We are at a mangrove forest in the night. This is my first trip here after daylight on a boat. The hands rowing the oars pause and the boat stops for us to take in the view. My eyes widen in awe looking at the stars sparkling and twinkling in the night sky. I give rein to my fantasy and imagine that these stars have descended to the earth from the sky and are shining like flowers on the trees of the mangrove forest. It seemed these stars, were silver coloured, sparkling and twinkling on the mangrove trees that were thick on both sides of the waterway! As the boat began moving, I felt as if I were in a trance, cruising softly on the water, mesmerised by this starry world of flowers. It was a never before experienced moment in my life.

When we say forests, we usually mean a thick verdant growth on the land’s surface but not many have travelled in a boat and seen mangrove forests. Those who have seen them grow on water would not remain unmoved by their magnificence.

For many of the travellers, the boat ride on the waterway is just a sightseeing pleasure trip. Only a very few understand the beauty and significance of the mangrove forests.

The mangrove forests are called by various names like tidal forests, coastal woodlands, walking forests in the sea, roots of the sea or oceanic rainforests. When considering these forests, we should not look at the trees, animals and the fish as separate entities; it is one wholesome ecological environment.

The Europeans did not look at these types of forests from this perspective. They assumed it to be dirty, inaccessible and full of mosquitoes, and ignored them! They considered these as infertile wastelands. The main reason behind this misconception is that there are no such mangrove forests throughout the Northern Hemisphere.

The mangrove forests such as the one above withstood the force of cyclone Aila in West Bengal

**Mangrove (tidal) forests and thermal power stations**

*Nakeenan*

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Features of a mangrove

Cyclonic storms wreak havoc on the coastal area first before hitting the land. When trees strongly rooted to the land cannot stand the might of these storms and are uprooted, these mangrove trees with roots just in the water and that too in brackish water are able to stand. To understand this phenomenon, one has to study the structure of the roots of these trees. It is a speciality with these trees not seen in other plants and trees rooted to land. These are the aerial roots.

In the case of normal trees and plants, their roots penetrate the earth firmly clutching onto the soil around them. The air cells in the gaps in the soil allow them to breathe. But these mangrove trees, standing on and fully surrounded by water have instead aerial roots which breathe. There are four different varieties of such aerial roots found among the vegetation in the mangrove forests in Tamil Nadu.

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Mangrove forests have three divisions or zones; the first, starting from the edge of the sea, is the pre-mangrove flora, the second is the after-mangrove plants and trees and the third division constitutes the vegetation found on the brackish or saline lands.

The first zone is called the Rhizophora section. The vegetation here is immersed in water by up to 20 to 40 cm and it is here that the largest number of species is found. These small trees of around 5 to 7 metres in height have deep roots. They are able to strongly hold themselves by creating a strong combination of bottom roots which grow about 2-3 metres from the base with roots flowing from the branches. This root arrangement by the Rhizophora trees is known as stilt roots. It is through these stilt roots that they breathe.
The thillai trees, on the other hand, retain and do not expel the salt. The Rhizophora tree manages to expel the salt through its stilt roots. One can notice the salt oozing out from both edges of the leaf. The salt component. Plucking a leaf from this white mangrove tree is similar to drinking salty water. While sucking the salty water through their roots, the plants retain the salt from the water. However, the saltiness is still substantial.

Much further away from the bank are the tall trees with visible white barks. They are the mangrove trees, the last set of trees to be noticed in this section of the forests. There are many other trees in the forest but this one has been singled out as a unique species. This naming of the trees follows a rationale. The Tamil name given to these trees is “Alaiaathi” which translates into calming the waves. As such, the locals call these forests by various names: Rhizophora forests, Mangrove forests, Kanna forests and Excoecaria agalloch (Thillai in Tamil), all deriving their names from the trees found in these forests.

The name Mangrove forest has stayed for the forests found around the Muthupet area. These forests possess the capacity to resist and slow down the windstorms blowing at 100 to 120 KMs/hr speeds and bring down the intensity of the sea waves caused by the storms. These forests made up of these mangrove trees are even stronger than concrete walls on sea shores.

The water in these forests is saline in nature. The salt concentration in sea water is 35 parts per thousand, whereas in the water bodies holding the mangrove forests it is 20 parts per thousand. This is because of the mingling of river waters with the waters in the mangroves. However, the saltiness is still substantial. Any normal plant would have died with this amount of brackish water. While sucking the salty water through their roots, the plants and trees in the mangrove forest retain the water and expel the salt component. Plucking a leaf from this white mangrove tree one can notice the salt oozing out from both edges of the leaf. The Rhizophora tree manages to expel the salt through its stilt roots. The thillai trees, on the other hand, retain and do not expel the salt.

