IMPACT OF SHRIMP FARMING AND SALT PRODUCTION PRACTICES ON MANGROVE FORESTS DESTRUCTION IN BANGLADESH

N.A. SIDDIQI* AND M.J. ALAM

Bangladesh Forest Research Institute,
Chittagong (Bangladesh).

Introduction

Natural mangrove forests occurred sporadically along the shoreline of Kutubdia, Sonadia and Moheshkhali Islands of Cox's Bazar District. The second largest natural mangrove forest of Bangladesh, the Chokoria Sundarbans, covering an initial area of 18,200 hectares also existed in the district at the delta of Matamohori River. Mangrove plantation programme along the exposed coastal areas in Cox's Bazar was initiated in 1968. Prior to increasing human pressure in different forms, the condition of natural and planted mangroves was reasonably good with moderate or dense vegetation cover.

Salt production and shrimp farming caused heavy damage to mangrove vegetation. The forests and scattered plants have been drastically destroyed through recent introduction of unplanned shrimp farming and irrational expansion of salt production areas. This paper aims to observe the effects of shrimp farming and salt production practices on natural and planted mangrove forests in the coastal areas of Cox's Bazar District. Both shrimp farming and salt production areas are expanding at the expense of mangrove forests. A clear understanding of the problem will help develop rational management of these resources and that ultimately enable establishment and conservation of the mangrove forests.

Material and Methods

Direct observations were made on the existing mangrove vegetation and previously mangrove covered areas, now barren or under other land uses. Available literature on shrimp farming and salt production for the area was reviewed. Species composition, planting areas, plantation success, magnitude of mangrove destruction and causes for the destruction were recorded from plantation journals maintained in six Forest Range offices for coastal forest management under Cox's Bazar District. Moreover, local people particularly those involved in shrimp farming, salt production practices and employees involved in forest management were consulted for gathering relevant information. The duration of the study was for one year during 2003 and 2004.

Study Area

Cox's Bazar is situated between the latitudes 20°30' and 22°N and longitudes 91°45' and 92°15' E. It lies in the

* Present address: Director of Administrative, Bangladesh Open University, Gazipur (Bangladesh).

southeastern part of Bangladesh, along the Bay of Bengal. Coastal afforestation activities in the district are managed by six Forest Ranges (Fig. 1). Important coastal resources in the area involve fisheries, aquaculture, salt production, mangrove vegetation, forestry and agriculture. Average monthly rainfall of the district is approximately 416mm, average maximum temperature 31°C and minimum 22°C. The tidal range at Baghkhali River of Cox's Bazar ranges from 0.07m at neap tide to 4.42m at spring tide. Coastal water salinity during dry period is 30-35ppt (parts per thousand) and it decreases to 20ppt during May-September due to monsoon (Hossain and Lin, 2001).

Results and Discussion

Status of Natural Mangroves

Most of the naturally occurring mangrove plants have vanished from the coastline. The existing plants are scanty, scattered and sporadically found. No compact mangrove stand was noticed. Commonly available commercial species in Cox's Bazar coast are mentioned in Table 1.

Naturally occurring mangrove plants were found along the shoreline of Kutubdia, Sonadia and Moheshkhali Island some 50 years ago. Distribution of natural mangroves and causes for their destruction are mentioned in Table 2. Bangladesh is providing considerable importance on planting in the coastal areas and documentation of this information will help selection of species for future mangrove rehabilitation programme.

