International Journal of Agriculture Innovations and Research
Volume 5, Issue 3, ISSN (Online) 2319-1473
Manuscript Processing Details (dd/mm/yyyy) :
Received : 03/12/2016 | Accepted on : 10/12/2016 | Published : 22/12/2016

Flora and Faunal Resources and Ecosystem Conservation in the Sundarbans

Dr. A.S.M. Helal Siddiqui
Senior Research Officer, Mangrove Silviculture Division, Bangladesh Forest Research Institute,
Ministry of Environment and Forest, Muzgunni, Khulna-9000, Bangladesh.
Email-helalrobfri@yahoo.com

***Abstract* – The Sundarbans is the largest single tract mangrove forest in the whole world. The Sundarbans has a high and rich biodiversity value. There are lot of flora and fauna here in the jungle. Biological diversity has three main components such as species diversity, genetics diversity and ecosystems diversity. Bangladesh is represented by 40% of the world true mangrove species. Bangladesh has lost 10% of the true mangrove species in recent years. Sundarbans possesses a rich faunal diversity even after disappearance of a good number of interesting species. A total of 4 species of mammal, 2 species of birds, 1 species of reptile has extinct and 10 species of mammal, 11 species of birds, 16 species of reptile and 1 species of amphibian has endangered. In addition, 2 species of Sundarbans fish has critically endangered, 2 species have been showed endangered and 5 more species are vulnerable. The degradation of biological diversity is a global crisis. Faunal losses have been mainly because of overexploitation of certain species for trading purposes. The wildlife species such as tiger (Panthera tigris tigris), estuarine crocodile (C. porosus), monitor lizards (Varanus spp.) have become endangered. The animal species, such as swamp deer (Cervus duvucela), Javan rhinoceros (Rhinoceros sondiacus), one horned rhinoceros (R.unicornis), hog deer (Axis procinus), water buffalo (Bubulus bubulus) and marsh crocodile (C. palustris) have already become extinct from the Sundarbans. Sundarbans is deteriorating and degraded its biodiversity by different manmade and natural causes. Water pollution, air pollution, green house effect as well as climate change are the causes of biodiversity loss and degradation of the Sundarbans. Illicit harvesting, poaching and weak management are responsible for degradation of the biodiversity. Biodiversity degradation is alarming.**

***Keywords* – Biodiversity, Ecosystem, Forest Degradation, Mangrove Forest, Sundarbans.**

I. Introduction

The Sundarbans is the single tract largest mangrove forest in the whole world. The forest occupies the south-west corner of Bangladesh between longitudes $89^0 00''$E and $89^0 55''$E and latitudes $21^0 30''$N and $22^0 30''$N. The forest cover an area of 6017 km^2, of which 4143 km^2 are landmass and remaining 1874 km^2 are under water bodies. The Sundarbans has a high biodiversity value in which is tidally inundated twice a day. Prain [17] reported 334 species belonging to 245 genera of spermatophytes and pteridophytes. Chaffey *et al*. [5] listed 66 species while Helal siddiqui [27] listed 130 species and latest Helal siddiqui [22],[23] listed 230 species which are not all the mangroves (table-1). Sundri (*Heritiera fomes*) and gewa (*Excoecaria agallocha*) are the major tree species in the forest[24], [25],[26]. The other important species are passur (*Xylocarpus mekongensis*), goran (*Ceriops decandra*), keora (*Sonneratia apetala*), amur (*Amoora cucullata*), baen (*Avicennia officinalis*), kankra (*Bruguiera* sp.), shingra (*Cynometra ramiflora*), khalshi (*Aegiceras corniculatum*), kirpa (*Lumnitzera racemosa*), golpata (*Nypa fruticans*), garjan (*Rhizophora mucronata*), dhundul (*X. granatum*)[22]-[26].

Fig. 1. Natural view of the Sundarbans

Fig. 2. Researchers searching the vacant area of the Sundarbans

Sandarbans is rich in its biodiversity. There are lot of flora and fauna here in the jungle. Biological diversity has three main components such as species diversity, genetics diversity and ecosystems diversity. As regards plants, Bangladesh has 28 true mangrove species against occurrence of 70 species in the world. Thus Bangladesh is represented by 40% of the world true mangrove species [18]. *H. fomes*, the dominant mangrove species is available only in the Indian Sundarbans, Bangladesh and Myanmar. The species appears to be in stressed condition by over exploitation and environmental causes. In addition, Siddiqi

[18] stated that Bangladesh has lost 10% of the true mangrove species in recent years. As regards to wildlife, the Sundarbans possesses a rich faunal diversity even after disappearance of a good number of interesting species. A total of 4 species of mammal, 2 species of birds, 1 species of reptile has extinct and 10 species of mammal, 11 species of birds, 16 species of reptile and 1 species of amphibian has endangered. In addition, 2 species of Sundarbans fish has critically endangered, 2 species has endangered and 5 more species are vulnerable [14]. Policy and management regulations are needed to ensure aquatic and terrestrial biodiversity. Keeping all these ideas in mind Bangladesh Forest Department has launched an Asian Development Bank aided project in Sundarbans called "Sundarbans Biodiversity Conservation Project" in 1999. The aim of this assignment is to promote a sustainable management and biodiversity conservation in the Sundarbans with the ecosystem approach is a strategy for the integrated management of land, water and living resources. The integrated approach is set to achieve biodiversity conservation and ecosystem improvement in the Sundarbans.

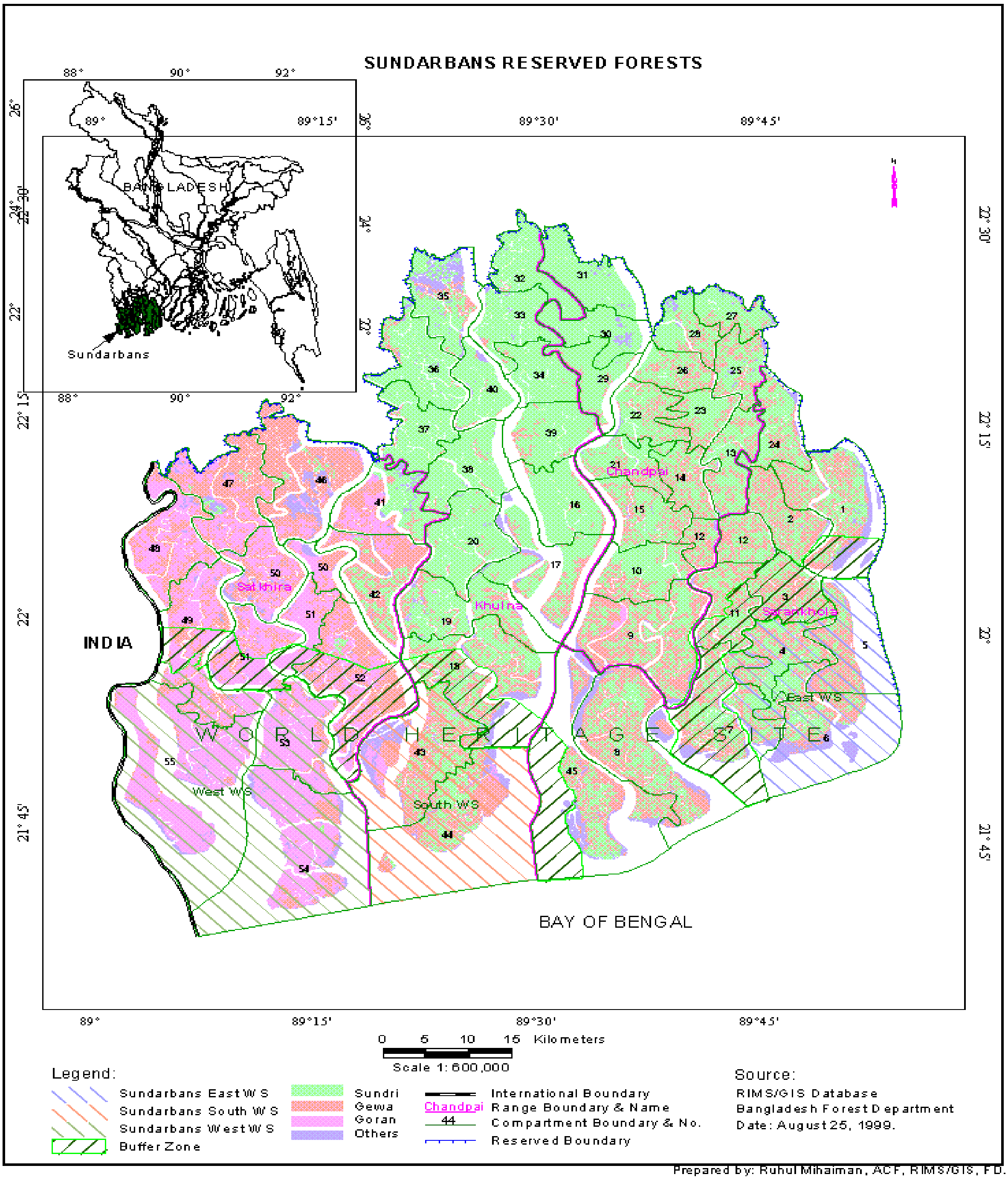

Fig. 3. Map of the Sundarbans

International Journal of Agriculture Innovations and Research
Volume 5, Issue 3, ISSN (Online) 2319-1473

II. Status of Biodiversity

Bangladesh being a humid tropical country is rich in biological diversity like many other tropical countries. The trees of the Sundarbans exhibit hydrophytic and halophytic adaptations which facilitate survival in water logged and saline conditions. The successional pattern of plant species development and variation depend on the flooding frequency and salinity level of the forest soil. Heritiera fomes and Excoecaria agallocha are the two most extensively occurring tree species in the Sundarbans[9]. This mangrove forest is very rich in biotic diversity than other mangrove forests. A total of 334 species of plants were identified [17], belonging to 245 genera of Spermatophytes and Pteridophytes from the Sundarbans forest and the adjoining areas. There has been a change in the species composition of Sundarbans mangrove flora [28].But at present nearly about 66 Angiospermic and Pteriodophytic species are found in the Sundarbans [5]. The Sundarbans flora belongs to Indo-Malaysian Sub group [29] and characterized by the abundance of *H. fomes*, *E. agallocha*, *Ceriops* spp., *Bruguiera* spp., *Sonneratia apetala* etc. Due to over use of the resources of the Sundarbans, increase in salinity of soil and water, siltation of river lands, water pollution, inadequacy of regeneration in some areas etc., the floral and faunal species diversity has greatly been affected. Sundri and passur the major tree species in the Sundarbans have been affected tremendously by top dying and heart rot disease; thus the forest becomes degraded.

