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# ENVIRONMENTAL ISSUES : LOCAL, REGIONAL AND GLOBAL ENVIRONMENTAL ISSUES

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**Abstract**

Human activities in past decades have raised serious issues related to environment and its conservation. Air pollution, poor management of its waste, growing water scarcity, falling ground water tables, water pollution, waste disposal, desertification, endangered species, preservation and quality of forest, biodiversity loss, and land/soil degradation, Global Climate change, pollution, environmental degradation, Global Warming, Greenhouse effect, Acidification, Ozone depletion and other local, regional and global level environmental problems and genetically modified foods are the current environment problem that make us vulnerable to disasters and tragedies now and in the future. In this chapter the essential aspects of environmental problems, causes, effects will be reviewed and some solution to overcome from the environmental issues.

**What is Environment?**

The word environment refers to all ecological units which are naturally present on earth in the form of land, water, air, soil, forest, sunlight, minerals, living organisms etc. This earth is full of natural surroundings, some are biotic and some are non- biotic. Biotic element are those elements like human, birds, animals, plants, and microorganisms. Whereas non-biotic elements are those which have no life like air, sunlight, water, land, soil, minerals etc. further it is also divided among four different sphere viz. biospheres, lithosphere, atmosphere and hydrosphere. In which hydrosphere is the largest part on the earth among all life on earth has become possible due to some kind of action and reactions between different kinds of resources that are present in environment.

Currently, the situation of environment is very poor that could never be imagine by our ancestor in previous time. We have endlessly spoil our environment by using its resources in very wrong way. We can see that every day and everywhere pollution is rapidly increasing on earth where it is air, land, water or soil pollution, deforestation, acid rain, and other dangerous disasters created by the human beings through technological advancement. Use of natural resources should be carefully planned and executed. For providing a better and healthy life to our forth coming generation.

**Environmental issues**

An environmental problem occurs when there comes a change in quality or the quantity of the environmental factor that directly or indirectly affect everything on earth. "***Environmental issues are defined as problems with the planet's system (air, water, soil etc.) that have developed as a result of human interference or mistreatment of the planet."***

A variety of environmental problems now affect our entire world. As globalization continues and the earth's natural processes transform local problems into international issues. Some largest problems now affecting the world are: acid rain, air pollution, global warming, hazardous wastes, ozone depilation, smog, water pollution, overpopulation and rain forest destruction. It is related to not only environment bur with everyone that live in the planet. It effect every human, animal, and nation on this planet.

Human have faced poor environmental conditions throughout history, but what we think of as environmental problems become more common and apparent with industrialization and urbanization. In the United State for the example, air and water pollution from the factories and dense urban living conditions attracted growing attention throughout the last centuries, and by the **1960s** become recognized as significant problems. Concern over air and water pollution rapidly spread to a range of other conditions-

soil erosion, pesticides contamination, deforestation, declining animal population and species and so on through the efforts of environmental scientist, activists, and policy-makers. These diverse concerns gradually merged into environmental problems, and the **1970 Earth Day** in **United States** and then the **1972 United Nation Conference** on the **Human Environment** in Stockholm helped turn "Environmental Quality" into a major international issue. By the time of the **United Nation Conference on Environment and Development** in **Rio De Janeiro in 1992**, significant **"Green Parties"** had been formed in Europe and environmental problems were the subject of citizen and governmental attention worldwide. Environmentalist, a social and environmental movement addresses environmental issues through advocacy, education and activism. The environmental issues can occurs at three levels local, regional and global.

**Local environmental issues-**Some major local environmental issues are given below-

1. Pollution
2. Waste Disposal
3. Desertification
4. Water Scarcity
5. Endangered Species

### 1. Pollution

Pollution can be defined as an undesirable addition of constituents to water, land, or air which adversely affect human life, species, living conditions and will deteriorate our resources. Pollution can be classified mainly into four categories- air pollution, water pollution, soil pollution, noise pollution. The pollution is occurs at the local and also global level.

**Air pollution:**

Air pollution is refers to any physical, chemical and biological change in the air. It is the contamination of air by harmful gases, dust and smoke which affect the plant, animals, and human drastically. There is a certain percentage of gases present in the atmosphere.

**Major air pollutants their sources and their impact:**

- **Carbon monoxide (CO)**: its main source is fuel combination from engines and vehicles. It reduces the amount of oxygen, aggravate heart disease, chest pain.
- **Lead (Pb):** it release from metal refineries and other metal industries, waste incinerators. It impacts on our nervous system, result in IQ loss, cardiovascular and renal effects in adult, effects related to anemia.
- **Nitrogen oxide:** it release in environment due to fuel combustion, wood burning. It's mainly impact our lung, lung diseases leading to respiratory symptoms increases susceptibility to respiratory infection.
- **Sulphur dioxide ($SO_2$)**: it release due to fuel combustion as well as natural occurrences like volcanoes. It causes asthma and breathing difficulty.

**Air pollution control:**

The techniques employed to reduce or eliminate the emission into the atmosphere of substances that can harm the environment or human health. Different types of method use for the air pollution control –

**Control of particulates**- airborne particles can be removed form a polluted airstream by a variety of physical process. Some common types of equipment for collecting fine particulates includes cyclones, scrubbers, electrostatic precipitators, and baghouse filters. Once collected, particulates adhere to each other, forming agglomerates that can readily be removed form equipment and disposed of, usually in landfill.

**Control of gases**- gaseous criteria pollutants, as well as volatile organic compounds (VOCs) and other gaseous air toxics, are controlled by means of three basic techniques: absorption, adsorption and incineration. These techniques can be employed singly or in combination. They are effective against the major greenhouse gases as well. In addition, a fourth technique, known as carbon sequestration, is in development as a mean of controlling carbon dioxide levels.

**b) Water pollution**

Water pollution is the contamination of pollutants in water bodies like lakes, rivers, oceans, aquifers and groundwater without treatment very often by human activities which leads to harmful effects.

**Source of water pollution:**

**Natural sources:** these includes decay, the composition of plants and animals, volcanic eruptions, coastal, cliff erosion, landslides and soil erosion.

**Anthropogenic sources:** this include industry, urban, agricultural and cultural sources.

**Effect of water pollution:**

- Death of aquatic animals.
- Irrigation by polluted water affect plants resulting in yellowish coloration and defoliation.
- Diseases- hepatitis, cholera, typhoid, jaundice, diarrhea and skin diseases.
- Disruption of food chains. Destruction of ecosystems.

**Control measure of water pollution:**water pollution, to a larger extent, can be controlled by a variety of methods. Rather than releasing sewage waste in water bodies, it is better to treat them before discharge. Practicing this can reduce the initial toxicity and the remaining substances can be degraded by the water bodies itself. If the secondary treatment of water has been carried out, than this can be reused in sanitary systems and agricultural fields.

Some chemical methods that helpin the control of water pollution are precipitation, the ion exchange process, reverse osmosis and coagulation. As an individual, reusing, reducing, and recycling wherever possible will advance a long way in overcoming the effects of water pollution.

**2. Waste Disposal**

Waste disposal, the collection, processing, and recycling or deposition of waste material of human society. Waste is classified by source and composition. Waste materials are either liquid or solid in form, and their components may be either hazardous or inert in their effects on health and environment. We used plastic bag, broken glass, obsolete cell phone, or used battery cells, they are all used products that require appropriate disposal to limit their harm to the environment. The term waste is typically applied to solid waste, sewage, hazardous waste, and electronic waste.

**Sources of waste:**

- **Medical or clinical sources of wastes-** this includes the surgical items, pharmaceuticals, blood, body parts, would dressing materials, needles, syringes.
- **Agricultural sources of wastes-** waste generated by agricultural activities, including horticulture, livestock breeding, market gardens and seedling nurseries are called agricultural wastes.
- **Industrial sources of wastes-** these are the wastes released from manufacturing and processing industries like chemical plants, cement factories, power plants, textile industries, petroleum industries.
- **Wastes from construction or demolition-** concrete debris, wood, huge package boxes. Some other sources such as Commercial sources, mining sources, radioactive sources, electronic sources are also the big sources of waste pollution.

**Waste disposal problems:**

- **Production of too much waste-** one of the major problem related to disposal is attribute to the generation of too much waste. Mumbai and Delhi generate about 11,000 and 8,700 tones of solid waste per day, respectively. India is getting buried under mounds of garbage as the country has been generated more than 1.50 lakh metric tone of solid waste every day. Worse approximately 90 per cent of the total amount is collected waste.
- **Most of the waste is toxic and harmful for the human beings and the environment-** the majority of the state and local authority legislations are generally lax on regulating the even expending manufacturing industries produce toxic products that end up getting thrown away after use. Most of the products contain hazardous and health threatening chemicals. This chemicals causes majority of water pollution, soil pollution.
- **Landfill are a problem as well-** most landfills lack proper on site waste management there by contributing to additional threats to the environment. In long term, landfills leak and pollute ground water and other neighboring environment habitat making waste disposal very difficult. They also give off potentially unsafe gases.
- **Reliance of dying technologies to reduce and recycling waste-** waste disposal and management facilities as well as state

resources have continued to rely on myopic and quickie solutions instead of developing effective recycling and waste reduction programs.

**Solution to Waste Disposal:**

- **Eco responsibility** –"reduce, reuse, recycle"- Eco-responsibility pertains to the three Rs mantra of reuse, reduce and recycle. Local communities authorities and state need to put more efforts towards the education of waste management.
- **Effective waste disposal and management-** it ensures there is gradual improvement of new and cost- effective facilities which aim to encourage higher environmental protection standards. An effective management strategy will also see to it that landfills are purposefully located to ease waste collection, transfer, and monitoring or recycling.
- **Control and monitoring of land filling and fly-**tipping activities- thousand of tones of construction and demolition materials are generated by various local construction industries. In most of case, a large portion of these waste materials can be re used, reclaimed or recycled. With the control and monitoring of land filling and fly- tipping activities in the area of public work, constructions and demolition materials an be resourcefully reclaimed, reused or recycled in other projects such as landscaping, village houses, recreation facilities or car parks, or roads.
- **Waste diversion plans-** A multifaceted approach on waste transfer and diversion in terms of more hygienic and efficient waste disposal management can offer tremendous solution to waste problems.
- **Improvement of thermal waste treatment-**thermal waste treatment have been proved not to be 100% green as they are normally pronounced. Therefore, to mitigate the problems that come with thermal waste treatments issues such as emission of toxic gases with organic compounds such as furans, PAHs, and dioxins: states and researches as well as green groups and academicians can explore the possible developments with regards to advanced thermal waste treatment techniques.

**3. Desertification** –

Desertification is a type of land degradation in dry lands in which biological productivity is lost due to natural processes or induced by human activities where by fertile areas become increasingly more arid. It is the spread of arid areas caused by a variety of factors, such as through climate change and through the overexploitation of soil through human activity.

**Various causes of desertification-**

- **Overgrazing** – if there are too much animals that that are overgrazing in certain spots it makes it difficult for the plant grow back, which hunts the biome and make it loss its former green glory.
- **Deforestation-** wood extraction, and infrastructure expansion such as road building and urbanization, then it contributing to problems related to desertification. Without the tree rest of the biome cannot thrive.
- **Farming practice-** some farmers do not know how to use the land effectively. They may essentially strips the land of everything that it has before moving the another plot of land. By stripping the soil of its nutrients, desertification becomes more of a reality for the area that is being used for the farming.
- **Excessive use of fertilizers and pesticides-** the use of excessive amount of fertilizer and pesticides to maximize to their crop yields in the short term often lead to significant damages for the soil. In the long run, this may turn from arable into arid land over time and not suitable for the farming.
- **Over drafting of groundwater-** over drafting is a process in which groundwater ids extracted in excess of the equilibrium yield of the aquifer that is pumping or the excessive pulling up of groundwater from underground aquifers. Its depletion causes desertification.
- **Climate change-** climate change play a huge role in desertification. As the days get warmer and periods of drought become more frequent, desertification becomes more and more eminent. Unless climate change is slowed down, huge areas of land will become desert.
- There are also some reason such as natural disasters, soil pollution, overpopulation and excessive consumptions, mining etc. causes desertification.

**Effects of desertification-**

- **Farming become next to impossible-**an area become desert than it's impossible to grow sustainable crops there without special technologies. This can cost a lot of money to try and do, so many farmer will have to sell their desert land. Hunger is

also a problem, without farms in this area the food that this farm produce will become much scarcer, and people try and deal with hunger problems.

- **Flooding-** without life in an area, flooding is a lot more imminent. Not all desert are dry; those that are wet could experience a lot of flooding because there is nothing to stop the water from gathering and going all over the place.
- **Biodiversity loss, endangerment and extinction of species-** the destruction of habitats and desertification may also contribute to a loss of biodiversity. Many species will not to able adjust to the altered environmental conditions and may suffer from serious decline in population.
- **Migration-** when large areas of land that are currently used for farming will no longer be suitable for farming due to water triggered by global warming. This results in serious migration movements.

**Solution to desertification:**

- **Policy changes related to how people can farm-**policy change related to how much they can farm and how much they can farm on a certain areas could be put into place to help reduce the problems that are often associated with farming and desertification.
- **Education-** in developing countries, education is an incredibly important tool that needs to be utilized in order to help people to understand the best way to use the land that they are farming on. By educating them on sustainable practices, more land will be save from becoming desert. Sustainable practice to prevent desertification from happening.
- **Technology advances-**research and application of the latest technology that pushes the limit of what we currently know about the drivers of desertification.
- **Restricting mining practice-** mining often implies the destruction of large area of land. Therefore it should be regulated by governments to keep the nature reserves intact and protect the natural habitats of many animals and plants. Thus, less land will arid and the desertification issues can be mitigated to a certain extent.
- **Reforestation-** the area that have been subject to deforestation in past should be considered for reforestation. Planting trees in those areas are quite important since they are natural carbon dioxide storage spaces; they slow down the global warming and contribute to maintaining a natural balance. Therefore, planting trees in the affected areas not only prevents desertification but also fight against additional environmental issues.

**4. Water Scarcity**

Water scarcity involves water crisis, water shortage, water deficit or water stress. Water scarcity can be due to physical water scarcity and economic water scarcity. Physical water scarcity refers to a situation where natural water resources are unable to meet a region's demand while economic water scarcity is a results of poor water management resources.

*"Water scarcity is the lack of sufficient available water resources to meet the demands of water usage within a region. It already 2.8 billion people around the world at least one month out of every year. More than 1.2 billion people lack access to clean drinking water."*

**Causes of water scarcity :**

- **Overuse of water-**water overuse is a huge issue that a lot of people are dealing with. It may be overused on people, animals, land or many other numbers of things.
- **Pollution of water-**water pollution can come from a variety of sources. Pollution comes from oil, carcasses, to chemicals, industrial wastes, and from municipality waste makes a lot of issues for people who may need to use it.
- **Global warming-** when our average air temperature become warmer, water from rivers and lakes evaporates faster, which may contribute to drying up of water bodies.
- **Illegal dumping-** industries frequently dispose of their industrial garbage into near by river and lakes since it is an easy and cheap way to get rid of this waste. It leads to serious water pollution, which may result in several water scarcity for their local people.
- **Natural disasters-** Natural disasters like tsunamis, floods may also cause serve water shortages for local population since important public infrastructure may be destroyed. The serve natural disaster may entirely collapse the local water supply.
- **Drought-** A drought is, in short, an area especially hot and dry, which is not getting enough rainfall to be able to sustain the

life that is residing there. Some areas are in a perpetual drought, whereas other areas may be dealing with a drought on occasion.

**Effects of water scarcity:**

- **Lack of access to drinking water-** the biggest problem that happens when you have water scarcity is that people are not able to get fresh, clean drinking water.
- **Hunger and poverty-** if there is no water that can be used to help water the crops, then you are going hungry. People who are dealing with water scarcity are often stuck in poverty as well .
- **Diseases and sanitation issues-** if we don't have clean water access than we will be more likely to get disease from the water .we need water for several tasks of our daily life, without having access to clean water for drinking, cooking, washing or bathing, it usually results in unhygienic conditions for people and causes diseases like diarrhoea, typhoid, cholera etc.
- **Destruction of habitats and loss of biodiversity-**water is crucial for all life forms on our planet. If water scarcity persists over a longer period, it lead to the destruction of whole habitats. Animals and plants may no longer be able to get enough water and may therefore die or have to move to other regions. Some animals become extinct they no longer be able to grow and reproduce in a sufficient manner causing serious biodiversity loss.

**Solutions to control water scarcity:**

- **Save water whenever possible**- this could mean limiting the use of water, the use of washing machines, taking shorts showers instead of full baths. Even if you are no vacation in countries where water is scare, try to save water. You should also try to convince your family and friends to save water.
- **Recycle water-** there are plenty of technologies available that allow you to recycle rainwater and other water that you may used in your home. Not only does it help to prevent scarcity, but it can save some money as well. Advance technology use to conserve water.
- **Improve practices related to farming-** farming and irrigation are often a huge culprit when it comes to water scarcity. Because of that, we need to improve practices so that we don't use as much water and those who are using water are using it to fullest potential.
- **Less use of chemical in farming-** At present, excessive levels of chemical fertilizers and pesticides are used to maximize crop yields. It leads to serious soil pollution, which in turn translates into groundwater pollution and contributes to the water scarcity issue. It is crucial that farmers reduce the use of chemicals for farming to ensure clean water and reduced water shortage problem.
- **Improve sewage systems-** clean drinking water stars with a good sewage system. Without proper sanitation, the water in an area becomes ridden with disease and any number of other problems. By improving the sewage systems, we can prevent water scarcity from becoming any worse.
- **Better water distribution infrastructure-** many people worldwide, especially in poor developing countries, are still not connected to the public water infrastructure. These people are at high risk to suffer from severe water shortages. By cone ting this people to the public water supply, water scarcity risk could be greatly reduced.
- **Education-** by educating those who are not dealing with it can get educated on how they can prevent the problem from becoming even worse in the future.

**5. Endangered species-**

An endangered species can be define as species that is very likely to be extinct in near future. The number of endangered species has dramatically risen over time. As of 2020, there are 6,811 species that are considered to be critically endangered. This is out of the 120,372 species currently tracked by the IUCN. If the number of endangered species is continuously increased we will loss many species in the future. To prevent this, governments and other institutions all over the world try to save the endangered species by measures by creating protected areas or forbidding hunting.

**Classifications of endangered species:**

**a)** **Least concern-** there is no immediate threat to the survival of the species.

**E.g.** saltwater crocodile, olive baboon, brown bear, cane toad, rock pigeon.

**b)** **Near threatened-** species in this category might be threatened in the near future.

**E.g.** emperor goose, American bison, mane wolf.

c) **Vulnerable-** high risk of endangerment in the medium run.

**E.g.** African leopard, carp, cheetah, golden hamster, blue crane.

d) **Endangered-** high risk of extinction in the near future.

**E.g.** African penguin, Bengal tiger, blue whale, giant otter, gray parrot.

e) **Critically endangered-** extremely high risk of extinction in the very near future.

**E.g.** Arabian leopard, Asiatic cheetah, axolotl, black rhino.

f) **Extinct in the wild-** already extinct in their natural environments, but there are some individuals who live in a captive state.

**E.g.** Guam rail, Hawaiian crow, scimitar oryx, Socorro dove, south china tiger.

g) **Extinct-** there is not a single living individual of this species left on the planet.

**E.g.** Blackfin cisco, Caspian tiger, eastern cougar, dodo, great auk, java tiger, toolache wallaby.

**Causes for endangered species:**

- **Destruction of habitats-** many animals and plants which lived in untouched nature are now adversely influences by human behavior since their natural environments are altered or even destroyed. Thus many animals and plants have to took out for new homes or they will be in danger of becoming extinct.
- **Hunting-** illegal hunting and poaching still is a big problem and can cause the extinction of whole species. since people are greedy and often want to make as much money as possible, theykill animals just to get their precious parts like their ivory or fur.
- **Pollution-** water pollution air pollution acid rain and other kind of pollution can harm many species in an extremely adverse way. If they are not adopt to the higher levels of pollution, they will be danger and die out.
- **Insufficient reproduction rate-**some species are quite eager to reproduce, others are just lazy to do so. Especially for animals that have a low reproduction rate, this cause big problems since they may likely not be able to sustain their species.
- **Disease-** not only do people suffer from epidemic diseases, also animal can be adversely affected. Disease like Ebola can cause thousands of deaths among certain species like monkeys and therefore diminish their numbers.
- **Degree of specialization-** highly specialized animals or plants are more likely to become endangered or extinct since they are not flexible at all in their conditions.
- **Conflicts between wildlife and humans**- since our world population is growing, we need more and more settlement space in order to build houses and other infrastructure. To gain this settlement space, it is often necessary to cut down forests or invade other habitats that are currently used by animals. These animals will lose their living space, which may force to move to other areas.

**Effect of endangered species:**

- **Biodiversity and chain reactions-**since nature is a big system in which species depend upon each other and function as a whole, the extinction of a small number of animals or plants can cause chain reactions to the whole ecosystem and thus have a big effect on the environment. For example, if a species A which eats another species B goes extinct, the number of species B would increase dramatically. Since species B will also eat other species C, species C now be endangered.This circle continues and will often have profound effects on the ecosystem.
- **Diseases-** some animals can serve as buffers between pathogens and humans. Animals can thus lower the probability that human get infected by certain diseases. Thus, if species become extinct, this buffer is lost and humans can be more likely hit by diseases.
- **Decrease in crop yields-** since insect like bees play important role in the crop growing process, losing this species would be extremely harmful to the crop yields of farmers and could also cause global famine.
- **Loss of medical sources-** many components that are contained in drugs are extracted from plants. If these plants become endangered or even extinct, we will not be able to use the plant ingredients for medical purposes anymore.
- **Economic effects-**animal often are popular attraction for tourists. Countries that can provide these animals can often make

significant amounts of money with touristic activities. However, if certain animal species become extinct, these countries will suffer from serve adverse economic effects since tourists may not come to their countries anymore after the animals vanished.

**Solution to save endangered species:**

- The endangered species act (ESA), passed in 1973, was enacted to half the rapid loss of plant and animal life. Frequently referred to as the "crown jewel" of our nation's environmental laws, the ESA has been responsible for saving many species formerly on the brink of extinction, including the bald eagle, gray wolf and California sea otter.
- Learn about endangered species in your area. Teach your friends and family about the wonderful wildlife, animals plants. First step to protecting endangered species is learning about how interesting and important they are.
- Recycle and buy sustainable products- buy recycle paper, sustainable products like bamboo and Forest Stewardship Council wood products to protect forest species. Never purchase products made from threatened or endangered species.
- Herbicides and pesticides may keep yards looking nice but they are in fact hazardous pollutants that effect wildlife at many levels.
- Harassing wildlife is cruel and illegal shooing, trapping, or forcing a threatened or endangered animal into captivity is also illegal and can lead to their extinction. Don't participate in this activity.

**Regional and Global environmental issues -** there some regional and global environmental issues are given below:

**1.** Global Warming

**2.** Ocean acidification

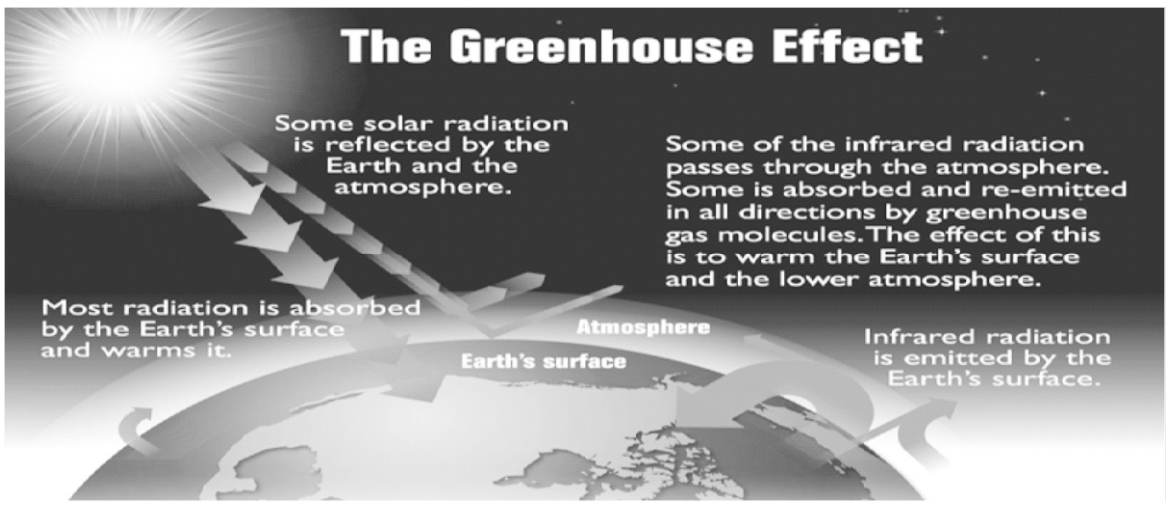
**3.** Pollution

**4.** Acid rain

**5.** Ozone depletion

**1. Global Warming**

Global Warming is the unusually rapid increase in earth's average temperature over the past century primarily due to the greenhouse gases released by people burning fossil fuels. Global warming occurs when carbon dioxide (CO2) and other air pollutants and greenhouse gases collect in the atmosphere and absorb sunlight and solar radiation that have bounced off the earth's surface. Normally, this radiation would escape into space—but these pollutants, which can last for years to centuries in the atmosphere, trap the heat and cause the planet to get hotter. That's what's known as the greenhouse effect.




**Causes Global Warming**

**Causes of global warming-**The issues that cause global warming are divided into two categories include "natural" and "human influences" of global warming.

**Natural cause of global warming-**

- The climate has continuously changing for centuries. The global warming happens because the natural rotation of the sun that changes the intensity of sunlight and moving closer to the earth.
- Another cause of global warming is greenhouse gases. Greenhouse gases are carbon monoxide and sulphur dioxide it trap the solar heats rays and prevent it from escaping from the surface of the earth. This has cause the temperature of the earth increase.
- Volcanic eruptions are another issue that causes global warming. For instance, a single volcanic eruption will release amount of carbon dioxide and ash to the atmosphere..
- Methane is another issue that causes global warming. Methane is also a greenhouse gas.

