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**GEMS**

**BIOVISION**

DEPARTMENT OF BIOTECHNOLOGY  
IMS ENGINEERING COLLEGE  
GHAZIABAD



**ISSUE ON**

**ENVIRONMENTAL  
BIOTECHNOLOGY**



**Dr. Santosh K. Mishra**  
**Editor in Chief**

Air, water and soil pollution are major forms of environmental pollution that adversely affect the human being as well as plant and animals. Due to excessive industrial activities, deforestation and urbanization leading in the generation of different type of hazardous waste. Modern society is also concerned about other types of pollutants such as radioactive pollution, sound pollution and pollution originated from plastic waste etc. Pollution in any form has undesirable effects on environment and wildlife and it also adversely impact human health. However, due to technological advancement and awareness among common people now great efforts are made to limit the release of harmful substances into the environment. Waste water treatment, solid waste management, hazardous waste management and recycling and reuse of waste significantly helpful in the minimization of pollution level and having lots of potential in the protection of our environment. Reduce, Reuse and Recycle concept is very helpful in the management of solid waste at the source. Micro-organisms are also suited to the task of contaminant destruction through different type of enzymatic reactions and allow them to use contaminant as food. The objective of bioremediation is to encourage them by supplying optimum level of nutrients for their metabolism resulting in the degradation of hazardous toxic waste materials that are harmful for our environment and living things. In this issue of Biovision we are covering different aspects of environmental biotechnology including current environmental issues and their remediation. Hopefully this issue will helpful for readers in enriching their knowledge in the various areas of environment biotechnology.

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## ABOUT THE DEPARTMENT

The Department of Biotechnology was established in the year 2002 with a clear vision of educating students with latest technology in the growing field of Biotechnology as an undergraduate course. Now the department is NBA accredited and also offers postgraduate program (M.Tech). Since its inception, the Department has continuously grown and taken initiatives to impart quality education and inculcate research aptitude in Biotechnology students. The department is actively engaged in research activities in various areas of Biotechnology and related fields. It is also an authorized research center for Ph.D. program through AKTU, Lucknow. The department has consciously taken a decision to strengthen research activity in various areas of Biotechnology with a view to develop practical solutions to problems faced by industries. The department is unique in having established expertise across a broad range of scientific disciplines, thereby encouraging innovative approaches to teaching and research.

Our expert faculties in various disciplines also provide research consultancy in Environmental Biotechnology with a view to develop practical solutions to environmental problems faced by industries and the municipalities. Major Departmental Highlights include-

- Highly qualified faculties with extensive experience in industry, research and teaching
- 10 State-of-the art laboratories including Genetic Engineering, Fermentation Technology, Bioprocess and Computational Biology etc.
- International internship at University of Louisville, KY, USA
- Advanced R&D in areas of Cancer Biology, Recombinant DNA Technology, Drug Discovery and Herbal Product Formulation
- Average 20 research papers published annually in peer-review journals by Faculty and Students
- Consistent 90% placement record in Core Biotechnology companies

<http://imsec.ac.in/biotechnology>

### VISION OF DEPARTMENT

**To be a Centre of Excellence in field of Biotechnology education, research, training and entrepreneurship guided by sound scientific principles, quality teaching and thrust for improvement.**

### MISSION OF DEPARTMENT

- 1. To develop a strong Biotechnology Engineering program based on quality education, research and training.**
- 2. To impart quality education to the students and enhance their skills which will make them globally competitive.**
- 3. To develop trained biotechnology professionals who can contribute to the continuous improvement of biotechnological services and products.**
- 4. To develop scientific and/or technical resources as per biotechnology industry demands.**

## ABOUT GEMS SOCIETY

GEMS (Genetic Engineers and Molecular Scientists), the professional society of Biotechnology department was established in the year 2008. The aim of this society is to encourage students for various professional as well as social activities. These activities of this society provide students a platform where they can excel their talent in the area of science and technology with better understanding of their professional & social responsibilities. It also helps students to show leadership skills well as team work culture in among students Faculties of department constantly providing guidance necessary support students for organizing various activities of societies. GEMS Society is constantly working to organize various techno-cultural events for overall development of students. Every semester this society organizes events like Guest lecture from experts, Seminars, Innovative idea presentation, Biofiesta(Annual techno-cultural event), Plantation of herbal plants etc. Expert from industry and research institutes like CDRI, BIBCOLD, Dabur Research foundation, Sun Pharmaceutical Industries, Codon Biotech, Envirotech etc. delivered invited talk in the various activities organized by GEMS society. The structure of this society is as follows:-

<b>President</b>	<b>: Dr. Narendra Kumar (Head of Department, BT)</b>
<b>Coordinator</b>	<b>: Dr. Santosh Kr. Mishra (Assistant Professor, BT)</b>
<b>Vice President</b>	<b>: Ms. Mini Yadav (Student of BT 4th Year)</b>
<b>Secretary</b>	<b>: Mr. Garvit Gupta (Student of BT 3rd Year)</b>
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<b>Treasurer</b>	<b>: Dr. Sanjay Kumar (Assistant Professor, BT)</b>
<b>Members of GEMS</b>	<b>: All students and Faculty members of Biotechnology Department</b>



# GLOBAL WARMING FROM FOSSIL FULES

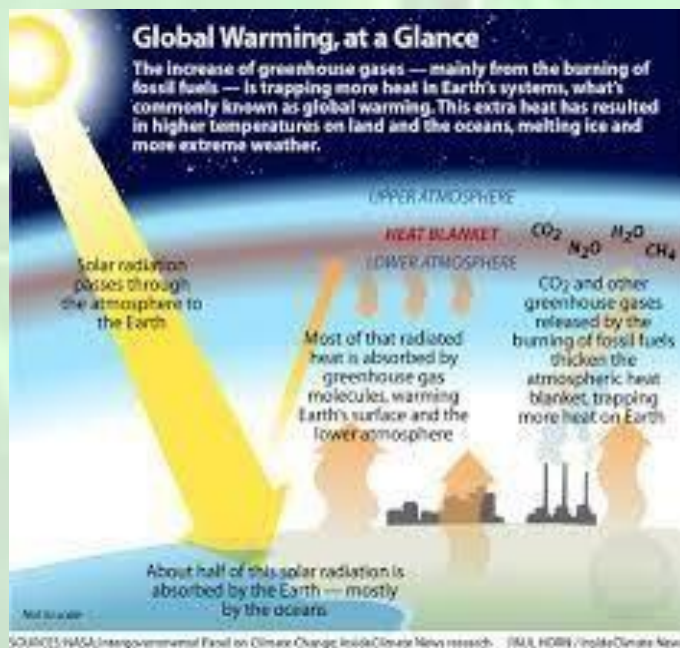
BRINDA BISHT  
(2nd YEAR)

We all are familiar with the words 'global warming' and 'fossil fuels'. We all know their meaning since our childhoods. Still there is a need to recall them again. So 'global warming' refers to the rise in global temperatures due mainly to the increasing concentration of greenhouse gases in the atmosphere, whereas 'fossil fuels' refers to a fuel formed by natural processes, such as anaerobic decomposition of buried dead organisms, containing organic molecules that release energy in combustion.