Kanna do not have the bundle of stilt roots that the Rhizophora have, but they have other kinds of roots called Pneumatophores (kind of breathing roots) to help them breathe. The roots of these trees are spread horizontally inside the water for several metres from the tree. Generally roots obey the force of gravity and grow downward; even the prop roots of the banyan trees fall downward. But, the shoots of these stilt roots defy gravity growing vertically from the horizontal roots and jut out of water above land! The approximately one foot long dense stick-like projections seen at close intervals of 6 inches are called the Pneumatophores of mangrove trees. Roots of Sonneratia alba trees also have similar stilt roots.

The roots of trees such as Bruguiera and Bruguiera in the Rhizophora area of the mangroves are cylindrical (I). Blume also possess similar root arrangements like the mangrove trees. However, though they also have long projections, their tips have changed to a blunt form appearing as if one is kneading down. It is for this reason that they are called Knee roots!

The offshoots of Rhizophora trees drop down like drumsticks. Though they have fallen on the ground, they stand upright and deep on the marshy land. These are not offshoots, but germinated seeds. Normally for seeds to germinate, they need a combination of three elements: soft water, oxygen and the appropriate atmospheric temperature. But in these mangroves, with the constant ebb and flow of tides, such an ideal situation is not possible.

Viviparous germination seen here is nature’s arrangement to overcome this constraint. In this germination process, the reproduction takes place in the mother plant itself. That is, the mother plant holds the seeds till the roots are formed and then the young roots lower them down into the water. The seeds from these trees are a foot long like a stick. Their lower tips are sharp. When they drop to the ground the sharp lower tipped root penetrates the muddy surface and plants itself and begins to grow leaves.

The roots of Xylocarpus obovatus or Xylocarpus granatum trees surround the main trunk and extend to the ground with Pneumatophores jutting out of the roots. These are termed Buttress roots.

The marshy surface of the mangroves gradually becomes sandy and that is where the last zone is. Unlike the Rhizophora growth, there is no dense growth of trees here. The types of plants and trees found here include the milking mangrove thillai, Suaeda, Acanthus illicifolius, Aegiceras curculiform and Lumnitzera racemosa Willd.

Out of these, Excoecaria agalloch can be seen to grow up to 12 metres in height. Milk flows from all parts of these trees. They are believed to be ‘blinding trees’. Animals do not graze on them. The temple town of Chidambaram is also known as “Thillai”, after the name of this tree.

The soil gradually becomes alkaline and there is the Acanthus Illicifolius with the blue flowers that thrives here. These are also known by the names aathumulli or kazhimulli. This soil has Sangu trees and Clerodendrum inerme plants. Plants like Sesuvium portulacastrum and Suaeda which grow in this area are capable of retaining the salt from the water.

2

Life Ecology

The biggest danger threatening the very existence of this planet is climate change. Global warming is the root cause of climate change and it is believed that the planet gets hotter by 0.3 degrees every 10 years. Even under normal conditions without global warming, when surface level temperature of the sea reaches 26 degrees C, the sea gets turbulent, but with global warming, tropical storms will turn even more furious. This will have serious adverse effects on the mangrove forests and if the mangrove forests are destroyed, then sea food, 80% of which is constituted by various varieties of fish, will also become extinct.

The back waters and lagoons of these mangrove forests are actually the cradle for most of the living organisms. For example, though the shrimps are hatched in the sea, they migrate as hatchlings to the mangroves to feed on the humus and grow. When they have grown big enough for reproduction they migrate back to
the sea.

It is estimated that in a hectare of a rich mangrove forest 8 to 10 tonnes of leaves and flowers whither and fall into the water decompose, and rapidly form humus. Thus there is abundant feed for the shrimps and other living organisms. A reduction in quantum or ratio of mangrove forest will jeopardize their food source.

This humus also provides nutrition for the planktons and enables them to grow and multiply. There are two types of planktons, phytoplankton and the zooplankton. There are a number of sub-categories as well. Humus, available here, is the feed for all these planktons. Along with these, amino acids and organic salts dissolved in the water serve as the diet for all the species living in the mangroves. Although the species living in the seas use only a small proportion of the salts dissolved in these waters, the silt, the fungi, bacteria and single cell organisms consume these directly as their food. This way, they form the first link in the food chain at the primary level. Our mangroves have 500 algae – plankton types and 195 fungi and bacteria.

