



## STUDIES ON THE PHYTORESOURCES OF COASTAL DUNE FLORA AT WEST BENGAL AND ADJACENT ORISSA, INDIA

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### ABSTRACT

Coastal dune floras have immense effect in dune stabilization and restoration. The coastal dune contains phytoresources having great socio-economical values which remains unexplored to most of the people, thus results in destruction and removal of dune floras continuously. This paper reports the composition and distribution of CSD floras including a total of 60 species belonging to 56 Genera and 33 families surveyed during August 2008-December 2011 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 and adjacent Orissa. These CSD floras under tremendous anthropogenic pressure due to rapid elimination of sand dunes and its associated vegetation and because of this the traditional knowledge with them is also gradually diminishing. Such sensitive and useful ecosystems need immediate restoration, conservation actions and sustainable use of the phytoresources.

**KEY WORDS:** Coastal sand dune, phytoresources, traditional knowledge, conservation, sustainable use.

### INTRODUCTION

Coastal sand dunes are the natural structures which protect the coastal environment by absorbing energy from wind, tide and wave action (Corre Jean-Jacques, 1991). These species are playing a vital 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 non-living 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 West Bengal is also rich in plant resources, which harbour 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 over-exploitation. 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 endangered species. So the exploration of knowledge and strategies for the conservation of biodiversity of such an important sensitive ecosystems along with their sustainable uses by the ethnic races present in proximity of the dune vegetation are required immediately.

### MATERIALS AND METHODS

#### Location

The study was carried out on the zone of Bay of Bengal specifically from the East(Purba) Medinipore district of West Bengal to the end part of Orissa Which lies in between the latitude 21°36'50"N and 19°48'00"N and longitude ranging from 85°52'40"E to 87° 37'00"E covering near about 176 km of coast line from Purba Medinipore district of West Bengal to Baleswar district of Orissa and it is evident that as much as 70 km is vulnerable to severe sea-erosion particularly during the south-west monsoon. After consulting geographical map of this particular area the beaches namely Mandarmoni, Sankarpur, Digha, New-Digha of West Bengal and Talsari, Udaypur, Chandbali of Orissa were several time visited by our team at different season from August 2008-December 2011 and the data were well documented including the records of native sand dune species composition.

#### Pattern of Survey

The large area that is 10m X 10m patches of sandy plant were chosen following the Quadrature method for study of species composition and relative cover. The plant samples were randomly collected using quadrature (1m<sup>2</sup>) along transects perpendicular to the shore.

#### Identification and preservation of specimen

A literature survey was carried out for compilation of existing information on various uses of the coastal sand dune species at different parts of the coast of West Bengal and adjacent Orissa (Anonymous, PID-CSIR, 1986; Hooker, 1984; Chapman, 1976; Untawale 1994). Each of the plant material was 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 were collected and identified by referring to standard flora(Hooker,1884).

The voucher specimens were maintained in the herbarium at Department of Botany and Forestry, Vidyasagar University, Midnapur, India.

## RESULTS AND DISCUSSION

### Species richness and phytoreources

Dune 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 ethno-

medicinal, 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 60 species belonging to 56 Genera and 33 families were identified during this survey and while comparing the studied population with the overall Indian coastal sand dune species using independent t-test at the 0.05 level, the means of two populations are Not significantly different (Table 7). 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. Among the species, herbs were found to be more (30 sp.) followed by trees (14 sp.), shrub (12 sp.) and climbers (4 sp.).

TABLE 1: Soil Sample analysis

State	Coastal site	Sand Quality	pH	Organic matter
West Bengal ( East Medinipore district)	Mandarmoni	Medium to Fine	7.5 – 7.6	0.07-0.23
	Shankarpur	Medium	7.3-7.4	0.07-0.21
	Digha	Coarse	7.1-7.2	0.01-0.14
	New Digha	Coarse	7.1-7.2	0.02-0.12
Orissa (Jaleswar, Puri District)	Talsari	Medium to Fine	7.5-7.6	0.08-0.21
	Udaypur	Medium	6.8-7.0	0.07-0.15
	Puri	Coarse	7.0 – 7.1	0.01-0.07

TABLE 2: Zonations of Different plant species.

