



ONLY NEWS PAPER PUBLISHED IN INDIA FOR SCIENTIFIC COMMUNITIES

# NESA NEWSLETTER

NATIONAL ENVIRONMENTAL SCIENCE ACADEMY

Vol. 23 Issue - 06 (MONTHLY)

June 2020



## NESA Annual Award 2020 Notification No. 2 APPLICATIONS ARE INVITED date is extended to 31<sup>st</sup> July 2020

### (1) NESA FELLOWSHIP AWARD

**AGE** 45 and above. The recipients shall get Citation, Certificate, Memento and a Gold plated medal, and can suffix F.N.E.S.A. after their names.

### (2) NESA EMINENT SCIENTIST AWARD

**AGE** 40 and above. The recipient shall get Citation, Certificate, Memento and a Gold plated medal.

### (3) NESA SCIENTIST OF THE YEAR AWARD

**AGE** 35 and above. The recipient shall get Citation, Certificate, Memento and a Gold plated medal.

### (4) NESA ENVIRONMENTALIST AWARD

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### (5) NESA GREEN TECHNOLOGY INNOVATIVE AWARD

**AGE** 35 and above. The recipients shall get Citation, Certificate, Memento and a Gold plated medal.

### (6) NESA YOUNG SCIENTIST AWARD

**AGE** : Up to 35. The recipients shall get Citation, Certificate, Memento and a Gold plated medal.

### (7) NESA JUNIOR SCIENTIST AWARD

**AGE** : Below 35. The recipients shall get Citation, Certificate, Memento and a Gold plated medal. a Gold plated medal.

### PRESCRIBED APPLICATION FORMS

The application forms could be downloaded from [www.nesa-india.org](http://www.nesa-india.org)

Separate application form should be submitted for separate awards. The application forms are non-transferable and it can also be obtained by sending a bank draft of **Rs. 1000/- only** (per form). Drawn in favour of **NATIONAL ENVIRONMENTAL SCIENCE ACADEMY** payable at NEW DELHI.

**\*Please log on to our website for Guidelines.**

**GENERAL SECRETARY**

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## CELEBRATE BIODIVERSITY FOR LIFE

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In the present day environment, which is the most wonderful on this Living Planet? It is undoubtedly, the biological diversity. That's why, we call it a Green Planet. The livelihood of various life forms (from bacteria to humans) is sustained by the Earth through the ecological functioning of various ecosystems, be it terrestrial or aquatic. So, what is needed to be protected, conserved and enhanced at the first place is biodiversity, being central to sustain life in the planet Earth. Global studies too have substantiated the relevance of biological diversity for human development and environmental sustainability.

“Celebrate Biodiversity” is the theme ascribed to the World Environment Day 2020. We, the Indians are known for appreciating and celebrating ecosystems, trees and all forms of life, owing to the socio-cultural values that we attach to them. Across spiritualism, we do witness diversity and division of labour. Both scenarios result in variability that is today visible as the mammoth biodiversity, which is only just 1% of the erstwhile biological diversity that vanished owing to catastrophes as recorded through geological era. The available diversity today is reflected in terms of colours, size and shape across commodities that we consume and conserve in our farm lands. Nevertheless, the extraordinarily broad genetic base of all food and non-food crops and livestock is worth appreciating. About 5000 years ago, we derived foods from as many as 5000 plants. We used to be cultivating about 60,000 varieties of rice and rear hundreds of livestock breeds. Such a perfect blend on the way the humans interact with the land, technology and biological diversity have manifested in different socio-cultural systems creating masses of cultural landscapes in this planet. While we appreciate the organisms in the wilderness and its spectacular views, the human beings have developed a process of appreciating a group of commodities that they consumed and so cultivated widely across different agro-climatic conditions manifesting rich agricultural diversity through a varied pattern of cultivation across the landscape.

Spelling out the beauty, fragrance and numerous virtues of agrobiodiversity, our agriculture is a unique example of biodiversity celebration. However, the so-called Green Revolution began in the West and landed the Indian soil in 1960s, has squeezed out most of the agrobiodiversity from our cultivation practices. The Green Revolution type agriculture depended on a limited number of so-called HYVs (high-yield varieties). The HYVs are fertilizer-responsive and their high yield potential can only be sustained by applying high doses of chemical fertilizers and frequent irrigation, which are not advocated as best practices in today's context. Further, climate change has posed a greater challenge on all spheres of human development, as it affects the soil-plant-atmosphere continuum.

Eventually, this calls for a collection and conservation of traditional crops, which although recorded low productivity but have had greater resilience to climatic variability and also diseases. This also calls for 'back to basics' as we say it, provisioning ample opportunities to



appreciate and validate our traditional agri-food systems, be it crops to cultivate, pattern of cultivation, processing or the traditional foods. Notwithstanding, urbanization and modernized life style have posed challenges on these diversities and systems.

Across time and space, this green planet has witnessed mass extinctions leading to loss of species that were majorly due to natural catastrophes. Nevertheless, the present-day, anthropogenic pressures on biodiversity are accelerating the species extinction process. It is estimated that due to adverse human activities, we shall have to lose ~50% of the total species by the end of the 21st Century. This would primarily be caused by unsustainable habitat management practices that have disadvantageous environmental and economic implications, and would snatch our hope to usher a sustainable and happy future. Over all, biodiversity and sustainability go hand in hand. Higher the level of biodiversity, greater is the degree of resilience for sustainability.

Observing the World Environment Day in 2020 should a self-awakening moment for all of us to “Celebrate Biodiversity”, appreciating the call for conservation and augmentation of Earth's biodiversity for sustainable human development by linking the best practices of ecology with economics and ethics.

Let this wonderful world of ours blossom with bountiful biodiversity and continue to provide the ecological services in a landscape for sustainability. We, the humans, need and depend on the biodiversity, and definitely not vice-versa. So, let us celebrate by biodiversity for our life.



## PLASTIC POLLUTION ON MARINE ENVIRONMENT

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In the last decade, plastic has affected the health and life of human beings very badly. Careless disposal of plastic can have dire consequences. A plastic bag looks like a tasty jellyfish to an indiscriminate feeder like the sea turtle, but plastic is indigestible. It can choke, block the intestines of, or cause infection in those animals that consume it.

Every day, more and more plastic is accumulating in our oceans. Recreational boaters are not the only group that improperly disposes off plastic refuse at sea. Plastics also enter the marine environment from sewage outfalls, merchant shipping, commercial fishing operations, and beachgoers.

### Causes of Plastic Pollution

More than 90% of the articles found on the sea beaches contained plastic. The plastic rubbish found on beaches near urban areas tends to originate from use on land, such as packaging material used to wrap around other goods.



On remote rural beaches the rubbish tends to have come from ships, such as fishing equipment used in the fishing industry. This plastic can affect marine wildlife in two important ways: by entangling creatures, and by being eaten.



Turtles are particularly badly affected by plastic pollution, and all seven of the world's turtle species are already either endangered or threatened for a number of reasons. Turtles get entangled in fishing nets, and many sea turtles have been found dead with plastic bags in their stomachs.

In one dead turtle found off Hawaii in the Pacific more than 1000 pieces of plastic were found in its stomach. A recent US report concluded that more than 100000 marine mammals die every year in the world's oceans by eating or getting entangled in plastic rubbish, and the position is worsening world-wide, 75 marine bird species are known to eat plastic articles.

### Effect on Ocean Wildlife

This plastic can affect marine wildlife in two important ways; by entangling creatures, and by being swallowed. Sixty per-cent of 6,136 surface plankton net tows conducted in the Western North Atlantic Ocean and Caribbean Sea from 1986 to 2008 contained buoyant plastic pieces, typically millimetre in size.

Plastics turn up in bird nests, are worn by hermit crabs instead of shells, and are present in sea turtle, whale and albatross stomachs. Over 260 species, including invertebrates, turtles, fish, seabirds and mammals, have been reported to ingest or become entangled in plastic debris, resulting in impaired movement and feeding, reduced reproductive output, lacerations, ulcers, and finally death.



Ingestion of plastic items occurs much more frequently than entanglement. At sea, plastic bags may often be mistaken for jellyfish, whilst on shorelines seabirds have been seen to pick up plastic items the same way they pick up cuttlefish bones.

On dives between 5,500 and 6,770 m, 15 items of debris were observed, of which 13 were plastic. The presence of plastic at shallow and greater depths may harm sediment wildlife such as worms, sessile filter feeders, deposit feeders and detritivores, all known to accidentally ingest plastics.

The hard surface of pelagic plastics also provides an attractive and alternate substrate to natural floating debris (e.g., seeds, pumice, and wood) for a number of opportunistic colonizers. The increasing availability of these synthetic and non-biodegradable materials in marine debris may increase the dispersal and prospects for invasion by non-indigenous species.

