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An Analytical Study on the Phytoresources and Vegetation Ecology of Coastal Medinipur of West Bengal in India

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Abstract: ***Any coastal region contains plant resources having great socio-economical standards which remain uncultivated to most of the people, thus results in obliteration and taking away of coastal floras incessantly. This paper reports the composition and distribution of Coastal floras including a total of over 90 species belonging to 66 Genera and 45 families surveyed using 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 villages of East Medinipore, West Bengal. These Coastal floras under marvelous anthropogenic heaviness due to hasty purging of sand dunes and its associated vegetation whereas sand dunes acts as natural guard wall at coast line throughout the world and constitutes different types of plants with different habits but moreover all of the plants having stress tolerance capability and more or less soil binding capacity. 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. Such susceptible and functional ecosystems necessitate instantaneous reinstatement, conservation measures and sustainable use of the phytoresources.***

Keywords: Coastal Region, conventional understanding, susceptible and functional ecosystems, sustainable use and phytoresource

1. Introduction

Coastal morphology shows the natural structure which protects the coastal environment by absorbing energy from wind, tide and wave action. These species are playing a crucial role in protecting the coast from erosion and flooding (Desai, 2000). Disturbance of this coastal vegetation has caused growing concern in the recent years. India has a approx 7500 km coastline with numerous types of plants, lagoons, beaches, estuaries and mangrove swamps, which supports rich living and nonliving resources (Anonymous,1987). From the point of view of geographical characteristics, 158 km long stretched of west Bengal coast is an important place on the eastern coastal sites enriched with natural resources (ICMAM Project Directorate, Government of India, 2007). The coastal belt of Midnapore in West Bengal is also wealthy in plant resources, which harbor many economic and medicinal plant species. The local community surrounding the coast depends upon these resources for their lively wood. They collect and utilize many plants for food, timber, fibre, fuel and medicine. Their high utility in economic and medicinal is an important contributing factor to their overexploitation. The continual use of coastal plants over many years without this being replanted and replenished has resulted in accelerated decline in the abundance or the loss of a wide range of threatened and in danger of extinction species. So the exploration of knowledge and strategies for the conservation of biodiversity of such an important responsive ecosystems along with their sustainable uses by the ethnic races present in nearness of the dune vegetation are required immediately.

2. Objectives

Vegetation plays a significant role in protecting sand dunes, alluvial tracts, banks of river, estuary, muddy bundh, bank of ponds, jhills, canals found in coastal area which are eroded seasonally by flood along with High tide and low Tide (HT/LT). Therefore, according to authors, Untawale (1994) and Banerjee (1994) coastal vegetation is an ecological storehouse rich in genetic diversity along with high ecological value. Not only have that, the species available there are playing a crucial functioned in defensive the coast from erosion and flooding (Desai, 2000). According to Corre Jean-Jacques (1991) coastal sand dunes over sea shore are the natural structures which protect the coastal environment by absorbing energy from wind, tide, and wave action. In the present study the area with low dune composition but high level of muddy flat basin that broadcasts prosperity of ground vegetation protect soil havoc to produce succession to reach the vegetation of plantation plunk to reach nearer climax. This formation starts with lichens and alga of green type from bed of basin and adjacent mouth of the river. All the species (both herbs and trees) play here a significant role to stabilize habitat and species both flora and fauna rich to richer. Therefore, study and research is essential to come in to a point of following kinds.

- To study the vegetation types and the pattern of Ecosystem dynamics persist on Midnapore coast.
- To show the flow of fuel wood and related materials collected by the local people.
- To study of illegal collection pattern of plant and similar products, and their impact on local vegetation.
- To prepare Parallel guideline to sustain local vegetation more better through better management of resources.
- To study ecological status and vegetation and role of Institutions to conserve the environment sound and healthy.

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3. Geographical Location of the Study Area

India is blessed by a long shoreline enclosing the State from three sides, i.e. 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 the part of this extensive shoreline of Bay of Bengal along the West Bengal coast. The 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 study area 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 the coastline is about 21°38'13.126"N to 21°42'30"N and 87°35'7.718"E to 87°46'14.29"E respectively.