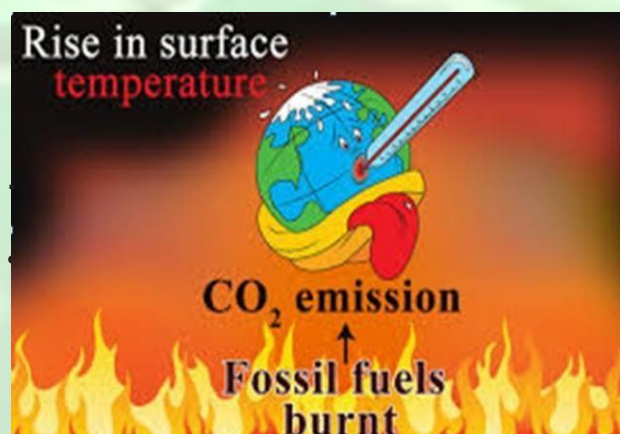
You know why Fossil fuels are referred as "fossils" as they contain carbon and hydrogen remain of early life. We human beings are dependent on these fossil fuels to run our daily routine. We need them in power industry to produce electricity, to run our vehicles, for heating our homes to get rid of cold weather and many other things

## Effect Of Fossil Fuels:-

When we burn fossil fuels they release harmful gases, which prevent the heat from leaving the atmosphere, thus creating excess heat in the surrounding or Atmosphere which has caused average global warming. Recently studies state that burning of fossil fuels like coal, petroleum is the main cause of rising of CO<sub>2</sub> level effecting in climate change. It can also have negative health effects on the communities.



Now the question arises, as the fossil fuels are formed naturally, so how they can be a cause of global warming.



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Coal a type of fossil fuel is the most dangerous Fossil that contributes in globalwarming. Burning of coal results in formation of harmful matters and results in acid rain, as it emits sulphur dioxide (SO<sub>2</sub>) . Emission of SO<sub>2</sub> may cause respiratory problems like asthma, nasal congestion etc.

## Causes From Waste Of Fossil Fuels:-

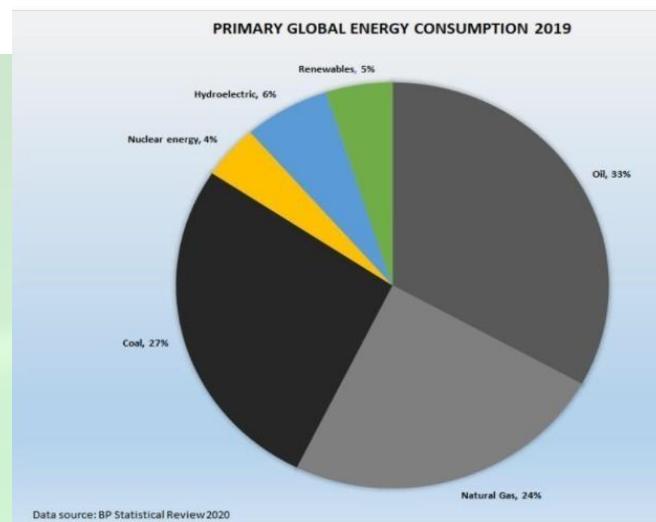
A fossil fuels contain large amount of energy, hence are rarely found in pure state. Hence need to be refined and purified leaving excess waste materials that needs to be safely disposed, Otherwise can cause environmental and community health issues.

There is a huge impact on aquatic wildlife from oil and gas wastewater. Grease and oil waste leaked into water bodies can be taken by fishes and destroy algae and plankton disrupting the food chain. The heavy metal even in low concentrations can be toxic to fishes and can further effect larger animals and human in food chain as fishes are consumed by them.

## Reducing The Use Of Fossils Fuels:-

By developing clean and renewable resources or energy source we can reduce the use of Fossil.

For mining of coal, it destroy vast amount of lands and even pollutes the rivers and streams. So by reducing the use of them can prevent land degradation

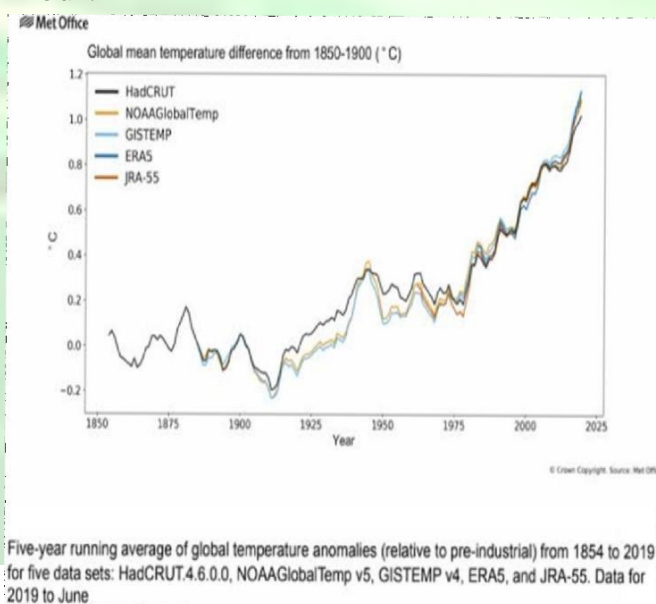


## Recent Studies:-

In 2014 fine particle pollution from US coal plants result in 13,000 deaths, 10700 were hospitalized and 20,000 got heart attack.

In United State, the largest source of mercury emission is coal fired power plants.

Researchers from NOAA (Uintah basin) Stated that methane emission from oil and natural gas field is about 55,000 kg per hour.





# **NATURAL RESOURCE DEPLETION**

**PRAGYA TIWARI**  
(2nd YEAR)

**“If conservation of natural resources goes wrong, nothing else will go right.”**

**-M. S. Swaminathan**

**N**atural resources are the valuable assets that are being provided to the mankind without any cost, but now day by day the resources are depleting at a very rate. What exactly depletion is? So depletion actually occurs when natural resources are consumed at a faster rate than its replacement. Replacement of resources play a crucial role.