### Plastic Pollution and Turtles

Turtles are particularly badly affected by plastic pollution, and all seven of the world's turtle species are already either endangered or threatened for a number of reasons. Turtles get entangled in fishing nets, and many sea turtles have been found dead with plastic bags in their stomachs.

It is believed that they mistake these floating semi-transparent bags for jellyfish and eat them. The turtles die from choking or from being unable to eat. One dead turtle found off Hawaii in the Pacific was found to have more than 100 pieces of plastic in its



stomach including part of a comb, a toy truck wheel and nylon rope.

Plastic ingestion by sea turtles is a relatively common occurrence, albeit often in small

quantities. However, even in small quantities, plastics can kill sea turtles due to obstruction of the oesophagus or perforation of the bowel for example.

Relief of gastrointestinal (GI) obstruction of a green turtle off Melbourne beach, Florida, resulted in the animal defecating 74 foreign objects over a period of a month, including four types of latex balloons, five different types of strings, nine different types of soft plastic, four different types of hard plastic, a piece of carpet-like material, and 2 to 4 mm tar balls.

Plastic ingestion may also indirectly lead to death of an animal through nutrient dilution, i.e., plastic pieces displacing food in the gut (and reducing the surface available for absorption).

Young pelagic sea turtles typically associate with “floating islands” of drifting seaweeds such as Sargassum. Floating plastics, tar from terrestrial and oceanic (ship) sources and lost fishing gear are drawn by advection into the same drift lines.

As young sea turtles indiscriminately feed on pelagic material, large occurrence of plastic is common in the digestive tract of these small sea turtles, often resulting their mortality.

As plastics can accumulate in multiple segments of the gut, stomach lavages underestimate the incidence of ingestion.

**Marine Mammals**

There is great concern about the effect of plastic rubbish on marine mammals in particular, because many of these creatures are already under threat of extinction for a variety of other reasons e.g. whale population has been decimated by uncontrolled hunting.

A recent US report concluded that 100000 marine mammals die every year in the world's oceans by eating or becoming entangled in plastic rubbish, and the position is worsening.

**NATURE BREATHING FREELY- THANKS TO CORONAVIRUS**

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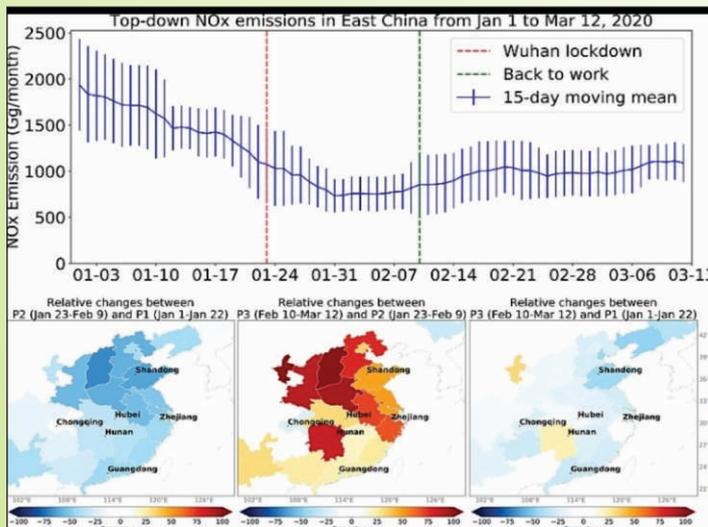
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'Coronavirus, we all are well aware of this term right now. On December 31, 2019, hospitals in Wuhan, Hubei province, China reported on a cluster of cases suffering from pneumonia of unknown cause. Two weeks later, new variant of coronavirus was identified, which was named 'severe acute respiratory syndrome coronavirus 2' (SARS-CoV-2). Over the next few weeks, it spread to 18 countries and on January 30, 2020, the World Health Organisation (WHO) had declared the outbreak to be a Public Health Emergency of International Concern (PHEIC). Subsequently, on March 11th, it was declared a pandemic as it had spread to 113 countries.

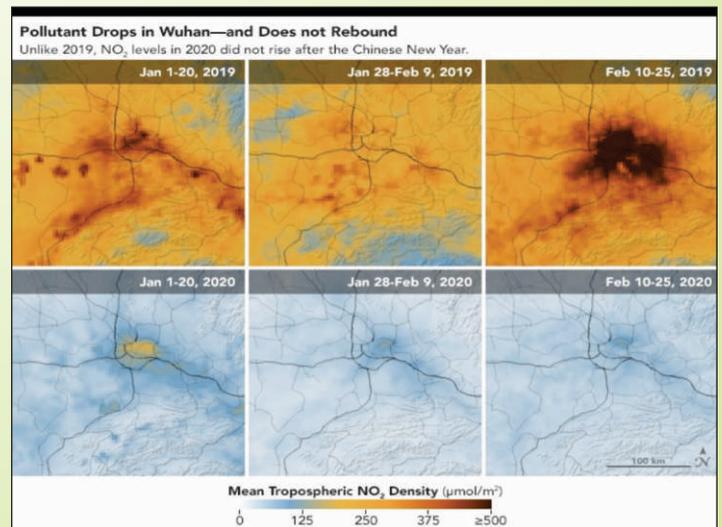
We all know about its fierce effect on animals more precisely on human beings. Everyone is concern about death rate and number of people getting affected day by day. But do we think about how this pandemic has changed our environment.

To reduce the transmission of Coronavirus from person to person and also to reduce the death rate different countries have chosen the path of lockdown and social distancing. All factories and industries are almost closed and all sort of transport has been stopped all over the world. In China, scientists estimated 25% reduction of carbon emission and 50% reduction of nitrogen oxides.

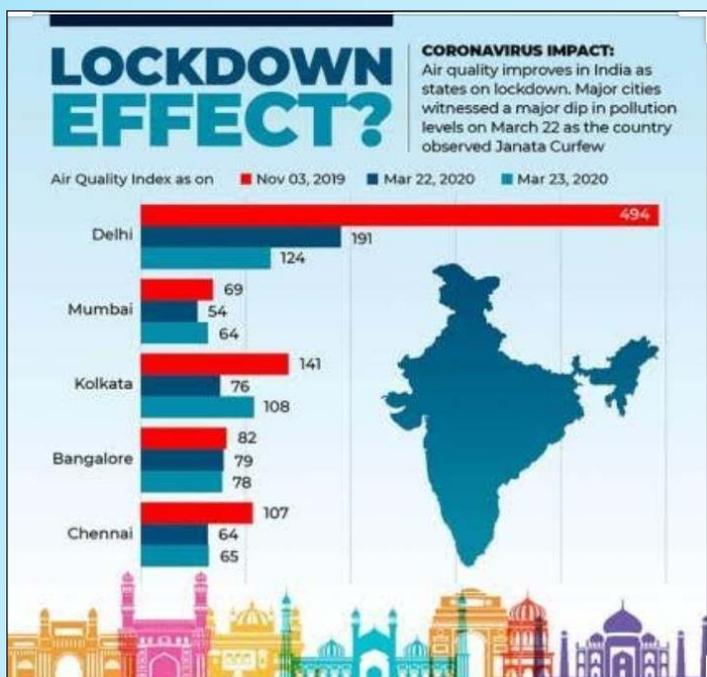
NASA uses Ozone Monitoring Instrument (OMI) to observe the ozone layer and analyze pollutants like NO<sub>2</sub>, CO<sub>2</sub> etc. These instruments helped NASA to obtain data about current situation of atmosphere. According to the research of NASA scientists, the decrease in nitrogen oxide first started in Wuhan, China and gradually the same is visible in other parts of the whole world.



Nirogen oxide emission changes in East China



Pollutant drops in Wuhan- NASA Earth Observatory Imges



Water pollution is also decreasing to some extent. Rivers and canals are also getting cleared day by day. Industrial pollutants, oil spills, pollutants of marine vehicles are not mixing with water. Hence, chances of death of marine animals and aquatic plants are declining. Recent news in West Bengal- clearing of Ganga water and view of Dolphins is trending now. The Venice mayor's office clarified that the increase in water clarity is due to the settling of sediments that is disturbed by boat traffic.

Lockdown to reduce the spread of COVID-19 resulted decrease of all economic activities as a result green house gas emission also lowered. But, due to lockdown everyone is at home, doing work from home, hence domestic energy consumption has increased. This is again a major effect of lockdown on environment.

It is clear that the decrease of such pollutants and green house gases is a good sign but after these lockdown and other restrictions are over, the sudden opening of all industries, factories and running of vehicles can be detrimental.

## PROSPECTS OF CULTIVATION OF AGAR WOOD: AN ENDANGERED MEDICINAL TREE (AQUILARIA MALACCENSIS LAM. SYN. A. AGALLOCHA ROXB.)