**Human activity influences global warming:**

- First issue is industrial revolution. Industrial have been using fossil fuels for power machines. Everything that we use is involved in fossil fuel. For example, when we buy a mobile phone, the process of making mobile phone have involve machines and machines uses fossil fuels, during the process carbon dioxide is releasing to the atmosphere. Besides industrial, transportation such as cars is also releasing carbon dioxide from exhaust.
- Another issue is mining. During the process of mining, the methane will trap below the earth. Besides, rearing cattle will also cause methane because cattle released the form of manure.
- Next is the most common issue that is deforestation. Deforestation is a human influence because human have been cutting down trees to produce papers, wood, build houses or more

**Effect of global warming:**

- First effect is polar ice caps melting. As the temperature increase, the ice at the North Pole will melt. Once the ice melt the first effect will be raise on sea levels because the melting glaciers become oceans. According to the National Snow and Ice Data Center "if the ice melted today the seas would rise about 230 feet". It affects many low lying areas such as the Netherlands. In future, the Netherlands will be cover by water once the North Pole is melted. However, it is not going to happen so fast but the sea level will continue rise.
- Another effect is the species loss of habitat. Species that include polar bears and tropical frogs will be extinct due to climate change.
- Next effect is more hurricanes will occur and economic consequences still affect as well. Hurricane causes damage to houses and government need to spend billions of dollars in damage and people need places to stay or have been killed. Once a disaster happens many people have died and diseases happen

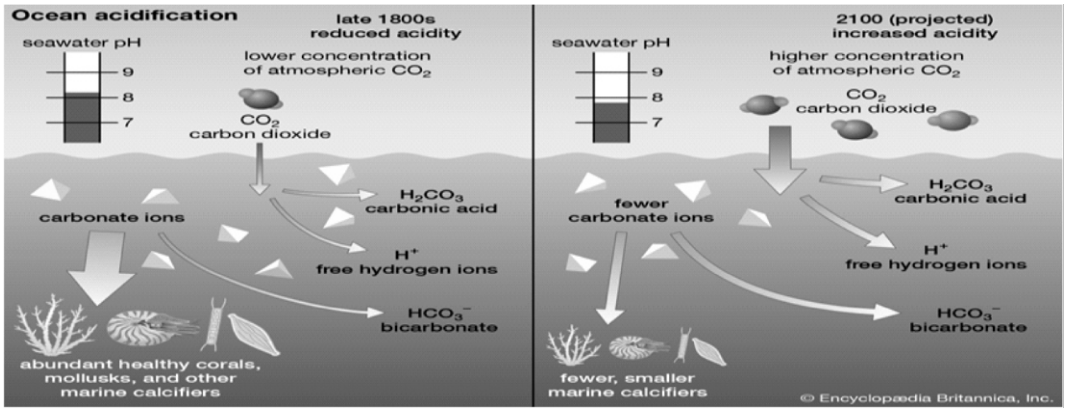
**Solution to Stop Global Warming:**

- However we human and governments need to move forward to implement the global warming solutions. To reduce global warming we can do to reduce the contribution of greenhouse gases to the atmosphere.
- To reduce gasoline mean we have a choice to choose a hybrid car that reduce using gasoline. Besides, petrol price are increasing. If a person everyday drives to work they need to pump petrol after 3 days and causes carbon dioxide. Another way to reduce gasoline is take public transport or carpool to work. It can help reduce carbon dioxide and save cost.
- Another way to reduce global warming is recycle. Recycle can reduce garbage by reusing plastic bags, bottles, papers or glass. For instance, when we buy foods, we can use our own containers instead of plastic bags. Besides, turn off electricity if unused. It can save thousands of carbon dioxide and buy product that have energy saving because it saves cost and save environment.
- Finally, human should stop open burning such as burning dry leafs or burning garbage. It will release carbon dioxide and toxic if burning garbage with plastic. Besides, government should reduce deforestation because the earth temperatures are increasing. Trees will help to improve the temperature on earth.

**2. Ocean Acidification**

Ocean acidification is the ongoing decrease in the pH of the Earth's oceans, caused by the uptake of carbon dioxide ($CO_2$)

from the atmosphere. Seawater is slightly basic (meaning pH > 7), and ocean acidification involves a shift towards pH-neutral conditions rather than a transition to acidic conditions (pH < 7). Carbon dioxide released from the burning of fossil fuels dissolves in seawater and produces carbonic acid, and this lower the pH of the ocean water finally lead to ocean acidification.




**Ocean Acidification**

**Causes of Ocean Acidification:**

- **The burning of fossil fuels-** Fuels such as petroleum, diesel, and coal produce lots of carbon dioxide when burnt. This increases the concentration of carbon gas in the atmosphere, which in turn finds a way into the water. Increase in concentration of carbon dioxide in the oceans, which causes acidification of ocean.
- **Waste disposal**- Industrial revolution leading to an increase in pollution. Due to increase in atmospheric carbon dioxide concentration. Alongside direct sewage waste disposal, there are other wastes that increase the level of acidity in the water.
- **Increase in the concentration of hydrogen ion due to the chemical reaction**- at the sea beds, there are some chemical reactions that may take place, and they can have negative impacts on the quality of the ocean water. Such reactions increase in hydrogen ion concentration which combined with other compounds such as nitrogen, water, among other gases, and their reactions lead to ocean water acidity.
- **Lack of eco-friendly laws and regulations-** the harm induced in the atmosphere can spread into the waters. This is when carbon dioxide released into atmosphere through various human activities. This in turn, contaminates the water. A decrease in carbonate ions

**Effects of Ocean Acidification:**

- **Loss of coral reefs**-Loss of marine plants as more carbon dioxide is absorbed into the oceans, it bonds to form carbonic acid. The acid then produces hydrogen ion and bicarbonate ion and the hydrogen ion bonds with free carbonate ions in the ocean to form other bicarbonate products.The problem with this reaction is that marine organisms possessing shells (corals, crustaceans, molluscs, foraminifera's, and coralline algae) need the carbonate ions to make calcium carbonate shells and skeletons.
- **Disturbance in food chain**-Ocean acidification leads to the death and disappearance of some plants and animals in the sea. When some organisms become extinct, their dependents are also threatened because they have nothing to feed on.
- **A decrease in local economy due to lack of fish and other marine products**- The seawater supports life at its normal conditions. Due to lowered or raised of pH level various type of fish, mammals such as whales, sharks and any many more are affected. when fish die human who depend on them or food and livelihood are hit by the socio- economic problems.
- **Impact on Human Health**-Humans depend on water for various purposes. When the ocean water acidity gets higher, the consumers or the users of such water are living in a perilous situation. Diseases such as cancers can easily be transmitted to humans when they consume fish intoxicated with higher sulfur concentrations.

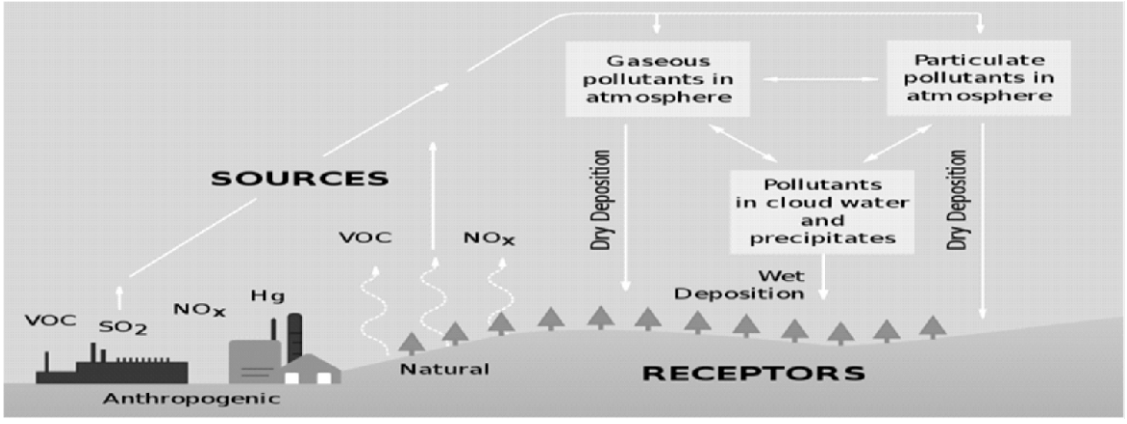
**Solution to Ocean Acidification:**

- **Reducing the use of fossil fuels**- Carbon emitted from fossil fuels can be reduced through the minimization of the use of such fuels. Adopting the use of alternative/renewable energy sources can be the best available option. Diversification of energy sources such as the use of solar and wind as the alternative energy sources can significantly pay off. Increasing the use of eco-friendly fuels.

- **Making strict regulations**- Human actions are best guarded by the policies of the land. The first step towards the fight against ocean acidification can be commenced through the ratification of legislation that can ensure that the waste handling, among other pollution-risk activities, is controlled. Such regulations would spread to the fisheries department to ensure that safety is maintained in food consumption.
- **Spreading the awareness to the masses and eating less meat-** This is not surprising at all. Raising livestock is a major source of greenhouse gases. It is these greenhouse gases that cause all the problems. By reducing our meat consumption, we would reduce the demand for meat. This, in turn, would result in lesser rearing and raising of livestock.
- **Use of Alternative Water Sources-**Because of the need to ensure that there is safety, scepticism may pay off. Such can be through the use of alternative water sources such as the use of boreholes, wells or tapped rainwater instead of ocean water domestically. This can help in minimizing possible ocean water pollution. Promotion of environmentally friendly initiatives. Use of geo- engineering.

**3. Acid Rain**

Acid rain, or acid deposition, is a broad term that includes any form of precipitation with acidic components, such as sulfuric or nitric acid that fall to the ground from the atmosphere in wet or dry forms. This can include rain, snow, fog, hail or even dust that is acidic. It can have harmful effects on plants, aquatic animals, and infrastructure. Acid rain is caused by emissions of sulfur dioxide and nitrogen oxide, which react with the water molecules in the atmosphere to produce acids. Some governments have made efforts since the 1970s to reduce the release of sulfur dioxide and nitrogen oxide into the atmosphere with positive results.




**Acid Rain Process**

**Causes of Acid Rain:**

- Although all bodies of water have acid in it, but the problem with acid rain is that too much acidic chemical compounds such as sulfuric and nitric acid, formed when Sulfur Dioxide (SO2) and Nitrogen Oxide(NOx) come into contact with water and oxygen in the atmosphere, lower the normal PH of water.
- Together with natural disasters such as wildfires, lightning, and volcanic eruption, which blasts pollutants into the air, rotting vegetation and biological processes are natural sources of acid rain forming gases.
- However, human based sources such as factories, power generations facilities, oil refineries and automobiles are the primary contributors to chemical gases. Electricity generating power plants burn coal and other fossil fuels which are the biggest contributors to gaseous emissions. They are responsible for about 60% of SO2 and 25% of NOx found in the atmosphere. Moreover, the exhaust from cars, trucks, and buses, especially in urban regions with heavy traffic, and factories in industrialized areas release high scores of pollutant gaseous into the air.
- These compound pollutants can be blown by winds or carried in jet streams around the world and turned into acid in presence of water and Oxygen. This acid is capable of reducing the normal pH of rain, which is 5.6, to about 4.3. The lower the number of pH is, the more acidic it is.

**Effects of Acid Rain:**

- Essential nutrients in soil such as calcium and magnesium, which are essential for trees to survive, are dissolved as a result of acid rain seepage into the soil. In absence of these vital nutrients, the trees and plants are less healthy and more vulnerable to infections and damage by cold weather and insects. Acid rain also causes Aluminum release in soil which makes it difficult for trees to take up water. It inhibits trees' ability to grow and reproduce.
- Water bodies and aquatic environment are the most affected by either direct acid rainfall or flow of precipitations into streams and lakes through forest, roads and fields, which usually contains amount of Aluminum leached from soil.
- Most lakes and streams have a pH level near 6.5, while acid rain reduces this number to about 5 or less and makes the water more acidic. At lower pH levels, most fish eggs cannot hatch and some adult fish even die. Increased acidity and aluminum level in water surfaces are toxic to aquatic wildlife and can also be deadly.
- Acid rain water is too dilute to cause direct health problems for human. However, infinitesimal acid particles like nitrogen oxides (NOx) and sulfur dioxide (SO2) known as gaseous particulates, when inhaled cause serious respiratory diseases or deteriorate them when inhaled. This includes asthma and chronic bronchitis as well as an increase in heart disease risk.
- Not only are living creatures affected, but acid rain damages many objects. It leaves irreplaceable damage on old heritage buildings as well as weathering limestone and marble buildings and monuments like gravestones. It causes corrosion of metals, like steel bridges, pipes, and even affects the surface of vehicles as it peels the paint.

**Solution to control Acid Rain:**

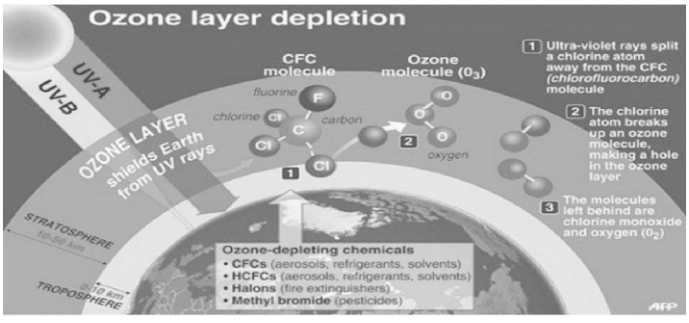
- Acid rain can be stopped in several ways. As well as governments' role in focusing on more sustainable energy sources, such as solar, wind and water energy, and putting restrictions on the use of fossil fuels, we people play a key role in reducing acid rain emissions.
- The biggest step to prevent acid rain is to conserve energy. Simply shutting off electrical appliance. Whenever you're not using them is a good start. You can also help reducing auto emissions by using public transport or carpooling as well as riding bikes or even walking to near destinations.
- Power plants need to do their part as well. Washing coal to remove some of the sulfur or using coal comprised of low sulfur are some actions they can do. They can also use devices called scrubber. They are capable of removing the sulfur dioxide from gases leaving the smokestack.

**4. Ozone Layer Depletion-**

Ozone layer depletion is the thinning of the ozone layer present in the upper atmosphere. This happens when the chlorine and bromine atoms in the atmosphere come in contact with ozone and destroy the ozone molecules. One chlorine can destroy 100,000 molecules of ozone. It is destroyed more quickly than it is created.Some compounds release chlorine and bromine on exposure to high ultraviolet light, which then contributes to the ozone layer depletion. Such compounds are known as Ozone Depleting Substances (ODS).

The ozone-depleting substances that contain chlorine include chlorofluorocarbon, carbon tetrachloride, hydrochlorofluorocarbons, and methyl chloroform. Whereas, the ozone-depleting substances that contain bromine are halons, methyl bromide, and hydro bromofluorocarbons.

Chlorofluorocarbons are the most abundant ozone-depleting substance. It is only when the chlorine atom reacts with some other molecule, it does not react with ozone.



**Ozone Layer Depletion**

**Causes of Ozone Layer Depletion:**

The ozone layer depletion is a major concern and is associated with a number of factors. The main causes responsible for the depletion of the ozone layer are listed below:

- **Chlorofluorocarbons-**Chlorofluorocarbons or CFCs are the main cause of ozone layer depletion. These are released by solvents, spray aerosols, refrigerators, air-conditioners, etc.
- The molecules of chlorofluorocarbons in the stratosphere are broken down by the ultraviolet radiations and release chlorine atoms. These atoms react with ozone and destroy it.
- **Unregulated Rocket Launches-**Researches say that the unregulated launching of rockets result in much more depletion of ozone layer than the CFCs do. If not controlled, this might result in a huge loss of the ozone layer by the year 2050.
- **Nitrogenous Compounds-**The nitrogenous compounds such as NO2, NO, N2O are highly responsible for the depletion of the ozone layer.
- **Natural Causes-**The ozone layer has been found to be depleted by certain natural processes such as Sun-spots and stratospheric winds. But it does not cause more than 1-2% of the ozone layer depletion.

**Effects of Ozone Layer Depletion:**

The depletion of the ozone layer has harmful effects on the environment. Let us see the major effects of ozone layer depletion on man and environment.

- **Effects on Human Health-**The humans will be directly exposed to the harmful ultraviolet radiations of the sun due to the depletion of the ozone layer. This might result in serious health issues among humans, such as skin diseases, cancer, sunburns, cataract, quick ageing, and weekend immune system.
- **Effects on Animals-**Direct exposure to ultraviolet radiations leads to skin and eye cancer in animals.
- **Effects on the Environment-**Strong ultraviolet rays may lead to minimal growth, flowering and photosynthesis in plants. The forests also have to bear the harmful effects of the ultraviolet rays.
- **Effects on Marine Life** -Planktons are greatly affected by the exposure to harmful ultraviolet rays. These are higher in the aquatic food chain. If the planktons are destroyed, the organisms present in the lower food chain are also affected.

**Solutions to Ozone Layer Depletion:**

- Following are some points that would help in preventing this problem at a global level:
- **Avoid Using Pesticides-**Natural methods should be implemented to get rid of pests and weeds instead of using chemicals. One can use eco-friendly chemicals to remove the pests or remove the weeds manually.
- **Minimize the Use of Vehicles-**The vehicles emit a large amount of greenhouse gases that lead to global warming as well as ozone depletion. Therefore, the use of vehicles should be minimized as much as possible.
- **Use Eco-friendly Cleaning Products-**Most of the cleaning products have chlorine and bromine releasing chemicals that find a way into the atmosphere and affect the ozone layer. These should be substituted with natural products to protect the environment.
- **The Use of Nitrous Oxide should be Prohibited-**The government should take actions and prohibit the use of harmful nitrous oxide that is adversely affecting the ozone layer. People should be made aware of the harmful effects of nitrous oxide and the products emitting the gas so that its use is minimized at the individual level as well.

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# ECOLOGICAL RESTORATION STRATEGIES AND MECHANISMS FOR NATURAL REGENERATION OF DECIDUOUS FOREST

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**Abstract**

The reduction in the forest cover is the result of human occupation by immigrants, subsequently to the increase in the agricultural area, industrialization, population growth, and urbanization. The Deciduous Forest in India is diminishing day by day in terms of the area; this is an alarming state. It is essential to recognize the need to conserve the vegetation in areas of permanent preservation and legal reserve that are not addressed well. This problem needs impetus for considering the loss of biodiversity due to the high degree of forest fragmentation, even when view other environmental services such as climate regulation, water purification, regulation of environmental risks, such as landslides and burials, among others.

Thus, restoration ecology, as a science, seeks solutions for the decomposition of the vegetation because it is related to the practice of helping in the restoration of a degraded, damaged, or destroyed environment. Various mechanisms of restoration like seed rain, seed soil bank, seedling bank, transposition of the seed bank, phytosociological aspects, recovery through nucleation are reviewed. These ecological restorations are based on the principle of succession, natural, and function as propellers of natural regeneration.

**Keywords:** restoration ecology, seed rain, seed soil bank, seedling bank, nucleation.

## Introduction

The use of the land for agronomic, economic activities, and human occupation resulted in the fragmentation of forest areas. According to Keenan et al., 2015, the world lost 3% of its forest cover, an average of 0.2% per year, which represents approximately 20,000 ha per day. The reduction of forest areas causes loss of biodiversity, and the size of the fragments has a direct effect on the maintenance and existence of the plant populations. According to Harper (1977), small pieces generate larger edge effect in the population, since the central area of the fragment, which contains the area effectively, preserved and similar to the original vegetation will be less.

According to Holl et al. (2011), after reducing natural areas, the remaining population is smaller than that it can guarantee its reasonable continuity and evolution. In a short time, these populations may have the frequency of their genes for the population, including losing alleles. While in the long run, it may favor the process of inbreeding, due to the higher probability of self-fertilization and crossing between related individuals. These play an essential role in balancing the environment since they act on air quality, water, and hydrographic services. It also serves as food sources and shelters for fauna, genetic diversity, soil erosion control, products such as wood, the raw material for the production of medicines, and handicrafts, among other benefits.

Based on the importance of these areas, studies that seek information to conservation and restoration of these ecosystems are fundamental to their continuity and maintenance of populations. In this context, seed rain, soil seed bank, seedling bank, and established natural regeneration as natural regeneration mechanisms indicative of how the forest will respond to an environmental change or, as is possible, to use the regenerative potential of the forest itself, through the given silvicultural treatment.

The seed bank transposition is a nucleating strategy of restoration where portions of the topsoil are removed from a degraded and transposed to a degraded environment of the same vegetation type (Garwood et al. 1989). In this sense, the seed germination

contained in the transposed soil can be to colonize the degraded environment; they form facilitation nuclei that probability of survival by other species and, thus, promote the continuity of the process of succession (Corbin, 2012). The use of the seed bank as an ecological restoration strategy in different ecosystems by enrichment of species and life forms, with the low financial cost and easy application to the field, has been reported by several authors (Hall et al., 2010).

The regeneration mechanisms in tropical deciduous forest deriving information for the conservation and recovery of these ecosystems are reviewed.

**Tropical Deciduous Forest**

Tropical Deciduous Forests are found in Africa, India, South America, Central America, and small islands in the Pacific. Tropical Deciduous Forests in India covers the significant land and is also as Monsoon forests. It is located in the region between the equator and the tropics and in subtropics regions. In India, it spreads in the states of Madhya Pradesh Uttar Pradesh, Bihar, Chhattisgarh, Orissa, and parts of Maharashtra.

This type of forest is known for the falling and shedding of leaves during the autumn season. The majority of tree species and the vegetation shed their leaves during the cold winter and re-grow new leaves in the next spring season i.e., in the Monsoon Season. This forest has a distinct ecosystem, forest floor growth as well as complex soil dynamics. They are sparsely dense and receive rainfall ranging from 70 cm to 200 cm. (Singh and Kushwaha, 2005)

This forest is broadly divided into two types -Moist Deciduous Forests and dry Deciduous Forests.

Moist Deciduous Forests comprise a mixture of trees and grass. They receive an average rainfall of 100 cm to 200 cm per year with bearing the average temperature 27ºC and the relative humidity of 65-75 percent. This type of forest is commonly encountered in the Western Ghats, the Chota Nagpur plateau, the Shivalik mountain range, Andaman and Nicobar Islands, and parts of West Bengal and Orissa.

Dry Deciduous Forests is commonly found in parts of Northern India in Bihar and Uttar Pradesh and southern parts of Deccan Plateau. It receives and an average rainfall of 100 cm to 200 cm (Singh and Kushwaha, 2005).

**Rain of seeds**

The seed rain comprises the events related to the dispersion of spreads and the area covered by this process, supporting the establishment of the seedling. The seed rain is the largest source of propagules dispersion for regeneration by natural method. The seeds originate from the local area species that promote self-regeneration of the forest. The seeds can be brought from other areas, representing the advanced regeneration of species (Martinez Ramos, Soto-Castro, 1993).

The seed rain depends on the dispersion agents, which can be: zoosporic where seeds are dispersed by animals, anemosporic where seeds are dispersed by wind), hydrosporic where seeds are dispersed by water and ballistic methods where plants have special mechanisms of the seed dispersal (Teegalapalli, et al., 2010).

The dispersion of fruits and seeds can still be primary and secondary. The primary dispersion occurs when the fruits and seeds detach from the plant and reach the site of development by only one dispersing agent. The dispersion involves more than one dispersing agent, for example, plants with the dispersion of seed on the ground and then seeds deposited are carried by rodents or other animals(Pickett et al., 1992).

Different environments exhibit different amounts of dispersed seeds. Martini (2000) studied the seed rain in four different environments: sub-forest adjacent to clearings, clearings natural areas, an area disturbed by fire, and an area of the forest close to the burning area. It was reported that the smaller amount of seeds from rain seedlings occurred in the clearing areas and, in the where they observed a higher presence of species with small seeds dispersed anemosporically. The importance of forest fragments close to the areas of change serves as sources of propagules in the burning area. Another essential factor that determines seed density is the species. The study of flowering can be approached at the community level where interaction between species of one or more communities and species level, which addresses the behavior of individuals species through sampling. The seasonality of production in relation to the community is linked to various factors such as periods of availability of water; rainy season reflects in several tree species blooming; and to the photoperiod, where there is a large number of blooming species with the increase of hours with light. The flowering season may vary according to year, place, and climatic conditions. There may be species that flower annually or that present intervals between the years of production (Uhl et al., 1988).

**Soil seed bank**

The soil seed bank consists of viable seeds found on the surface and buried in the ground that is capable of replacing plants

that die. The seed bank is formed by the set of viable seeds in the soil or associated with litter. Seed rain is composed of a system through dispersal and germination and formation of the seedling by abiotic or biotic processes. The period for these seeds remain in the soil is determined by their physiological properties, such as the speed of germination, dormancy, and viability (Garwood, 1989).

The seed bank is considered a dynamic system that varies with the seed rain and removal of seeds like germination, predation, loss of viability natural. The seeds can remain in the soil without germinating are biotic factors like chemical inhibitors, dormant periods, microorganisms, etc. and abiotic factors like light, temperature, humidity, etc. The changes occur in the diversity and abundance of species of the seed bank according to the floristic composition and the seasonality of fruiting communities. The dormancy as innate factor that is present in the seed before of the dispersion, or induced factor that is induced after dispersion and imposed factor where the favorable conditions of germination are prevalent (Tekle and Bekele, 2000).

According to Garwood (1989) the seed bank responsible for regeneration of forests may be represented by dormant or that are accumulated in the soil for a long period of time, waiting for favorable conditions to germinate (persistent seed bank), or through of the seeds recently dispersed in the area (transient seed bank).In the persistent soil seed bank, it is possible to observe the occurrence of seed of early pioneer and secondary species as these species have efficient mechanisms of dispersion, large seed production and dormancy, which causes them to remain stored in the soil for longer periods of time. The late secondary species and climax form the seed bank transient, with seedling bank. Predation is a factor that can affect the amount of seeds directly due to damage to flowers, fruits and seeds or indirectly due to herbivory in vegetative parts. Predation in seeds is caused by insect larvae that consume the seeds compromising their quality (Fenner and Thompson, 2005).

In tropical forests, the seed bank is involved in at least four levels of the regeneration process. The first step is colonization and establishment of populations; followed by second step of the maintenance of species diversity. The third step is the establishment of groups and the last step is the restoration of species richness during forest regeneration after natural or anthropic disturbances (UHL et al., 1988; Garwood, 1989). The seed bank of the soil together with seed seedling bank reflects the composition of the regeneration of the forest after some disturbance (Baider et al., 1999).

The seed bank is one of the most important factors in natural recolonization of disturbed areas, initiating the successional process (Zanini and Ganade, 2005), forms a deposit of high density, with a variety of pioneering species and in the state of dormancy (Garwood, 1989).

**Seedling bank and natural regeneration**

The establishment of seedlings represents the final process of regeneration. The beginnings of the seedling phase can be defined by complete germination. In many cases this is marked by appearance of the radicle, followed by the cotyledons, with growth towards the light.

According to Garwood (1989) there are five stages of development of seedlings:

1$^{st}$Step: Stage of seed, which includes from maturation to germination;

2$^{nd}$ Step: Expansion of the seedling from germination with emergence of radicle and cotyledons;

3$^{rd}$ step: Reserve phase when the individual depends on the seed reserves;

4$^{th}$ step: Autonomy stagewhen the seedling becomes an individual photosynthesizing; and

5$^{th}$ Step: Youth training that ranges from young individuals to those who areadult population.

According to Fenner and Thompson (2005) the factors that may limit the establishment of seedlings are: light, water, nutrients, through competition, and by herbivory, by vertebrates (often rodents) and invertebrates (insects and molluscs).

The ways in which species respond to these factors success or failure to establish a set of individuals capable of develop and compose natural regeneration (MELO, 2008). The natural regeneration allows an analysis effective to diagnose the conservation status of the fragments and the response to natural or anthropogenic changes in the environment, since they form a set of individuals capable of being recruited to higher stages. Definitions of the term natural regeneration are diverse. Baider et al (2001) natural regeneration can be classified by means of size classes, limits are determined on the basis of the objectives of the studies and characteristics of forests.

The guarantee of the establishment and development of species, which natural regeneration, will depend on environmental conditions within the forest. According to Leck (1989) in the germination, establishment, development and reproduction of forest species, it is possible to wide range of responses to these processes, depending on the light intensity present on the site, finding species that require more light intensity and temperature to stages, and other species that are intolerant of these of environment. Within this

range of variation, there are species that characteristics or intermediate ecological adaptations, as regards the demands and tolerance to light.

Budowisk (1965) classifies species into four ecological groups:

Pioneer species: individuals with height between 5 - 8 m, intolerant to rapidly growing, very rare in the seedling bank, forms a very dense stratum, produce large amounts of seeds, with long-term viability, forming a seed bank of the ground.