The food chain in the mangroves can be classified into three levels. In the first stage of the food chain are the species like shrimps, molluscs, crabs and culture worms. These form the food for the second stage consumers like forage fish. The predator fish form the third stage consumers. One can appreciate the beauty of these mangroves if one takes into consideration that a total of 25 types of prawns, 138 types of crabs and 546 fish tribes are entirely dependent on them!

Not only this; these waters are home to some 308 varieties of snails, 7 kinds of fish parasites, 3 amphibians and 11 types of sea grass varieties. But all these living organisms in the mangroves are not easily visible to the observer. The reason for this is the colour of the water. As the bunch of roots of the trees in these mangroves mix with the water and turn into the colour of sludge, it has created an environment in which all these species manage to hide themselves from potential enemies or predator species.

In addition, mangrove forests are home to 711 insects, 745 types of invertebrates, 85 types of reptiles, 70 mammals and 433 birds which can be described as an environment embodying a large biosphere. At the apex of this life ecology are the Bengal Tigers of the Sunderbans forests, which, incidentally is not only India’s national animal but also that of Bangladesh.

One of the consequences of climate change is the rise in sea level. The Rhizophora trees will manage to gradually grow and reproduce better than other trees like Bruguiera gymnorrhiza Lamk, Ceriops decandra and Xylocarpus granum because they have better resistance to brackishness. If the sea erodes the coast, the natural tendency for these plants is to intrude into land but construction works on the coasts prevents their intrusion into land. The plants and trees in the mangroves are thus constrained to grow and sustain themselves within a limited space. This also affects the diversity of the vegetation in the mangrove forests. One immediate example of this predicament could be the availability of only Excoecaria agalloch trees in the Arasalaar delta of Kaaraikad.

Another telling manifestation of climate change is change in rainfall pattern. This alters the character of the brackish water in the mangroves causing conflict between plants growing in the brackish water and the adjoining marshlands.

The increasing surface temperature impacts the plant ecology in the mangrove forests in two ways. First, it will completely change the features of the sub-species. Second, it will alter the flowering and maturing seasons.

There is an even more significant effect of climatic change which has to do with photosynthesis that is essential for plants. Under normal conditions, the temperature difference due to seasonal changes should not exceed 5 degrees. The maximum temperature for ideal photosynthesis for mangroves is considered between 28 and 32 degrees centigrade. If the temperature goes up to 38-40 degrees centigrade, photosynthesis will stop. This will mean that these mangroves will be completely destroyed.

**Impact on aquatic animals**

Climate change could prove to be a threat to other life resources. The Molluscs cannot stand the increase in the heat. Although it is felt that several types of crabs and snails can bear heat and still grow, the increase in heat and the dryness caused by it could cause an environment where these crabs and snails could be affected. This happens when the rising heat mixes with the highly salty brackish zone. Species particularly living on the edge of the sea get threatened by change in sea temperature and with the increase in sea levels. Some of these species could face extinction, having to move from the accustomed tide levels and intrude into other species zones.

For example, the commercially valuable Sea Bass is found in abundance around the marshy roots of Rhizophora trees. Similarly, another variety, the Silver Silago, which is also of commercial value, is found only in sandy waters. When the sea water levels increase and the waters enter the zone, both the Silver Silago fish living in the interior and the Sea Bass living in the seafront will face extinction due to habitat changes.

A parallel example can be drawn with the Gobius fish which were found around the roots of Acanthus ilicifolius in plenty have now completely vanished.

The mangrove forests in Tamil Nadu are home to abundant variety of fish (Mullet Sp., Kendai, Cat fish Sp., Reef Cod, Treadfin bream, Thogapodi, Sethal, kathalai, Koi, Paingalai Kaala, Elaathi, Vallampodi Karumooral, Ilangan and Kuloori), shrimps (Peneaus indicus, Metapeneaus monoceras, Tiger prawns (peneaus monodon), Metapeneaus Sp and Peneaus semiesculatus and the Macrobanchium Sp variety of prawns), crabs (Stone crab, Kazhi crab, Mud crab, Seevali crab, Root crab, Thillai crab Kadukka crab and Nedungaal crabs) and oysters. This is of great economic value, with a potential to be converted into a commercial proposition.

Times are changing. In earlier times one could insert a hand in the water and pick up a fist full of muck with thousands of baby prawns. In the eighties, about 245 tonnes of fish resources used to be obtained. Out of this, shrimps alone would be about 205 tonnes. Each boat will catch 200 kilos of prawns; but now it is only 2 to 10 kilos per boat. Similarly the yield of Sea Bass has come down by over 80% in the last 15 years. The Silver Silago fishes which were available in lots earlier are now down to only
one to two kilos. There has been a drastic drop in the availability of Reef Cod fish which used to be available earlier in generous quantities and Sennakunni, a variety of tiny dried shrimps, has completely vanished. There are three reasons for this: (1) Closure of the Estuary, (2) Increasing shallowness and (3) Increase in water temperature. These are not natural phenomena but solely brought about by human activities.