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Agar wood is called as woods of God. It is native of south East Asia. It is a forest tree and reaches to a height of 40 meters and 80 centimetres wide approximately. These wild trees become infected by some molds or parasitic fungi called *Phialophora parasitica* and begin to produce agar wood in heartwood due to unaffected response to this attack. It is an odourless prior infection. The Agarwood tree is in the verge of extinction in the wild. In Assam, reputed to be India's agarwood capital, the adaptability of the critically endangered trees to oil-contaminated agricultural plots and its proliferation in home gardens, have

**THE EFFECTS OF LOCKDOWN ON ENVIRONMENT**

- AIR POLLUTION DROPPED SUDDENLY**  
Due to the lockdown, air pollution suddenly dropped all over the world. This is one of the major positive effects on the environment because of the coronavirus outbreak.
- WATER IS CLEAN ONCE AGAIN**  
This is another unexpected effect on the environment due to lockdown. Because of the coronavirus, the number of tourists reduced so that all the water of seas and rivers is cleaner than they have been in living memory.
- GREENHOUSE GAS EMISSION**  
This lockdown period lowers oil demand. The international energy agency said that this year global oil demand is expected to decline because the impact of coronavirus spreads all over the world.
- RISING THE USE OF DOMESTIC ENERGY**  
In the whole world, more and more people are at their homes due to the lockdown. So in this situation, the use of domestic energy is increasing. This also becomes one of the major effect of lockdown on environment.
- ECONOMIC CRISIS**  
The essential works are halt. The schools, colleges, industries, and airlines all the things are temporarily stopped. All these things cause the huge economic loss in all over the world.

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The clarity of water and fresh air resulted decrease in death of people due to such pollutants. As all economic activities have stopped, huge number of people had become jobless. All countries are facing such economic crisis, mainly developing countries like India.

This pandemic also has some social impact. During this difficult situation we came across lot of good practices, which we have to follow throughout our lives to restrict such pandemics to happen. Maintaining social distancing, wearing masks and gloves, washing hands frequently, not touching mouth and eyes without any need are such good practices to be followed everyday even after the pandemic gets over. These precautions can help us to get rid of a lot more diseases along with Coronaviral infection.

### Reference

1. www.ecoleglobale.com
2. www.pinterest.com

raised hopes of conserving the embattled species, amid the absence of a policy to support agar cultivation and industry

### Commercial importance

Agarwood has been traded and highly coveted for thousands of years. The resinous wood is used as incense, for medicinal purposes, and pure resin in distilled form is used as an essential oil as well as a perfume component. Outside its native countries, it is most widely known in the Middle East, China, Taiwan, and Japan. A strong connection exists between use, religion, and curative properties, and elaborate traditional and religious ceremonies are known around the world. Faith healers in the Middle East use it at curative ceremonies, Japanese pilgrims donate flowers and agarwood oil to Shinto-Buddhist temples, and



Aquilaria malaccensis

Vietnamese religious groups are obliged to bring agarwood to ceremonies at their temples in Mekong Delta communities.

#### Therapeutic Uses

Wood is used as stimulant, aphrodisiac, tonic in diarrhoea, vomiting and used in skin related ailments like wounds, injuries, pain, indigestion, heart related ailments, blood purifier against gout, impotence and urine related disorders. The plant acts as anti-inflammatory, stimulates the nervous system, is antirheumatic and antiparalysis.

#### Agarwood Value

The value of first-grade Agarwood is extremely high. A wide array of products of different grades is available on the market, varying with geographical location and cultural deposition. Prices range from a few dollars per kilo for the lowest quality to over fifty thousand US dollars for top quality oil and resinous wood. *Aquilaria crassna* is listed as a critically endangered species in Viet Nam, and *A. malaccensis* is listed as vulnerable by the World Conservation Union, IUCN.

#### Morphological Characteristics

This plant is a large evergreen tree about 20 meters tall and 1.5–2.4 meters in girth with somewhat straight and fluted bole. Leaves are alternate 0.5-10 cm by 2-5 cm, oblong, lanceolate or elliptic, caudate, acuminate and glabrous with slender nerves. Venation is parallel. Petiole is 0.3-0.5 cm long. It is commercially used as fragrant and in preparation of drugs. The tree contains plenty of oleoresin and has irregular dark patches. The wood burns with a bright flame giving off pleasant smell.

#### Distribution

It is widely grown in West Bengal and North-Eastern States of India namely Assam, Meghalaya, Manipur, Mizoram, Arunachal Pradesh and Nagaland.

#### Climate and Soil

This is a tropical tree which grows over high rainfall tract throughout humid regions. The region experience low temperature variations between 20°C to 28°C and relative humidity around 80%. *Aquilaria* can grow on a wide range of soils, including poor sandy soil. Seedlings require a great deal of shade and water but will grow rapidly, producing flowers and seeds as early as four years old. It grows over sandy loam and slightly acidic soils.

#### Propagation Material: Seeds.

##### Nursery Technique

- **Raising Propagules:** Seeds mature during July-August. It loses viability soon. Thus seeds are sown within a week of collection. Raising seedlings in poly-bag is preferred. Seed germination is more than 80%.
- **Propagule Rate and Pretreatment:** 4500 plants/ha are required.

##### Planting in the Field

- **Land Preparation and Fertilizer Application:** Before transplanting of seedlings, land should be thoroughly ploughed and harrowed to bring it up-to a good tilth. FYM @ 20 t/ha may be applied at the time of land preparation supplemented with NPK @ 60:60:40 may be applied in split doses. The fertilizer level is increased with age from 3rd year onwards.

- **Transplanting and Optimum Spacing:** Seedlings when attain a height of 30-40 cm should be transplanted in the field during rainy season (April-June) at optimum spacing of 3X 3 meter.
- **Intercropping System:** Annual or biennial medicinal herbs viz *Andrographis paniculata* (Kalmegh), *Withania somnifera* (Ashwagandh), *Rauwolfia serpentina* (Sarpagandha), *Bacopa monnieri* (Bhrami), *Piper longum* (Pippali) etc. may be cultivated as catch crops till the trees attain growth.
- **Inter-culture and Maintenance Practices:** Spading and simultaneous weeding at 90 days after transplanting is required.
- **Irrigation Practices:** Rainfed plantation.
- **Weed Control:** Hand weeding is done after 90 days of transplanting, thereafter Gramoxone @ 0.5 kg/ha may be applied when necessary. Glycel @ 1.5 kg/ha may be applied to eradicate weeds.
- **Disease and Pest Control:** Attack of *Heortia vitessoides* is observed during May-August. This causes defoliation of whole tree. Application of Thiodan @ 2 ml/lit at 15 days interval during infestation is found to control the pests effectively.

#### Harvest Management

- Agar-wood develops a peculiar, persisting strong odour because of infestation by a fungal identified as *Zeuzera conferta*, it penetrates the hard wood, through wounds, injury or borers. All attempts to induce artificial infestation have failed; it is a natural phenomenon. It develops black patches and stores resinous oil which is separated through distillation of the woody chips. This oil has high value in medicine and perfumery industry.
- **Crop Maturity and Harvesting:** Time of harvesting depends on disease infestation in hard wood. Agar is regarded as a pathological product formed as result of infection. Black patches in the bark indicate occurrence of infection and can be used for harvesting hard wood to commercial use.
- **Post-harvest Management:** Wood chips or chips powdered mechanically without generating heat are soaked in water for 2-3 days and transferred to stainless steel vessel which is part of a distillation unit. The distillation is done for 30-36 hours. Oil and water is collected in a separator and stored. The oil and water ratio in the condenser is kept low on account of the high boiling point. Oil is stored in closed container preferable in Aluminum bottles.
- **Chemical Constituents:** Presence of the woody chips attains an essential oil from 0.8% to 2.2% is in fungal infested wood in 8-50 years old plant. The wood contains hexadecanoic acid (25.0%), pentadecanoic acid (6.7%) and oleic acid (4.9%); other constituents range from 0.1 to 2.1%. Agar wood, on distillation, yields an essential oil known as AGAR OIL.
- **Yield and Cost of Cultivation (Hectare):** This oil is exceptionally costly and its sells at 6.0 lacs or more per liter.

## ADVANCEMENTS IN COSMETIC INDUSTRIES USING ACTIVATED CARBON.

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Activated charcoal is defined as a dark fine powder that is produced using a bone burn, shells, peat, oil coke, etc. At first, charcoal is activated as it is prepared at exceptionally high temperatures. Due to the high temperature, several changes could be seen in its structure. Activated carbon has been in

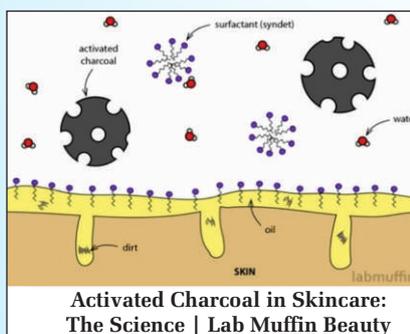


Activated Carbon or Activated Charcoal - Tehran Times Images

the limelight since ancient times and is one of the widely used adsorbent for the air and water. It's application in the adsorption process depends on the surface area and the porosity. Activated carbon has a fantastic property i.e. adsorption property which makes it ideally active in the field of cosmetics.

