SURVEY AND ROLE OF MANGROVES IN DISASTER MITIGATION IN NAMKHANA, WEST BENGAL: PROTECTION OF COASTAL ZONE

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Abstract

The Mangroves provides support in various ways regarding the safeguarding of the coastal section from the exasperation of environmental disasters instigated due to alteration of weather pattern, specifically providing so as to fight against the consequences like rising sea level, invasion of salt water, seaside soil weathering, superstorm upsurge, and devastation due to cyclone. Altogether, they behave as a line of defence to the coastal areas where they endure. The cyclone exerts a lesser amount of destruction due to the presence of the mangrove delta.

Keywords-Mangroves, coastal area protection, tropical cyclone, salinity rise, mangrove species.

Introduction

Mangroves are a spread of littoral plant formations that are found along tropical and subtropical shielded coastlines. Mangroves are halophytic shrubs that germinate underneath the highwater mark of spring tidal flow and have an intriguing capacity for saltwater forbearance. Mangroves are salt-defiant and heat-defiant plant genres that developed in tropical and subtropical seashore areas. Mangrove families, predominantly the mangrove forests in India, have a spread of adaptations in their anatomy, morphology, and physiology to enable them to measure in wet soils, high salinity, storms, and tide surges. Mangrove forests are especially found round the equator in tropical and subtropical latitudes. The mangroves show extraordinary characteristics like pneumatophores which stand up straight and creep on the ground. They serve humans for both economic purposes and their daily livelihood needs like wood, medication, and honey (Tabuchi, 2003). They also play a crucial role in providing shield to human life and their property and belongings from the hands of various marine catastrophic events like cyclones and floods.



Photo 1: Pneumatophores of mangrove species which stand upright

Mangroves are critical habitation for the coastline biodiversity. Many oceanic species like fishes, crayfish, and crabs use the mangroves as origin habitats. The mangroves are a distinctive forestry ecosphere that spreads over tropic and sub-tropic areas. The mangroves play a significant role in the coastline ecosphere and also substantially provide safeguarding to the shoreline areas. They are also consequential across the mitigation of coastline weathering, and tropical storm destruction reduction. Mangroves act like bio-shields, thus protecting against dreadful weather occurrences like floods, and cyclones. Most people, mainly in exurban areas, depend on mangrove ecosystems for heterogeneity of biomass-based professions. The Sundarbans represent the greatest mangrove forest all over the world which includes a conglomeration of isles escorted by diversified and copious resources. The Sundarbans are the natural habitat of a broad spectrum of plants and animals in terms of both number and variety, those which are natively and universally are at risk. It is the sole mangrove ecosystem ensconced by tigers.

In recent times, the rate of occurrence of the cyclone in the Bay of Bengal has elevated as a consequence of changes in the global climatic system and temperature. As a result, chaos is spread among both living and non-living components. The abrupt increase in the occurrence of cyclones gives rise to excessive inundation in the coastline and its surrounding low-lying areas. The capacity of inundation due to the cyclone relies on some particular aspects like the intensity of the storm, velocity of air current, seashore gradient, type of vegetation around that coastal zone, and inland geomorphology.

Literature Review

Natural disasters of the hydro-climatological source are in recent times arising as a prime issue to be concerned about universally. In comparison to the past centuries, these natural calamities have accelerated in frequentness and magnitude. The Bay of Bengal brings forth an ideal site for the origination of tropical cyclogenesis, attributing to 6-10% of global cyclone initiation and leaving human livelihood in uncertainty (Hossain *et al.*, 2019). The rate of occurrence of tropical cyclones in India is about 4 to 5 times a year. Odisha is highly subjected to the risk of cyclone attack, along with West Bengal, Tamil Nadu, and Andhra Pradesh (Sahoo and Bhaskaran, 2017). The northward conglomerating configuration of the Bay of Bengal provides a perfect stage for the upsurging of cyclones, mostly vigorous in the Odisha-West Bengal shoreline on the account of immense shoal continental platforms, leading to rising in sea level and swamping. According to studies, the shoreline of West Bengal is extremely unsecured because of its open locality, specifically congested non-urban