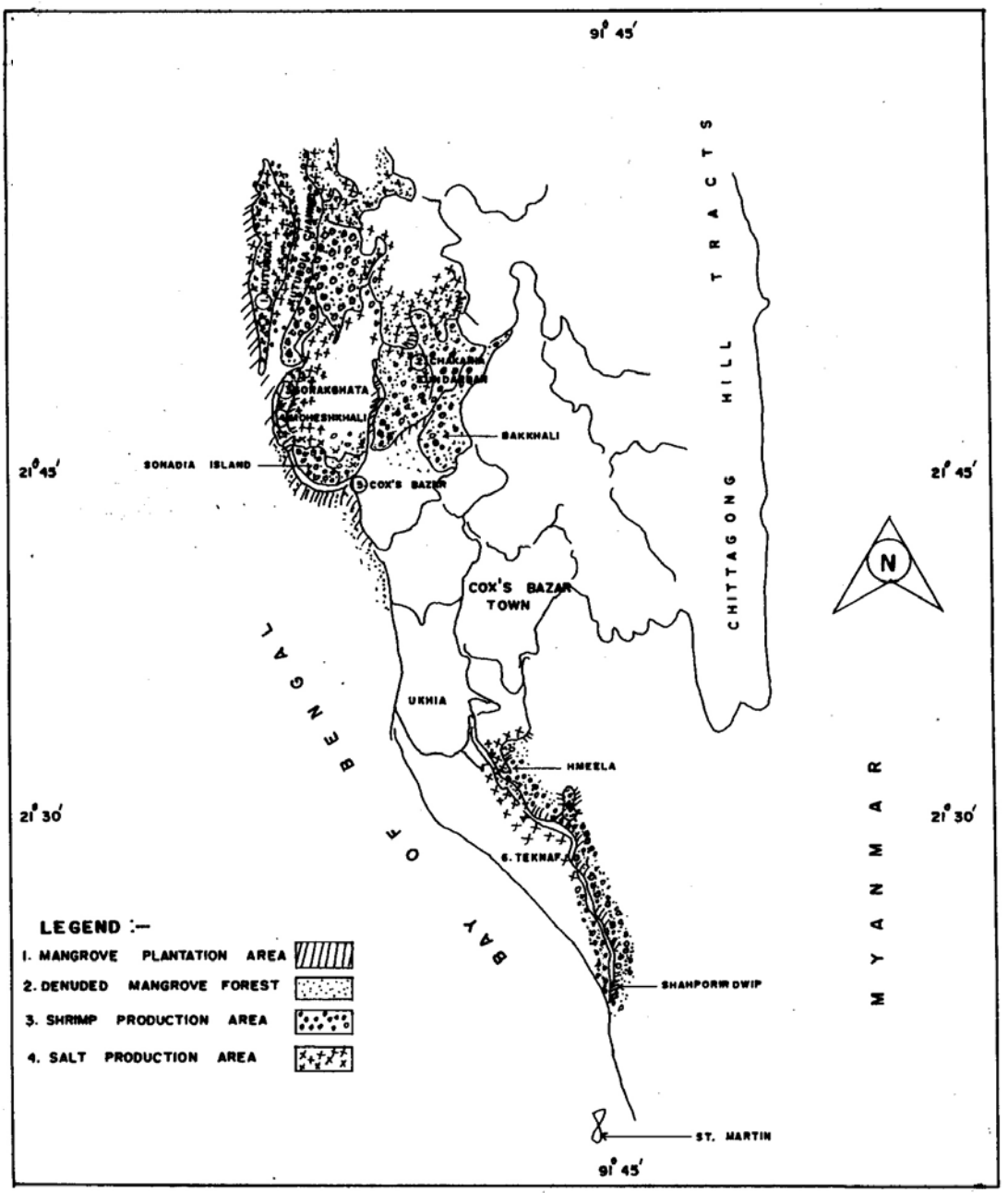
Vegetation of the Chokoria Sundarbans was moderately dense before human stresses in the forms of fishing, cattle grazing, fuelwood collection and salt production. However, final destruction of the forests was made through their

Table 1

Naturally available mangrove plants in Cox's Bazar.