*How does activated carbon work?* The basic principle of the activated carbon is adsorption. It is a highly porous material that has the property to attract and hold the harmful chemicals or materials leading to contamination. Adsorption occurs due to the electrostatic forces of attraction that are known as Van Der Waal forces of adsorption and this phenomenon is known as chemisorption or chemical adsorption. It can also remove bad odour as well as bad taste from the water. This is the reason why the activated carbon has tremendous applications. Also, it has a

highly porous structure which basically results from the raw material processing carried out at high temperature reactions. The volume of the pores of the activated carbon mainly ranges from 0.20 to 0.60 cm<sup>3</sup>/g to 1cm<sup>3</sup>/g. Also, it has been found that the activated carbon is completely an environment friendly



Activated Charcoal in Skincare: The Science | Lab Muffin Beauty

adsorbent and can be used in many industries.

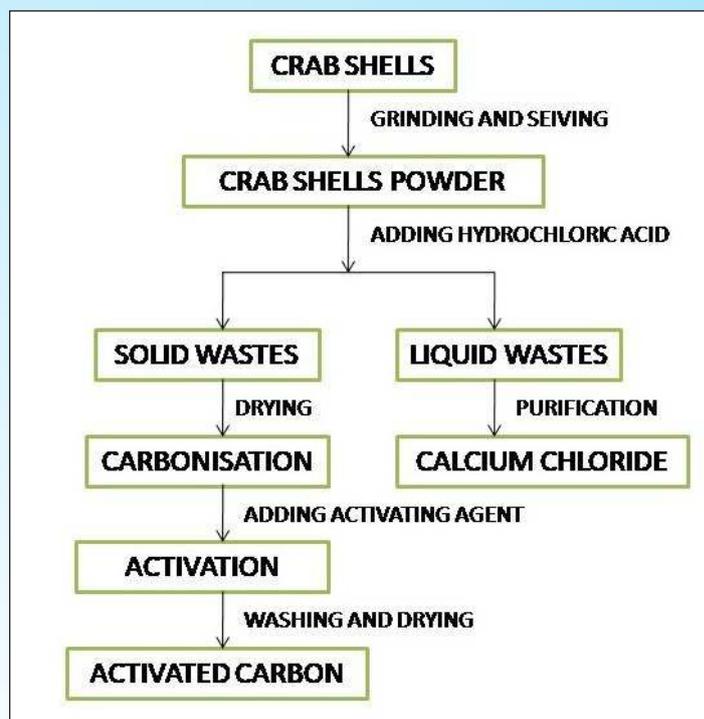
### Activated Carbon production process

The stepwise process for the production of activated carbon from its raw material is as shown in the flowchart. The process is simple and easy to carry out and also gives a high yield of activated carbon.

### Role of activated carbon in cosmetics

Our skin is the protective layer of our body and also very sensitive. Skin is the part that is majorly exposed to environmental pollution. Skin has a very major role to play i.e. to stimulate the metabolism by its property of the occlusive effect.

Activated carbon is one of the best substances that can be used for the treatment of acne, oily skin and it can also cure blackheads. It



is a gentle exfoliant that helps to scrape off the dead cells from the surface of the skin. Also, the best advantage is that it does not irritate sensitive skin even it does not harm any allergy-prone skin. As a result, it can be used in the daily care. It is basically an all round beauty ingredient that can be brought into use in several ways. Some of them are described in this article.

**HAIRFALL:** Hair fall is one of the most common problem that is experienced by most of the people. Hair fall and stunted growth can be seen due to a variety of reasons. Some of them may be like clogged hair follicles, dandruff, scalp infections, clogged pores, etc. Activated carbon is the source that can help you get back your hair pattern infact the natural hair growth pattern. Using activated carbon, in certain haircare products, helps to speed up hair growth. It removes all the impurities and provides a sort of freshness and increases the volume. Also, it provides an additional greasing to the hair.

**ACNE:** As mentioned before, our skin is one of the most sensitive part having pores of its own. The skin is a permeable membrane along with the pores present which allows the passage of the chemicals and toxins to pass into and out of our body. Acne can be caused due to many reasons. Some of them include blocked pores on the skin, dirt and bacteria present on the skin's surface and excess of sebum or oil. The main reason is the poor diet that causes acne. After the application of the activated carbon on your skin, all the detritus is removed from the skin's surface. It is also capable of extracting the toxins present beneath the skin. The best application of activated carbon is that it can remove the chemicals, dirt, bacteria and any other sort of micro-particles from the skin. This helps to attain a flawless complexion and eliminate acne.

**FACIAL MASK:** The facial skin is the delicate part that can be protected by the application of various cosmetics that are only meant specifically for the facial application. These may include creams, lotion, face mask or peel off mask etc. Peel off mask is

basically a form of dosage which is gently applied onto the facial skin surface, kept for sometime, then peeled off after its application. It is one of the best remedies that is used to treat face related problems. These problems include wrinkles, ageing, acne and mainly it is used to open the pores that are closed due to the accumulation of dust. Activated charcoal is the active substance that is used in the peel off mask. It is so because it adsorbs the dust particles and opens the pores that are clogged.

**BODY CARE:** Activated carbon is the best substance that can even lighten underarms. It functions by effectively removing all the dead cells present in the skin. If it is consistently applied, effective results can be observed. It can also remove the body odour and can give relief from the insect bites.

**Use of activated carbon effectively:**

- **Face and body scrub:** For the preparation of this scrub, 10 portions of the activated carbon powder is taken along with the four tablespoons of olive oil and one tablespoon of honey. The scrub obtained can be used to clean the skin containing impurities and the dead skin cells are removed. It must be used once a week.
- **Activated carbon for oily hair:** One capsule containing the powder is added to the shampoo and then the hair is washed twice a week. The hair will be clean and fresh but as a result the hair may feel dry due which moisturizing the hair later will be essential. A conditioner can be used for the same.

**Recent studies in activated carbon:**

- Rice straw is an agricultural waste material which is a waste material in the environment. Various samples of it

were collected and the one with the highest lignin content (DM105) was selected and later rice straw activated charcoal (RSAC) was produced. The activated charcoal which had the highest iodine number, methylene blue and aflatoxin B1 was investigated. It was concluded that DM105(with highest lignin content) has the maximum potential in cosmetic applications.

A shampoo has been formulated that contained activated carbon. It had the ability to clear sebum, dirt and dandruff in the hair. It is prepared by using natural herbs like Reetha, Tulsi, Vettiver, Amala, etc. Due to its adsorption capacity and dirt removal capacity, it has been proven to give best results. Since, herbs were used, so there were no ill effects.

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**AGRICULTURAL WASTE AS POTENTIAL BIOSORBENT FOR HEAVY METAL REMOVAL**

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Heavy metals are usually defined as metals having density more than 5 g/cm<sup>3</sup>. They are classified as essential and non-essential metals. The metals which are need for normal cellular growth are essential metals e.g. zinc, nickel, copper, etc. Such metals are required in low concentrations (nM), but at higher concentrations (µM to mM) all heavy metals have detrimental effects to organisms. If the metals have no known biological function, they are called as non-essential metals e.g. lead, cadmium, mercury. Such metals are toxic at any concentration.

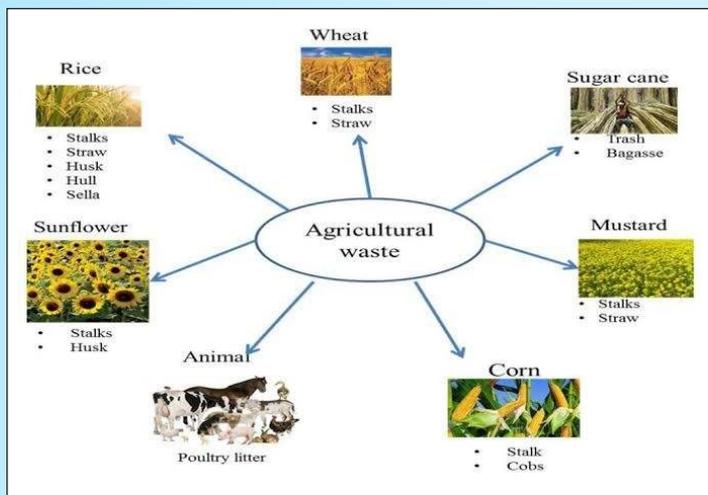
Toxic heavy metal ions get introduced to the aquatic streams by means of various industrial activities viz., mining, refining ores, fertilizer industries, tanneries, batteries, paper industries, pesticides etc. and posses a serious threat to environment. The major toxic metal ions hazardous to humans as well as other forms of life are Cr, Fe, Se, V, Cu, Co, Ni, Cd, Hg, As, Pb, Zn etc. These heavy metals are of specific concern due to their toxicity, bio-accumulation tendency and persistency in nature. Several past

disasters due to the contamination of heavy metals in aquatic streams are Minamata tragedy in Japan due to methyl mercury contamination and "Itai-Itai" due to contamination of cadmium in Jintsu river of Japan. Various regulatory bodies have set the maximum prescribed limits for the discharge of toxic heavy metals in the aquatic systems. However the metal ions are being added to the water stream at a much higher concentration than the prescribed limits by industrial activities, thus leading to the health hazards and environmental degradation.