Fig. 4. A big passur tree of the Sundarbans

Fig. 5. Heart Rot affected passur tree in the Sundarbans

Table 1: Vegetation of the Sundarbans and adjacent areas.

Sl. No.	Scientific Name	Family	Vernacular Name	Type of plant
1.	*Acacia nilotika* Willd.	Leguminosae	Babla	Tree
2.	*Acalypha godseffiana* Linn.	Euphorbiaceae	Muktajhuri	Small shurb
3.	*Acalypha indica* Linn.	Euphorbiaceae	Muktajhuri	Small herb
4.	*Acanthus ilicifolius* Linn.	Acanthaceae	Hargoza	Scrambling, thorny herb
5.	*Achyranthes aspara* Linn.	Amaranthaceae	Upang	Rough chaff shrub
6.	*Acrostichum aureum* Linn.	Polypodiaceae	Hodo,Tiger fern	Gregarious fern
7.	*Aegialitis rotundifolia* Roxb.	Plumbaginaceae	Dhalchaka	Small tree
8.	*Aegiceras corniculatum* Bl.	Myrsinaceae	Khalisha, khalshi	Shrub or small tree
9.	*Aeschynomene aspara* Linn.	Leguminosae	Joloz Shola	Grass
10.	*Aeschynomene indica* Linn.	Leguminosae	Joloz Shola	Grass
11.	*Albizia lebbeck* Benth.	Leguminosae	Kala koroy	Tree
12.	*Albizia procera* Benth.	Leguminosae	Sada koroy	Tree
13.	*Albizia richardiana* King & Prain	Leguminosae	Raj koroy	Tree
14.	Amaranthus spinosus Linn.	Amaranthaceae	Kantanote	Small spinus shurb
15.	*Amoora cucullata* Roxb.	Meliaceae	Amur	Small tree
16.	*Aponogeton natans* Engl.	Aponogetonaceae	Swampy herb	Swampy herb
17.	*Argemone maxicana* Linn.	Papaveraceae	Shialkanta	Thorny weed
18.	*Argemone maxicana* Linn.	Papaveraceae	Shialkata	Thorny herb
19.	*Asparagus racemosus* Linn.	Lilliaceae	Satamuli	Climber
20.	*Avcennia officinalis* Linn.	Avicenniaceae	Baen	Tree
21.	*Avicennia alba* Bl.	Avicenniaceae	Morcha baen	Small tree
22.	*Avicennia marina* Vierh.	Avicenniaceae	Sada baen	Small tree
23.	*Barringtonia acutangula* Gaertl.	Barringtoniaceae	Hijal	Small tree
24.	*Barringtonia racemosa* Spreng.	Barringtoniaceae	Kumba, kumbi	Small tree

Sl. No.	Scientific Name	Family	Vernacular Name	Type of plant
25.	*Blumea lacera* Burm.	Compositae	Bon gash	Aromatic herb
26.	*Boerhaavia diffusa* Linn.	Nyctaginaceae	Punarnava	Small herb
27.	*Borassus flabellifer* Linn.	Palmae	Tal	Palm tree
28.	*Bouea hurmanica* Griff.	Anacardiaceae	Muriam	Small tree
29.	*Brownlowia tersa* Benth.	Tiliaceae	Sundri lata	Scandent shrub
30.	*Bruguiera gymnorrhiza* Lamk.	Rhizophoraceae	Kankra	Tree
31.	*Bruguiera parviflora* W. & A.	Rhizophoraceae	Kankra	Tree
32.	*Bruguiera sexangula* Lam.	Rhizophoraceae	Kankra	Medium tree
33.	*Buettneria herbacea* Roxb.	Sterculiaceae	Kamraj	Climber
34.	*Buettneria pilosa* Roxb.	Sterculiaceae	Harjora	Climber
35.	*Caesalpinia crista* Linn.	Leguminosae	Kutum katta	Scandent, armed shrub
36.	*Caesalpinia sappan* Linn.	Caesalpinoidae	Gulmo	Scandent, armed shrub
37.	*Calamus tenuis* Roxb.	Palmae	Bet	Climber
38.	*Calophyllum inophyllum* Linn.	Guttiferae	Puinal	Small tree
39.	*Calotropis procera* Br.	Asclepiadaceae	Akanda	Shrub with coppices
40.	*Casia alata* Linn.	Leguminosae	Dadmordon	Shrub
41.	*Casia fustula* Linn.	Leguminosae	Sonalu	Medium tree
42.	*Casia occidentalis* Linn.	Leguminosae	Kalkasunda	Shrub
43.	*Cassia sophera* Linn.	Leguminosae	Kalkisinde	Shrub
44.	*Casuarina littorea* Linn.	Casuarinaceae	Jhau	Tree
45.	*Cayratia padata* Linn.	Vitaceae	Gulialata	Climber
46.	*Cayratia trifoliate* Linn.	Vitaceae	Amal lata	Climber
47.	*Celosia argentea* Linn.	Amaranthaceae	Swampy weed	Weed
48.	*Celosia cristata* Linn.	Amaranthaceae	Swampy weed	herb
49.	*Centala asiatica* Linn.	Unbellifera	Thakuni	Small creeper
50.	*Cerbera manghas* Gaertn.	Apocynaceae	Dagor	Small tree
51.	*Ceriops decandra* Griff.	Rhizophoraceae	Goran	Small tree with coppices
52.	*Ceriops tagal* Robins.	Rhizophoraceae	Moth goran	Small tree with coppices
53.	*Cissus quadrangularis* Linn.	Vitaceae	Harvhanga lata	Climber
54.	*Cissus Repens* Lam.	Vitaceae	Marmaria lata	Climber
55.	*Clerodendrum viscosum* Vent.	Verbenaceae	Ghetu	Herb
56.	*Clerodendrum inerme* Gaertn.	Verbenaceae	Sitka, sitki	Scandent shrub
57.	*Coccinia cordifolia* Cogn.	Cucurbitaceae	Telakuchha	Climber
58.	*Coix lachrymajobi* Linn.	Gramineae	Kunce	Weed
59.	*Colocasia nymphaefolia* Kunt.	Araceae	Jongli Kachu	Herb
60.	*Crotolaria saltiana* Andr.	Papilionoideae	Jhunjana	Shrub
61.	*Croton bonplandianum*	Euphorbiaceae	Putri	Weed
62.	*Curcuma zedoria* Rose.	Zingiberceae	Sothi	Tuber like herb
63.	*Cuscuta reflexa* Roxb.	Convolvulaceae	Swarnolata	Parasite
64.	*Cymbopogon martini* Roxb.	Graminae	Gandhabena	Herb
65.	*Cynodon dactylon* Linn.	Graminae	Durba grass	Grass
66.	*Cynometra ramiflora* Linn.	Leguminosae	Shingra	Shrub
67.	*Cyperus corymbosus* Roxb.	Cyperaceae	Bon Mathi	Grass like herb (sedge)
68.	*Cyperus difformis* Linn.	Cyperaceae	Behua	Fodder grass
69.	*Cyperus iria* Linn.	Cyperaceae	Motha grass	Grass
70.	*Dalbergia candenatensis* Prain.	Leguminosae	Chanda lota	Scrambling climber
71.	*Dalbergia spinosa* Roxb.	Leguminosae	Kalilota	Scandent, armed shrub
72.	*Datura fastuosa* Linn.	Solanaceae	Dhutra	Shurb
73.	*Datura innoxia* Mill.	Solanaceae	Dhutra	Shurb
74.	*Delima sarmentosa* Linn.	Delliniaceae	Salia lata	Climber
75.	*Dendrophthoe falcate* Ett.	Loranthaceae	Porgassa	Woody parasite in tree crown
76.	*Derris sinuata* Benth.	Leguminosae	Mahajonilata	Climber
77.	*Derris scandens* Benth.	Leguminosae	Pan lota	Climber
78.	*Derris trifoliata* Lour.	Leguminosae	Gila lota	Climber
79.	*Diospyros peregrine* Gur.	Ebenaceae	Gub	Tree
80.	*Doemia extensa* Linn.	Asclepiadaceae	Dodhi lata	Climber

Sl. No.	Scientific Name	Family	Vernacular Name	Type of plant
81.	*Drypetes roxburghii* Hur.	Euphorbiaceae	Achet	Scandent shrub
82.	*Echinochloa colonum* Link.	Graminae	Grass	Herb
83.	*Eclipta alba* Hassk.	Compositae	Keshraj	Herb
84.	*Eichornia crassipes* Solms.	Lemnaceae	Kachuripana	Floating species
85.	*Eliocharis sp.*		Jol Ghash	Basket making grass
86.	*Emilia sonchifolia* DC.	Compositae	Sadhimodi	Herb
87.	*Entada phaseoloides* Merr.	Leguminosae	Gila lata	Climber
88.	*Equisetum arvense* Roxb.	Equisitaceae	Calamophyta	Horse tail fern
89.	*Equisetum debile* Roxb.	Equisitaceae	Calamophyta	Horse tail fern
90.	*Eriochloa procera* Hubb.	Gramineae	Nol gash	Grass
91.	*Erythrina variegate* Linn.	Leguminosae	Bonmander	Soft thorny tree
92.	*Eugenia fruticosa* Roxb.	Myrtaceae	Ban jam	Small tree
93.	*Eugenia lancaefoliaa* Roxb.	Myrtaceae	Pania jam	Medium tree
94.	*Eugenia operculata* Roxb.	Myrtaceae	Tepa jam	Medium tree
95.	*Eupatorium odoratum* Linn.	Compositae	Asamlota	Climber
96.	*Euphorbia antiquorum* Linn.	Euphorbiaceae	Dudhia	Herb
97.	*Euphorbia nivulia* Ham.	Euphorbiaceae	sij	Shurb
98.	*Excoecaria agallocha* Linn.	Euphorbiaceae	Gewa	Tree
99.	*Excoecaria indica* Muell.	Euphorbiaceae	Batla, batul	Small tree
100.	*Ficus bengalensis* Linn.	Moraceae	Bot	Tree
101.	*Ficus hispida* L.F.	Moraceae	kakdumur	Tree
102.	*Ficus microcarpa* La.	Moraceae	Jir	Tree with aerial roots
103.	*Ficus racemosa* Linn.	Moraceae	Jogdumur	Tree
104.	*Flagellaria indica*	Flagellariaceae	Abetaa	Climber
105.	*Flueggea mycrocarpa* Bl.	Euphorbiaceae	Sitka, sitki	Scandent shrub
106.	*Girardiana heterophylla* Decene.	Urticaceae	Gulmo	Shurb
107.	*Hedyotis corymbosa* Linn.	Rubiaceae	Khetpapra	Grass
108.	*Heritiera fomes* Buch.-Ham.	Sterculiaceae	Sundri	Tree
109.	*Hibiscus tiliaceous* Linn.	Malvaceae	Bhola	Shrub
110.	*Holarrhena antidyssenterica* Wall.	Apocynaceae	Kuriz	Shrub
111.	*Hoya parasitica* Wall.	Asclepiadaceae	Pargacha	Epiphyte
112.	*Hydrilla sp.*		Joloz plant	Fern
113.	*Hydrocotyle sibthorpiodes* Lam.	Umbellifera	Thankuni	Herb
114.	*Hygroryza aristata* Nees.	Gramineae	Uridhan	Grass
115.	*Imperata arundinaceae* Linn.	Gramineae	Songash	Grass
116.	*Imperata cylindrical* Beauv.	Gramineae	Dhanshi/ ulu	Grass
117.	*Intsia bijuga* Kunt.	Leguminosae	Bhaela, bharal	Small tree
118.	*Intsia retusa* Kunt.	Leguminosae	Hinge	Small tree
119.	*Ipomoea alba* Linn.	Convolvulaceae	Dudhkalmi	Succulent, herb
120.	*Ipomoea aquatica* Forsk.	Convolvulaceae	Kalmisak	Swamp creeper
121.	*Ipomoea fistulosa* Mart.ex	Convolvulaceae	Dholkalmi	Succulent, herb
122.	*Ipomoea hediracea* Jack.	Convolvulaceae	Dudh kalmi	Succulent, creeper
123.	*Ipomoea pescaprae* Linn.	Convolvulaceae	Sagolkuri	Succulent, herb
124.	*Ipomoea quamoclit* Linn.	Convolvulaceae	Tarulata	Cupid’s flower, creeper
125.	*Ixora arborea* Roxb.	Rubiaceae	Bon bakul	Small tree
126.	*Jatropha curcas* Linn.	Euphorbiaceae	Bonveranda	Shrub
127.	*Kaempferia rotunda* Linn.	Zingiberaceae	Bhui chapa	Tuber
128.	*Kandelia candel* W. and A.	Rhizophoraceae	Gura, gurae, gural	Small tree
129.	*Lagerastroemia speciosa* Linn.	Lythraceae	Jarul	Tree
130.	*Lannea coromandelica Merr.*	Anacardiaceae	Jiga	Small 454eciduous tree
131.	*Lantana camara* Linn.	Verenaceae	Chotra	Lantana herb
132.	*Leea aequata* DC.	Vitaaceae	Kagjanga	Shrub
133.	*Leersia hexandra* Swartz.	Leguminosae	Arali	Herb
134.	*Lemna paucicostata* Hegelm.	Lemnaceae	Khudipana	Duck weed
135.	*Lepisanthes rubiginosa* Lee.	Sapindaceae	Bon lichu	Tree