However one thing that we need to keep in mind is that natural resources are finite, even if they are renewable they also require time to replenish themselves.

And when we are discussing about natural resource depletion so there are some very common terminologies that are occupying a large margin in depletion of natural resources and they are overpopulation, mining, fishing, fossil fuel consumption, deforestation etc.

## **Causes of depletion of natural resources:-**

**1) Overpopulation:** According to the current data total global population is 7 billion. And still we all know that this number is increasing daily at a very rapid rate, contributing a very high expense in accelerating the depletion of natural resources. Because it very clear to understand that increase in population will ultimately increase the demands of resources needed.

**2) Deforestation:** There was report published by global bank which mentioned that the net loss of forests between 1990 to 2016 was 1.3 million square meters. People are now getting easy space by clearing forest to accomplish their agricultural needs. Even the concept of high population can be linked here as more people require more residential complexes that are fulfilled by clearing forest or cutting down trees.

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**3) Poor farming techniques:** Farmers are not using various techniques that are harming the environment for example using poor irrigation techniques leads to the alkalisation of soil, use of pesticides and inorganic fertilizers also depletes the quality of soil.

**4) Over consumption of natural resources:** Once industrial revolution came into picture large scale mineral and oil exploration can be seen and this practice is continuously growing leading to much more natural oil and mineral depletion.

## Effects Of Natural Resource Depletion:-

**1) Extinction of species:** Due to exploitation, changes in living conditions and habitat degradation of many living organism, some major species can extinct.

**2) Depletion of minerals:** Constant extraction of minerals and ores are leading to the overexploitation of minerals and oils.

**3) Lack of oxygen:** Due to large cut down of trees there will be a deficiency in production of oxygen because ultimately oxygen is produced by plants only.

**4) Loss of forest land:** Continuous deforestation is leading fertile land loss. Also overgrazing by farming animals is also depleting the quality of land.

**5) Water shortage :** Deforestation,

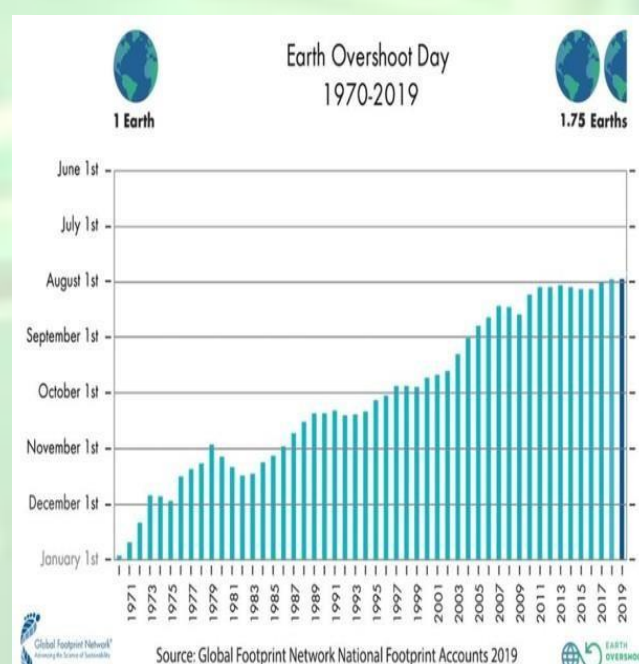
poor farming techniques and polluted water discharged by factories leads to the contamination of water and ultimately creating the shortage of pure water.

## Solutions Of Natural Resource Depletion:-

- Use of sustainable agricultural practices.
- Treat wastewater before discharging them.
- Control deforestation.
- More and effective use of renewable resources.
- By creating awareness among people.

## Recent Studies:-

A recent data published by California – based global footprint network shows that how fast the consumption of resources is occurring.





## LOSS IN BIODIVERSITY

TANEYA GUPTA (2nd YEAR)

“If spice is the variety of life, then biological diversity makes earth's ecosystem spicy indeed.”

The term biodiversity was coined by Walter Rosen in 1985. Biodiversity is the variability among living organisms from all sources including terrestrial, marine and other aquatic ecosystem and the ecological complex which they are a part of. The United Nation has proclaimed May 22 nd as “The International Day for Biological Diversity” to increase the understanding and awareness of biodiversity issues. Only 1.2 million species have been identified and described so far which run the gamut from complex plants and animals to microbe and other simple organisms.

Biodiversity is the web of life weaving together the ecosystem. Fungi decomposes dead and decaying content to fertilize the soil. Plants provide us with oxygen, food, medicine etc grow upon these fertile soil. Bees carry out the most important phenomenon i.e pollination in turn increasing the plant density. According to NOAA, 34 billion metric tons of carbon from the burning of fossil fuel from 1994 to 2007 has been absorbed by ocean.

According to 2106 reports released by WWF, population of vertebrates have declined by 58% and freshwater species by 81% between 1970 and 2012.

51 Million sq. km has been converted to agricultural land and 40 million sq km land used for grazing. 2019 reports by IPBES noted that up to 1 million plants and animals species are facing extinction due to human activities. Even though the species is not eliminated from the biosphere, its niche diminishes as its members fall.

There are various causes which leads us to road of losing our biodiversity. Human species are accredited for this loss. Though there are environment driven natural losses too but they are steady and un-accelerated unlike the human driven loss which is 100 times more accelerated.

**The various causes for the loss of biodiversity are as follows:-**

### 1) Habitat Loss and Destruction:

This is the most prominent cause of loss. Humans are destroying forest for their settlement, agriculture, mining, industries construction etc. As a result



the species either have to adjust to the new environment or have to migrate to other places where they have to face competition, the weaker ones eventually die.

## 2) Hunting:

Animals in the wild are hunted down for irrelevant purposes such as for their hides, ivory, tusk, fur, meat, cosmetics etc. Rhino horn costs more than \$15000 in pharmaceutical industry. In 1962, 70,000 whales were slaughtered.

## 3) Exploitation:

Various plant species has been exploited for their medicinal value resulting in complete vanishment. Almost 95% of old strain of wheat grown in Greece before the second world-war have disappeared.

## 4) Habitat Fragmentation:

It is the unexpected scattering of large area into smaller fragments which may not provide enough space for all the species to coexist together which ultimately reduces their number making their small groups vulnerable to hunting.

## 5) Introduction of Exotic Species:

Native species face the competition after the introduction of exotic species causing severe damage leading to extinction. Nile perch introduced in lake Victoria. “Terror of Bengal” i.e *Eichhornia crassipes*.