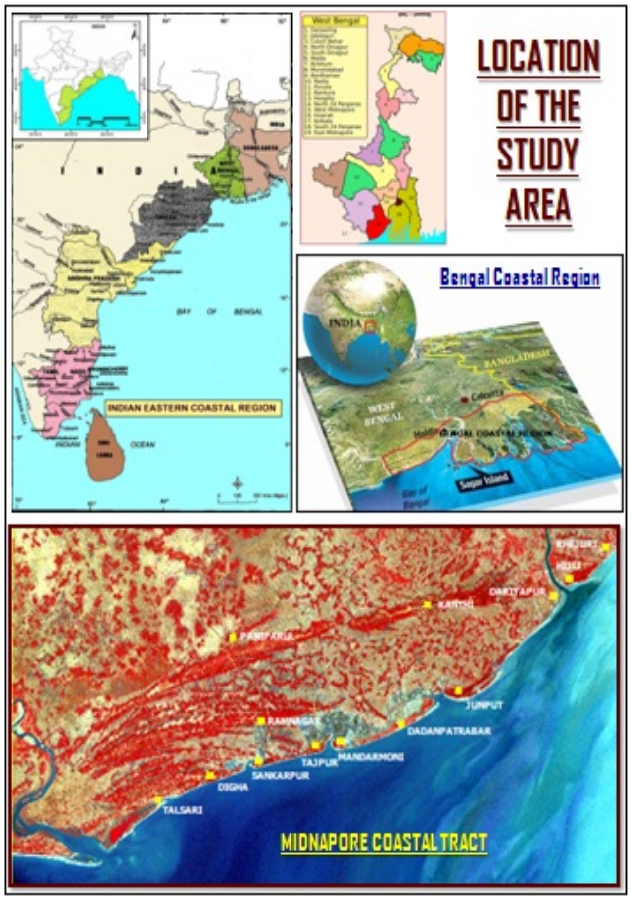

Figure 1: Location of Coastal Medinipur

4. Sub-Surface Geology & Geomorphology

According to Chakraborty(1991), this coastal area is underlain by unconsolidated sediments of sand, silt and clay. These sediments have been categorized into seven different zones based on their physical, mineralogical and biological characteristics. The depositional environments indicate marine and non-marine conditions alternating with each other.

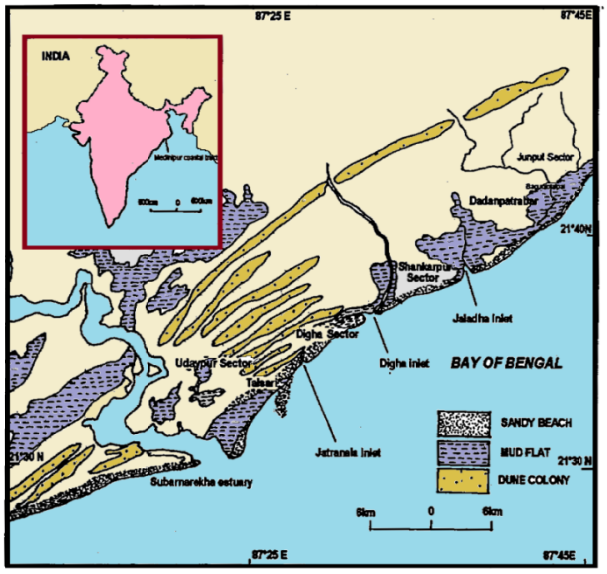

Figure 2: Major Geomorphic Featues of Coastal Medinipur

Based on tidal amplitude only, West Bengal coast can be sub-divided into two different coastal environments namely (Figure 3):

1) **The macro tidal (tidal range > 4 m)** Hugli estuarine plain characterized by a network of creeks encompassing the islands with spectacular mangrove vegetation and off-shore linear tidal shoals from Sagar Islnd to the border of Bangladesh to the east.
2) **Meso tidal (tidal range 2 – 4 m)** Medinipur (Digha-Sankarpur-Junput) coastal plain to the west of the Hugli estuary with rows of sandy dunes separated by clayey tidal flats from Sagar Island to Orissa border to the west.

Figure 3: Location map of West Bengal coast. Erosional shores are outlined in blue, accretional areas in red

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5. Materials and Methods

- **Pattern of Survey**
  The large area that is 10m X 10m patches of sandy plant were chosen following the Quadrate method for study of species composition and relative cover. The plant samples were randomly collected using quadrate ($1m^2$) along transects perpendicular to the shore.

- **Identification and preservation of specimen**
  An intensive literature survey has been carried out for assemblage of existing information on various uses of the coastal plain and sand dune species at different parts of the coast of Midnapore. Each of the plant material has been assigned a field note books and documented as to Binomials with family, local name, part used and therapeutic uses, plant parts that were identified as useful in ethno-botany were collected, compressed, the voucher specimens have been collected and identified by referring to standard flora(Hooker,1884). The voucher specimens are maintained in the herbarium.

6. Results and Discussion

6.1 Species diversity as phytoresources

Coastal Dune and plain area vegetation is an ecological storehouse rich in genetic diversity along with high ecological values (Untawale, 1994; Banerjee, 1994). These species are playing a vital role in protecting the coast from erosion and flooding (Desai, 2000).Sand dune vegetation is not commonly used for economic gain, but it also identified for ethnomedicinal, handicrafts etc uses (Table 3-6). Indian CSDs consist of 154 species belonging to 108 Genera and 41 families (Arun et al., 1999; Rao and Sherieff 2002) while over 90-species belonging to 66 Genera and 45 families have been acknowledged during this survey. Poaceae is the most dominant family followed by Papilionaceae, Convolvulaceae, Cyperaceae and Arecaceae. Among genera the most notable were Phoenix and Ipomoea with two and three species respectively.