Sl. No.	Scientific Name	Family	Vernacular Name	Type of plant
136.	*Ludwigia adscendens* Hara.	Onagraceae	Keshordam	Floting herb
137.	*Lumnitzera racemosa* Willd.	Combretaceae	Kirpa, kripa	Small tree
138.	*Lycopodium clavatum*	Lycopodiaceae	Club moss	Herb like fern
139.	*Macrosolen cochinchinensis*	Loranthaceae	Porgassa	Woody parasite on crowns
140.	*Macuna gigantea*	Leguminosae	Doyal	Climber
141.	*Magnifera indica* Linn.	Anacardiaceae	Aam	Tree
142.	*Mallotus repandus* Muell.Arg.	Euphorbiaceae	Bon notoy	Scandent shrub
143.	*Marsilea pilularia*	Marsiliaceae	Joloz fern	Swampy soft plant
144.	*Marsilea quaadrifolia*	Marsiliaceae	Joloz plant	Swampy soft plant
145.	*Melochia corchorifolia* Linn.	Sterculiaceae	Tikiokra	Herb
146.	*Mikania cordata* Roxb.	Compositae	Asamlata	Climbing hemp weed
147.	*Mikania scandens* CI..	Compositae	Tara lata	Climbing hemp weed
148.	*Mimusa pudica* Linn.	Leguminosae	Lazzabati	Shrub
149.	*Monochoria hastate* Linn.	Pontederiaceae	Swampy weed	Swampy grass
150.	*Mucuna pruriens* DC.	Leguminosae	Bilaiasra	Climber
151.	*Myriostachya wightiana* Hook.f.	Gramineae	Dhanshi	Grass, on new accretions
152.	*Nelumbo nucifera* Gaertn.	Nymphaeaceae	Paddo	Floating flower
153.	*Nymphaea nouchalli* Burm. f.	Nymphaeaceae	Sada sapla	Water lily
154.	*Nymphaea stellata* Willd.	Nymphaeaceae	Shaluk	Water vegetation
155.	*Nypa fruticans* Wurmb.	Palmae	Golpata	Palm, underground stem
156.	*Ocimum americanum* Linn.	Labiatae	Bon tulshi	Herb
157.	*Ocimum basilicum* Linn.	Labiatae	Vui tulshi	Shrubby basil
158.	*Operculina terpethum* Silva.Manso.	Convolvulaceae	Dudh kalmi	Climber, grass
159.	*Oryza coaractata* Roxb.	Gramineae	Uridhan/ dhanshi	Grass
160.	*Paederia foetida* Linn.	Rubiaceae	Ganda vadali	Grass
161.	*Pandanus foetidus* Roxb.	Pandanaceae	Kewa katta	Prickly succulent pine
162.	*Paramignya citrifolia* Hk.f.	Rubiaceae	Bonlebu	Shurb
163.	*Pergularia daemia* Chiov.	Asclepiadaceae	Dudhialata	Creeper
164.	*Petunga roxburghii* DC.	Rubiaceae	Narikili	Small tree
165.	*Phoenix paludosa* Roxb.	Palmae	Hantal	Thorny palm
166.	*Phoenix sylvestris* Roxb.	Palmae	Khejur	Date palm
167.	*Phragmites karka* Rtz.	Gramineae	Nol kagra	Grass
168.	*Pistia stratiotes* Linn.	Araceae	Topapana	Water lettuce
169.	*Polygonum hydropiper* Linn.	Polygonaceae	Panimoris	Herb
170.	*Polygonum lanigerum* Br.	Polygonaceae	Sadakukri	Herb
171.	*Polygonum orientale* Linn.	Polygonaceae	Bishkathali	Herb
172.	*Polygonum plebejum* Br.var.	Polygonaceae	Chemti sag	Herb
173.	*Polypodium cuculatum*	Polypodiaceae	Polypodium	Fern
174.	*Polypodium parasiticum*	Polypodiaceae	Polypodium	Fern
175.	*Pongamia pinnata* Pierre.	Leguminosae	Karanj, karanja	Small tree
176.	*Potresia sp.*	Leguminosae	Bunodhan	Herb
177.	*Premna corymbosa* Linn.	Verbenaceae	Serpoli, setpoli	Shrub or small tree
178.	*Psilotum nudum*	Psilotaceae	Pteridophyte	Rootless parasite
179.	*Pteris longifoliata*	Polipodiaceae	Sun fern	Sub aerial fern
180.	*Rhinacanthus communis* Nees.	Acanthaceae	Juipana	Floating pana
181.	*Rhizophora apiculata* Bl.	Rhizophoraceae	Jhana	Tree with stilt roots
182.	*Rhizophora mucronata* Lamk.	Rhizophoraceae	Garjan,	Tree with stilt roots
183.	*Saccaharum bengalense* Linn.	Gramineae	Jhati/Munda grass	Grass
184.	*Saccaharum officinalis* Linn.	Gramineae	Son	Grass
185.	*Saccaharum spontaneum* Linn.	Gramineae	Kash	Grass
186.	*Sagittaria sagittifolia* Linn.	Alismataceae	Choto kut	Tuber
187.	*Salacia chinensis*	Celastraceae	Choyt barai	Small tree
188.	*Salvi plebej* Br.	Labiatae	Bhui Tulshi	Herb
189.	*Sarcolobus globosus* Wall.	Asclepiadaceae	Bowali lota	Climber
190.	*Sargassum nereocystis*	Sargassaceae	Brown shaibal	Shaibal
191.	*Selaginella rupestris*	Selaginellaceae	Club moss	Prennial moss

Sl. No.	Scientific Name	Family	Vernacular Name	Type of plant
192.	*Sesbania sesban* Merr.	Liguminosae	Katshola	Common sesban
193.	*Sida acuta* Burm.	Malvaceae	Kureta/Ban methi,	Herb
194.	*Smilax zeylanica* Linn.	Liliaceae	Kumari lata	Creeper
195.	*Solanum indicum* Linn.	Solanaceae	Bon begun	Shurb
196.	*Sonneratia apetala* Ham.	Sonneratiaceae	Keora	Tree
197.	*Sonneratia caseolaris* Engl.	Sonneratiaceae	Choyla	Tree
198.	*Stenochlaena paludosa*	Blechnaceae	Dheki lata	Climber
199.	*Stenochlaena palustris*	Blechnaceae	Deki lota	Climbing fern
200.	*Syzygium cumini* Skeels.	Myrtaceae	Jam	Medium tree
201.	*Syzygium operculata* Roxb.	Myrtaceae	Butijam	Medium tree
202.	*Tamarindus indica*Linn.	Leguminosae	Tentul	Tree
203.	*Tamarix gallica* Linn.	Tamaricaceae	Jhao, nonajhao	Small tree
204.	*Teris longifoliata*	Polipodiaceae	Common fern	Sub aerial fern
205.	*Tetrastigma bracteslatum*	Vitidiaceae	Golgoti lota	Climber
206.	*Thumbergia sp.*	Thumbergiaceae	Jermani lota	Climber
207.	*Tinospora cordifolia* Miers.	Menispermaceae	Gulancha	Creeper
208.	*Tragia involuerata* Linn.	Euphorbiaceae	Bisuti	Perennial hairy twinner
209.	*Trapa bispinosa* Roxb.	Trapaceae	Paniphal	Floating plant
210.	*Trewia polycarpa* Benth.	Euphorbiaceae	Pithali	Small tree
211.	*Trichossanthes cucumerina*	Cucurbitaceae	Banchichinga	Herbacious climber
212.	*Typha elephantiana*Roxb.	Typhaceae	Hogla	Grass used mat making
213.	*Typhonium trilobatum* Schott.	Araceae	Ghet kachu	Tuber
214.	*Urena lobota* Linn.	Malvaceae	Banokra	Small shurb
215.	*Utricularia aurea* Laur.	Utriculariaceae	Swampy weed	Herb
216.	*Vallisueria spirlis* Linn.	Hydrocharitaceae	Bicha	Climber
217.	*Vanda roxburghii* Br.	Orchidaceae	Rashna	Parasite
218.	*Vangueria spinosa* Roxb.	Rubiaceae	Maina	Small grass
219.	*Vetiveria zizanioides* Hash.	Gramineae	Bena	Grass
220.	*Vicia hirsuta* Coch.	Leguminosae	Bon lota	Climber
221.	*Vigna radiata* (L.)Wilizek.	Leguminosae	Arohi lata	Climber
222.	*Viscum album* Linn.	Loranthaceae	Banda lota	Woody parasite in tree crowns
223.	*Viscum orientale* Willd	Loranthaceae	Shamu lota	Woody parasite in tree crowns
224.	*Vitex negundo* Linn.	Verbenaceae	Nishanda	Small shurb
225.	*Vitis lanceolaria* Laws.	Vitaceae	Harinia lata	Climber
226.	*Vitis quadrangularis* Wall.	Vitaceae	Harjora	Climber
227.	*Vitis trifoliate* Linn.	Vitaceae	Anal lata	Climber
228.	*Wolffia arrhiza*	Lemnaceae	Shuzi pana	Floating duck weed
229.	*Xylocarpus granatum* Koen.	Meliaceae	Dhundul	Small tree
230.	*Xylocarpus mekongensis* Pierre.	Meliaceae	Passur	Tree