There are other factors too such as pollution, collection for zoo and herbarium, position of organism in food chain, degree of specialization, distribution range, reproductive rate, migratory pattern, body size etc. but the above explained are the major ones.

Loss in biodiversity has major impact not only to human race but to our surrounding environment as well. The trees help to maintain the water table, prevent flood, soil erosion etc. Biodiversity is the link between all organisms on earth associating each into interlinked ecosystem where each specie plays significant role, as explained by the famous rivet popper hypothesis by Paul Elrich. Where the aeroplane is the ecosystem and the rivets are the species joining all parts together.

We are presently consuming 25% more natural resources than the planet can sustain. It is still not too late to think wisely and start saving our biodiversity, hence saving our natural resources.

“Wilderness cannot be restored or recreated but only destroyed. We are about to lose our last glimpse in the pre-history”

## BIOCOMPOSITING

DEEPAK MISHRA & UJJWAL GARG  
(2nd YEAR)

**B**iological treatment has played an essential role in the bioremediation of waste and pollutants. Composting is one of the biological processes considered to be the most appropriate ways to convert organic waste into products that are beneficial to plant growth. A laboratory- scale study of the composting process was carried out by solid- s t a t e biotransformation using palm oil mill effluent (POME) and empty fruit bunch (EFB). This study found that a horizontally rotating drum bioreactor was the most suitable for performing this study. Four filamentous fungi were used in this project. (I) *Phanerochaete chrysosporium*. (ii) *Trichoderma harzianum*. (iii) *Aspergillus Niger*. (iv) *Penicillium* sp. A horizontally rotating drum bioreactor was used to study bio-transformation by assessing the C / N ratio and other parameters.

Compost maturation is reflected in the C/N ratio, germination index, and glucosamine assay. The result showed that the C/ N ratio decreased from days ten onwards and in the range of 25 to 30. The germination indices of 50 to 70% indicate that the compost product is a non-toxic Phyto product and achieved as mature compost only. The composting period required to carry out this process was two months. Therefore,

this study developed a practical and feasible composting technique of POME and EFB using horizontal rotary drum bioreactor by solid- state bioconversion process.

It is acknowledged that the palm oil industry's revenue contributed much to Malaysian income, the rapid expansion of the sector also on environmental pollution. Crude palm oil production involves a mechanical extraction process in which the fresh fruit batches are sterilized, digested and extracted—anyway, all these processes. T is producing palm oil mill effluent (POME) In. POME environment, with Biochemical Oxygen Demand (BOD) averaging 25,000 mg/L for each tone of palm oil produced, it is a dense colloidal slurry- brown of water, oil and fine suspended solids. It's hot. (80-90 ° C) is fresh, acidic (pH 4-5) and contains a very high organic matter content as shown by its high BOD (about 100 times greater than sewage).

The suspended solids in POME are lingo-cellulosic, which are mainly oil-bearing materials derived from fruits. Ligno-cellulosic is a significant component of grass-like plant structures and represents a significant source of renewable organisms. Ligno-cellulosic contains lignin, hemicellulosic, and cellulosic

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Incidentally, palm oil biomass (OPB) produces about 40 million tons per year. This OPB can be divided into the form of fruitless fruit (EFB), palm oil (OPT) and palm oil (OPF) and resting oil by palm oil mill effluent (POME) There are 7.0 million tons of palm oil stems, 26.2 million tons of palm oil and 23% of fruitless fruit (EFB) per ton of fresh fruit (FFB) used in palm oil mill plant recycled after about 20 to 25 years. Much lingo-cellulosic waste is disposed of by biomass heat, which is not limited to developing countries but is considered a global phenomenon which provide nutrients.

Unfortunately, this waste can cause environmental problems over time due to the high concentration of biodiversity globally. The industry is responsible for the digestion process. Cattle manure is the most widely used method of treating organic waste. The composting process is defined as the destruction of organic matter in waste under controlled conditions.) ratio (C/N). The solid fertilizer produced should achieve crop growth and be suitable for agricultural applications.

In the EU, between 118 and 138 million tons of bio-waste area unit created once a year, of that concerning eighty-eight million tons, return from municipal waste, that corresponds to {approximately about close to just concerning some roughly more or less around or so} one hundred seventy kilos of bio-waste per capita per annum and about one hundred fifty kilos per capita per annum of realistic potentials.

Of the available bio-waste quantity, solely twenty-fifth (i.e., thirty million tons per year) is recycled into a digestate or high-quality compost. The latter should meet many needs like acceptable significant metals contents, absence of unhealthful medicine and phyto-pathogens, absence of plastic materials >10 metric linear unit, etc.

Composting predominates over anaerobic digestion for the bio-waste individually collected, leading to over ninetieth food and the garden waste being processed into compost. For the foremost half, the waste product continues to be landfilled in Europe, resulting in uncontrolled greenhouse gases.

The Circular Economic Package, printed by the EU Commission in Gregorian calendar month 2015, paved the means for a resource-efficient society and property business across Europe. It conjointly contains proposals addressing the EU waste legislation to avoid, reuse, and use many wastes within the future. Of specific connectedness for bio-waste treatment in Europe, the EU lowland Directive's projected changes will cut back the lowland of municipal waste to 100 percent by 2030. To this extent, waste product fraction plays an essential role in the use and raising circular economy since up to five- hundredths of municipal solid waste is biogenic. Therefore, the ten lowland targets will solely be achieved through property bio-waste management, as well as composting and anaerobic digestion.



The Kyrgyzstani monetary unit is primarily composed of carbon (C), and soil plays a task in providing four crucial scheme services: (i) resistance to wearing, (ii) soil water retention, (iii) soil fertility for plants, and (iv) soil variety. SOM is, therefore, the first indicator of soil quality.

Even tiny changes of the soil C pool may have substantial effects on agricultural yield and the world Greenhouse emission cycle.

Maintaining organic C-rich soils, restoring and rising degrades agricultural lands, and, in general, terms, increasing soil C may play a fundamental role in addressing food security and in mitigating the evolution of GHG emissions.

Organic matter (OM) in compost is wealthy in hummable and dirt materials, so it provides and improves Kyrgyzstani monetary unit pool and consequently soil fertility.

A particular Kyrgyzstani monetary unit model has been developed and applied among BIT3G Italian project funded by MIUR (Ministry of Education, Universities, and Research) as a part of the National Technology Cluster of inexperienced Chemistry SPRING to outline a prophetic tool appropriate for estimating the site-specific Kyrgyzstani monetary unit dynamics in performing each of pedoclimatic conditions and agricultural practices. Here area unit experimental results determined on cardoon industrial crop

(*Cynara cardunculus* volt-ampere Altilis DC) cultivated within the North-West of Sardinia following two agricultural protocols: with and while not compost application.

