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Centre for Environmental Studies (CES)

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CLIMATE CHANGE IMPACT ON ALGAE & CORAL REEF ENVIRONMENT



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From the Director's Desk...



Odisha ENVIS Centre is always trying to bring out environmental issues those are most vital in the State in newsletters. We have covered many issues of environment of the State in our previous publications. The objective is to disseminate information to the users and bring awareness among the society and policy makers.

This time we are covering an issue of **Climate Change Impact on Algae and Coral Reef Environment**. I hope the information contained in the issue will be useful to users.

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Climate Change Impact on Algae and Coral Reef Environment

Climate change

There is consensus among climatologists that anthropogenic loading of the atmosphere with carbon-dioxides and other heat-dropping gases will alter the Earth's future climate in some way. Global warming will cause sea level to rise everywhere for two principal reasons: water expands as it is heated and the Antarctic and Greenland ice caps will melt faster than they do presently. Rising sea levels due to climate change require corals to grow to stay close enough to the surface to continue photosynthesis. Also water temperature changes will induce coral-bleaching as and killing many reefs. Warming seawater may also encourage an emerging problem: coral disease coral is much more prone to diseases including black band disease, white band disease and skeletal eroding band. If global temperature increases by 20C during the twenty-first century, corals may be able to adopt quickly enough. Further rise in global temperature by 4.2°C will result in an end to coral reefs.



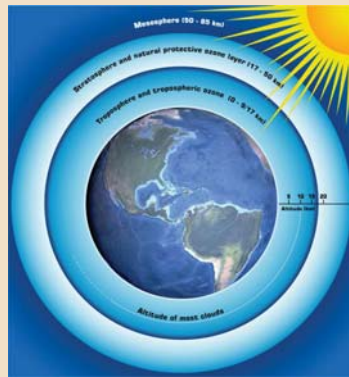
Global Issues of Depletion of Ozone Layer and Global Warming

The depletion of ozone layer and global warming is one of the major problems before the present generation. In order to understand the phenomenon of global warming and green house effect, it is necessary to know about the ozone layer and the role it plays in the protection of our planet.

Ozone Layer - Ozone (O_3) is a colourless gas, which is an allotropic form of oxygen (O_2). It has three atoms compared to oxygen. Ozone is produced by recombination of Oxygen under the influence of ultraviolet radiations from sun in the open layers of atmosphere. The Ozone formation occurs 16 km above the surface of the earth. It is mainly found in the stratosphere and extends from 12 km - 35 km. This part of the stratosphere, which is rich in Ozone is called Ozone sphere, Ozone umbrella or Ozone layer.

The presence of Ozone layer in the stratosphere forms a protective umbrella around the earth. It absorbs the harmful short wave ionizing ultraviolet (UV) radiations coming from the sun reach the surface of the earth then there would be no life on this planet. Thus ozone layer forms a protective umbrella around the earth and protects the entire living organism on the earth from the harmful effects of ultraviolet radiations

coming from the sun. In this way, Ozone layer acts as a great friend of mankind and all other living creatures. It also plays a crucial role in controlling the earth's atmosphere, wind pattern and rain etc.



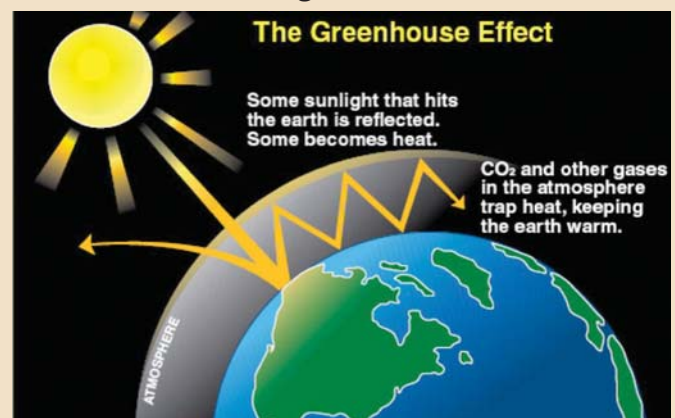
The high useful Ozone blanket in the upper atmosphere has been under threat by the wide range of human activities. In the year 1985, Farman and his team of scientists noted that gap or hole in Ozone layer exists over the Antarctica region on the earth. This is called Antarctica hole or Ozone hole. This depletion of ozone layer has many adverse effects. The ultraviolet rays, which were earlier almost completely blocked by this ozone layer, can now enter the earth's lower atmosphere to some extent through this ozone hole. This will increase gradually on the surface of the earth. As stated earlier, high level of ultraviolet radiations are harmful to nearly all forms of life.