Source: Helal Siddiqui (2009,2012)

III. Algal Component

Algal component of the Sundarbans is a poorly studied. Islam[13] recorded 165 species of benthic marine and brackish water algae from the coast of Bangladesh. The Division Chlorophyta is represented by 6 genera and 9 species belonging to the families Volvocaceae, Palmelaceae, Ulvaceae, Cladophoraceae, Zymnemaceae and Codiaceae [13]. Division Cynophyta is represented by 9 genera and 16 species belonging to the families Chroococcaceae, Oscillatoriaceae, Nostocaceae and Riviulariaceae. Division Bacillariophyta is represented by 16 genera and 35 species while Division Euglenophyta is represented by 2 genera consisting of 2 species. Existing knowledge regarding the detailed composition of algal flora and functional relationship of the group with the environment of the Sundarbans is not complete. Ecological characteristics, particularly the intermixing of saline and fresh water seasonally fluctuating salinity and the silt brought down by the rivers greatly influence the distribution and abundance of algae in the Sundarbans. Based on their adaptations, Islam [13] classified the brackish water benthic algae of the Sundarbans into the following three categories.

i. Benthic forms attached to littoral muddy shores and forest floor: Commonly species of *Boodleopsis vauceria*, *Colpomenia*, *Cladophorella* and several blue-green algae namely *Oscillatoria*, *Aphanothece*, *Schizothrix*, *Scytonema* spp.

ii. Drift or detached forms: *Enteromorpha Spp.* occasionally species of *Rhizoclonium* and *Chactomorpha* with *Lyngbya* species.
iii. Benthic forms attached to pnematophores and other wooden logs and barks of trees at littoral and upper littoral level, *Chaetomorpha* spp.

IV. Faunal Complex

The Sundarbans fauna is also rich and varied but many more are endangered and in a vulnerable condition due to various reasons. Detail survey on the population status of animals has seldom been carried out. So it is difficult to assess the absolute or relative population density of various animals. Important faunal species in the Sundarbans are shown in table 2 .

Table. 2. Important fauna species in the Sundarbans [14]

Group	Species in Bangladesh	Species in Sundarbans	Share with Bangladesh (%)	Extinct species (no.)	Endangered species (no.)
Mammal	110	49	45	4	10
Bird	628	261	42	2	11
Reptile	109	50	46	1	16
Amphibian	22	8	36	-	1

V. Vertebrate Fauna

At least 32 mammal species are known to occur in the Sundarbans [12], [30]. A list of mammals in the Sundarbans and adjacent areas are given in Table 3. It is also the most important habitat of the globally endangered Royal Bengal Tiger. The present population of the Royal Bengal Tiger in the Sundarbans is nearly 450. This covers nearly 10% of the world's tiger population. Some important wildlife species such as swamp deer (*Cervus duvanceli*), hog deer (*Axis porcinus*), water buffalo (*Bubalis bubalis*), javan rhinoceros (*Rhinoceros sondiacus*), homed rhinoceros (*Rhinoceros unicomis*) and the marsh crocodile (*Crocodylus palustris*) have already become extinct [30].Presently many of the wildlife species such as tiger, crocodile, monitor lizards etc. have become endangered.

Table. 3. Important mammals in the Sundarbans.

Animal group	**Scientific name**	**Vernacular name**
Insectivora	*Sancus murinus*	House Shrew
Chiroptera	*Cynopterus sphinx*	Greater short-nosed Fruit Bat
	Pteropus giganteus	Flying Fox
	Magaderma lyra	Greater False Vampire Bat
	Coelops frithi	EastAsiaticTailless Round-leaf Bat
Primates	*Macaca mulatta*	*Rhesus Macaque*
Rodentia	*Dremomys* sp.	-
	Vandeleuria oleracea	Tree Mouse
	Bandicita indica	Great Bandicoot Rat
	Rattus rattus	Roof Rat
	M. booduga	Field Mouse
	Hystrix hodgsoni	Crestless Malay Porcupine
Cetacea	*Sotalia plumbea*	Plumbeous Dolphin
	Delphinus delphis	Common Dolphin
	Occaella brevirostris	Irrawaddy Dolphin
	Platanista gangetica	Gangetic Dolphin
Carnivora	*Vulpes bengalensis*	Bengal Fox
	Canis aureus	Jackal
	Herpestes edwardsi	Mongoose
	Panthera tigris	Tiger
	Felis viverrina	Fishing Cat
	F. chaus	Jungle Cat
Artiodactyla	*Sus scrofa*	Wild Boar
	Muntiacus muntjak	Barking Deer
	Axis axis	Spotted Deer

VI. Bird Species

There is a wide variety and colourful bird life in the Sundarbans out of 260 species of birds reported to be occurring in Bangladesh mangrove ecosystem and at least 186 have been recorded in the Sundarbans and it is likely that many more will be added in the future since the list made by Salter [30]. The Sundarbans provides roosting and breeding sites for a number of birds species that feed in adjacent cultivated areas. An estimated 25% are migrants present only during the winter months. The important bird species of the Sundarbans is presented by Tamang in 1993[12].

VII. Degradation of Biodiversity

The degradation of biological diversity is a global crisis. There is hardly any region on the Earth that is not facing ecological catastrophes. Of the 1.5 million species known to inhabit the Earth (humans are just one of them), one fourth to one third is likely to extinct within the next few decades. Biological extinction has been a natural phenomenon in geological history. But the rate of extinction was perhaps one species every 1000 years. But man's intervention has speeded up extinction rates all the more. Between 1600 and 1950, the rate of extinction went up to one species every 10 years. Currently it is perhaps one species every year. The destruction of the world's tropical forests are disappearing at an alarming rate. This is one of today's most urgent global environmental issues. Rich species diversity is slowly being lost forever. Tropical forests are estimated to contain 50 to 90 per cent of the world's biodiversity. The loss of biodiversity has immediate and long-term effect on human survival. Mangrove biodiversity is one of the most significant in the world. In the last few decades Bangladesh has lost its second largest natural mangrove forest (Chokoria Sundarbans), polluted its water bodies and decreased density of the world's largest mangrove forest (Sundarbans). It was informed that already one species of *Bruguiera*, i.e. *B. parviflora* has become extinct from the Sundarbans and also noted that many other plant species, such as kirpa (*L. racemosa*), dhundul (*X. granatum*), sada baen (*A. marina*), garjan (*R. mucronata* and *R. apiculata*), gura (*K. candel*), batla (*E. indica*), singra (*C. ramiflora*), amoor (*A. cucullata*) etc. are already threatened [19]. Over emphasis on timber logging has affected many animal species. Faunal losses have been mainly because of overexploitation of certain species for trading purposes [15]. Salter [30] observed those many of the wildlife species such as tiger (*P. tigris*), estuarine crocodile (*C. porosus*), monitor lizards (*Varanus* spp.) have become endangered. Salter [30] noticed that animal species, such as swamp deer (*Cervus duvucela*), Javan rhinoceros (*Rhinoceros sondiacus*), one horned rhinoceros (*R.unicornis*), hog deer (*Axis procinus*), water buffalo (*Bubulus bubulus*) and marsh crocodile (*C. palustris*) have already become extinct from the Sundarbans[15]. Unplanned development works and overexploitation of resources have made its living resources most vulnerable. Overexploitation has not only resulted in shortages of various materials but also left our biodiversity exposed to various ecological threats. Under such circumstances, none can say how many species have already lost from the mangrove forest of Bangladesh.

Fig. 6. Tiger killed by the villagers outside the Sundarban

s

Fig. 7. Sidr hit at Katka in the Sundarbans

Fig. 8. In deep forest Dr.K Alam and Dr.HelalSiddiqui thinking for research planning

Fig. 9. Dr. Helal Siddiqui searching the degraded site for enrichment planting in deep forest of the Sundarbans.

The causes of degradation of ecosystem in the mangrove forest of Bangladesh with the consequent degradation of biodiversity are [19] (i) Destruction of habitat: shifting cultivation, (ii) Hunting, (iii) over exploitation of biological resources, (iv) encroachment of forest land, (v) traditional management practice, (vi) short sighted development project, (vii) fuel shortage, (viii) natural calamities, (ix) lack of awareness amongst the messes regarding usefulness of biological diversity, (x) Introduction of exotic species: Native species are subjected to competition for food and space due to introduction of exotic species, (xi) rapid urbanization rate, (xii) rapid growth of population, (xiii) Pollution: Air and water pollution ; It alters the natural habitat, (xiv) lack of national conservation policy framework, (xv) the weak implementation tools etc.

VIII. Measured to be Needed

1. Promote and implement a system of biodiversity conservation and sustainable forest management system.
2. Improve the institutional capacity to effectively manage the Sundarbans.
3. Reduce the poverty level to about 3.5 million people living adjacent to the Sundarbans termed as impact zone by expanding economic opportunities, improving social infrastructure, improving organization for resource users and facilitating stakeholder participation in resource management.
4. Undertake activities adhering to increase awareness of the environment and ecotourism and building necessary infrastructure.
5. Developing a strong forestry database through MIS for the local and international users.
6. Developing a sound wildlife, ecotourism and fisheries management system for the Sundarbans.
7. Improving planning, monitoring and applied research capabilities
8. Providing training to professional, stake holders and user groups.
9. From the management point of view the project divides the area into 4 functional zones:
10. *Production zone*: Sustainable management of terrestrial and aquatic resources will be practiced in this zone. It includes about 75% of the total area.
11. *Protection zone*: This zone will be managed for wildlife sanctuary i.e. 25% of the total area declared as the World Heritage Site in 1997 by the UNESCO.
12. *Impact zone*: This zone is defined between 0-20 km of the Sundarbans boundary. Socio-economic development activities will be undertaken in this zone. It includes 17 upazillas under 5 districts around the Sundarbans.
13. *Marine zone*: The 20-km water bodies of the Bay of Bengal outside the Sundarbans lying within this zone, will be managed for fisheries development with restriction to protection of endangered species e.g. marine turtles, sharks, dolphins, sawfish and stingrays.