The mangroves in Pichavaram and Muthupet in Tamilnadu are substantial in size. The Pichavaram mangrove forests are located between the Vellaar estuary and the Kollidam estuary. In Muthupet, there is a lagoon where five rivers merge. This lagoon has an estuary which joins the sea. These estuaries are the primary spots in the mangrove forests. It is through these estuaries that shrimp and fish hatchlings enter the waters of the mangroves. Since sea waters entering through these lagoons are deep, it suits these hatchlings to grow. However, these estuaries have undergone changes in recent times. To cite as evidence, the lagoons of Pichavaram used to be open all through the year till about 25-30 years ago. But now, they are open only during the monsoon season and that too, only if the rains are heavy. Otherwise, they are only partially open. Sand dunes are getting larger there now. The lagoon gets totally closed in the month of May and continues to be closed till October. By then the flood waters from the northeast monsoon push the sand towards the sea. So, for a short period, the lagoon opens up. It is a similar story with the lagoons of Muthupet. These lagoons which were 2.5 kms long and 2 to 2.5 kms deep 25 years ago are hardly 1 km long and 1 km deep. This has brought down the numbers of species which come to these parts for reproduction.

It was during the summer that the high priced fishes would enter the mangroves from the sea. If the opening in the estuary was broad enough, large quantities of fish would enter. Some of the fish varieties from inside the mangroves would go back to the sea. This is how the Eels go to the sea and the Hilsa fish come to the river for reproduction. During the monsoons, only Mullets and Kendai fishes would migrate from the sea. Now their numbers have reduced considerably. Varieties like Reef Cod fish have become rare. Shallowness of the water is also one of the reasons and fish like Silver Silago which would visit for food during the kondai wind seasons, are not seen nowadays mainly due to the water here getting heated up.

3 Shifting of Sands

The Marina Beach considered as the second longest beach in the world is not a naturally formed beach but has been created by human endeavour. About 130 years ago, the Marina beach was just mud and sludge filled with fish.

The Chennai (then Madras) harbour was built in 1881. At that time, artificial wave inhibitors were erected for the sake of the harbour. On the south of the harbour, sand started accumulating, where there was mud and sludge earlier. In 1884, the then Governor Elphinstone, got a promenade constructed where the sand was accumulating for his own use and gave it the name Marina. This is the story of the birth of the Marina beach.

Ever since the Marina beach came into being, sand kept accumulating but on the northern side of the harbour, the sands kept reducing on the surface. As on date the sand accumulation on the Marina continues to increase its surface area at the rate of 40% each year, whereas towards the north of the harbour, the 700 Mtrs long Ennore beach has vanished. This beach is an ancient beach dating back to the Gondwana period with sand and alluvial sands. It also had Archean period rocky sands and clay deposits. The northern side receded after the harbour was built.

Tamil Nadu enjoys two monsoon seasons; one is the South West monsoon and the other, North East monsoon. These are not just seasons of winds or rains. These are the seasons when shifting of sands takes place.

In the eastern shores of Tamil Nadu alone 500,000 Cubic Feet of sand shifts south to north and back each year. This is how: during the south-westerly winds, sea waters travel from south towards the north and this carries the sand northward. Similarly, when the north-easterly wind blows, the sea water’s direction changes towards the south and as a result of this, the sand also gets carried back towards the south. This phenomenon takes place throughout the year which maintained a natural balance.

Here, the tidal activity is quite rapid during the south westerly winds and due to this the quantum of sand pushed towards the north is also high. This goes on for around 9 months. On the other hand, the north easterly winds are active only for 3 months in a year with lesser intensity. Therefore, the quantity of sand washed ashore towards the south is proportionately less.

With the building of the Chennai harbour, the boulders erected as artificial wave inhibitors in the harbour controlled the sea water flow, blocking the sand carried towards the north and let it accumulate at the south of the boulders, creating the Marina beach. The opposite result of this is the erosion of the sea in the north.

Substantiating this is the recent example of Pondicherry. People who had seen the beach there 25 years ago are astonished to see it missing now. The reason for this is the new harbour in Pondicherry. What must be understood here is that sea erosion is not a natural phenomenon for if it was we would hardly have any beach left in the world.