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

The distribution reveals that the diversity of flora is increasing 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 troupitii* 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 useful 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 the 60 species of sand dune vegetation of traditional and ethno-botanical interest are recorded after critical screening with the available literature. These are recommended for the further phytochemical investigations, which might result in the discovery of new dunes for human welfare. Several authors pointed out in various parts of the world, many ecosystems support high plant richness and diversity values. From this point of view this study also indicates the richness flora with highest number of native plants.

**TABLE 3:** List of plant species having medicinal uses.

Plant Name	Family	Uses
<i>Acanthus ilicifolius</i> L.	Acanthaceae	Plant parts like leaves are used in rheumatism and asthma.
<i>Achyranthes aspera</i> L.	Amaranthaceae	Plant decoction is used as an emmenagogue, in piles and skin eruptions.
<i>Ageratum conyzoides</i> L.	Asteraceae	Herb infusion is given in stomach ailments such as diarrhoea, dysentery and intestinal colic with flatulence.
<i>Alternanthera sessilis</i> R.Br.	Amaranthaceae	It is used for indigestion, burning sensation, diarrhoea and fever and also used as leafy vegetables.
<i>Anacardium occidentale</i> 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.
<i>Argemone maxicana</i> L.	Papaveraceae	Leaves are useful in cough and skin diseases. Roots are useful in guinea worm infection, skin disease and leprosy.
<i>Azadirachta indica</i> A.Juss	Meliaceae	Flowers are fried and eaten. The oil extracted from flowers, fruits, seeds keeps skin clean and protect from infection also acts as mosquito repellent.
<i>Barringtonia acutangula</i> Gaertn.	Barringtoniaceae	Fruit is bitter, anthelmintic, astringent. Leaf juice is given in diarrhoea.
<i>Borassus flabellifer</i> L.	Arecaceae	Root is diuretic and anthelmintic. Fruits are used in dyspepsia, flatulence, colic and skin diseases.
<i>Caesalpinia bonduc</i> (L.) Roxb.	Caesalpinaceae	Leaf paste is applied on swollen testicles; useful against jaundice and rheumatism.
<i>Calophyllum inophyllum</i> 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.
<i>Calotropis gigantean</i> (Linn.) R.Br.ex Ait.	Asclepiadaceae	Root bark is diaphoretic and expectorant; acts as a mild stimulant. Powdered root bark gives release diarrhoea and dysentery.
<i>Cassia occidentalis</i> L.	Caesalpinaceae	Whole plant has purgative, febrifuge and diuretic properties; plant decoction is used in sores, dysentery and stomach troubles.
<i>Casuarina equisetifolia</i> L.	Casuarinaceae	Bark is a tonic and astringent, useful in diarrhoea and dysentery.
<i>Catharanthus roseus</i> L.	Apocynaceae	Whole plant body has important medicinal property including treatment of cancer, fever etc.
<i>Cissus quadrangularis</i> L.	Vitaceae	Stem and root paste is used in bone fractures.
<i>Citrullus colocynthis</i> L.	Cucurbitaceae	Commonly known as bitter cucumber to the local people, fruits and roots are useful in kidney infection, jaundice etc.
<i>Clerodendrum inerme</i> (L.) Gaertn.	Verbenaceae	Fresh and dry leaves possess alternative and febrifugal properties. Root boiled in coconut oil is useful in rheumatism.
<i>Cocos nucifera</i> 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.
<i>Crotalaria retusa</i> L.	Papilionaceae	Root powder mixed with spices used as a remedy for colic. leaves is used in fevers
<i>Croton bonplandianum</i> Baill.	Euphorbiaceae	Leaves are useful in skin diseases and wounds.
<i>Cynodon dactylon</i> (L.) Pers.	Poaceae	Plant decoction is diuretic; useful in dropsy and anasarca.
<i>Cyperus rotundus</i> L.	Cyperaceae	The root extract oil instilled into eyes in conjunctivitis reduces the pain, redness and ocular discharges.
<i>Eragrostis viscose</i> Retz.	Poaceae	Used as livestock fodder.
<i>Evolvulus alsinoides</i> (L.)L.	Convolvulaceae	Herb is used to cure dysentery, chronic bronchitis, fever, hiccups and jaundice and as antiseptic.
<i>Gisekia phernaceoides</i> L.	Aizoaceae	leaves and roots are useful for skin infection and stomach ache.
<i>Hemidesmus indicas</i> (L.) R.Br.	Asclepiadaceae	Root and black pepper paste is used in stomach pain and diarrhoea.
<i>Ipomoea pes-caprae</i> (L.) R.Br.	Convolvulaceae	It is a sand binder; leaves and roots are useful for gonorrhoea, rheumatism, skin infection and stomach ache.
<i>Jatropa gossypifolia</i> L.	Euforbeaceae	Roots are used for leprosy; bark decoction as emmenagogue; leaves to cure stomach ache, venereal diseases and as blood purifier.
<i>Kyllinga triceps</i> Roth.	Cyperaceae	The juice of the leaves are used in the skin injury by the ethnic races.
<i>Lantana camara</i> L.	Verbenaceae	Invasive species of this particular zone.
<i>Launaea sermentosa</i> (Willd.) Schult-Bip.ex O.Kuntze	Asteraceae	Good sand binder and plant juice is applied for the treatment of rheumatism.