Sr. No.	Vernacular Name	Scientific Name	Family
1.	Moricha Baen	*Avicennia alba* Blume	Avicenniaceae
2.	Sada Baen	*Avicennia marina* (Forsk.) Vierh	Avicenniaceae
3.	Kala Baen	*Avicennia officinalis* L	Avicenniaceae
4.	Kankra	*Bruguiera gymnorrhiza* (L.) Lam	Rhizophoraceae
5.	Kankra	*Bruguiera sexangula* (Lour.) Poipet	Rhizophoraceae
6.	Choyla	*Sonneratia caseolaris* (L.) Engl.	Sonneratiaceae
7.	Sundri	*Heritiera fomes* Buch.-Ham.	Sterculiaceae
8.	Gewa	*Excoecaria agallocha* L.	Euphorbiaceae
9.	Golpata	*Nypa fruticans* Wurmb.	Palmae
10.	Goran	*Ceriops decandra* (Griff.) Ding Hou	Rhiporaceae
11.	Kalshi	*Aegiceras corniculatum* (L) Blanco	Myrsinaceae
12.	Passur	*Xylocarpus mekengensis*, Pierre	Miliaceae

Fig. 1



Map of Cox's Bazar District showing locations of coastal forest ranges and mangrove forest

Table 2

Previous/existing distribution of natural and planted mangrove species.

Locations	Natural plants	Planted trees	Causes for destruction	Remarks
1	2	3	4	5
Kutubdia Range	*Avicennia alba*, *Bruguiera gymnorrphiza, Sonneratia caseolaris*	*Avicennia alba, Sonneratia apetala*	Shrimp culture and salt production	High saline zone (30-35 ppt).
Chakoria Range (Charandip Ilisha, Palak Khata, Rampur, Badarkhali)	*Tanarix indica, Nypa fruticans*, *Excoceoria agallocha, Acanthus ilicifolius*, *Heritiera fomes*, *Avicennia alba*, *A. marina, A officinalis*	*Avicennia alba, A. marina, A. officinalis, Sonneratia apetala*	Shrimp culture and salt production	*S. apetala* plantation removed by shrimp farming in 1977
Mognama	*Tamarix indica*, *Acanthus ilicifolius, Avicennia alba*	*Avicennia alba, A. marina*	Shrimp culture and salt production	Plantations converted to shrimp pond and salt pan in 1980
Gorakghata Range Uttar noibil	*Avicennia alba, A. marina, Excoecaria agallocha*	*Avicennia officinalis, Sonneratia apetala*	Shrimp culture and salt production	High saline zone
Kalarmarchora	*Avicennia alba, Acanthus ilicifolius, Tamarix indica, Sonneratia caseolaris*	*Avicennia officinalis, Sonneratia apetala*	Shrimp culture	-
Dolghat	*Avicennia. alba, Tamarix indica, Acanthus ilicifolius*.	*Avicennia alba, A. marina, Sonneratia apetala*	Shrimp culture	-
Matharbari	*Avicennia alba, Sonneratia caseolaris, Acanthus ilicifolius*	*Avicennia alba, A. marina, A. officinalis, Sonneratia apetala*	Shrimp culture and salt production	*S. apetala* plantation converted to shrimp pond in 1977

Contd...