Initial secondary species: species of this group reach 12 - 20 m height, are intolerant to shade and fast growing, little present in regeneration, form two well differentiated strata, have seedsof small size and with viability for long period.

Late secondary species: plants with height between 20-30 m, tolerant to shade in the juvenile stage, form a seedling bank, with large mortality rates in the early small to medium with low viability.

Climax species: species with a height between 30 - 45m, slow growing, tolerant to shade in the young phase and intolerant in the adult phase, abundance of individuals in natural regeneration and has large and short seeds viability, not forming soil seed bank.

**Phytosociological Aspects**

The most used phytosociological parameters to characterize the speciesin plant communities are: density, frequency, besides dominance, when the diameter is measured. These parameters allow to obtain the value o fimportance and value of coverage, which temper the species within the forest. On the other hand, many studies use only the density, frequency and dominance to characterize vegetation.

The density represents the number of individuals of each species per unit of the area, within the vegetal association (Baker, 1989). The frequency represents the uniformity of horizontal distribution of each species in the area, characterizing the its occurrence within the parcels, while the dominance expressed in terms of the size, volume or coverage ratio of each species, relation to the space .The value of importance is the sum of the relative values of density, frequency and dominance of a given species, thus defining its ecological importance on the site and its potential to exploit the resources of its habitat (Brower and Zar, 1984).However, studies on the young population of a forest, represented by natural regeneration, are generally only approached for density and frequency of species (Chandran, 2020).Measurements of very thin individuals lead to error and difficulty of working. In relation to the community, the variation in the number of individuals of species existing in a community, can be represented and quantified through the diversity indexes.

Among these indexes one can use the Shannon index. The Shannon index assumes that individuals are sampled from of an infinitely large population, and that all species are represented in the sample, being a non-parametric index based on the species abundance. Some studies show different values for the Shannon index, such as for example, in the Seasonal Deciduous Forest (Dias et al. 2020).

The Pielou Equability Index is derived from the diversity index of Shannon and allows to represent the uniformity of the distribution of individuals between existing species. This value has an amplitude of 0 (uniformity minimum) to 1 (maximum uniformity), the closer to 1 the Index valuebest distributed are individuals among species (Brower and Zar, 1984).

**Ecological restoration through nucleation**

The recovery of degraded ecosystems dates back a long time. examples of its history in different peoples, times and regions, but only recently takes into account knowledge about the processes involved in the dynamics of natural formations (Schlawin and Zahawi, 2008).From the 80's, there was the development of restoration ecology as science, where recovery programs are no longer an agronomic or silvicultural, and have the objectives of restoring degraded environments, seeking the original conditions and the return of the complex interactions of the community Biological (Zahawi et al., 2013).

The accumulated knowledge and experience gained led to a change in the principles restoration theory, the idea of the new paradigm of ecology was accepted, in which the successional changes of vegetation can occur following multiple trajectories, that is, there is no stable and unique climax. Therefore, the purpose of restoration environment has been to restore the biological integrity of ecosystems and their resilience to which can be self-sustaining over time.

In order to obtain success in restoration a series of factors must be observed, among them, the area's history and the surrounding landscape matrix, the identification of barriers that prevent or hinder natural regeneration, in addition to having the clear objectives within the resources available ( Holl et al., 2011).Nuclear strategies have been promising to promote restoration small points of vegetation in the degraded area act in a way that facilitates the natural succession processes, involving producers, consumers and decomposers(Reis et al., 2007).

Some species, called facilitators, may improvement in environmental qualities, thus increasing the likelihood ofoccupation of the area by other species, usually more demanding (Yarranton and Morrison, 1974). In the initial phase of colonization, the facilitating species tend to environmental conditions in a community, so species are more easily established. Yarranton and Morrison (1974) described the spatial dynamics of the primary successionin Canadian dunes and observed that some species formed micro-habitat, whichimproved environmental conditions and attracted other organisms, thus forming nuclei ofdiversity. The nucleation theory proposed by these authors inspired the development ofrestoration techniques through nucleation, with the majority of studies being developed in Brazil and Costa Rica (Holl et al., 2000).The application of nucleating strategies represents an efficient alternative, besides economic, to accelerate the restoration of degraded areas, since it facilitates and promotes development of the vegetation around the nucleus over time (Zahawi et al., 2013). Micro-habitats formed by nucleation introduced rescue the ecosystem's functionality by favoring the development of natural regeneration, by the arrival of plant species of all forms of life and the interaction between organisms (Holl et al., 2000).

The nucleating techniques provide the increment of interspecific interactions, involving various types of ecological interactions, such as the reproductive processes of plants, pollination and dispersal of seeds, are based on the processes of natural succession, thus, may be one of the best ways to promote restoration(Holl et al., 2011).

Among the nucleation techniques are artificial shelters, soil transposition, transposition of seed rain, artificial perches, planting of native trees in groups and others. These techniques have been developed recently,and several authors report satisfactory results but there is still a need for greater number of studies (Holl et al., 2000, 2011).

**Transposition of soil seed bank**

The technique of transposing the seed bank consists of removing the layer surface of a conserved donor area and deposition in a degraded area of the same. The deposition of the seed bank can be done in nuclei, that is, in pointsspaced in the ground or in total area (da Rocha et al.,2020). When done incertain points in the degraded area, can form nuclei of diversity that favor thechanging the condition of the area, following the nucleation theory proposed by Yarranton and Morrison (1974).

The group of regenerating species in the nuclei of soil transposed fragments preserved will establish a new successional rhythm in the degraded area, since it tends toattributes and functions of the original conserved soil and interactions between organisms. This nucleus of diversity expands, being able to connect with the natural units of the landscape.

The introduction of species from neighboring communities through the transposition of theallows the establishment of various forms of life, which can increase. Therefore, the group of regenerating species, mostly pioneers, acts asthe environment as it promotes soil and microclimate changes, conditions for the arrival and development of other species (Engel,2001). The technique is effective for the introduction of colonizing plants, herbs and shrubs, as well as such as anemochromic and anemophilic (Hall et al., 2010).The initial herbaceous-shrub phase that predominates in the seed bank is essentialfor the beginning of the successional process and arrival of the community to mature phases, it is emphasizedthat each phase has importance for community building, so we accelerate internshipsrefers to the loss of functions during the succession process points out that transposition of the seed bank should notthe introduction of a representative number of tree species, since it is composed ofmainly by pioneer and ruderal species, and that the increase in the number of speciesdepending on the intensity and diversity of seed rain orenrichment.In addition, by transposing the soil, biological diversity is reintroduced.genetic variability to the area, from the reintroduction of populations of several species of the micro, meso and macro fauna / flora of the soil (microorganisms decomposers, fungi mycorrhizal, nitrifying bacteria, earthworms, algae, among others), important in cyclingnutrients, soil restructuring and fertilization (Hall et al., 2010).The transposition of the soil of neighboring fragments at different successional levels canfavorable because it increases the diversity and genetic variability of the degraded area and canincrease the chances of recruitment of species adapted to adverse conditions. Yet, Care should be taken in the choice of donor areas so that there is no introduction of species exotic and invasive species that could compromise the success of the restoration. The information on the floristic composition of the seed bank by means of preliminary study may assist in the planning of the technique (Tekle and Bekele, 2000;).

Regarding the depth of collection in donor areas, Reis et al. (2014) suggest 5-10 cm, already Rodrigues and Gandolfi (2009) suggested the removal of a deeper layer (20cm), but the literature mentions that about 60% of the seeds of the bank are in the first 2.5 cm of soil. (Baider et al., 2001) studying different nucleation techniques in three units demonstration of ecological restoration, observed that soil transposition is a technique simple and low cost. The author suggests 100 cores of 1 m2 for the hectare, covering, thus, 1% of the area. Soil transposition was reported by several authors as an efficient methodology rehabilitation of mined areas, where, in such cases, the soil deposited throughout the degraded area serves as a source of propagules to optimize the (Teegalapalli et

al., 2010), however some authors report the need to enrich the areas (Hall et al., 2010).

The soil of areas that will be used in new ventures like mining, construction of roads and artificial reservoirs for electric power generation, among others, can also be used as a way to mitigate the impacts generated by the genetic material and the variety of species of fauna and flora contained in the seed bank, besides recomposing the soil of the area degraded by the input of organic matter and other propagules (Cole et al., 2010). The utilization of the seed bank exclusively from the areas of native vegetation authorized for suppression in public utility ventures or social interest, such as artificial hydroelectric reservoirs, roads and mining, and should be used for the recovery of degraded areas of the same plant of the same catchment area are suggested. When there is no suppression of regulated native vegetation for the mentioned purposes, the seed bank collection should be small and at spaced points of mature forests, in this way, the seed bank is rapidly healed.

The transposition of the soil seed bank can also be used to enrichment of the community in areas in the process of restoration, low natural regeneration and species diversity. Therefore, seed bank transposition can accelerate the succession process by the incorporation of plant and animal material, introduction of ecological groups and different forms of life, providing soil cover, besides presenting low cost However, a greater number of studies are needed, as Corbin and Holl(2012).

**Conclusion**

The species richness of the transposed seed bank increased over the months and years, the density of individuals was influenced by the winter period and condition of the place in relation to the soil hydromorphic characteristic. The high number of herbaceous seeds in the soil seed bank, associated with the high representativeness of secondary species and climax in the seed rain, seedling bank and established natural regeneration, allow classifying this remainder in the medium stage of succession. Seed rain is an important mechanism for maintaining the soil seed bank and seedling bank, considering the conservation of tree and shrub species present in the study area and adjacent areas. The isolated use of the soil seed bank is not sufficient to recompose an altered area with tree and shrub species, requiring the complementation, based on the use of other naturally occurring species, in the region and specific environment. The mechanisms of natural regeneration in the area are important maintaining species in the forest.

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# ON AN ACCOUNT OF MIRIDAE (INSECTA : HEMIPTERA : HETEROPTERA) FROM MAHARASHTRA, INDIA

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**Abstract**

Present study comprises 21 species belonging to 16 genera from the Maharashtra. 12 species were new to the state and *Lygus decoloratus* Distant, 1904 and *Calocoris dohertyi* Distant, 1904 species new to India.

**Introduction**

Carvalho's classification, published in his catalogue of the Miridae of the World (Carvalho, 1959), has been modified Schuh (1984). About 11,123 valid species under 1200 genera of Miridae are known from all over the world. Study of Indian Miridae done by Distant, 1902 and 1910. The present paper incorporated the account of 21 species of Miridae belonging to 16 genera from the state of Maharashtra

**Material and Methods**

During the survey of the Chhattisgarh by the team of Zoological Survey of India Kolkata, altogether 102 specimens of Miridae bugs. by handpicking, net trap and light tarp methods. We sorted the specimens, pinned the bugs, dried them and identified with the help of available literature.

**Results**

SYSTEMATIC ACCOUNT

Superfamily MIROIDAE

Family MIRIDAE

Subfamily: MIRINAE

**TRIBE: STENODEMINI**

**Genus 1. *Notostiropsis* Poppius, 1914**

1909. *Ebutius* Distant, *Annals and Magazine of Natural History* (8) **4**: 440-454.

1914. *Notostiropsis* Poppius: Die Miriden der Äthiopischen Region II –Macrolophinae, Heterotominae, Phylinae. Acta Societatis Scientiarum Fennicae 44(3): 1–136.

**1. *Notostiropsis bellus*** Carvalho, 1959

1909. *Ebutius bellus* Distant, *Annals and Magazine of Natural History* (8) **4:** 440 - 454.

*Material examined*: 2exs, Ukshi, Dist-Ratnagiri, 01.VII.2014, M. E. Hassan & Party Coll.

*Length*: 6.5 – 7 mm.

*Distribution:* India: Maharashtra (Ratnagiri); Maharashtra, and Sikkim.

**Genus 2. *Trigonotylus* Fieber, 1858**

1858. *Trigonotylus*, Fieber, *F.X., Criterien Zur generischen Theilung der phytocorides (Capsiniauct). Wiener entomologische Monatschrift* 2: 289 -327.

**2. *Trigonotylus tenuis* Reuter, 1893**

1893. *Trigonotylus doherty* Reuter, *O. M., B. [New species of Miridae]. In: Bergroth, E., Mission scientifique de M. Ch. Alluaud aux Iles Sechelles. Revue d' Entomologie, Caen* 12: 197--209.

*Material examined*: 1ex, Dharmapuri, Dist-Parbhani, N19.308575, E76.726646, 10.iii.2015, M. E. Hassan & Party Coll.

*Length*: 4 mm.

*Distribution*: India: Maharashtra (Parbhani); Orissa, West Bengal. Elsewhere: Myanmar, and Sri Lanka

**Genus 3.** Dolichomiris, **Reuter 1882**

1882.*Dolichomiris* Reuter, *Ad cognitionem Heteropterorum Africae Occidentalis. Öfversigt af Finska Vetenskapssocietetens Förhandlingar* 25: 1—43.

**3. Dolichomiris linearis Reuter, 1882**

1882.*Dolichomiris linearis* Reuter**,** *Ad cognitionem Heteropterorum Africae Occidentalis. Öfversigt af Finska Vetenskapssocietetens Förhandlingar* 25: 1-43.

*Material examined*: 1ex, Jalgaon, Dist- Jalgaon, 24.ii.2013, M. E. Hassan & Party coll.

*Length:* 7.5 to 8 mm.

*Distribution*: India: Maharashtra (Jalgaon). *Elsewhere*: Myanmar, Sri Lanka.

TRIBE II. MIRINI

**Genus 4. *Creontiades* (Distant 1883)**

1883.*Creontiades* Distant, *Insecta. Rhynchota. Hemiptera-Heteroptera. Biologia Centrali Americana,* Vol. 1 :225 -264.

4.***Creontiades pallidus*** (Rambur,1839)

1839. *Phytocoris pallidus* Rambur, *Faune entomologique de l'Andalousie. Arthur Bertrand, Paris*: 97-176.

*Material examined*: 1ex, Malhura, Dist-Hingioli, 11.iii.2015, M. E. Hassan & Party Coll.

*Length*: 5 - 6 mm.

*Distribution*: India: Maharashtra (Hingioli).

5. ***Creontiades pallidifer*** (Walker,1873)

1873. *Capsus pallidifer* Walker, *Catalogue of the specimens of Hemiptera Heteroptera in the collection of the British Museum.,* Part VI: 210.

*Material examined:* 1 ex., Bujwadi, Dist. Kolhapur, 23.vi.2014, coll. M. E. Hassan & party

*Length*: 5 mm.

*Distribution:* India: Maharashtra (Kolhapur) and South India. *Elsewhere:* Korea, Japan, Sri Lanka.

Genus 5. ***Stenotus*** (Distant 1904)

1904. *Nymannus* Distant, *Annals and Magazine of Natural History*, (7) **13**: 194-206.

1974. *Stenotus* Wagner, *Entomologische Abhandlungen*, 37 Suppl., iii + 484 pp.

7. ***Stenotus rubricatum*** (Distant,1904)

1904. *Megacoelum rubricatum* Distant, *Fauna Brit. India, Rhynchota*, **2**: 243-503.

1959. *Stenotus rubricatum* Carvalho, *Arquivos do Museu Nacional, Rio de Janeiro,* **48**: 384.

*Material examined*: 1 ex., Bijlinagar, Dist. Sindhudurg, 28.vi.2014, coll. M. E. Hassan & party.

*Length:* 5.5 mm

Distribution: India: Maharashtra (Sindhudurg), South India. *Elsewhere*: Sri Lanka.

Genus 6. ***Charagochilus*** (Fieber, 1858)

1858. *Charagochilus* Fieber, *Wiener entomologische Monatschrift,* **2**: 289-327.

8. ***Charagochilus longicornis*** (Reuter,1885)

1885.*Charagochilus longicornis* Reuter, *Entomologisk Tidskrift,* **5**: 195-200.

*Material examined:* 1 ex., Agartakli, Dist. Nasik, 4.iii.2013, coll. M. E. Hassan & party.

*Length*: 2mm.

*Distribution*: India: Maharashtra (Nasik); and Nicobar Island. *Elsewhere*: Sri Lanka.

**Genus 7. *Lygus* Hahn 1833**

1829. **Lygus** Hahn., *Wanz. Ins*. I: 147.

**9. *Lygus annandalei* Distant 1909**

1909. *Lygus annandalei* Distant, Description of oriental capsidae. Annals and Magazine of Natural History (8) 4: 509-523.

*Material examined*: 1ex., Kinnala, Chopala, Dist. Nandurbar, 10.iii.2013, coll. M, E. Hassan and party.

*Length*: 3.5 mm.

*Distribution*: India: Maharashtra (Nandurbar), and West Bengal.

**10. *Lygus patrius* Distant 1959**

1909. *Lygus annandalei* Distant Description of oriental capsidae. Annals and Magazine of Natural History (8) 4: 509 - 523.

*Material examined*: 1 ex., Gayanganga WLS, Dist. Buldhana, coll. M. E. Hassan & party.

*Length*: 4mm.

*Distribution*: India: Maharashtra (Buldhana), and Eastern Himalayas.

**11. *Lygus decoloratus* Distant, 1904[#]**

1904**.***Lygus decoloratus* Distant, *The fauna of British India*. 2: 243--503.

*Material examined*: 2 exs., Ambad, Dist. Jalna, 2.xi.2014, coll. M. E. Hassan and party.

*Length*: 5mm.

*Distribution*: India: Maharashtra (Jana). Elsewhere: Sri Lanka.

Genus 8. ***Calocoris*** Fiebr 1858

1858. *Calocoris* Fiebr, *Wiener entomologis che Monatschrift,* **2** : 289 - 327 .

**12. *Calocoris dohertyi* Distant, 1904[#]**

1904. *Calocoris dohertyi* Distant *The fauna of British India*, 2: 243-503.

*Material examined*: 1 ex, Ramgaon, Dist. Amravati, 8.xi.2014, coll. M.E. Hassan and party;

*Length*: 7 mm.

*Distribution*: India: Maharashtra (Amravati). *Elsewhere*: Myanmar.

13. ***Calocoris rama*** Distant, 1909

1909.*Calocoris rama* Distant, *Annals and Magazine of Natural History* (8) **4** : 509-523

1959.*Calocoris rama* Carvalho, 1959. *Arquivos do Museu Nacional, Rio de Janeiro,* **48**: 384.

*Material examined*: 1 ex., Malegaon, Dist. Washim, 5.xii.2014., coll. M. E. Hassan and party

*Length:* 5.5 mm

*Distribution*: India: Maharashtra (Washim), and West Bengal.

Genus 9. *Paracalocoris* Distant ,1871.

1871. *Paracalocoris* Distant, Hemiptera insularum Philippinarum- Bidrag till Philippinska öarnes Hemipter-fauna. *Öfversigt af Kongliga Vetenskapsakademiens Förh*andlingar 27: 607-776.

**14. *Paracalocoris burmanics*** (Distant, 1904)

1904.*Paracalocoris burmanicus* Distant, the fauna of British India, including Ceylon and Burma. Rhynchota. Taylor & Francis, London. Vol. 2, part 2, pp. 243--503.

*Material examined*: 1 ex., Kathoda, Dist. Amravati, 08.xi.2014, coll. M. E. Hassan & party.

*Length*: 6mm.

*Distribution:* India: Maharashtra (Amravati), and South India. ***Elsewhere***: China, Myanmar, Nepal, Thailand

**TRIBE III HYALOPEPLINI**

Genus 10. ***Hyalopeplus*** Stal,1871

1871. *Hyalopeplus* Stål, *Öfversigt af Kongliga Vetenskapsakademiens Förhandlingar,* **27**: 607-776.

15. ***Hyalopeplus lineifer*** (Stal,1855)

1855. *Capsus vitripennis* Stal*, Ofversigt at kongliga vertenslca p saka demiens Forhand Linger* **12**:181–192.

1916.*Hyalopeplus uncariae* Roepke, *Tijdschrift voor Entomologie,* **59**: 180-183.

1995. *Hyalopeplus lineifer* Kerzhner & Schuh**,** *American Museum Novitates,* **3137**: 11.

*Material examined*: 1 ex., Ninyar, Kudal; Dist. Sindhudurg, 31.xi.2011, coll. M. E. Hassan & party.

*Length:* 9 to 10 mm.

*Distribution*: India: Maharashtra (Sindhudurg), and Assam. *Elsewhere*: North Queensland, Philippines, Sri Lanka, Myanmar**.**

**SUBFAMILY IX: BRYOCORINAE**

**TRIBE: DICYPHINI**

Genus 11. ***Nesidiocornis*** Distant , 1904

1902. *Nesidiocoris* Kirkaldy, *Transactions of the Entomological Society of London*, **1**: 243-272.

16. ***Nesidiocoris tenuis*** (Reuter,1895)

1895.*Cyrtopeltis tenuis* Reuter, *Revue d'Entomologie, Caen,* **14**: 131-142.

1969. *Nesidiocoris tenuis* Eckerlein & Wagner, *Acta Entomologica Musei Nationalis Pragae,* **38**: 155-194.

*Material examined*: 1 ex., Ninyar, Kudal; Dist. Sindhudurg, 31.xi.2011, coll. M. E. Hassan & party.

*Length*: 3 mm.

*Distribution*: India: Maharashtra (Sindhudurg), Assam, and West Bengal. *Elsewhere*- Myanmar.

SUBFAMILY PHYLINAE

TRIBE V: PHYLINI

**Genus 12 . *Camphylomma* Reuter, 1878.**

1878.*Campylomma* Reuter, *Hemiptera Gymnocerata Europae. Hémiptères Gymnocérates d'Europe, du bassin de la Méditerranée et de l'Asie russe. I. Acta Societatis Scientiarum Fennicae* 13: 1—188.

**17. *Campylomma lividum* Reuter, 1885**

1885.*Campylomma livida* Reuter, *Species Capsidarum quas legit expeditio danica Galateae descripsit. Entomologisk Tidskrift* 5: 195-200.

*Material examined*: 1 ex, Nagewadi, Dist. Jalna, 1.xi.2014, coll. M.E. Hassan and party.

*Length*: 2.5 mm

*Distribution:* India: Maharashtra ( Jalna, ); Bengal , Tamilnadu .

*Elsewhere*: Nepal, Philippine Is, SriLanka.

SUBFAMILY X: ORTHOTYLINAE

TRIBE: ORTHOTYLINI

Genus 13. ***Cyrtorhinus*** Fieber 1858

1858.*Cyrtohinus* Fieber, *Wiener entomologische Honatschrift,* **2** : 289 -327 .

**18. *Cyrtorhinus lividipennis* Reuter,1885**

1885. *Cyrtorhinus lividipennis* Reuter, *Entomologisk Tidskrift,* **5** : 195 -200 .

*Material examined*: 1ex., Belati, Dist. Sholapur, 16.vi.2014, coll. M. E. Hassan and party.

*Length*: 2.5 – 3.5 mm

*Distribution:* India: Maharashtra (Sholapur) Tamil Nadu, and Nicobar Island.

**TRIBE VI DERAEOCORINI**

Genus 14. *Deraeocoris* (Fieber,1858)

1858.*Camptobrochis* Fieber, *Criterien zur generischen Theilung der Phytocoriden (Capsini auct.). Wiener entomologische Monatschrift* 2: 289—327.

**19. *Deraeocoris orientalis* (Distant,1904)**

1856. *Capsus Deraeocoris* Kirschbaum , *Rhynchotographische Beiträge. Jahrbuch des Vereins fur Naturkunde im Herzgothum Nassau* 10: 163-348.

***Material examined*:** 1 ex, Wagoli, Dist. Akola, 26.x.2014, coll. M.E. Hassan and party.

***Length*:** 5mm.

***Distribution:*** India : Maharashtra ( Akola ).

***Elsewhere:*** Pundaluoya , Sri Lanka .

**Genus 15. Eurybrochis Kirkaldy, 1902**

1902.Eurybrochis Kirkaldy, Memoir upon the Rhyncotal family Capsidae Auctt. Transactions of the Entomological Society of London: 243—272.

**20. Eurybrochis politus (Distant, 1909)**

1909.Pacorus politus Distant, Descriptions of Oriental Capsidae. Annals and Magazine of Natural History (8)4: 509-523.

***Material examined:*** 1 ex., Kathoda, Dist. Amravati, 08.xi.2014, coll. M. E. Hassan and party.

***Length:*** 5mm.

***Distribution:*** India: Maharashtra (Amravati), and West Bengal. Elsewhere :

**Tribe:** Auricillocorini

**Genus16. Zaratus Distant, 1909**

1909. Zaratus Distant, Oriental Capsidae. Entomologist 42: 58-60.

1958. Zaratus Carvalho, A catalogue of the Miridae of the world. Part III. Arquivos do Museu Nacional, Rio de Janeiro 47: 161.

**21. Zaratus repandus Distant, 1909**

1909. *Zaratus repandus* Distant, *Oriental Capsidae. Entomologist* 42: 58-60.

*Material examined*: 1 ex. Phonda, Dist. Sindhudurg, 26.vi.2014, coll. M. E. Hassan and party.

*Length*: 4mm.

*Distribution*: India: Maharashtra (Sindhudurg) and Tamil Nadu.

**Summary**

The present paper incorporated the account of 21 species of Miridae belonging to 16 genera from the state of Maharashtra, all the species are first time recorded from the state. For each species the original and the subsequent references, distributional records in India and elsewhere, keys to various taxa have been provide. This is the first comprehensive account of Mirid bugs from the state of Maharashtra.

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4. Schuh, R.T. 1984. *Revision of the phylinae (Hemiptera, Miridae) of the Indo-Pacific: Bulletin of the American Museum of Natural History* 177 (1): 1 - 476.

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# IMPACT OF SEWAGE SLUDGE APPLICATION ON SOIL MYCOFLORA - A REVIEW

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Recently we have been witnessing utilization of sewage sludge in agricultural fields as a popular tool for waste disposal. Municipal sewage sludge, frequently referred to as bio waste, is a by-productof municipal sewage treatment. Itscomposition varies greatly along with its physical, chemical and biological properties. On account of the inherentfertilization value, sewage sludge appears quite sensible and justified to be utilized for agro-technical purposes. The application of sewage sludge to agricultural land not onlyadd valuable plant nutrients and organic matter to the soil but also provide a mean of waste disposal. However, presence of toxic compounds in its chemical composition, including heavy metals, limits its application strictly. The application of sewage sludge can either stimulate soil microbial activity, due to an increase in available carbon and nutrients, or inhibit activity, due to the presence of heavy metals and other pollutants.

One of the key reasons behind the loss of agricultural produce is plant diseases, which are mostly caused by soil borne pathogens, out of which fungi are the most destructive. Biological control of plant pathogens has been considered as a potential control strategy and the search for these bio control agents has been gaining ground in recent years.

The aim of this review paper is to delve deeper into ways to find outpercent occurrence of mycoflora isolated from sewage and soil samples collected from control and treated fields.In view of the above, the effects of land application of partly treated sewage, released from Gomti Sewage Treatment Plant, situated near Sultanpurdistrict on soil mycoflora have been studied following the standard microbiological techniques.

**Introduction**

Soil water is one of the important factors influencing the growth and survival of soil-borne pathogens. It governs the activity and population dynamics of the microorganism indirectly in soil. In plant disease control, the knowledge about soil water plays an important role with regard to growth of microorganism, antagonism, host exudation and other factors which affect pathogenic as well as non-pathogenic microbes in the soil (Singh &Deol, 2004).