areas, those which have sighted multiple cyclones and storms that affirmed human livelihoods, destroyed the floral and faunal diversity, worn away the waterproof dikes and submerge the shoreline with salt water (Paul *et al.*, 2021). In addition, the inflowing tidal magnitude and composite shoreline conformation of the earth's biggest delta, that is Ganga-Brahmaputra-Meghna delta, consists of several draining outlets, tributaries, and wetlands, has designed the region to be more delicate (Gayathri *et al.*, 2015). In the year 2009, the cyclone Aila, was an immensely catastrophic storm in the past couple of decades that occurred during the pre-monsoon period in the Bay of Bengal, resulting in a vast flood in the region of Sundarbans of both West Bengal and Bangladesh (Palit and Batabyal, 2010). In recent time, just 2 years before, the most powerful super cyclone Amphan occurred in 2020, with colossal wind velocity and heavy rainstorms (Das *et al.*, 2020). Furthermore, a year ago, west Bengal was hit by another cyclone, Yaas in 2021. The cyclone Yaas had fierce consequences in the two Indian states, namely Odisha and West Bengal.

The coastal region of West Bengal is an immensely endangered zone owing to the fact of its frequent subjection to the risk prevailed by tropical cyclones, which are responsible for the serious destruction of human livelihood, land, and vegetation (Samanta,1997). The Multinational Seminar on Tropical Cyclones proclaims that the aggressiveness of cyclones has elevated in the past 35 years as a result of continuous increase in the temperature of surface seawater, which is generally higher than marginal temperature, that is, 28 degree Celsius as a consequence of climatic variations (Dasgupta *et al.*, 2010).

The coastal length in West Bengal is about 210 km. The coastal areas include coastal arid regions, deltaic regions, beaches, bays, and isles. The coastal regions in West Bengal comprise two separate littoral surroundings: (i) an intermediate tidal region having a tidal range of 2-4 m is the westward division shoreline comprising the Purba Medinipur district, and (ii) a tidal region with a tidal range exceeding 4 m is eastward division shoreline comprising of South 24 Parganas district. The Purba Medinipur sector includes Mandarmani, Digha, Tajpur, Shankarpur, Junput, Contai, Haldia, Khejuri, and the South 24 Parganas sector includes Bakkhali, Fresergunj, Sagar Island, Kakdwip, Namkhana, and Sunderbans. The coastal regions in West Bengal are categorized as standard lowland coastlines accompanied by shoal water height. The Purba Medinipur coast covers about 27% of the coastline (Chakraborty, 2010). Tropical cyclone formation in the Bay of Bengal has shown a high surge in the time period during both pre- and post-monsoon, along with rising in its intensity has been observed on the grounds of synchronous worldwide changes in the weather pattern and rising global warming at present (Bhardwaj et al., 2019). In West Bengal, the districts that are most susceptible to cyclonic destruction are Purba Medinipur, South 24 Parganas, Kolkata, and North 24 Parganas. The Purba Medinipur region has encountered 22 cyclonic situations among which 12 were dreadful cyclones and South 24 Parganas has encountered 29 cyclonic situations among which 16 were dreadful cyclones in the period between 1891-2017 (Paul et al., 2021). In due course, the hazard vulnerability aspect have been categorized as extremely high as a mark of respect to the district along the coast in West Bengal and the livelihood of local people is becoming more hazardous than before (Mohapatra et al., 2012).



Photo 2: District Purba Medinipur and South 24 Parganas, the coastline districts of West Bengal (Source: Paul *et al.*, 2021)

Synopsis of Challenges Faced By Coastal Areas

The seashore regions face two kinds of problems. The coastline might abrade due to persistent weathering or in the time of a superstorm, and the coastline might undergo a deluge in the period of high tide circumstances like cyclones, tornados, and tsunamis. The Mangrove woodland does not retard the seashore weathering, but at the same time, they amplify coastal accumulation. So, sowing mangroves around the coastal regions will help to protect the coast from getting eroded for a longer period. With respect to flooding, the mangroves bring about an appreciable wave reduction and diminish the flux rate. The altitude of water is not reduced by the mangroves (Verhagen, 2012).