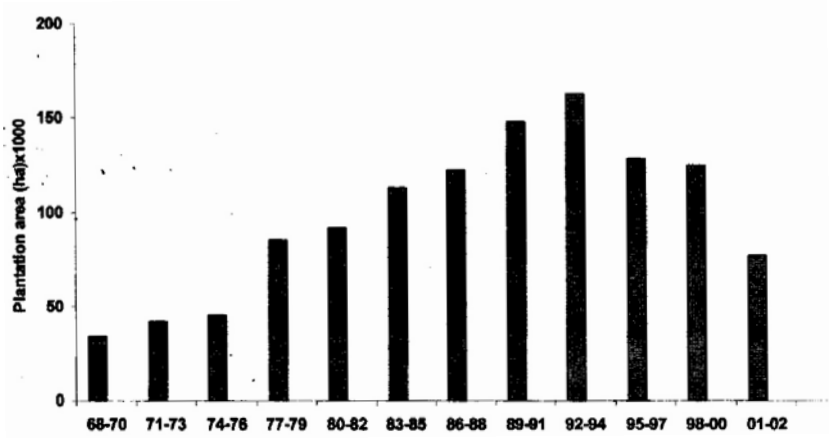
1	2	3	4	5
Moheshkhali Range Japua Beat	*Avicennia alba, Tamarix indica, Acanthus ilcifolius*	*Avicennia alba, A. marina, S. apetala*	Shrimp culture and salt production	High saline area (30-35 ppt)
Bordia Beat	*Avicennia alba, Excoecaria agallocha*	*Avicennia alba, Sonneratia apetala*	Shrimp culture and salt production	-
Sonadia Island	*Avicennia alba, A marina, Bruguiera gymnorrhiza, Ceriops decandra, Heritiera fomes, Aegiceras corniculatum, Xylocarpus mekongensis, Nypa fructicans*	*Avicennia alba, A. marina, Sonneratia apetala*	Shrimp culture	Some land encroached for dwelling purpose
Cox's Bazar Range Bakkhali Beat	*Avicennia alba, A marina, Excoecaria agallocha, Bruguiera gymnorrhiza, Nypa fructicans*	*Sonneratia apetala, A. alba, A. marina*	Shrimp culture	Whole area converted to shrimp ponds in 1990
Kurushkul Beat	*Avicennia. alba, A. marina, A. officinalis, Sonneratia caseolaris*	*Avicennia alba, A. marina, Sonneratia apetala*	Shrimp culture	Converted to shrimp ponds in 1993.
Taknaf Range Headquarter	*Nypa fructicans,*	*Sonneratia apetala, Avicennia alba, A. marina, Nypa fructicans A. officinalis*	Shrimp culture, business centre and human settlement	Established plantations converted to shrimp ponds and business centre in 1992.
Neela Beat	*Nypa fruticans Avicennia alba, A. marina, A. officinalis*	*Sonneratia apetala, A. alba, A. marina, A. officinalis*	Shrimp culture	-
Shahporirdwip	-	*Sonneratia apetala*	Shrimp culture	-

conversion to shrimp ponds in recent decades under the permission of the government. The Chokoria Sundarbans supported 53 mangrove species belonging to 42 genera and 22 families (Cowan, 1926). *Ceriops decandra*, *Avicennia alba* and *A. marina* were the dominant species. All the trees in this natural forest were exploited and the vegetation was destroyed. The forests practically disappeared because of over-exploitation of trees, minor forest produce and fuelwood, over grazing the area, human settlements, salt manufacture, damaging regeneration by fishing and finally the worst of all, the introduction of shrimp farming (Siddiqi, 2001). Naturally occurring trees existed scattered along the coastline and offshore islands of Cox's Bazar District. They are now rare (Siddiqi *et al*., 1994).

Status of Plantation

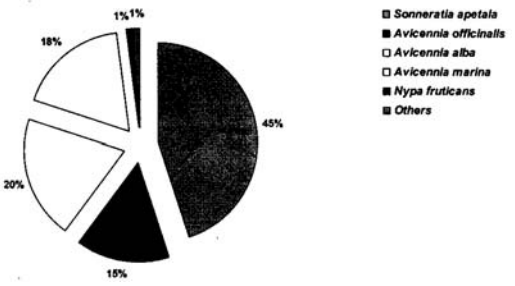
Avicennia marina, *A. alba*, *A. officinalis* and to a small extent *Sonneratia apetala* were the planting species for coastal afforestation programme in Cox's Bazar District. *Avicennia alba* appeared suitable for high salinity areas compared to *A. marina* and *A. officinalis*. Locations of plantations and magnitude of destructions of established plantation are mentioned (Table 2). Up to 2000, an area of 5,000 hectares was planted with mangroves. Area under successful mangrove plantations and their species composition are shown in Figs. 2 and 3. Plantation success particularly for *A. alba* and *A. marina* was satisfactory with an initial survival above 80%. However, height increment of plants varies with locations, maximum at Moheshkhali under Gorakghata Range and stunted at Gotibanga in Sonadia Island as apparent from visual observations. Trees attained a height of 5m at Gorakghata in 10 years, whereas 2m in 25 years at Gotibanga. Salinity and inundation are most determining factors for mangrove growth and these vary between the two locations. Survival of *Sonneratia apetala* was low with the exception of Teknaf area where good survival and growth rate were noticed. It may be noted that *S. apetala* marked most suitable planting species for other coastal areas of Bangladesh.