Conventional methods for removing heavy metals include chemical precipitation, ion exchange, oxidation/reduction, filtration, electrochemical processes, membrane separation and evaporation. These methods have several disadvantages like high cost, incomplete removal, low selectivity and high-energy consumption. Recently attention has been diverted towards the biomaterials which are byproducts or the wastes from large scale industrial operations and agricultural waste materials. The major advantages of biosorption over conventional treatment methods include: low cost, high efficiency, minimization of chemical or biological sludge, no additional nutrient requirement, and regeneration of biosorbents and possibility of metal recovery.

A great deal of interest in the removal of pollutants from wastewaters has focused on the use of agricultural waste/byproducts as biosorbents. Biosorption can be defined as a simple metabolically passive physicochemical process involved in the binding of metals ions (biosorbate) to the surface of the biosorbent which is of biological origin.

Agricultural wastes especially those with high percentage of cellulose and lignin contains polar functional groups like amino, carbonyl, alcoholic, phenolic, and ether groups having high potential for metal binding. These groups donate a lone pair of electrons and form complexes with metal ions in the solution. Due to their unique chemical composition (the presence of



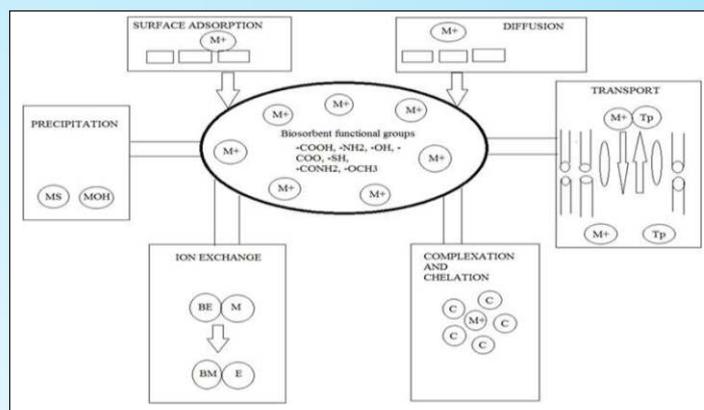
hemicellulose, lipids, lignin, water hydrocarbons, simple sugars, and starch having a variety of functional groups) and availability, the use of agro-wastes seems to be a viable option for heavy metal remediation.

The mechanism of biosorption is a complex process which involves the binding of sorbate onto the biosorbent. Many natural materials can be used as biosorbents which involve the Biosorption binding of metal ions by physical (electrostatic interaction or van der Waals forces) or chemical (displacement of either bound metal cations (ion exchange) or protons) binding, chelation, reduction, precipitation, and complexation.

**Table 1: Use of agricultural wastes for biosorption of metal ions**

Agricultural waste	Heavy metal	Biosorption efficiency	Mechanism
Cabbage waste	Pb (II)	60.57 mg g <sup>-1</sup>	chemisorption
Cauliflower waste	Pb (II)	47.63 mg g <sup>-1</sup>	chemisorption
Peanut hull	Cu	12 mg g <sup>-1</sup>	Ion exchange
Barley straw	Cu	4.64 mg g <sup>-1</sup>	chemisorption
Barley straw	Pb	23.20 mg g <sup>-1</sup>	Ion exchange
Cassava peelings	Cu (II)	127.3 mg g <sup>-1</sup>	Ion exchange
Cassava peelings	Cd (II)	119.6 mg g <sup>-1</sup>	Ion exchange

\*mg g<sup>-1</sup> indicates milligram of heavy metal removal per gram of dry weight of the biosorbent



Mechanisms of biosorption: M<sup>+</sup>: heavy metal ions, C: chelating agents, BE: molecules with exchangeable ions, BM: molecules with metal ions, Tp: transport protein

Biosorbents contain chemical/functional groups like amine, amide, imidazole, thioether, sulfonate, carbonyl, sulfhydryl, carboxyl, phosphodiester, phenolic, imine, and phosphate groups that can attract and sequester metal ions.

**Conclusion**

Making use of biosorbents is an effective method to adsorb toxic heavy metals from effluents not polluting the ground water and at the same time utilizing the discarded open agricultural wastes in the environment for a useful purpose of waste water treatment. This method not only requires minimal energy input, less labour and low investment, but also proves to be very economical, biodegradable and effective compared to synthetic adsorbent and chemicals. The bio-adsorbents once used could be re-used through desorption methods for a certain period of time and this could be employed commercially in the future.



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## ENVIRONMENTAL CONVENTIONS AND LAWS

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The Earth's biological resources are vital to humanity's economic and social development. As a result, there is a growing recognition that biological diversity is a global asset of tremendous value to present and future generations.

The United Nations Environment Programme (UNEP) convened the Ad Hoc Working Group of Experts on Biological Diversity in November 1988 to explore the need for an International Convention on Biological Diversity. By February 1991, the Ad Hoc Working Group had become known as the Intergovernmental

Negotiating Committee. Its work culminated on 22 May 1992 with the Nairobi Conference for the Adoption of the Agreed Text of the Convention on Biological Diversity.

The Convention was opened for signature on 5 June 1992 at the United Nations Conference on Environment and Development (the Rio "Earth Summit"). It remained open for signature until 4 June 1993, by which time it had received 168 signatures. **The Convention entered into force on 29 December 1993.** The first session of the Conference of the Parties was scheduled for 28 November – 9 December 1994 in the Bahamas.

#### It has 3 main objectives:

1. The conservation of biological diversity
2. The sustainable use of the components of biological diversity
3. The fair and equitable sharing of the benefits arising out of the utilization of genetic resources

#### Other conventions related environment

Name of the Convention	Purpose	Year
World Heritage Convention	Defines the kind of natural & cultural sites which can be considered as World Heritage Site under UNESCO	1988
Vienna Convention	Framework on Protection of Ozone Layer	1988
Ramsar Convention on Wetlands	Framework for Conservation of Wetlands & their Resources	1971
Convention on International Trades in Endangered species	Protection of Wild Animals and Plants from Illegal trade to save their life	1963
Minamata Convention	Protection of Human Health and Environment from the Harmful Effect of Mercury	2013
Bonn Convention	Conservation of Migratory Species of Wild Animals	1983
UN Framework Convention on Climate Change	To stabilize Greenhouse Gas concentration in atmosphere	1992
Basel Convention	To Reduce the Movements of Hazardous Waste	1989
UN Convention on the Law of the Sea	For Rights & Responsibilities of Nations for Use of Ocean Water and established Guidelines for Marine Natural Resources	1982
Convention of Desertification	To Combat Desertification and Mitigate the Effects of Drought through National Action Programs	1994
Barcelona Convention	Protection of Mediterranean Sea from Pollution	1976
Rotterdam Convention	The Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade	1998

#### ENVIRONMENT LAWS AND ACT

The need for protection and conservation of environment and sustainable use of natural resources is reflected in the constitutional framework of India and also in the international commitments of India. The Constitution under Part IVA (Art 51A-Fundamental Duties) casts a duty on every citizen of India to protect and improve the natural environment including forests, lakes, rivers and wildlife, and to have compassion for living creatures. Further, the Constitution of India under Part IV (Art 48A-Directive Principles of State Policies) stipulates that the State shall endeavour to protect and improve the environment and to safeguard the forests and wildlife of the country.

Several environment protection legislations existed even before Independence of India. However, the true thrust for putting in force a well-developed framework came only after the UN Conference on the Human Environment (Stockholm, 1972). After the Stockholm Conference, the National Council for

Environmental Policy and Planning was set up in 1972 within the Department of Science and Technology to establish a regulatory body to look after the environment-related issues. This Council later evolved into a full-fledged Ministry of Environment and Forests (MoEF). MoEF was established in 1985, which today is the apex administrative body in the country for regulating and ensuring environmental protection and lays down the legal and regulatory framework for the same. Since the 1970s, a number of environment legislations have been put in place. The MoEF and the pollution control boards ("CPCB", ie, Central Pollution Control Board and "SPCBs", ie, State Pollution Control Boards) together form the regulatory and administrative core of the sector.

