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Community study of plant species in coastal areas of Mohana and Old Digha of Purba Medinipur District with special reference to Eco-sustenance of life in near future

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Abstract

The present paper reflects vegetation cover along with plant species of different kinds in Coastal area of Mohana to Old Digha of West Bengal, India. It consists of 81 plant species under 76 genera and 42 families of angiosperms. The five dominant families, as per the relative abundance (RA) studied are Asteraceae with 13.7, Fabacaea with 9.7, Scrophulariaceae with 5.4, Solanaceae with 8.6 and Verbenaceae with 9.7 value. The family Poaceae with four species having 11.3 abundance values (Total), but only the species *Spinifex littoreous* showed 9.0 RA which is highest for a single species of monocot among all the members of Poaceae in the said area. This species is dominant in the said area and found as soil and sand binder. Majority of the plant species found there are natural kind but a few of them are agricultural type and some are plants of introduced type used for various purposes. The tidal areas along with coastal canals are diverse due to presence of halophytes and halophytic associates. Some exotic elements of ecological importance have also been recorded from the sites with stress conditions need further study. These are *Lantana*, *Eupatorium* and *Parthenium* species as exotics. All the plants have made influence on the said habitat and extensively used by local people as fire wood or fuel purpose. Others species forming large vegetation of the said area boosts huge protection for the eco-habitat and change the habitat best suit for new comer. As the site is saline prone and stressed in condition, need elaborate work to advocate the requisites to a stress tolerant condition for sustenance of life by eco-restoration programme.

Key words: Mohana-Old Digha, Purba Medinipur District, Check list of species, Phytodiversity conservation-management, Eco-restoration.

The environment on coastal dunes is characterized by strong winds, sand movements (accretion and erosion), high evaporation, salinity, and limited availability of macronutrients. A gradient is usually found such that environmental extremes diminish away from the shore. Sand dunes are, therefore, by any standard stressful habitats, and plants have evolved special strategies for survival in this harsh environment. Sand accretion on fore dunes may fluctuate to a great extent, and sand movement is considered among the most important factors that affect the distribution of plant communities on sand dunes[14]. So, Coastal areas are ecosystem of fragile areas and forecast very much importance due to its varied types of flora and fauna which have ecologically significant. The site is playing a crucial role to adjust as the transitional zone due to varied physicochemical properties. Since a long back the site is playing flood and cyclone cascade zone due to large sand dunes and great deposition of vegetation both halophytic types as well as halophytic associates. But today's activities imposed by man in such a ways that the ecosystem is much hampered due to unorganized tourism, fishery (both deep sea fishing as well as fresh water kind), and setting industries of different kinds. The over burden is that anthropogenic activities cause great loss of natural ecosystem fragile and destroying vegetation knowingly or unknowingly. The permanent settlement of people in the coastal area generally suppressing the local environment, destroying the eco-habitats and the environment become intolerable and fuzzy. The carrying capacity or threshold therefore poses to loss and their unlawful life style causing more stress on environment so that the said habitat is running under threat. Generally, the people break the rules and regulations imposed by development authority and destroying vegetation havoc day by day and causing degradation of land more and more. The good example is nearer to the Old Digha site of West Bengal, *i.e.* at Mohana village where people destroying *Spinifex* vegetation situated on sand dunes and creating garden of their own by drawing fencing outside the occupied area which once was a great shrubberies covered by *Pandanus* and *Calotropis* along with *Spinifex* sp. (Poaceae member). Now, the site is filled with a small number of bushes composed of *Pandanus* and *Calotropis* along with frequently found *Spinifex* jungle on low lying land prepared by them from sand dune in the said area. A large patch of *Clerodendrum inerme* vegetation was also observed. Most of the people are engaged in fishing in the deep sea and preparing dry fish for transport. Therefore, land is required for the processing and drying the fishes before packaging them. The whole part of the sand dunes from Digha to Mohana is filled with a large number of residences for fisherman and their daily activities. So, by and large they changing the habitat and destroying the habitat particularly the sand dunes havoc and causing land degradation. Not only that, they always engaged with plantation of *Casuarina* and horticultural varieties for the same land and destroying local vegetation from there which is another threat and loss of biodiversity of local kind also. Nobody look after that, even the negative activities of them increasing so that they think they are the ruler and emperor of the present area. As a whole, the great change of the habitat, causing threat on vegetation, therefore, degradation of habitat and culture is going loss from there. Therefore, the area and neighboring areas would create loss of a few halophytes along with the halophytic

associates. Ultimately local species along with the halophytes may vanish from the said area within 2 to 3 years for ever. The good example may be *Spinifex* sp.and *Cannavelia* sp.