Calamities and Mangroves

Tidal waves like tsunamis are the longer wave ranges in seawater. The nature of tsunami wavelets undergo alteration in the shallow water bodies and at the sea coast, they act as transitional wavelets. The mangroves provide additional resistance to the movement of water, but they could not be esteemed as an efficacious barrier against storms and cyclones. Anyhow, owing to the appearance of the tract of mangroves, the inhabitants do not reside straight away near the coastline area (Verhagen, 2012).

Reasons for Deterioration of Mangroves

There are various reasons for the deterioration of the mangrove ecological community. Formerly, numerous mangroves were being destroyed and transformed into towns along the coastline. The Metropolitan city of Kolkata is even constructed over mangrove land. The loss of biodiversity in the mangrove areas has been observed to be serious in the last few decades. The mangroves are affected due to the pressure of both man-made causes and ecological factors which are enhanced by natural calamities, whose rate of occurrence has shown a surge in the past few years.

1. Man-made causes:

The insufficient control system for conservation, rehabilitation, and misuse is the reason for the major yearly decrease in resources received from the mangrove forestland. Recently, the behaviour of humans is the cause of major environmental changes that are being faced by the nature like drastic changes in climatic conditions, global warming, destruction of the ecological community, and an increase in loss of biodiversity (Savari *et al.*, 2022). Several man-made reasons for the deterioration of mangrove communities are the over-exploitation of grasslands, increase in population, forestland exploitation, pollution of coastal areas, higher demands for resources received from forests, and rise in the rate of coastal and forest touristy. These factors have provoked the destruction of the mangrove belt (Savari *et al.*, 2022).

2. Ecological Causes:

Presently, a rise in levels of greenhouse gases has been detected due to the effect of which huge changes in global climatic patterns have been observed. This alteration in climatic patterns is the biggest challenge we are facing in recent times. The meteorological changes include an increase in temperature, an increase in drought conditions that persist for several days, soil degradation, forest fires, the occurrence of smog, and environmental damage. The prolonged study of the environmental factors that affect the climate demonstrates that incidents of forest fires and global warming are increasing day by day. The principal variation in climate pattern which brought about the serious risk to the mangrove ecological community is the decrease in average rainfall. As a consequence of the decrease in average rainfall, the availability of freshwater decreases, which leads to an increase the in salinity of soil and reduces the soil's productive capacity (Soucy et al., 2020). The rate of occurrence of natural disasters like cyclones has increased in the present era which is again a serious risk to the mangrove ecological community and is a major reason that causes weathering of the coastline. Thus, the major environmental causes which lead to the deterioration of the mangrove ecological community are a rise in salinity, coastal weathering, an increase in sea level, natural disasters, an increase in temperature, and a decline in freshwater.



FIG. 1: Schematic representation of reasons for deterioration of mangroves

CYCLONES THAT AFFECTED THE MANGROVE COMMUNITY IN WEST BENGAL: -

Destruction During Cyclone Aila:

Severe Cyclone Aila occurred in the year 2009. Cyclone Aila was formulated due to the disruption created over the Bay of Bengal on May 23, 2009. The wind speed during the cyclone Aila was 110 km/hr. It was comparatively a powerful tropical storm that brought about a large scale of destruction in India and Bangladesh. In India, more than 100 people died due to the storm and thousands of people lost their households. Several trees were rooted out which clogged the roadway. The entire transport system from Kolkata to other places and districts of West Bengal terminated and everyday life ceased as a consequence of the cyclone. The coastal areas of West Bengal were extensively affected due to Cyclone Aila. (Financial Express, 26.05.2009)

The regions that had been affected due to the cyclone in West Bengal were Kolkata, Howrah, East Midnapore, South 24 Parganas, Hooghly and Burdwan. About 100 river barricades were ruptured during Aila. Agricultural lands were destroyed during the storm. The power supply and water supply were disrupted, and cell phone connectivity was lost. Streets were inundated and many houses were noted to be under stagnant water.