Some of the important legislations for environment protection are as follows:

**1986-The Environment (protection) Act** authorizes the central government to protect and improve environmental quality,

control and reduce Pollution from all sources, and prohibit or restrict the setting and/or operation of any industrial facility on environmental grounds.

**1986-The Environment (protection) Rules** lay down procedures for setting standards of emission or discharge of environmental pollutants. 1991-The Environment (Protection) Act Amendment.

**1989-The Hazardous Waste (Management and Handling) Rules** is to control the generation, collection, treatment, import, storage, and handling of hazardous waste.

**1989-The Manufacture, Storage, and Import of Hazardous Rules** define the terms used in this context, and sets up an authority to inspect, once a year, the industrial activity connected with hazardous chemicals and isolated storage facilities.

**1989-The Manufacture, Use, Import, Export, and Storage of Hazardous Micro- organisms/Genetically Engineered Organisms or Cells Rules** were introduced with a view to protect the environment, nature, and health, in connection with the application of gene technology and microorganisms.

**2003-The Hazardous Wastes (Management and handling) Rules**

**1991-The Public Liability Insurance Act and Rules and Amendment 1992** was drawn up to provide for public liability insurance for the purpose of providing immediate relief to the persons affected by accident while handling any hazardous substance.

**1991-Coastal Regulation Zone Notification and Coastal Regulation Zone Amendment-2001:** with an objective to ensure livelihood security to the fishing communities and other local communities living in the coastal areas, to conserve and protect coastal stretches and to promote development in a sustainable manner based on scientific principles, taking into account the dangers of natural hazards in the coastal areas and sea level rise due to global warming.

**1995-The National Environmental Tribunal Act** has been created to award compensation for damages to person, property and the environment arising from any activity involving hazardous substances.

**1998-The Biomedical Waste (Management and Handling) Rules** is a legal binding on the health care institutions to streamline the process of proper handling of hospital waste such as segregation, disposal, collection, and treatment.

**2003-The Bio-Medical Waste (Management and Handling) Rules Amendment.**

**1999-The Environment (Siting for Industrial projects) Rules,** 1999 lay down detailed provisions relating to areas to be avoided for siting of industries, precautionary measures to be taken site selecting as also the aspects of environmental protection which should have been incorporated during the implementation of the industrial development projects.

**2000-The Noise Pollution (Regulation and Control) Rules and 2002-** The noise pollution (regulation and control ) (amendment) Rules lay down such terms and conditions as are necessary to reduce noise pollution, permit use of loud speakers or public address systems during night hours (between 10:00 p.m. to 12:00 midnight) on or during any cultural or religious festive occasion.

**2000-The Municipal Solid Wastes (Management and Handling) Rules, 2000** apply to every municipal authority responsible for the collection, segregation, storage, transportation, processing, and disposal of municipal solid wastes.

**2000-The Ozone Depleting Substances (Regulation and Control) Rules** have been laid down for the regulation of production and consumption of ozone depleting substances.

**2001-The Batteries (Management and Handling) Rules,** 2001 rules shall apply to every manufacturer, importer, re-conditioner, assembler, dealer, auctioneer, consumer, and bulk consumer involved in the manufacture, processing, sale, purchase, and use of batteries or components so as to regulate and ensure the environmentally safe or religious festive occasion.

**2002-The Biological Diversity Act and 2004-Biological Diversity Rules:** is an act to provide for the conservation of biological diversity. Sustainable use of its components, and fair and equitable sharing of the benefits arising out of the use of biological resources and knowledge associated with it.

**2004-National Environment Policy (Draft)** intended to be a guide to action: in regulatory reform projects and programmes for environmental conservation; and review and enactment of legislation, by agencies of the Central, State and Local Governments.

**E-Waste (Management and Handling) Rules,** 2011 have been notified on May 1, 2011 and came into effect from May 1, 2012, with primary objective to reduce the use of hazardous substances in electrical and electronic equipment by specifying threshold for use of hazardous material and to channelize the e-waste generated in the country for environmentally sound recycling.

**Forest and Wildlife Related Acts**

**1927-The Indian Forest Act and Amendment, 1984** is one of the many surviving colonial statutes. It was enacted to consolidate the law related to forest. The transit of forest produce, and the duty leviable on timber and other forest produce.

**1972-The Wildlife Protection Act, Rules 1973** and amendment 1991, 2003 provides for the protection of birds and animals and for all matters that are connected to it whether it be their habitat or the waterhole or the forests that sustain them.

**1980-The Forest (conservation) Act and Amendment 1988** provide for the protection of and the conservation of the forests. 1981-The Forest (Conservation) Rules and amendment 1987, 1989 for protection and conservation of the forests

**Water Related Acts**

**1882-The Easement Act** allows private rights to use a resource that is, groundwater, by viewing it as an attachment to the land. It also states that all surface water belongs to the state and is a stage property.

**1887- The Indian Fisheries Act** establishes two sets of penal offences whereby the government can sue any person who uses dynamite or other explosive substance in any way (whether coastal or inland) with intent to catch or destroy any fish or poisonous fish in order to kill.

**1956-The River Boards Act** enables the state to enrol the central government in setting up an advisory river board to resolve issues in inter-state cooperation

**1970-The Merchant Shipping Act** aims to deal with waste arising from ships along the coastal areas within a specified radius.

**1974-The Water (Prevention and Control of Pollution) Act** establishes an institutional structure for preventing and abating water pollution. It establishes standards for water quality and effluent. Polluting industries just seek permission to discharge waste into effluent bodies. The CPCB (Central Pollution Control Board and State Pollution Control Boards (SPCB) were constituted under this act.

**1975-The Water (Prevention and Control of Pollution) Rules**

**1988-The Water (Prevention and Control of Pollution) Amendment Act.**

**2003-The Water (Prevention and Control of Pollution) Cess Amendment Act.**

**Air Related Acts**

1948-The Factories Act and Amendment in 1987 was the first to express concern for the working environment of the workers. The amendment of 1987 has sharpened its environmental focus and expanded its application to hazardous processes.

1981-The Air (Prevention and Control of pollution) Act provides for the control and abatement of air pollution. It entrusts the power of enforcing this act to the CPCB.

1982-The Air (prevention and Control of pollution)Rules defines the procedures of the meetings of Boards and the powers entrusted to them.

1982-The Atomic Energy Act deals with the radioactive waste.

1987-The Air (prevention and Control of pollution) Amendment Act empowers the central and state pollution control boards to meet with grave emergencies of air pollution.

1988-The Motor Vehicles Act states that all hazardous waste is to be properly packaged, labelled, and transported.

2010-The National Green Tribunal Act, 2010 (No. 19 of 2010) (NGT Act) has been enacted with the objectives to provide for establishment of a National Green Tribunal (NGT) for the effective and expeditious disposal of cases relating to environment protection and conservation of forests and other natural resources including enforcement of any legal right relating to environment and giving relief and compensation for damages to persons and property and for matters connected therewith or incidental thereto.

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## **COVID-19 PANDEMIC: A WAY FORWARD FOR ENVIRONMENT AND SUSTAINABLE DEVELOPMENT UNDER CLIMATE CHANGE SCENARIO**

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The world is recently facing the most disruptive events (for public health)of the century in the form of new coronavirus disease, COVID-19. The outbreak of COVID-19 caused by the new coronavirus (SARS-CoV2) has been declared as pandemic in March 2020, by the World Health Organization (WHO), as it has spread in more than 200 countries of the world affecting several million people(1). The COVID-19 pandemic has enforced governments and society to put a brake on the fluently moving nature and to remain in pause mode for an extended period. It has led to the major transformation not only in people's behaviour but also in the strategies and measures for the future production and distribution systems(2). It seems that it is just a beginning and there are many more phases of such events in the future.

Before this pandemic, the world was struggling with the measures to develop and strengthen strategies for mitigating the unprecedented impacts of climate change. Now the human society has to face the COVID-19 and climate change together(2). Although it is logically difficult to envisage the massive hazards of these events at present, but they may have some linkage with each other and may impact considerably in near future(3). Therefore, the world needs to leverage COVID-19 recovery programs in coordination with the climate change mitigation agendas for developing strategic for more sustainable post-COVID-19 situation. Though both of these phenomenon are different as the pandemic directly affects the human health systems in short-term, whereas climate change weakens broader natural and human systems in unprecedented way in long-term(3). In this article, I have given emphasis on: (1) how people's perceptions have changed during the pandemic, (2) how these acute changes are affecting the environment, and (3) how these changes will mediate sustainable development goals.