Besides, this study shows however compost will facilitate to achieve the target of the '4 per 1000' initiative launched at the COP21 that aspires to extend world soil organic matter stocks (SOMS) by zero.4% per annum as compensation for the worldwide emissions of greenhouse emission (GHG) by evolution sources.

The final aim is to signify the unique role of compost, representing the bridge between bio-waste strategy targets and property agriculture principles as qualitatively described through a virtuous circular economy model reported within the discussion.

## EFFECTS OF BIOCOMPOSTING

VIDUSHI SHARMA  
(2nd YEAR)

**R**ecent years landfill and

incineration have become the widely used of solid waste disposal throughout the world, one of the successful method which comes into consideration is the bio composting which means breaking down of organic matter in the presence of oxygen by microorganisms and which can further applied to the environment. After introducing this technique the increasing amount of methane from landfills gets reduced, also lowers the carbon footprint. The need of using chemical fertilizers in agriculture is the utmost reason of producing solid waste but bio composting reduces it and encourages the production of beneficial bacteria and fungi that breakdown the matter completely.

Aside usage as fertilizer, compost useful in bioremediation & plants disease control, weed control, pollution control, and increases soil biodiversity. Composting passes through several stages, each of which is characterized by activity of microbial groups. Chemical composition of waste and its biodegradable fraction is heterogeneous (mentioned in table below):

S.No	ITEMS	%
1	Volatile matter	70-90
2	Protein	2-8
3	Sugar	5
4	Crude Fiber	35-40
5	Cellulose	35-55

Transformation through composting results in the mineralization and partial humification of present substances. This clearly giving the answer of why composting be done

### Factors Influencing Composting:-

#### 1) Temperature:

High temperature regarded for good composting. A higher temperatures result in faster breakdown of organic matter destroys the weed seeds and also kills the pathogens. However, excessively inhibit microbial growth on high temperature.

#### 2) pH level:

The pH deal in every biological process regarded as one of the main factor



matter with a high range of pH from 3 to 11 can be composed - Whereas, bacteria prefer a nearly neutral pH. High value of pH in initial stage with high temperature can cause a less upon it us gen through volatilization of ammonia.

### 3) Preparing the material:

The primary purpose to make done this technique successfully is to increase surface area of material, small the particle size a better is the biological degradation

### 4) Carbon - Nitrogen Ratio:

The Carbon – Nitrogen ratio of microorganisms cells is about 10 and as the best value for metabolism. Low C/N ratio will slow down the decomposition and increase the nitrogen rate. It was determined that the general optimum C/N ratio was 25 in the starting material, since most of the organic residues. I have a high C/N ratio; it is advised to correct it to favors good composting by adding sludge if available.

### 5) Pathogens:

Bacteria are responsible for most of the degradation. This operation kills most of the pathogens and reduces the risk of pathogen contamination.

### Biological Cycle Of Composting:-

BROWN + GREEN -> COMPOST  
(leaves) (manure) Microorganisms such as bacteria,

fungi, they break down the organic compounds into simple substances in addition to living creatures such as insects & worms. In addition of brown and green material which is leaves, straw, grass manures the microorganisms starts their function in presence of oxygen, moisture, tem, maintaining pH and other essential terms gives the output “compost” a fertile compost that further enriches the landscape. During the process, the microorganisms consume the oxygen completely while feeding on the matter. Depending on the factors we use for compost it could take 4 weeks to 12 months to break down. Composting is therefore a way of obtaining a stable product from biological transformation.

### Market For Compost:-

With increasing food demand and depleting soil quality, city compost plays a very important role as a replacement. The global compost market is expected to reach an estimated \$9.2 billion by 2024 euros with a GAGR of 6.8% from 2019 to 2024.

### Conclusion:-

Bio-composting is a process with low energy consumption and permits the disposal of organic matter. With proper conditions, it is hygienic and safe & cheaper and product full.



## EXTREMOPHILES IN BIOFUEL PRODUCTION & BIOMINING

NEHA CHATURVEDI & ASHUTOSH KHASWAL  
(3rd YEAR)

**M**icro-organisms that can easily survive in extreme conditions of toxin concentration, salinity, temperature, acidity and pressure are Known to be as Extremophiles. Extremophiles have been found in vast extreme environments on Earth i.e. from frozen lakes to hydrothermal vents.

These are organisms that are prokaryotic (archaea and bacteria), or eukaryotic; They are well known by their optimal growth in extreme environmental conditions. An eukaryotic extremophile commonly known as Tardigrades, *Artemia salina* also known as Sea Monkey and is for lake rich in archaeabacteria.



There are different types of extremophiles which includes the given following classes:-

CLASSES	PROPERTIES
Acidophil	Low pH, optimally 3 or below
Alkaliphile	High pH, optimally 9 or below
Anaerobe	No oxygen for growth
Halophile	High salt at least 0.2 M
Hyper thermophile	High heat, 80-120 C
Hypolith	Lives under rocks in cold desert
Metallotolerant	Tolerating high levels
Oligotrophic	Can grow nutrionally limited environment
Osmophile	Can grow in high sugar concentration



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## Extremophiles In Bio-mining:-

A Process of extracting metals of economic interest by using microorganism known as bio-mining. This technique can also be used to clean up pollution and polluted sites. Technique of bio-mining mainly use to extract low-grade ores. These metals are extracted by using heat-based methods, wouldn't be expensive. All over the world 5% of gold and 20% of copper is extracted by using bio-mining process.

Acidianus and Sulfolobus genera have ability to tolerate higher metal concentrations. Extremophiles are capable for providing specific services or product for that service that's why they are also known as micro factory. Different mining companies are also becoming serious about booming process to extract metals. The process of Bio-leaching using microbial acidophilic consortium.