<i>Leucas aspera</i> (Willd.) Link	Lamiaceae	Leaf juice is used for chronic skin eruptions and painful swellings.
<i>Mimosa pudica</i> 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.
<i>Oldenlandia stricta</i> L.	Scrophulariaceae	
<i>Opuntia Stricta</i> (Haw.) Haw.	Cactaceae	Baked fruit is given for whooping cough.
<i>Pandanus fascicularis</i> Lam.	Pandanaceae	Flowers are used in perfumes. Leaves are useful in making mats and baskets.
<i>Pedaliium murex</i> 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.
<i>Phoenix paludosa</i> (L.) Roxb.	Arecaceae	Fruits are edible. Popularly used as thatching material and in fencing.
<i>Phoenix sylvestris</i> (L.) Roxb.	Arecaceae	Dried leaves are used as brooms. Fruits are eaten after ripening. It is also used in fencing.
<i>Phyla nudiflora</i> (L.)Greene.	Verbenaceae	Fresh plant paste or poultice is applied as sappurent for boils, swollen cervical glands and chronic indolent ulcers.
<i>Prosopis juliflora</i> (Swand.)	Mimosaceae	The leaves having insecticidal effect.
<i>Ricinus communis</i> L.	Euphorbiaceae	Seed oil gel is useful in dermatitis; protective in occupational eczemas and dermatitis.
<i>Saccharum spontaneum</i> L.	Poaceae	Grass is used as fodder; also used for thatching and for making ropes.
<i>Tamarix troupii</i> Hole	Tamaricaceae	Used as remedy of ulcer.
<i>Tephrosia purpurea</i> (L)	Papilionaceae	Excellent medicine for eczema when applied with turmeric.
<i>Tephrosia villosa</i> (L.) Pers.	Papilionaceae	Root paste and powder is effective for brushing the teeth and also applied for the relief of pain of Scrotum.
<i>Thespesia populnea</i> (L.)	Malvaceae	Roots are used for relief from Cholera and dysentery.
<i>Pongamia pinnata</i> (L.) Pierre	Papilionaceae	Dried flowers decoction is given to Diabetics,seed oil in Scabies,leucoderma.

**TABLE 4:** List of plant species used as Vegetables.

Plant Name	Family	Uses
<i>Canavalia maritima</i> (Aubl.) Thou.	Fabaceae	Young pods and seeds are used as vegetables.
<i>Salicornia brachiata</i> Roxb.	Chenopodiaceae	Leaves and young shoots are eaten.
<i>Ipomoea aquatica</i> L.	Convolvulaceae	Leaves are eaten as vegetables with high food value.
<i>Salvadora persica</i> L.	Salvadoraceae	Plants are used for making salads and are often taken as fried snacks with rice.