With the increasing need to develop sustainable agricultural practices, the use of waste products has been the target of many studies in various countries. Sewage sludge (SS), for example, is a residue rich in organic matter, generated during the treatment of residual waters in Sewage Treatment Plants (STP). Population growth allied to an expansion in industrial activity has resulted in a considerable increase in the production of this residue. Parallel to the great production of this sludge, there has been an increase in the concern to use it in a sustainable and economically viable way without damage to the environment. As a result of various inconveniences in dumping sewage sludge in landfills or incinerating it, its application in agriculture has emerged as a promising technique (Vieira et. al.2016).

Singh et.al. (2011)have shown that sewage sludge amendment increased soil microbial and soil enzyme activities; however, reduction in soil enzyme activity has also been reported. When incubation periods of sewage sludge were longer, heavy metal bioavailability increased.

Monitoring soil quality by means of biological indices can be of help for the management and sustainability of soils that received sewage sludge application.Fernandeset.al. (2005)showed that basal respiration, the C and N microbial biomass, metabolic quotient

($qCO_2$) and enzymatic activity in the soil increased as sewage sludge was added, and their values were positively correlated with sewage sludge doses.

Chandra (1990) observed the inhibition of fungal growth in nutrient medium amended with different concentrations of sewage and sludge. The fungi *Fusariumoxysporum*f.sp. *lini*, *Curvularialunata*, *Trichodermaharzianum*, *Penicilliumcitrinum*, *P. granulatum*,*Aspergillusniger*, *A. luchuensis*, *Cladosporiumcladosporioides* were inhibited due to sewage treatment. Bundela et.al. (2009)reported prevalence of fungi in municipal solid waste of the city.

Chitra &Vittal (1989) have reported that the total number of fungal species isolated from raw sewage were greater than that from oxidation pond and aerated lagoon. Abdel-Malleck&Bagy (1988) also observed that treatment of soil with sewage significantly increased total fungi. The fungi differed in responses to different doses of sewage. The total count of fungi was significantly raised by the low dose of sludge after soil treatment.

Treated or untreated domestic sewage is one of the main sources to irrigate the crops in adjacent city areas. Presence of various inorganic and organic constituents in the sewage is known. Sewage mycoflora play important role in digestion of organic matter and pollutants (Cook, 1976). Downing (1971) observed toxic effluents to inhibit microbial population in activated sludge treatment plants.

Suppressiveness to soil-borne plant pathogens is one of the most important soil properties, and the applications of organic matter alter this characteristic. On the other hand, incorporation of sewage sludge into the soils can reduce or increase or did not interfere with the incidence or the severity of plant disease. Sewage sludge reduced the incidence and the severity of the diseases caused by *Sclerotiumrolfsii* and increased emergence and the final stand of the bean plants in three bean cropping seasons (dos Santos &Bettiol, 2003).

The biological characterization of natural soil is centered on the soil fungi as they exert profound impact on mobility of waste constituents. The higher fungal population recorded from control soil as compared to the treated one could be either due to presence of some toxic substances therein or due to higher bacterial population which might have suppressed the fungal growth and their population. Microbial population is considerably influenced by the environmental factors. The microbial/fungal population in soil varied with different moisture regions and thus it appears that the moisture has a profound influence. Similar result was reported by Prakash & Khan (1971).

Variation in fungal population in soil occurs due to seasonal fluctuation of edaphic factors such as moisture, pH, temperature, aeration, organic matter and available nutrients (Alexander, 1977). The rare occurrence of some fungal species in both the soil samples seems to be due to their inability to withstand competition with other microorganisms. Fernandeset.al. (2005) suggest that the amount of sewage sludge applied has to be calculated based on the N crop needs, and annual applications must be avoided to prevent over-applications.

The levels of several metals in barley and red fescue grown in both treatments exceeded background values found in the literature. The Cu content in barley straw exceeded 100 mg $kg^{-1}$ in both treatments and might be toxic to grazing animals (Forsberg &Ledin, 2006). Healthy and diseased plant roots have been shown to support different fungal species which leads to the difference in the mycofloral population and its composition during decay of roots (Rai&Upadhyay, 1977).

A review of literature on similar work indicates a lot of opportunity areas to focus on. The present work was, therefore, undertaken to study the following aspects in detail:

1. Survey of sewage from study area of the district to select the sewage sludge irrigated fields and the control ones in the vicinity.
2. Isolation and study of mycoflora (fungi) with reference to their population dynamics from sewage treated and untreated (control) soil samples collected from the selected fields.
3. Compilation of data and analyses of observations.

**Study Site**

Two fields situated in nearby area of Sultanpur, one irrigated with sewage obtained from the Gomati Sewage Treatment plant (hereafter called as treated field), and the other irrigated with tubewell water (hereafter called as control field) were selected for the present study. The crops grown in these fields are chickpea, linseed, pigeonpea, wheat, barley, paddy and some vegetables like tomato, cauliflower and potato.

The soil samples of both the fields were collected in sterilized polythene bags while sewage was collected in sterilized plastic bottles

from the sewage treatment plant at monthly intervalin the third week of each month from July 2010 to June 2011. The triplicate samples of two liters were collected in polythene bottles (non-transparent) and brought into laboratory in ice boxes for the analysis of mycoflora.

**Isolation and Characterization of Soil Fungi**

Serial dilution agar plating (Apinis, 1963), Warcups soil plate and Waksman Direct inoculation methods were employed for the isolation of soil microbes; suspension was diluted up to $10^{-5}$. The aliquots were cultured for fungus on CzapekDox Agar and Potato Dextrose Agar media. For primary isolation Rose Bengal (30mg/L) was also added to the medium. Three plates from each soil samples were incubated for 24-96 h at 25±2°C, and each morphologically unique fungal colony was sub-cultured and purified using standard techniques. The fungal species were identified and characterized based on their morphological characters and microscopic analysis by using taxonomic guides and standard procedures (Domsch et. al., 1980).

The following morphological characteristics were evaluated: colony growth (length and width), presence or absence of aerial mycelium, colony color, presence of wrinkles and furrows, pigment production etc.

Fungal plant pathogens viz., *Fusariumoxysporum* f.sp. *ciceri*and *F.oxysporum* f.sp. *lini*, *Acrophialophorafusispora*, *Aspergillusflavus*, *A. luchuensis*, *A. niger*, *A. terreus*,*Curvularialunata*, *Penicilliumcitrinum*, *P. chrysogenum*, *P. rugulosum*, and *Trichodermaharzianum*were isolated from different hosts showing typical disease symptoms. Isolation of pathogens was done by cutting 1 to 2 mm pieces of diseased samples and surface sterilizing them in 0.1 percent mercuric chloride solution and were transferred to sterilized PDA in petriplatesunder complete sterile conditions in isolation chamber under laminar air flow. The fungal strains were stored at 4°C immersed in water. They were routinely grown on potato dextrose agar (PDA; Difco Laboratories).

**Percent Occurrence of Mycoflora**

Effects of land application of sewage on soil mycoflora in terms of percent occurrence has been studied during present course of investigation as irrigation with sewage has been a regular practice in agricultural fields around cities. It makes the land fertile due to which crop yield is appreciably increased. Its continuous use significantly changes the physical, chemical and biological composition of soil affecting the growth and yield of the crops.

The results obtained during present course of investigation are presented in the form of percent occurrence of mycoflora isolated from sewage and soil samples collected from control and treated fields (Tables 1, 2, & 3).Twenty eight, thirty and nineteen fungal species were recorded from soil samples collected from control and treated field (Tables 3 and 2), and under sewagesamples (Table 1), respectively. A maximum number of fungal species was recorded in August from control soil, in July from treated soil and in March and April from sewage samples.

A lower number of fungal species was recorded in May and June from all the samples but in December and January also from the sewage samples. The fungal isolates obtained exhibited a varied pattern of occurrence with their own characteristic percent frequency. *Aspergillusterreus*,*Fusariumoxysporum* f. sp. *ciceri* and *F. oxysporum* f. sp. *lini* were recorded in very high frequency from both the soil samples while*Aspergillusfumigatus* was found to be very low in both the soil samples and very high in sewage samples (Tables 1,2,&3). Some fungal isolates appeared less frequently among which *Alternariatenuissima*and *Aspergilluscandidus*in control soil, *Aspergillussydowi* and *Candida* species in treated soil, and*Gliocladiumsagariensis* in sewage samples come in the picture quite evidently.

**Summary**

The purpose of this study was to examine the influence of sewage irrigation on the quantity and distribution of soil fungal organisms, and to find out the percent occurrence of different mycoflora. The results showed that the quantities of the soil fungi varied significantly after sewage treatment. The distribution of fungi in the soil rhizosphere of study sites showed substantial deviation after sewage irrigation. These results provided theoretical basis for the application and standard establishment of sewage irrigation in the agricultural land.

**Table - 1 : Percent Occurrence of Mycoflora Isolated from Sewage**

| Name of Species | Jul | Aug | Sep | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 8.5 | 9.3 | - | - | - | - | - | 11.6 | 7.6 | 8.1 | - | - |
| 2 | - | - | - | - | - | - | - | 21.5 | 41.4 | 47.6 | | - |
| 3 | 7.1 | - | 45.4 | - | - | - | 17.6 | 12.3 | 21.5 | 21.8 | 17.1 | - |
| 4 | 58.5 | 36.9 | 28.5 | 23.1 | 22.7 | 11.9 | 12.4 | 21.9 | 27.8 | 31.1 | 26.4 | 21.1 |
| 5 | 9.1 | 17.6 | 12.6 | 11.5 | - | 10.7 | - | - | 7.6 | 15.8 | 17.8 | 34.9 |
| 6 | - | - | - | - | - | - | - | - | - | - | 9.8 | 17.2 |
| 7 | 8.3 | 9.3 | 10.2 | 6.7 | - | - | - | 11.8 | - | 15.3 | - | - |
| 8 | 32.5 | 37.4 | 34.2 | 22.8 | 10.2 | - | - | 23.5 | 25.1 | 10.1 | - | - |
| 9 | - | - | - | - | - | 11.5 | 17.1 | - | - | - | - | - |
| 10 | - | - | - | - | - | - | - | - | 10.6 | 9.3 | 6.7 | - |
| 11 | - | - | - | - | - | - | - | - | 7.6 | 8.1 | - | 2.3 |
| 12 | - | - | - | - | 9.5 | - | - | - | - | - | - | - |
| 13 | 7.6 | 9.3 | - | - | - | - | - | - | - | - | - | - |
| 14 | 6.8 | 9.7 | 11.4 | 13.5 | - | - | - | - | 1.5 | | - | - |
| 15 | - | 10.1 | - | - | - | - | 4.6 | 10.7 | 12.2 | - | - | - |
| 16 | - | 9.6 | 10.8 | 12.3 | 9.7 | - | - | - | 8.2 | 9.5 | - | - |
| 17 | - | - | 12.1 | - | 6.4 | - | - | - | - | - | - | - |
| 18 | - | - | - | 14.5 | 16.9 | - | - | - | - | - | - | - |
| 19 | - | - | - | - | 13.5 | 10.7 | - | - | 7.1 | 8.5 | 7.1 | 12.6 |
| **Total Number of** | **8** | **9** | **8** | **7** | **7** | **4** | **4** | **7** | **12** | **11** | **6** | **5** |

**Table - 2 : Percent Occurrence of Mycoflora Isolated from Soil Irrigated with Sewage**

| Name of Species | Jul | Aug | Sep | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 6.2 | 4.1 | 3.6 | 7.6 | 5.4 | - | - | - | - | 1.7 | 1.2 | 1.1- |
| 2 | 4.5 | 4.8 | - | - | - | - | - | - | - | - | - | - |
| 3 | - | - | 5.1 | 9.6 | 11.8 | - | - | - | - | 5.1 | - | - |
| 4 | 3.4 | 3.9 | 2.5 | - | - | - | - | - | - | - | - | - |
| 5 | - | 4.1 | 7.8 | - | - | - | - | 5.5 | - | 4.9 | - | - |
| 6 | 4.2 | 6.3 | - | - | - | - | - | 6.8 | 4.7 | - | - | - |
| 7 | - | - | 5.1 | 7.9 | - | - | - | - | - | 9.3 | - | 3.2 |
| 8 | - | - | - | - | - | - | - | - | - | 5.4 | - | - |
| 9 | 6.5 | - | - | - | - | - | - | - | - | - | - | - |
| 10 | 31.1 | 26.6 | 19.3 | 15.6 | 12.5 | 10.6 | 11.7 | 23.7 | 12.1 | 13.5 | 7.8 | 3.7 |
| 11 | - | - | - | 5.2 | - | - | - | - | - | - | - | - |
| 12 | - | 2.3 | 3.7 | 3.1 | - | - | - | - | - | - | - | - |
| 13 | - | - | - | - | - | - | - | 5.5 | 6.8 | - | - | - |
| 14 | 7.4 | 10.3 | 9.2 | 7.6 | 5.7 | 3.5 | 6.2 | 9.7 | 11.1 | - | - | - |
| 15 | 27.4 | 21.3 | 19.3 | 17.5 | 15.7 | 10.5 | 11.5 | 14.6 | 18.7 | 13.8 | 11.4 | 9.7 |
| 16 | 24.2 | 17.2 | 13.5 | 11.6 | 10.7 | 6.5 | 8.2 | 13.5 | 23.2 | 19.3 | 8.6 | 7.1 |
| 17 | - | - | - | - | 10.5 | - | - | - | 8.5 | 7.2 | - | - |
| 18 | - | - | - | - | - | - | - | - | 6.5 | - | - | - |
| 19 | 9.5 | 7.2 | 5.3 | 2.7 | - | - | - | - | 4.9 | - | - | - |
| 20 | - | - | - | - | 5.8 | 4.9 | - | - | - | 4.7 | - | - |
| 21 | - | - | - | - | 6.1 | - | - | - | 4.8 | 2.1 | - | - |
| 22 | 9.2 | 8.4 | 6.7 | 5.1 | 4.7 | 4.1 | 3.2 | 2.2 | 3.4 | 4.6 | 1.9 | 1.1 |
| 23 | - | - | - | - | - | - | - | 5.4 | 6.1 | - | - | - |
| 24 | 4.2 | - | - | - | - | - | - | 10.7 | 7.5 | - | - | - |
| 25 | 7.4 | 8.9 | 7.7 | - | - | 6.4 | 3.4 | 5.9 | 6.3 | - | 9.3 | - |
| 26 | 4.2 | - | - | - | - | - | - | 6.2 | - | - | 3.2 | 2.5 |
| 27 | - | - | - | - | - | - | - | 4.1 | - | - | - | - |
| 28 | 4.3 | 2.1 | - | - | - | - | - | - | - | - | 8.5 | - |
| 29 | 7.4 | 6.5 | - | - | - | - | - | - | - | - | 9.2 | 11.5 |
| 30 | 17.1 | 10.3 | 9.1 | 7.6 | 5.5 | - | - | - | - | - | - | - |
| **Total Number of Species** | **17** | **16** | **14** | **12** | **11** | **7** | **6** | **13** | **14** | **12** | **9** | **8** |

**Table 3: Percent of Occurrence of Mycoflora Isolated from Control Soil**

| Name of Species | Jul | Aug | Sep | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 9.6 | 11.4 | 8.3 | 6.5 | 3.2 | - | - | - | - | - | 3.9 | - |
| 2 | - | - | - | - | 3.9 | 2.7 | - | - | - | - | - | - |
| 3 | - | - | - | - | - | - | - | 5.2 | - | - | - | - |
| 4 | - | - | - | 4.3 | - | - | - | - | - | - | - | - |
| 5 | 8.7 | 9.3 | 7.4 | 6.7 | 5.2 | - | - | 6.2 | 11.7 | 13.5 | - | - |
| 6 | 2.3 | 2.8 | - | - | - | - | - | 2.7 | 3.5 | 2.9 | - | - |
| 7 | 9.2 | 4.8 | 6.8 | - | - | - | - | 6.2 | - | 9.3 | - | - |
| 8 | - | - | - | - | - | - | - | - | - | 5.2 | 4.3 | 2.7 |
| 9 | 13.7 | 12.5 | 9.3 | - | - | - | 7.6 | - | - | 4.1 | - | - |
| 10 | - | - | - | - | - | - | - | - | - | - | 5.4 | 3.2 |
| 11 | 11.6 | 13.3 | 18.6 | 19.1 | 15.6 | 10.5 | 7.6 | 16.7 | 27.6 | 17.6 | 10.8 | 4.6 |
| 12 | - | - | - | - | 5.4 | 4.7 | - | - | - | - | - | - |
| 13 | - | 4.3 | 3.9 | 3.6 | 3.1 | 1.9 | 2.7 | 6.2 | 3.8 | - | - | - |
| 14 | - | - | - | - | - | - | - | 5.9 | - | - | 3.1 | - |
| 15 | - | 4.8 | - | - | - | - | 2.8 | 4.3 | 5.2 | 3.9 | - | - |
| 16 | 12.7 | 15.6 | 13.2 | 11.5 | 8.7 | 5.6 | 6.8 | 9.4 | 14.3 | 16.6 | 10.5 | 5.4 |
| 17 | 11.4 | 12.8 | 12.1 | 11.2 | 9.4 | 6.1 | 7.8 | 8.3 | 10.5 | 13.6 | 9.7 | 4.3 |
| 18 | - | - | - | - | 9.3 | 5.7 | 7.6 | - | 8.2 | - | - | - |
| 19 | - | 4.8 | - | - | - | 6.5 | - | - | - | - | - | - |
| 20 | - | - | - | - | 6.9 | - | - | 5.4 | - | - | - | - |
| 21 | 8.4 | 7.1 | 6.8 | 5.9 | - | - | - | - | - | - | - | - |
| 22 | 5.8 | 8.6 | - | - | - | - | 7.6 | - | 6.2 | 5.1 | - | - |
| 23 | 9.6 | 11.8 | 8.4 | - | - | - | - | 6.2 | - | - | - | - |
| 24 | - | - | 6.8 | 7.5 | - | - | - | - | 4.3 | - | - | - |
| 25 | 5.7 | 8.9 | 6.8 | 5.2 | - | - | - | 6.6 | - | - | - | - |
| 26 | - | - | 9.4 | 7.2 | - | - | - | - | 6.4 | - | - | - |
| 27 | 7.3 | 8.6 | 6.1 | 5.7 | 5.1 | 3.9 | 2.1 | - | - | - | - | - |
| 28 | 9.3 | 8.7 | 6.8 | 6.1 | 5.7 | 4.1 | 3.4 | 5.2 | 7.6 | 5.7 | 4.3 | 2.7 |
| **Total Number of Species** | **14** | **17** | **15** | **13** | **12** | **10** | **10** | **14** | **12** | **11** | **8** | **6** |

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# PLASTICULTURE : SCOPES AND CHALLENGES IN INDIA

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**Abstract**

Plasticulture is a system wherein crops are grown in a way such that a significant benefit is derived from using plastic polymers. It constitutes the application of plastic including polyethylene and polypropylene as plastic mulch, plastic tunnel, pipeline for drip irrigation, for constructing greenhouses etc. This review critically discusses the current understanding of the scope, reliability and environmental consequences of plasticulture. Besides acting as a local 'greenhouse', and an agrarian economy booster, this method is also very promising when it comes to water conservation and reduction of the fertilizer input burden. However, very less is known about the ill effects of plasticulture and its associated technologies. This opens up the future realm of study. Workers around the world have questioned the feasibility of the use of plastics in agriculture, as this might deteriorate top soil quality more than doing any good to it. Studies on microplastics contamination in soil have thrown light on the same. Associated threats of the interaction of these microplastics with various chemical entities (Like POPs, PAHs etc.) in the soil are an inevitable peril. Few studies have also reported the release of carcinogenic phthalate acid esters from these microplastics.

**Introduction**

Enhancing agricultural produce has been the priority of an agrarian economy. Various technological and chemical interventions have been tried and tested for obtaining the requisite yield. Plasticulture is a physical measure that enhances soil properties like soil porosity and water retention thereby increasing agricultural yield. The plasticulture system is a complex system composed of plastic mulches, drip irrigation, fumigation and solarization, windbreaks, stand establishment technology, seasonal-extending technology, pest management, cropping strategies, postharvest handling and marketing(Lamont, 1999).

Plasticulture is a widely practised for its instant economic benefits such as higher yields, improved fruit quality, reduced leaching of fertilizers, more efficient use of fertilizer, a potential decrease in the incidences of diseases, earlier harvests, and increased water-use efficiency, reduced soil and wind erosion etc. (Lamont, 1999; Steinmetz et al., 2016). Though, applying plastic mulch to nutrient-deficient and previously uncovered arid soil only temporarily reduces erosion (Prosdocimiet al., 2016). In long run it may even result in more fragile soil structures(Steinmetz et al., 2016). This technology also poses certain challenges like plastic film and plastic fragments disposal, emission of greenhouse gases such as a Nitrous oxide ($N_2O$) recovery and reuse of abandoned plastic sheet fragments etc(Bergeret al., 2013).

For countering the challenge of degradation of the abandoned plastic and promoting sustainable agriculture, Green Plasticulture comes into play. It implies the usage of sustainable practices like employment of degradable plastic polymers. Scientists have classified polymer degradation into four different classes based on their mode of action. These are *Thermal degradation* (alteration of high and low temperature to break polymer chain), *Chemical degradation* or disintegration (which involves the provision of acidic/basic condition ), *Biological degradation* (utilization of the starchy part of the polymer by the microorganism, as their carbon source), and *Photooxidative degradation* (which involves photon energy sourced from ultraviolet (UV) light to initiate breakage of the polymeric chain of polymers)(Akidah et al., 2016).

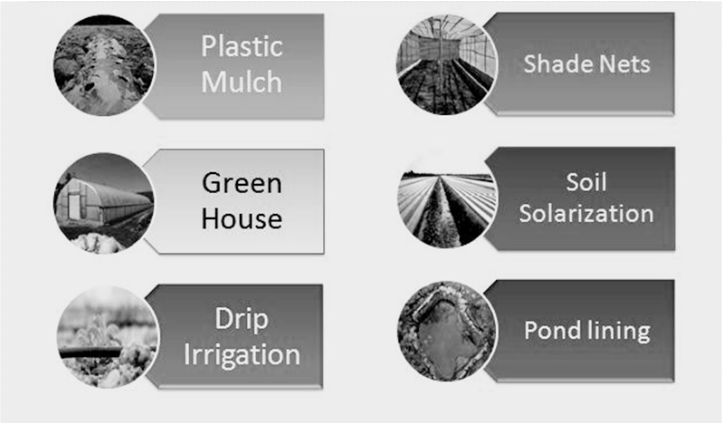


**Fig. - 1 : Various components of Plasticulture.**

Plastic finds its way in agriculture through following prominent techniques (Fig. 1)-

a) **Plastic mulching-** It is an example of in-organic mulching, which implies covering the cultivated agricultural patch with a plastic sheet (Low- density polyethylene-LDPE and Linear low-density polyethylene-LLDPE) (Kasirajan & Ngouajio, 2012) either transparent or black. This prevents weed growth, ascertains required temperature and moisture content in the soil. This also prevents Methyl Bromide, a fumigant and an ozone-depleting agent from escaping the soil.

b) **Drip Irrigation** - This process involves supplying plastic mulched patch with water dropwise either via the soil or directly to the root zone. This ensures judicious use of water, and plastic mulching prevents its rapid evaporation.

c) **Greenhouse** – It is a structure built out of plastic (polyethene film, polycarbonates) or glass, which encloses a controlled environmental condition, simulating the condition suitable for the growth of the plants under consideration.

d) **Plastic tunnel**- This technique facilitates the entrapment of carbon dioxide gas inside the plastic sheet, thus enhancing the carbon source for photosynthesis.

Besides these, plasticulture technologies also include plastic shade net, sun solarization technique, lined ponds, water sprinklers etc. The objective of this work was to understand the merits and demerits of Plasticulture by analyzing published research.

**Plasticulture in India**

Prominent Government schemes that promote plasticulture include National Mission on Micro Irrigation (NMMI), Rashtriya Krishi Vikas Yojana (RKVY), National Horticulture Mission (NHM), Horticulture Mission for North East and Himalayan States (HMNH). As a solution to improve resource utilization and improve yields, the Government has set up National Committee on Plasticulture Applications in Horticulture (NCPAH) to popularise adoption of plasticulture in India (Singh, 2018). To decentralize this further, and for its efficient implementation, Precision Farming Development Centres have been set up in many states to promote Precision Farming & Plasticulture Applications in horticulture. This addresses key aspects like water resource management (promotion of micro-irrigation), nursery management, judicious irrigation, environmentally sound cultivation etc. As of now, there isn't any BIS standard for the manufacture of plastic mulch. However, it has compiled a code of practice - IS:15177:2002: Surface Covered Cultivation - Plastic Mulching - Code of Practice, which may be referred to (BIS 2002).

**Benefits of Plasticulture**

The early researches (before 1960) conducted were on the impact of colour (black or clear) of the plastic film on soil temperature, moisture retention and vegetable yields. Colour affects the surface temperature of the mulch and the underlying soil temperature(Lamont, 1999). Black coloured plastic cover acts as a black body-absorbing nearly all incident sunlight, and re-radiating it back to the surrounding. Since the soil has good thermal conductivity, its proximity with the overlying black plastic sheet ascertains thermal conduction of heat. This raises the soil temperature considerably. Transparent plastic sheet, with water vapours on its soil facing side, ascertains absorption of the short wave energy wave but hinders the radiation of long-wave infrared radiation to escape the soil micro-environment. This raises the soil temperature. Certain wavelength-selective plastic sheets have also been tested. These ensure the selective transmission for long-wave infrared waves, thus elevating the soil temperature. Thus, these plastic mulches directly affect the microclimate around the plant by modifying the radiation budget(Schrader, 2000) (Fig. 2).

Many studies had established the fact that plasticulture is known to increase crop production not only by keeping soil

temperature and water content high but also by restricting weed growth (Berger et al., 2013). Plastic fragments are non-degradable. However, fragmented, aged and weathered degraded fragments of the same polymer containing iron, manganese or cobalt as typical prooxidants, support microbial growth in the absence of any other source of carbon. Many studies show that plastic residues can impose selective pressure on distinct microbial taxa as anthropogenic substrates(Qi et al., 2020).

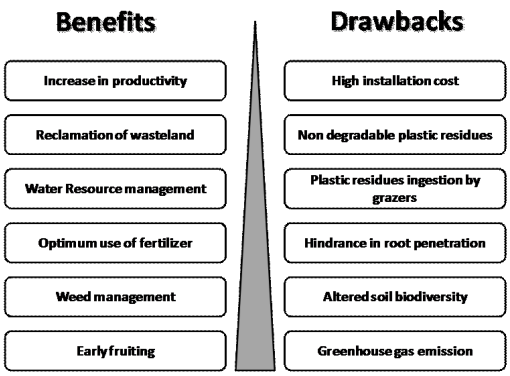


**Fig. : 2 - Benefits and drawbacks of Plasticulture.**

**Plasticulture: An Evil in Disguise**

Comparative studies on the macro and micro fragments of low-density polyethene-based and biodegradable starch-based plastic mulch show surprising results. Based on the study conducted on the wheat plant, the latter has shown a more negative effect on its vegetative growth than the prior (Qi et al., 2018). Studies have also reported the increase in pH and decrease in EC of the soil mulched with plastic as compared to untreated soil. Comparative studies on the macro and micro fragments of low-density polyethene-based and biodegradable starch-based plastic mulch show surprising results. Based on the study conducted on the wheat plant, the latter has shown a more negative effect on its vegetative growth than the prior(Qi et al., 2018). Studies have also reported the increase in pH and decrease in EC of the soil mulched with plastic as compared to untreated soil. Scandinavian and Czech researchers have held these plastics accountable for Microplastic (plastic particle in the size range of 100 nm to 5mm) pollution in the farmland and beyond. Plastic fragments tend to adhere to hydrophobic chemicals administered to the soil. These carcinogenic chemicals bioaccumulate and biomagnify up the food chain. These microplastics are known to show their potential interaction with the Persistent Organic Pollutants (POPs)-like dioxins, Poly Aromatic Hydrocarbons (PAHs), heavy metals etc.(Yazdaniet al., 2019).