IX. Policies and Laws

National forest policy provides the basic guidelines towards the formulation of Acts and Rules, for the management of forests in totality. In this sub-continent, first formal Forest Policy was declared in 1894. This policy basically aims to save the interest of agriculture. Under this policy, the first management plan for the Sundarbans came in force during 1893-98 and regular management plan of the Sundarbans for a 20 years period of 1913-32 was also prepared under this policy. The Forest Act 1927, which also provides all the regulatory power with respect to Sundarbans, was promulgated under this policy. In 1955, the then Government of Pakistan announced its first National Forest Policy, which emphasized the enhancement of forest revenue. Under this policy, for the first time, Forestal Forestry produced a detail report of the growing stock along with maps carried out a thorough forest inventory of the Sundarbans. This inventory indicated the yield of gewa to support the supply of a news print mills. Management plan for the Sundarbans for 20 years period beginning in 1960 came in force under this forest policy. A Wildlife Ordinance was promulgated in March 1973, which was ultimately adopted as Wildlife Act 1974, with slight amendments. The present Forest policy of 1994 is very elaborate and for the first time incorporated the participatory forestry concept and idea of wetland and biodiversity conservation. Bangladesh Wild life act 2012 also been implemented all over the country.

Sundarbans being a part of Bangladesh territory is subjected to all Acts and Laws applicable in the country. But Forest Act 1927, Wildlife (Preservation) (Amendment) Act 1974, Brick burning Act 1992, The Conservation of Fish Act 1950, Sundarbans Forest Transit Rule 1960 and Felling Rules for non-timber forest produce have special regulatory functions to play on the control, management and production of the Sundarbans. In conformity with the principles of current policies, acts and management prescriptions step-by-step procedures of fieldwork execution have been enunciated from time to time through “standing orders”. This standing orders relates to various subjects connected with the overall management of the Sundarbans and came in force since 1943 and till date over 130 such standing orders have been issued by the Divisional Forest officer, Sundarbans (personal observation)[7].

X. Contribution of the Resources

The Sundarbans mangrove forest constitutes about 45% of total forest area and 4.2% of the total land area of the country[13]. These mangrove resources play an important role in the national economy of Bangladesh and can be divided into forestry, fisheries and aesthetic components. A network of rivers, canals and creeks intersect this forest, thus creating a different set of habitats to that provided by other forest types in the country. It is also a habitat, nursery ground and refuge for many species of coastal fishes, shrimps, crabs, molluscs [3]; and is utilised by mammals (e.g. dolphin), several species of marine turtles, estuarine crocodile and different species of monitor lizards[8].

The commercial use for mangrove products have been well documented[13] but the local subsistence use is generally documented. In the Sundarbans out of 334 plant species, important woody species such as *H. fomes* (sundari), *X. mekongensis* (passur), *B. gymnorrhiza* (kankra), *E. agallocha* (gewa), *C. decandra* (goran), *H. tiliasus* (bhola), *C. ramiflora* (singra), *S. apetala* (keora), *N. fruticans* (golpata), a palm and many other medicinal plants are of commercial importance. Sundari was extensively used as timber for house construction, beams and posts and for boat building, although the sundari harvest has been banned since 1989. Different mangrove branches are used for fishing poles and fish traps all round its distribution [10] including the Sundarbans. Bhola, singra and goran were extensively used as firewood, shingra and sundari tops were used as the raw material for the Khulna Hardboard Mills, gewa is the prime raw material for the Khulna Newsprint Mills and the Dhaka Safety Match Factory. Keora, passur and kankra timber are used for furniture and indoor house posts. Golpata leaf is widely used as thatching and fencing material in the village houses. *Phoenix* has been used as farm posts, keora leaves as fodder and fruits as raw and processed human foods were a staple commodity available from Sundarbans, and the extract from the bark of goran is a source of tannin and medicine worldwide including the Sundarbans.

XI. Timber

Timber resources from major tree species e.g. sundari, gewa, pasur, keora, kankra, dhundal are an important source of forest revenue. A number of industries depend upon the Sundarbans for raw material. Once it was the important for the Khulna Newsprint Mills and the Khulna Hard Board Mills. In addition, match factories; furniture makers, boat builders and sawmill greatly depend on these resources.

XII. Non-Wood Forest Products (NWFP)

Large quantity of fuel wood mostly from *C. decandra*, *Cynometra ramiflora*, *Hibiscus tiliaceous*, *Amoora cucullata*, harvested from the Sundarbans. Additionally, two palm species e.g. *N. fruticans* leaves and *P. paludosa* stalk are harvested as thatching material and posts and three types of grasses e.g. *Cyperus javanicus*, *Imperata cylindrica* and *Phragmites karka* as thatching and fencing materials are also harvested.

Fig. 10. Harvested golpata leaves

Fig. 11. Hantal made Furniture

Collection and processing of non-wood forest produces also support large revenue income from the Sundarbans. This sector also employs large number of rural people though most of the employment is seasonal. NWFP are of both plant and animal origin. Plant based NWFP are identified as goran (*C. decandra*), golpata (*N. fruticans*), hantal (*P. paludosa*), Grasses (*I. cylinrdica, C. javanicus*), nal khagra (*P. karka*), shingra (*C. ramiflora*), bhola (*H. tiliaceous*)[31]. In addition, animal based NWFP includes fish, shelfish, molluscs, honey, wax etc. NWFP provides fuel wood, thatching material, house post, medicine, food and materials for cottage industries and domestic use of the adjoining people[31],[32].

XIII. Fuel Wood

Sundarbans support large amount of fuel wood for local and industrial uses. Goran, shingra, kirpa, amur, bhola are the major fuel wood species. In addition, branches of sundari, baen, keora are used as fuel wood. But goran is a good quality fuel wood with high combustible value. The bark of goran is rich in tannin which is locally used for dyeing fishing nets[32].

XIV. Thatching Material And Post

Golpata is used for thatching and fencing houses in the coastal areas. Hantal is another useful species of the family palmae. Its stem is used as house and fence posts, rafters and special posts for betel leaf farms. Grasses are used in the cottage industries as raw materials [31].

International Journal of Agriculture Innovations and Research
Volume 5, Issue 3, ISSN (Online) 2319-1473

XV. Honey and Wax

The wild honeybee produces honey and wax in their colony which are harvested annually during the month of April-June. A comb may produce 4-14 kg of honey depending on the size [18] and about 300 tons of wild honey and 100 tons of wax is produced annually. Honey from khalshi nectar is considered the best of all honey collected.

Fig. 12. Bee hives in the Deep forest

Table 4. Extraction and revenue of Sundarbans Forest Division from Oyster, honey and bee wax.

Finncial Year	Oyster (Mt)	Revenue Tk.	Honey (Mt)	Revenue Tk.	Wax (Mt)	Revenue Tk.
2007-2008	50.00	1,27,225.00	139.00	7,48,040.00	35.00	2,80,546.00
2006-2007	75.00	35,605.00	210.00	1,13,1617.00	52.00	4,24,690.00
2005-2006	1,196.00	1,61,535.00	119.00	6,43,600.00	30.00	2,41,350.00
2004-2005	875.00	1,15,145.00	147.00	7,92,,400.00	37.00	2,97,150.00
2003-2004	567.00	1,27,905.00	125.00	6,75,600.00	31.00	2,53,350.00
2002-2003	287.00	77,460.00	104.00	5,81,800.00	24.00	1,92,750.00
2001-2002	1,204.00	32503.00	87.00	6,21,600.00	23.00	1,29,850.00
2000-2001	2,525.00	60,079.00	146.00	3,46,580.00	36.00	1,29,967.50
1999-2000	2,273.00	60,898.00	207.00	5,55,250.00	52.00	2,08,387.50
1998-1999	3,361.00	90,040.00	159.00	4,27,200.00	40.00	1,60,312.50
1997-1998	3,127.00	84,009.00	130.00	3,48,900.00	33.00	1,30,837.50
1996-1997	1,800.00	84,220.00	192.00	5,15,500.00	48.00	1,93,312.50
1995-1996	4,279.00	1,14,744.00	160.00	7,28,700.00	40.00	1,60,762.00
1994-1995	3,947.00	1,05,750.00	86.00	2,40,000.00	22.00	90,000.00
1993-1994	4.363.00	11,691.00	106.00	2,84,100.00	26.00	1,06,537.00
1992-1993	3,348.00	89,704.00	182.00	4,89,020.00	46.00	1,83,382.00
1991-1992	3,169.00	84,405.00	159.00	4,26,443.00	44.00	1,47,525.00
1990-1991	2,445.00	65,519.00	210.00	5,63,400.00	53.00	2,11,200.00

Source: (Personal communication with Conservator of Forest, Khulna, 2008, Helal Siddiqui1998, Helal Siddiqui 1999).

XVI. Fishery Resources

The fishery resources are important aquatic lives in the Sundarbans that includes fish, molluscs and crustaceans and engages about 1,50,000 commercial and artesian fishermen. The Sundarbans water supports 210 species of finfishes, 38 species of crustaceans including shrimps and crabs, 34 species of molluscs that includes snail, mussel and oysters[2].The fishery of the Sundarbans represents the most important non-wood product component of the region which constitutes 5% of the total fish harvest of Bangladesh [8]. The fisheries value of the Sundarbans has been estimated at 209.9 million US$ [1] with the stock of fish at 2.9 to 3.7 t/km^2 [6].

XVII. Fishes, Crustaceans And Molluscs

Sundarbans supports a total 291 species of fishery resources and constitutes an important commercial and artisanal fishery industry that produces fresh fish, iced fish, sun dried fish, smoked fish, salted fish, fish meal and sharks oil. Thus, Sundarbans provides a considerable harvest of whitefish, shrimps, prawns, mud crabs, snails/oysters and billions of shrimp/prawn post-larvae for shrimp aquaculture farms. These industries support about 1,55,000 fishermen throughout the year. Hambrey [11] reported that economic valuation of the fisheries function of mangroves was estimated to range from US$ 66 to almost $ 3,000/ha.