There is a connection between mangrove forests and the phenomenon discussed above. Around 3 kms to the north of the Vellaar estuary, in Pitchavaram, there is a plan to set up a thermal power plant by the KFS Group. For this thermal plant, the firm is planning to construct a harbour bridge or wave inhibitors 1650 metres into the sea at Pudukkuppam. If this happens, there is a real threat of the shifting of sands towards the north being obstructed and the Vellaar estuary, which is currently closed for only a few months in a year, will be closed for ever. One can imagine only what would happen to the mangroves, thus adding to the damage already being caused to its existence.

Wastes

It is believed that the mangroves are a natural filter and utilise their special adaptable capacities to filter and bury in the sand bio-degradable and non-bio-degradable objects. For this reason all wastes are thrown into the mangroves. This faulty belief has lead
to the mangrove forests of Mangalore in Karnataka turning into a dump yard and they are on the brink of destruction.

Abdul Rahman, a biologist, trashes the idea that mangroves have the capacity to remove heavy metals from effluents as superstitious belief. His conclusion was based on a research in 1983 by Klow. It is likely that these trees might not be affected by heavy metals or pesticides but the sediment fauna are definitely affected. Abdul Rahman avers that the mangrove forests are not meant for dumping wastes and refers to how planktons were damaged due to red palm oil wastes in Malaysia.

There is evidence of similar damage being caused to the mangroves in Kerala. In Tellichery, Kerala, a hospital near a mangrove forest is releasing phenyl waste. This has shrunk the number of fungi in the mangroves from 135 to 35. We cannot appreciate this destructive behaviour since it is these fungi that play a huge role in enabling the falling leaves from plants and trees to decompose and it is this compost which is the food for the fish and shrimp.

Another damaging effect is the plastic wastes accumulating in the mangroves. Oceanographer and founder of the Algalita Marine Research Foundation, Captain Charles J. Moore, conducted a study in north Pacific on the mixing of plastic particles in the sea with planktons. According to him, while in 1990 the ratio of planktons to plastic particles was 1:6, that is, for every plankton, there were six plastic particles, by 2008 this ratio skyrocketed to 1:40! The damage that can be caused to planktons which end up consuming these plastic particles can be realised when we see turtles dying after eating plastic bags, mistaking them for jellyfish. These types of plastic wastes reaching the mangroves in unlimited quantities through river waters poses a grave danger to the mangroves and life forms dependent on them including humans.

**Agricultural Wastes**

Another waste which affects mangroves is agricultural waste. Fresh water reaching these mangroves through the rivers, carry chemical residues of fertilizers and pesticides which contaminates the waters. In addition to the damage caused by the excess carbon and nitrous oxide from chemical fertilizers, a huge amount of DDT from the pesticides is also detected in the marshlands of the mangroves in Pitchavaram. Linden is also found in excess. Endosulphan is found in excess in the silts and DDT in high quantities in the biota. These have spread substantially to the microorganism in the sea. These pollutants are found high in planktons. In planktons 8.11 micrograms of DDT, 1.72 micrograms of Lindens and 0.20 micrograms of Endosulphan have been found. These are observed in the fishes also and higher especially in Karuvaaval, Tuna, Vella and Mackerel.

When sand dunes form at the mouth of the estuary and close, heavy metals and pesticides are prevented from entering the sea. Added to this, changes in rainfall patterns result in rivers bringing insufficient quantities of fresh water, food and silt. It is a truism that where there is plenty of fresh water, there will be plenty of marshy land vegetation. A prime example is the availability of the Macrobrachium prawns around the Acanthus ilicifolius trees in the month of November when the fresh water flow is at its height.

**Wastes from Prawn Culture Farms**

The expansion of prawn culture farms is also affecting the mangrove forests. The prawn farms surrounding the Muthupet lagoon have retained 110-115 cm high water with 25 Kgs of prawn feed and 250 to 350 Kgs of lime water. These are added per 0.5 hectare to increase the pH of the water.

Antibiotics like Akyetitra caiklain, ulmit, micopor and pesticides are all being used. When all these are released as wastes and mix in the lagoon, the availability of shrimps in the mangrove forests, which was itself a natural prawn farm, dwindles. In addition, these prawn culture farms are accelerating environmental damage by giving fillip to climate change. When marshy lands silted for thousands of years are converted into prawn farms, 75 tonnes per hectare of carbon emissions are released into the atmosphere.