The fragments of plastic film left in fields can also accumulate pesticides and other toxins applied to crops. This poses a risk for sheep, goats and another livestock grazing on crop stalks because of their potential to ingest plastic material or the chemicals that leach from it. Studies have also deciphered the ill effect of the plastic mulch on the metabolism of the natural microbiota in response to the different carbon sources. A study by Cao et al , 2017) shows the detrimental effect of these microplastics on the immune system of the earthworm and consequently on their growth and overall life expectancy. Microplastic exposed worms show gut inflammation too. As the plastic further fragments off (up to nanoscale), it might infiltrate a cell, surpassing gut, consequently affecting a high array of other organisms too. Plastic mulch is also known to cause a considerable threat to the soil biodiversity and related ecosystem functions in agroecosystems. Farmlands subjected to plastic mulch has shown a considerable decrease in the microbial activity (Wang et al., 2016) and taxonomic richness of invertebrates as the function of temperature and soil moisture content (Schirmelet al., 2018). Surface runoffs from plastic mulched farms affect aquatic ecosystem. This increases the threat of heavy metal contamination in the adjoining water body(Luckenbachet al., 1996).

**Conclusion and Way Forward**

Plastic mulching could be held promising for enhancing the agricultural yield as it controls the physical- edaphic factors, which consequently determines the plant's growth. It also ascertains the judicious use of the water resource (through smart irrigation practices like drip irrigation) and optimum application of fertilizers. Hence this mulching process helps in checking the secondary effects associated with these fertilizers like soil leaching, heavy metal pollution,bioconcentration,biomagnification, cancer to name a few. Nonetheless, the usage of plastic products in this technology cannot be neglected.

Biogeochemical processes involved in plastic mulching has not been studied widely. Its potential impact on the ecosystem services needs further considerations. More researches need to be done on the proper collection, segregation and transportation of the plastic waste from the site of use to the point where it is processed, and then to the point of incineration. Greenhouse emissions at the incineration site too need considerations.

To deal with the peril posed by plastics, several measures could be taken viz., use of straw mulch, development and use of photodegradable or biodegradable materials like biodegradable aliphatic polyesters (e.g., polyhydroxybutyrate or polylactic acid) or starch–polymer blends (which just disappear, hence countering the problem of waste transportation, management and disposal.), using the plastics several times (hence decreasing and delaying the fresher plastic demand); using lightweight films (lesser waste production), recycling (hence minimizing /delaying environmental consequences) and incineration (waste to energy). Incinerating hard to dispose of items like plastic mulches and drip irrigation tapes helps to recover their substantial fuel value(Hemphill, 2018).

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*Three Major dimensions of life : Environment, Agriculture and Health*
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# MARINE POLLUTION, SOURCES, EFFECT AND MANAGEMENT

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**Abstract**

**Marine pollution** is the harmful effect caused by the entry into the **ocean** of chemicals or particles. ... Many particles combine chemically in a manner highly depletive of oxygen, causing estuaries to become anoxic. This article explains the causes, consequences and cure of Marine pollution. Three different kinds of marine pollution have been categorised – caused through land, caused through air and caused by means of transportation. The pollutants from the land like industrial wastes and other wastes are discharged into sewerage and more untreated waters of from fertilizer and pesticide run off from agricultural lands that further is disposed into the waterways. Daily use of plastics is also contributing to the marine pollution. Oil spills and negligent acts of the transporters of the oil have a hazardous impact on marine life. Microorganisms and other animals eat the plastic assuming it as food and die off. There are many different enacted legislations which have provided for the prevention of the environment. This paper shall chalk out the steps to prevent the pollution that has been caused by endless pollutants.

This short review summarizes the present knowledge on pollutant impacts on marine viruses, virus-host systems and their potential ecological implications. Excess nutrients from sewage and river effluents are a primary cause of marine eutrophication and mucilage formation, often related to the development of large viral assemblages. At the same time, hydrocarbons, polychlorinated biphenyl and pesticides alter ecosystem functioning and can determinate changes in the virus-host interactions, thus increasing the potential of viral infection. All these pollutants might have synergistic effects on the virus-host system and are able to induce prophage, thus increasing the impact of viruses on marine ecosystems.

**Introduction**

**Marine pollution** occurs when harmful effects result from the entry into the ocean of chemicals, particles, agricultural and residential waste, noise, or the spread of invasive organisms. Eighty percent of marine pollution comes from land. Air pollution is also a contributing factor by carrying off pesticides or dirt into the ocean. Land and air pollution have proven to be harmful to marine life and its habitats.

The pollution often comes from nonpoint sources such as agricultural runoff, wind-blown debris, and dust. Pollution in large bodies of water can be aggravated by physical phenomena like the biological effects of Langmuir circulation. Nutrient pollution, a form of water pollution, refers to contamination by excessive inputs of nutrients. It is a primary cause of eutrophication of surface waters, in which excess nutrients, usually nitratesor phosphates, stimulate algae growth. Many potentially toxic chemicals adhere to tiny particles that are then taken up by plankton and benthic animals, most of which are either deposit feeders or filter feeders. In this way, the toxins are concentrated upward within ocean food chains. Many particles combine chemically in a manner highly depletive of oxygen, causing estuaries to become anoxic.

When pesticides are incorporated into the marine ecosystem, they quickly become absorbed into marine food webs. Once in the food webs, these pesticides can cause mutations, as well as diseases, which can be harmful to humans as well as the entire food web. Toxic metals can also be introduced into marine food webs. These can cause a change to tissue matter, biochemistry, behaviour, reproduction, and suppress growth in marine life. Also, many animal feeds have a high fishmeal or fish hydrolysate content. In this way, marine toxins can be transferred to land animals, and appear later in meat and dairy products.

In order to protect the ocean from marine pollution, policies have been developed internationally. There are different ways for the ocean to get polluted, therefore there have been multiple laws, policies, and treaties put into place throughout history.

**Definition**

**Marine Pollution (UN definition) –**

"The introduction by man, directly, or indirectly, of substances or energy to the marine environment resulting in deleterious effects such as: hazards to human health, hindrance to marine activities, impairment of the quality of seawater for various uses and reduction of amenities." Marine pollution is a combination of chemicals and trash, most of which comes from land sources and is washed or blown into the ocean. This pollution results in damage to the environment, to the health of all organisms, and to economic structures worldwide.

**Types of Marine Pollution**

**Eutrophication**

When there is an excess of chemical nutrients mainly nitrates and phosphates in the water, it leads to eutrophication or nutrient pollution. Eutrophication decreases the level of oxygen, reduces the quality of water, makes the water inhabitable for fish, affects the breeding process within the marine life and increases the primary productivity of the marine ecosystem.

**Acidification**

Oceans act as a natural reservoir for absorbing the carbon dioxide from the Earth's atmosphere. But, due to rising level of carbon dioxide in the atmosphere, the oceans across the world are becoming acidic in nature, as a consequence, it leads to acidification of oceans. Researches and scientists have not been able to uncover the potential damage ocean acidification may have on the Earth's atmosphere. But, there is a strong concern that acidification might lead to dissolution of calcium carbonate structures, that can affect the shell formation in shellfish and also the corals.

**Toxins**

There are persistent toxins that do not get dissolved or disintegrate with the marine ecosystem rapidly. Toxins such as pesticides, DDT, PCBs, furans, TBT, radioactive waste, phenols, and dioxins get accumulated in the tissue cells of the marine lifeforms and lead to bioaccumulation hampering the life underwater and sometimes leads to a mutation in aquatic life forms.

**Plastics**

The ever-growing dependence of human population on plastic has filled the oceans and the land, it consists of 80 percent of the debris found in the oceans. Plastic dumped and found in the oceans are dangerous for the marine life forms and wildlife, as sometimes it strangles and chokes them to death. The rising levels of plastic dumps found in the oceans are suffocating, ingesting, and entangling the life underwater as well as above it.

**Types of Oceans**


Over time, the number of oceans have evolved from a single water body to something different.

But it really depends where you are from if you recognize that there is a fifth ocean.

Pacific, Atlantic, Indian, Arctic… and the Southern Ocean which is off the coast of Antarctica.

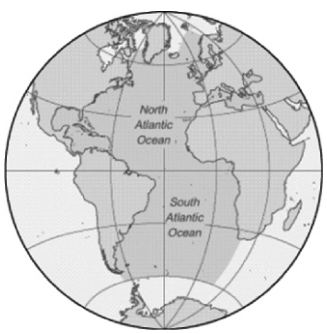
Today, we list the top 5 largest oceans in the world and the evolution of 5 oceans on Earth.

The Pacific Ocean is the largest ocean covering more than 30% of the Earth. This is close to half of the water on Earth.

It touches the west coast border of the Americas along with east Asia and Australia.

The equator divides the Pacific Ocean into two separate parts – North Pacific Ocean and South Pacific Ocean.

Pacific means "peaceful" in Latin. It has the deepest trenches with an average depth of 3800m.




**2. Atlantic Ocean**

The Atlantic Ocean is situated between the Americas and European/African continents. Atlantic Ocean is the second largest and saltiest ocean in the world.

It resembles an S-shape between the Americas, Europe and Africa. "Atlantic" originated from the Greek god "Atlas" who carried the sky for eternity.

The ocean bottom is composed of mid-Atlantic Ridge. This submarine mountain range extends all the

way from Iceland to 58 degrees South latitude. It's part of the longest mountain range in the world.

The Vikings, Portuguese and Christopher Columbus have extensively explored the Atlantic Ocean. Similarly to this day, it's being used for trade routes such as the transatlantic trade route.

**3. Indian Ocean**

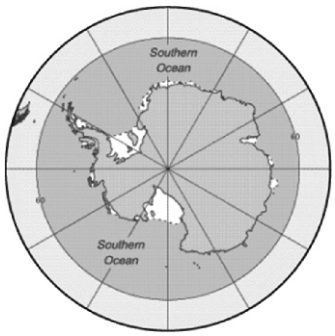

Indian Ocean is the third largest ocean surrounding a densely populated region. It contains additional 20% of water on Earth's surface.

It borders India at the North, East Africa, Australia and the Southern Ocean. Because if higher water temperature, it has limited marine life.

Since about 800 A.D. the Indian Ocean has played an important role in trading. For centuries, navigators have sailed along major ocean currents for shipment routes.

It is bounded by 4 tectonics plate boundaries and may include an additional plate boundary. It is the geologically youngest of the 5 oceans with spreading ridges at divergent plate boundaries.

**4. Southern Ocean**




In 2000, the Southern Ocean is the newest ocean recognized by the International Hydrographic Organization. It borders Antarctica in its entirity.

In terms of size, it's the fourth largest at 20,327,000 square kilometers. It extends out to 60 degrees South latitude.

It's an extreme environment and is the least understood of the 5 oceans. This is because it is unexplored, far from populated areas and has a severe climate.

Despite the Southern Ocean being unexplored, about 80% of all oceans in the world are unexplored. There's still a lot of work to do for ocean exploration.

**5. Arctic Ocean**

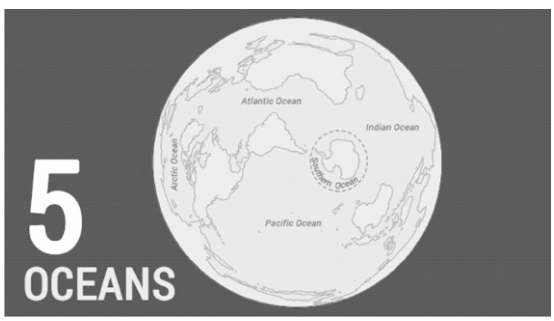
Arctic Ocean is the world's smallest and shallowest ocean of all 5 oceans. Further to this, it is the coldest and least salty ocean.


In size, the Arctic Ocean is about the size of Russia. Because it's located at the North Pole, the Arctic Ocean has polar ice. But over the years, glaciers have melted threatening sea levels to rise.

Despite the IHO recognizing it as the “Arctic Ocean”, some oceanographers still call it the “Arctic Sea”.

The Arctic Ocean is the most diverse in terms of fish species. It has a wide variety of marine species including whales, jellyfish, etc.

But because of its frigid temperatures, it has little plant life. This makes it one of the most fragile ecosystemson the planet.




**Sources of Marine Pollution**

Marine pollution is a growing problem in today's world. Our ocean is being flooded with two main types of pollution: chemicals and trash.

Chemical contamination, or nutrient pollution, is concerning for health, environmental, and economic reasons. This type of pollution occurs when human activities, notably the use of fertilizer on farms, lead to the runoff of chemicals into waterways that ultimately flow into the ocean. The increased concentration of chemicals, such as nitrogen and phosphorus, in the coastal ocean promotes the growth of algal blooms, which can be toxic to wildlife and harmful to humans. The negative effects on health and the environment caused by algal blooms that hurt local fishing and tourism industries.

Marine trash encompasses all manufactured products—most of them plastic—that end up in the ocean. Littering, storm winds, and poor waste management all contribute to the accumulation of this debris, 80 percent of which comes from sources on land. Common types of marine debris include various plastic items like shopping bags and beverage bottles, along with cigarette butts, bottle caps, food wrappers, and fishing gear. Plastic waste is particularly problematic as a pollutant because it is so long lasting. Plastic items can take hundreds of years to decompose.

This trash poses dangers to both humans and animals. Fish become tangled and injured in the debris, and some animals mistake items like plastic bags for food and eat them. Small organisms feed on tiny bits of broken-down plastic, called microplastic, and absorb the chemicals from the plastic into their tissues. Microplastics are less than five millimeters (0.2 inches) in diameter and have been detected in a range of marine species, including plankton and whales. When larger animals eat small organisms that consume microplastics, the toxic chemicals then become part of their tissues. In this way, the microplastic pollution migrates up the food chain, eventually becoming part of the food that humans eat.

Solutions for marine pollution include prevention and cleanup. Disposable and single-use plastic is abundantly used in today's society, from shopping bags to shipping packaging to plastic bottles. Changing society's approach to plastic use will be a long and economically challenging process. Cleanup, in contrast, may be impossible for some items. Many types of debris (including some plastics) do not float, so they are lost deep in the ocean. Plastics that do float tend to collect in large “patches” in ocean gyres. The Pacific Garbage Patch is one example of such a collection, with plastics and microplastics floating on and below the surface of swirling ocean currents between California and Hawaii in an area of about 1.6 million square kilometers (617,763 square miles), although its size is not fixed. These patches are less like islands of trash and, as the National Oceanic and Atmospheric Administration says, more like flecks of microplastic pepper swirling around an ocean soup. Even some promising solutions are inadequate for combating marine pollution. So-called “biodegradable” plastics often break down only at temperatures higher than will ever be reached in the ocean.

Nonetheless, many countries are taking action. According to a 2018 report from the United Nations, more than sixty countries have enacted regulations to limit or ban the use of disposable plastic items.

Pollutants are dumped into the ocean. This waste affects the daily life of fish and other marine creatures.

**From Land**

80% of non-biological marine pollution comes from land based activities

Most obvious inputs via pipes discharging directly into marine water (sewage, industrial,chemical and food processing wastes)

Riverine flows into the sea carry pollutants from the entire catchment area.

**From Air**

Global atmospheric inputs to the sea from air discharges .

**Sources of Pollution cont'd.**

**Maritime**

Oily discharges from ballast water and bilge water) during routine ship operations and illegal dumping of solid waste

Designated dumping grounds at sea (dredged spoil, old munitions, sewage sludge, fly ash, oil based drilling muds)

Accidental spills from Ships carrying hazardous substances, oil, gas etc.

**Marine Pollutants**

**Worldwide**

10 billion tonnes of ballast water withinvasives.

Est. 10,000 million gallons of sewage annually

- 3.25 million metric tonnes of oil annually
- Millions of tonnes of Solid waste

**Major Marine Pollutants - Metals**

Introduced dangerous metals include mercury, lead, and copper

Heavy Metals are a great concern because they enter the food chain

Fuel combustion, electric utilities, steel and iron manufacturing, fuel oils, fuel additives and incineration of urban refuse are the major sources of oceanic and atmospheric contamination by heavy metals

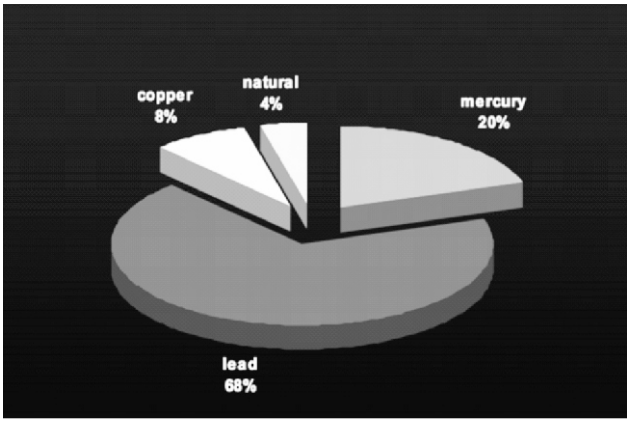
Copper is dangerous to marine organisms and has been used in marine anti-fouling paints

Mercury and lead poisoning cause brain damage and behavioral disturbances in children

Contaminated land runoff, rain of pollutants from the air, and fallout from shipwrecks pollute the ocean with dangerous metals

Human activities release 5 times as much mercury and 17 times as much lead as is derived from natural sources.

**Heavy Metals Entering Oceans**




**Major Marine Pollutants - Solid Waste**

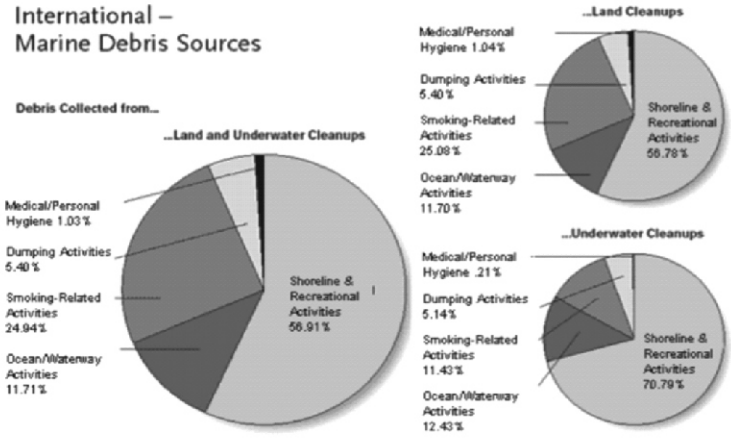
A large portion and great danger is non- biodegradable plastic

46,000 pieces of floating plastic/sq. mile of ocean surface off the N.E U.S. coast.

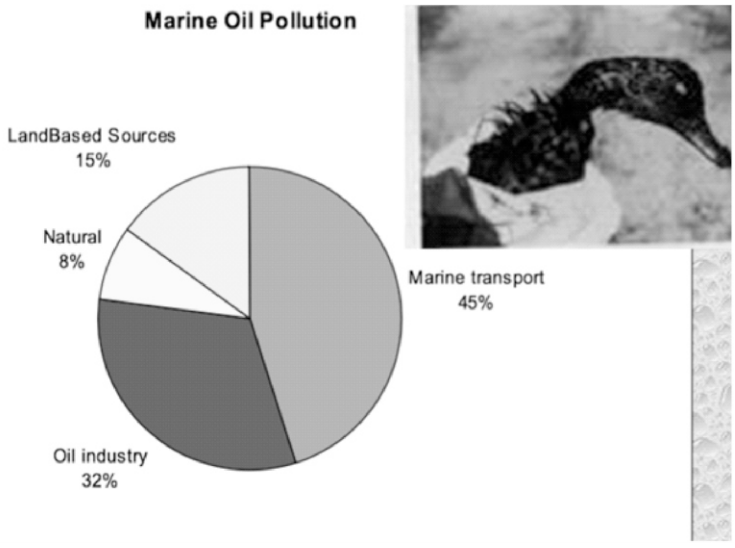
Sea turtles mistake plastic bags for jellyfish and die from internal blockages.

Seals and sea lions starve after being entangled by nets or muzzled by six-pack rings (decomposition time 400 years).

Plastic debris kills 100,000 marine mammals and 2 million sea birds die annually .



**Major Marine Pollutants - Oil**




**Major Marine Pollutants - Biological**

International Maritime Organization top ten: Cholera, CladoceraWater Flea, Mitten Crab, toxic algae (R,G,B tides), Round Goby, European Green Crab, Asian kelp, Zebra Mussel, North Pacific Sea star, North American Comb Jelly.

Spreading infestation of Jamaican waters by a Green mussel .

**Impacts of Marine Pollution**

Generally marine pollution affects ecosystem health, public health, recreational water quality and economic viability in the following ways:

Mechanical
Eutrophication
Saphrogenic
Toxicity
Mutagenic and Carcinogenic

**Cost of Marine Pollution**

3.25millionmetrictonsofoilwastedvs.3.4million tons used by Jamaica annually

100,000mammaland2millionbirddeathsannually

ReductionofGDPbydecreasingfisheryresource (11.9k tonnes – 7.7k landed 1960-97) and decreased tourism earnings

Lossofbio-diversityandpotentiallifesaving medicines (for AIDS &Cancer)

**Solutions to Pollution**

Two main methods

– Correction – costly and time intensive

- Prevention – requires attitude changes

Coastal Scientists believe that prevention is better than cure since the effects of marine pollution may be irreversible and we may therefore be creating everlasting damage to the marine ecosystem.

"An ounce of prevention is worth a pound of cure"

**Marine Pollution Conventions**

There are no less than 6 international marine pollution conventions. Some are listed below:

Convention for the Prevention of Marine Pollution by Dumping from Ships and Air craft (1972) The Oslo Convention

Convention for the prevention of pollution from ships (1973)MARPOL

Convention for the Prevention of Marine Pollution from Land-based Sources (1974) The Paris Convention

Convention for the Protection of the Marine Environment of the North-East Atlantic (1992) The OSPAR Convention

**Conclusion**

Although the ocean-and the resources within-seem limitless, there is clear evidence that human impacts such as overfishing, habitat destruction, and pollution disrupt marine ecosystems and threaten the long-term productivity of the seas. Declining yields in many fisheries and decay of treasured marine habitats, such as coral reefs, has heightened interest in establishing a comprehensive system of marine protected areas (MPAs)-areas designated for special protection to enhance the management of marine resources. Therefore, there is an urgent need to evaluate how MPAs can be employed in the United States and internationally as tools to support specific conservation needs of marine and coastal waters.

**Marine Protected Areas** compares conventional management of marine resources with proposals to augment these management strategies with a system of protected areas. The volume argues that implementation of MPAs should be incremental and adaptive, through the design of areas not only to conserve resources, but also to help us learn how to manage marine species more effectively.

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4. -WIKIPEDIA
5. -nationalgeographic.org

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# AN ACCOUNT OF MIRIDAE (INSECTA : HEMIPTERA : HETEROPTERA) FROM CHATTISHGARH, INDIA

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**Abstract**

Present study comprises 13 species belonging to 12 genera from the Chhattisgarh. 12 species were new to the state and one species new to India.

**Introduction**

The family Miridae is the largest family of true bugs. In the United States and Canada, members of the group are usually called plant bugs. They are commonly known as capsids, in Britain and Blindwanzen in Germany. Carvalho's classification, published in his catalogue of the Miridae of the World (Carvalho, 1959), has been modified Schuh (1984). About 11,123 valid species under 1200 genera of Miridae are known from all over the world. Study of Indian Miridae done by Distant, 1902 and 1910. study comprises 13 species belonging to 12 genera from the Chhattisgarh. 12 species were new to the state and *Diognetus intonsus* Distant, 1904 species new to India

**Material And Methods**

During the survey of the Chhattisgarh by the team of Zoological Survey of India Kolkata, altogether 50 specimens of Miridae bugs. by handpicking, net trap and light tarp methods. We sorted the specimens, pinned the bugs, dried them and identified with the help of available literature.

**Results**

SYSTEMATIC LIST

SUPERFAMILY: MIROIDEA

FAMILY: MIRIDAE

SUBFAMILY IRINAE

TRIBE: STENODEMINI

**Genus 1. *Notostiropsis* Poppius 1914**

1909. *Ebutius* Distant, *Annals and Magazine of Natural History* (8) **4**: 440-454.

1914. *Notostiropsis* Poppius: Die Miriden der Äthiopischen Region II –Macrolophinae, Heterotominae, Phylinae. Acta Societatis Scientiarum Fennicae 44(3): 1–136.

**1. *Notostiropsis bellus*** Carvalho, 1959*

1909. *Ebutius bellus* Distant, *Annals and Magazine of Natural History* (8) **4** : 440 - 454.

*Material examined*: 3exs, Belio, Dist. Koriya, Chhattisgarh, 22.X.2012, Mandal and party Coll.

*Length*: 6.5 – 7 mm.

*Distribution*: India : Chhattisgarh (Koriya), Maharashtra , Sikkim .

**TRIBE: MIRINI**

Genus 2. ***Stenotus*** (Distant,1904)

1904. *Nymannus* Distant, *Annals and Magazine of Natural History*, (7) **13**: 194-206.

1974. *Stenotus* Wagner, *Entomologische Abhandlungen*, 37 Suppl., iii + 484 pp

2. ***Stenotus rubricatum*** (Distant, 1904)

1904. *Megacoelum rubricatum* Distant, *Fauna Brit. India, Rhynchota*, **2**: 429.

1959. *Stenotus rubricatum* Carvalho, *Arquivos do Museu Nacional, Rio de Janeiro,* **48**: 384.

*Material examined*: 1ex, Parihat, Dist- Koriya, Chhattisgarh, 28.ix.2011, Mandal & Party Coll.

Length: 5.5 mm.

*Distribution*: India: Chhattisgarh. *Elsewhere*: Sri Lanka.

Genus 3. ***Lygus*** (Hann,1833)

1833. *Lygus* Hann, *Die wanzenartigen Insecten. C. H. Zeh*, *Nurnberg*., **1**: 119 -236.

3. ***Lygus partensis*** **Linnaeus,1758**

1758. *Cimex pratensis* Linnaeus: 448.

1959. *Lygus pratensis* Crvalho, *Cat*, 152.

*Material examined*: 1ex, Devidham, Dist- Korea, Chhattisgarh, 07.x.2011, Mandal & Party Coll .

*Length:* 4 mm.

*Distribution:* India: Chhattisgarh (Korea), Eastern Himalayas, and West Bengal.

Genus 4. ***Calocoris*** Fieber., 1858

1858. *Calocoris* Fiebr, *Wiener entomologische Monatschrift,* **2** : 305.

4. ***Calocoris rama*** Distant, 1909

1909. *Calocoris rama* Distant, *Annals and Magazine of Natural History* (8) **4:** 509-523.

1959. *Calocoris rama*: Carvalho, *Arquivos do Museu Nacional, Rio de Janeiro,* **48:** 384.