Aila was not a powerful cyclone, nonetheless, the tremendous rainstorm storm upsurge was sufficient to flood the mouthpiece of river Ganga in India. The Sundarbans mangrove forest along with some isles of the Bay of Bengal was swamped and saline water had intruded which brought the mangrove forest to a major concern as saline water once entered cannot be brushed out with the normal water filtration process. The saltwater-saturated environment is an oxygen-deficit condition that was responsible for the loss of many mangrove species, other floral species, and faunal species like tiger, crocodile, and deer of the Sundarbans region. Many Sundari trees were exterminated due to high tide conditions provoked by Aila. (Financial Express, 26.05.2009)



Photo 3: Submergence of river barricades caused by Cyclone Aila (Source: The Third Pole)

Destruction During Cyclone Amphan

The cyclone Amphan is the first and foremost super cyclone that occurred in the Bay of Bengal subsequently since 1999. It struck West Bengal in the year 2020 on 20th May, which was during the pandemic caused by the coronavirus. It is considered among the most destructive super cyclone that has shattered the southern districts of West Bengal including Kolkata. The coastal areas and the Sunderbans region were majorly affected due to the cyclone. According to the studies, it was found that about 28 percent of the Sunderbans region was critically damaged due to the cyclone Amphan. As per reports, it was evaluated that about 1200 sq. km area of the Sunderbans forest has undergone severe destruction. The cyclone has badly harmed the areas Namkhana, Kakdwip, Frasergunj, Bakkhali, Sagar, Ghoramara, and Pathar Pratima Island, which are located in the district of South 24 Parganas. (Sen, 2020)

The wind speed during cyclone Amphan was 230 km/hr. Sunderbans being around the coast had first experienced the severe impact of the super cyclone with greater storm upsurge and strong wind. The damage due to the cyclone Amphan has chiefly occurred in India than the Bangladesh area. The West Bengal government had been supervising the situation at the administrative secretariat Nabanna subsequently from Tuesday (19.05.2020) night. The supervisors from the administrative secretariat Nabanna said that the consequences of Amphan were more severe than the effect of coronavirus. (News 18, 21.05.2020)

The sectors which were badly destroyed in the district South 24 Parganas were Kultali, Pathar Pratima, Kakdwip, Namkhana, Frasergunj, Bakkhali, Sagar and Ghoramara Dweep areas. Due to the cyclone, intrusion of saline water was witnessed, on the account of which the leaves of the trees in the Sunderbans showed a change in colouration from yellow to red.

The local people had experienced a tough situation after the cyclone Amphan. At the instance when the cyclone had landfall, there was a disruption of cell phone service and power supply. Numerous images broadcasting the huge scale of demolition caused due to the cyclone were ruling over social networking websites. According to them, this was the most violent super cyclone that has struck West Bengal in the last 100 years which caused massive destruction of the natural vegetation and property during the period when the world was undergoing a tough time that resulted due to the pandemic caused by the novel corona virus. According to the survey report, lakhs of citizens were left homeless, and more than 10 lakh homes were demolished due to Amphan. Further above 5000 trees were uprooted.



Photo 4: Destruction during cyclone Amphan (Source: The Indian Express 21.05.2020)



Photo 5: Destruction in the coastal areas in West Bengal during cyclone Amphan (Source: The Indian Express 21.05.2020)

Destruction During Cyclone Yaas

The cyclone Yaas hit the east coast including West Bengal and Odisha on May 26, 2021, putting behind a series of devastation. The wind speed during the cyclone Yaas was 150 km/hr. The trees, roof, and rafters were witnessed fluttering due to the high wind speed. The cyclone lashed the Indian easterly coast, dropping heavy downpours, and ruining a large number of houses and farmsteads. A dense sheet of rainfall left the wide shoreline out of focus as the cyclone hit the land, increase in water level flooded the local areas. Cyclone Yaas has left the littoral states unstable.