**TABLE 5:** List of plant species used as House materials.

Plant Name	Family	Uses
<i>Calophyllum inophyllum</i>	Clusiaceae	Making of wooden showpiece and other wooden equipments.
<i>Casuarina equisetifolia</i> 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.
<i>Crotalaria retusa</i> 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.
<i>Pandanus fascicularis</i> Lam.	Pandanaceae	Flowers are used in perfumes. Leaves are useful in making mats and baskets.
<i>Phoenix paludosa</i> (L.) Roxb.	Arecaceae	Fruits are edible. Popularly used as thatching material and in fencing.
<i>Phoenix sylvestris</i> (L.) Roxb.	Arecaceae	Dried leaves are used as brooms. Fruits are eaten after ripening. It is also used in fencing.
<i>Saccharum spontaneum</i> L.	Poaceae	Grass is used as fodder; also used for thatching and for making ropes.
<i>Phragmites karka</i> (Retz.)	Poaceae	Leaves are used in making of mats, fish baskets,thatching materials.
<i>Ipomoea fistulosa</i> L.	Convolvulaceae	Though it is an invasive species but it is often used by the people in demarcation of their house area.

**TABLE 6:** List of potential sand binder plant species.

Plant Name	Family	Uses
<i>Bulbostylis barbata</i> Roth.	Cyperaceae	Potent soil binding species.
<i>Hydrophyllax maritima</i> L.f.	Rubiaceae	It is a good sand binder and protect the coast from erosion
<i>Ipomoea pes-caprae</i> (L.) R.Br.	Convolvulaceae	It is a sand binder; leaves and roots are useful for gonorrhoea, rheumatism, skin infection and stomach ache.
<i>Launaea sermentosa</i> (Willd.) Schult-Bip.ex O.Kuntze	Asteraceae	Good sand binder and plant juice is applied for the treatment of rheumatism.
<i>Panicum repens</i> L.	Poaceae	This species also a dangerous weeds but this species could be used for soil erosion control.
<i>Sesuvium portulacastrum</i> (L.) L.	Aizoaceae	A very good sand binder. Young plants are edible after boiling to remove the excess the salt.
<i>Spinifex littoreus</i> (Burm.f.) Merr.	Poaceae	It is an excellent soil binder. Dried grass is used as fuel.

**TABLE 7:** Comparison between Species richness of Coastline of West Bengal and adjacent Orissa with Indian perspective and Independent *t-Test* on Data1 col(A) and col(B) showing at the 0.05 level, the two means are NOT significantly different.

Category	A (No. Of species, Genera and family throughout coastal belt of India)	B (No. Of species, Genera and family throughout coastal belt of West Bengal and adjacent Orissa)
Species	154	60
Genera	108	56
Family	41	33

(Contd. with Tab.8) Independent t-Test on Data1 col. (A) and col. (B):

Data	Mean	Variance	N
A	101	3229	3
B	49.66667	236.33333	3

t = -1.51038  
p = 0.20546

At the 0.05 level, the two means are NOT significantly different.

### Vegetation Zonations

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

### Causes of Dune degradation and possible conservational strategies:

Causes of dune degradation in this area are as follows:-

A) Anthropogenic activities like massive tourist development, road constructions, dune recreational pressure, human trampling, off-road vehicles and parking lots etc.

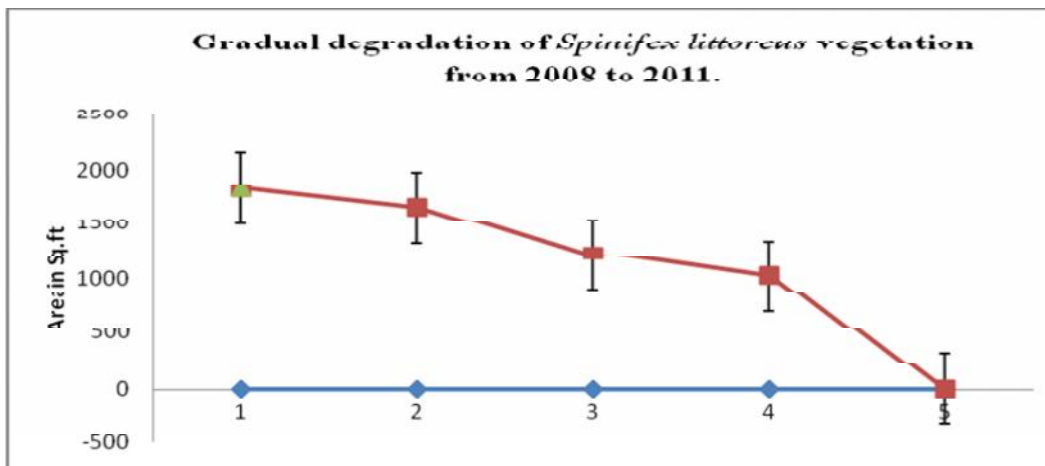
B) Natural disasters like heavy storm like Super Cyclone which had dropped down on the year 2001 at the coastal zone of Orissa