**Thermal power plants**

Some Environmentalists are familiar with the term ‘Minamatta disease’. Minamatta is a small town in Japan. One day quite suddenly all the cats in this town started behaving as if they had gone mad, shrieking and convulsing. Some cats threw themselves from the top floors and killed themselves. The owners of these cats just could not understand this behaviour of the cats. Exactly 3 years later, the people in the town also were subject to numbness of the body impaired vision blindness, brain damage, shrieking, fainting, coma and finally death. Nobody could make out the reason behind this phenomenon. This was followed by children born with deformity. Initially, it was believed that this was contracted from the cats. This mysterious disease, which attacked the central nervous system and made the brain dysfunctional, was named the ‘Minamatta disease’. Finally, one doctor helped solve the mystery.

Thermal power plants are a threat not only to the environment but humans also.
Mercury released from a factory was found to be the reason for this mysterious disease although it could not be ascertained as to how mercury penetrated the human body.

Ions of the mercury effluents when mixed with the silt in the estuary react with the bacteria and get converted to 'Methyl mercury'. This cannot be detected in the water. When these mix with the planktons, they get consumed by the biota. This biota is eaten by the big fish. Thus the poison gets transferred from one place to another. It is after eating such fish that the cats fell ill and when humans consumed the fish, the poison penetrated their bodies and caused the disease in them. Minamatta disease was caused by a chemical factory owned by the Chisso Corporation, Japan which was discharging mercury waste into the Minamatta bay.

The discharge from thermal power stations along Tamil Nadu's coastline has the same disastrous implications similar to the Minamatta incident. 12 thermal power stations to produce 14,700 Mega Watts of electricity are being proposed to be built on the coastal areas between Pichavaram and Muthupet. These thermal plants can cause immense damage to the mangrove forests and the environment.

There is already a power generation unit operating at Perumalpet near Tranquebar, using Naphthalene and Natural Gas (P.P.N.I). This plant uses sea water for cooling the plant cells. Since the thermal power plants will also be using the same process the waters used for cooling purposes will be poured back into the sea.

The hot water poured back into the sea is nothing but the pollution from the thermal power station. Sea resources are being destroyed by this hot water. Fishes in the tropical regions already live under highly warm conditions which is the maximum temperature the fishes can withstand.

Even though the project reports on these thermal power plants claim that the water released after the cooling process is higher by just 5 degrees, (the actual temperature, though, is much higher) even this increased heat is sufficient to cause the extinction of the fish population.

Fishermen from the Tranquebar area claim that there are no fishes to be found in an area of 5 kms circumference where the P.P.N.I is discharging the heated waters from their plant. They also inform that in other places, shrimps, Katla and Mackerel have reduced in quantity.

Not only that; when 2 litres of sea water is softened, only 0.8 litre of soft or fresh water is obtained. The balance 1.2 litres which have turned doubly saline is sent back into the sea. Apart from affecting the fish resource, this highly concentrated salinity spreads into the mangroves and damages the flora and fauna.

When sea water is drawn from a distance of 400 metres, 25 litres of chlorine gets added per hour. This is done to avoid any micro organisms from the sea getting deposited in these pipes carrying water for cooling the furnace (this method already exists in Kalpakkam). It is this excess amount of chlorine that damages the cells of the phytoplanktons which results in reduced photosynthesis. Besides, it affects the first stage consumers in the food chain. The fact that the phytoplanktons living on the edges of the estuary and marshy lands have declined in numbers has been confirmed by Dr. R. Santhanam, who did a research in 1990, on the effects of the effluents from the Tuticorin thermal power plant.

Another research confirms that 60% of the zoo-planktons have died. Further, there are other chemical reactions caused by chlorine in sea water. It changes into a Trihalomethane (TCH) compound, which can cause cancer. The excess chlorine combines with ammonia and the mixture obtained in the forms of chloramines and bromamines are poisonous and these have been found in the fishes, crabs and prawn varieties.

Our thermal power plants operate with coal as the primary raw material or fuel. When coal is burnt to produce electricity, mercury gets released both in the air and in the waste water. Generally it is claimed that the presence of mercury in coal is insignificant. That is, 1 kilo of mercury can be found in 4 million kilos of coal. The volume of coal needed by a plant with a capacity to produce 1000 MW electricity is about 5.50 million tonnes a year. The proposal to set up thermal power plants to produce 14,700 MW would need a huge quantity of coal to meet its requirement. It is scientifically proven that it is sufficient for one gram of mercury to turn the fishes poisonous in a surface area of 25 acres. Each 100 MW thermal power plant will release 11 grams of mercury in a year. If all the plants to collectively produce 14,700 MW power start operating for just a few years, it would be catastrophic to have tonnes of mercury wastes released into the sea. There is no guarantee that these will not enter the estuaries and mangroves deposit in the silts react with the bacteria and change into methyl mercury!