The beautiful town in East Midnapore, that is Digha, which shares a borderline with the district Balasore of Odisha was left heavily flooded. Zones of neighbourhood tourist spots like Tajpur, Mandarmani, and Shankarpur were also swamped with sea-water, which intruded on the hotels and the outlying areas. Besides these, numerous local shops and houses were destroyed. In a few areas, sea waves were observed to be going up to the height of a coconut tree. In the East Midnapore, not only the farmlands but also the fisheries areas had undergone serious damage. The standing crops of betel leaf, flowers, and vegetables were extensively damaged in areas of East Midnapore like Contai, Ramanagar, Nandigram, Kolaghat, and Khejuri. (First Post 26.05.2021)

In the district South 24 Parganas, thousands of residents were evacuated from Namkhana, Kakdwip, Frasergunj, Gosaba, and the Sundarbans area. Numerous houses were destroyed due to the rise in water level and strong winds. The Sagar Island was inundated at the junction of the Bay of Bengal and Hooghly. According to survey reports, about lakhs of households and many barricades were destroyed due to the consequences of the cyclone. The Kapil Muni Ashram was swamped as the waves were seen to have risen as tall as 5 feet. Quite a number of fishing boats were damaged at the dockyard of Namkhana, leaving the livelihood of fishermen helpless. The influx of salt water from the sea has caused severe damage to four zones of South 24 Parganas- Patharpratima, Kakdwip, Namkhana, and Sagar.

The local people were expectantly waiting for faster recovery from the damage caused due to cyclone Yaas, the saltwater intrusion has affected their major income sector which is the cultivation of paan and paddy. The saline water has also destructed the ponds of freshwater which are used for the rearing of fish. Recently, the surge in the rate of occurrence of cyclones in the Bay of Bengal has made their livelihood consistently in a bit of bother. They have no stable solution to protect their lodging place and agricultural land from the hands of rack and ruin. The forceful entrance of saline water has caused damage to a great degree to them as well as to the mangrove forest area which acts as the "Armour plate" against the cyclone. (First Post 26.05.2021)



Photo 6: Destruction during Cyclone Yaas at the coastline areas. (Source: Deccan Herald 26.05.2021)



Photo 7: Picture of high tidal waves that were observed in Digha during the landfall of Yaas. (Source: Deccan Herald 26.05.2021)

Materials and Methodology

Study Area

The study area Namkhana is located in the southern end of the state of West Bengal. It is situated in the district, South 24 Parganas. The coordinates of the study area are Latitudinal wise is 21°46′12″N and Longitudinal wise 88°13′53″E. The general climatic condition of Namkhana can be described as warm and humid. It experiences sufficient rainfall during the monsoon. The area receives rainfall due to the effect of both north-east and south-western monsoons. The hottest month is May with the highest possible temperature at 40°C. Figure 2 below shows the location map of the study area.

Methodology

The present study is a list of the mangrove species present in the study area, their physiological and morphological features along with their uses. The data was collected from a one-day field survey in Namkhana. A total of 10 mangrove species were studied and information about them was collected from the field survey and was studied accordingly in a tabular form. Tables 1, 2 and 3 depict the list of information collected after the field survey.

Information on the importance of mangroves, how the cyclone has affected the local people, plantation patterns used, and steps taken to recover the damage caused in the mangrove area were noted down.



Photo 8: Map of study area: Namkhana

Result and Discussion

Based on the field survey in Namkhana, a total of 10 mangrove species were documented. The checklist below (table 1) consists of ten mangrove species of one genus belonging to the Malvaceae family; three genera belonging to the Acanthaceae family; one genus belonging to the Primulaceae family; one genus belonging to the Plumbaginaceae family; two genera belonging to the Rhizophoraceae family; one genus belonging to the Euphorbiaceae family; one genus belonging to the Arecaceae family.

Further, from the field study information about the flowering and fruiting time of the 10 mangrove species were noted and tabulated in table 2. The different uses of those 10 mangrove species are represented in tabular form in table 3. Data on the importance of mangroves, how the cyclones have affected the local people, plantation patterns used, and steps taken to recover the damage caused in the mangrove area were noted.