One of the most important causes for formation of ozone hole and depletion of ozone layer is the use of chemical called aerosols like Fluoro-Carbons and Chlorofluorocarbons (CFCs) and nitrous oxide, which are depleting it by 14 percent and 35 percent respectively at the current emission rate. The Fluoro-Carbons are compounds containing Carbon, whereas Chlorofluorocarbons are compounds containing carbon, chlorine and fluorine. The Chlorofluorocarbons, which are used in spray and as refrigerants, react with them and Chlorine gas is released. This Chlorine gas reacts with ozone and destroys it. It is estimated that one atom of Chlorine may destroy over 5000 molecules of ozone per month. Similarly, the oxides of Sulphur and Nitrogen also eat the ozone molecules and destroy the ozone layer. The emissions produced by supersonic jet aeroplanes and nuclear explosions also cause the depletion

of ozone layer in the upper atmosphere. If no proper precaution is taken to control the release of Chlorofluorocarbons, then there is a danger that the entire ozone layer may deplete, allowing all the ultraviolet radiations to fall on the earth and thus destroying the very life on this planet.

Green House Effect

It has been discussed above that there is a protective layer of ozone in stratosphere, that is, in the upper part of the atmosphere. There is also blanket or layer of dioxide gas in the lower atmosphere. When the sun light consisting of ultraviolet rays, visible light and infra-rays fall on the top of the atmosphere, then first of all the harmful ultraviolet radiations are absorbed by the ozone layer. The visible and infra-red rays pass through the layer of carbon dioxide and fall on the surface of the earth. It must be noted that the infra-red rays coming from the sun are of short wave length and they pass through the layer of carbon dioxide easily. The infra-red rays have the unique heating effect in them, so they heat the earth and various objects on the surface of the earth. Since the earth and its objects become hot, they also start emitting heat rays or infra-red rays. These infrared-rays cannot escape out from the carbon dioxide gas in the atmosphere, which absorbs all the infra red rays or heat rays in the atmosphere of the earth is heated up. This heating up of the atmosphere of the earth due to trapping of infra-red rays of long wave length by the carbon dioxide layer in the atmosphere is called green house effect. Thus green house effect is the



progressive warming up of the earth's surface due to blanketing effect of carbon dioxide in the atmosphere. It is mainly the carbon dioxide which is responsible for causing the green house effect. It is estimated that 72 percent of the global warming is contributed by carbon dioxide, whereas, methane is responsible to the extent of 18 percent for causing global warming.

It has been observed that there is a rise in carbon dioxide concentration from 275 ppm, 100 years ago to 350 ppm present. It is also estimated to rise further to 450 ppm by the year 2040. This rise in carbon dioxide concentration will considerably increase the temperature of earth and its atmosphere. In fact, we have already started feeling the effect of global warming. The present generation is nothing the considerable change in the weather conditions. The winters are delayed. The summer comes early and stays for a longer period. As per the findings of the UN Intergovernmental Panel on Climate Change (IPCC), over the 20th century, the global average surface temperature has increased by about 0.6 degree C, more than earlier estimated to 1994. This appears to be the largest increase in any of the last ten years. Globally 1990 was the warmest decade and 1998, the warmest year recorded since 1861. Since the 1950's, the lower part of the atmosphere has warmed at about 0.1 degrees C per decade, as snow and ice cover have decreased to extent by about 10 percent and Arctic sea's ice thickness has decreased more than this. The carbon dioxide has now increased 31 percent since 1750. The methane concentration in the atmosphere has increased 150 percent since 1750 and contributes a fifth of the warming effect.