The damage due to the pollution caused by thermal power plants is not only direct. Their long term existence affects the climate. The thermal power plants produce gases which are responsible for creating the hole in the Ozone layer resulting in global warming.

As evidence mounts it is known that every thermal power plant with a capacity of 500 MW releases 105 tonnes of Sulphur Di-oxide. This can induce acid rain, damage crops and destroy, the vegetation in the mangrove forests.

The plant also produces 24 tonnes of Nitrogen Di-oxide every day! This can cause the water bodies to turn acidic. The mangroves in these tidal forests will also be affected. The place at one time was so pure that according to the Tamil Sangam period Literature ‘neithal’ flowers used to flower here.

It has been decided to build a separate harbour to unload and store coal, and then to be carried to the planned thermal plants. The companies expected to operate here are Tridem with an 1850 MW plant and Nagai Power Pvt. Ltd, with a plant starting from 300 MW and later to expand up to 1200 MW. Ashes from the coal contain the following poisonous substances: Arsenic (11 ppm); Cadmium (9.0 ppm); Chromium (120 ppm); Copper (100 ppm); Lead (35 ppm) and Nickel (150 ppm). All these exceed the limits prescribed by the World Health Organisation (WHO).

The Forest Department in Alam near Thalaignaiyuru is at the same time creating a new mangrove forest. In spite of this, the government is toying with the idea of creating Special Economic Zone (SEZ) for chemicals and allied products at a place called Agaraperunthottam close to the Pichavaram mangrove forests!

Forest Department documents has strongly pointed out that this is the location where the turtles cohabit and engage in reproduction
of their species.

In today’s context, where development at any cost is the priority there are still people who ask this question and wonder why there is talk about turtles, mangrove forests, Minamata disease and so on. Similarly, proclamations of development were repeatedly made when the Green Revolution was launched. Now, after our food and the earth on which it is produced have been poisoned, these people are proclaiming long-term development.

Our contention is that this long term development and non-polluting technology should co-exist! People who talk of Global Biodiversity fully well understand that it includes the human race as well. Water is the basic necessity of life. There is no life without water. Any industry that destroys the source of water can never be good endeavour. Water is more important than economics. A 500 MW thermal power plant consumes 80,000 litres of water every hour. This includes sub-soil water as well. Ground water, which was available at 8 feet, has now gone down to 20 feet and saline water has entered these water sources.

Those who have this pre-conceived notion that development even in the case of thermal plants should not be prevented should keep the following points in mind.

Growth of all parts of the human body is real growth. If only one part of the body grows, it cannot be called growth. The kind of growth that is foreseen is meant for the rich capitalists rather than for the people.

The total power requirement of Tamil Nadu state is only around 13,000 MW. This newly planned thermal power plant with a capacity to produce 20,000 MW power is at the behest of private power producers. The transnational corporations are consuming more electricity than all the people put together. If there is a shortfall in power production, it is the people who suffer.

Air-conditioners in the rooms of the transnational corporations don't stop even for a second. This is being done at the cost of polluting our water, earth and air. All this is done in the name of development and growth.

Growth does not encompass just our lives today; it includes our children and the future generations. Those who believe that it includes all living beings should definitely speak up on this. We are tenants on this earth and so were our ancestors and so will be our future generations. We have no right to spoil it. People who clearly understand this will not be chanting ‘development’ all the time!

It was only after the Tsunamis that we realised the value of the mangrove forests. But mangroves are not only wave inhibitors. The mangrove forests also operate to counter climate change by helping in reducing of greenhouse gas emissions. To cite an example, the thillai trees absorb three times more carbon dioxide than other varieties of trees and plants. Similarly, mangrove plants produce chemical substances in large quantities and release them in the air. Results of a survey by the Centre for advanced studies in marine biology indicate that these chemical substances in the air help deflect the ultra-violet radiation.

Mangrove forests can also be considered as an economic unit which can yield a high income. About 80% of the fish production in the country is dependent on the mangrove forests. The income generated from mangroves is 25% higher than the agricultural income. Likewise from the Sunderbans forests, 111 tonne honey is collected in a year. This constitutes 90% of the country’s honey production. The mangrove forests contribute in different activities such as coastal security, protection of fish, wooden logs, tourism, recreation and improvement in quality of water, is estimated to be around US $ 1.6 Billion annually or 0.90 million US dollars per square kilometre.