Therefore, study on such vegetation and monitoring of the vegetation is essential to restore the ecosystem in pristine as soon as possible by the help of coastal zone management authority along with the State and Central Government in near future. Not only that, it would be helpful to study the vegetation and introduced type for their co-existence to make the local ecosystem eco-sustainable and holistic towards the people centric way rather than business oriented type. The sand binders and local flora along with associated fauna will survive soon and disperse immediately due to proper management and conservation even by planning the area as confined one without occupying any rigidity. All will come together and will work soon in such a way that the habitat will revive soon to fulfill the activities of natural process without any illegal operations. The present study is therefore a study of vegetation and initial step of monitoring the same habitat to revive the habitat from eco-degradation and a mile stone for eco-restoration.

Area under study :

Study area fall under Contai-subdivision of Purba Medinipur District, West Bengal, It lies in between Mohana in the East and Old Digha in the West. The site filled with Sand dunes, clayey plots, rice fields, eroded area, area with artificial ponds, plantation stand, markets, extreme coasts, seashore and canals passing through this site. The site filled with varied ecological conditions. The microclimates of the habitats vary with the variation of high magnitude of various floral elements *i.e.* halophytes to mesophytes including xerophytic vegetation. The hydrophytic elements also found in the said area though they are both the ecological types though most of them are ecotone species. The soil conditions also vary from site to site with low amount of macronutrients including Soil Organic Matter (SOM) as found in almost all coastal areas. The degree of altitudinal variation differs minutely though temperature and humidity fall which greatly vary from site to site. Therefore, the present study was taken which includes the study of different pocket elements from almost all sites of the study area of 6-7 kms range.

Soil and climate :

The soil in this area comes of interaction of river and tides[20]. Therefore, soils of this area are alluvial, sandy and saline. Alluvial soil is found towards inland from the coast. This is very fertile from the coast in nature and therefore, different types of crops mainly rice, vegetable are grown. Sandy soil is available on the sand dunes and is generally devoid of organic matter. Saline soil is found in this area and a number of salt pan is available to a far distance from Old Digha. Climate of the area is very fine. In the March-June the temperature does not exceed 30^{o} centigrade and in winter (Nov. to Feb.) it seldom falls below 20^{o} centigrade. So, eventually it ranges in between 11 to 28 degree centigrade. In summer moderate wind blows from the south west and normally continues during the monsoon. The monsoon is generally associated with low depressions which rarely intensify to a cyclone storm but at the initial stage and the recession

stage of the monsoon. Heavy cyclonic storm generally originate in the Bay of Bengal within 200-500 kms far away from the shoreline during the pre or post monsoon period. This devastating storm is 4 times powerful than the Arabian Sea stormed. It acts on vegetation and people who are in fishing or in different activities near the shoreline or in deep sea. Along with the heavy rains storms and flood wash all the surface soil nearer to shoreline every year in a great extent. This means that, vegetation less area gradually diminishes surface soils and cascade the onset of vegetation in each year due to over raining, cyclone and devastating flood.

Extensive field visits were carried out to different places of the study site which falls in Between eastern part of Mohana to Western part of Old Digha by pointing some stations. The study sites having different zones, like sea shore, sea bank, sand dunes, highland, ponds, creaks, canals and low lying land have been taken for vegetation association studies. The entire coastal area has low plantation of *Casuarina* along with *Melaleuca* sp. The orchard species also found there in the gardens and boundary areas of self occupiers in coastal Digha. The sites fall under Contai Sub-division of Purba Medinipur District in the state of West Bengal. Association studies of plants have been taken for terrestrial ecosystem though for checklist preparation nearer species was also taken. So, the sites with low fluctuations and high eco-niche have been omitted to avoid the biasness of the data. The quadrats as well as transects were taken for monitoring vegetation in late summer, monsoon and winter also as per the latest ecological methods. For eco-restoration study, vegetation monitoring was done following the concept of Greipsson[14]. Parameter taken for stability study and concept of structure and function of elements in ecosystem along with dynamics of vegetation idea of Dash and Dash[13] was taken. The management of the policymaker and similar managerial was taken from internet to get idea regarding the present day scenario of coastal area. Books, Journals and magazines including registers of different departments were also consulted for Literature work. Interviews and cross references were studied using Participatory Rural Appraisal (PRA) technique in field. Plant specimens from field were also collected and processed for presentation as herbarium specimens and for identification using botanical and ecological standard. Specimens were carefully studied, critically examined and cross checked with the specimens housed in the CAL herb, BSI, Shibpore, Howrah. For conformity of specimens, local floras were consulted[16,17,21]. To consult some publications, Taxonomy and similar research papers from website have been downloaded and followed by Chakraborty *et al*.,[8], Mandal *et al*.,[20], Das[11] and Das and Das[12]. Some books published by West Bengal Forest Directorate, Research Wing (2005, 2010) have also been consulted to analyze the report along with my collections that the plants are either medicinal or not. Methodology used for abundance study followed by Groom *et al*.,[15] along with the thesis of Das[10]. Relevant literature have been collected and consulted for the preparation of the manuscript. The voucher specimens were housed in departmental herbarium, Darjeeling Govt. College, Darjeeling, and some are housed in my personal custody.