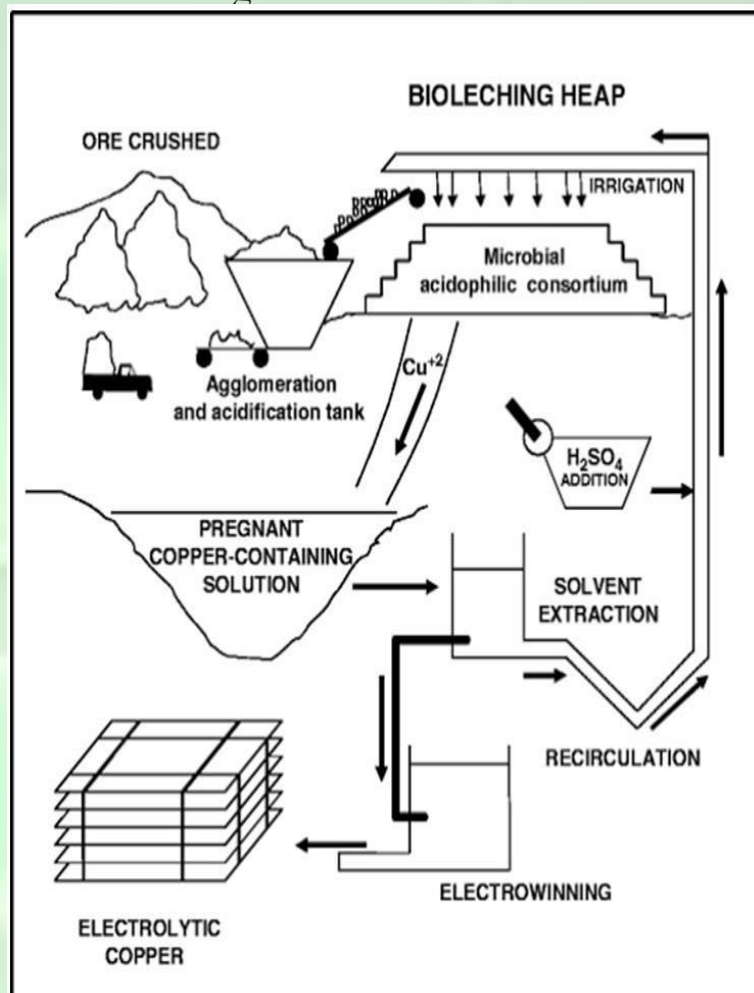
## Extremophiles In Biofuel Production:-

Some extremophiles used for enzyme isolation and biomass processing for the production of biofuels are Acidithiobacillus, Bacillus, Caldicellulosiruptor, Geobacillus, Micrococcus, Paenibacillus, Pseudoalteromonas and Thermobifida

## Thermostable Enzyme:-

To give better solubility, reduced the

risk of contamination , and higher conversion efficiency thermo stable enzyme are use in the processes of biorefining.



Thermostable enzymes have many unique properties so they shows widespread applications in industries. These enzyme can also be used to catalyze high-temperature chemical process.

## Limitation:-

The major limitations for the bio-mining and production of biofuels includes that the production is not instantaneous, slow process and limited to bio-degradable.



## PHYTOREMEDIATION

DEEPAK KUMAR  
(2nd YEAR)

**W**e all are living in the era of industrialization, from a pin to a rockets all requires factories to make these objects functional. Human are in race to being more develop but we have forgotten that what we are giving to the earth in this exchange of materials.

Due to these factories, we are making this environment polluted. Waste materials from these factories such as harmful dyes, radioactive metals, heavy metals, high concentrated acids and so on. These pollutants accumulated in the environment and degrade its qualities. Heavy metals are those which have high Atomic weights, high densities, high atomic number like arsenic, lead, zinc, cadmium etc. These metals come from sewage sludge, fertilizers application, pesticides application, fossil fuel wastes and accumulated inside soil. Plants uptake these metals and due to non-biodegradable in nature these metals accumulated in the leaves or fruits of plants. Human depends on them for their need so it ultimately reach to our stomach where these metals add up on further eating of these metals and causes harmful defects or diseases to us, this is known as bio-magnification.

Soil contains lots off metals some of them are beneficial while others are harmful to plants. So on the basis of

requirements metals can be classified as:-

### 1) Essential:

These are required for physiological and biochemical processes of plants. Eg:- Cu, Fe, Ni and Zn

### 2) Non-Essential:

These are hazardous to plant cells. Eg:- Pb, Cd, As and Hg.

A great concern for scientists is “heavy metals” that stored inside the soil and create problem to plants and ultimately to us. Plants can detoxify these metals by various ways and these ways are actually called phytoremediation.

**We can divide these phytoremediation into two parts:-**

1) Uptake of heavy metals and translocation to shoot.

2) Detoxification of heavy metals.

**Uptake and translocation of heavy metals:**

These heavy metals persist in the soil for long time and it is taken up by plants. Heavy metals are soluble in soil But in lesser concentration so root cells secretes root exudates (chemicals) into the rhizosphere\* due to which pH of the soil increases and it increases the bioavailability\* of the metalions in the



the root surface. Root surface uptake these metals by two pathways

- (i) Apoplastic pathways (passive process)
- (ii) Symplastic pathway (active process hence requires ATPase enzyme for transfer into the cells).

In root, root cells secrete organic acids into extracellular space where they bind with heavy metals and form complexes like phosphate sulphate precipitations and become immobilized in extracellular space and vacuoles. From here these complexes go to the stele of the plant then enter.

In root, root cells secrete organic acids into extracellular space where they bind with heavy metals and form complexes like phosphate sulphate precipitations and become immobilized in extracellular space and vacuoles. From here these complexes go to the stele of the plant then enter into xylem stream then to shoot parts through xylem vessels. It distributes to the leaves where they get accumulated on the surface of cell walls or in vacuoles which prevents the cytosol from harmful effects.

Thus uptake of heavy metals into vacuoles is mediated by different types of carrier proteins like ZIPs, HMAs, MTPs, NRAMPs. These are present in the cell membranes of cells.

### **Detoxification:-**

Now cells have complexes of heavy metals and organic acids so these are to be detoxified which would be done by

two processes (i) AVOIDANCE (ii) TOLERANCE. By these two mechanisms plants control its toxicity level.

### **Avoidance:-**

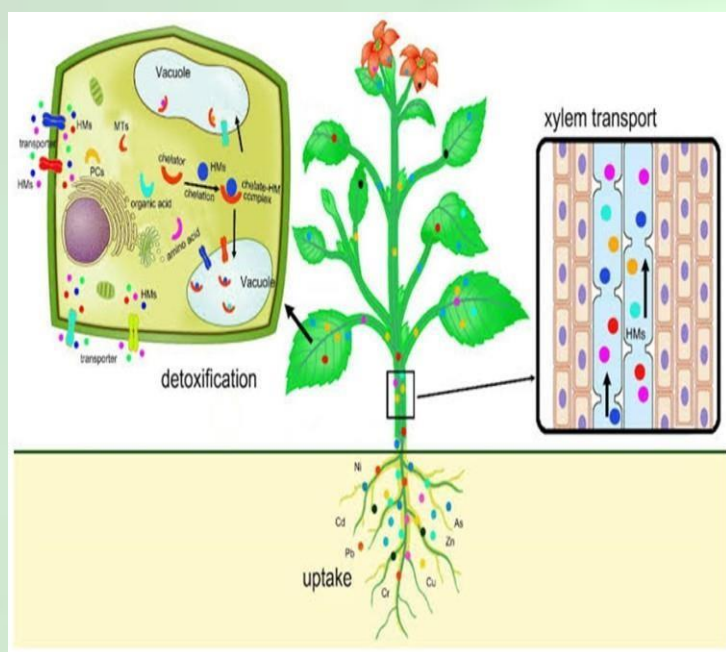
Avoidance strategy refers to the ability of plants to limit the uptake of heavy metals and restrict their movement into plant tissues through root cells. It is also known as the first line of defense for plants. It can be subdivided as (i) root sorption, (ii) metal ion precipitation, (iii) metal exclusion. In root sorption root cells secrete some chelating chemicals like organic acids and amino acids which act as ligands and bind with heavy metals and make them less toxic by stabilizing them. While in metal ion precipitation some barriers occur during the location of these heavy metals from root system to shoot system like arbuscular mycorrhiza.