Fig. 2



Area under successful mangroves in Cox's Bazar District from 1968-2002

Fig. 3



Species composition of mangrove plantations established in Cox's Bazar

Destruction of Forest

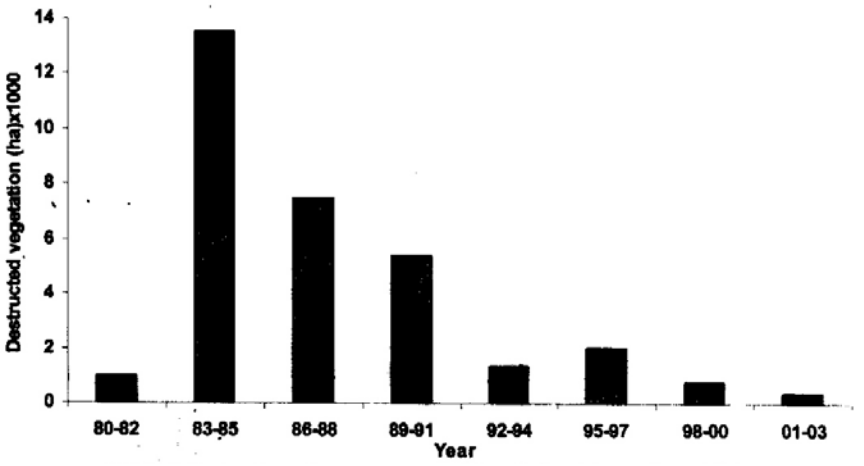
Natural Mangroves : Increasing human population in the coastal region directly affected the mangrove vegetation. Stresses as a result of illicit harvesting, fuelwood collection, fishing, cattle grazing and human settlement caused deterioration of natural vegetation. Apart from this, failure to implement a socio-economically suitable forest management plan was a cause for mangrove depletion. In fact, traditional practice of forest management was not appropriate in a densely populated area. Policing of job for forest management did not work. People's participation in forest management could have been encouraged for the conservation of this ecosystem. Salt production and subsequently shrimp farming virtually destroyed the entire Chokoria Sundarbans forest (Siddiqi, 2001). Necessary steps are not taken yet for the rehabilitation of degenerated mangroves although it is technically feasible to bring the barren areas under vegetation cover (Shahidullah and Siddiqi, 1994, Siddiqi *et al.,* 1994).

Plantation Mangroves : Like other parts of the coastal areas, mangrove plantations in Cox's Bazar were raised by Bangladesh Forest Department. Due to introduction of shrimp farming and expansion of salt production areas, many successful mangrove plantations have been destroyed (Fig. 4). It is apparent from the available records that an area of about 26,040 ha has been converted to shrimp farms in Cox's Bazar following destruction of mangrove forests during last 23 years from 1980 to 2003. Additionally, an area of about 5,450 ha mangrove plantations has been converted to salt production areas and 158 ha for other purposes during the same time. Fig. 4 shows rapid expansion of salt production area during the period from 1960 to 2003. Moreover, some lands under plantations have also been encroached for human settlement and business purposes. Thus about 31,645 ha established plantations raised in an ecologically adverse environmental condition at heavy expenditure were destroyed. The process of destruction is still underway. Besides, there are always stresses on the created plantations by neighbouring coastal population to meet their needs from the newly developed ecosystems. It has become difficult to maintain the existing established plantations and bring the emerging accreted lands under vegetation cover.