*Material examined*: 2exs, Maharshop, Dist-Surguja, Chhattisgarh, 09.xi.2011, Mandal & Party Coll.

*Length:* 5.5 mm

*Distribution*: India: Chhattisgarh (Surguja), and West Bengal.

Genus 5. ***Lygocoris*** Reuter,1875

1875. *Lygocoris* Reuter, *Bih. Vet.-Akad. Handl.,* **3** (1): 16.

5. ***Lygocoris pabulinus*** (Linnaeus, 1761)

1761. *Cimex pabulinus* Linnaeus, *Fauna Svecica sistens animalia Sveciae Regni. L. Salvii, Holmiae*., p. 578.

2001.*Lygocoris Lygocoris pabulinus* Lu & Zheng, Revision of Chinese species of Lygocoris (subgenus Lygocoris) Reuter (Hemiptera: Miridae: Mirinae). *Acta Zootaxonomica Sinica* 26: 121-153.

*Material examined*: 1ex, Belio, Dist-Korea, Chhattisgarh, 22. x.2012, Mandal & Party Coll; 2exs, Maharshop, Dist-Sarguja, Chhattisgarh, 09.xi.2011, Mandal & Party Coll.

*Length*: 5 mm.

*Distribution*: India: Chhattisgarh (Koriya, sarguja); Maharashtra, Uttarakhand, West Bengal. *Elsewhere*: China, Britain, USA, and Japan.

Genus 6. ***Creontiades*** (Distant, 1883)

1883. *Creontiades* Distant, *Biologia Centrali Americana,* **1**: 225-264.

**6. *Creontiades pallidifer* (Walker, 1873)**

1873. *Capsus pallidifer* Walker, *Catalogue of the specimens of Hemiptera Heteroptera in the*

1998. *Creontiades pallidifer* Yasunaga, *Entomological Science* **1**: 63-70.

*Material examined:* 1ex, Maharshob, Dist- Surguja, Chhattisgarh, 9.xi.20111, Mandal & Party Coll.

*Length*: 5 mm.

*Distribution:* India: Chhattisgarh (Surguja) and South India. *Elsewhere:* Korea, Japan, Sri Lanka.

Genus 7. ***Phytocoris*** (Fallen, 1814)

1814. *Phytocoris* Fallen, Specimen novam Hemiptera disponendi methodum exhibens. Lundae. 26

**7. *Phytocoris crinitus* Distant ,1904**

1904. *Phytocoris crinitus* Distant, *The fauna of British India, including Ceylon and Burma. Rhynchota. Taylor & Francis, London*. Vol. 2, part 2, pp. 243-503.

1959. *Phytocoris crinitus* Carvalho, A catalogue of the Miridae of the world. Part IV. *Arquivos do Museu Nacional, Rio de Janeiro* 48: 384.

*Materialexamined* : 1ex, Balod F.R.H, Dist- Durg, Chhattisgarh, 30.iii.2014, S.K.Gupta & R.P.Gupta Party Coll.

*Length*: 4.5 mm

*Distribution*: India: Chhattisgarh (Durg), Himachal Pradesh, and West Bengal.

*Elsewhere* – Sri Lanka.

**8. *Phytocoris stoliczkanus* Diastant ,1879**

1879.*Phytocoris stoliczkanus* Distant, *Descriptions of new species of Hemiptera, collected by Dr. Stoliczka during the Forsyth Expedition in Kashgar in 1873--1874. Transactions of the*

*Material examined*: 1ex, Narayanpur, Dist-Jhaspur, Chhattisgarh, 25.xi.2011, Mandal & Party Coll.

*Length*: 6mm

*Distribution*: India: Chhattisgarh (Dist-Jhaspur) and Punjab. *Elsewhere*: Myanmar and Pakistan.

**Genus 8. *Diognetus* Distant 1904**

1904. *Diognetus*: Distnat *The fauna of British India, including Ceylon and Burma. Rhynchota*. Vol. (2): 243-503.

1959.*Diognetus* Carvalho , A catalogue of the Miridae of the world. Part (4): 48- 384.

**9. *Diognetus intonsus* Distant, 1904**[#]

1904. *Diognetus intonsus* Distnat. , The fauna of British India, Rhynchota. Vol. (2): 243-503.

1959. *Diognetus intonsus* Carvalho , *A catalogue of the Miridae of the world. Part IV. Arquivos do Museu Nacional, Rio de Janeiro* 48: 384.

*Material examined*: 1ex, Badbhum F.R.H, Dist –Durg, Chhattisgarh, 01.IV.2014, S. K. Gupta & R.P.Gupta Party Coll.

*Length*: 5.5mm

*Distribution:* India: Chhattisgarh (Durg). *Elsewhere*: Sri Lanka.

**SUBFAMILY BRYOCORINAE**

**TRIBE DICYPHINI**

**Genus 9. *Helopeltis* Signoret, 1858**

1858.*Helopeltis* Signoret, *Note sur les Hemipteres Heteropteres de la famille des unicellules . annals de la sociate entomologique de france* (3) 6 : 499 - 502.

**10. *Helopeltis theivora* (Waterhouse, 1886)**

1886. *Helopeltis theivora* Waterhouse, *Some observations on the tea-bugs (Helopeltis)of India and Jva . Transactions of the Entomological society of London* (4): 457 - 459.

*Material examined*: 1ex, Badbhum F.R.H, Dist- Durg, Chhattisgarh, 29.iii.2014, S.K. Gupta & R.P.Gupta Coll .

*Length:* 6 -7 mm.

*Distribution*: India: Chhattisgarh (Durg), Assam, and Sikkim. *Elsewhere*: China, Java, Malaya, Sri Lanka, and Thailand.

**SUBFAMILY 3. PHYLINAE**

**TRIBE I. HALLODAPINI**

Genus 10. *Azizus* Distant 1910

1910. *Azizus* Distant, Descriptions of Oriental Capsidae. Annals and Magazine of Natural History (8)5: 10-22.

**11. *Azizus basilicus Distant* ,1910**

1910. *Azizus basilicus* Distnat, Descriptions of Oriental Capsidae. Annals and Magazine of Natural History (8)5: 10-22.

*Material examined*: 1ex, Badbhum F.R.H, Dist- Durg, Chhattisgarh, 29.iii.2014, S.K. Gupta & R.P.Gupta Coll .

*Length*: 5.5 mm

*Distribution*: India: Chhattisgarh (Durg), West Bengal.

**TRIBE II . PHYLINI**

**Genus 11. *Campylomma* Reuter,1878**

1878.*Campylomma* Reuter, Hemiptera Gymnocerata Europae. Hémiptères Gymnocérates d'Europe, du bassin de la Méditerranée et de l'Asie russe. I. *Acta Societatis Scientiarum Fennicae* 13: 1—188.

**12.*Campylomma lividum* Reuter,1885**

1885.*Campylomma livida* Reuter, Species Capsidarum quas legit expeditio danica Galateae descripsit. Entomologisk Tidskrift 5: 195-200.

*Material examined:* 1ex, Parihat, Dist- Korea, Chhattisgarh, 28.ix.2011, Mandal & Party Coll.

*Length:* 2.5 mm

*Distribution:* India: Chhattisgarh (Dist-Korea), West Bengal.

**SUBFAMILY X: ORTHOTYLINAE**

**TRIBE: ORTHOTYLINI**

Genus 12. ***Cyrtorhinus*** Fieber 1858

1858.*Cyrtohinus* Fieber, *Wiener entomologische Honatschrift,* **2** : 289 -327 .

13. ***Cyrtorhinus lividipennis*** Reuter,1885

1885. *Cyrtorhinus lividipennis* Reuter, *Entomologisk Tidskrift,* **5** : 195 -200 .

*Material examined*: 2exs, Parihat, Dist- Korea, Chhattisgarh, 28.ix.2011, Mandal & Party Coll.

*Length*: 2.5 – 3.5 mm

*Distribution:* India: Chhattisgarh (Korea), Madurai, and Nicobar Island.

**Summary and Conclusion**

The present paper incorporated the account of 13 species of miridae belonging to 12 genera from the state of Chhattisgarh, all the species are first time recorded from the state. For each species the original and the subsequent references, distributional records in India and elsewhere, keys to various taxa have been provide. This is the first comprehensive account of mirid bugs from the state of Chhattisgarh.

**Acknowledgement**

Authors express their sincere gratitude to the Director, Zoological Survey of India for providing all sorts of laboratory facilities during the entire period of work. Thanks are also due to Dr. C. Ragunathan, Scientist - E and divisional-in-charge, Entomology Division - B for their continuous encouragements and valuable guidance. The co - operation extended by the staff member of the Hemiptera Section is thankfully acknowledged.

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# EFFECT OF PHARMACEUTICALS WASTEWATER ON ENVIRONMENT AND THEIR PROMISING MITIGATION METHODS: AN OVERVIEW

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**Abstract**

India is considered as the fifth largest contributor for pharmaceutical production. During the last two decades, pharmaceuticals industries has drawn much attention for the deteriorating impact on environment while giving rise to unexpected and harmful consequences on human health. Several Pharma Products cannot be removed from water even after their treatment from wastewater treatment plants and remain suspended in water bodies that ultimately causes ill effect on plants and aquatic life. Sometimes, it becomes persistent and causes bio magnification by entering into the food chain. The occurrence of varieties of these pharma waste into water bodies such as surface, ground and drinking water around the globe has raise much concern towards their mitigation. Pharma industries are categorized into three broad categories namely biological , chemical and medicinal while chemical products was considered to be a major creator of persistent toxicant in water bodies. Numerous Technologies have been developed so far for the decontamination of water where adsorptive treatment was found to be the most convenient and cost effective method.

**Introduction**:

Pharmaceutical industries have showed a significant contribution to high economic growth since its industrialization but simultaneously it possess some serious threat to environment and human health around the globe. Occurrence of Pharmaceuticals waste in surface water was first reported in US and Europe in 1961 while its impact on aquatic life has drawn attention in 90s after the feminization of fish living in downstream of waste water was discovered (Gadipelly et al., 2014). Similarly, Decline in the population of vultures were reported where presence of some anti-inflammatory drugs was diagnosed for the renal failure of the species. Moreover, chemicals that are often used in household, industrial and agricultural purposes can enter the environment through wastewater (Liu et al., 2020). Pharmaceutically active compound are well reported for their intrinsic biological activity that leads to the disruption of hormonal activities mostly in aquatic living species. Likewise, most of the compounds used today as pharmaceutical products are prepared by chemical synthesis (Stackelberg et al., 2004). The Production of pharmaceutical compounds using chemical synthesis comprises of multiple series of mainly batch processes, in which many intermediate stages and chemical reactions are achieved consecutively. These by product so formed during the synthesis are considered as wastes and emissions. Traditional wastewater treatment methods, such as activated sludge, Trickling filter are not enough for the complete removal of Pharmaceutical waste especially persistent compounds (Lin et al., 2016) Thus, an alternative method needs to be discover for their proper treatment. Later on, membrane filtration, reverse osmosis and activated carbon were discovered that works along with traditional methods for treatment of industrial wastewater. In the present review, the ill effect of several pharmaceutical waste water on environment was summarized with their respective treatment methods.

**Characteristics of Pharmaceutical Wastewater**

Pharmaceutical Effluents are generated from these industries possess solids, biodegradable and non-degradable organic

compounds etc. The physico-chemical analysis of the effluents indicates the standard parameters needs to be monitored before their discharge into the main stream. An important pollution index of industrial wastewaters is the oxygen content in chemical oxygen demand (COD) and biological oxygen demand (BOD), where the nutrients status are measured in terms of amount of nitrogen and phosphorus in waste water. Besides this, other significant water quality parameters include pH, temperature and total suspended solids (TSS). However; pharmaceutical effluents are also categorized by their unusual turbidity, conductivity, COD, TSS and total hardness

**Classes of Pharmaceutical Wastes**

WholesaleProduction of pharmaceuticals compounds are manufactured by performing variety of processes including chemicalsynthesis, fermentation, extraction, and other complex methods. Moreover, the pharmaceuticalindustry produces many products using different kinds of raw material as well as processes;hence it is difficult to generalize its classification. Thus, they have classified on the basis of the application of the manufactured product. There are three main classes i.e. medicinal where drugs such as antibiotics, vitamins, antihistamines and antipyretics etc. have been manufactured .Similarly, Biological class of pharma industries produces vaccines and toxoids and serum while botanical class includes those industries where product extracted from plants such as morphine and quinine etc.

**ffect on Environment**

Pharmaceutical remains even in a very minute quantity can effect environment severely. Meanwhile, the occurrence of these pollutant has drawn much attention due to their persistent nature while sometimes these compounds directly interact at cellular level where it induces toxic effect on organism–(Liu et al., 2020). The presence of these pharma residues in the environment due to some significant processes such as adsorption to soils and sediments, complexation with metals and organics, chemical oxidation, photolysis, volatilization, and biodegradation. While a Thus, physicochemical properties of water and soil like water partition coefficient, dissociation constants, vapor pressure, or Henry's Law constant, may decide whether the compounds resolve will be concentrated in the aquatic, terrestrial, or atmospheric environment or removed by natural phenomenon. Similarly the chemical structure and composition of drugs plays an important role in their persistence and reactivity towards nature.

**Impact on Aquatic life**

Pharmaceutical residuals discharged into the aquatic environment may cause surprising and detrimental consequences on aquatic organisms as they have been especially designed to bring noticeable biological effects even at very low concentration levels.In freshwaters, various aquatic species is a food source of terrestrial life that becomes a cause of transmission of toxicant from water bodies to terrestrial animals. Several pharmaceuticals and their metabolites have been introduced in urban aquatic ecosystems, mainly originating from effluents of wastewater treatment plantsas these micro-pollutants could not be completely removed by the conventional treatment processes adopted in the plants that may cause bio magnification due to its accumulation in food chain(Schwab et al., 2005).

**Toxicity in Plants**

Pharmaceuticals remain in treated wastewater used to irrigate agricultural crops. Reuse of treated wastewater for agricultural irrigation is rising in dry and semi-arid areas, while increasing amounts of alternatives such as pesticides and fertilizers being applied to fields to improve agricultural outputswhich may enter agricultural soils and potentially contaminate food crops(Wu et al., 2015). A major public concern regarding agricultural applications of treated wastewater is the introduction of contaminants into crops through plant uptake (Christou et al., 2017). Contamination of food by these chemicals may cause potential health risks to humans. Pharmaceutical compounds was likely to be small through daily consumption of crops grown in treated wastewater irrigated soil. A study on waste water irrigated root crops such as carrots and sweet potato was performed which showed significantly higher concentration of several pharmaceutical compounds like ibuprofen, diclofenac and sulfamethoxazole etc. where maximum concentration was diagnosed in leaves rather than roots (Malchi et al., 2014).

**Effect on Human Health**

The main concern attributed to the presence of pharmaceuticals and their metabolites is the potential for adverse effects on human health and other living organisms, which thus far not has been well-documented(Schwab et al., 2005). Substantial work has been conducted to evaluate potential health effects of pharmaceutical compounds present in drinking water sources are still very much limited for potential toxic effect on human health (Semerjian et al., 2018).

**Technologies For Treatment**

Wastewater effluent from pharmaceuticals industries before dumping into main stream treated by wastewater treatment

plant. However, the traditional treatment plant consist of activated sludge process which was found to be insufficient to remove all the pharmaceutical residues from waste water. Thus various alternative techniques have been developed to treat the wastewater so as to remove considerable amount of toxicant from water bodies(Deegan et al., 2011). There are three main methods so far developed for the decontamination of water bodies. These are:

**Biological Method**

In this method application of biological component has been utilized to disintegrate the contaminant(Mayabhate et al., 1988). Broadly it is divided into two subcategories namely aerobic and anaerobic method. Aerobic applications include activated sludge, membrane batch reactors and sequence batch reactors while anaerobic methods include anaerobic sludge reactors, anaerobic film reactors and Anaerobic filters. Another version of activated sludge known as membrane bioreactors was found to be effective for the removal of bulk organics that could be suitable for traditional methods(Shariati et al., 2010). However, the wastewater characteristics play a key role in the selection of biological treatments. Activated sludge treatment is unsuitable for the treatment of wastewater where the COD levels are greater than 4000 mg/L.The benefits of anaerobic treatment over aerobic methods is due to its capability to treat comparatively higher volume of wastewater with lower consumption of energy,Nutrient, operating cost and improved biogas recovery(Oktem et al., 2008). Despite these advantages it possess some drawbacks where wide range of natural and xenobiotic organic chemicals in pharmaceutical wastewaters are recalcitrant and non-biodegradable to the microbial mass which make this method ineffective for treatment of wastewater.

**Physico-chemical Method**

Physio chemical method for decontamination of wastewater is based on the principles where physical interaction and chemical reaction occurs to break down the complicated structures of pharmaceuticals compounds. There are several methods that have been studied for the wastewater treatment**.** These technologies include membrane separation, nano adsorbent,activated carbon, chlorination, ultraviolet irradiation and other innovative methods. The efficiency of these methods for the treatment of pharmaceutical wastewater varies significantly while nanoparticle based adsorbent was found to be a promising candidate for wastewater treatment

**Chemical Methods**

A chemical method developed which is also taken into consideration for tertiary treatment of wastewater. A technology has been developed where chlorination was utilized to remove various pharma residues such as estradiol andsulfonamides. Similarly, Chlorine dioxideis also effective for the removal of sulfamethoxazole and diclofenac.Further, Oxidation reactions have primarily been used to supplement rather than replace conventional systems and to enhance the treatment of refractory organic pollutantsOzone has been applied to the treatment of waters primarily due to its strong disinfection and sterilizationproperties(Akmehmet Balcıoğlu and Ötker, 2003). Its application for thetreatment of waters containing pharmaceutical residuesis now a broad area of research.

**Conclusion**

Pharmaceutical compounds have been emerged as one of the noxious pollutant present in theenvironment. The impacts of drugs are entering into and occurring on ecosystems, biota and humans. The ill effects of these contaminants on Plants, aquatic and terrestrial life need to be investigated through qualitative and quantitative toxicological studies. Genuine efforts are required to reduce the problem along with some adequate regulations to monitor or to control them. Water quality guidelines enforced in India needs to include analysis of most commonly used pharmaceutical compounds in drinking water sources. The present wastewater treatment plant is found to be not much satisfactory for the removal of these persistent toxic compounds Moreover, the modern remedial methods need to be implemented at larger scale for effluent treatment plants of pharmaceutical industries to control chronic deteriorated impact of these compounds on long term environmental and human health.

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# AN EFFECTIVE RECLAMATION STRATEGY OF FLY ASH *VIA* ITS UTILISATION IN ARABLE LANDS

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## Introduction

Fossil fuels accomplish the energy needs of organisms and have significant role in the global energy production. However, the utilization of these energy sources has an extreme effect on our environment, which is well documented. Coal, one of the most significant primary fossil fuels, a carbon-rich solid that can be used as a source of energy from which several synthetic compounds can be produced and in the production of coke for metallurgic processes. It is also important in the production of electrical power using steam generation. Around 3.5.109mg of coal is mined in the world annually, which accounts for almost 38% of the world's electricity source (Ram and Masto 2010). Its combustion causes a large amount of wastes in the form of Coal Combustion Products (CCPs) which are categorized in four group includes fly ash (FA), slag, ash-slag mixture, microspheres, bottom ash from fluidized bed, gypsum and other wastes. Among them, FA deserves prime consideration because it has a significant negative impact on the environment, while its properties could make it a desired secondary raw material in many industry branches (Szponder and Trybalski 2009).

FA, a coal combustion residue, is an amorphous ferro-aluminosilicate with a matrix very similar to soil (Pandey and Singh, 2010). The global generation of coal FA is estimated to be above 600 million tonnes (Raza*et al*., 2000), while only in India, 120 million tonnes is generated every year by 82 power plants and it will cross the figure of 150 million tonnes in the coming years (Singh and Siddiqui, 2003).The disposal of this huge amount of FA needs global concern, as it is one of those environmental pollutants that disturb the ecosystem (Dwivedi, 2016). Dumped FA may also adversely affect the environment by mobilization of its hazardous constituents and thus contaminate the surface and ground waters, soils and vegetation (Sikka and Kansal, 1995).

An interesting peace of research surrounding role of FA in human welfare was recently published by scientists at Vector Control Research Centre (VCRC) of the Indian Council of Medical Research (ICMR) and Pondicherry University. They have successfully used fly ash as a carrier for *Bacillus ThuringiensisIsraelensis* (Bti), a bio-pesticide used for killing larvae of many insects (Tamilselvan 2017). This is just one example describing the proficiency of FA to serve us. FA has splendid and peculiar properties which can be utilized in diverse fields, most significantly in the field of agro-farming, which happens to be the chief occupation of developing nations like India.

According to the data of Central Electricity Authority (CEA, 2015) out of the total FA produced, 61% of the FA was utilised in various sectors whereas a large percentage of 39% was left dumped and unutilised (Figure 1). This dumped percentage of FA is a cause of concern as it is pollutant.It is one of those polluting agents that cause air, water and soil pollution and disturb the biological cycles.The disposal of this huge amount of FA needs global concern, as it is one of those environmental pollutants that disturb the ecosystem (Dwivedi, 2016). Dumped FA may also adversely affect the environment by mobilization of its hazardous constituents and thus contaminate the surface and ground waters, soils and vegetation (Sikka and Kansal, 1995).

From past few decades, the use of low concentration of FA in agriculture sector has been increased. A number of studies

showed that the addition of FA up to 40% to the agricultural soil was beneficial for better yield of crops, above which it had adverse effect on the yield of crops (Khan and Khan, 1996; Singh and Siddiqui, 2003; Agrawal*et al*., 2004). Figure 1 shows that agriculture accounts only 1% of the total FA produced.

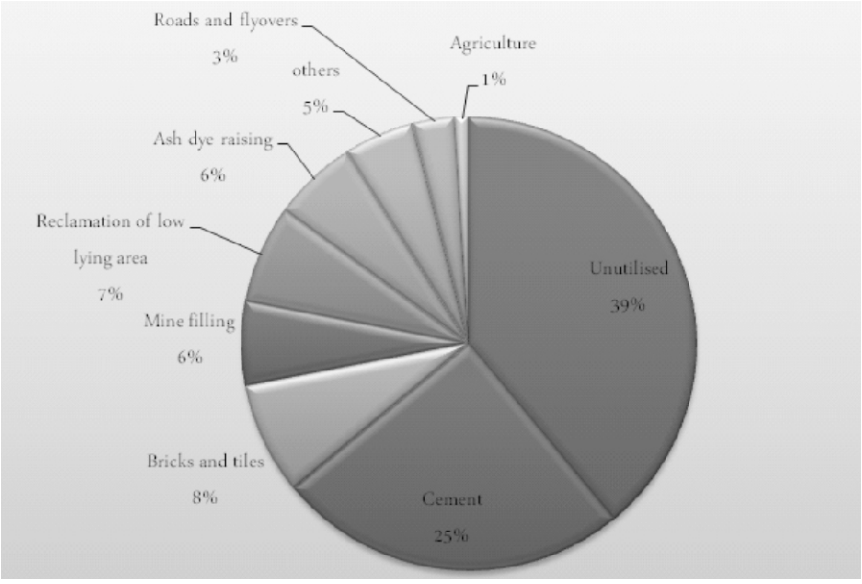


**Figure : 1 - Pie chart Diagram representing FA utilisation in India (CEA, 2015)**

There is multidimensional ways to use FA in agriculture. Firstly, it can provide mineral nourishmentto the plants which improves the physical, chemical and biological properties of soils. It has also been used to ameliorate the growth responses of the plants as well as to reduce the amount of heavy metals accumulated in plants.

- **Soil ameliorating properties of fly ash:**

FA is such a beneficial coal industrial waste output that possesses splendid soil amending qualities.However this level of amendment depends on the dynamic ratio of physical and chemical properties of both soil and FA. The physico-chemical properties of FA heavily relies on the conditions under which the coal is combusted (Karapanagioti and Atalay2001;Pandey and Singh 2010).In India, most of the FA produced is alkaline in nature. Hence, an application of this to agricultural soil increases soil pH (Sarangi*et al*., 2001). This property of FAcan be exploited to neutralise acidic soils (Elseewi*et al*. 1978). There are several research sources which document influence of FA in modifyingphysico-chemical properties of edaphic profile.It was revealed that soil FAmixture tend to have lower bulk density, higher water-holding capacity and lower hydraulic conductivity than soil alone due to its textural manipulation through fly-ash mixing (Basu*et al.,* 2009). FA exhibits variable silt content due to which it also amends the surface texture of soil. Application of FA(in percent) by weight in clay soil significantly reduced the bulk density and improved the soil structure, which in turn improves porosity, workability, root penetration and moisture-retention capacity of the soil (Kene*et al*., 1991; Garg*et al*., 2005).

FA contains approximately 95–99% oxides of Si, Al, Fe and Ca, and about 0.5 to 3.5% of Na, P, K and S and the remaining ash are trace elements (Garima*et al.,* 2005). It contains a range of essential nutrients *i.e*. both macronutrients (Ca, Mg, K and S) and micronutrients (B, Fe, Mn, Cu, Zn, *etc*.) needed for plant growth and metabolism except organic carbon and nitrogen (Jala and Goyal, 2006). Among the elements generally enriched in ashes are As, B, Ca, Mo, S, Se and Sr (Gupta *et al*., 2002). Lal*et al*. (1996) stated that at a low rate it increases the soil conductivity, organic carbon, microbial activity, soil porosity and water holding capacity (Ghodrati*et al*., 1995). The abundantly present mineral resources are among the chief micronutrients required by plants; and fly ash can act as a crop enhancer and a cost effective substitute of other mineral supplements. FA contains most of the necessary plant nutrients (except of

nitrogen and organic carbon, which are oxidized in the combustion process). This deficiency is compensated by high concentrations of phosphorus, which by reaction with aluminum, iron and calcium contained in the alkaline FA, can be easily absorbed by plants (Szponder and Trybalski 2011).

- **Role of Fly ash on Plant Growth**

A number of studies showed that the addition of FA up to 40% to the agricultural soil was beneficial for better yield of crops, above which it had adverse affect the yield of crops (Khan and Khan, 1996; Singh and Siddiqui, 2003; Agrawal*et al*., 2004). According to Khan and Khan (1996), addition of FA to soil influenced the physico-chemical properties of soils, which might be able to influence the heavy metal uptake and its translocation in different plant parts. Singh *et al*. (2008) studied the impact of FA incorporation on heavy metal accumulation, growth and yield responses of *Beta vulgaris*. Sao and Sahu (2013) documented the effects of FA and growth promoters on morphological characters and chlorophyll content of *Arachishypogoaea*. The positive impact of 10-25 % of flyash has been recorded on different morphological parameters in rice cultivars (Dwivedi *et al*., 2007). Similar results have been reported by Chaudhary*et al*. (2011), while studying the growth and metal accumulation potential of *Vignaradiata* grown under FA amendments. Mishra (2013) also observed the beneficial effects of low doses of FA on *Acoruscalamus*.

- **Role of Fly ash on microbial flora of soil**

Growth and nutrient uptake of two arbuscularmycorrhizal fungi*Glomusmosseae* (Nicol. and Gerd.)Gerdemann and Trappe and *Glomusversiforme* (Karsten) Berch, grown on soil admixed with FA showed good growth and better nutrient uptake by maize (Bi *et al*., 2003). Effect of FA and *Helminthosporiumoryzae* on growth and yield of three cultivars of rice Pusa Basmati, Pant dhan-4 and Pant dhan-10 was observed in a 120-day old greenhouse experiment where FA amendment up to 40% (v/v) showed an increase in growth and yield respectively (Singh and Siddiqui, 2003).