Table 1: C	becklist of Mangrov	ve Species studied	l in the study	area along	with their IUO	CN
status:						

Sl. No	Name of Family	Name of Species	Local Name (Bengali)	IUCN Status
1.	Malvaceae	Heritiera fomesBuchHam	Sundari	Endangered
2.	Acanthaceae	Avicennia alba Blume	Kala bani	Least Concern
3.	Acanthaceae	Avicennia marinaForssk	Peyara bani	Least Concern

4.	Acanthaceae	Avicennia officinalis L.	Jaat bani	Least Concern
5.	Primulaceae	Aegiceras corniculatum (L.) Blanco	Khalsi	Least Concern
6.	Plumbaginaceae	Aegialitis rotundifolia Roxb.	Tora	Near Threatened
7.	Rhizophoraceae	<i>Bruguiera gymnorrhiza</i> (L.) Lam	Kankra	Least Concern
8.	Rhizophoraceae	Ceriops decandra Ding Hou.	Jaat Goran	Near Threatened
9.	Euphorbiaceae	Excoecaria agallocha L.	Genwa	Least Concern
10.	Arecaceae	Nypa fruticans Wurmb	Golpata	Least Concern

Table 2. Flowering	and fruiting	time of different	mangrove species.
Table 2. Provering	and in untiling	unic of unici chi	mangiove species.

Name of	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Species												
Heritiera												
fomes												
Avicennia												
alba												
Avicennia												
marina												
Avicennia												
officinalis												
Aegiceras												
corniculatum												
Aegialitis												
rotundifolia												
Bruguiera												
gymnorrhiza												
Ceriops												
decandra												
Excoecaria												
agallocha												
Nypa												
fruticans												

Flowering and fruiting months indicated by-



Table 3: Uses of different mangrove species:

Sl. No	Name of Species	Uses
1.	Heritiera fomes	They provide timber, are used in viscose rayon industries, and are used to cure gastro-intestinal diseases, skin diseases, and hepatic disorders.
2.	Avicennia alba	They provide fuel wood, leaves are used for fuel and fodder, dry leaves are smoked for relief from asthma and the plant is used as a remedy to cure leprosy. The flower of the plant is a rich source of honey. The resin from the seeds is applicable to ulcers and tumors. The fruit is apparently edible.
3.	Avicennia marina	They provide fuel wood and fodder, the decayed leaves constitute of fish food, and the flowers are a magnificent source of bee wax and honey.
4.	Avicennia officinalis	They provide wood for furniture purposes. The ash obtained from wood is used for cleaning purposes. They are used in the treatment of skin diseases, ulcers, paralysis, and snake-bites.
5.	Aegiceras corniculatum	The wood is used as firewood, to make handles for knives. The plant helps to cure diseases like diabetes, asthma, and rheumatic arthritis.
6.	Aegialitis rotundifolia	They are used to produce honey and are used by the local citizens to heal pain and any kind of inflammation.
7.	Bruguiera gymnorrhiza	They are mainly used for various wooden commodities. It is also used to treat diseases like fever, diarrhoea, and diabetes.
8.	Ceriops decandra	They are used to treat gastrointestinal disorders, snakebites, infections, and cancer.
9.	Excoecaria agallocha	The leaves are dried and are utilized to form poisonous darts. They also serve to treat diseases like ulcers, pneumonia, asthma, and paralysis.
10.	Nypa fruticans	The leaves are used to construct house roofs by the local people. They are also used in alcoholic drinks, vinegar, and syrups and to yield biofuel.