Table 1: Soil Sample analysis

Coastal Sites	*Sand Quality*	*Soil pH*	*Soil Organic Matter*
New Digha	Coarse	7.1-7.3	0.01-0.13
Old Digha	Coarse	7.1-7.3	0.01-0.14
Sankarpur	Coarse to Medium	7.3-7.5	0.07-0.20
Tajpur	Medium	7.4-7.5	0.06-0.24
Mandermoni	Medium	7.4-7.6	0.07-0.22
Dadanpatrabad	Medium to Fine	7.5-7.6	0.12-0.27
Junput	Medium to Fine	7.5-7.7	0.15-0.26
Dariapur	Fine	7.5-7.7	0.13-0.27
Hijili	Fine	7.5-7.7	0.16-0.31
Khejuri	Fine	7.5-7.6	0.17-0.42

6.2 Vegetation Zonations

Typical zonations can be observed easily on the sand dunes. The zonations and the corresponding species are listed in table no.2

Table 2: Zonations of Different plant species

Edaphic status	*pH*	*Vegetation*	*Floristic Elements*
Part under Direct Tidal Influence	7.5-7.9	No vegetation found	No
Semi Aerated Upper Tidal Zone	7.3-7.6	Sparse elements	Hydrophylax maritima
Outer Strand Zone (well Aerated sandy soil with Leached Out Upper surface)	7.2-7.5	Pioneers species found	Ipomoea pes-caprae,,Lippia sp. ,Hydrophylax maritime,spinifex littoreus,etc
Central strand Zone	7.0-7.3	Pioneers & associated species found.	Ipomoea pes-caprae, Cyperus sp., Euphorbia sp., Crotalaria sp. , Tephrosia sp. etc
Inner strand Zone(High Humus)	6.8-7.0	Mixed ground vegetation with background trees	Casuarina equasetifolia, Pandanus tectorius, Phoenix sylvestris, Cocos nucifera,Opuntia monacantha etc.

The distribution reveals that the flora is growing gradually from seaward to inner strand zone. The pioneer species like Launaea sermentosa, Ipomoea pes-caprae, Spinifex littoreus and Hydrophylax maritime are excellent sand binder and protect the costal dune system from erosion (wind and water). Some sand dune species are having medicinal properties (Sridhar and Bhagya, 2007). People are using these plants for treating several diseases. The stem and leaves of Sesuvium portulacastrum are eaten after boiling to remove excess salt from the body. Leaf and twig decoction of Tamarix troupii is used for sloughing ulcers and its infusion as a gargle for sore throat. Juice of whole plant of Ageratum conyzoides, Casuarina equisetifolia bark, Thespesia populnea root and Hemidesmus indicus root are functional in curing dysentery and diarrhoea. Flowers of Pandanus fascicularis is used for making perfumes. Curry of Alternanthera sessilis and salads of Salvadora persica leaves are also used. All species of coastal vegetation of customary and ethno-botanical attention are recorded after significant viewing with the on hand literature. This study also reflects the prosperity of flora with highest number of inhabitant plants.

There are many medicinal plants found which are potentially important in the shrubberies, gardens, bund of Ponds and Canals, even in protected sites of Govt. and semi-Govt. Institutes and in wasteland. Medicinal plants of potential importance are species like **Adhatoda vasica, Aloe vera, Ambroma augusta, Andrographis paniculata, Azadirachta indica, Bryophyllum calycinum, Catharanthus roseus, Centella asiatica, Cissus quadrangularis, Clerodendum serratum, Costus speciosus, Emblica officinalis, Enhydra fluctuans, Euphorbia nerifolia, Gloriosa superba, Ichnocarpus frutescens, Jatropha gossypifolia, Marselia quadrifolia, Ocimum sanctum, Plumbago zeylanica, Smilax ovalifolia, Stephania japonica, Swietenia macrophylla, S. mahagoni, Tylophora tenuis** and **Wedelia calandulacea** (Table 3).These are used locally even are widely used by common people in different forms. These are also marketed outside the area and marketed by stack holders. These

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products are marketed and channelized to the nodal markets for their company based value. Pharmaceutical companies use the products like dry **Centella asiatica** plant; dry **Ichnocarpus frutescens** plants, **Gloriosa superba** roots and plant materials of **Plumbago zeylanica**.