The global warming has following effects.

↳ The global warming can lead to the melting of ice peaks and thereby leading to rise in the sea level. Thus there is a threat to the coastal cities like Mumbai, Chennai and Kolkata etc. of being submerged under water.

↳ Global warming may change the rainfall pattern, which may affect the agricultural outputs in the various regions of the world.

↳ Global warming will bring about major changes in the water distribution and have impact on water resources. The flow of water in streams located in high altitudes and south East Asia will increase while it will decrease in Central Asia, Southern Africa, Australia and the Mediterranean.

↳ The rise in temperature due to global warming may lead to the death of micro organisms like phytoplankton and bacteria and thus ecosystems will be disturbed.

The global warming will also have socioeconomic impacts. Many economic sectors, particularly physical infrastructure will be affected by the climate change. The flooding and landslide will result in a large scale human migration. This will adversely affect the living conditions in other human settlements.

Coral reefs:

A coral reef is an organically constructed, wave-resistant rock structure created by carbonate-secreting animals and plants. The biodiversity and tropic dynamics of a reef ecosystem are so distinctive and spectacular that they deserve serious consideration. Accordingly these corals reefs are resilient ecosystems that support an incredible diversity of marine life. Their fish population feed many people, they are important for tourism and their hard limestone structure acts as a natural storm barrier that protects the nearby shoreline from wave erosion.



Recently scientists have been alarmed by a disturbing trend. Perhaps, as much as 30 percent of the world's reefs have been seriously damaged or killed outright. Locally, reef decline is an even more serious problem, as for example, in Jamaica and Costa Rica, where 90 percent of coral reefs are now dead. What factors are responsible for this global devastation ?

Biology of corals:

The vast bulk of coral reef consists of the build-up of loose to well cemented organic debris-fragments of Shell and Skeleton- composed of calcium carbonate (CaCO_3). In rock form, it is referred to as limestone. The living part of the reef is mainly a near growing on the surface of massive limestone deposits that record the existence of ancient reef communities. In effect, the thick limestone base is covered by a thin living 'skin' when coral and other carbonate secreting organisms in the reef mass grow in size over geologic time.

Corals are animals with a rather simple anatomical design that belongs to the Phylum Cnidaria and the class Anthozoa. The coral animal itself consists of a polyp, the body of the living organism that is housed for protection in a rigid calcium-carbonate exoskeleton called a Corallite. The bottom of the Corallites is divided in to compartment by vertical partition known as septa. The polyp resembles a cup or sac, with an opening at the top that is combined mouth and anus and that leads to the gut. The opening is surrounded by tentacles that may have stinging mucus-secreting cells for catching prey. Polyps live either as solitary individuals or in a colony. The colonial forms are what create the massive skeletal frameworks of coral reef.

Ocean Algae in Coral environment:

Most photosynthesis in the marine wetlands is accomplished by the diatoms and dinoflagellates of marine microalgae. A measure of the great abundance of marine phytoplanktons, each

individual of which is no larger than the smallest dust mole that can be seen in a bright ray of sunshine, is provided by the bioluminescent species of dinoflagellates. These cells emit a brilliant white flash of light that lasts for less than a second. Sparkling breakers crashing on a reef or shore on an overcast night in late summer provide a breathtaking sight. Dinoflagellates left on the beach by a wave light up again when new waves stroke them. People walking on the wet sand leave glowing footprints behind. The bodies of swimmers glow brightly, often in various hues. Some species can even metabolize petroleum. Large clusters of them are used to help clean up oil spills.