- **Role of Fly ash on pest Control**

Narayanasamy (2003) stated that more than 50 species of insect pests of various major crops were susceptible to fly-ash treatment. He also stated that fly-ash dusting at 40 kg ha1 on rice could control both chewing and sucking pests such as leaf folder, yellow caterpillar, spiny beetle, ear head bug, brown bug, black bug, grasshoppers, brown plant hopper and green leafhopper. Bio-efficacy of fly-ash-based herbal pesticides on certain insect groups was tested (ArputhaSankari and Narayanasamy, 2006). Thiyagarajan and Narayanasamy (2003) reported successful use of fly-ash as an insecticide in horticultural crops. Pesticide dusting formulation with fly-ash up to 40% was a suitable dispersant to solve the problem of agglomeration in the case of pulverized white clay, and moreover, it also saved the time, electricity, manpower, natural resource with no adverse effect on paddy (*Oryza sativa*), tomato (*Solanumlycopersicum*), brinjal (*Solanummelongena*) and jatropha (*Jatrophacurcas*) in the trials with regard to yield and quality (Bagchi and Jadhan, 2006).

- **Role of Fly ash on Floriculture**

Floriculture industry is being foreseeing as an important field since it has emerged as most lucrative business due to much higher return than other crops. Effect of FA on growth responses of ornamental plant *Polyanthestuberosa*reveals an overall increasing response in terms of germination, morphological characteristics, flowering, chlorophyll contents at 20%FA (Kumar *et al.,* 2015). The results coincide with the findings of Niaz*et al*. (2008) on *Ecliptaalba.*

- **Role of Fly ash in the field of agricultural sector: a novel approach**

FA is definitely a wonderful amalgamation of several micronutrients. Previous section of the chapter have also elucidated about soil ameliorating properties of FA. These beneficial properties gave rise to proclivity towards utilizing FA as a fertilizer and thus have triggered a revolution in agricultural sector. This approach is seemingly decent since FA has endogenous constituents efficient enough to augment the soil with quintessential micronutrients. It has abundant resources to modify physico-chemical aspects of soil. Its soil catering efficiency also depends on its synergistic behaviour on the soil microbial flora to improve soil fertility. These aspects have been extensively studied by various researchers and several such works enumerating remunerative properties of FA in agriculture are enlisted in Table 1.

**Table : 1 - Effect of Fly ash on different crop plants**

| ***CROP PLANT*** | ***RESPONSE OF FA*** | ***REFERENCES*** |
|---|---|---|
| Wheat (*Triticumaestivum*) | Positive effect on plant yield | Garg et al., 2005 |
| Tomato (*Lycopersiconesculentum*) | Cultivars had higher tolerance to wilt fungus *Fusariumoxysporium* | Khan and Khan 2001 |
| Mustard (*Brassica*), rice (*Oryza sativa*) and maize (*Zea mays*) | All these three crop showed improved growth over control | Kalra et al., 2003 |
| Pearlmillet (*Sorghum*) | grain and straw yield were increased | Grewal et al., 2001 |
| Soybean (Glycine max) | The amino acid content in was found to show an increase | Goyal et al., 2002 |
| Lettuce (*Lattuca sativa*) | Higher seed germination and root length | Lau and Wong, 2001 |
| Bottle gourd | helped in reducing infection byroot rot fungus, *Rhizoctoniasolani*by 25% at concentration of10% FA | Shamim et al., 2004 |
| wheat , mung bean and urad beans | enhances the seed germination alongwith positive effect on overall growth and yield | Nilesh et. al. 2012 |
| Aromatic grasses palmarosa (*Cymbopogon martini* ) and citronella ( *Cymbopogonnardus* ) | High yield was attributed to increased availability of major plant nutrients | Neelima *et al*., 1995 |
| Alfalfa ( ***Medicago sativa*** ), barley (*Hordeumvulgare* ), Bermuda grass ( *Cynodondactylon* ) and white clover ( *Trifoliumrepens)* | Increment in crop yield | Weinstein *et al*., 1989 |

Perusal of literature deciphers that lower concentration of FA has beneficial effects. However, higher concentration implicits negative effects on growth and morphogenesis.Wong and Wong (1989), noted increased germination rate at lower concentration of FA in two species of *Brassica*, *B. parachinensis* and *B. chinensisat* and inhibition of plant growth, leaves, flower and pod number at higher concentration.

While FA treatment has been shown to increase chlorophyll and carotenoid content in several plant species (Gupta *et al.,* 2010; Qurratul*et al*., 2013). Higher pigment concentration in FA exposed plants may also be attributed to the presence of Fe and Mg in FA and increase in leaf area of the plants (Jana, 2017).Gautam*et al.* (2012) reported significant increase in protein content in *B. juncea* when soil was amended with 60% FA. As far asproline content estimation, it was significantly increased in FA treated sets as reported by Raj and Mohan (2016). This increasing proline content is an outcome of heavy metal toxicity which is an associated concern with

FA amendment. Severe metal toxicity due to these heavy metal constituents leads to generation of Reactive Oxygen Species (ROS) and amino acid proline activates non-enzymatic activity for scavenging these toxic oxidants.

Since FA is assemblage of several heavy metals, its soil amendment poses some serious threats at higher concentration. Accumulation of heavy metal often induces DNA damage and inhibits DNA repair, either by direct interaction or mediated by ROS. Genotoxic effect of FA on *Brassica* species indicated significant increase in DNA damage at both time points, when compared to the control plants(Jana, 2017).

**Conclusion**

Bulk of coal residual FA is released from coal combustion and this huge mass of residual FA needs to be cautiously reclaimed and since arable lands face the problem of nutrient deficiency, so FA's usage may in the mainstream rural life may have revolutionary influence in agro based systems. This novel idea is both cost effective, being easily accessible. Chemical fertilizers, although, are efficient supplements of essential micronutrient, but these synthetic fertilizers altercates with the soil edaphic profile adversely. On contrary, utilization of FA is a wonderful restitution method for environmental pollution, which reinforces the concept of sustainable development.Major concern using FA is due to heavy metals, however since ornamental plants are not directly consumed, henceforth FA can serve as an effective substitute to chemical fertilizer for the purpose of yield enhancement.

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# TOXIC EFFECT OF PESTICIDES OF HEALTH AND ENVIRONMENT

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**Abstract**

With the increase in population, there was a need to increase the productivity of crops so that increasing demand of food supply can be met. This made scientists to develop various pesticides. Pesticides are the chemicals that prepared in laboratory to prevent or destroy the unwanted organisms or pants that lessen the productivity of crops. Earlier, it finds success in this. And farmers used to use various pesticides indiscriminately and inappropriately. Later on many adverse effects have been found to be associated with its use. Extensive use of pesticides affected human health as well as environment badly. It is affecting the biodiversity and ecological balance. Thus, this is the time to focus on organic farming as well development of safer pesticides.

**Introduction**

Pesticides are the substances or mixture of substances that are intended for preventing, destroying, repelling any pest. Pesticides are generally chemicals but some made from natural materials such as plant, or animals. The term "pesticide" describes a very large and diverse group of chemicals or products. Use of any chemical to control pests was first reported by Sumerians 4500 years ago. They also used to dust elemental sulphur for pest control. Rigveda mentions the use of poisonous plant for pest control. 17$^{th}$ century witnessed the use of nicotine based pesticides. After the First World War there was a need to search for such type of pesticides to enhance the food production. As a result in 1940s, there was sudden rise in the production of synthetic pesticides worldwide. DDT, Pyrethrin, Triazines were most commonly and frequently used pesticides Till 1950s, use of pesticides was considered advantageous and manufacturers began to produce large amounts of pesticides and their use became widespread. There was no concern for its adverse effect on human or on environment.

**Figure : 1 - Application of Pesticides on nature.**

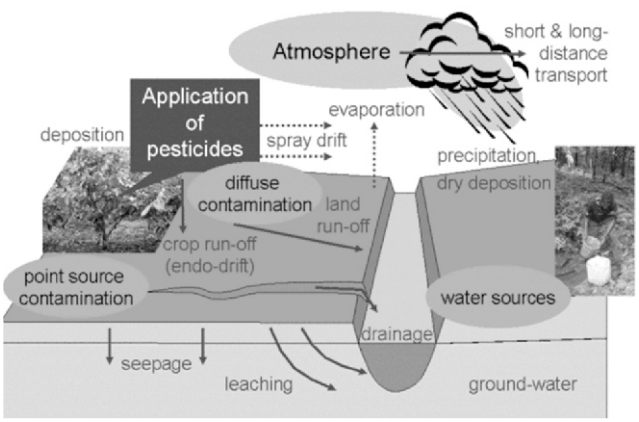
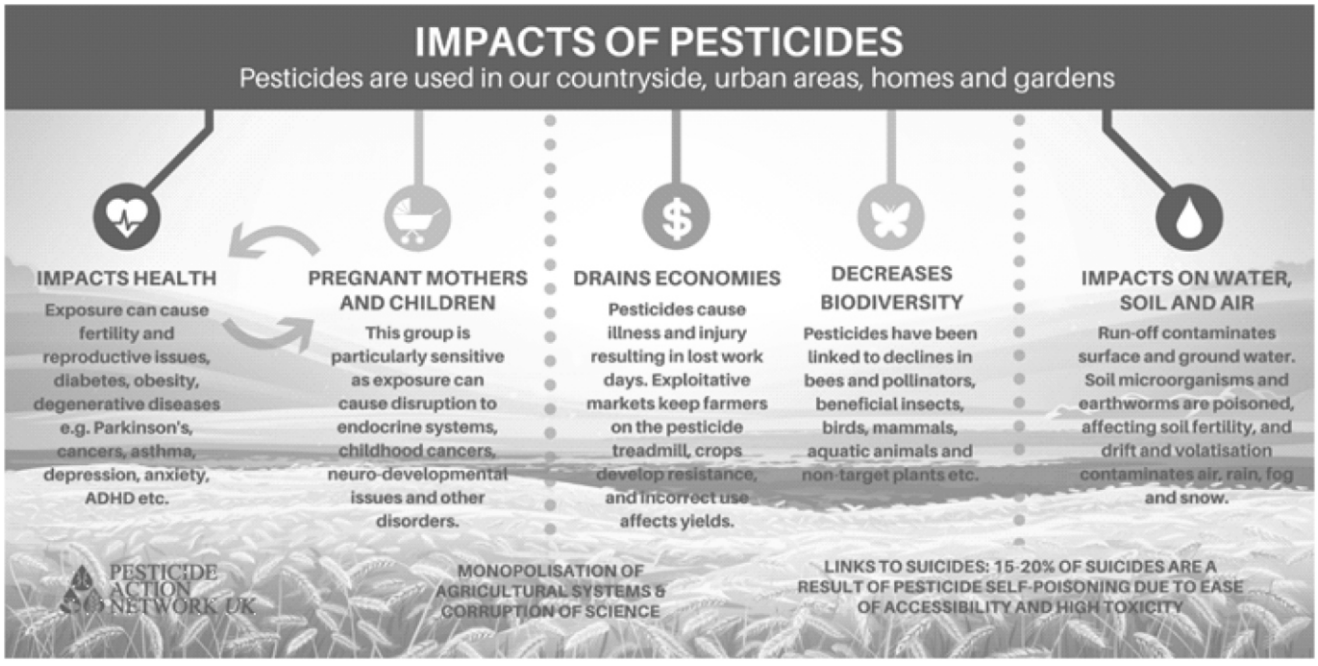


**Figure : 2 - Impacts of Pesticides on Human Health and Environment.**




**Classification of Pesticides**

All the commonly used terms such as insecticides, herbicides, weedicides, fungicides comes in the category of pesticides. Depending on their purpose, toxicity, and chemical nature etc., Pesticides have been classifies in many categories. Some of them have been discussed here in detail.

**2.1. Classification on the Basis of Purpose**

| **Category of pesticides** | **Purpose** |
|---|---|
| Insecticides | Kills insects |
| Fungicides | Kills moulds, mildew or other fungi |
| Herbicides | Kills weeds or unwanted plants |
| Weedicides | |

**2.2 Classification of Pesticides on the Basis of their Toxic Effects**

Toxicity of pesticide mainly depends on two factors namely dose and time. Hence, how much of the substance is involved (dose) and how often the exposure to the substance occurs (time) give rise to two different types of toxicity- acute and chronic toxicity.

**2.2 (a) Acute Toxicity**

A pesticide is said to have acute toxicity when only a small amount becomes deadly for the human, animal or plants either consumed, inhaled or comes in contact.

**2.2 (b) Chronic Toxicity**

Chronic toxicity refers to delayed poisonous effect from exposure to a pesticide.

**2.3. Classification of Pesticides on the Basis of Chemical Composition.**

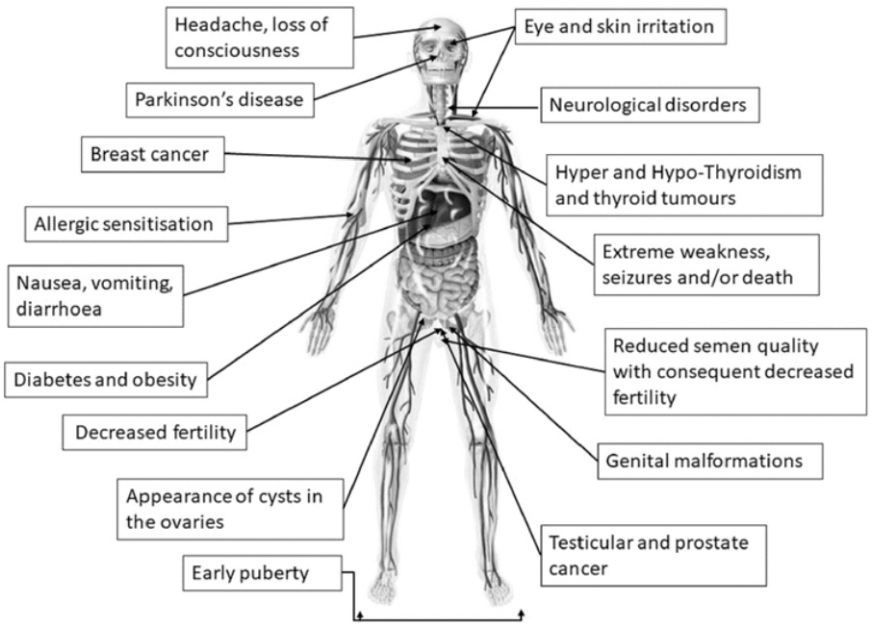
**Table : 1 - Classification of pesticides based on their chemical nature.**

| No. | Chemical Group | Chemical Name |
|---|---|---|
| 1 | Organochlorines | DDD,DDT,Dicofol,Eldrin,Dieldrin, Lindane, BHC,Endosufan etc. |
| 2 | Organophosphates | Dimefox, Mipafox, Methyl Parathion, Ronnel,Malathion,Trichlorofan etc. |
| 3 | Carbamates | Dimethan,Dimetilan,Isolan,Carbofuran,Pyrolan,Aldicarb, VernolateDiallate,Methan,Thiram,Amoban,Zineb,Maneb, etc. |
| 4 | Pyrethroids | Allethrin, Bonthrin,Tetramethrin,Cypermethrin Alphamethrin, |
| 5 | Phenyl Amides | Barban,Carbetamide,Chloroprofan,Neburon, Bromuron, Solan, Alachlor, Butachlor, Karsil etc |
| 6 | Phenoxy alkonates | 2,4-D(2,4-Dichloro phenoxyacetic acid)<br>2,4,5-T(2,4,5-trichlorophenoxyacetic acid) |
| 7 | Traizines | Altrazine, Simazine,Amytryn, etc |
| 8 | Benzoic Acids | Dicamba, Chloroambin,Dichlorobenil, Bromoxynil, etc |
| 9 | Phathalimides | Captan,Diflotan, Folpet etc |

**Hazardous effects of Pesticides**

Pesticides have been found to be associated with many harmful effects to human and environment. There are many ways by which one can come in the exposure with pesticides such as ingestion, inhalation, from bioaccumulation in food, or absorption through intact skin. After entering the body by any route, pesticides produce harmful effects. They may produce immediate effects or their effects may be observed after a prolonged period. They may affect some tissues or their impact may be seen on the functioning of body. Among various effects of pesticides the most common are dermatological, gastrointestinal, respiratory, carcinogenic, neurological, reproductive and endocrine effects. The effects may be acute or chronic. Among acute effects, there may be Headache, nausea, skin irritation, rash, etc. Among chronic disease there may be cancer, reproductive, and nervous system problems, organ damage. Not only may this high occupational, accidental or intentional exposure of pesticides result in hospitalisation or death. Harmful effects of some commonly used pesticides have been discussed below.

**Figure : 3 - Hazardous Impacts on Human body by Pesticides.**



### 3.1 Organochlorine Pesticides -

The commonly used pesticides of this category are DDD, DDT, Aldrin, Dialdrin etc. These pesticides are high persistence, low polarity, low aqueous solubility, and high lipid solubility. Their biodegradability property is also very low. Therefore they are highly persistent and cause very high risk to environment and human health. DDT have been banned in 1970s, but its traces are still found in soil and water.

Aldrin and Dialdrin have been found to have neurotoxic, reproductive, developmental, genotoxic, nausea, etc on human. These pesticides also affects mouse, rats, dogs and pigs severely. The common effects observed in them are convulsions, loss in boy weight depression, increased irritability, excess salivation etc.

BHC have been found to be associated with several harmful effects related with skin such as itching, psoriasis, eczema, leukoderma, skin rashes. It also has been found for the cause of nausea, prickling sensation.

DDT, one of the very common pesticides frequently used in early1950s had shown so many adverse effects and on human health and environment. It is banned now. The harmful effects of DDT was liver tumour. It causes the thinning of egg shells, it affects membrane function and enzyme function in fishes. It also developed neurotoxicity in rats and other rodents. Hyperactivity, anxiety and depression was observed in mammals due to exposure of DDT.

Diazion, another very common pesticide used in this class have been found to show many adverse effects, such as dark or blurred vision, anxiety and restlessness, depression, memory loss, and confusion and acute pancreatis. It also has adverse effects on mammals such as dogs, rats. In dogs inhibition of ACTH hormone was caused due its exposure.

Endosulfan resulted in decrease in white blood cells count and macrophage migration. It affects semen quality, sperm count, sperm morphology and other defects in male sex hormone.

Lindane damages human liver kidney neural and immune systems, induces birth defects, causes cancer, neurotoxicity, and hepatotoxicity.

### 3.2 Organophosphates (OP) -

Organophosphates are esters of phosphoric acid. These are commonly used for agricultural purposes. Besides this, these pesticides are used at homes in smaller quantities, schools, hospitals, yards to control pests. [9] Organophosphates poising occurs due to the exposure of organophosphates either by ingestion, inhalation of vapours or absorption through skin. Common symptoms include increased saliva and tear production, diarrhoea, vomiting, sweating, muscle tremors, and confusion dizziness, muscle twitching, restlessness, miosis and pulmonary enema,. Toxic psychosis can also Problem may be acute to chronic. Hence symptoms may appear within minutes to hours, or even weeks. In a study in Canada, it has been reported that exposure of Ops are associated with isolated asthma, and pulmonary function change. In another study among Kenyan farmers OPs poising resulted in chest pain, difficulty in breathing, cough, running nose, whizzing, and other respiratory systems, and irritation of throat

In another study conducted in Bhopal, Madhya Pradesh, India, its symptoms have been found relates with ophthalmological changes, dermatological disorder, and respiratory disorders.

OPs are designed to attack on insect's nervous system by inhibiting the acetylcholinesterase enzyme (ACHE) at the nerve endings. Therefore OPs have been found to have adverse effects among children. OPs causes neurological disabilities in children. Not only this organophosphate poisoning occurs most commonly as suicide attempt in farming areas of the developing world and less commonly by accident. It appears that the inhalation of the excessive amounts of pesticides is resulted in choking.

### 3.3 Effects of Carbamates -

Carbamates also affects in the same way as the OPs inhibiting ACHE. This results in increased levels of acetylcholine. Therefore central nervous system related symptoms appears which include confusion, hallucinations, tremor, and seizures. Severe poisonings result in flaccid paralysis.

### Threats of indiscriminate use of pesticides on environment -

Indiscriminate and uncontrolled use of pesticides is affecting biodiversity severely. Though pesticides benefit the crops; however, they also impose a serious negative impact on the environment. Excessive use of pesticides may lead to the destruction of biodiversity. Many birds, aquatic organisms and animals are under the threat of harmful pesticides for their survival. Pesticides are a concern for sustainability of environment and global stability.

The threats associated with the use of uncontrolled use of these toxins cannot be overlooked. It is the need of the hour to

consider the pesticide impact on populations of aquatic and terrestrial plants, animals and birds.

**Threats to aquatic biodiversity -**

Pesticides enter the water via drift, by runoff, leaching through the soil or they may be applied directly into surface water in some cases such as for mosquitoes' control. Pesticide-contaminated water poses a great threat to aquatic form of life. It can affect aquatic plants, decrease dissolved oxygen in the water and can cause physiological and behavioural changes in fish populations.

These pesticides are not only toxic themselves but also interact with stressors which include harmful algal blooms. With the overuse of pesticides, a decline in

Populations of different fish is observed. Amphibians are chiefly affected by pesticides contaminated surface waters, in addition to overexploitation and habitat loss. Chlorpyrifos and endosulfan also cause serious damage to amphibians. The reproductive potential of aquatic life forms also reduces due to herbicide spraying near weedy fish nurseries which eventually reduces the amount of shelter that is required by young fish to hide from predators

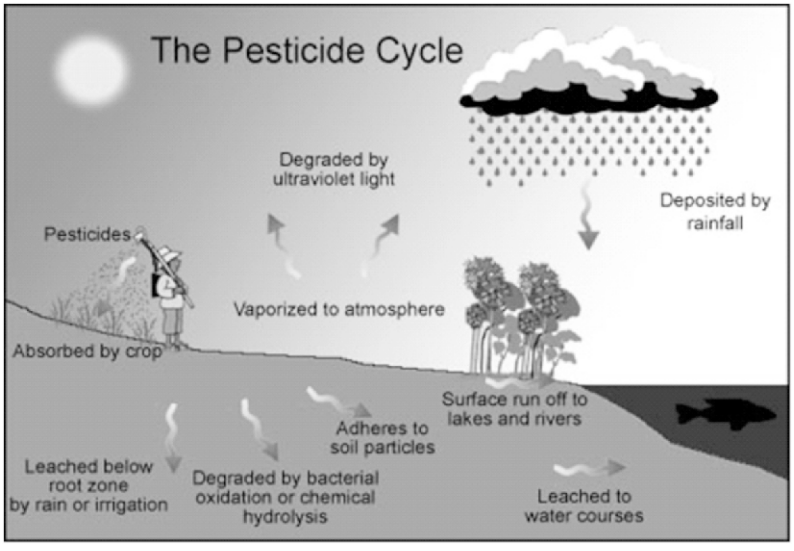
**Threats to terrestrial biodiversity -**

Terrestrial biodiversity is badly affected by pesticides. Some species are endangered now. In Birds, for example, exposure to certain pesticides can impede singing ability, making it difficult to attract mates and reproduce. Pesticides can also affect birds' ability to care for offspring, causing their young to die. Populations of beneficial insects such as bees and beetles can significantly decline by the use of broad-spectrum insecticides such as carbamates, organophosphates and pyrethroids. Earthworms play a significant role in the soil ecosystem. They are said to be farmer's friend. Earthworms also contribute to soil fertility. Pesticides have not spared earthworms from their toxic effects and hence affecting soil fertility badly. It has been reported that insecticides and

Fungicides produce neurotoxic effects in earthworms and after a long term exposure they are physiologically damaged (Schreck et al. 2008). Glyphosates affect feeding activity and viability of earthworms. Thus, it is evident that no aspect of environment has been left untouched with the hazardous effects of pesticides.

Pesticide exposure can also cause sub-lethal effects on terrestrial plants in addition to killing non-target plants. Drifting or volatilization of phenoxy herbicides can injure nearby trees and shrubs. Herbicide glyphosate increases susceptibility of plants to diseases and reduces seed quality. Even low doses of herbicides, sulfonylureas, sulphonamides and imidazolinones have a devastating impact on the productivity of nontarget crops, natural plant communities and wildlife.

**Figure : 4 - Cyclic Damaging Impact of Pesticides on Ecosystem**




**Conclusion**

Pesticides have been employed to meet the hunger of the growing population. No doubt it has improved productivity of crops, but at the same time hazardous effects of pesticides on human, animal, plants cannot be ignored. It is disturbing the ecological balance of the environment. Many species are endangered because of inappropriate use of pesticides. Herbicides, along with affecting the target weeds and plants, also harm the anthropoids that are essential for pollination. Not only have this herbicides reached up to

consumers through food chain. Similarly, insecticides affects the invertebrates. However, these effects have been found to be short lived for the majority of agrochemical products which are currently in use. Pesticides having severe effects have already been banned earlier. Still there is a need to focus on minimising the use of pesticides and switch over to organic farming. There are some natural materials such as neem leaf, salt spray, ginger garlic powder, turmeric powder, tobacco leaf powder, pyrethrum flower etc which acts as natural pesticides. These pesticides have no adverse effect on human, plant or animals. Also scientific community should focus on research of safer pesticide to meet the demand of food security.

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# IMPACT OF COVID-19 LOCKDOWN ON WATER QUALITY OF INDIAN AQUATIC ENVIRONMENT

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**Abstract**

The COVID-19 lockdown may have mandatory people to stay home, but the benefit of it's for the aquaticenvironment and the natureappears in rebuilding mode. With this effect, pollutants in the many rivers ofIndia significantlyreduced which inspired us to discussconcerning lock-down to be the powerful alternative tool to be applied for controlling water pollution created by human activity.During the lockdown, Ganges one of the most polluted river in the world, its water quality alsorises because the industrial discharge with organic pollutants are stopped. Organic pesticide contaminants into water bodies also reduced. Central Pollution Control Board (CPCB) recorded the 50% decreased in the release of industrial and sewage pollutants. According to M. Arif (2020) River Yamuna, also showed the reduction of pH, DO (Dissolved Oxygen), BOD (Biological oxygen demand) and COD (Chemical Oxygen Demand) from 1-10%, 51%, 45-90%, 33-82% respectively during the lockdown. CPCB reported that Fecal Coliform Count (FCC), the primary indicator of portability has also decreased.

However, lockdown is considered fruitful for the recovery of aquatic environment but it is not a permanent solution toclean the river water. Lockdown dropped the Indian economy badly and now to improve Indian economy government unlocked all human activity one by one. It is found that again the pollution level increased in the aquatic environment after the unlock. Therefore, we need to develop a method to clean water which should be permanent, safe and economically feasible. Bioremediation is considered as safe, less expensive and eco-friendly method for removing the toxic chemicals into nontoxic chemicals from the water bodies by living organisms.