Table 3: List of plant species having medicinal uses

Sl. No.	*Name*	*Family*	*Uses*
1.	Acanthus ilicifolius L. (Harkatch/Hargoja)	Acanthaceae	Plant parts like leaves are used in rheumatism and asthma.
2.	Acanthus volubilis Wall. (Lata Harkatch)	Acanthaceae	
3.	Achyranthes aspera L.	Amaranthaceae	Plant decognotion is used as an emmengogue, in piles and skin eruptions.
4.	Adhatoda vasica Nees	Acanthaceae	Leaves
5.	Ageratum conyzoides L.	Asteraceae	Herb infusion is given in stomach ailments such as diarrhoea, dysentery and intestinal colic with flatulence.
6.	Aloe vera Tourn. ex L.	Liliaceae	Leaves
7.	Alternanthera sessilis R.Br.	Amaranthaceae	It is used for indigestion, burning sensation, diarrhoea and fever and also used as leafy vegetables.
8.	Ambroma augusta L.f.	Sterculiaceae	Flowers and seeds
9.	Anacardium occidentale L.	Anacardiaceae	Bark and leaves infusion is used to relief from toothache and sore gums.Roasted and raw kernels are eaten as a desert, employed in confectionery and are highly nutritious.
10.	Andrographis paniculata (Burm.f.) Wall ex Nees	Acnthaceae	Leaves
11.	Argemone maxicana L.	Papaveraceae	Leaves are useful in cough and skin diseases. Roots are useful in guinea worm infection, skin disease and leprosy.
12.	Azadirachta indica A.Juss	Meliaceae	Fruits, bark and leaves Flowers are fried and eaten. The oil extracted from flowers, fruits, seeds keeps skin clean and protect from infection also acts as mosquito repellent.
13.	Barringtonia acutangula Gaertn.	Barringtoniacae	Fruit is bitter, anthelmintic, astringent. Leaf juice is given in diarrhoea.
14.	Borassus flabellifer L.	Arecaceae	Root is diuretic and anthelmintic. Fruits are used in dyspepsia, flatulence, colic and skin diseases.
15.	Bryophyllum calycinum Salisb.	Crassulaceae	Leaves
16.	Caesalpinia bonduc (L.) Roxb.	Caesalpiniacee	Leaf paste is applied on swollen testicles; useful against jaundice and rheumatism.
17.	Calophyllum inophyllum L.	Clusiaceae	Seed oil is used as a stimulant embrocating in rheumatism and gout; Oil cures scabies and other cutaneous disease. Stem bark is astringent.
18.	Calotropis gigantean(Linn.) R.Br.ex Ait.	Ascleapiadacee	Root bark is diaphoretic and expectorant; acts as a might stimulant. Powdered root bark gives release diarrhoea and dysentery
19.	Cassia occidentalis L.	Caesalpiniacee	Whole plant has purgative, febrifuge and diuretic properties; plant decoction is used in sores, dysentery and stomach troubles.
20.	Casuarina equisetifolia L.	Casuarinaceae	Bark is a tonic and astringent, useful in diarrhoea and dysentery.
21.	Catharanthus roseus L.	Apocynaceae	Whole plant body has important medicinal property including tie treatment of cancer,fever etc.
22.	Cissus quadrangularis L.	Vitaceae	Stem and root paste is used in bone fractures
23.	Citrullus colocynthis L.	Cucurbitaceae	Commonly known as bitter cucumber to the local people,fruits and roots are useful in kidney infection,jaundice etc.
24.	Clerodendrum inerme (L.) Gaertn.	Verbenaceae	Fresh and dry leaves possess alternative and febrifugal properties. Root boiled in coconut oil is useful in rheumatism.
25.	Cocos nucifera L.	Arecaceae	Roots are astringent and diuretic. Juice of young fresh spadix is intoxicating; useful in dyspepsia and diarrhoeas and leprosy. Fresh unripe fruit pulp is diuretic
26.	Crotalaria retusa L.	Papilionaceae	Root powder mixed with spices used as a remedy for colic.leaves is used in fevers
27.	Croton bonplandianum Baill.	Euphorbiaceae	Leaves are useful in skin diseases and wounds
28.	Cynodon dactylon (L.) Pers.	Poaceae	Plant decoction is diuretic; useful in dropsy and anasarca.
29.	Cyperus rotundus L.	Cyperaceae	Cyperaceae The root extract oil instilled into eyes in conjunctivitis reduces the pain, redness and ocular discharges.
30.	Eragrostis viscose Retz.	Poaceae	Used as livestock fodder.