C) Rapid expansion of invasive species like *Calotropis gigantea*, *Lantana camara* etc leading to the loss of native species like *Ipomoea pes-caprae* etc.

Broadly speaking the most severe damaging cause of dune vegetation in this particular area is the anthropogenic activities. In Mandermoni and adjoining areas of 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 massive dune occupation most of the coast line of West Bengal and Orissa shows signs of erosive patterns

particularly in most of the tourist spots like Tazpur, Mandermoni, New-Digha of West Bengal and adjoining Orissa. As for example it is evident that the patches of the pioneer soil binding grasses *Spinifex littoreus* (Burm.f.) Merr. is degrading gradually at Mandermoni, West Bengal (Fig.1) during the recent years (as the data measured during quadrat sampling at the month of December on each year from 2008 to 2011).

Among the methods to stabilize the population of dune vegetation the method of revegetation is the best alternative as it is cheap and self sustaining. The plantation of tree species effective 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 necessary. Development of tourism is also required to fulfil the need of civilization but the constructions must be planned apart from the dune 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.



**Fig.1.** The trend of degradation of Patches (In Square Feet) of *Spinifex littoreus* (Burm.f.) Merr. At Mandermoni, West Bengal during the recent years (1=2008, 2=2009, 3=2010,4=2011) with 5% standard error.



**Fig.2.** Flowers *Ipomoea pes-caprae*



**Fig.3.** Male flower of *Spinifex littoreus* (Burm.f.) Merr.



**Fig.4.** *Pandanus fascicularis* Lam



**Fig.5.** *Gisekia fernaceoides*



**Fig.6.** *Bulbostylis barbata*



**Fig.7.** *Casuarina equisetifolia* L.



**Fig.8.** Construction of hotel destroying dune flora.



**Fig.9.** *Lantana camara* L., invasive species at the coastal dune.



**Fig.10.** Destruction of dune vegetation due to construction at Mandermoni.



**Fig.11.** *Salicornia brachiata* Roxb.



**Fig.12.** *Phyla nudiflora*



**Fig.13.** *Sesuvium portulacastrum* (L.) L.



**Fig.14.** Flower of *Calophyllum inophyllum* near Digha sea beach.



**Fig.15.** *Calotropis gigantea* (Linn.) R.Br.ex Ait. ,invasive species at the coastal dune.



**Fig.16.** *Launaea sermentosa* (Willd.) Schult-Bip.ex O.Kuntze



**Fig.17.** Fruit of *Pandanus fascicularis* Lam.

After the preliminary study we can conclude that the sand dune 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 above statement. The stable virginity of Mandermoni is still conserved rather the dune vegetation of Digha has already been destroyed due to huge constructions and other anthropogenic activities. The honorable high court of West Bengal (India) has already given stay order to stop the constructions at Mandermoni, West Bengal. Several different types of projects which involve people and groups in beach and dune related activities are described. Involvement in such activities is

seen as key to education and enhanced awareness on the role of sand dunes in the overall coastal system. Planting for wind breaker of species like *Phragmites karka* and *Saccharum spontaneum* are useful to check the blowing sands from coming into crops. Some of the following poisonous plants needs attention because they are unpalatable and poisonous. For example *Ricinus communis*, *Datura alba*, *C.gigantea*, *Euphorbia prostrata*, *Cistanche tubulosa* should be eradicated as soon as possible.

## CONCLUSION

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. Conservation and judicious utilization of the costal 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. The inventory of 81 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 ethno- botanical knowledge held by these 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 costal habitats.

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