Photographs of Different Mangrove Species















Photo 13: Avicennia marina



Photo 14: Avicennia officinalis



Photo 15 and 16: Aegiceras corniculatum



Photo 17: Aegialitis rotundifolia



Photo 18 and 19: Bruguiera gymnorrhiza



Photo 20 and 21: Ceriops decandra



Photo 22 and 23: Excoecaria agallocha





Photo 24 and 25: Nypa fruticans

Importance of Mangroves

- i. Coastline balance- The mangrove belt maintains the balance of sedimentation and its residues that are precipitated by geomorphic processes.
- ii. Defence from cyclones: The mangroves are prone to destruction by cyclones and superstorms. Besides, they act as a shield from the rigorousness of destruction induced due to the effect of natural hazards like cyclones.
- iii. The mangroves help to stabilize the coastline sands which facilitate maintenance of the deepness of the channel for undisturbed navigation.
- iv. Conservation of aquatic life: The mangroves contribute an ambiance suitable for the conservation of aquatic lifeforms which includes fishes and other wild aquatic animals that grows in the mangrove area and as well as beyond the mangrove area.
- v. Conservation of coral lifeforms: The mangroves confine the alluvial sediments from moving above the corals and inhibit the production of algae as a result of eutrophication, thus helping in coral conservation.
- vi. The mangrove is a risk-free habitat for a wide range of birds. The migrant birds favour the mangrove region for dwelling and also for feeding.
- vii. The wood, leaves, and other parts of the mangrove vegetation are used by the local people for various purposes for firewood, making furniture goods, and mainly for the treatment of multiple diseases. The different uses of mangrove species are described in table 3.
- viii. The mangroves provide opportunities that favour carbon-neutral tourist programs for the local residents which on other hand envisions sustainability and wildlife conservation.
- ix. Elimination of carbon from the environment: The mangroves are capable of carbon elimination. They arrest the carbon and store the carbon dioxide from the environment.

How Cyclone Has Affected The Local People

The local people of the Namkhana area had undergone a distressing situation after the cyclone Amphan as well after the cyclone Yaas. They had experienced several days without electricity. Mobile connectivity services took months to get restored. Many residents have lost their houses and other belongings. They had led a very difficult time as these cyclones took place when the whole world was facing a pandemic situation due to coronavirus. Many trees were eradicated due to which roads were blocked creating difficulty in the transportation system for them.

The intrusion of saltwater in the agricultural field has caused damage to the soil which was favourable for paddy and betel leaf cultivation. The saltwater has degraded the soil quality, where performing cultivation of paddy and betel leaf is now difficult. Thus, it is the reason for their economic decline.

Steps Taken To Recover The Damage Caused By The Cyclone

It is well known that the mangroves possess the ability to rejuvenate. The destruction caused due to the cyclones is believable to heal. But every injury requires its own time to heal from the damage caused. Major damage was caused during cyclone Aila, but with time rehabilitation was observed in the mangrove forest. However, the two successive cyclones

Amphan and Yaas have caused intense destruction and gave no time to the mangrove forest to rehabilitate the injury caused. Cyclone Amphan has rooted out around 12000 trees in the mangrove forest which will require ample time to recover.

The State government has taken up the initiative to handle the loss. The reforestation of the mangrove forest program was conducted. The seeds were planted in the river, shoreside, and marshlands. Many saplings of different mangrove species were sown, especially the saline water bearable species. As the Bay of Bengal is now more vulnerable to cyclones, so actions are being taken to protect the river and coastal embankments by preventing the gnawing away of soil.

The steps taken to recover the damage caused by the cyclone are:

- (a) The inclination of embankments was minimized, which acts as the intervention slope, leading to the contraction of topsoil and rectification of the drainage system by decreasing the seeping compression.
- (b) Many hedgehog-like structures were embedded in a chain at an angle such that the angle of inclination is more than the angle of declination, which accelerates the rate of sedimentation absorbing the alluvial particles.
- (c) Mangrove saplings are being planted especially those which are salt-water tolerant, and these saplings are being monitored from time to time to observe their growth level.
- (d) The local residents were motivated to perform saltwater resistive rice paddy farming.
- (e) Public awareness programs are conducted stating about the significance of mangrove communities, which oppose the effect of cyclones from severely affecting the land.
- (f) They are trying to reduce the excessive use of resources which are obtained from the mangrove forest by the local people and are spreading awareness to use alternative resources which can reduce the consumption of resources from the mangrove forestry as much as possible.
- (g) Steps are taken to reduce prawn cultivation in the mangrove areas as cultivation of prawns affects the mangrove forestry.

Integrated Coastal Zone Management (ICZM)

The coastal areas of the Indian subcontinent are furnished with a broad range of mangrove ecological communities, seagrass beds, areas of coral reef, saline land, barren land, estuaries, and peculiar aquatic and coastal ecosystem.