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31.	Evolvulus alsinoides (L.)L.	Convolvulaceae	Herb is used to cure dysentery, chronic bronchitis, fever, hiccups and jaundice and as antiseptic.
32.	Emblica officinalis Gaertn.	Euphorbiaceae	Fruits
33.	Enhydra fluctuans Lour.	Asteraceae	Twigs
34.	Euphorbia antiquorum L.	Euphorbiaceae	Roots
35.	Euphorbia nerifolia L.	Euphorbiaceae	Leaves
36.	Gisekia phernaceoide L.	Aizoaceae	leaves and roots are useful for skin infection and stomach ache.
37.	Gloriosa superb L.	Liliaceae	Tuber, roots, Leaves and Flowers
38.	Hemidesmus indicas(L.) R.Br.	Asclepiadaceae	Root and black pepper paste is used in stomach pain and diarrhoea.
39.	Ichnocarpus frutescens R. Br.	Apocynaceae	Roots
40.	Ipomoea pes-caprae (L.) R.Br.	Convolvulaceae	It is a sand binder; leaves and roots are useful for gonorrhoea, rheumatism, skin infection and stomach ache.
41.	Jatropha gossypifolia L.	Euphorbiaceae	Twigs, stems, Roots are used for leprosy; bark decoction as emmemagogue; leaves to cure stomach ache, venereal diseases and as blood purifier.
42.	Kyllinga triceps Roth.	Cyperaceae	The juice of the leaves are used in the skin injury by the ethnic races.
43.	Lantana camara L.	Verbenaceae	Invasive species of this particular zone.
44.	Launaea sermentosa (Willd.) Schult-Bip.ex O.Kuntze	Asteraceae	Good sand binder and plant juice is applied for the treatment of rheumatism.
45.	Leucas aspera (Willd.) Link	Lamiaceae	Leaf juice is used for chronic skin eruptions and painful swellings.
46.	Marselia quadrifolia L.	Marseliaceae	Leaves
47.	Mimosa pudica L.	Mimosaceae	Root paste in the water collected after washing the raw rice is given orally for the snake bite. Leaf paste is applied to glandular swellings.
48.	Ocimum sanctum L.	Lamiaceae	Leaves
49.	Oldenlandia stricta L.	Scrophulariacee	
50.	Opuntia Stricta (Haw.) Haw.	Cactaceae	Baked fruit is given for whooping cough
51.	Pandanus fascicularis Lam.	Pandanaceae	Flowers are used in perfumes. Leaves are useful in making mats and baskets.
52.	Pedalium murex L.	Pedaliaceae	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.
53.	Phoenix paludosa (L.) Roxb	Arecaceae	Fruits are edible. Popularly used as thatching material and in fencing.
54.	Phoenix sylvestris (L.) Roxb.	Arecaceae	Dried leaves are used as brooms. Fruits are eaten after ripening. It is also used in fencing.
55.	Phyla nudiflora (L.)Greene	Verbenaceae	Freash plant paste or poultice is applied as sappurent for boils, swollen cervical glands and chronic indolent ulcers.
56.	Plumbago zeylanica L.	Plumbaginacee	Roots
57.	Pongamia pinnata(L.) Pierre	Papilionaceae	Dried flowers decoction is given to Diabetics,seed oil in Scabies,leucoderma.
58.	Prosopis juliflora (Swand.)	Mimosaceae	The leaves having insecticidal effect
59.	Ricinus communis L.	Euphorbiaceae	Seed oil gel is useful in dermatitis; protective in occupational eczemas and dermatitis.
60.	Saccharum spontaneum L.	Poaceae	Grass is used as fodder; also used for thatching and for making ropes
61.	Smilax ovalifolia Roxb.	Smilacaceae	Roots
62.	Stephania japonica (Thumb.) Miers.	Menispermacee	Leaves
63.	Swietenia macrophylla King	Meliaceae	Seed/Fruit
64.	Swietenia mahagony L.		
65.	Tamarix troupii Hole	Tamaricaceae	Used as remedy of ulcer
66.	Tephrosia purpurea(L)	Papilionaceae	Excellent medicine for eczema when applied with turmeric.
67.	Tephrosia villosa(L.) Pers	Papilionaceae	Root paste and powder is effective for brushing the teeth and also applied for the relief of pain of Scrotum
68.	Thespesia populnea (L.)	Malvaceae	Roots are used for relif from Cholera and dysentery
69.	Tylophora tenuis Bl.	Asclepiadaceae	Roots
70.	Vitex negundo L.	Verbenaceae	Leaves

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71.	Wedelia calandulacea Less. Non Rich.	Asteraceae	Leaves

The demand of the local plants of wild kind is high in local markets. Source and sink relation is directly connected via multidirectional ways as the products are community dependant and with a good kith and kin relation among them. Highly priced and demandable species found there is **Moringa oleifera** (Table 4) and species of demandable kind are **Musa paradisiaca**, **Polygonum plebejum, Spondias pinnata, Tamarindus indica, Typhonium trilobatum, Marselia quadrifoliata, Amorphophalus sylvatica** and **Colocasia esculenta**. The corms of **Typhonium** rtrilobatum is also marketed for its great demand and used in cancer research.

Table 4: List of plant species used as vegetables of wild and semi-wild in occurrence

Sl. No.	*Name*	*Useful Parts*	*Remarks*
1.	Amorphophalus campanulatus auct. non Blume ex Decne.	Corm	Demandable
2.	Averhoeea carambola L.	Fruits	Low Demand
3.	Canavalia maritime (Aubl.) Thou.	Young pods and seeds are used as vegetables	Demandable
4.	Centella asiatica (L.) Urban.	Whole plant (Dry)	Marketed
5.	Chenopodium album L.	Green Veg.	Marketed
6.	Colocasia esculenta (L.) Schott	Corm	Demandable
7.	Dillenia indica L.	Fruits	Highly Demandable
8.	Dioscorea alata L.	Tuber	Demandable
9.	Diplazium sp.	Fronts (Leaves)	Less Demandable
10.	Enhydra fluctuans Lour.	Green twigs	Demandable
11.	Ipomoea aquatic Forsk.	Twigs	Demandable
12.	Ipomoea aquatica L.	Leaves are eaten as vegetables with high food value.	Highly Demandable
13.	Ipomoea batatas (L.) Lam.	Tuberous Roots	Highly Demandable
14.	Marselia quadrifolia L.	Leaves with twigs	Highly Demandable
15.	Moringa oleifera Lamk.	Leaves, Fls., Fruits (Drumsticks)	Demandable
16.	Musa paradisiacal L.	Plantain	Highly priced and demandable
17.	Paederia scandens (Lour.) Merrill	Gadal/Gandhi	Demandable
18.	Polygonum plebejum R. Br.	Twigs as Chikuni	Low Demand
19.	Salicornia brachiata Roxb.	Leaves and young shoots are eaten	Demandable
20.	Salvadora persica L.	Plants are used for making salads and are often taken as fried snacks with rice.	Highly Demandable
21.	Spondias pinnata (L. f.) Kurz	Fruits	Demandable
22.	Tamarindus indica L.	Twigs, green raw fruits	Demandable
23.	Typhonium trilobatum (L.) Schoot	Leaves with petiole	Demandable