Salt Production and Shrimp Farming

Preparation of salt ponds involves removal of all trees, shrubs and other plants and creation of facilities for solar input allowing evaporation of saline water. Due to physical and chemical changes in soil condition, the area becomes unsuitable for mangrove colonization. In Bangladesh, salt is produced in the sea beach and adjacent lands of Cox's Bazar District. High salt content in water and coarser sea beach favoured salt production. Yearly salt

Fig. 4



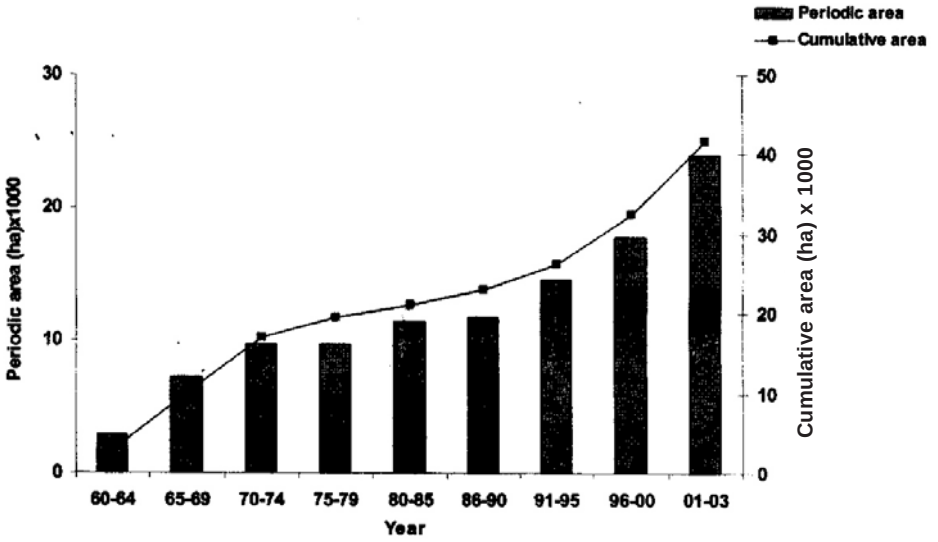
Destruction of mangrove vegetation in Cox's Bazar from 1980 to 2003

requirement in Bangladesh is 10 lac MT. One lac MT is imported. In 2003-04, 914,000 MT of salt was produced in Bangladesh (Source: Eng. Md. Saleh Uddin Choudhury).

Salt was produced in Cox's Bazar coasts since 15th century. However, commercial production of salt started in 1947. The main salt production areas are Sadar Upazila, Ramu, Maheshkhali, Kutubdia, Chokoria and Teknaf. Since 1960, salt production area steadily expanded (Fig. 5) at the expense of different resources (Iftekhar, 2001). About 19,670 hectares are under salt production practices along the Cox's Bazar coast. Annual average salt production per unit area in the locality is 21.50 MT/ ha, which is lower than other countries because of short evaporation season and limited mechanization (Hossain and Lin, 2001). So, there is scope to increase production by improving technology using less area. The excess area could be brought under coastal afforestation instead of bringing forest area under salt production.

Shrimp farming in the coastal areas mostly developed from 1985 in order to meet the growing demand of shrimps in the international markets. In recent years, there was extensive expansion of shrimp farming areas leading to disappearance of Chokoria mangrove forest and much of other natural and planted mangrove vegetation (Hossain and Lin, 2001). Annual shrimp production varies considerably along the coastline of Bangladesh. In Cox's Bazar District the shrimp farmers practise extensively or traditionally farming with production rate of 230 kg/ha. For the Chokoria Sundarbans yearly maximum yield of shrimp is low, about 180 kg/ha (Chowdhury *et al*., 1990). So, it was preferable to develop shrimp pond or salt-pan in open areas instead of converting natural forest to such uses. That would also lower initial investment for shifting to a different type land use from the prevailing one. Compared to other

Fig. 5



Expansion of salt production area from 1960 to 2003 in Cox's Bazar

countries, the yield of salt and shrimp per unit area is low. So it is wise to modernize the practices for higher yield instead of spreading the practices over greater area. This would reduce pressure on mangrove vegetation.