### **People's perceptions and government recommendations during COVID-19 pandemic**

During the pandemic, the practice of social distancing has become daily lifestyles as it has been viewed as the most effective measure to minimize the spread of virus, and thus, the loss of human life(2). Some of the major forms of social distancing are self-quarantining, working from home, providing online education, sending students back to their residences, avoiding large gatherings, reducing travel, limiting visits to stores, etc. Thus, the international and inter-state movements within a country are on halt(2). These activities showed the relevance of strengthening local resources for such unprecedented events. Developing short food supply chains based on local productions and consumption system has been emerged as the best possible way during these times4. Indian government has started the self-reliant India (Aatmanirbhar Bharat) campaign recently which is also a kind of developing short supply chains for the locals. These reinforcements for developing the local micro-economy are not only useful for present, but it also proved to be useful during non-crisis situations on one hand and would provide employment to the local people on the other hand(4).

With this brief description of the changes in people's perceptions, government recommendations and international movements, I would like to draw your attention towards the fate of environment in these days and the future perspectives in terms of sustainable development in the next few sections.

### **Environmental impacts of COVID-19 pandemic**

In addition to its effect on human health and economy, there are several unprecedented and indirect impacts of the coronavirus outbreak on environment. From Delhi to Beijing to New York, the COVID-19 pandemic has facilitated remarkable improvements (reduction) in air and other waste emissions(2). Due to the worldwide lockdown imposed massive slowdown in industrial and public activities (such as transportation, electricity generation, and industrial production), we are witnessing decreased air pollution, greenhouse gas (GHG) and particulate (PM2.5) emissions, clean water bodies and beaches, and reduction in noise pollution (2,3,5). The climate experts forecast the reduction in GHG emissions to a massive level never before seen since World War II6. Particularly, a massive fall in one of the major GHG viz. N<sub>2</sub>O has been observed from most of the developing nations like France, Germany, Italy, and Spain(7) as

well as in China. These observations revealed how intertwined modern economic life and developmental activities (based on fossil fuels burning) are in modern lifestyle which later severely impacts the environment and the climate(3). Moreover, the social distancing measures as well as reduction in travel and tourism resulted in cleaning of many beaches around the world. Similarly, reduction in the use of transportation (both private and public) as well as commercial activities has resulted in significant fall in the noise levels in most countries(5).

While there have been several positive environmental benefits observed during this pandemic, there are some negative environmental aspects of this pandemic as well. Among those negative environmental aspects, massive generation of wastes (domestic organic and inorganic wastes), poor recycling of wastes (due to shutdown of waste recycling industries and chances of contamination), excess domestic water use, and contamination of water and land resources are the major one(5). Massive generation of medical wastes like contaminated masks, gloves, used or expired medications, etc. has also been increased several folds<sup>8</sup>. For example, hospitals in Wuhan are producing an average of 240 MT of medical waste per day nowadays, which is five times higher than the wastes generated before pandemic event. Thus, there is a great challenge for treating such hazardous wastes and to dispose of separately during this pandemic. This may cause a massive land contamination and abandonments for several years. Further, high level of chlorinated products are being used for fumigation and disinfection of air and water systems which may accumulate in nearby water bodies and may contaminate them, resulting in negative ecological impacts later(5).

In addition to several positive environmental impacts during this pandemic, among which the decline in carbon emissions in 2020 is one of the major benefits, the issue of climate change will still remain the major concern(2). Such short-term decline in GHG emission might not be going to continue in the long-term trend for climate change mitigation, as observed during several previous events (e.g. 2008 economic crisis)(9). As and when the situation become normal and the people shall start working, there will be a sharp increase in the human activities even as observed before. The potential reason will be the revitalizing national economies(2). As it is already observed in the United States, the government is planning to utilize the available resources for reviving the national economy, keeping aside the climate change agendas. During this pandemic, the lockdown lead to the decline in fossil-fuel uses, and thus, decline in their prices. However, a surge in the use of these resources will have been expected after the COVID-19 pandemic, which may result in severe pollution level(2).

Recently, on social media, number of pictures and videos of animals wandering in the streets and urbanized places have been shared which might be emerging due to decreased human activity. There are two facets of these activities. Many people are taking it as a positive sign in the form of freedom for animals, however, this might be a misconception as several species are endangered, and thus, need care and support by the human (caretakers) to survive. But due to lockdown, these animals are now being left uncared for by the non-harmful human activities (10). Overall, there are several positive and negative aspects of COVID-19 pandemic on social and economic aspects of human and related animal counterparts. As nations rationalised massive resources to vitalise the economic and social disparities after COVID-19, they need to

parallel focus on addressing the climate change mitigation aspects to avoid such (or other severe) calamities in the near future(3). This can only be possible by adapting sustainable development measures for the next few decades. In the next section, a brief insight has been given on this aspect.

**COVID-19 pandemic and sustainable development goals (SDGs)**  
 COVID-19 is affecting every pillar of sustainability, the long-term implications the of the pandemic remain to be seen in the coming months and years(2,3). Among three goals of sustainability—economic development, social development and environmental protections—the first two goals are severely affected during the COVID-19 pandemic whereas third goals can be assessed later. The UN, in 2015, developed 17 Sustainable Development Goals (SDGs) for ensuring judicious development of the society, which were: 1. No poverty, 2. Zero hunger, 3. Good health and wellbeing, 4. Quality education, 5. Gender equality, 6. Clean water and sanitation, 7. Affordable and clean energy, 8. Decent works and economic growth, 9. Industry, innovation and infrastructure, 10. Reduced inequalities, 11. Sustainable cities and communities, 12. Responsible consumption and production, 13. Climate action, 14. Life below water, 15. Life on land, 16. Peace, justice and strong institutions, and 17. Partnerships for the goals (11). However, the COVID-19 pandemic has shown that human (physical and mental) health and well-being can be one of the important sustainability goals which should need further weightage in comparison to economy, environment and society for the sustainability of civilization(10). Hakovirta and Denuwara(10) advocated for including human health as separate fourth pillar of sustainability as it does not stand under any of the other three pillars.

As stated earlier, after COVID-19 pandemic the world will have two options to stand strong. One being the traditional conquering nature by rapidly utilizing the resources to revive the economy and social livelihood in short-term whereas the other being sustainable in nature by utilizing the opportunity in developing renewable and clean energy measures, developing skills and technologies for adopting telecommuting, virtual meetings, and online education for long-term (2). By following the first approach we may accelerate the climate change phenomenon, another havoc to be faced by the humanity. We should develop and implement the circular economy concept(12), particularly for strengthening local or micro-economy of a country. The self-reliant India campaign may prove to be a better adoption for achieving the sustainability under the COVID-19 (or any future such events) and climate change conditions.

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## TOXIC XENOBIOTIC COMPOUNDS IN OUR DAILY LIFE: THREATS TO HUMAN HEALTH AND ENVIRONMENT

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Xenobiotic compounds are not produced in organism. They are man-made chemicals present in ecosystem at unnaturally high concentration. The term 'Xenobiotic' comes from Greek root word 'Xenos' meaning foreigner. These compounds are foreign to organism. They are persisting in nature. Xenobiotic compounds include pesticides, heavy metals, persistent organic pollutant, synthetic drugs, fertilizers, polychlorinated biphenyls, plastics, dyes etc. In this article we briefly discuss about Xenobiotic compounds' basic nature, structures, sources and their adverse impacts on environment and human health.

**Keywords:** Xenobiotics, Xenoestrogen, pesticides, Persistent organic pollutants

### Introduction

Xenobiotic is a general term applied to substance that is foreign to an environment and organism. They are recalcitrant in nature because they resist biodegradation and therefore persist in environment. They are man-made chemicals present in environment at high concentrations. Xenobiotic substances are recalcitrant because of some reasons: (1) They are chemically and biologically inert because of presence of substitution of groups like halogens, amino, carbamyl, methoxy groups and others (2) These substances are insoluble in water and can become absorbed to soil (3) They have high molecular weight (4) They are very toxic (5) These substances are not recognized as substrate by existing degradative enzymes<sup>1</sup>.

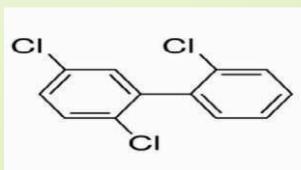
These substances are classified in six broad categories: (1) Halocarbons, (2) Polychlorinated biphenyls, (3) Synthetic polymers, (4) Alkyl benzyl sulphonates, (5) Oil mixture and (6) others. Halocarbons compounds contain halogens: Cl, Br, F or I atoms. Examples include: Chloroform, Insecticides (DDT, lindane

etc.) and Herbicides. Polychlorinated Biphenyls (PCB's) are compounds having two covalently linked benzene rings with halogen. Examples include: Plasticisers, insulator coolants in transformers<sup>1</sup>. Dioxin is an example of highly toxic xenobiotic compound. The toxicity of other dioxins and chemicals like PCBs that act like dioxin cause many health issues in human. Dioxin is formed as an unintentional by-product of many industrial processes involving chlorine such as waste incineration, chemical and pesticide manufacturing and pulp and paper bleaching. Dioxins have been detected in soil, surface water, sediment, plants and animal tissue. Dioxins formed during the burning of fuel and wastes also get released into the air. In surface waters and sediments, dioxins can pass into aquatic organisms and eventually find their way into the food chain. Dioxin is an unintentionally produced byproduct which acts like contaminant formed in the production of some chlorinated organic compounds, including a few herbicides such as Silvex.