Plants of Research Importance in Physiologically dry soil and in sandy beach area are some halophytes. These are **Sonneretia apetala** (Keora), **Salicornia herbacea** (Penisak), **Suaeda monoica** and **S. maritima**. Fern found there as common one is species like **Acrostichum aureum**. Fodder grass found there is **Aleuropus lagopodides**. Sand binder species found there are **Ipomoea pes-capre, Salsola kalitenuifolia, Porteresia coarctata, Launea sermentosa, Hydrophylax maritima, Gisekia pharnacoides . Halophytic associates are species like Excoicaria agallocha** (Geo) and **Acanthus ilicifolius** (Hargoja). Species of rare occurrence is **Acanthus volubilis**. Common cactus found there is **Opuntia monocantha** (Table 5).

Table 5: Plants of Research Importance in connection with Ecology at the habitat of physiologically dry soil

Sl. No.	*Name*	*Family*	*Ecological Notes*	*Important Notes*
1.	Acanthus ilicifolius L. (Harkatch/Hargoja)	Acanthaceae	Common in coastal canals	Gregarious aside the ecotone ridge of tidal swamp.
2.	Acanthus volubilis Wall. (Lata Harkatch)	Acanthaceae	Rare in occurrence	Twining shrub now rare species along the sea coast joined with canal.
3.	Acrostichum aureum L.	Pteridaceae	Widely distributed	Need shrubby and tree vegetation
4.	Aleuropus lagopodides (L.) Trin	Poaceae		
5.	Arthrocenemum indicum (Willd.) Moq.	Chenopodiaceae		
6.	Avicennia alba Bl. =A. officinalis var. alba Cl. (Dulia Bain)			Lanceolate-acute leaves and narrow –ellipsoid fruits

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7.	Avicennia marina var. marina (Fors.) Vierh. (Boro Baen)		Rare in occurrence, It is apioneer species towards sea-ward areas subjected to high wave action , high salinity, and silt deposition and stabilizes intertidal land mass.	Elliptic oblong to elliptic ovate leaves
8.	Avicennia officinalis L. (Kalo Baen)	Avicenniaceae	Low population	Large sized tree, obovate to ovate-oblong leaves.
9.	Bulbostylis barbata (Rottb.) C.B. Cllarke (Phulur)	Cyperaceae	Moderately abundant	Herbs
10.	Excoicaria agallocha L. (Geoan)	Euphorbiaceae	Common	Tree
11.	Gisekia pharnaceoides L. (Salup)	Azoiaceae	Common	Herb
12.	Hydrophylax maritima L. (Comir)	Rubiaceae	Less common	Herb
13.	Ipomoea pes-capre (L.) R.Br.	Convolvulaceae	Common	Climber
14.	Launea sementosa (Willd.) Schult. –Bip.ex O. Kuntze (Halde)	Asteraceae	Common	Herb
15.	Opuntia monocantha Haw. (Fanimansa)	Opuntiaceae	Less abundant	Shrub
16.	Porteresia coarctata (Roxb.) Tateoka (Dhanighas)	Poaceae	Less abundant	Herb
17.	Salicornia herbacea L. (Saltwort)	Chenopodiacaea	Mineral rich plant	Herb
18.	Sonneretia apetala Buch. -Ham. (Keora)	Sonneretiaceae	Previously it was widespread but now it is near threatened	Narrowly elliptic leaves, apetalous flowers.
19.	Suaeda monoica Forsk. Ex Gmel. (Nunia)	Chenopodiaceae	Salinity indicator	Small herb
20.	Suaedia maritime var. australis (R.Br.) Domin (Nonasak)	Amaranthaceae	Salinity indicator	Herb

Table 6: List of potential sand binder plant species

Sl. No.	*Name*	*Family*	*Uses*
1.	Bulbostylis barbata Roth.	Cyperaceae	Potent soil binding species.
2.	Hydrophylax maritima L.f.	Rubiaceae	It is a good sand binder and protect the coast from erosion
3.	Ipomoea pes-caprae (L.) R.Br.	Convolvulaceae	It is a sand binder; leaves and roots are useful for gonorrhoea, rheumatism, skin infection and stomach ache.
4.	Launaea sermentosa (Willd.)	Asteraceae	Good sand binder and plant juice is applied for the treatment of rheumatism.
5.	Panicum repens L.	Poaceae	This species also a dangerous weeds but this species could be used for soil erosion control
6.	Sesuvium portulacastrum (L.) L.	Aizoaceae	A very good sand binder. Young plants are edible after boiling to remove the excess the salt.
7.	Spinifex littoreus (Burm.f.) Merr.	Poaceae	It is an excellent soil binder. Dried grass is used as fuel.