Conservation of Forests

Mangrove vegetation has a great role to play for the protection of coastal population against cyclone and tidal surges. In fact, the value of protective role, in other words, intangible benefit of coastal forests and plantations is much higher than the productive role although never estimated. In the past, management was not properly shaped to address protection of mangrove forests and other diversified coastal resources. Present management approach is also inadequate to save and conserve the forests due to increasing human population and their subsequent pressure on the coastal environment. Up to now, mangrove forests are managed only by the Forest Department without any involvement of the local people. To ensure continuity of the existing forests and further establish successful new mangroves, strong people's participation is indispensable. Many countries in South-East Asia suffered heavy loss from land depletion as a result of shrimp farming. Although shrimp culture provides quick and higher economic return, sustainable management of ecosystems is not beyond risk. Salt production is profitable and the return is quicker. However, expansion of salt production should be rational and must not be at the expense of mangrove ecosystems. Government needs to develop proper policies and management plans for the optimal utilization of coastal environment in order to derive sustainable direct and indirect benefit.

Conclusions

Bangladesh is a pioneer country in raising successful mangrove plantation along the shoreline and offshore islands. However, plantations and natural stands in many places are in the process of destruction and disappearance as a result of wrong planning and human induced pressure. Thus natural mangrove forests in Cox's Bazar District have been destroyed and plantations developed since 1968 are under deterioration due to expansion of salt production area, shrimp farming and human encroachment of forestland for settlement. For higher economic return at a short time, salt production and shrimp farming gained importance at the expense of mangrove ecosystems. The need of for maintaining a continuous mangrove forest along the coastline is necessary in Bangladesh, being a cyclone prone country. The great intangible benefit of mangroves to coastal population is neglected or underestimated. Moreover, income from shrimp farming is uncertain because of fluctuating market demand. Changes in soils and site conditions may not also permit long-term shrimp culture. Already the Chokoria Sundarbans is becoming unsuitable for shrimp farming and restoration of mangrove forests is necessary for a productive ecosystem. Similarly expansion of salt production areas has to be arrested. Up to now government alone is involved in the maintenance of mangrove forests. Under the prevailing socio-economic condition, protection and conservation of mangroves are impossible without people's participation. So, participatory approach of forest management should be considered for the development and conservation of mangrove forests.

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SUMMARY

Shoreline and offshore islands of Cox's Bazar District (Bangladesh) supported dense and scattered natural mangrove vegetation. Huge mangrove plantations have also been established on the exposed coastline. Naturally occurring mangroves have virtually vanished due to shrimp farming, expansion of salt production area and various forms of human pressure. Recently created mangrove plantations are also under severe stress for similar reasons and in the process of deterioration. Adequate measures should to be taken for the rehabilitation and conservation of mangroves. Coastal environment needs to be rationally utilized for sustainable production of various resources and maintenance of stable ecosystems.

बंगलादेश के वायुशिफ वनों के विनाश पर झींगा–मछली पालन और नमक उत्पादन क्रियाओं का प्रभाव

एन०ए० सिद्दीकी व एम०जे० आलम

सारांष

कॉक्स बाजार जिले की तटरेखा और तट से हटे द्वीपों पर कभी घनी और बिखरी हुई प्राकृतिक वायुशिफ वनस्पतियां हुआ करती थी। विवृत हुई तटरेखा पर भारी वायुशिफ रोपवन स्थापित किए गए हैं। झींगा–मछली

पालन करने, नमक उत्पादन क्षेत्र को बढ़ाते जाने और विविध प्रकार से पड़ते मानव दबावों के कारण प्राकृतिक रूप से होने वाले वायुशिफ वस्तुतः विलुप्त हो गए हैं। इन्हीं कारणों से पिछले कुछ समय हुए लगाए गए वायुशिफ रोपवन भी भारी दबाव में आए हुए है और विनष्ट होने की तरफ अग्रसर हैं। इन वायुशिफों को फिर से स्थापित और संरक्षित करने के लिए पर्याप्त उपाय किए जाने चाहिए। विभिन्न संसाधनों को लम्बे समय तक उत्पादन देते रहने तथा परिस्थिति संहतियों को सुस्थिर बनाए रखने के लिए समुद्रतटीय पर्यावरण को बुद्धिसगंत ढंग से उपयोग करने की आवश्यकता है।

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