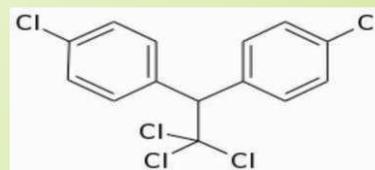
### Features and structures of Xenobiotic compounds

Structure of Xenobiotic compounds which makes them more recalcitrant:

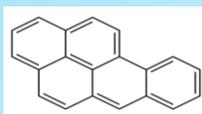
- Presence of Halogens in place of hydrogen.
- Substitution of H by other groups (halogens, amino, carbamyl, methoxy groups etc).
- Cyclic structures and heterocyclic compounds.
- Branched linear Chains.
- These features make their structure more complex which resist microbial degradation. As linear chain or aliphatic compounds are easily degradable rather than branched linear chains and cyclic structures. Presence of halogen makes highly stable compounds. Thus their complex structure makes them, more recalcitrant.



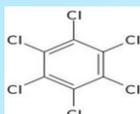
Polychlorinated biphenyls (PCBs)



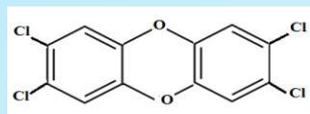
Dichlorodiphenyltrichloroethane (DDT)



Benzo-α-pyrene



HCB

2, 3, 7, 8-Tetrachlorodibenzo-  
p-dioxin (TCDD)

### Sources of Xenobiotic compounds

Xenobiotic compounds found in environment due to manmade activities. Such substances include pesticides, heavy metals, persistent organic pollutant, synthetic drugs, fertilizers, polychlorinated biphenyls, plastics, dyes, etc. Their synthesis includes production of cosmetic products, food additives, hydrocarbons, use and production of pesticides & agrochemicals, emitted from cigarettes smoke, drugs, emissions of industries, ink & dyes, gasoline etc.

### Xenoestrogens:

Xenoestrogens are a type of xenohormone that imitates or mimics the function of estrogen hormones. They may be of either synthetic or natural chemical compounds. Synthetic xenoestrogens include some widely used industrial compounds, such as PCBs, BPA, and phthalates, 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. Xenoestrogens are dangerous because they can mimic the functions of endogenous estrogen and thus have been reported many times for causing precocious puberty and other disorders of the reproductive system.

### Threats to Environment

Xenobiotic cause many potential hazards to environment, some of them are as follows:

1. Xenobiotic compounds are lipophilic and recalcitrant therefore they cause bioaccumulation and biomagnification. They get accumulates in a lipid deposits of body. Also gets biomagnified while eating and being eaten relationship in any food chain.
2. They are persistent and progressively build up in a high concentration in environment.
3. Xenobiotic compounds like agrochemicals, fertilizers etc used in soil, they results in soil health degradation, leaching and ultimately entering into ground water systems, volatilization, sorption and uptake by organisms.
4. As it was noticed on the night of December 2, 1984, methyl isocyanate (MIC), that spilled out from Union Carbide India Ltd's (UCIL's) pesticide factory. That leads Bhopal tragedy in which huge death and as well till dates birth defects are also being reported due to residual MIC at environment. The factory used to manufacture three pesticides: carbaryl, aldicarb, and sevidol.

### Threats to Human Health

Xenobiotic cause numerous potential hazard to human health also that are listed below:

1. Many Xenobiotic compounds are carcinogenic. Many increased incidences of testicular cancer in males and breast tumors in females have been reported<sup>2</sup>.
2. Chemical exposure of these compounds to children is linked to hormone related disorders that include birth defects, developmental disorders, declining proportion of male newborns and mental deficiencies in families of pesticide workers<sup>2</sup>.
3. Xenobiotic compounds disrupt endocrine function which causes abnormal development of reproductive tissues and

leads to decreased in fertility or sterility. Benjamin J. Danzo (1997) showed that some Xenobiotic compounds, mainly DDT congeners interfere with binding of natural ligands to two or more binding moieties thus disrupt endocrine function and also effect on estrogen responsive gene<sup>3</sup>.

4. Some carbamate pesticides like methomyl, carbofuran, carbaryl, and thiodicam are act as acetylcholinesterase inhibitors that lead to reversible neurological disorders<sup>4</sup>.
5. Endosulfan is a highly toxic insecticide, its long term exposure cause many adverse effects because it is carcinogen, teratogen, male reproductive toxicant, nephrotoxic and respiratory paralysis<sup>4</sup>.
6. Many Xenobiotic compounds used in cosmetic products such as formaldehyde which is toxic to immune system and also a carcinogen, Eugenol toxic to nervous system and a endocrine disruptor.
7. Many lung related diseases are linked with Xenobiotic compounds like asthma, bronchitis, black lung disease, and silicosis.
8. Environmental toxicants such as pesticides, herbicides etc may cause Parkinson's disease which is a neurodegenerative disease. A study of Alaska native by Dr. Tanner and colleagues found that hexachlorobenzene and PCB levels are higher in patients of Parkinson's disease than healthy<sup>5</sup>.
9. High level of PCB can impair the neurobehavioral development in children, cancer, immunological effects, and skin infections.
10. Mercury is highly toxic heavy metal, its high level exposure cause lung damage, mucous membrane changes, vomiting, diarrhea, nausea, skin rashes, hypertension, nephrotoxicity, and severe neurologic abnormalities. As noticed during 1950s and 1960s in minamata bay of Japan, methyl mercury caused Minamata disease. There are many respiratory problem also caused by mercury vapors such as bronchitis, asthma.
11. Cadmium is nephrotoxic metal, its accumulation reduces the glomerular filtration rate. Cadmium toxicity is associated with ouch-ouch disease, hepatic, reproductive and cardiovascular dysfunctions.

### Conclusion

Xenobiotic compounds impose many health and environment threats. Humans are exposed to such chemicals through dietary, inhalation from air, and from occupational exposures. For this we should take proper precautions and government should take necessary steps for prevention and regulate their standards in respect to safety for environment and human health like in Europe, North America and many countries of South America banned the use of many pops but in developing countries some organochlorine pesticides are still used e.g. DDT which is used for malaria.

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**From the Editor's**

Dear Readers,

I wish my warm wishes!!

In June issue, we recount the articles published from authors from diverse field to recount the status on various activities related to World Environment Day. This issue includes Annual awards by Academy for its members actively involved in their field or events and activities organised by the Academy. NESA is well known for its environmental awareness activities.

I express my sincere and huge thank to all the persons who contributed writing the wonderful and inspiring articles, without which there wouldn't have been this newsletter issue. Please continue sharing such articles and share with your friends also. I would like to thank President and General Secretary, NESA, New Delhi, and the Editorial team including Print, Designer and Publication committee for their nonstop support and efforts throughout this edition.

The month of June will witness World Environment Day with its theme Biodiversity. The theme aims to show that biodiversity remains the answer to several sustainable development challenges that the world faces).

We hope this edition makes an interesting read. Please feel free to offer any suggestions for improvement.

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Vol. 23 Issue - 06 (Monthly)

June 2020

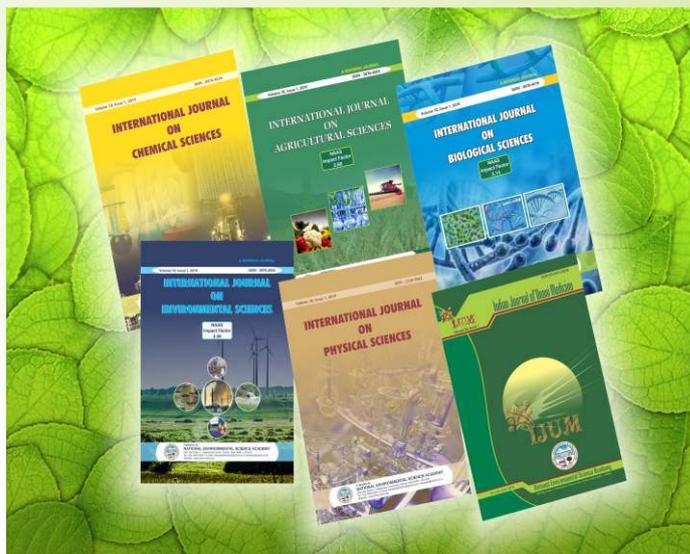
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