected, by increased erosion through vegetation removal and the restriction of sediment flows, many houses built on the fore dune and hind dune areas are and have been damaged by storms.

CONCLUSION

Coast line of East Midnapore district is a golden treasury of natural flora. Its natural vegetation carries a distinct character. Sand dunes and sand dune vegetation make its own identification. The sand dune species of costal West Bengal are extremely important resources, which play a vital role in the economic and social life of nearby people. Plant succession on sand dune is tremendous character. Adaptation of various plants is remarkable. Various plants show the xerophytic. Leaf of Casuarinas equisetifolia shows succulent character of xerophytes. Sand dune vegetation is the main protester of storm and flood. Xerophytic plant such as Opuntia dillenii, Spinifex littoreus etc. are found throughout coastal area. But this area is facing a problem due to manmade plastic pollution and destruction of sand dunes. At Tajpur & Mandermoni the natural

vegetation and sand dunes are destroying for hotel business. Conservation and judicious utilization of the coastal plant wealth is important because they have become threatened by over exploitation, clearing of forest for industrialization, rapid urbanization, pisciculture, human settlements, etc. The vegetation cover of old dunes should be protected, as their base sand surfaces are always washed away by river or sea water. These vegetation and dunes are natural protection from natural forces like storm, flood, tsunami etc. As these are destroying, a natural disaster may be occurred. So, immediate steps should be taken by government and local authorities. The different plant species as used by the local coastal people throws some light on the economic and medicinal importance of these species. Hence, there is a need for detailed investigations of ethno- botanical knowledge held by the local villagers before such valuable knowledge is lost forever. A rational and sustainable method of utilization can help improving the life of the local people while maintaining ecological balance of coastal habitats. There should be needed a deep-heart interdisciplinary study on not only dune ecology, but also over the fragile coastal landscape of this coastal sector including whole of the Bengal coast. Unfortunately, most of the studies relating coastal landscape of our Bengal are implemented for the academic or report based administrative selves. There are a few examples to enlighten that can be treated as the study for the society, development and environment of the green-blue coastal landscape. So, in self of the coastal sustainability, there should be needed to conduct, adopt and also implement the frequent and urgent discussion, meeting, seminars, workshops, training programmes, planning programmes, policy making/modifying platform, legal justice for coastal sensitiveness and application of EIA method maintaining CRZ Rules and Regulations through the participating, sharing, exchanging and providing the newer ideas, thought, ways, techniques and technologies from different disciplines, sectors, levels and groups of community, society, administration, politics, planners, social workers, environmentalists and other broad thinkers who heartily like and love to do it.

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