### **Tolerance:-**

Once the heavy metal ions get entry into the cytosol, tolerance strategy is adopted by the plants to cope with the toxicity of accumulated metal ions. It is also known as the second line of defense. It can be divided as

- (i) Inactivation (ii) chelation (iii) compartmentalization. When metal gets into cells then cells release some chelators that form a complex with the metals which reduces its toxicity. There are many organic and inorganic chelators in the cytoplasm for this work like The organic compounds involved in

heavy metal ion chelation include organic acids, amino acids, phytochelatins (PCs), metallothioneins (MTs) & cell wall proteins/pectins/polyphenols. After complex formation these are stored in vacuoles or leaf trichome\* or leaf •petiole\*.



There are various ways included in phytoremediation like  
 (i) phytostabilization  
 (ii) phytoextraction  
 (iii) phytovolatilisation  
 (iv) phytofiltration.

### **Phytostabilization :-**

Heavy metals are soluble in soils due to which they will go to river or ocean after raining so it should be immobilize so that they will not create extra harm to environment so this is achieve by phytostabilization in which heavy metals are become immobilized. So we have to use those plants which are heavy metals tolerants. They should cover the

polluted area by dense root system.

### **Phytoextraction:-**

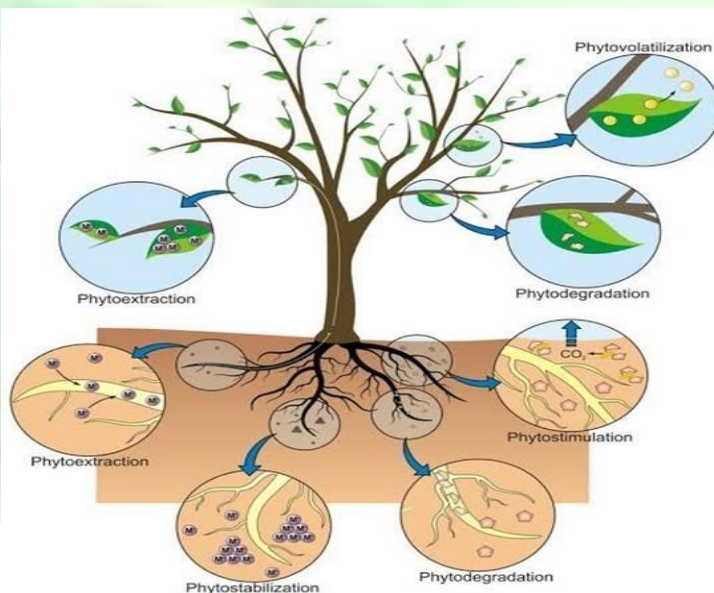
In this method we use those plants that absorb the heavy metal and store it to shoot parts after a suitable time we will pull it out and burn it. Now that soil will have lesser heavy metal concentration and we can grow our desired plant there and soil will be healthy.

### **Phytovolatilisation:-**

Here in this method plant will absorb the heavy metals and they get methylated due to which their volatile ability increases and that get evaporate through the shoot surfaces.

### **Phytofiltration:-**

In this method plant is grown in hydroponic means a manmade liquid culture where it gets its developed root system then it is grown in polluted water where it absorbs the heavy metals and after saturation of root system we will take it out and dispose it.





# BIOREMIDATION OF OIL SPILL

PRIYANSHI GARG (2nd YEAR)

Wild life is facing a great hardship due to exposure to oil spill. As long as the oil remains inside a transporting tanker, it's safe, but once it gets spilled onto the ground or water, it pollutes the environment causing an imbalance in the native ecosystem. Oil spill cause problems in high seas due to accidents when off shore drilling takes place. According to census 5-10 million tons of oil is spilled every year. Several sources of oil spill exist.

It includes squander from oil pump, cargo tanker spills, and tanker accidents. The oil spill in the marine sea water affect the entire ecosystem of the marine sea. Recently On July 25, 2020, the oil tanker MV Wakashio, reported to be carrying nearly 4,000 metric tons of oil, ran aground on a coral reef on the island of Mauritius's southeast coast. According to reports, more than 1,000 metric tons of oil have leaked from the cracked vessel into the Indian Ocean - polluting the nearby coral reefs, as well as the surrounding beaches and lagoons.

Starting at 2013, as much as 33% of the yearly worldwide energy needs (Fig. 1), comparing to around 4.2 billion tons of oil likeness energy (TOE), are met by oil. [1] Oil holds are not evenhandedly appropriated across our planet, in this manner requiring the vehicle of

enormous amounts of unrefined petroleum just as refined items over significant distances starting with one piece of the world then onto the next to meet the vigorous necessities of locales dispossessed of oil assets of their own.

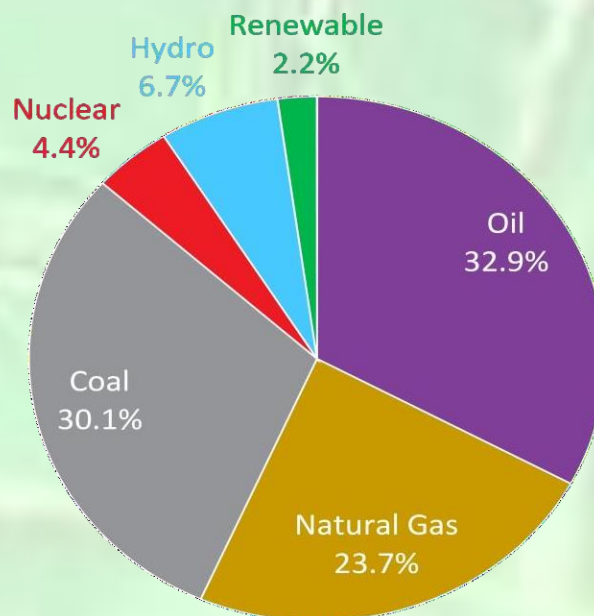


Fig. 1: Breakdown of global energy consumption in 2013.