Threats to coral Reefs

Bio-invasion on corals:

Invasive species invade, colonize and destabilize eco-systems in new geographical location, which are not their native habitats. Such bio-invasion is usually prohibited by quarantine procedures, but may happen either accidentally or intentionally because of human being for definite purposes. These invasive species are the greatest and significant threat to marine biodiversity, marine derived bio-resources and corals. India has recorded 14 invasive species, including four species of macro-algae in her marine territories. Such invasion could specifically destroy the branching corals which have already reduced to minimum live cover due to other factors. It may also adversely affect other native marine communities (Sea grasses, coral reefs and fishes) either directly or indirectly.

Over-fishing:

Coral reefs are among the richest and most diverse fishing grounds in the oceans. A variety of non-sustainable techniques are used to kill or capture fish that live in reefs. These include trawling the reefs, blasting fish with dynamite and poisoning them with sodium cyanide which involves spraying or dumping cyanide on to reefs

to stun and captive fish. Most of these methods kill organisms indiscriminately and often seriously damage the reef edifice or disturb ecological relationships that affect the reef's health. Exposure of corals to cyanide can result in a reduction or cessation of respiration.

Bleaching:

Bleaching due to global warming is also responsible for affecting coral reef ecosystems. Corals are intolerant of elevated temperatures and respond by ejecting the phytoplankton, the zooxanthellae, which live in their tissue and are responsible for the polyp's variegated colours. The bleaching event causes the corals to go "white".

Pesticides and chemicals:

The agricultural leakages, pesticides and fertilizers ultimately find their way by rivers to the coastal waters, where they can have a serious impact in a variety of ways. On the health of coral reefs the nutrient input causes eutrophication and algal blooms, which kills corals. These dangerous chemicals interfere with growth and reproduction of organisms.

Industrial effluents:

These are a variety of industrial substances that have an impact on coral reefs. Heavy metals toxic manufacturing compounds and leachates from landfills are examples of harmful chemicals that are regularly injected in to coastal water by river input. These can cause extensive die-offs of corals.

Coastal development and tourism:

The climate and beauty of tropical coastline attract many people. Tourism is growing exponentially, much of it occurring pristine tropical reefs. The impact of many people living or visiting reefs can equally overwhelm and destroy coral ecosystems.

Environmental issues with Coral reefs

Marine pollution and Coral reefs

Coastal environments constitute a critical national and global resource that suffers wide

spread degradation due to human impact. Reefs in close proximity to human population are subject to poor water quality from land and marine based sources while corals from magnificent wave breaking shields in the shallow waters, it is the sandy areas that afford the next protective barrier but no more. According to a coast conservation department (CCD) survey, some million tons of sand are lost due to sand mining.

Protection of coral reefs:

Coral mining activities in the southern and eastern coasts in the late 1960s caused much damage to living reefs. Although it was banned since 1984, it continues to thrive in the south. Corals are mined to serve as a primary construction material. Coral lime is also a sought-after component of local construction material and reefs are broken to make lime, coastline jewellery and to be sold as souvenirs. The industry has left a trail of destruction with filling, degrading and contaminated pits damaging the coast. Trips to coral reefs have also caused considerable physical damage due to bed abrasions and collisions, chipping off reefs. The world famous Buena Vista reef in the resort area of Hikkaduwa, 62 km south of Colombo has been severely defaced. Most other exotic reefs were severely beached in the 1998 El Nino. A single kg of coral sells for Rs. 10,000 making it a lucrative industry. Following the ban, the penalty for coral mining is a hefty (Rs 10,000-20,000) and under section 31(a) of the coast conservation act, offenders could also be jailed for two to five years.



steps to be taken how to reconstruct the manmade barriers and fortify the natural ecosystems to protect the coral reef ecosystem. New engineering techniques should be prepared in the coastal areas to suit extreme condition, an aspect, overlooked before. The new constructions will be designed to withstand extreme calamities for proper coral reef habitat management and their protection. Pollution can smother coral reefs lower water quality and make corals more susceptible to disease. coral reefs need clean, clear water to survive, when sediment and other pollutants enter the water, they smother coral reefs, spread the growth of damaging algae and lower water quality.