Fig. 13. Dry fish in the Sundarbans

Sundarbans fishery resources consist of fish, molluscs and crustaceans. Hilsa, sea bass, Bombay duck, ribbon fish, pomfrets, croackers, grunts, catfishes, mullets, anchovies are important among whitefish. Mud crab, giant fresh water prawn, tiger shrimp, white shrimp, brown shrimp are important among crustaceans. Loligo, octopus, squid, giant oyster and other mussels and calm are important among molluscs. All these constitute fishery items and are harvested by 16 different methods and gears. About1,50,000 fishermen are engaged in fishing except shrimp larvae catching. Fish caught are iced and dried and are transferred to local and international markets. In addition, Sundarbans Dubla Island fishery produces large amount of dry fish of different species that are exported to local and international markets. Many fish market, fish processing plants and fishmeal factories have been established based on Sundarbans fishery production.

Fig. 14.Crab of the Sundarbans

Fig. 15.White fish of the Sundarbans

Fig. 15. Lobster of the Sundarbans

The *nypa* palm in addition to thatching and fencing e.g. leaf petioles is used as floats for fishnets. Chopped leaf petioles are boiled for salt, young leaflets are used as cigarette wrappers and older leaflets to weave hats, umbrella, baskets and mats but not in the Sundarbans[31]. The gelatinous endosperm of young seeds can be eaten raw and various components of the fruit were also used to treat toothache, headaches and herpes in other parts of the world but not the Sundarbans. The nypa fruit sap contains 14 to 17% sucrose, and is a valuable commodity used to produce soft drink and alcoholic beverage [10].

The Sundarbans also provides shelter and habitat for wild honeybee (*Apis dorsata*) and thus supports yield of about 300 t of crude honey and 80 t of wax [13]. These products are widely used in the pharmaceutical industry. The important economic products that are regularly harvested and used are shown in Table 4. However, this forest supports livelihood and earnings for about 2,00,000 people of the adjoining areas at least part of the year i.e. during winter season for fishing, collection of nypa leaf and goran fuelwood [12],[22].

In addition, birds, mammals including the Bengal tiger, reptiles including the estuarine crocodile, amphibians, and other wildlife within the 1,39,000 ha wildlife sanctuary have made the Sundarbans an excellent site for students, researchers and natural history film makers. The Sundarbans is a potential tourist attraction, renowned for its beauty and unique ecosystem[22]. The Sundarbans also plays an important role as a buffer in protecting the agricultural hinterlands from the onslaught of frequently occurring cyclones and tidal surges. Mongla, the second seaport of Bangladesh, is situated on the coastal river Passur at the bottom of Sundarbans. This port uses the Passur channel as entrance and exit routes to and from the Bay of Bengal for international ships. In addition, Raimongal-Jamuna-Shibsa river routes inside the Sundarbans is used by the Indian Government for transport of goods to and from Kolkata River port to other river ports in the eastern part of India. Some sea fishing fleets use the Sundarbans channel to and from the Bay of Bengal to land their catch in the southern part of the country, e.g. at Bagerhat, Khulna and Satkhira city. The Bangladesh Navy and Coastguards also use the Sundarbans channel for regular patrol to and from the Bay of Bengal.

The Sundarbans comprises 45% of the total productive forest in the country, contributing about 50% of forest-related revenue. Approximately 100,000 to 200,000 people work inside the Sundarbans for at least 6 months, while the number of people entering the forest in a year can be as high as 3,00,000 [12]. Of these about 25,000 people work in fish drying, and 60,000-90,000 people in shrimp post-larvae collection inside the Sundarbans [8]. About 1,00,000 people are engaged in shrimp larval collection in the rivers and creeks outside the Sundarbans [6]. Approximately 2.5 million [13] people live in small villages surrounding the Sundarbans, while the number of people within 20 km of the Sundarbans boundary is 3.14 million. The dependency of local people on the Sundarbans is very high, with nearly half (46%) of all household income within 10 km of the forest boundary being derived from Sundarbans resources. About 1,00,000 to 2,00,000 people derive all or part of their income by collecting non-wood forest products from the Sundarbans [16]. The fishery of the Sundarbans represents the most important non-wood product component of the region and constitutes 5% of the total fish harvest of Bangladesh [8]. The fisheries value of the Sundarbans has been estimated at 209.9 million US$ (46,083 US$/km^2) (Anon 1997). The stock of fishes in the area has been estimated at 2.9 to 3.7 t / km^2**[6]**.

Table 5. Extraction and revenue of Sundarbans Forest Division from timber and other forest products.

Forest product	**Yield / Year**				
	1995-96	**1996-97**	**1997-98**	**1998-99**	**1999-2000**
Timber	479885 cft	159149 cft	194970 cft	123646 cft	176443 cft
Gewa	3927033 cft	2603364 cft	9480733 cft	2118817 cft	1517997 cft
Fuel wood	463060 cft	310839 cft	524685 cft	106655 cft	136374 cft
Goran	41916 t	51923 t	53569 t	27235 t	23076 t
Golpata	66167 t	63518 t	53900 t	39780 t	30093 t
Fish	11089 t	9900 t	8900 t	8077 t	7790 t
Honey	238 t	210 t	212 t	176 t	213 t
Wax	57 t	50 t	48 t	41 t	53 t
Oyster	4500 t	2100 t	3245 t	3590 t	1980 t
Grass	4200 t	6020 t	5300 t	5050 t	3900 t
Hantal	4550 t	2500 t	770 t	492 t	579 t

Source: Sundarbans Forest Office record, 2000.

XVIII. Extraction

These are collected by local fishermen and forest department earn an good deal of revenue. The most attractive shrimp and crab is exported to USA, Belgium, Japan, UK, Netherlands, Singapore and other countries. Bagda and Golda shrimp has revolutionized the harvesting fish from the Sundarbans. Dry fish collection begins from September – October and continue up to March and earns a lot of revenue shown in table 7.However Sundarbans East and west Forest Division which are under Khulna Circle earned a handsome revenue every year[7]. Annual statement of revenue of the Khulna Circle is shown in table-8[22].

Table 6. Goran, Golpata and Hantal extraction and revenue of the Sundarbans Forest Division.

Financial Year	**Goran (Mt)**	**Revenue Tk.**	**Golpata (Mon)/ (Mt)**	**Revenue Tk.**	**Hantal (Mt)**	**Revenue Tk.**
2007-2008	422.00	711175.0	83.0	79948.00	194no.	338.00
2006-2007	10,875.00	31,68,038.00	19,750.00	24,65,894.00	46.00	14,884.00
2005-2006	10,691.00	31,20,295.00	29,198.00	33,67,868.00	973.00	55,005.00
2004-2005	9,306.00	30,52,550.00	27,890.00	31,28,214.00	825.00	58,269.00
2003-2004	11,990.00	38,69,983.00	18,941.00	22,22,510.00	1,369.00	1,26,947.00
2002-2003	9,845.00	28,60,559.0	21,060.0	36,67,430.00	1,122.00	94,818.00
2001-2002	16,452.00	37,23,840.0	18,174.0	2583615.00	562.00	27,165.00
2000-2001	18,899.00	26,26,822.4	18,899.0	27,92,091.00	1,300.00	57,,239.00
1999-2000	19,183.00	30,52,520.0	30,324.0	26,87,723.00	971.00	50,438.00
1998-1999	16,727.00	24,94,101.9	38,562. 0	35,10,609.50	447.00	24,697.55
1997-1998	51,988.00	76,00,082.0	52,222. 0	47,77,405.00	580.00	30,797.00
1996-1997	50,392.00	71,41,255.0	61,548. 0	52,29,647.00	1,451.00	71,557.00
1995-1996	51,878.00	75,36,789.0	64,215. 0	55,97,181.00	4,338.00	2,31,312.00
1994-1995	70,383.00	1,03,50,396.0	64,283.0	58,59,694.00	1,412.00	1,05,474.00
1993-1994	64.995.00	97,54,801.0	68,094.0	59.06,901.00	6,725.00	3,38,549.00
1992-1993	52,432.00	65,30,757.0	66,516.0	54,46,593.00	6,053.00	3,91,380.00
991-1992	1,360.00	5,40,240.00	2,434.00	8,21,518.00	,032.00	,47,657,00
990-1991	1,043.00	4,21,960.00	2,148.00	7,98,607.00	,747.00	,34,404.00

Source: (Personal communication with Conservator of Forest, Khulna, 2008, Helal Siddiqui1998, Helal Siddiqui 1999,).

IJAIR
International Journal of Agriculture Innovations and Research
Volume 5, Issue 3, ISSN (Online) 2319-1473

Table-7. Shrimp-fish, Dry-fish & Crab extraction and revenue of Sundarbans Forest Division.

Financial Year	Shrimp-fish (Mond)	Revenue Tk.	Dry-fish (Mond)	Revenue Tk.	Crab (Mond)	Revenue Tk.
2007-2008	5,06	1,74,27,155.0	53,98	54,91,383.00	40,148	41,30,651.00
2006-2007	1,81	1,02,99,013.0	10,41	13,30,292.00	2,135	26,1,573.00
2005-2006	2,23	73,54,883.0	19,79	11,73,312.00	2,998	35,0,534.00
2004-2005	20,32	73,45,708.0	36,84	10,89,369.00	2,924	33,4,319.00
2003-2004	1,97	71,22,434.0	65,29	14,64,148.00	2,144	20,9,524.00
2002-2003	1,90	58,91,905.0	44,00	15,65,557.00	1,384	11,1,426.00
2001-2002	2,13	45,53,107.0	30,65	14,81,813.00	3,642	16,7,582.00
2000-2001	8,64	15,06,561.0	17,58	10,14,813.0	10,64	3,78,168.00
1999-2000	10,05	17,02,101.0	16,72	9,51,720.0	14,64	5,20,588.00
1998-1999	9,59	18,67,352.0	14,03	9,13,168.0	11,76	4,70,765.00
1997-1998	9,10	20,52,416.0	17,52	11,38,229.0	21,99	8,79,268.00
1996-1997	9,25	22,16,664.0	19,75	12,83,522.0	26,55	10,66,409.00
1995-1996	10,95	24,03,10.0	17,51	11,38,235.0	17,14	6,89,598.00
1994-1995	12,92	25,00,339.0	15,88	10,34,492.0	19,06	7,55,221.00
1993-1994	12,34	24,56,186.0	22,91	14,89,200.0	14,11	5,62,979.00
1992-1993	13,16	27,14,831.0	21,20	13,78,332.0	13,16	5,26,699.00
1991-1992	13,23	27,76,345.0	14,29	9,28,954.0	7,34	2,93,876.00
1990-1991	11,89	35,85,176.0	16,35	10,61,540.0	3,20	1,26,753.00

Source: (Personal communication with Conservator of Forest, Khulna, 2008, Helal Siddiqui1998, Helal Siddiqui 1999,).

Table 8. Statement of Total Revenue earned 1981-82 to 2013-14 From Khulna Circle.