The numerical strength and biomass of organisms affect the functioning of

ecosystems. Living organism can change, modify and regulate their environment to some extent by their activities. In the course of millions of years, numerous biotic communities have been evolved. It is, therefore, important to study the diversity of these communities in space and time, so as to understand their role in ecosystem development and evolution, and in the maintenance of stability[13]. The study site contained with 81 plant species of varied types which fall under 76 genera and 42 families (Table-1). In dry season, the number of species reduces in a great extent and in monsoon it increase so that, there is always a degree of fall which need to study in a later phase to know the actual status of vegetation in a lucid but more conspicuous form. The table shows the list of species available in the said area with relative abundance of species which have made in terms of density of species of the study area.

Table-1. Ecological status of Species in Coastal Digha to Mohana, Purba Medinipur, W.B, India.

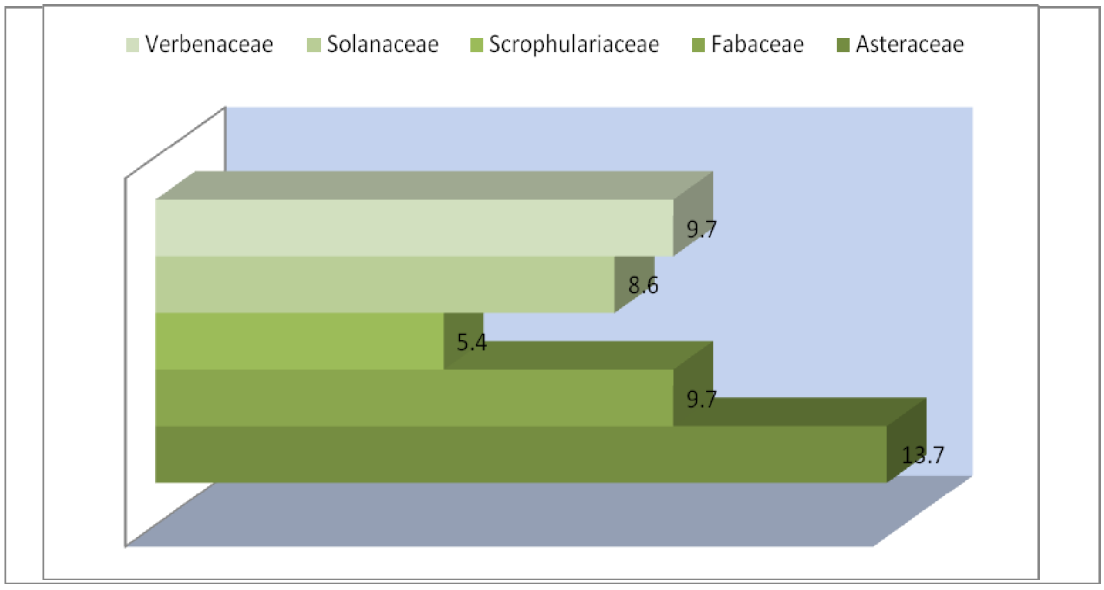
Sl. No.	Name	Family	Density in Community
1.	*Acacia nilotica* (L.) Willd. Ex Dellile	Mimosaceae	1.1
2.	*Acanthus ilicifolius* L.	Acanthaceae	0.1
3.	*Aleuropus lagopodides* (L.) Trin.	Poaceae	0.1
4.	*Ammania baccifera* L.	Lythraceae	0.2
5.	*Anisomeles indica* (L.) Kuntze	Lamiaceae	0.1
6.	*Bouganvillea spectabilis* Willd.	Nyctaginaceae	0.1
7.	*Bonnaya brachiata* Link & Otto.	Scrophulariaceae	1.0
8.	*Borassus flabellifer* L.	Arecaceae	0.1
9.	*Caesalpinia bonducella* (L.) Fleming	Caesalinaceae	1.2
10.	*Calophyllum inophyllum* L.	Clusiaceae	0.5
11.	*Calotropis procera* (Aiton) W.T.Aiton	Asclepiadaceae	2.0
12.	*Cannavalia rosea* (Sw.) DC.	Fabcaeae	0.5
13.	*Capparis sepiaria* L.	Cappridaceae	1.0
14.	*Carissa carandas* L.	Apocynaceae	0.5
15.	*Casuarina equisetifolia* L.	Casuarinaceae	2.0
16.	*Clerodendron indicum* (L.) Kuntz.	Verbenaceae	1.5
17.	*Clerodendrum inerme* (L.) Gaertn	Verbenaceae	3.5
18.	*Clerodendrum infortunatum* L.	Verbenaceae	1.1
19.	*Cocos nucifera* L.	Arecaceae	0.1
20.	*Coldenia procumbens* L.	Boraginaceae	0.5