**Introduction**

In Wuhan, China, December-19 the first victim of the coronavirus (COVID-19) was arrived (Huang.et.al.2020) which speedily grow all over the world. Because of COVID-19, more than 7,73,000 people have died, till 18 August 2020 worldwide (WHO, 2020).A coronavirus is a highly contagious disease and reported to be transmitted into humans from wild animals selling market. According to current evidence, the COVID-19 virus is primarily transmitted between people (Li X., 2020) through respiratory droplets and contact routes. Therefore, to decrease the level of contamination among people governments of various parts of the world take strong action to control the upsurge of transmission and imposed lockdown, as there is no specific medicine or vaccine is available to control the disease (Das and Paital, 2020). As a result of which, the entire world is found to stands still. In India, First Janta Curfew was declared on Sunday, 22nd March 2020 (Fig. 1). After its success, the national lockdown was declared by the Government of India on 24th March 2020. The Government of India directed the citizens to maintain adequate social distancing and to use personal protective equipment like masks during the lockdowns.

Lockdown led to shutting down all the industries, vehicle transportations such as city buses, subways, outbound transportations (airlines, trains, and long-distance buses), businesses to decrease the advance of the infection and established isolation.But emergency service providers such as people for medical care, food security; general security, medicine supply chain are usually allowed during the lockdown.

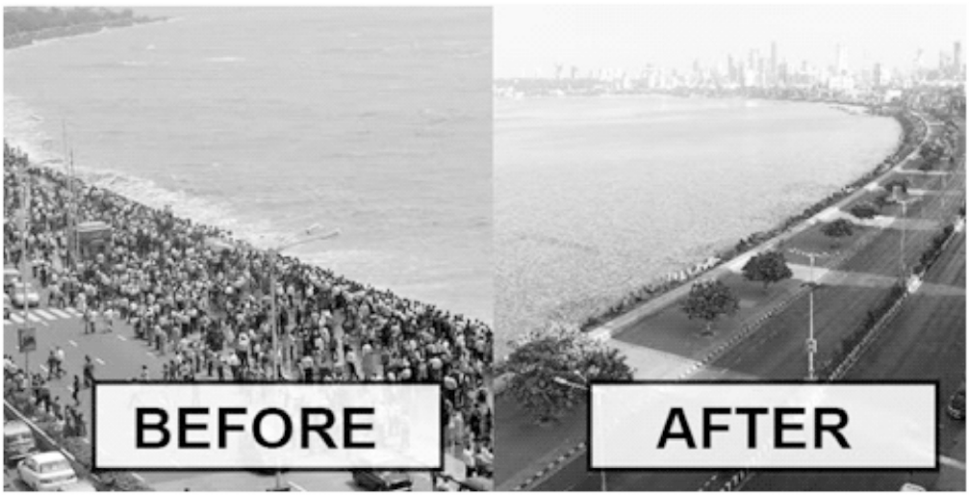


**Fig-1: Marine Drive in Mumbai observed empty on the day of Janta Curfew on 22nd March 2020. Source: https://winkreport.com/here-are-some-before-and-after-lockdown-pictures-from-india/?amp**

However, the COVID-19 has generated tragic circumstances for all and it would have a bad consequence on Indian economy (Economic Times., 2020) as it leads to termination in the activity of 1.3 billion people which badly influence the manufacturing sector due to shut down in the labor market, but it has the positive side too. The utmost effect ofthe COVID-19 lockdown was the rejuvenation of our water ecosystem to a certain extent due to the abandonment of industrial functioning. Which involved complete obstruction of discharge of industrial waste, crude oil, heavy metals, and plastics (Häder et al. 2020). The Bathing Ghats and washing of clothes at vital rivers were also close for the local people duringthe lockdown. Behavioral changes in human beings also led to the enrichment of water sources. According to CPCB pollution level in 88 cities across the country acutely lower (Sharma et al., 2020) only after four days of beginning lockdown. Researchersbelieve that the self-cleansing property of river Ganga has improved which has enhanced the water quality by 40–50% during the lockdown (Hindustan Times, 2020a). Scientists have claimed that water quality has remarkably improved at Haridwar Ghats which is up to drinking standards (News18 Buzz.,2020). The pollution discharge has drastically fallen sharply in Buddha Nullah which carries effluents from 2423 industrial units into Sutlej River in Punjab during the lockdown(Hindustan times, 2020b). According to the Zoological Survey of India, Dolphins are good indicators of water quality, have started resurfacing in the river as visible from different Ghats of Patna. According to the environmentalist number of small fishes, frogs and turtles have also increased. The toxic foam in water caused by detergents and chemicals from industries and sewage has vanished clearly in south Delhi.

In this paper information from the government and non-government agencies has been collected and analysed to understand the water bodies' recovery and we study the impact of COVID-19 lockdown on water pollution in India. This study we will use to develop methods in the future for mitigating the pollutant from the water bodies. Outcomes of the study will also help the government to define the Post-COVID strategy for the country, as the pollution level which we were not able to achieve during the pastfew years has become a real thing due to the lockdown. This study can also be used as a baseline study to analyse the health impact on animals and human being due to the reduction in water pollution in the Indian River.

**Impact on Water Quality**

In India, water quality has degraded with time due to urbanization that ultimately leads to increased sedimentation there by also increasing the pollutant in run-off. During lockdown industries were closed which have Positive culminating effect to the system.

**Impactof Lockdown on Water Quality of Ganga**

During the nationwide lockdown period, the most polluted river in India i.e. Gangaturns cleaner at several places like Haridwar, Rishikesh,Prayagraj etc.which is reported by Central Pollution Control Board (CPCB) (Fig. 2 and 3).It was also reported by CPCB that the pollutants from the Industrial and sewage waste, decreased 50%.

During the pre-lockdown period the dissolved oxygen (DO) levels were 8.3 mg/l reported but it was increased up to 10 mg/l during the lockdown period of river Ganga at Kanpur and Varanasi (SANDRP,2020; Times of India April 2020). In 2019 it was ranged

around 6.5 mg/l and 4 mg/lrespectively (Pathak and Mishra, 2020).

Meanwhile, there has been a 34% reduction infecal coliform and 20% in biochemical oxygen demand (BOD) in Haridwar reported by Uttarakhand Environment Protection and Pollution Board (UEPPB).

The River Ganga water quality in Uttar Pradesh has also superficially improved.Healthyand drinkable water should have a dissolved oxygen (DO) level of at least 7 mg/l, according to the Uttar Pradesh Pollution Control Board (UPPCB). The dissolved oxygen (DO) level of River Ganga at Haridwar and Rishikeshis 8.9 mg/l while at Praygraj and Varanasiit is 8.3 mg/l was reported by UPPCB (Table 1). This data clearly shows that water quality of river Ganga has improved expressively and is ideal for bathing as well as for other purpose.

Various news reportsindicated that 'life seemed to be returning to the river' and the lockdown had also improved the health of River Ganga, which many projects of the government of India could not do during the past few years(India Today, 2020)

**Indicators for the Water Quality of Ganga**

| Parameter | Its Effect | Pre-Lockdown | Lockdown |
|---|---|---|---|
| **DO** | It is the measure of oxygen in its dissolved form. If more oxygen is consumed than is produced, Do level decline, as a result of which sensitive aquatic animal may become weaken or die. | 8.3 | 10 |
| **BOD** | The amount of oxygen needed by micro -organism to breakdown waste. The greater demand for BOD indicates rapidly depletions of oxygen in the water bodies making lesser availability of oxygen for higher forms of aquatic life. | 3.8 | 2.8 |
| **FCC** | Fecal Coli forms are the organisms used to detect the removal of pathogens from wastewater treatment plants. The greater the level of fecal coli form the greater is the chances of contaminated diseases. | 2200 | 1400 |

**Table : 1 - Source:Times of India**

**https://timesofindia.indiatimes.com/india/how-lockdown-has-been-a-gift-for-river-ganga/articleshow/75569852.cms#:~:text=Specifically%2C%20there%20has%20been%20significant,low%20BOD%20indicating%20good%20quality.**


**Fig. : 2 -Source: https://www.talescart.com/10-viral-pics-around-the-world-before-after-lockdown-proves-it-is-blessing-in-disguise/**

A B

**Fig. 3. Source: (A)https://www.indiatoday.in/india/story/ganga-river-water-unfit-for-drinking-bathing-1538183-2019-05-30 (B)https://www.amarujala.com/india-news/water-quality-of-river-ganga-improved-in-varanasi-and-kanpur-due-to-covid19-lockdown**

**Impact of Lockdown on Water Quality of Yamuna**

Delhi pollution control committee (DPCC) has reported, the reduction of industrial effluents in the River Yamuna and the reduction in human activity as reasons for the improvement in the river water quality (Fig. 4). According to M. Arif (2020) the River Yamuna, also showed the reduction of pH, DO (Dissolved Oxygen), BOD (Biological oxygen demand) and COD (Chemical Oxygen Demand) from 1-10%, 51%, 45-90%, 33-82% respectively during the lockdown, which is a signal of good water quality. CPCB reported that Fecal Coliform Count (FCC), the primary indicator of portability has also decreased.


**Fig. 4: Quality of Yamuna water increases due to complete stoppage of industrial and commercial activities during lockdown. Less Smog can be seen after lockdown.Source: https://www.planetcustodian.com/river-yamuna-looks-cleaner/13835/**

### 2.3 Impact of Lockdown on Water Quality of Lakes

Vembanad Lake of Kottayam is the longest freshwater lake in India also showedis the improvement in surface water quality by the reduction of suspended particulate matter (SPM) (Ali P. et al.2020). The analysis of SPM concentrations data states that the concentrations during the lockdown period were 15.9% lower than those in the pre-lockdown period (Fig.5).

According to Bhim Singh Rawat, the Environmentalist said that due to the reduction in organic pollutants during lockdown self-cleaning properties of rivers have improved as a result of which water quality improved ( The Economic Times April 2020).

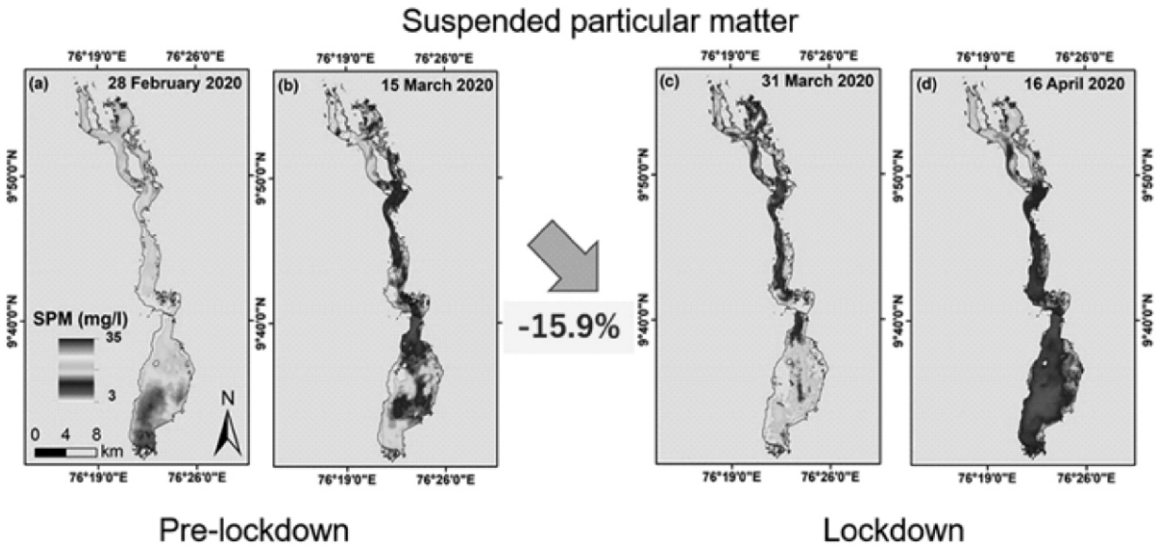


**Fig. 5: Reduced Suspended particular matter observed during lockdown period in the lake Vembanad. Source:(Ali et al. 2020)**

**Conclusion**

The clarity detect in the river water in the course of lockdown is much better than the several attempted for cleaning rivers where a vast sum was invested but the outcome was never going satisfactory and the position of the water bodies remained the same.The primary cause is the lack of industrial effluents entering the rivers due to the halt in human activity under this pandemic situation. Our paper showed that the pollutants reduced greatly when industries and agricultural activities also being hang. With the increase in urbanization, pollution level also increases in theriver; necessary measures should be taken to reduce the future decline of water quality in the river. National Mission for Clean Ganga (NMCG) authority specifies that the lesson from the lockdown is to strictly ensure industries to meet effluent discharge standards. For which few major should be taken from the scenario of rivers during lockdown are that industries on river banks have to become zero liquid discharge and environmental flow is a must in the river.

The challenge would be to keep the river in similar conditions post-lockdown, which can be possible by developing methods for mitigating the pollutant from the water bodies. For which bioremediation is considered as safe, less expensive and eco-friendly method for removing toxic chemicals from the water bodies. Bioremediation is the process in which living organisms can degrade toxic chemicals into non-toxic substances.

**Future Prospective**

The lockdown can upgrade the standard of environment for the short time but it may hamper the economy of any country. For long-term sustainable development with low environmental influence, there is need to bring the changes in human behavior.

The treatment of contaminated aquatic environment by the conventional method is found to be very high cost. Therefore, bioremediation has come out by the researchers as a natural, cheap, sustainable, safe approach which can replace the contaminated environment with the help of microbial organisms. For long-term sustenance we can use bioremediation method to clean the environment in the future.

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*Three Major dimensions of life : Environment, Agriculture and Health*
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# ENVIRONMENTAL ESTROGENS

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Xenoestrogens are also called environmental estrogens or "EDC" (Endocrine Disrupting Compounds). The Endocrine Society, regard them as serious environmental hazards that have hormone disruptive effects on both wildlife and humans. Environmental estrogens are pollutants present in our surroundings. Xenoestrogens are a type of xenohormone that imitates estrogen. They can be either synthetic of industrial origin or natural chemical compounds present in our biosphere. Normally, our endocrine system releases hormones that signal different tissues telling them what to do. When chemicals from the outside get into our bodies, they have the ability to mimic our natural hormones; blocking or binding hormone receptors. This is particularly detrimental to hormone sensitive organs like the uterus and the breast, the immune and neurological systems, as well as human development. Thus, endocrine disruptors are a category of chemicals that alter the normal function of hormones.

Xenoestrogens are endocrine disruptor group of chemicals that have estrogen-like effects. Estrogen is a natural hormone in humans that is important for bone growth, blood clotting and reproduction in men and women. The body regulates the amount needed through balanced biochemical pathways. Xenoestrogens have a similar molecular structure to estrogen. Due to this similarity it can bind with estrogen receptor sites, causing serious concequences. When xenoestrogens enter the body they increase the total amount of estrogen resulting in a phenomenon called, estrogen dominance. Xenoestrogens are not biodegradable so, they are stored in our fat cells. Build up of xenoestrogens have been indicated in many conditions including: breast, prostate and testicular cancer, obesity, infertility, endometriosis, early onset puberty, miscarriages and diabetes.

Xenoestrogens are found in a variety of everyday items. The chemical compounds found in vegetation, called natural estrogens or phytoestrogens or dietary estrogens, have been a part of the diet of human beings and animals for millennia under naturally present concentration and animal kingdom has evolved with their presence in the environment and therefore, these do not have so severe adverse physiological effect per unit of their dietary intake as do the environmental estrogens of the industrial origin. Mycoestrogens, from fungi, are another type of xenoestrogen that are also considered mycotoxins.

Synthetic xenoestrogens include some widely used industrial compounds, such as polychlorinated biphenyl ( PCBs), peroxyaromatic hydrocarbon (PAHs), bisphenol A (BPA), and phthalates (plasticizers), which have estrogenic effects on a living organism even though they differ chemically from the estrogenic substances produced internally by the endocrine system of any organism. The dioxins produced in the process of municipal solid waste incineration are also found to exhibit xenoestrogenenic activity. Benzopyrene from cigarette smoke and automotive exhaust and certain constituents in sewage show xenoestrogenic activity.

We are constantly exposed to these substances in the world we live in. Examples of everyday items that may include xenoestrogens are: fruits and vegetables sprayed with pesticides, plastic water bottles, Tupperware, nail polish, makeup, birth control etc. The list is long. Unfortunately, all of the above alter the way our body naturally functions.

Here are some of the chemicals that are xenoestrogens:

**Skincare:**

1. 4-Methylbenzylidene camphor (4-MBC) and Benzophenone (sunscreen lotions)
2. Parabens (methylparaben, ethylparaben, propylparaben etc. used as preservative)

**Industrial products and Plastics:**

1. Bisphenol A (plasticizers)

2. Phthalates (plasticizers)

3. DEHP (plasticizer for PVC)

4. Polybrominated biphenyl ethers (PBDEs) (flame retardants used in plastics, foams, building materials, electronics, furnishings, motor vehicles).

**Food:**

1. Phenosulfothiazine (a red dye)

2. Butylated hydroxyanisole / BHA (food preservative)

**Building supplies:**

1. Pentachlorophenol (general biocide and wood preservative)

2. Polychlorinated biphenyls / PCBs (in electrical oils, lubricants, adhesives, paints)

**Insecticides:**

1. Atrazine (weed killer)

2. DDT (insecticide, banned)

3. Dieldrin (insecticide)

4. Endosulfan (insecticide)

5. Lindane / hexachlorocyclohexane (insecticide, used to treat lice and scabies)

To avoid exposure to synthetic xenoestrogens following steps should be followed –

**Food:**

1. Avoid all pesticides, herbicides, and fungicides.

2. Choose organic, locally-grown and in-season foods.

3. Peel non-organic fruits and vegetables.

4. Buy hormone-free meats and dairy products to avoid hormones and pesticides.

**Health and Beauty Products:**

1. Avoid creams and cosmetics that have toxic chemicals and estrogenic ingredients such as Parabens.

2. Minimize your exposure to nail polish and nail polish removers.

3. Use naturally based fragrances, such as essential oils.

4. Use chemical free soaps and toothpastes.

**Plastics:**

1. Reduce the use of plastics whenever possible.

2. Do not microwave food in plastic containers.

3. Avoid the use of plastic wrap to cover food for storing or microwaving.

4. Use glass or ceramics whenever possible to store food.

5. Do not leave plastic containers, especially your drinking water, in the sun.

6. If a plastic water container has heated up significantly, throw it away.

7. Avoid freezing water in plastic bottles to drink later.

This paper presents a critical review of effect of certain pollutants that have been present in our environment and are already known for their adverse impact on environmental quality as well as on human health.

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# ROLE OF ENVIRONMENTAL STRESS ON YIELD OF CROP

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**Introduction and Effect of Stress on Yield of Crop**

Stress or pressure is an amount of force for a given unit area. When sufficient force is applied to material, the material bends and the change in length is termed as stress. In short, 'stress' is the action whereas 'strain' is the reaction. In regard to agriculture , stress is produced by natural environment factors such as extreme temperature, wind, drought and radiation. Human does not have much control over stress. It is very important to understand how important for humans to understand factors affect plants and other living things so that we can have some preventive measure.Environment stress cause by abnormal conditions in soil and climatic conditions for normal plant growth and development process which is the reflection of amount of environmental 'pressure'.It also effect the plant metabolism, growth and reduce the yield of crop.For eg water stress in paddy, grain filling result in reducing of yield of grain.Not only obstruction in plant physiological process but has direct bearing on several other biological functions and subsequent reduction in yield.

**Effect of High and Low Temperature Stress**

High temperature has the most obvious and huge impact on crop yield. Apart from creating the problem of water shortage and dry environment high temperature also affects the biology and ecology of standing crops, thereby affecting the yield. Pollination is one of the most sensitive phenological stages to temperature extremes across all species and its development is the most affected factor due to rise in temperature. Body mass and size are least affected. Also rise in temperature affects the transpiration and evapo transpiration processes of the plants leading to water loss in the plants body which ultimately affects the yields. Also High temperature results in water shortage in the environment (Soil), this indirectly leads to availability of less water to the crops.

Low Temperature Affects Enzyme Activity, lowering the temperature slows the motion of molecules and atoms, meaning this flexibility is reduced or lost. Extreme lower temperature also causes protein denaturation. Prolonged lower temperature affects plants health and hardiness. A lack of water may cause wilting and sometimes death of crop stand.Crops on higher locations becomes victims to cold winds and sunscald caused by exposure to winter sun. Crops on higher locations becomes victims to cold winds and sunscald caused by exposure to winter sun.

**Effect of Frost and Chilling**

Prolonged extreme cold temperature leads to frost and chilling conditions. Chilling injury occurs at temperature well above freezing point. The tissue becomes weakened leading to cellular dysfunctions, which in turns affects production.Ice formation on the plants and in the plants tissue what causes the damage, especially when the tissue thaws.Frosting freezes the water the water in plants system causing them to rupture and injuring the crop stand resulting in lowered yields.

**Effect of Radiation**

Light is important for photosynthesis but irregular light availability affects the plants life cycle in an irregular manner.Quantity, intensity and duration of light are important.Intensity of light(brightness) is an important factor for the process of photosynthesis.Also the quality of light affects the ripening and maturity of standing crops.

UV-B radiations have an indirect damaging effect on plants.Under uv-b exclusion, chlorophyll content of leaves goes higher,

the chlorophyll a/b ratio and carotenoids contents were lower than the leaves under ambient level of uv-b radiation.Exposure to ultraviolet radiation reduces plant growth vigor, chlorophyll contents, carotenoids, amino acids, proteins, total sugar and starch. Uv radiation induced accumulation of flavonoids, proline, copherol and ascorbate contents

**Green House Gases**

Carbon dioxide is one of main component for the process of photosynthesis. Its presence is always needed and demanded in all the metabolic activity of the crops.However photosynthesis rate increases with rise in co2 concentration but it plateaus with further increase this will affect the crop yield.Co2 increase have also been a major cause for global warming which has its own adverse effects on crop yield.

Ozone formation requires sunlight, periods of high ozone concentration coincide with the growing season. Ozone damage to plants can occur without any visible signs. Many farmers are unaware that ozone is reducing their yields. It enters the plant's leaves through its gas exchange pores (STOMATA) DISSOLVES IN THE water within the plants and reacts with other chemicals, causing a variety of problems. Ozone interacts with lipid components affecting growth and photosynthes is slows resulting in slower plant growth.

**Precipitation**

Irregular rainfalls are a major hampering reason in agriculture. Many farmers who depends on rain for water requirements face a major problem cause of irregular precipitation.Early rainfalls changes the planting dates of many crops which may result in untimely sowing and harvest leading to less yield and also delayed rainfalls results in crop loss due insufficient moisture availabilty.

Floods are not exactly a precipitation isssue but it is due affected by precipitations. It causes huge soil loss and leaching which deprive the land of its fertility. Also floods damages the standing crops in field causing 100% damage.It also deprive the land of its fertilty and sometimes it also leads to disposition of accumulates in agricultural lands which hampers the crops growth.

Drought is also not a precipitation issue but irregular precipitation do leads to drought.Droughts are conditions when we have no water or moisture in the land available for uses.Water is an basic need of all plants and its scarcity needless to say affects the plants.The crops cant survive without water since its an important ingredient of photosynthesis, and thus without water plants wont make any food and dies. This will obviously lead to crop failure and yield loss.

**Remedies for Environmental Stress**

Use of ephemerals, Plants can modify their life cycles to avoid abiotic stress. use of salt tolerant, use of stress tolerant high performance plants..Adjusting sowing times and use of sprinklers.

**Conclusion**

All of these stressful factors affect both crop yield and quality, directly or indirectly. Given that increase of land suitable for agriculture cannot be expected in the future, producing more of the desired products per unit area of land will be an important task. There are a number of approaches for increasing crop yields per unit, but one of them is definitely to enhance crop tolerance to various stresses caused by GEC (Global Environmental Changes). Plants are very tough and have developed strategies to adapt to various environments during their long evolutionary process.

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# BIOSECURITY – UNDERSTANDING AND MANAGING THE MULTI DIMENSION OF LIFE

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What is biosecurity? Biosecurity refers to measures that are taken to stop the spread or introduction of harmful organisms to human, animal and plant life in order to minimise the risk of transmission of infectious diseases to people, animals and plants caused by viruses, bacteria or other microorganisms.

Biosecurity's ultimate aim is to enhance national ability to protect human health, agricultural production systems and the people and industries that depend on them. The goal of biosecurity is to prevent, control and/or manage risks to life and health in a particular biosecurity sector. In doing so, biosecurity is not only essential for sustainable agricultural development but also very important in poultry farm, swine farms, fish culture etc. The aquaculture industry is also vulnerable to pathogenic organisms, including fungal, bacterial, or viral infections which can affect fish at different stages of their life cycle. Interactions between people, animals, wildlife and the environment are unavoidable and present a risk to both industry and the environment

Our agricultural systems are linked to our natural systems in which animal and plant biosecurity is as relevant as environmental biosecurity. It helps us to understand & identify any gaps in regulation and monitoring problem areas. E.g. farm visitors, stock routes, wild animals etc. Environmental biosecurity goes beyond our food to our backyards, our walks and our beaches. Interactions between people, animals, wildlife and the environment are unavoidable and present a risk to both industry and the environment. It,s about our way of life.

World Health Organization (WHO) describes the aim of biosecurity being "to enhance the ability to protect human health, agricultural production systems, and the people and industries that depend on them", with the goal "to prevent, control and/or manage risks to life and health to the particular biosecurity sector".

**Goals of Biosecurity:**

The main aim of biosecurity is to protect human health and to increase and protect agricultural produce through the prevention, control and management of biological risk factors. Biosecurity also aims to protect against acts of bioterrorism and to prevent adverse biosecurity events as well as offering advice on appropriate interventions and political and social changes that should be adopted by government regulatory agencies.

**Managing the multidimension of life: This can be broadly classified as -**

**1. Environment biosecurity:** It addresses the risks posed to the natural environment by non-native pests, diseases and weeds. Environment biosecurity prevents them from entering, emerging and establishing itself in the natural environment. Caring for our species, ecosystems, land, sea and aquatic environment benefits us all. It is important so that mankind can continue to enjoy and benefit from our environment now and in the future.

**2. Animals and plants:** Threats to animal and plants has a direct impact to human health. Animal biosecurity will protect them from infectious /disease agents as well as from non-infectious agents such as toxins or pollutants. Biosecurity awareness can help prevent zoonosis i.e. biological agent that can be transmitted naturally between wild or domestic animals to humans. Some examples of zoonosis are anthrax, bird flu, bovine tuberculosis etc. Biosecurity of animals and plants can be executed in areas as large as nation or as small as a local farm.

**3. Human health:** Direct threats to human health may come in the form of epidemics or pandemics, such as the 1918 Spanish flu pandemic and MERS, SARS, or the 2019-2020 COVID-19 pandemic, or they may be deliberate attacks (bioterrorism). The country or state health departments are usually responsible for managing the control of outbreaks and transmission and the supply of information to the public.

**4. Biosecurity in laboratories:** Clinical laboratories, diagnostic centers, public health laboratories, research centres, all are at risk of biosecurity incidents. Managing hazardous waste during COVID-19 pendamic and preclinical trials for corona virus vaccine are some examples of 'biorisk'.

**The Future:** Biosecurity requires the cooperation of scientists, technicians, policy makers, security engineers, and law enforcement official. Measures taken to counter biosecurity risks typically include compulsory terms of quarantine, which minimises the risk of invasive pests or diseases arriving at a specific location that could damage crops and livestock as well as the wider environments.

Biosecurity is the cheapest yet most effective means of managing the multi dimensions of life. It is a shared responsibility, which gives dividends in the form of sustainable economic growth, protection of environment and the community. This paper presents a critical review on biosecurity, how it is important in managing and controlling the environment quality and human health.

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