The Great Barrier Reef:

In the 21st century the Great Barrier Reef (GBR), a thriving limestone complex stretched out for more than 2,300 kilometers along the northeast coast of Queensland is a natural marvel of 'Universal value' which UNESCO duly recognized as a world Heritage site in 1981. GBR is remarkably resilient to some environmental disturbances, such as storm waves but they are highly susceptible to small changes in water temperature, even a slight 0.50C - 1.00C increase over the ambient temperature of the water can stress corals by stimulating high rate of photosynthesis among these zooxanthallae such that cellular oxygen levels build up to toxic levels.

As bleaching events and acidification affect corals over the next century, the reef edifice itself will next disappear. Rather reef-building coral will be uncommon or wiped out entirely and replaced by opportunist species. Such a radical transformation of the base of the food web, of course will transform the ecological relationships and trophic functions of reefs.

Steps to be taken:

The management response to ongoing bleaching events of corals need to be communicated to communities, industries and

policy officials that are invested on the health of the GBR and coral reefs elsewhere. The implementation of the discussion taken in COP21 International Summit at Paris, requires to raise a campaign that encourages people and industries to reduce green house gas emission so that anthropogenic increase in levels of atmospheric CO₂ for the next few centuries are minimized as much as possibilities. Finally, the concerned efforts at reducing other stress factors nutrient pollution by agricultural runoff, freshwater flooding, sediment input, overfishing coastal development and excessive tourism can help to sustain the innate resilience of the coral reefs to global climate change.

Awareness should be created for implication of the following Ecosystem services:

1. Capture of solar energy and conversion in to biomass, which is used for food, building materials, and fuel;
2. Decomposition of wastes such as sewage
3. Regeneration of nutrients in forms essential to plant growth (e.g., nitrogen fixation)
4. Storage, purification and distribution of water (e.g., flood control, drinking water purification and transportation)
5. Generation and maintenance of soils
6. Control of pests by insectivorous animals such as birds, bats and insects
7. Provision of a genetic library for development of new foods and drugs by means of both Mendelian genetics and bioengineering.
8. Maintenance of breathable air
9. Control of both micro-and macro climate
10. Provision of buffering capacity for adapting to changes to recover from natural stresses such as flood, fire and pestilence
11. Pollination of plants, including agricultural crops by insects, bats and other pollinators
12. Aesthetic enrichment from vistas, recreation and inspiration.

Celebration of 61th National Wildlife Week on 09.10.2015

Odisha ENVIS Centre, Centre for Environmental Studies(CES), Bhubaneswar organized an awareness meeting on the occasion of the 61th Wildlife Week on 09.10.2015 at 10.30 AM in the conference hall of Orissa Environment Society, Bhubaneswar. The wildlife week is celebrated in India every year from 2nd October, coinciding with the birth day of Mahatma Gandhi.

The theme of 2015 is "Living with Wildlife".

Wildlife Week is dedicated to create awareness to the general people towards the wildlife preservation or by doing some special activities connected with the wildlife conservation.

Dr. S.N. Patro, President, Orissa Environment Society inaugurated this program and he emphasized to protecting and conserving the wildlife in our state and their habitats. Dr. Sailabala Padhi, Director-cum-ENVIS Coordinator told that we must be aware towards the noble cause of this week and we should take care of our nature properly. Sri Pravat Mohan Dash, Programme Officer told about the theme and importance of the wildlife conservation. During the function an ENVIS Newsletter on "Honeybees for Safer Environment" was released by the Guests. A large number of Bhubaneswar based NGO Representatives, Environmentalists, School Teachers, Nature Lovers attended the programme and shared their ideas on this occasion.



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