These great mangrove forests are now depleting at the rate of 1% per year. Out of the total spread of 4445 square km in India, Tamil Nadu has only 35 Sq. km. The area in Pichavaram has come down from 4000 hectares in the last century to 1100 hectares now. Muthupet mangrove was 12000 hectares earlier but today, it has come down to 6803.01 hectares. Even out of this, only 4% constitutes the well grown mangrove forests.

In Tamil Nadu, the rich sea surface yielded 12 tonnes per Sq. km of fish up to a depth of 50 metres and 6 tonnes per Sq. km in depths of 50 to 200 metres. The degradation of the estuaries and the destruction of the mangrove forests have affected these quantities of fish yield. Yet, Tamil Nadu ranks third in the country in the fishing industry and aspires to be the first. By saving the mangroves, the livelihood of communities can also be protected. Mangroves provide employment to a million people worldwide. On the East Coast alone, there are a total of 1000 villages fully dependent on mangrove forests. The only source of meat proteins for these people is fish and prawns which have been their staple food. But today diseases have become widespread among the children of the fishermen due to malnutrition. Deficiency in Vitamin A and B appear to be the main cause of the ailments.

The WHO recommends a quantity of 15 kilos of seafood per person, annually. But even an average of 7.5 kilos is not available to an Indian despite India having a long sea coast. It is ironical that the government which encourages the export of the iodine rich prawns for consumption by foreigners recommends our people to eat iodised salt.

When pleas are made to save the mangrove forests, it is ignored. Instead, they are busy proposing setting up thermal power plants in the area! If these thermal power plants come into existence, they will gradually destroy the mangrove forests until the mangroves disappear. The fish available for consumption now will not exist. Only the fish poisoned with lead would have multiplied.

Migratory birds visit the marshes next to Muthupet between October and December. The most important of these birds are the Flower Storks. There was a time when 250000 Flower Storks used to land here. Now, not even 50,000 turn up. The reason for this is pollution emitted by the salt factory of Chemplast which produces industrial salts.

The wastes from this factory penetrate the earth and water and kill the microorganisms on which these storks fed. The blue green alage which is one of the planktons available in the marshland and the shrimps which consume them are the favourite essential food for these storks. It is in these that the Beta carotenoid pigments are available. Dunaliella is a cell plant which is another item of food for the storks. It is the precursor in the preparation of Vitamin A which is also full of Beta carotenoid pigments. These pigments give the storks their Juvenile Red colour (one can notice this colour
while cooking prawns). When the stork injects these pigments, an enzyme is secreted in its liver breaking the carotenoid and converts it into juvenile red or reddish yellow and changes the colour of the stork. Without these pigments, the storks would remain white or grey in colour.

There is the remarkable spectacle of fireflies in the mangrove forests of Pornea. The fireflies come in thousands looking for the leaves of a mango tree which is called the ‘apple of the mangrove’. These trees are almost nearing extinction in Tamil Nadu. With its disappearance, the fireflies would never appear again.

Mumbai is a cosmopolitan city raised on the graves of mangrove forests. The same is the case with the Kadla port in Gujarat and Paradeep port in Odisha. There are several such evidences. Those who claim that these are compulsions of the times may not have heard of nature’s reaction or fury. Nature can manifest itself with a sudden unforeseen occurrence in the form of a tsunami which can in many cases never be predicted.

Ariyalur, which is today a town in the centre of the state of Tamil Nadu was once part of the sea and the town Pukar, once a major port in the world 2000 years ago, is now sleeping at the bottom of the sea. This can be a dire precursor to the coastal cities of India.

The worst case scenario
- Nights at the mangrove forests without the sparkle of the fireflies
- The East coast is full of Lead fish
- If the Bengal tiger becomes extinct, which will be the next national animal of India?
- It is not necessary to worship the mangroves as a deity as is being done in Andhra Pradesh and in Kenya. There can be a concerted effort to see that this precious legacy is not transformed into wastelands. Ken Saro Wiwa, Nigerian environmental activist sacrificed his life to save the mangrove forests in his country and there could be a beginning made here to embrace and conserve the mangrove forests.

Notes:
1. As far as prawns are concerned, there are two types, sea prawns and fresh water prawns. Out of this, the usage of prawn in English denotes only fresh water prawns. The ones living in the estuaries and the sea are to be called shrimps only.
2. When the Earth was formed it was one homogenous continent. It was called Benjia. Today, after a gap of between 51 crore and 18 crore years, this continent has split into two. To the North, it is called Lauresia and the Southern continent is named Gondwana.
3. Archean period is the ancient era when the universe was a hot ball and the period when it took the shape of the world as it is today. At that time, the surface of the Earth was three times hotter than it is today.

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