21.	*Commelina benghalensis* L.	Commelinaceae	0.1
22.	*Crinum asiaticum* L.	Liliaceae	0.5
23.	*Crotalara pallida* Aiton	Fabaceae	6.1
24.	*Cuscuta reflexa* Roxb.	Cuscutaceae	0.1
25.	*Cynodon dactylon* (L.) Pers	Poaceae	1.1
26.	*Cyperus difformis* L.	Cyperaceae	1.3
27.	*Datura metel* L.	Solanaceae	1.0
28.	*Dysoxylum excelsum* Blume	Meliaceae	0.1
29.	*Eclipta indaca* L.	Asteraceae	0.5
30.	*Enhydra fluctuans* Lour.	Asteraceae	0.5
31.	*Eriocaulon quinquangulare* L.	Eriocaulaceae	0.1
32.	*Erythrina indica* Lam.	Fabaceae	2.1
33.	*Glinus oppositifolius* (L.) Aug. DC.	Molluginaceae	2.4
34.	*Glycosmis pentaphylla* (Retz.) DC.	Rutaceae	1.2
35.	*Gnephalium luteo-album* L.	Asteraceae	1.1
36.	*Grangea maderaspatana* (L.) Poir.	Asteraceae	1.0
37.	*Hydrolaea zeylanica* (L.) Vahl.	Hydrophyllaceae	0.1
38.	*Ichnocarpus frutescens* (L.) W.T. Aiton	Apocynaceae	1.2
39.	*Ipomoea aquatic* Forssk.	Convolvulaceae	1.0
40.	*Ipomoea hederacea* Jacq.	Convolvulaceae	1.1
41.	*Ipomoea pes-caprae* (L.) R. Br.	Convolvulaceae	6.5
42.	*Jatropha gossypifolia* L.	Euphorbiaceae	1.0
43.	*Lantana camara* L.	Verbenaceae	2.0
44.	*Launea sarmentosa* (Willd.) Schip. Bip.ex O. Kuntze	Asteraceae	3.5
45.	*Mallotus repandus* (Willd.) Muell.-Arg.	Euphorbiaceae	1.5
46.	*Mangifera indica* L.	Anacardiaceae	0.1
47.	*Martynia annua* L.	Pedaliaceae	0.1
48.	*Mecardonia procumbens* (Mill.) Small	Scrophulariaceae	1.2
49.	*Melaleuca leucadendron* (L.) L.	Myrtaceae	0.1
50.	*Ocimum tenuiflorum* L.	Lamiaceae	0.2
51.	*Opuntia dilenii* (Ker.-Gawl.) Haw.	Opuntiaceae	2.8
52.	*Pandanus fasciculatus* Lam.	Pandanaceae	0.3
53.	*Papaver somniferum* L.	Papaveraceae	0.1
54.	*Phoenix sylvestris* (L.) Roxb.	Arecaceae	0.2