Table 7: List of plant species used as House materials

Sl. No.	*Name*	*Family*	*Uses*
1.	Calophyllum inophyllum	Clusiaceae	Making of wooden showpiece and other wooden equipments
2.	Casuarina equisetifolia L.	Casuarinaceae	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.
3.	Crotalaria retusa L.	Papilionaceae	Root powder mixed with spices used as a remedy for colic.leaves is used in fevers. It also yields fibre, which is used in cordage and canvas
4.	Pandanus fascicularis Lam.	Pandanaceae	Flowers are used in perfumes. Leaves are useful in making mats and baskets
5.	Phoenix paludosa (L.) Roxb.	Arecaceae	Fruits are edible. Popularly used as thatching material and in fencing.
6.	Phoenix sylvestris (L.) Roxb.	Arecaceae	Dried leaves are used as brooms. Fruits are eaten after ripening. It is also used in fencing
7.	Saccharum spontaneum L.	Poaceae	Grass is used as fodder; also used for thatching and for making ropes.
8.	Phragmites karka(Retz.)	Poaceae	Leaves are used in making of mats, fish baskets,thatching materials.
9.	Ipomoea fistulosa L.	Convolvulaceae	Though it is an invasive species but it is often used by the people in demarcation of their house area.

Table 9: Mangrove associates in Khejuri-Hijili Coast of Purba Medinipur, West Bengal, India

Sl. No.	*Name*	*Family*	*Habit*	*Habitat*
1.	**Barringtonia racemosa** Roxb.	Baringtoniaceae	Small tree	Near bank of river and pond
2.	**Cannavelia rosea** (Sw.) DC.	Fabaceae	Twiner	Near bank of river

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3.	**Caesalpinia bonduc** (L.) Roxb.	Caesalpiniaceae	Bushy shrub	Shrubberies, Coastal bund
4.	**Clerodendrum inerme** Gaertn.	Verbenaceae	Shrub	Wasteland, Degraded land
5.	**Fimbrystylis ferruginea** (L.) vahl.	Cyperaceae	Small shrub	Coastal canalside.
6.	**Ipomoea tuba** (Schl.) G. Don	Convolvulaceae	Creeper	Coastal dyke
7.	**Merope angulata** (Willd.) Swingle	Rutaceae	Herb	Coastal canal side
8.	**Pandanus odoratissimus** L. f.	Pandanaceae	Bushy Shrub	Coastal area and in rice field.
9.	**Pluchea alba** Less.	Asteraceae	Shrub	Garden side
10.	**Salacia chinensis L.**	Hypocrataceae	Herb	Near river bank
11.	**Stenochlaena palustre** (Burm.) Bedd.	Polypodiaceae	Under shrub	Underneath of Canal shrubberies
12.	**Stictocardia tillifolia** (Desr.) Hall.f.	Convolvulaceae	Twiner	Cnal shrubberies
13.	**Thespesia populnea** (L.) Sol. Ex Correa	Malvaceae	Tree	Planted as in garden and bank of Pond
14.	**Tylophora tenuis** Bl	Asclepiadaceae	Twiner	Coastal dyke and in jungle.

Floral elements as Mangrove associates found there are tree species like **Thespesia populnea, Barringtonia racemosa**, whereas bushy shrubs are **Caesal[pinia bonduc** and **Pandanus odoratissimus**. Shrubs as mangrove associates are species like **clerodendrum inerme, pluchea alba**. Herbs found in the same site, are species like **Merope angulata, Salacia chinensis** etc. (Table 9). A special twiner i.e. **Cannavelia rosea** is also found there which is found with **Ipomoea pes-capre** in sea shore. The study revealed that, the present study sites need immediate protection of some key stone species. These are **Tylophora tenuis, Stictocardia tillifolia** and **Salacia chinensis**. For the study of microclimate, these species are necessary along with nutrients cycling of the species in the same site. Other species of shrubberies habitat, need protection with the special attention of the community as in- situ type. Species like **Ichnocarpus frutescens** R. Br. (A species of low occurrence need immediate protection because this species is used in various ways and need local protection), **Phoenix sylvestris** Roxb. (Leaves used in thatching purpose and even to prepare broom need immediate protection as a fruit tree even producing molasses), **Zizyphus oenoplea** Mill. and **Syzygium cumuni** Skeels need immediate and urgent protection to enhance the ecosystem sound due to their all great range of importance. **Typhonium trilobatum** require special concentration to safeguard the same in the present habitat, because it is now-a –days used in cancer research.