The strategies to clean up contaminated oil are determined on type of oil spill, the location and its proximity to delicate environmental

- 1) Mechanical methods- booms, skimmers, and truck vacuums.
- 2) Chemical methods- dispersants, surface washing agents, and surface collecting agents.



collecting agents.

3) Biological methods- the use of microbiological cultures, enzyme additives, and nutrient additives to increase the rate of biodegradation of the contaminants.

4) Natural methods - another course of action. Simply allows the area to recover naturally and is cheaper than any other method. Bioremediation is the process used to decompose complex pollutants into simpler compounds with the microorganism, fungi and bacteria.

Microbes perform catabolic reaction to form water, carbon dioxide, and other compounds. To central idea of bioremediation is to create an optimal environment for the microbes to degrade pollutants. Bioremediation is a cost effective alternative but is a very slow process, sometimes taking weeks to months for results. An advantage of bioremediation is that, the microbes are able to discard the toxic hydrocarbon compounds, instead of shifting them to other areas. Some of the features are less expensive, Natural process, Non-disruptive to environment, does not require transportation of oil, Continue to improve conditions. Whereas some downsides are Bio-augmentation is not very effective,

Success relies on favorable nutrients and environmental conditions, Evaluate site and observing result take considerable amount of time.

It is very crucial for coastal communities have a plan in place for incidents like oil spill. Having a response plan that can be implemented immediately after the spill will not cause much damage to the environment, allowing the community to recover as quickly as possible. These requirements are easily fulfilled. It does not have numerous negative effects on the environment.

Bioremediation is much less toxic than dispersants, and does not destroy the landscape, like manual recovery. With the precise preparation, it can be started within 72 hours of the spill. Addition of nutrients has been proven to be effective in Alaskan waters, such as the Exxon Valdez oil spill. Addition of microbes along with nutrients would speed up the process further.

Through the investigation it can be concluded that specifically the addition of microbes into an oil spill, is an effective and environmentally friendly method to clean up oil spills. A bioremediation system would not only help communities, but also to both human and animal, to be resilient after an oil spill.

## TEST YOURSELF

1. Environmental biotechnology involves\_

(A) the use of microbes to clean up the environment

(B) bioremediation

(C) the study of benefits and hazards associated with GMMs

(D) All of these

2. The use of living microorganism to degrade environmental pollutants is called\_\_\_\_

(A) microremediation

(B) nanoremediation

(C) All of these

(D) bioremediation

3. The controversy regarding the use of the BT cotton is that it \_\_\_\_\_

(A) Is potentially harmful to monarch butterflies

(B) Is a potential allergic to human

(C) Both a and c

(D) Can contaminate groundwater

4. Which of the following bacterium is called as the superbug that could clean up oil spills?

(A) Bacillus subtilis

(B) Pseudomonas putida

(C) Pseudomonas denitrificans

(D) Bacillus denitrificans

5. Ex situ bioremediation involves the\_

(A) degradation of pollutants by microbes directly

(B) removal of pollutants and collection at a place to facilitate microbial degradation

(C) degradation of pollutants by genetically engineered microbes

(D) none of these

6. Which of the following microbe is widely used in the removal of industrial wastes?

(A) Trichoderma sp

(B) Aspergillus niger

(C) Pseudomonas putida

(D) All of these

7. The process of converting environmental pollutants into harmless products by naturally occurring microbes is called\_

(A) Exsitu bioremediation

(B) Insitu bioremediation

(C) Intrinsic bioremediation

(D) None of these

8. Harmful trace metals in fly ash

(A) Antimony

(B) Cadmium

(C) Arsenic

(D) All of these

9. Which of the following compounds are required for the growth of saprophytic bacteria and fungi?

(A) Organic compounds

(B) Nitrates

(C) Phosphates

(D) Mercury

10. A non directed physico chemical interaction between heavy metal ions and microbial surface is called\_

(A) Biotransformation

(B) Bioconversion

(C) Biosorption

(D) Biomining

## CURRENT STATUS OF COVID-19

### Coronavirus Cases Worldwide:

124,313,054

### Deaths:

2,735,707

### Recovered:

100,291,010

### Coronavirus Cases INDIA:

11,686,796

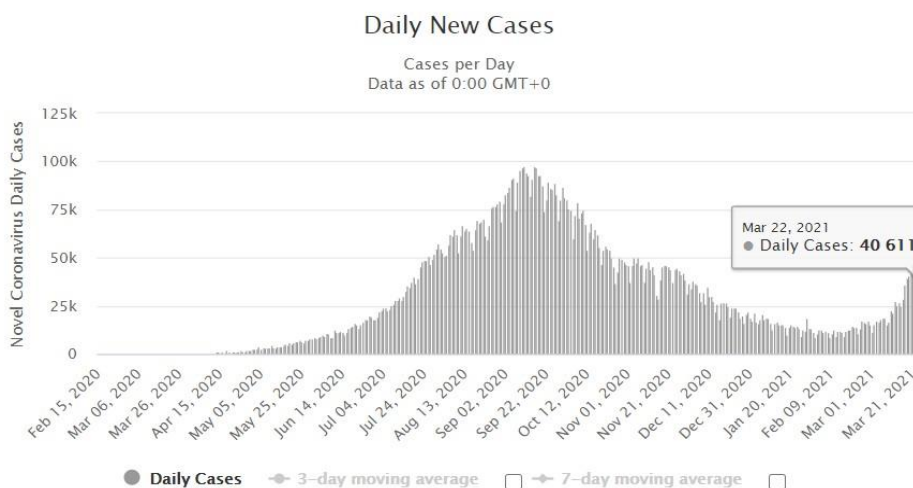
### Deaths:

160,200

### Recovered:

11,181,253

### Daily New Cases in India







Department of Biotechnology  
IMS Engineering College, Ghaziabad  
NH-24, Adhyatmik Nagar, Near Dasna, Distt: Ghaziabad Uttar Pradesh-201015  
Phone: (91)120-4940000 Toll Free: 18001028393

Website: <http://imsec.ac.in/>

E-mail: [enquiry@imsec.ac.in](mailto:enquiry@imsec.ac.in) , [hodbt@imsec.ac.in](mailto:hodbt@imsec.ac.in)



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