To make the ICZM operative, the naturally occurring phenomenon like the wind and water stream and their intercommunication with the adjustment practices with the natural ecosystem must be taken into account. Safeguarding of the coastal areas, forestland, seashores, aquatic environment, and reefs from the effects of cyclones, tidal waves, and strong winds and the intercommunication of natural adaptation of mainly the plants must be studied and practiced for the sustainable management of coastal areas.

Goals of ICZM

1. **Provides shield to the coastal areas:** Sowing of different mangrove species along the seashore help to decrease the weathering of the coastline and safeguards the coastal settlements from the hands of cyclones and tsunamis, strong winds, and tidal waves.

- **2. Restoring the mangrove ecological community:** The objective of ICZM is to encourage living without ruining the mangrove ecological community. These can be accomplished through eco-friendly practices which include sustainable utilization of the goods from the mangrove.
- **3.** Conserving of the present mangrove ecological community: The conservation of biodiversity can be accomplished by the formation of areas for protecting and conserving the mangrove ecological community, and the construction of natural reserves, national parks, and wildlife reserves.
- **4. Sequestration of carbon:** The mangrove ecological community is more efficient in absorbing atmospheric carbon than any other forest ecosystem.

Plantation Pattern

For the plantation of mangrove plantlets, one or two procedures were exercised. The first procedure is to gather kernels and fruits and grow them into plantlets and the second procedure is to gather and transplant them straight on the riverside, which is comparatively a simple procedure.

The plantation pattern also involves the selection of the appropriate mangrove species to be planted according to the nature of the soil. The halophilic mangrove species that mature naturally like the Sundari (*Heritiera fomes*), Jaat Goran (*Ceriops decandra*), Kankra (*Bruguiera gymnorrhiza*), Genwa (*Excoecaria agallocha*), Jaat bani (*Avicennia officinalis*), and Khalsi (*Aegiceras corniculatum*) have unique habituation to hold on the coastal zones with the nature of soil being alluvial soil with clay deposits. They also have the ability to withstand the strong tidal waves and winds and are highly salt-tolerant species. (Sen, 2021)



Photo 26: Pattern of Plantation

Conclusion

The mangroves are an extremely precious resource from both direct and indirect perspectives which aids the different needs of mankind. The natural system of mangroves is universally endangered due to the extensive use of their resources for serving human needs. Due to this, large-scale destruction of the mangrove belt took place all over the world. Presently, there is a requirement for an integrated management scheme for the restoration of destructed mangrove belts.

There is information that proves that the mangrove ecological community has undergone several changes in the climatic conditions. The principal climatic changes that have occurred are a rise in the temperature of the atmosphere and water, rise in salinity due to cyclones, an increase in sea level, weathering of soil, and the ferocity of storms and cyclones. The cyclones are the reason for the fractures that are formed in the riverside embankments which are done in order to prevent the intrusion of salt-water, and loss of many lives and property. Several man-made activities like pollution also affect the mangrove ecosystem. The discharge of wastewater from the metropolitan city and unprocessed sewage water into the rivers is harmful to the mangrove belt. Pollution due to synthetic chemical compounds is an important cause of the decrease in the biological diversity of mangroves. So, in order to secure the mangrove belt pollution should be minimized to a greater extent.

Organized technical comprehension of the mangrove area dynamics, several environmental factors, social-economical situations of local citizens, forecasting increase in the ground level of the sea, and many other factors are crucial for the sustainable growth of the mangrove belt. Well-planned ICZM (Integrated Coastal Zone Management) strategies should be taken into account in order to prevent natural disasters like cyclones, tsunamis, variation in climatic patterns, and increase in sea level, and secure human lives and their surrounding habitat. In order to attain the goal, the active involvement of government and local citizens is very essential. Initiative to plant more saplings of various saltwater tolerant as well as the other mangrove species in the proper procedure should be done. The river barricades should be restored properly so that the intrusion of saltwater can be avoided as much as possible.

Thus, it is high time that necessary actions should be taken in order to protect the mangrove ecological community, because their absence might cause difficulties to human livelihood as well as to those species whose existence is highly dependent on the presence of the mangroves.

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