55.	*Phylla nodiflora* (L.) Greene	Verbenaceae	1.6
56.	*Physalis minima* L.	Solanaceae	1.0
57.	*Pithecellobium dulce* (Roxb.) Benth.	Mimosaceae	0.5
58.	*Polygonum plebejum* R. Br.	Polygonaceae	0.1
59.	*Pongamia pinnata* (L.) Pierre	Fabaceae	0.5
60.	*Prosopis juliflora* (Sw.) DC.	Mimosaceae	1.5
61.	*Rothia indica* (L.) Druce	Fabaceae	0.5
62.	*Saccharum spontaneum* L.	Poaceae	1.1
63.	*Scirpus articulatus* L.	Cyperaceae	0.2
64.	*Scoparia dulcis* L.	Scrophulariaceae	1.0
65.	*Solanum nigrum* L.	Solanaceae	0.1
66.	*Solanum sisymbrifolium* L.	Solanaceae	5.5
67.	*Solanum torvum* Sw.	Solanaceae	1.0
68.	*Sonneretia apetala* Buch.	Sonneratiaceae	0.5
69.	*Sphaeranthus indicus* L.	Asteraceae	5.5
70.	*Sphenoclea zeylanica* Gaertn	Sphenocleaceae	0.5
71.	*Spinifex littoreous* (N. L. Burman) Merrill	Poaceae	9.0
72.	*Stephania hernandifolia* (Willd.) Walp.	Menispermaceae	1.5
73.	*Suaeda maritima* (L.) Dumort	Amaranthaceae	1.1
74.	*Swietenia mahagoni* Jacq.	Meliaceae	0.3
75.	*Tiliacora acuminata* Colebr.	Menispermaceae	0.5
76.	*Torenia affinis* De Wild.	Scrophulariaceae	1.1
77.	*Tribulus terrestris* L.	Zygophyllaceae	1.1
78.	*Tylophora indica* (Burm.f.) Merr.	Asclepiadaceae	0.5
79.	*Vandellia crustacea* (L.) Benth.	Scrophulariaceae	1.1
80.	*Xanthium strumarium* L.	Asteraceae	1.6
81.	*Zizyphus oenoplea* (L.) Mill.	Rhamnaceae	1.3
Total	81 species eported from Mohana, Digha (Old)		99.6

In the present study five dominant families were observed from the sea shore areas in Coastal Digha (Mohana to Old Digha). The families were Asteraceae (7 species), Fabaceae (5 species), Verbenaceae (5 species), Solanaceae (5 species) and Scrophulariaceae (5 species) found there as heterogeneous group. Other families with low number of species showed a less degree of distribution as they were homogenous found in a habitat of specified kind. So, study of homogeneity to heterogeneity may be a new parameter to

study the actual status of vegetation in the same site for study and survey in an eco-restoration programme. This need based study requires study of nutrients in soil or in dunes for actual kind of group vegetation study particularly at ecotone area. The study also focuses on diversity and dominance of a group of species in the same site (Fig. 1) by considering families rather than species. This may be regarded as association parameter of species in a particular eco-habitat. This also amplifying the documentation of record species and their density at a glance which may be under threat or may be threat under different physicochemical factors need elaborate studies from Plant physiology, anatomy and environmental studies to make the species either fit in the habitat or not. This guideline may be the guideline for resource studies in near future for a need based way to record the modern day research and extension activities in Coastal areas of Purba Medinipur, West Bengal.



[Fig. 1 Bar Graph showing Relative Abundance (RA) of five dominant families in study site. Note that, Family Asteraceae with 13.7, Fabacaeae with 9.7, Scrophulariaceae with 5.4, Solanaceae with 8.6 and Verbenaceae with 9.7 abundance value, though Poaceae with four species having a total 11.3 abundance value, here, *Spinifex littoreous* is a dominat hedge with 9.0 RA value which is highest for single species of monocot in the said area. The species is dominant in the said area as soil and sand binder showed significant ecological value. Some species like *Cannavelia rosea* and *Avicennia* sp.are found with a small patch in such a way that these species posses least abundance and for uniformity of result their values are not included here.]