7. Causes of Coastal Degradation and Threats to the Coastal Bio-diversity

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 Purba Medinipore district of west Bengal clearly reveals and proves the aforesaid testimonial. The steady virginity of Mandermoni is still preserved rather the dune vegetation of Digha coast has already been smashed due to **gigantic constructions and other civilized interventions**. The honorable high court of West Bengal (India) has already given stay order to stop the constructions at Mandermoni.
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. As sea erosion is a major problem in temperate and tropical regions, extensive projects have been implemented to avoid beach erosion in West Bengal and adjacent Orissa.
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 equisitifolia 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 Digha, new Digha of Purba Medinipore District of West Bengal and Puri in Orissa are completely destroyed and facing **a serious erosion problem** every year during the Monsoon time.
6) **Stone fencing at different places in eastern coastline** reduce the input of nutrients to the sand dunes. These construction activities adversely affected sand dune vegetation specifically disturbing the biogeochemical cycle, microbial activities.
7) Mostly talking the harshest detrimental grounds of coastal vegetation in this particular area is the anthropogenic activities. In Mandermoni, Tajpur, Junput, Hijili and Digha-Sankarpur adjoining areas of Midnapore Coast, West Bengal the large 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 most of the coast line of West Bengal shows signs of erosive patterns particularly in most of the tourist spots like Hijili, Tazpur, Mandermoni, New-Digha of West Bengal. As for example it is manifest that the patches of the pioneer soil binding grasses Spinifex littoreus (Burm.f.) Merr. is humiliating steadily at Mandermoni, Sankarpur at the coast of Bengal during the recent years.

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8. Possible Conservational Strategies

Among the methods to stabilize the population of coastal vegetation the method of revegetation is the best substitute as it is contemptible and self sustaining. The plantation of tree species successful in trapping sand and decreases the wind velocity but the plantation of the exotic species Casuarina in this area throughout the coastal line has yet not been too much effective from our point of view. Legal protections of the plant species along the coastal line are very essential. Development of tourism is also mandatory to fulfill the need of civilization but the constructions must be intended apart from the coastal vegetation keeping distance sufficiently from the sea shore. Raising public awareness and also to provide programmes and economic support to the local communities for the restoration and protection of the all the flora and the fauna of the coastal line.

For the coastal zone, two types of linkages are necessary to achieve inter-sectoral cohesion viz. (i) linkages between the agricultural sector and the industrial sector and (ii) Inter-industry linkages. The planned development of Haldia is apparently considerate to the latter. However, for the vast outlying rural areas including the remotely located places in the Sundarbans region, a linkage relationship is to be established between the agriculture and the industrial sector for a symbiotic growth. Agro-based industry should be set up for reducing the pressure on land and rectifying the increasingly adverse mainland ratio. This could also help in providing the rural population with opportunities for improving their living standards. The said linkage could help provide market for rural skill based products. The frame of work should be made by Scientists, researchers and Government while the force should be overwhelmed by policymakers and politicians to make it a complete and eco-sustainable in near future. So, more and more projects are required to make a comprehensive report of the said area to solve the problem in near future.

9. Future Scope of the Study

There are some specific limitations, which should be addressed as a means of improvement for further study. This study has equipped based on intensive literary and field survey, but it was not possible to perform a questionnaire survey and enough instrumental survey and analysis in the field because of time limits. Planning is never whole without local people's opinions incorporated. The study can be considered as the guideline or instruction for ecotourism planning based on coastal environment including the geology and geomorphology, climatology and ecology of this coastal corridor. More ecological Researches on stabilization and protection, dynamics of coast character including other perspectives as well as documentation of flora and fauna are urgently needed. Yet, this research will expose opportunities for further research and investigation, and help decision makers to review what options exist for improving and humanizing coastal environment with its tourism facilities having uninterrupted ecology over Medinipur coastal belt as the Coastal and Beach Tourism Circuit in Purba Medinipur of West Bengal, Digha–Shankarpur–Tajpur-Mandarmani-Junput-Hijili-Nijkasaba, has been increasing its tourism gravity day-to-day and how they can better ecotourism planning especially, from a point of reducing the negative impacts from comprehensive development in this region.

10. Conclusion

The species of costal Midnapore are extremely important resources, which play a vital role in the economic and social life of nearby people. Preservation and thoughtful utilization of the costal plant wealth is important because they have become endangered by over mistreatment, 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. The inventory of over 90 plant species as used by the costal people throws some light on the economic and medicinal importance of these species, Hence, there is a need for detailed investigations of geo-environmental analysis with ethno- botanical knowledge held by these local villagers before such costly knowledge is lost everlastingly. A balanced and sustainable method of exploitation can help humanizing the life of the local people while maintaining ecological sense of balance of costal habitats.


- **Ipomoea pes-caprae**
- **Pandanus fascicularis Lam**


- **Casuarina equisetifolia L.**
- **Salicornia brachiata Roxb.**


- **Calotropis gigantea (Linn.) R.Br.ex Ait**
- **Bulbostylis barbata**

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Mangrove vegetation Saw palmetto


Cabbage palm Railroad vine


Sesuvium portulacstrum Cannavelia lineata

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