SL.No	Year	Revenue earned
01	1981-82	15,87,14,134/-
02	1982-83	14,00,58,507/-
03	1983-84	16,07,47,142/-
04	1984-85	21,94,14,660/-
05	1985-86	26,93,61,362/-
06	1986-87	23,08,14,168/-
07	1987-88	28,26,45,190/-
08	1988-89	31,99,72,900/-
09	1989-90	12,87,27,604/-
10	1990-91	7,08,20,858/-
11	1991-92	15,24,84,003/-
12	1992-93	12,33,08,500/-
13	1993-94	17,19,82,684/-
14	1994-95	22,77,74,257/-
15	1995-96	19,54,83,692/-
16	1996-97	11,05,92,450/-
17	1997-98	10,68,78,679/-
18	1998-99	8,62,44,886/-
19	1999-2000	8,36,48,197/-
20	2000-2001	7,84,08,010/-
21	2001-2002	4,50,46,992/-
22	2002-2003	7,30,01,683/-
23	2003-2004	6,07,13,673/-
24	2004-2005	6,72,38,120/-
25	2005-2006	5,82,13,326/-
26	2006-2007	6,59,23,411/-
27	2007-2008	7,32,07,969/-
28	2008-2009	5,51,69,919/-
29	2009-2010	6,98,37,332/-
30	2010-2011	8,07,99,220/-
31	2011-2012	7,28,27,677/-
32	2012-2013	7,96,59,851/-
33	2013-2014	6,98,05,056/-

Source: Personal communication with Mr. Sunil Kumar Kundu, Conservator of Forest, Khulna, 2014.

XIX. Enrichment Planting

The canopy closure of the forest has declined in the last decades of the past century. Merchantable stocking of sundari (*Heritiera fomes*) and gewa (*Excoecaria agallocha)* has become depleted 40% and 45% respectively over a period of 25 years [5]. Due to the problem of sundri top dying it contributes 65% of total merchantable timber aggravated. About 40% of the sundry stands are moderately or severely affected by top dying problem. More than 50% passur trees are affected by heart rot disease [22]-26]. So, initiatives have been taken for enrichment planting with suitable mangrove species in the affected and poorly regenerated sites of the Sundarbans [21].

XX. Ecosystem Conservation

Nurseries have been maintained with mangrove species at Bogi Forest Research Station, Saronkhola, Bagerhat; Dhangmari Forest Research Station, Dakop, Khulna and Munshigong Forest Research Station, Shamnagor, Satkhira in the Sundrbans. Experiment plantations have been raised and maintained in the different degraded locations of the Sundarbans for ecosystem development.

To restore the Sundarbans ecosystem it needs increasing its productivity and conserve the resources and remaining unchanged of the timber species. Mangrove Silviculture Division has been conducting experiments to select suitable mangrove species and methods for enrichment plantation in less productive areas in the Sundarbans for the following purposes [21].

- Increasing productivity.
- Resource creation for industrial and energy use.
- Creation of employment opportunity.
- Gene conservation.
- Supplement the natural regeneration.
- Improving density and proportion of more valuable species.
- Introduction of valuable species where the native species are low in productivity, poor in form, less utility, slow growing and possessing other undesirable traits.
- Replacement of the natural regeneration.
- Cover up the vacant and poorly regenerated areas in the Sundarbans.
- Development of a suitable silvicultural technique for its proper management in the Sundarbans.
- Improvement of the Sundarbans ecosystem.

The objectives of enrichment plantation in the Sundarbans with mangrove species are more related to the following concept.

- Environmental protection and biodiversity conservation.
- Production of unavailable species that is less or more or threatened species.
- To fulfill the community needs.
- Production of industrial resources through enrichment plantation with mangrove species where the natural forests can no longer fulfill these functions.

The selected enrichment plantations sites are [21] as follow:

- Degraded forest
- Swampy charland
- Newly accreted char land
- Old or mature char land
- Mouth of the estuaries, river and canals
- Water logged areas
- Vacant areas
- Less or poorly regenerated areas
- Non commercial cover (NCC)
- River banks
- Storm damage areas
- Top dying areas lacking advance regeneration or available regeneration
- Felling areas
- Mix forest where expected species are not available
- High lands where there is no regular tidal inundation

XXI. Conclusion

Sundarbans biodiversity and its ecosystem is more essential commodities for the ecological point of view. The flora, fauna and the other factors of the Sundarbans are highly responsible for its ecotype protection and minimize natural calamities. Biodiversity of the Sundarbans is a great source of food, fodder, fuel wood, medicine and shelter belt. The Sundarbans is being managed in Bangladesh forestry for over 125 years for wood and revenue, that has switched over to a modern concept of management to maintain the ecosystem. Now the Sundarbans is deteriorating and degraded its biodiversity by different manmade and natural causes. Water pollution, air pollution, green house effect as well as climate change and thus global warming are the causes of biodiversity loss and degradation of the Sundarbans. Illicit harvesting, poaching and weak management are responsible for degradation of the biodiversity. The continuous worldwide Biodiversity degradation is alarming. The dynamic nature of the ecosystem needs to be considered and an integrated management approach on a sustained yield basis needs to be initiated with the creation of true mangrove reserves to conserve the biodiversity at large. The status of the Sundarbans mangroves is still encouraging, considering tremendous biotic and abiotic interference on all the natural resources and consequent shrinkage of vegetation under other forest types.

References

[1] Anon. 1997. *Meghna Esturay Study*. Technical Notes MES-009. Bangladesh Water Development Board, Dhaka.

[2] Bernacsek, G. 2000. *Annotated Checklist of Aquatic Biodiversity of the Sundarbans*. Sundarbans Biodiversity Conservation Project, Forest Department, Khulna, 6 pp.

[3] Blaber, S.J.M. 2000. *Tropical Estuarine Fishes*. Ecology, Exploitation and Conservation, Blackwells, Oxford, pp.185-267.

[4] Canonizado. J.A. and Hossain M.A. 1998. *Integrated Forest Management Plan for the Sundarbans Reserved Forest*. Forest Resources Management Project. GOB/WB. Mandala

Agricultural Development Corporation and Forest Department, Bangladesh.

[5] Chaffey, D.R.; Millar, F.R. and Sandom, J.H. 1985. *A Forest Inventory of the Sundarbans, Bangladesh: Main Report*. Project Report No. 140, Overseas Development Administration, London. 196 pp.

[6] Chantarasri, S. 1994. *Integrated Resource Development of the Sundarbans.* Fisheries Resources Management for the Sundarbans, UNDP/FAO, BGD/84/056, Khulna, Bangladesh. 171 pp.

[7] Chowdhury, R.A. and Ahmed, I. 1994. History of forest management. *In:* Hussain, Z. and acharya, G. (eds). *Mangrove of the Sundarbans, Volume two: Bangladesh*. IUCN, Bangkok. pp.155-179

[8] FAO. 1994. *Mangrove area management guideline*. *FAO Forestry Paper* 117. 256 pp.

[9] Forestal. 1960. Forest Inventory 1958-59, Sundarbans Forests. Forestal International Incorporated, Oregon, Canada.

[10] Hogarth, P.J. 1999. *The Biology of Mangroves.* Oxford University Press, Oxford. pp. 2-180.

[11] Hambrey, J. 1999. *Mangrove, Fisheries and Economic*. Aquaculture and Aquatic Resource Management Program, Asian Institute of Technology, Thailand. pp.1-4. Website address http://www.agri-aqua.ait.ac.th/mangroves/Ham3.htm.

[12] Hussain, Z. and Karim, A. 1994. Introduction. *In:* Hussain, Z. and Achary, G. (eds.). *Mangroves of the Sundarbans Volume two: Bangladesh*. IUCN, Bangkok. pp.1-10.

[13] Islam, M.A. 1993. *Some Relevant Information about Sundarbans.* Sundarbans Forest Division, Khulna, Bangladesh. 21 pp.

[14] IUCN. 2000. *Red Lists of Threatened Animals of Bangladesh.* IUCN-The World Conservation Union, Bangladesh. 54 pp.

[15] Khan, M.A.R. 1986. Wildlife in Bangladesh mangrove ecosystem. *Journal of Bombay Natural History Society* 83: 32-48.

[16] MARC. 1995. *Socioeconomic Studies on the Sundarbans Reserved Forest.* Multidisciplinary Action Research Center, Dhaka, Bangladesh. 128 pp.

[17] Prain, D. 1903. *Flora of the Sundarbans.* Records of the Botanical Survey of India. Periodical Expert Book Agency, Delhi. 231-370 pp.

[18] Siddiqi, N.A. 2001. *Mangrove Forestry in Bangladesh*. Institute of Forestry and Environmental Science, University of Chittagong, Chittagong. 201 pp.

[19] Rahman,M.M.2004. Biodiversity Degradation in Mangrove Forest of Bangladesh. Proceedings of the seminar, Organised by Mangrove Silviculture Division, Bangladesh Forest Research Institute. Muzgunnni, Khulna-9000. *21-37pp.*

[20] Islam,S.A. 2004. Plantation Techniques of Some Mainland Species in the Raised Lands of the Sundarbans. Proceedings of the seminar, Organised by Mangrove Silviculture Division, Bangladesh Forest Research Institute, Muzgunnni, Khulna-9000.115-122pp

[21] Helal Siddiqui, A.S.M. 2004. Plantation Establishment with Mangrove Tree Species in the Poorly Regenerated Areas of the Sundarbans (Enrichment planting). Proceedings of the seminar, Organised by Mangrove Silviculture, Division, Bangladesh Forest Research Institute, Muzgunnni, Khulna-9000. 123-129pp.

[22] Helal Siddiqui, A.S.M. 2009.*Sundarbans and Visit to the Sundarbans.*Published by Angikar Prokashoni, 38 BanglaBazar, Dhaka. ISBN-984-32-2195-8. 287pp.

[23] Helal Siddiqui,A.S.M. 2012. Heart rot disease of passur (*Xylocarpus mekongensis*), a valuable timber yielding species in the Sundarbans mangrove forest, Bangladesh. Ph. D. Thesis Submitted to the Jahangirnagar University, in fulfillment of the requirements for the degree of Doctor of Philosophy in Botany, Savar, Dhaka : 175pp.

[24] Helal Siddiqui,A.S.M. and Khair,A.2012. Regeneration Status and Identification of Heart Rot Disease of Pasur (*Xylocarpus mekongensis*) Tree in the Sundarbans of Bangladesh.Indian Journal of Forestry, Vol.35(4):435-442pp.