The study enlightens the strategy of cost benefit analysis in later stage if planted. Some versatile tree species found in the said area. As for example, *Pongamia pinnta*, the local Karanja tree. Author found some seedlings which are commonly growing there with deep root system. The species may be used in the site as cyclone prone shelter belt species as well as sand belt for sand dunes. Not only that, it may be used in a large area particularly n plantation sites for its fuel as well as oil bearing seeds which have economic importance. As *Pongamia pinnata* is naturally germinated and grown on varied soils which are generally not used for crop production. Therefore, there are no direct costs required for developing natural *Pongamia* plantations, as it is un-browsable[23]. So, forest department should take initiative in a large scale way to raise *Pongamia* plantation through the direct involvement of villagers of the said area which is eco-friendly. A trial for the said purpose may be made if not, Digha Sankarpur Development Authority (DSDA) may take the initiative of the same as avenue tree in a large scale along the coast of Old Digha to Mohana as it is natural element and suit for the saline habitat along with the sand dune areas in Mohana. Another important medicinal plant, *Rothia indica* (Fabaceae) is found in the seashore of Mohana along with *Crotalaria pallida* with low frequency and low abundance. The species is found in China, Srilanka, and also in Indian seashore[18]. All the eco-viable species is therefore need to be protected to protect the coastal line and to revive the sand dunes at a glance. All species are the competitors in the said habitat and used naturally to oscillate the vegetation and bring change in the succession. So, studies of species of individual type on a community are essential to know the functional attributes of each kind before going to climax. Bestelmeyer *et al*.,[7] proposed, six types of mechanisms driving vegetation change including (1) Stability, (2) Size oscillation of plants, (3) loss and re-establishment of plants within functional groups, (4) loss of one plant functional group and replacement by another, (5) spatial reorganization of vegetation patches, and (6) cascading transitions that spread from small to broad scales. In the present study, vegetation and soil is also going to change due to different catastrophic changes. Man made cause is also influencing the pattern of change in addition to the natural type. Here, loss of functional group and stability change parameter is critically discussed with the pattern of species dominance in a broad scale basis. This may change the patches of vegetation change from small to big to bigger in a way. So, monitoring of vegetation along with spatial cascade in terms of stability in a succession stage is important to describe the need based work in the same field. This means that, incorporate some species like natural kind and fill the gap in between the spaces where nominal development is going on through pattern change. Not only may that, with high degree of loss of soil and disturbances in sand deposition lead to fluctuate the stand pattern so nutrient recycling study is required immediately. This may help to raise the scenario of development of climax vegetation. The present situation may be studied following the study of Bestelmeyer *et al.*[7] in near future to establish a role model to restore the seashore and sand dune ecosystem more static rather than dynamic.

Eco-stress of people is another important factor that can suppress the area

PHOTO PLATE -1

Photographs (1-9): (1) Village-Mohana with naturally growing Spinifex sp., (2) Area occupied by tracing cemented fencing with abolished Spinifex vegetation replaced by Casuarina plantation, (3) Magnified view of Spinifex sp (showing by author), (4) Destruction of sand dunes and habitat, (5) Sand binder Ipomoea sp., (6) Drying of Sea foods-a common occupation, (7) Dead body of a turtle-a result of intensive fishing, (8) Processing of sea foods at Mohana, (9) Community composition of Sand binders.

and vegetation and can increase the loss of species and composition structure as well as loss of nutrients through gradual change of habitat. Example for this answer is that occupation in the same site for different habitants. Case study revealed the scenario of the same more illustrative to establish the species loss or habitat loss for long term basis. Proportionate entities *i.e*. Economy versus business, support the fall or decline the shape and size of the habitat due to urgent need based trophic structure. Over pressure of introduced species of plants, animals as well as humans, enhance the activities day by day. Because, most of the people inhabiting in the said area are under Scheduled caste category though some people are found as fisherman from other caste category settled there to earn money. The number is moderately low. In case of reserved category they belong to poundra group. The record reference is also supported the result that the Poundra Kshatriyas are mainly concentrated in the district like Midnapore[3]. Some are Namasudra and engaiged in different activities along with the activities fishing and fish industry. A large number of people are coming from different parts of country to settle here and firmly attached with different activities to develop economy. As the economy is concerned with these activities in coastal area, so as by product the land and ecosystem will pose to be degraded. But remembering the eco-restoration term, we should take care to mitigate the problems which need solve in urgent basis. Otherwise, environment will change and will generate loss of diversity in different way which would cause devastating loss of trophic structure at different levels in near future. So, for eco-sustenance of life and ecosystem both we must follow the rules and regulations of Coastal management authority time to time. Keeping these views in mind, more and more research project should be lunched, to generate path to show the effects in a large scale in near future to draw a line in between present and future status of vegetation and wildlife along with human activities in an eco-friendly basis. This is our common motto that, "live together and live better" Therefore, we always be realistic rather than optimistic inn a eco-friendly habitat for better suit in a long term basis.

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