[25] Helal Siddiqui,A.S.M. and Khair,A.2012. Infestation status of Heart Rot disease of Passur (*Xylocarpus mekongensis),* Tree in the Sundarbans. Indian Forester, vol 138(2);

[26] Helal Siddiqui, A.S.M., Dr. Abul Khair, DR. M. Masudur Rahman and S.M. Mosfeka Hasnin, 2013. SILVICULTURAL ASPECT OF PASSUR (*XYLOCARPUS MEKONGENSIS*) TREE IN THE SUNDARBANS WITH SPECIAL REFERENCE TO HEART ROT DISEASE. Pakistan Journal of Forestry, Pakistan Forest Institute, Peshawar 25120, Khyber Pakhtunkhwa, Pakistan, vol.63(1).2013. pfiesbranch@gmail.com

[27] Helal Siddiqui, A.S.M.1998. *Ek Polock – A Sundarbans* (Sundarbans at a glance) Published by Rezina Begum, RiphatKuthir, Bhatghara, Kaliganj, Jhenaidah, ISBN-948-31-0272-2; 64pp

[28] Khatun, B.M.R. and Alam, M.K.1987. Taxonomic studies in the genus *Avicennia* Linn. From Bangladesh. Bangladesh Journal of Botany 16 (1): 39-44

[29] Chapman, V. J. 1975. Mangrove biogeography. *In:* Walsh, G.E., Snedaker, S.C. and Teas, H.J.(eds.).*Proceedings of International Symposium on Biology and Management of Mangroves*. Hawaii, Gainesville, University of Florida. 3-22.

[30] Salter,R.E.1984. Integrated Development of the Sundarbans Bangladesh (Status and Utilization of Wildlife). Report prepared for the Government of Bangladesh. FAO, Rome; 59pp.

[31] Helal Siddiqui, A.S.M. (1999). Minor forest products in the Sundarbans of Bangladesh. Indian Journal of Non Timber Forest Products, Vol. 6:(1/2):19-25 pp.

[32] Helal Siddiqui, A. S. M., Faizuddin, M., Rahman, M.M., Shahidullah, M. and Rashid, M. H.(1997).Economic Importance, role and uses of goran, a resourceful species in the Sundarbans, Indian Journal of Non Timber Forest Products, Vol. 4:(3/4):123-125 pp.

AUTHOR'S PROFILE

Dr. A.S.M. Helal Uddin Ahmmed Siddiqui was born in Kaliganj , Jhenaidah, Bangladesh in the year 1964 in a respectable Muslim Family. After obtaining B. Sc. (Hons.) and M.Sc. Degree in Botany Department from Rajshahi Univarsity in 1986 and 1987 respectively he took up an appoint as a Social Service Officer in Social Well fare Department of Bangladesh Government at Shariatpur on the July 1992. He worked there one and half a year and resigned the post on 14 November, 1993. He was apointed as a Research Officer at Mangrove Silviculture Division under the Bangladesh Forest Research Institute on the 16th November, 1993 and working till date.

Dr. Helal Siddiqui is brilliant academic career all through his life. He did his Doctoral degree (Ph.D.) in plant Pathology under Professor Dr. Abul Khair, Department of Botany from the Jahangirnagar University, Dhaka, Bangladesh. He has conducted his Ph.D. works entitled," *Heart rot disease of passur (Xylocarpus mekongensis), a valuable timber yielding species in the Sundarbans mangrove forest, Bangladesh."* since 2007-2008 to 2012. The University conferred on him the Ph.D. degree on 23rd March, 2014. He was awarded Ph.D. fellowship under the NSICT Ministry.

He also got some training on Forestry Research Management, Office and financial Management etc. He was looking after the Forest Research Stations activities both financial and administration. He delivers the Radio talk on different aspects at the Khulna Radio Center. He used to teach different training program in the stake holders of the Sundarbans dwellers and different GO and NGOs. He is a good resource person of various training program. He visited Malaysia in 2000 in connection with IUFRO World Conference and presented his paper. He also presented many papers in the National Seminars during his present job. He visited all Over the Sundarbans and many other diversified forest areas in these regions.

He is a member of many national and international organizations like Bangladesh Association for the Advancement of Science, Senior Forest Research Officer's Association, Bangladesh Botanical Society, University Students Association (former President, Rajshahi University local Association) *Member of Bangladesh Biggani Somity, Graduate Somity, Kaliganj, Jhenaidah.*

He has so far number of publication (60+) at his credit in the field of forestry on wildlife and silvicultural aspect published in the National and International journals, like Tiger Paper, Indian Journal of Forestry, Indian Forester, Indian journal of Non Timber Forest Products.Pakistan Journal of Forestry, Bangldesh Journal of Forest Science. His some books are already renowned such as *Sundarbans at a glance*, *Sundarbaner Kobita* (Poetry of Sundarbans, 51 poems), *Sundarbans and Visit to the*

Sundarbans, Palm species of Bangladesh, Cultivation and Uses (Published by Bangla Academy,2009), *Arannyo Bilash*,(46 poems, poetry of the nature and the Sundarbans)etc. Besides, his editorial comments and features are highlighted so far in different aspects in the daily news paper. He is experienced as a researcher and the administrator.

His few Major works are as follows:

- Helal Siddiqui,A.S.M. and Khair,A.(2012). Regeneration Status and Identification of Heart Rot Disease of Pasur (*Xylocarpus mekongensis*) Tree in the Sundarbans of Bangladesh.Indian Journal of Forestry, Vol.35(4):435-442pp.
- Helal Siddiqui,A.S.M. and Khair,A.(2012). Infestation status of Heart Rot disease of Passur (*Xylocarpus mekongensis),* Tree in the Sundarbans. Indian Forester, vol 138(2);
- Helalsiddiqui, A. S. M. 1999. Status of the major mangrove species in the Sundarbans of Bangladesh. Indian Journal of Forestry. Voll.22. No. 3 : 197-202pp.
- Helal Siddiqui,A.S.M.2002. Silvicultural Aspect of Baen (*Avecennia* spp.)-The Pioneer tree species in the Sundarbans. Silver Jubilee Supplement of Indian Journal of Non-Timber Forest Products, Vol. 9(3/4):156-162 pp.
- Helal Siddiqui, A.S.M. (1999). Minor forest products in the Sundarbans of Bangladesh. Indian Journal of Non Timber Forest Products, Vol. 6:(1/2):19-25 pp.
- Helal Siddiqui, A. S. M., Faizuddin, M., Rahman, M.M., Shahidullah, M. and Rashid, M. H.(1997).Economic Importance, role and uses of goran, a resourceful species in the Sundarbans, Indian Journal of Non Timber Forest Products, Vol. 4:(3/4):123-125 pp.
- Fazuddin, M., Rahman, M. M. and Shahidullah, M., Helal Siddiqui, A.S.M.., Hasnin, M. and Rashid, M. H. 2000. Survival and growth performence of golpata (*Nypa fruticans*) in the newly accreted sites of the Sundarbans mangrove forests of Bangladesh. Bangladesh Journal of Forest Science Vol. 29(2):79-84pp.
- Faizuddin, M. Rahman, M.M., Shahidullah, M., Helal Siddiqui, A.S.M.H.A., Hasnin, M. and Rashid, M. H. 1999. Survival and growth performance of some mangrove species planted in the Sundarbans of Bangladesh. *Bangladesh Journal of Forest Science*, 27(2): 121-127pp.
- Helalsiddiqui, A. S. M. 1998. Present status of wild life, Human casualties by Tiger, and wildlife conservation in the Sundarbans of Bangladesh. Tiger Paper, 25(2): 28-32pp
- S.A. Islam Fazuddin,M, Helal Siddiqui, A.S.M, Rashid, M. H, Rahman, M. M.; Hasnin, S.M.M. and Shahidullah, M. 2008. Effect of Felling Top Dying Affected Sundri (*Heritiera fomes*) Trees on the Abundance of Regeneration in the Sundarbans of Bangladesh. Bangladesh Journal of Forest Science Vol. 31(1&2):57-68pp.
- S.A. Islam Fazuddin,M, Rashid, M. H, M. M, Rahman, Hasnin, S.M.M., Helal Siddiqui, A.S.M,; and Shahidullah, M. 2008. Influence of Deer (*Axis axixs*) on the Newly Recruited Seedlings of Some Major Mangrove Species in the Sundarbans of Bangladesh. Bangladesh Journal of Forest Science Vol. 31(1&2):75-85pp.
- Helal Siddiqui, A.S.M., Dr. Abul Khair, DR. M. Masudur Rahman and S.M. Mosfeka Hasnin, (2013). SILVICULTURAL ASPECT OF PASSUR (*XYLOCARPUS MEKONGENSIS*) TREE IN THE SUNDARBANS WITH SPECIAL REFERENCE TO HEART ROT DISEASE. Paper published; Pakistan Journal of Forestry, Pakistan Forest Institute, Peshawar 25120, Khyber Pakhtunkhwa, Pakistan, vol.63(1).2013**.**pfiesbranch@gmail.com
- Helal Siddiqui,A.S.M. (2012). Heart rot disease of passur (*Xylocarpus mekongensis*), a valuable timber yielding species in the Sundarbans mangrove forest, Bangladesh. Ph. D. Thesis Submitted to the Jahangirnagar University, in fulfillment of the requirements for the degree of Doctor of Philosophy in Botany, Savar, Dhaka : 175pp.
- HelalSiddiqui,A.S.M.2000.Sundarbaner Kabita (Poetry of the Sundarbans). Rosi Siddiqui, Riphat Kutir, Kaliganj, JhenaidhaISBN-984-31-0945-7, 96 pp.
- Helal Siddiqui, A.S.M. (2009).Palms of Bangladesh, Cultivation and uses. Published by Bangla Academi, Dhaka.104p. ISBN-984-07-4763-0.
- Helalsiddiqui, A. S.M.2014. Arannyo Bilash, A poetry of the Sundarbans and the nature, Edited by Professor Bikash Chandra RoY, Department of Bangla, Govt. Hossain Shahid Shohrawardi Collge, Magura; Published by Anggkar prokashoni, 38 Banglabazar, Dhaka-1100. ISBN-978-984-33-4041-5; 80pp.
- Helal Siddiqui, A.S.M. (2009).The Disease and Disorder of the Mangrove Species in the Sundarbans. Abstract, Section II, Twenty First Bangladesh Science Conferene, BARI, Gazipur, 18-20 February,2009 23-24pp.
- Helal Siddiqui, A.S.M. (2009).Sundarbon O Vromon prosongo, Published by Angikar Prokashoni,38 Banglabazar, Dhaka, 287p.ISBN-984-32-2195-8.
- Helal Siddiqui, A.S.M.1998. *Ek Polock – A Sundarbans* (Sundarbans at a glance) Published by Rezina Begum, RiphatKuthir, Bhatghara, Kaliganj, Jhenaidah, ISBN-948-31-0272-2; 64pp.
- Helal Siddiqui, Dr.A.S.M. 2014. Impact of Climate Change of the Coastal Ecosystem in Bangladesh. International Journal of Research and Innovations in Earth Science, Volume 1, Issue 2, ISSN (Online): 2394-1375.64-72pp.